Automotive Mechanics

Level-III

Based on October 2023, Curriculum Version II

Module Title: Maintaining Two and Three Wheeler Vehicles

Module Code: EIS EIS AUM3 M08 1023

Nominal Duration: 80 Hours

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Acronyms

OS	Occupational Standard
LAP test	Learning Activity Performance test
RWD	Rear Wheel Drive
CV joints	Constant Velocity joint
SAI	Steering Axis Inclination
CD-ROM	Compact Disc, Read-Only-Memory
VIN	Vehicle Identification Number

Acknowledgment

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Introduction to Module

This module covers the knowledge, skill and attitude required to carry out removing, dismantle, repair, adjust and replace engine and power train system components of two and three wheeler vehicle. This includes preparation for work, inspection and diagnosing, overhauling and testing of functionalities of engine and power train assemblies of two and three-wheeler vehicle and preparation for use / storage.

This module covers the units:

- Introduction to Two and Three Wheeler Vehicle
- Remove, Disassemble and Inspect Two- and Three-Wheel Vehicle
- Overhauling Two and Three-Wheeler Vehicle

Learning Objective of the Module

- Introduce to Two and Three Wheeler
- Perform Inspect Two- and Three-Wheel Vehicle System
- Overhaul and Three-Wheeler Engine and Power Train Assembly

Module Instruction

For effective use these modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit.
2. Accomplish the Self-checks at the end of each unit.
3. Perform Operation Sheets which were provided at the end of units.
4. Do the “LAP test” giver at the end of each unit and
5. Read the identified reference book for Examples and exercise.

Unit One: Introduction to Two and Three Wheeler

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Classification of Heat Engine
- Construction of IC Engine
- Basics of Two and Three Wheelers
- Engine System
- Electrical System
- Transmission System
- Special Tools and Equipment

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Classification Heat Engine
- Construction of an IC Engine
- Understand the Basics of Two and Three Wheelers
- Maintain engine system
- Maintain Electrical System
- Maintain Transmission System
- Special Tools and Equipment

1.1.Classification Heat Engine

Heat engine is a machine for converting heat, developed by burning fuel into useful work. It can be said that heat engine is equipment which generates thermal energy and transforms it into mechanical energy.

1.1.1 Based on Combustion of Fuel

A. External Combustion Engine

Here, the working medium, the steam, is generated in a boiler, located outside the engine and allowed in to the cylinder to operate the piston to do mechanical work.

B. Internal Combustion Engine

In internal combustion engine, the combustion of fuel takes place inside the engine cylinder and heat is generated within the cylinder. This heat is added to the air inside the cylinder and thus the pressure of the air is increased tremendously. This high pressure air moves the piston which rotates the crank shaft and thus mechanical work is done.

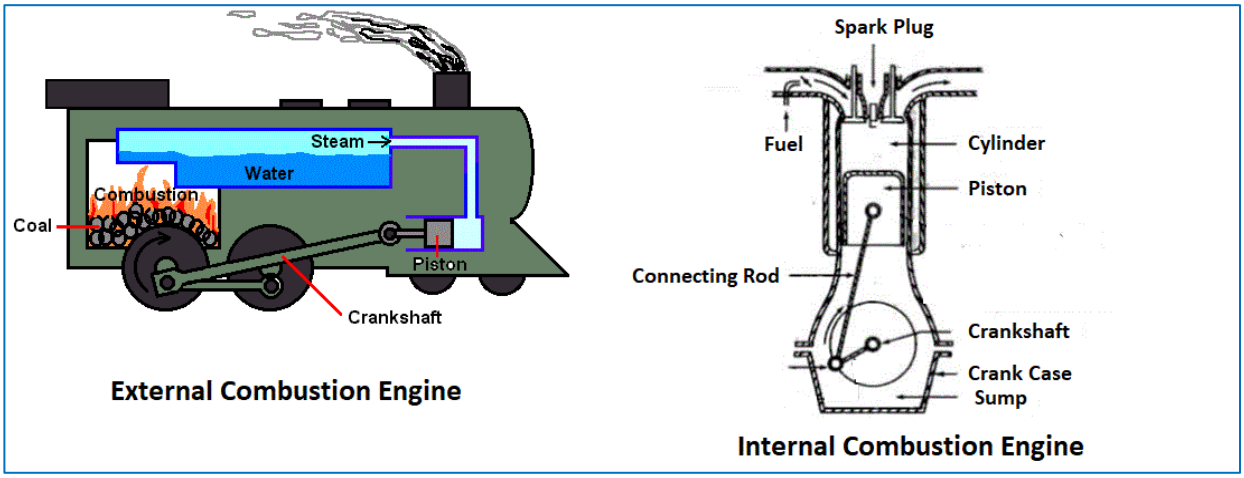


Figure 1:1Internal and External Combustion

1.1.2 Based On Fuel Used

- Diesel engine – Diesel is used as fuel
- Petrol engine – Petrol is used as fuel
- Gas engines – propane, butane or methane gases are used

1.1.3 Based Ignition of Fuel

A. Spark Ignition Engine (Carburettor Type Engines)

Spark ignition engine – a mixture of air and fuel is drawn in to the engine cylinder. Ignition of fuel is done by using a spark plug. The spark plug produces a spark and ignites the air-fuel mixture. Such combustion is called constant volume combustion (C.V.C.).

B. Compression Ignition Engine (Injector Type Engines)

Compression ignition engine – In compression ignition engines air is compressed in to the engine cylinder. Due to this the temperature of the compressed air rises to 700-900 C. At this stage diesel is sprayed in to the cylinder in fine particles. Due to a very high temperature, the fuel gets ignited. This type of combustion is called constant pressure combustion (CP.C.) because the pressure inside the cylinder is almost constant when combustion is taking place.

1.1.4 Based on Working Cycle

A. Four Stroke Cycle Engine

A four-stroke engine is an internal combustion engine in which the piston completes four separate strokes which comprise a single thermodynamic cycle. A stroke refers to the full travel of the piston along the cylinder, in either direction. While risqué slang among some automotive enthusiasts names these respectively the "suck," "squeeze," "bang" and "blow" strokes, they are more commonly termed.

B. Two Stroke Cycle Engine

In two stroke cycle engines, the whole sequence of events i.e., suction, compression, power and exhaust are completed in two strokes of the piston i.e. One revolution of the crankshaft. There isno valve in this type of engine. Gas movement takes place through holes called ports in the cylinder. The crankcase of the engi ne is air tight in which the crankshaft rotates.

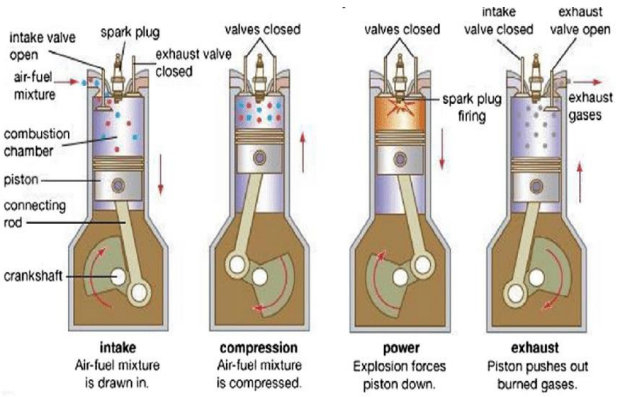


Figure 1: 2 Four Stroke Cycle Engine

I. Upward stroke of the piston (Suction + Compression)

When the piston moves upward it covers two of the ports, the exhaust port and transfer port, which are normally almost opposite to each other. This traps the charge of air- fuel mixture drawn already in to the cylinder.

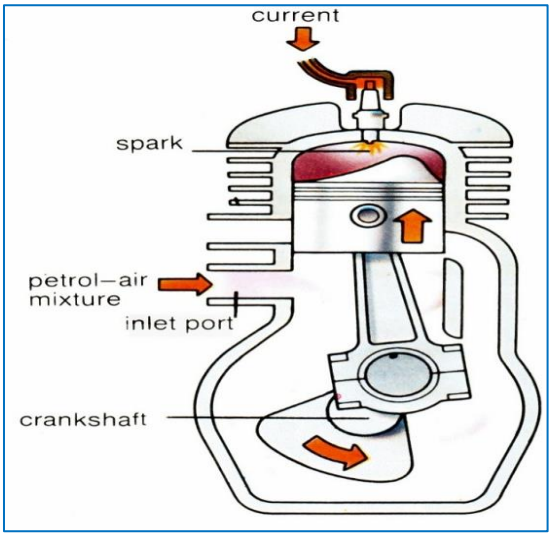


Figure 1:3 Upward Stroke

Further upward movement of the piston compresses the charge and also uncovers the suction port. Now fresh mixture is drawn through this port into the crankcase. Just before the end of this stroke, the mixture in the cylinder is ignited by a spark plug. Thus, during this stroke both suction and compression events are completed.

II. Downward Stroke (Power + Exhaust)

Burning of the fuel rises the temperature and pressure of the gases which forces the piston to move down the cylinder. When the piston moves down, it closes the suction port, trapping the fresh charge drawn into the crankcase during the previous upward stroke. Further downward movement of the piston uncovers first the exhaust port and then the transfer port.

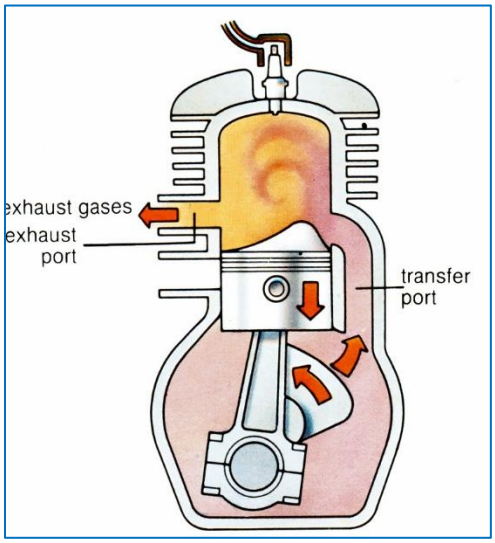


Figure 1: 4 Downward Stroke

III. Scavenging Process

A basic part of the cycle of an internal combustion engine is the supply of fresh air and removal of exhaust gases. This is the gas exchange process. Scavenging is the removal of exhaust gases by blowing in fresh air. Charging is the filling of the engine cylinder with a supply or charge of fresh air ready for compression. With supercharging a large mass of air is supplied to the cylinder by blowing it in under pressure.

Efficient scavenging is essential to ensure a sufficient supply of fresh air for combustion. In the four-stroke cycle engine there is an adequate overlap between the air inlet valve opening and the exhaust valve closing. With two stroke cycle engines this overlap is limited and some slight mixing of exhaust gases and incoming air does occur.

Number of different scavenging methods is in use in slow-speed two-stroke engines. In each the fresh air enters as the inlet port is opened by the downward movement of the piston and continues until the port is closed by the upward moving piston. The flow path of the scavenge air is decided by the engine port shape and design and the exhaust arrangements.

Three basic systems are in use:

All modern slow-speed diesel engines now use the uni-flow scavenging system with a cylinder-head exhaust valve.

a) Cross Flow Scavenging

In cross scavenging the incoming air is directed upwards, pushing the exhaust gases before it. The exhaust gases then travel down and out of the exhaust ports. Figure above illustrates the process.

b) Loop Flow Scavenging

In loop scavenging the incoming air passes over the piston crown then rises towards the cylinder head. The exhaust gases are forced before the air passing down and out of exhaust ports located just above the inlet ports. The process is shown in Figure below.

c) Uniflow Scavenging

With uniflow scavenging the incoming air enters at the lower end of the cylinder and leaves at the top. The outlet at the top of the cylinder may be ports or a large valve. The process is shown here.

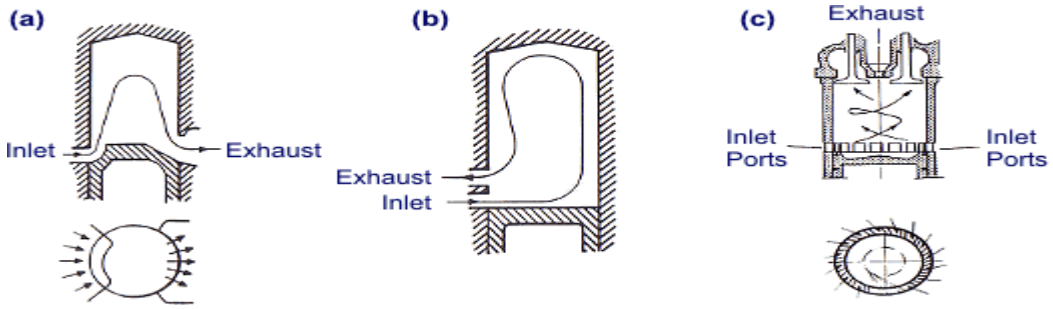
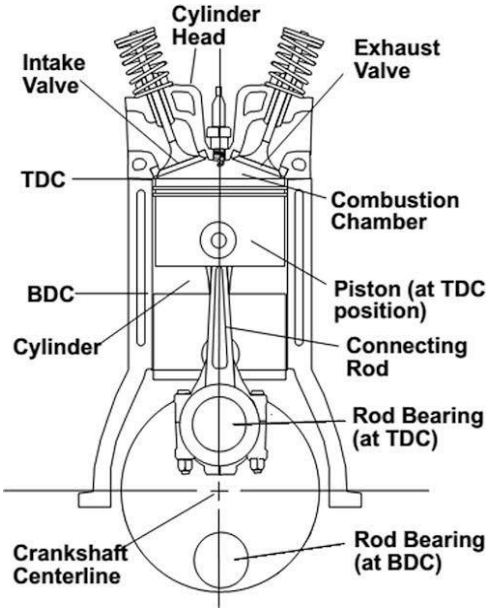


Figure 1:5 Scavenging Process

1.2 Construction of an IC Engine

Internal combustion engine converts the reciprocating motion of piston into rotary motion of the crankshaft by means of a connecting rod. The piston which reciprocating in the cylinder is very close fit in the cylinder. Rings are inserted in the circumferential grooves of the piston to prevent leakage of gases from sides of the piston. Usually a cylinder is bored in a cylinder block and a gasket, made of copper sheet or asbestos is inserted between the cylinder and the cylinder head to avoid ant leakage. The combustion space is provided at the top of the cylinder head where combustion takes place.

The connecting rod connects the piston and the crankshaft. The end of the connecting rod connecting the piston is called small end. A pin called gudgeon pin or wrist pin is provided for connecting the piston and the connecting rod at the small end. .



The other end of the connecting rod connecting the crank shaft is called big end. When piston is moved up and down, the motion is transmitted to the crank shaft by the connecting rod and the crank shaft makes rotary motion. The crankshaft rotates in main bearings which are fitted the crankcase.

A flywheel is provided at one end of the crankshaft for smoothing the uneven torque produced by the engine. There is an oil sump at the bottom of the engine which contains lubricating oil for lubricating different parts of the engine.

1.2.1 Cylinder Head

The cylinder head is bolted to the machined surface on the top of the cylinder block.

The cylinder head fits directly over the cylinders and forms the combustion chamber of each cylinder. In these chambers, the engine burns air and fuel to produce mechanical energy.

Figure 1: 6 Cylinder head and its components

Figure 1: 7 Construction of an IC Engine

A. Valve

The valve mechanism opens or closes the intake valve and exhaust valve at the proper timing in order to input the air-fuel mixture into the combustion chamber space and output the combustion gas into the outside. The operation is provided by pear-shaped cams, on a rotating camshaft, driven by a chain or a belt.

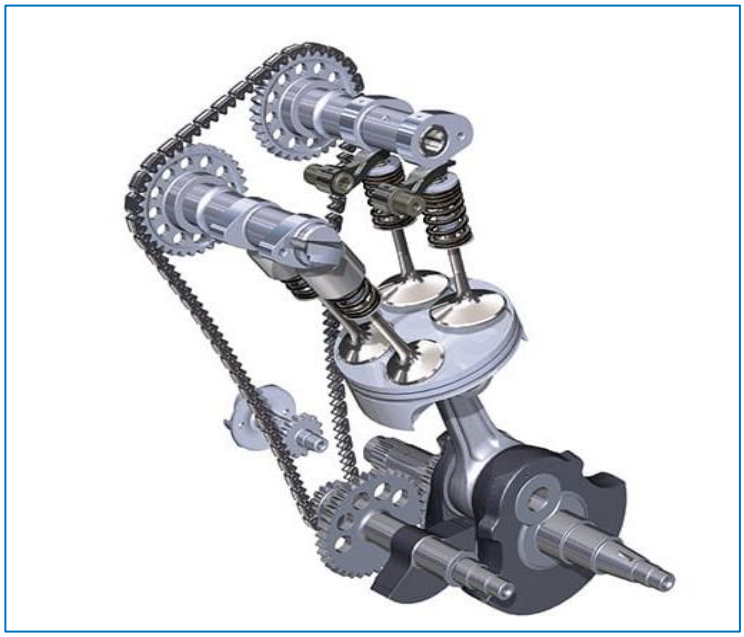


Figure 1: 8 Valve Mechanism

I. **Inlet valve** is detail, which allows air-fuel mixture into the cylinder at precise moment.

II. **Exhaust valve** is detail, which allows the spent gases escape at precise moment.

B. Cylinder Head Gasket

The head gaskets are elements in fibreglass or synthetic material assembled between the engine body and the upper part to ensure optimal compression. They are carefully adjusted with laser techniques and treated on the surface.

Figure 1: 9 Cylinder Head Gasket

1.2.2 Cylinder Block

The biggest part of the engine is the cylinder block; the cylinder block is a large casting of metal (cast iron or aluminium) that is drilled with holes to allow for the passage of lubricants and coolant through the block and provide spaces for movement of mechanical parts.

Figure 1: 10 Cylinder Head Gask

A. Piston

It is the moving component that is contained by a cylinder and is made gas-tight by piston rings. In an engine, its purpose is to transfer force from expanding gas in the cylinder to the crankshaft via a piston rod and/or connecting rod. The piston contain piston rings.

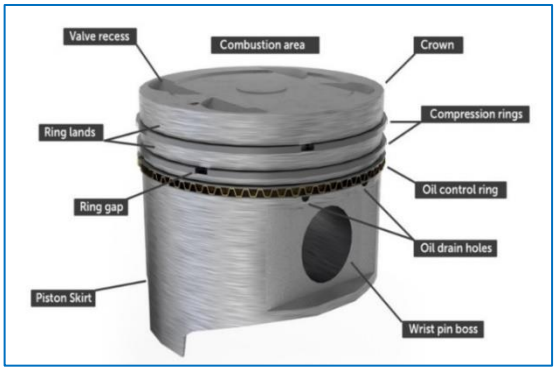


Figure 1: 10 Piston rings

The piston rings are metallic split type rings which are fitted into the grooves of the outer diameter of a piston in an IC engine to maintain good deal between piston and cylinder wall. Generally 3 to 4 rings are used in an IC engine. The Function of Piston Rings are

- It provides a pressure seal for burnt gases so that they cannot enter into the crankcase.
- They provides path for heat conduction from piston crown to cylinder walls.

They control the flow of oil to the skirt and prevent mixing with gases inside combustion chamber. There are two types of piston rings

Figure 1: 11 Piston Parts

I. Compression Rings

There is generally two or three compression rings fitted on the piston. The number of compression rings depends on the compression ratio.

II. Oil Control Rings

An oil ring is the piston ring located in the ring groove closest to the crankcase. The oil ring is used to wipe excess oil from the cylinder wall during piston movement. Excess oil is returned through ring openings to the oil reservoir in the engine block.

B. Connecting Rod

The main function of a Connecting Rod is to connect Piston and Crankshaft. The Piston pin receives the push and pulls (reciprocating motion) from the Piston and transfers this motion to Crank pin. A Connecting Rod mainly contains three parts- Shank, a small end and a big end.

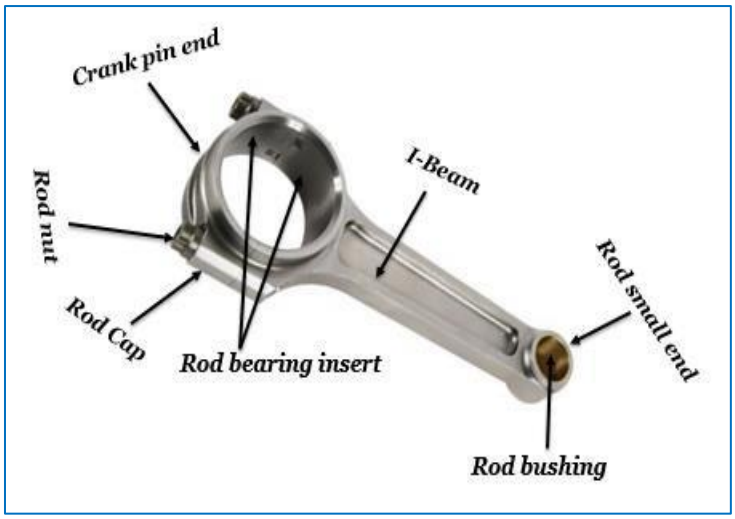


Figure 1: 12 Connecting Rod

The small end of the Connecting is connected to the Piston via Piston pin also known as 'Gudgeon Pin' and the big end is connected to the Crankshaft.

C. Gudgeon Pin

It forms the link between the small end of the connecting rod and the piston. It is a small pin as shown in Figure 2.13.

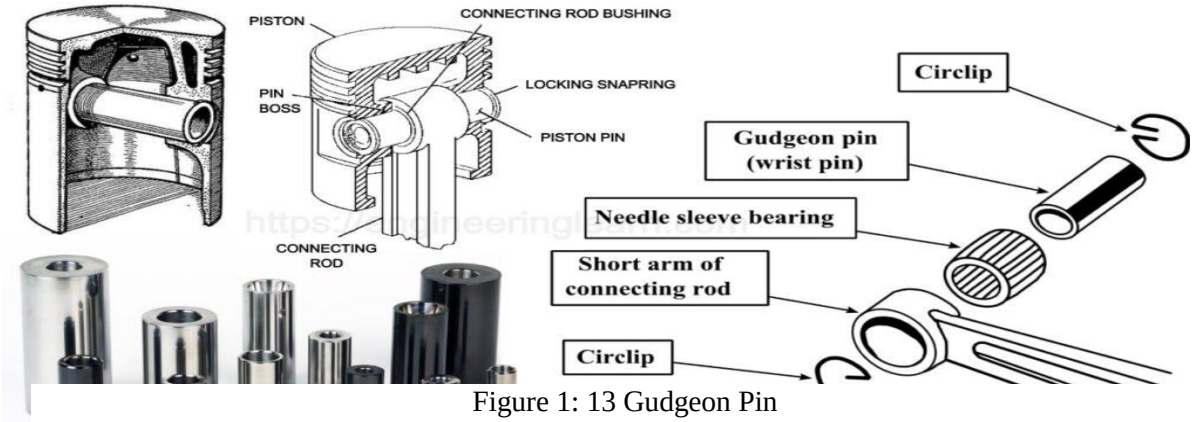


Figure 1: 13 Gudgeon Pin

D. Crankshaft

A crankshaft is an essential part of the power transmission system. In which, the reciprocating movement of the piston is converted into the rotating movement by using the connecting rod.

A crankshaft consists of crankpins, crank webs (crank arms or cheeks), balancing weights, and main journals. The large end of the connect ing rod is attached to the crankpin of the crankshaft.

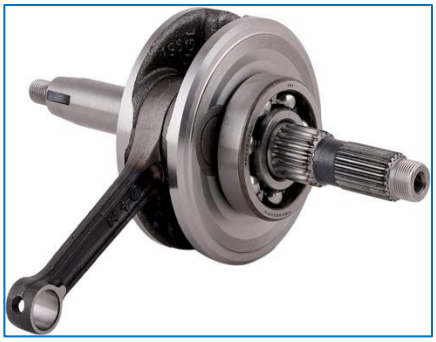


Figure 1: 14 Crankshaft Assembly

E. Flywheel

A flywheel is one of the most important components of an automobile engine. Below are the functions of the flywheel in an automobile engine:

I. **Engine Balancing**: because the pistons are offset from the centre of the crankshaft vibration and wobbles occur. This is also because of each piston fires at a different angle.

II. **Engine Start**: the flywheel plays another role while starting the engine. The gear teeth on the flywheel are attached to a starter motor. This starter motor is controlled with the car key so when the car is started the starter motor turns the flywheel.

Figure 1: 15 Fly Wheel Assembly

III. **Engine speed smoothing**: The crankshaft converts the piston movement into rotary motion which is jerky as the power is generated. The rotational speed of the crankshaft is constant and the engine runs smoothly. This is because the mass of the flywheel applies inertia which kept the engine crankshaft spinning between each piston firings.

IV. **Weight manipulation**: the weight of a flywheel determines the performance of an engine. The weight is designed base on the performance of the vehicles.

F. Camshaft

The camshaft provides the outside force to open the valves. It is a long shaft that extends through the length of the cylinder block and it has a series of egg-shaped lobes (cam lobes) Shows one of these lobes in the position required to open the valve. The camshaft, driven by a gear mechanism attached to both it and the crankshaft, rotates once for every two revolutions of the crankshaft on a four-stroke cycle engine.

Figure 1: 16 Camshaft

1.3 Basics of Two and Three Wheelers

1.3.1 Two Wheelers Vehicles

A two-wheeler is a vehicle that runs on two wheels. The two wheels may be arranged in tandem, one behind the other, as with single-track vehicles, or arranged and also side by side, on the same axle. If on the same axle, the vehicle may have no other support, as with di cycles, or have additional support, which is often also the source of motive power.

Two-wheelers include motorcycles, scooters and mopeds. Motorcycles are the largest and heaviest category of two-wheeler, with the most powerful engines.

- **Motorcycle:** is used to encompass all three types of two-wheeler described here.
- **Scooters** tend to have smaller wheels compared to other types of two-wheelers. They have a distinctive design with the engine and fuel tank mounted under the driver seat, and a foot-platform between the driver seat and the handle bars.

- **Mopeds** are small, light vehicles that are usually started by pedalling (the name derives from motorcycle + pedal).

Figure 1: 18 Two Wheelers Vehicles

Figure 1: 17 Two Wheelers Vehicles

Parts of Motorcycle

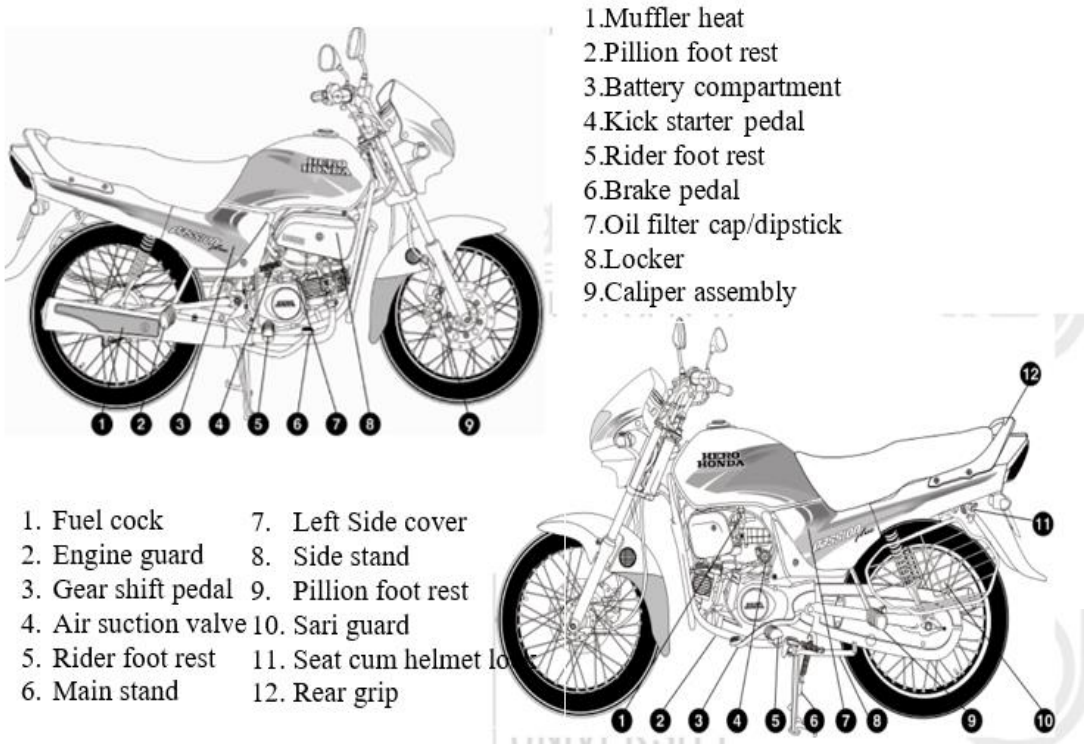
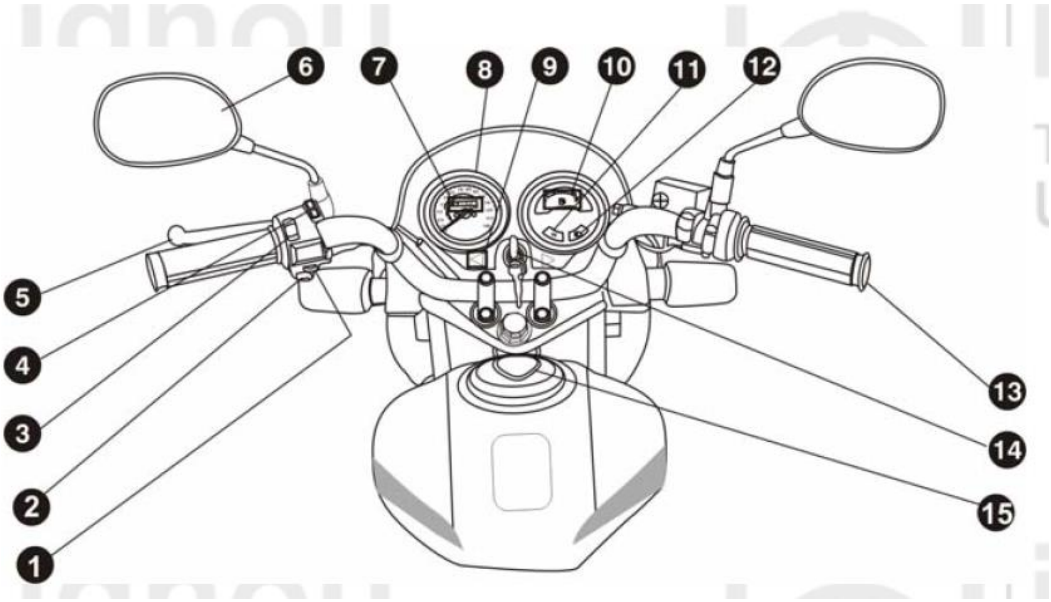


Figure 1: 19 Dashboard Instrumental



1. Turn signal switch
2. Horn switch
3. Headlight dimmer switch
4. Headlight switch
5. Clutch lever
6. Rear view mirror
7. Odometer
8. Speedometer
9. Indicator lights
10. Fuel indicator
11. Neutral lights
12. High beam indicator
13. Throttle grip
14. Ignition switch cum steering lock
15. Fuel tank cap

1.3.2. Three Wheelers Vehicles

A three-wheeler is a vehicle with three wheels. Some are motorized tricycles, which may be legally classed as motorcycles, while others are tricycles without a motor, some of which are human-powered vehicles and animal-powered vehicles.

The auto rickshaw (Three Wheelers) is a common form of transport around the world, both as a vehicle for hire and for private use. They are especially common in countries with tropical or subtropical climates, since they usually are not fully enclosed, and are found in many developing countries because they are relatively inexpensive to own and operate. There are many different auto rickshaw designs.

The most common type is characterized by a sheet-metal body or open frame resting on three wheels; a canvas roof with drop-down side curtains; a small cabin at the front for the driver operating handlebar controls; and a cargo, passenger, or dual purpose space at the rear. Another type is a motorcycle that has an expanded sidecar or, less often, is pushing or pulling a passenger compartment.

Figure 1.21three wheeler body part

1.4. Engine Systems

1.4.1. Lubrication System

This is an arrangement that consists of oil pump, oil sump, oil lines and lubricant. The lubricant is meant to lubricate the engine moving parts and it also cleans the moving parts of the engine.

A. Necessity of Lubrication

- To lubricate the various parts of engine.
- The supplementary function of lubrication is to cool and clean the engine parts.
- To prevent engine parts from rusting.
- To provide sealing for combustion gases from entering into sump.
- To damp down engine noise.

B. Types of Lubricant

Lubricant is a material which circulates through the lubrication network to provide lubrication at various points. Lubricants are classified in three forms: Fluid oils, semisolid and solids.

a) Fluid Oil

These are liquid oils and used in engine lubrication system.

b) Semi Solids

Such as Grease. These types of lubricant are used in chassis lubrication system.

c) Solid

Such as graphite and mica. Such types of lubricant are used in journal bearing and springs with some fluid oils.

Fluid oils can also be classified according to their sources – as animal, vegetable, and mineral oil. Mineral oils are used for lubricating automotive engines because they have most of the desired qualities and simultaneously they are available easily and cheap. The function of a lubricant is to decrease friction by preventing direct contact of rubbing surfaces. It makes a layer between adjacent surfaces. The ability to keep two surfaces apart depends onits various properties.

C. Various Properties of Lubricant

I. Viscosity

The property of lubricant which is a measurement of the internal friction of lubricating oil is called its viscosity. The viscosity of an oil is specified in time (seconds) taken by the given quantity of oil to flow freely through a standard size hole at given temperature.

II. Viscosity Index

Every lubricant thins out when its temperature increases and gets heavier as temperature decreases but this change does not occur at the same rate for every lubricant. A number is given to indicate the rate at which it thins out or gets heavier; this is known as viscosity index.

III. API Classification

American Petroleum Institute (API) gives a classification for various oils as per the ingredients in the oil. Some of the functions of these ingredients are: anti-foaming, anti-septic, anti-rust, etc. The classification starts from SA, SB, SC, SJ . . . etc.

IV. SAE Number

SAE viscosity numbers are recommended by Society of Automotive Engineers (SAE). The range of viscosities within which it falls at the given temperature determines the SAE viscosity number of any lubricating oil. The lubricating oil recommended by Hero Honda Motors Ltd for their 100 cc models is of grade range SAE 20 W 40 SJ and for 125 cc is SAE 10 W 30 SJ grade.

D. Type of Lubrication Systems

The complete lubrication of a vehicle can be divided into two systems.

I. Engine Lubrication System

This system facilitates the lubrication of all the engine components, gears and other associated parts. The brief description of engine lubrication system is given below.

Working of Engine Lubrication System

The oil flows from oil pump into the distribution chamber, where it is divided into two parts. One part enters into the right crankcase cover and flows into the centrifugal rotor. Due to centrifugal action the impurities are collected at the periphery and clean oil goes inside the

crankshaft to the crankpin. Through the opening on either side of the connecting rod at crank pin area, the oil flows up and lubricates piston, piston rings, and piston pin and cylinder liner. The second part of oil goes through one of studs to the cylinder head, hence it goes into the camshaft and comes out of small holes on the cam lobe area. This oil lubricates valve, spring, rocker arm etc. The oil also comes out from dowel pin, which has cam sprocket installed on to it. This oil lubricates the cam chain.

II. Chassis Lubrication System

This lubrication system consists of outer body parts, which are lubricated from outside of the body. The points for lubrication

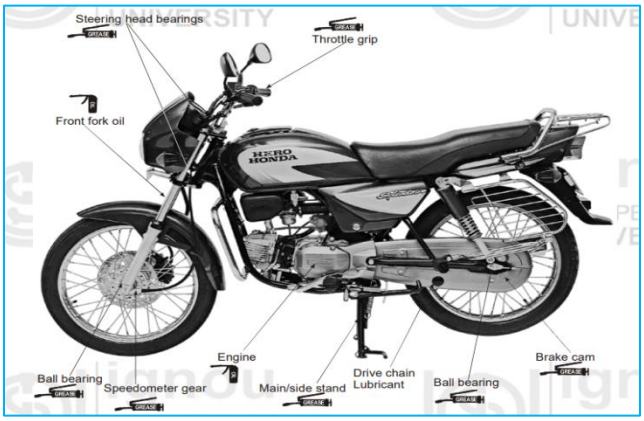


Figure 1.23 two wheeler Lubrication point

Table1:1Lubrication Points

Sl.	Name	Type of Lubricant
1.	Ball Bearing	Grease
2.	Speedometer Gear	Grease
3.	Engine Engine	Oil
4.	Main Stand	Grease
5.	Brake Pedal	Grease
6.	Drive Chain	Oil
7.	Front Fork	Oil
8.	Throttle grip	Grease

9.	Steel Balls, Cone Race,	Grease
10	Ball Race	Grease

1.4.2.Cooling System

A cooling system is designed to remove a part of heat generated inside the cylinder that may be harmful to engine parts. The heat is produced in the engine cylinder by the burning of fuel. A part of this heat is converted into the useful energy. But the remaining part of heat that cannot be utilised has to be discharged properly from the engine and surrounding parts, otherwise it might be a cause of serious problems in the engine like piston seizure.

A part of unutilised heat escapes with the exhaust gases and lubricants but still some extra heat has to be removed and this part of unutilised heat is removed by the cooling system.

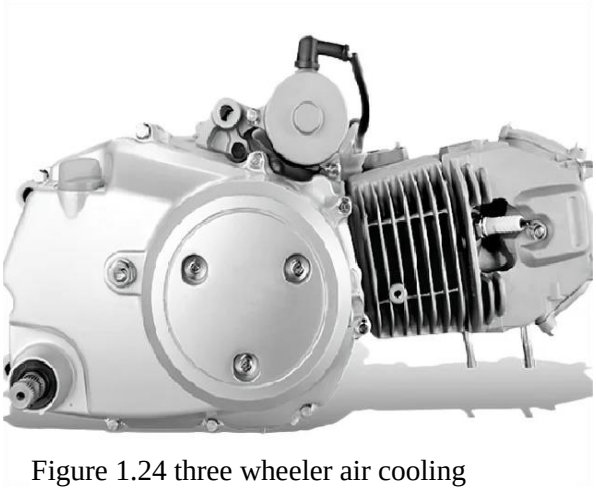


Figure 1.24 three wheeler air cooling

A. Necessity of Cooling System

- To prevent the engine from excessive heating.
- To avoid the piston seizure due to thermal expansion.
- *To prevent burning of lubricant and warping of valves.*
- To prevent scoring of cylinders, binding of pistons and bearings.

B. Types of Cooling System

Three types of cooling system are used in two and three wheelers.

I. Air-Cooling

In this type of cooling, the engine cylinder is surrounded by fins on the outside, which allow it to circulate cool air in the engine area. This then cools down the engine. This method is the most common system is also quite inexpensive. However, it is also the least effective system since it does not always prevent overheating.

II. Oil Cooled System

This type of system uses engine oil to cool the engine and maintain optimum temperatures. Engine oil, when heated, gets thinner and thus less effective. In order to keep it cool, the oil is then circulated between an oil cooler, where air cools the oil. This cooled oil is circulated back into the engine, thus keeping it cool.

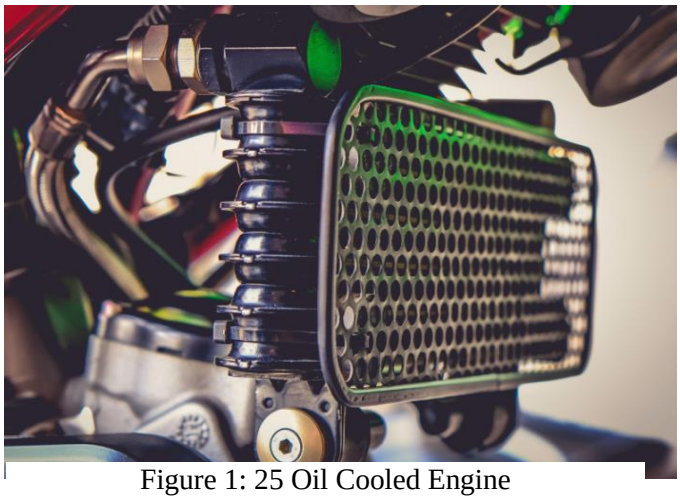


Figure 1: 25 Oil Cooled Engine

III. Liquid Cooled Systems

Liquid cooling is a high-concept method that is found in high capacity vehicles as well as in cars. This system uses a network of small passages in and around the engine, through which a coolant is circulated.

This coolant absorbs the heat and then is cooled down again in the radiator, before being circulated again in the system.

Figure 1: 26 Liquid Cooled Engine

1.4.3.Fuel Feed System

Fuel feed system is provided to serve the air fuel mixture to the engine in an appropriate ratio so that it can burn efficiently and transmit power to crank shaft. Carburettor is used in the motorcycle to perform some important functions. Carburettor is the most important part of fuel system. The function of carburettor is to supply combustible mixture of fuel and air in correct proportion during all conditions of engine working.

A. Carburettor

It supplies the air fuel mixture at varying proportions that suits the changing operating conditions of motorcycle. Carburettor has Following Main Functions:

- It breaks the fuel into small particles (fine mist). This function is known as atomization. The atomized particles of liquid evaporate to produce vapour of fuel.
- To mix both air and fuel.
- Provide adequate quantity of air fuel mixture according to temperature, load and speed conditions.

I. Components of a Carburettor

a) Venturi Tube

A venturi is basically an air passage that has a shape similar to that shown in Figure 2.29 that is narrower at the middle known as venturi tube. As air travels through the narrow part of venturi, its velocity increases and the pressure drops.

b) Throttle Valve

The throttle valves control the quantity of mixture supplied to the cylinder. This is controlled by throttle grip with the help of a cable. When we open throttle valve, the quantity of mixture supplied to cylinder is increased, as a result power generated inside the cylinder is also increased that may increase the vehicle speed.

c) Choke

This is incorporated in the main air passage and used to control the air quantity tosupply rich mixture. While starting an engine, the choke shuts off the air supply to the carburettor so the resulting mixture will be rich in fuel and this opens automatically as the engine heats up.

The ideal carburettor passes a complete vaporized fuel air mixture in the proper proportions into the cylinder. A part of atomized fuel is vaporized in heated spots in the intake manifold.

Working Principle of Carburettor

All carburettors work on one basic principle, the venturi. A venturi is a very simple device that changes air pressure by changing the velocity of the air. As velocity increases, pressure drops and as velocity decreases, pressure rises. As air travels through the narrow part of the venturi, its velocity increases and the pressure drops.

If there is a fuel passage at that low pressure point and the fuel reservoir is at a higher pressure, fuel will be pushed into the venturi, i.e. a carburettor needs pressure difference to allow flow of fuel. Venturi, thus, creates the pressure difference.

II. Operating Conditions of Carburettor

a) Idle Circuit

During Idling while the throttle valve is almost closed the vacuum is very high at Venturi area and no air-fuel mixture is drawn through the main circuit, as the jet needle is not lifted from the seat. At idle, the throttle valve is pushed most of the way down by a spring, almost completely closing off the main bore. To keep the idle conditions stable, a slow speed circuit is devised and controlled through the air-screw where the air-fuel mixture is regulated. Because of suction, the air-fuel mixture is delivered in atomized form through the slow jet opening.

b) Ideal Speed Circuit (36 to 40 k/h)

Motorcycle is brought into this condition by raising the throttle valve and an incorporated jet needle. The air enters through the main passage the fuel enters through the main jet

c) High Speed Circuit

The speed of motorcycle is further increased by raising the throttle valve. In this condition, fuel and air enter through main passage and main jet.

III. Mixture Requirement

a) Rich Mixture

It generally ranges from approximately 7:1 to 13:1 proportion of air to fuel by weight. To get a high power rich mixture is required. In fact to start the enginefrom cold, a rich mixture is required, because fuel does not vaporize completely.

b) Lean Mixture

It generally ranges from approximately 15:1 to 17: 1. By the use of this fuel, engine runs for higher economy

1.5.Two and Three Wheelers Electrical System

Electrical system consists of a battery, spark plug, lighting system, ignition system, charging system and electricity generator. These components of electrical system are used to fulfil particular functions. This system facilitates a required current for lighting, horn, ignition of fuel in the engine and other purposes.

Necessity of Electrical System

- Lights and horn for safe riding of vehicle even at night.

- Electricity for ignition of fuel in the engine.
- Battery Charging.

1.5.1.Ignition System

The purpose of the ignition system is to produce the high voltage surges required to ignite the compressed air fuel mixture in the engine combustion chamber at the proper instant under all speed and load conditions. The ignition system is supplied a 12 volt or less battery voltage or charging system voltage and increases to 20,000 to 30000 volts required to create a spark across the spark plug electrodes in the combustion chamber.

A. Types of Ignition system

I. Battery Coil Ignition System

a) **Primary Circuit:** It consists of 6 or 12 V battery, ammeter, ignition switch, primary winding it has 200-300 turns of 20 SWG (Sharps Wire Gauge) gauge wire, contact breaker, capacitor.

b) Secondary Circuit: It consists of secondary winding. Secondary winding consists of about 21000 turns of 40 (S WG) gauge wire. Bottom end of which is connected to bottom end of primary and top end of secondary winding is connected to centre of distributor rotor. Distributor rotors rotate and make contacts with contact points and are connected to spark plugs which are fitted in cylinder heads (engine earth).

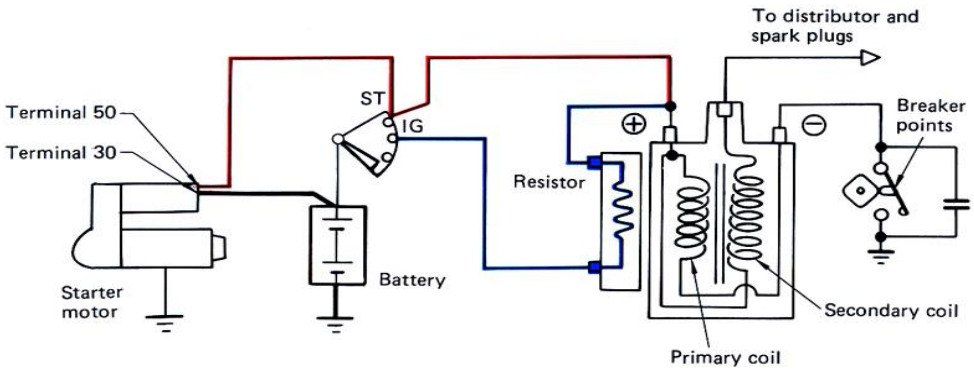


Figure 1: 27 Battery Coil Ignition System

II. Magneto ignition system

The magneto is a self-contained generator of high voltage that provides ignition to an engine through spark plugs. A magnet—hence magneto—spins in close proximity to a coil of wire.

As the magnet spins (or the magnet rotor is turned), it generates a strong magnetic force that is “held back” by a primary coil.

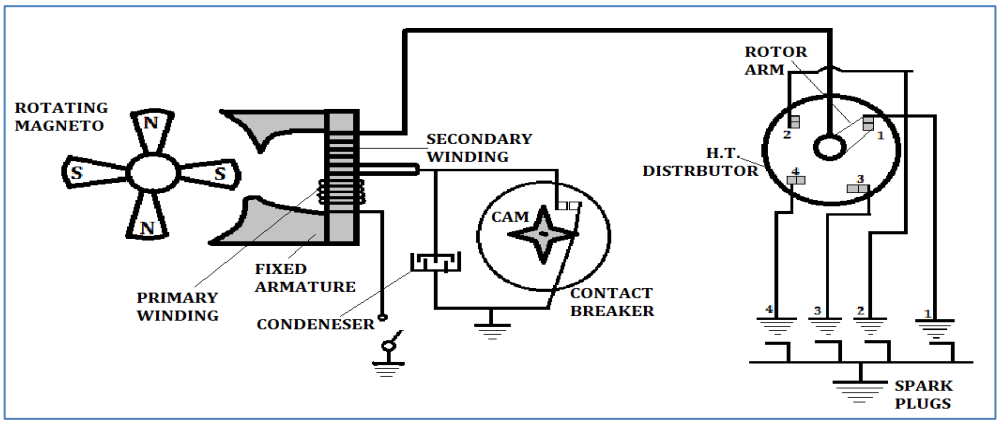


Figure 1: 28 Magneto ignition system

An alternating current (AC) is generated when a magnet moves between two stationary coils. In a magneto, a coil of wires moves between two magnets to produce AC. This AC supply is rectified before use. After rectification this current is also used for other electrical purposes.

The CDI unit consists of a capacitor which is charged through the AC current.

When reflector comes in front of the pulsar coil a small amount of current (pulse) is sent to the CDI unit which discharges the capacitor. The discharged current flows through the primary windings of the ignition coil. This induces current in the secondary coil and the voltage is stepped up. This high voltage current jumps across the gap between spark plug electrodes and generates spark.

III. Electronic Ignition System

The need for higher mileage, reduced emissions and greater reliability has led to the development of the electronic ignition systems. These systems generate a much stronger spark which is needed to ignite leaner fuel mixtures. Breaker point systems needed a resistor to reduce the operating voltage of the primary circuit in order to prolong the life of the points. The primary circuit of the electronic ignition system operates on full battery voltage which helps to develop a stronger spark.

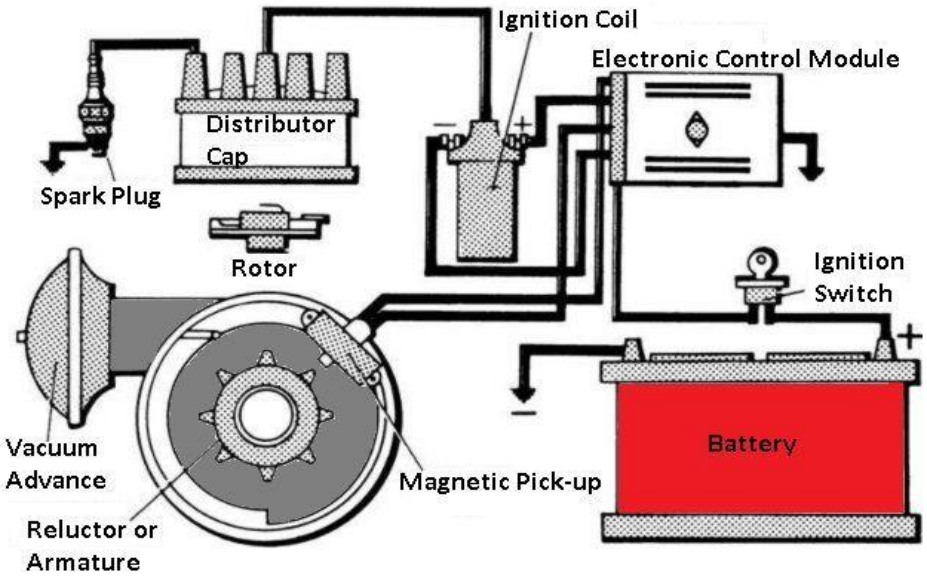


Figure 1.29 electronic ignition system

1.5.2.Starting System

The starter system is an electrical circuit that is useful for starting or starting the vehicle engine. This system can convert electrical energy from the battery into mechanical energy.

A. Kick Start System

A kick start is a method of starting an internal combustion engine. This method of starting the engine is most commonly executed on a motorcycle or off-road vehicle in lieu of an electric starting system. Most motorcycles in the past featured kick start systems as the exclusive method of starting the engine, but the application of electric starters to motorcycles has largely replaced the kick start method.

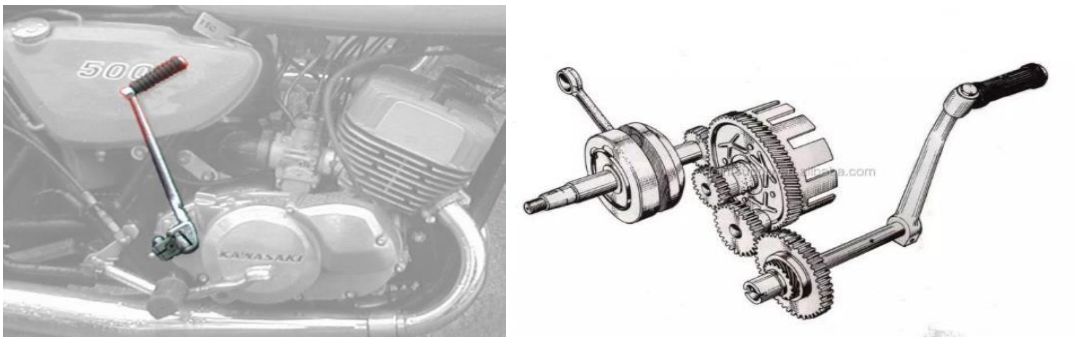


Figure 1:30 Kick Start System

A. Self-Starter System

Self-Start System is the method of rotating the crankshaft with the help of a starter motor to start the engine. The Starter motor helps to rotate the crankshaft, which allows reciprocating the piston inside the cylinder to start Engine.

1.5.3.Lighting System

The motorcycle lighting system consists of head light, turn indicators, brake lights and panel board lights. Shows a DC circuit of the electrical system of the motorcycle.

Three wheeler lighting assembly

Figure 1: 31 Two wheeler lighting assembly

Figure 1: 32 Two Wheelers lights

1.6.Two and Three Transmission System

In a two and wheeler, the transmission system means the whole arrangement that transmits the power from the engine crankshaft to the rear wheel.

A. Necessity of Transmission System

The main purpose of Transmission system is to provide a means to vary the torque ratio between the engine and the road wheels.

It means the wheel may not be able to run at engine speed every time. So the transmission system provides the required speed.

The transmission also provides a neutral position, so that the engine and the road wheels are disconnected even with the clutch in the engaged position, aposition of idle run of engine.

B. Concept of Torque (Speed) Variation in Transmission System

When two different size gears are running at same speed, then the small gear makes more revolution than the big gear. This means the speed ratio can vary with the gear size.The same principle is applied in the speed variation of motorcycle. When smaller gear on the main shaft is in mesh with larger gear on the counter shaft, the revolutions of the counter

shaft will be lesser than the main shaft, because the larger gear mounted on countershaft will make less revolution than the smaller gear mounted on main shaft.

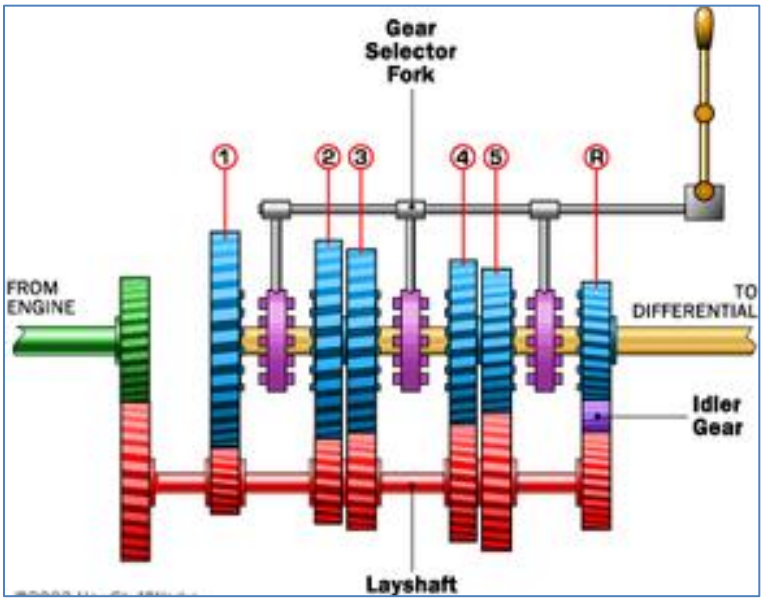


Figure1.32 Transmission Power flow

The transmission system mainly consists of clutch, gears and drive chain. a clutch is mounted on the main shaft of the gear box. A primary drive gear mounted on main shaft of the engine drives the driving shaft of the clutch through primary driver gear while the driver shaft of the clutch is connected to the main shaft of the gear box. The drive chain connects the counter shaft and rear wheel. The power is transferred from the main shaft to the counter shaft through various gears and then to the rear wheel through a drive chain.

A higher torque is required to bring the motorcycle into running condition from stationary state but when the motorcycle is running at high speeds the torque required is less.

1.6.1 Clutch

Clutch is a part which is used to transmit the rotary motion of one shaft to another shaft, when desired; the axis of second shaft must be in line with the axis of the firstshaft (coaxial). The clutch in the motorcycle works on the principle of friction. When arotating disc comes in contact with other disc, then by the virtue of friction of theseplates, both the discs rotate as a single unit.

The clutches are operated mechanically through linkages. When operator presses the clutch lever, the pressure on the clutch plates reduces to zero, hence the contact breaks between clutch plates and friction plates and as a result each plate becomes free to move independently and engine is disconnected from gearbox. This 3helps in smooth gear shifting.3

Figure 1: 33 Clutch Assembly

A. Types of Clutch

I. Single Plate Clutch

A clutch is a mechanical device that provides for the transmission power (and therefore usually motion) from one component (the driving member) to another(the driven member) when engaged, but can be disengaged. Clutches are used whenever the transmission of power or motion must be controlled either in amount or over time (e.g., electric screwdrivers limit how much torque is transmitted through use of a clutch; clutches control whether automobiles transmit engine power to the wheels).

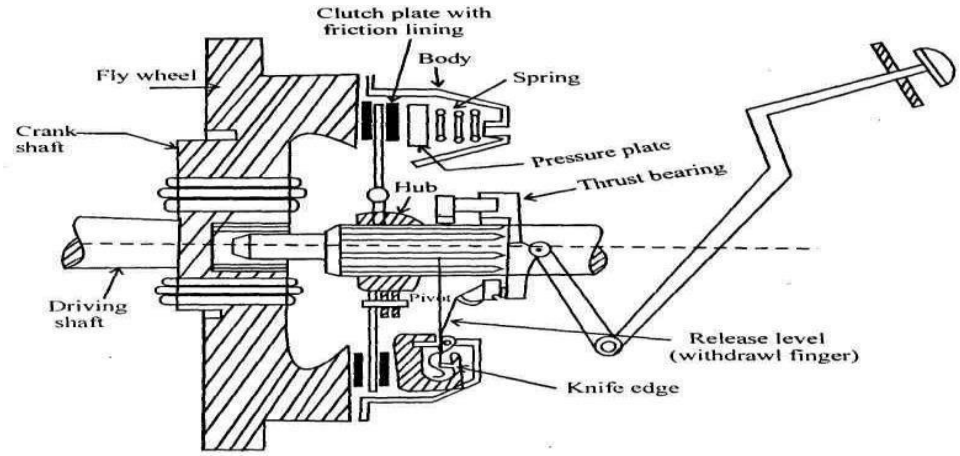


Figure 1: 34 Single Plate Clutch

The three levers (also known as release levers or fingers) are carried on pivots suspended from the case of the body. These are arranged in such a manner sothat the pressure plate moves away from the flywheel by the inward movement of a trust bearing. The bearing is mounted upon a forked shaft and moves forward when the clutch pedal is pressed. When the clutch pedal is pressed down, its linkage forces the thrust release bearing to move in towards the flywheel and pressing the longer ends of the levers inward.

The axial pressure exerted by the spring provides a frictional force in the circumferential direction when the relative motion between the driving and driven members tends to take place. If the torque due to this frictional force exceeds the torque to be transmitted, then no slipping takes place and the power is transmitted from the driving shaft to the driven shaft.

II. Multi Plate Clutch

Automobiles use various kinds of clutches such as single plate or multi plate clutch. Each clutch has got its own design construction and working principle. Multi plate clutch consists of a number of clutch plates, whereas single plate clutch has only one clutch plate. As the number of clutch plates are increased, the friction surface also increase. The increased number of friction surfaces in clutch increases the capacity of the clutch to transmit torque in automobiles.

Figure 1: 35 Multi Pleated Clutches

The plates are alternately fitted to the engine shaft and gear box shaft. They are firmly pressed by strong coil springs and assembled in a drum.

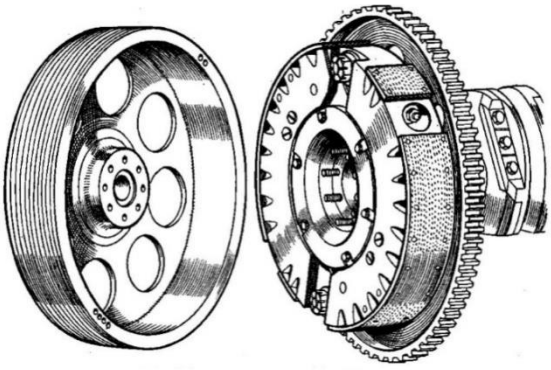


Figure 1: 36 Centrifugal Clutch

Each of the alternate plate slides in grooves on the flywheel and the other slides on splines on the pressure plate. Therefore, each alternate plate has inner and outer splines.

The multi pleated clutches operating condition may be dry or wet. When the clutch is operated in an oil bath, it is called a wet clutch. When the clutch is operated dry, it is called

dry clutch. The wet clutches are generally used in conjunction with the automatic transmission automotive. Multi plate clutch works in the same way as the single plate clutch i.e. by operating the clutch pedal.

- **Centrifugal Clutch**

The input of the clutch is connected to the engine crankshaft while the output may drive a shaft, chain, or belt. As engine RPM increases, weighted arms in the clutch swing outward and force the clutch to engage. The most common types have friction pads or shoes radically mounted that engage the inside of the rim of a housing. On the centre shaft there are an assorted amount of extension springs, which connect to a clutch shoe. When the centre shaft spins fast enough, the springs extend causing the clutch shoes to engage the friction face. It can be compared to a drum brake in reverse.

This type can be found on most home built karts, lawn and garden equipment, fuel powered model cars and low power chainsaws. Another type used in racing karts has friction and clutch disks stacked together like a motorcycle clutch. The weight edarms force these disks together and engage the clutch. When the engine reaches a certain RPM, the clutch activates, working almost like a continuously variable transmission.

1.6.2. Gear Boxes

The motorcycle gear box contains a number of gears in different sizes. In the process of gear switching, different pairs of gearwheels lock together. A large and small wheel lock together in the lowest or slowest gear. Similar size wheel slock together in the highest or fastest gear. The motorcycle gear box is the component that makes the actual ratio between the engine and the driving wheels. It is also referred to as transmission gear.

Types of Gear Box:

In a general manner, the motorcycle gear box can be of three types, they are:

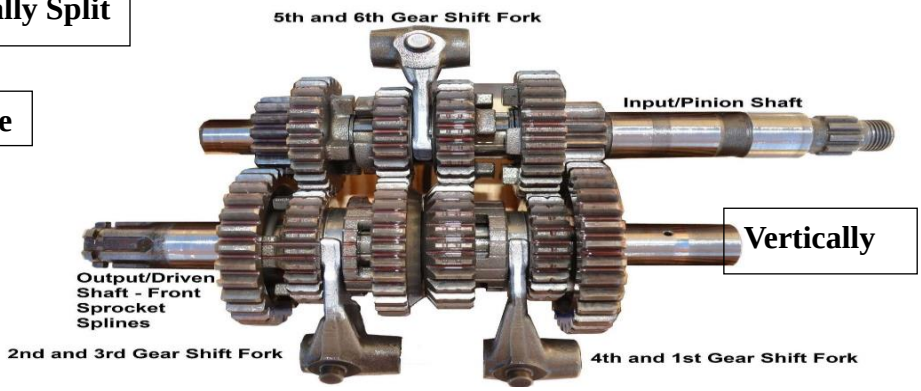
•**Horizontally Split**: It has a seam on the horizontal plane.

•**Vertically Split**: It has a seam on the vertical plane.

• **Cassette Type**: The gears are loaded in from one side.

Horizontally Split

Cassette Type



Vertically

Characteristics of Gear Box:

The gears are constantly meshed with one another and they are always spinning.

- It controls gear and shaft alignment.
- It controls the engine RPM.
- It protects the gears and lubricants from water, dust and other environmental contaminants.

Figure 1: 37 Gear Box Types

Figure 1: 38 Gear box set

Function of Gear Box:

A gearbox is a mechanical method of transferring energy from one device to another and is used to increase torque while reducing speed. Torque

is the power generated through the bending or twisting of a solid material. This term isoften used interchangeably with transmission

It is located at the junction point of a power shaft, the gearbox is often used to create a right angle change indirection, as is seen in a rotary mower or a helicopter. Each unit is made with a specific purpose in mind, and the gear ratio used is designed to provide the levelof force required. This ratio is fixed and cannot be changed once the box is constructed.

The only possible modification after the fact is an adjustment that allows the shaft speed to increase, along with a corresponding reduction in torque.

In a situation where multiple speeds are needed, a transmission with multiple gears can be used to increase torque while slowing down the output speed. This design is commonly found in automobile transmissions. The same principle can be used to create an overdrive gear that increases output speed while decreasing torque.

1.6.3. Under chassis System

There are numerous types of suspensions for connecting the wheels to frame body. The suspension plays the vital role in handling and driving motorcycle comfortably. People tend to overlook the basics of the suspension.

1.6.4. Suspension System

In addition to connecting the wheel to the frame, the suspension also absorbs shocks from the road surface. If the wheel is directly fixed to the frame, road shock is transmitted directly to the frame, impairing riding comfort and causing damage to the functional parts. By providing a cushion through shock absorber between the wheel and the frame the motorcycle is protected against shock damage and riding comfort is maintained. The suspension of a motorcycle basically consists of a coil spring and a damper.

Figure 1: 39 Three Wheelers Suspension

First, let us study the functions of the coil spring. The coil spring is installed between the wheel axle and the frame. When the wheel hits the bump the spring is compressed. The compression of spring absorbs the shock and prevents the transfer of these shocks to the vehicle body. This movement of the coil spring is termed as cushion effect. After compression, the spring rebounds and pushes the frame upwards. As this spring extends, compression occurs again, thus the frame bounces up and down, making the rider uncomfortable.

Figure 1: 19 Swing Arm Shock Absorber

The damper is a device which suppresses the spring oscillation without impairing the cushion function of the spring. The damper absorbs the energy of oscillations. The absorption of energy by the damper is called the damping effect. With the combination of coil spring and damper, that is cushion and damping effect, the suspension absorbs the road shock quickly, ensuring the smooth running of the vehicle.

Necessity of Suspension System

- Not to transmit road shocks to the motorcycle components.

- To guard the driver from road shocks and to make sure the stability of the vehicle in rolling, while in motion.

- **Types of Suspension System Used in Two Wheelers**

a) Telescopic Hydraulic Fork

This type of suspension system is used to serve for front part of motorcycle mostly. It consists of main and rebound springs, main and bottom tubes, piston, washer, distance tube. A hydraulic fluid fills the space which resists the motion of the piston thus dampens the oscillations. When a road shock exerts on to the suspension system it is transmitted to the spring instead of motorcycle frame and the spring starts to oscillate. The springs are supported on the piston which is not allowed to move much by the hydraulic fluid.

Because of road shock initially piston moves upward and compresses the spring. The damping oil from chamber A transfers to chamber B through a bigger hole. During the reverse movement of the piston the damping oil transfers from chamber B to chamber A but this time through a smaller hole. The transfer of oil offers resistance to spring oscillations hence some energy is lost to overcome this resistance. As a result the spring oscillation amplitude (movement) will be lower than before. In this way finally the oscillations of spring will be stopped.

b) Swing Arm Shock Absorber

This type of suspension is used to serve for rear part of motorcycle. The advantage of this type of suspension is that large deflections are absorbed.

It mainly consists of shock absorber, spring at cushion assembly that swings up and down about a pivot when shock exerts on it. The cushion assembly works on the same principle as front fork suspension.

Figure 1: 20 Three Wheeler Wheel

1.6.5. Wheels

The wheel, along with the tyre has to take the vehicle load, provide a cushioning effect (to protect against force or shock) and cope with the steering control. The wheel must fulfill the following requisite functions :

• It should be strong enough as well as lightest in weight as far as possible.

• It should be replaceable.

• It should be balanced in both static (stationary conditions) and dynamic (moving conditions).

• Its material should not be susceptible to corrosion.

1.6.6. Tyres

Different bikes respond differently to different tyres, so it is impossible to make a generic recommendation. It mainly consists of outer cover and inside tube. The tyre tube assembly is mounted over the wheel rim. The air inside the tube carries the entire load and protects against the shock and force.

Figure 1: 21 Two and Three Wheelers Tire

- **Necessity of Tyres**

• To supports the motorcycle load.

• To provide cushion against shocks.

•To allow smooth handling of motorcycle.

• To transmit driving and braking forces to the road.

- **Tyre Function and Structure**
  - **Overall Tyre Width:** Rectilinear distance between both side, including all patterns and character on tyre sidewalls.
  - **Tyre Height:** Half of height obtained by subtracting the rim diameter from the tyre outer diameter.
  - **Tread Width:** The width of the tyre tread surface. This corresponds, as a rule, to the distance between the most protruding portions on both sides.

- **Tread Radius:** This is also referred to as the crown R. The radius of curvature is expressed in millimetres.
- **Rim Width:** Rim width suitable for effective tyre performance.
- **Aspect Ratio:** Aspect ratio isa percentage ratio (oblate ratio) of tyre height to tyre width.

Aspect Ratio = H/W × 100 (%)

1.6.7. Braking System

A brake is a component of a motorcycle which is used to apply frictional resistance to a moving vehicle to stop or retard it by absorbing its kinetic energy. The functional difference between a clutch and a brake is that a clutch connects two moving parts of a machine whereas a brake connects a moving part to a stationary part.

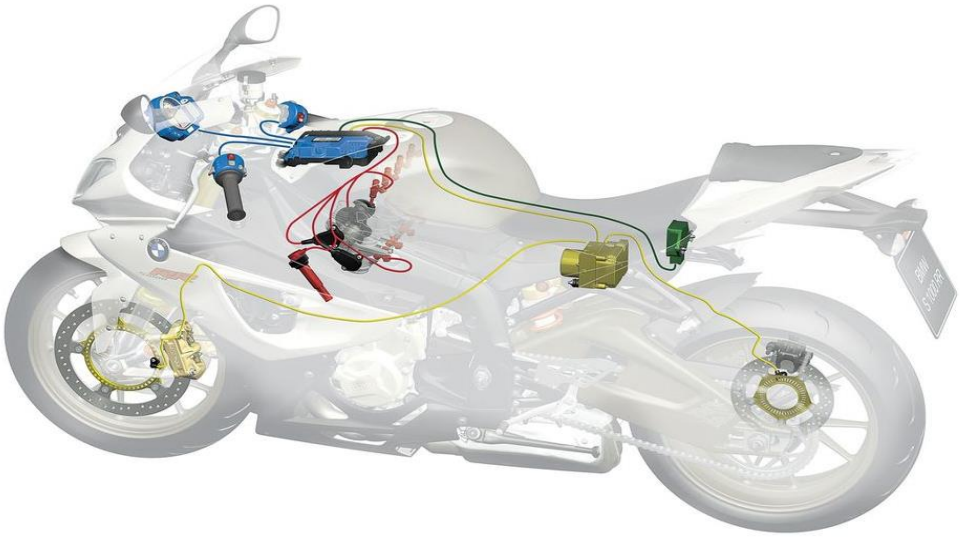


Figure 1: 22 Two Wheelers Brake system Layout

- **Necessity of Brakes**
  - To stop a vehicle in normal as well as emergency conditions.
  - To slow down the speed to turn, pass hurdles etc.
- **Types of Brake**

The brakes used in motorcycles can be classified as follows:

a) Drum Brake

In a rotating brake drum stationary brake shoes are attached concentric to the axle hub. A back plate is mounted on the axle casing but in case of front axle, the back plate is bolted to the steering knuckle. The back plate protects the drum and shoe assembly from mud and dust and provides support for the expander, anchor and brake shoe. When we apply brake to the motorcycle that means we are applying force 'F' to the brake shoes. This force pushes the brake shoes towards the drum surface.

Figure 1.44 Figure **Drum Brake**

The brake shoe pushes the brake linings which are high friction components against the drum surface. The contact between brake lining and drum reduces the speed of the vehicle. By the virtue of friction between drum and shoes, the kinetic energy (energy of motion) is converted into heat. If we are continuously applying the force on the brakes of the vehicle, the vehicle will stop finally.

b) Disc Type Brake

The disc brake consists of a pearlitic grey cast iron disc bolted to the wheel hub and a stationary housing called calliper. Casting in two parts makes the calliper, each part contains a piston. In the sliding calliper type of disc brakes, there are two parts of piston between which fluids under pressure is sent which then presses one friction pad directly onto the disc, whereas the other pad is pressed indirectly via the calliper.

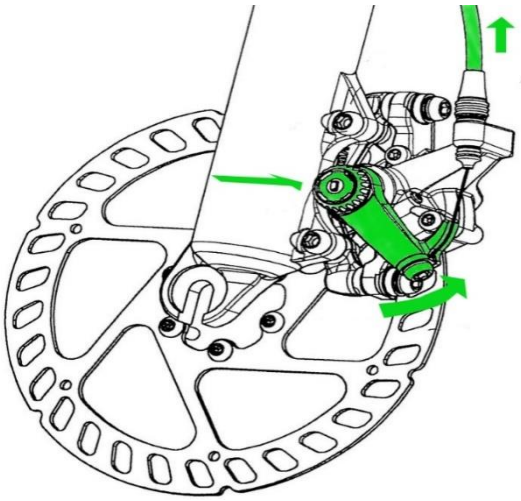


Figure 1: 23 Disc Type Brake

1.7.Two and Three Wheeler Special Tools and Equipment

Figure 1: 24 Two and Three Wheelers Special Tools

Figure 1: 25 Gas Filling Station

Figure 1: 48 Two and Three Wheelers Hydraulic Lift

Unit Two : Removing Disassemble Inspect Two- and Three-Wheel Vehicle System

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Visual checks
- Removing and disassembling system assembly
- Disassembling electrical and mechanical aggregates

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Apply Visual checks and functional assessments
- Remove and disassemble system assembly
- Disassemble electrical and mechanical aggregates

2.1 Visual checks and functional assessments

2.1.1. Intake System Fault

1. Heating of the Engine

The improper functioning Air intake will not let the engine generate power properly. This will lead to improper functioning of the engine as well as the malfunction of components like the cooling system etc. The ultimate result will get the engine unnecessarily heated.

2. Engine Stalling

If there is a leak in the inlet manifold of the air intake, it will not provide sufficient air for the air-fuel mixture to the engine. As a result, the engine may not run properly or it may have a rough idle condition, depending on how bad the crack in the system is.

3. Noises from the Engine

There may be some disturbing sounds and noises coming from the engine. In the case of leakages, there may be even sound coming like whistles. There can be metallic noises as well as coming from the inlet manifold pipes also.

4. Reduced Performance

If the Air Intake system is having some failure, it will affect the overall vehicle performance and the power generation process as well. The torque and horsepower of the vehicle will decrease and off-road vehicles may start to get stuck in clays and sand.

2.1.2. Daily Safety Checks Before starting the vehicle,

It is recommended to do following checks:

- Make sure that mirrors, lights and reflectors are clean and unobstructed
- Fuel: Enough fuel in tank
- Check fuel pipes for cracks/leakage.
- Replace if found defective
- Electrical: Operating of all teal lights, switches, horn etc.
- Brakes: Effectiveness, lever play, dragging of the brakes.
- Steering / Suspension: Smoothness, any play or looseness.
- Controls: Free play, smooth operation, positive return to the close position

➢ **Fuel Saving Tips**

✓ Ride smoothly and steadily at an optimum speed of 30 40 km/h

- ✓ Change the gear judiciously according to the speed requirement.
- ✓ Avoid following
  - Sudden acceleration and frequent / sudden braking.
  - Driving with foot on brake pedal.
  - Driving with partial disengaging of clutch (half clutch).
  - Overloading &driving at high speeds.
  - Over / under inflated tires.
  - Keeping the engine running at traffic signals if the idling time is more.

➢ **Air Filter Cleaning**

- ✓ Open clips of air filter assembly.
- ✓ Remove air filter element.
- ✓ Clean the air filter element by blowing air jet from inside & tapping the element on ground.
- ✓ Clean air filter housing by air jet and wipe it clean.
- ✓ Assemble the air filter element in the housing, fix the clips.

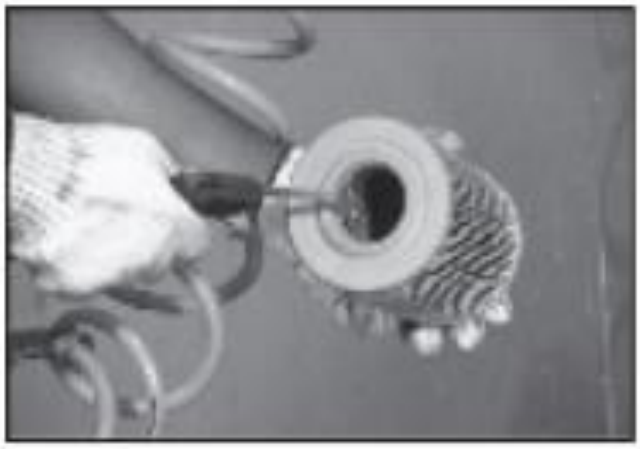


Figure 2.1 air filter cleaning

➢ **Battery**

- Check and ensure that the electrolyte level is between the upper (Max) and lower (Min) level in each cell.
- If electrolyte level is below lower level in any cell, top up to upper level with distilled water only.

Figure 2.2 Battery (12V 32Ah)

Warning

Ordinary tap water is not a substitute for distilled water and will shorten the life of the battery. Check battery terminal voltage and Sp. gravity. Charge the battery, if required. Check connections of battery terminals and starter relay. Apply petroleum jelly on battery terminals

- **Propeller Shaft Greasing**

Bellows of propeller shaft should be kept in good condition and replaced immediately if torn. Torn bellows will allow dust and water entry into the propeller shaft flanges which will cause damage to flanges, slider blocks and pins and reduce its life. Do the Propeller shaft greasing at every 5000 kms. Use only following recommended grease for greasing the propeller shaft.

Hindustan petroleum - AP3
Castro/ volvotine - NLGI-3 } Or equivalent
Indian Oil - Servo RR3

- **Brake Oil container:**

Brake oil container is located on Master Cylinder near brake pedal.

- Check the brake fluid level by looking at the reservoir.
- Check that the fluid level is between the "Max" and "Min" lines.
- If the brake fluid level is near the "Min" line, fill it up to the "MAX" line with recommended brake fluid

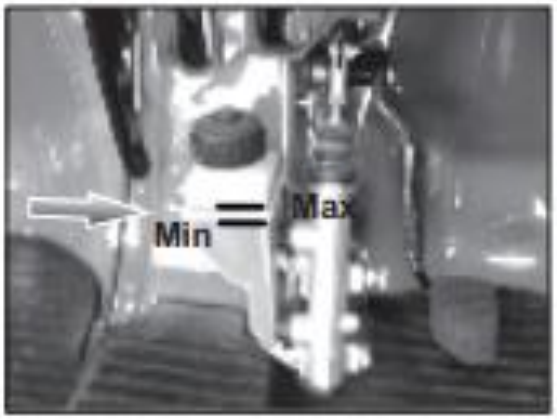


Figure 2.3 Brake Oil container*:*

- **Free Play Free play for:**

A. a. At brake pedal: 10-15 mm
B. b. At clutch Lever: 4-5 mm
C. c. Accelerator grip: 2-3 mm
D. d. Choke cable: 2-3 mm (at engine end)
E. e. Spark plug gap: 0.6-0.8 mm

- **Tire Pressure:**

Keep appropriate tire pressure as mentioned below to increase life of the tire and for better fuel consumption.

- Front 2.1 kg/cm^2 (30 PSI)
- Rear 2.4 kg/cm^2 (34 PSI)

2.2.Removing and disassembling system assembly

Removing the system components are essential work in the three wheeler to maintain, service and repair the components they listed some system component below: -

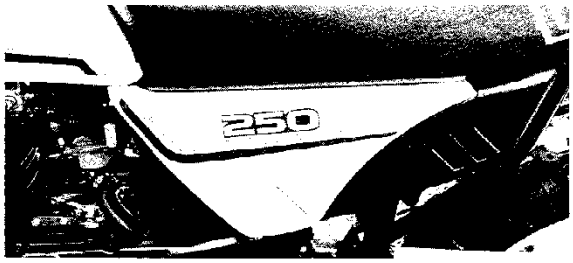
- **Engine Removal**

Tools Needed: Oil and gas catches/basins, 19, 17, 13, 12, 10 mm wrenches, Pliers, large flat blade screw driver, 8 & 3mm Allen wrench, 19 mm socket & long extension, Ural pin spanner, hammer, Tommy bar, floor jack and misc. pieces of wood. Example (Suzuki DR250 Service Manual)

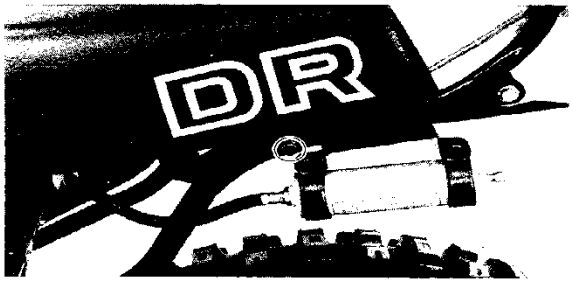
2.2.1. Engine Removal

Before taking the engine out of the frame, thoroughly clean the engine with a suitable cleaner.
The procedure of engine removal is sequentially explained in the following steps.

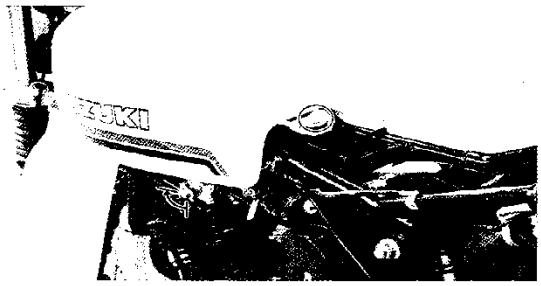
- Remove the left and right frame covers.



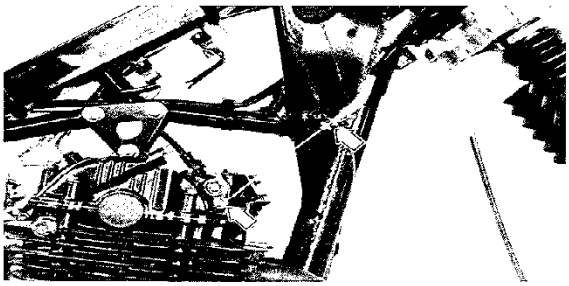
- Remove the seat securing bolts from both sides, then take off the seat.



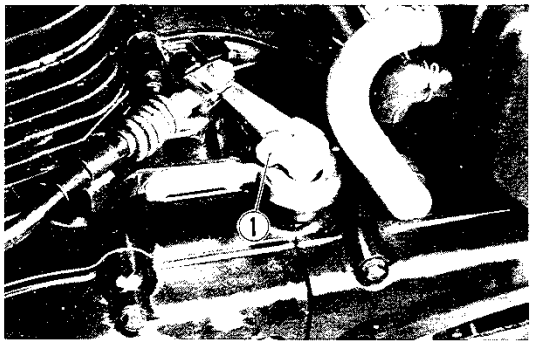
- Turn the fuel cock to the "OFF" position. Disconnect fuel hose from the fuel cock, then remove the fuel tank rearward.



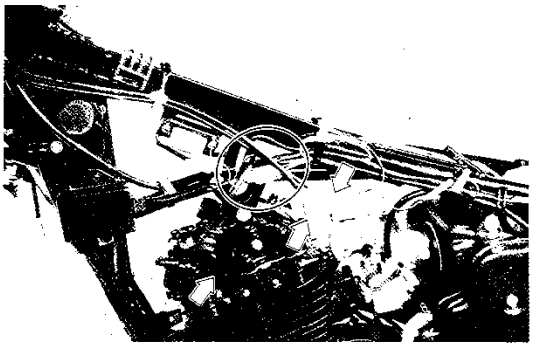
- Remove de-compression cable.



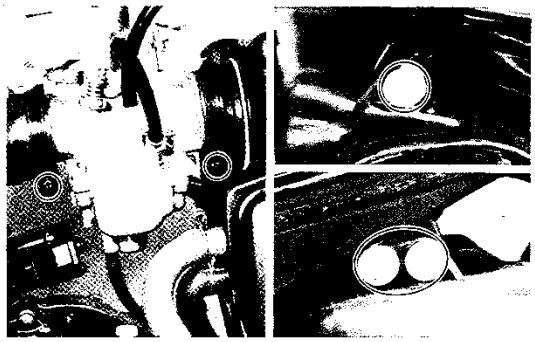
- Remove clutch cable by removing release arm bolt ①.



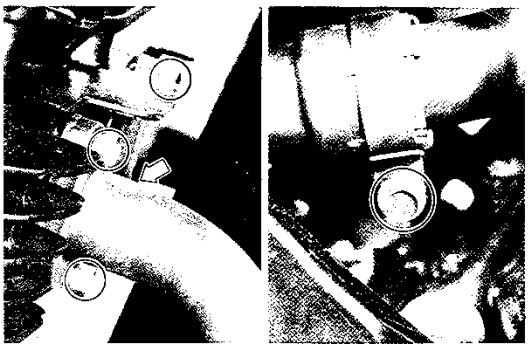
- Disconnect magneto lead wires.
- Pull out spark plug cap.
- Remove throttle cables.



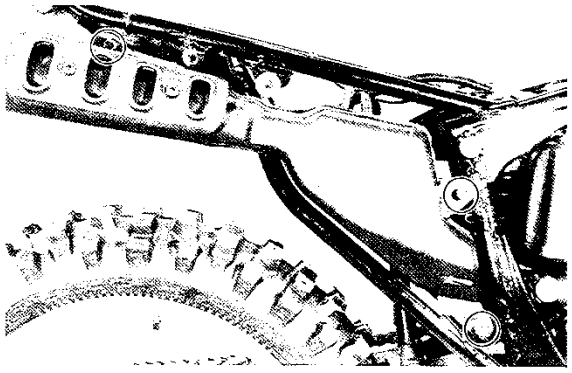
- Loosen inlet pipe clamp screws, and remove air cleaner case mounting bolts, then take off the carburetor.



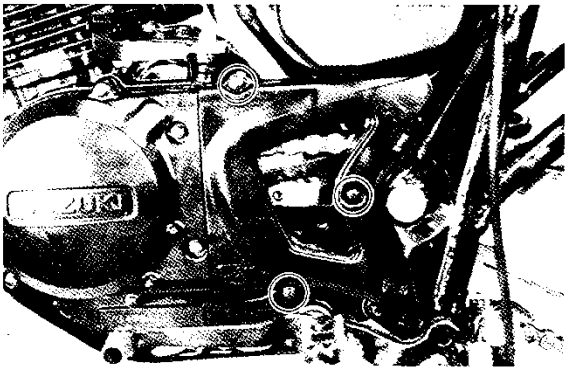
- Remove exhaust pipe bolts and muffler clamp bolt.



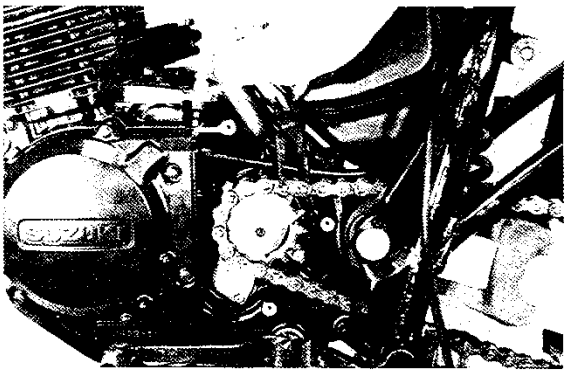
- Remove muffler mounting bolts, then take off the muffler and exhaust pipe.



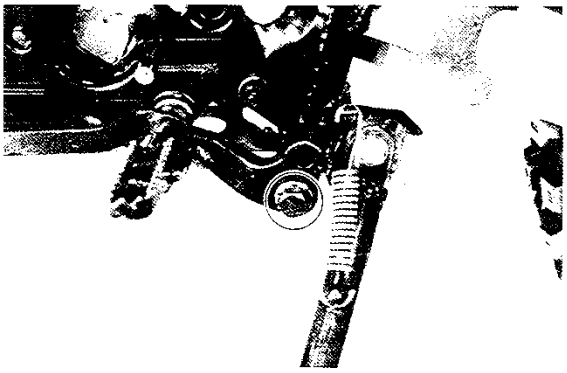
- Remove engine sprocket cover.



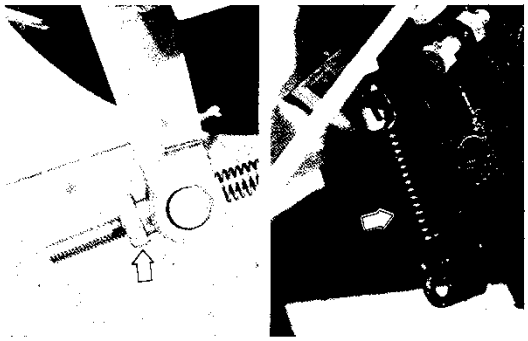
- Remove drive chain.



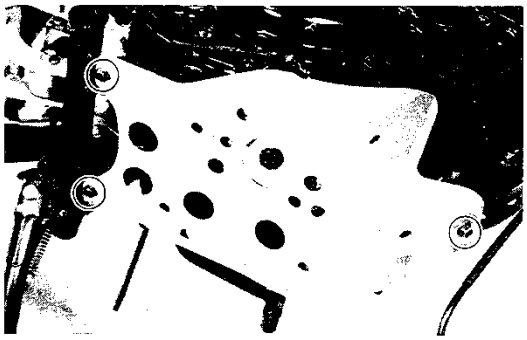
- Remove left and right footrests.



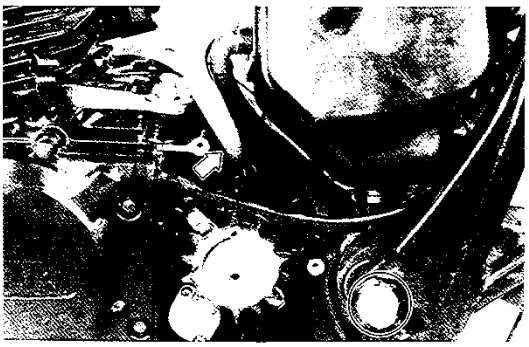
- Remove brake adjuster nut and brake pedal return spring.



- Remove engine protector.



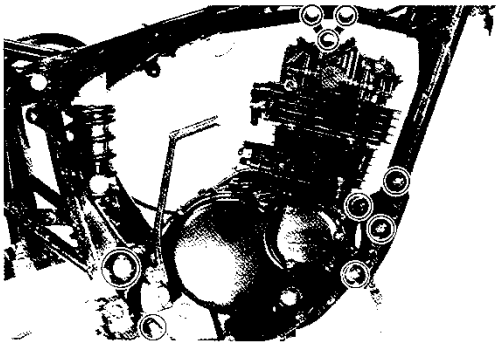
- Remove breather hose from crankcase, and then take off the air cleaner case.
- Remove swing arm pivot nut.



- Remove engine mounting bolts and brackets.
- Use both hands, and lift the engine from the frame.

NOTE:
The engine must be taken out from the right side.

CAUTION:
Be careful not to draw out the swing arm pivot shaft completely from the right side swing arm pivoting hole. Insert the shaft or rod into the left side pivoting hole from the left side of the frame to keep the alignment of the frame holes and swing arm pivoting holes.



2.3. Dismantling and assembling of two wheeler gear box.

Gearbox:

- ✓ Power comes from engine to clutch shaft and clutch gear, which is always in mesh with a gear on the lay shaft.
- ✓ Helical gears are in mesh always. Helical gears are setting the power with the help of fork, dogteeth and collar. Dogteeth clutch are splined to gear shaft.
- ✓ Gears are provided with integral dogteeth.
- ✓ Collar having internal teeth locks the dogteeth on gear and dogteeth is fixed to the input shaft.
- ✓ Collar is operated by means of fork lever.
- ✓ Lay shaft is a forged component integral with built in gears.
- ✓ Lay shaft is supported in the gearbox housing with the help of bearings.

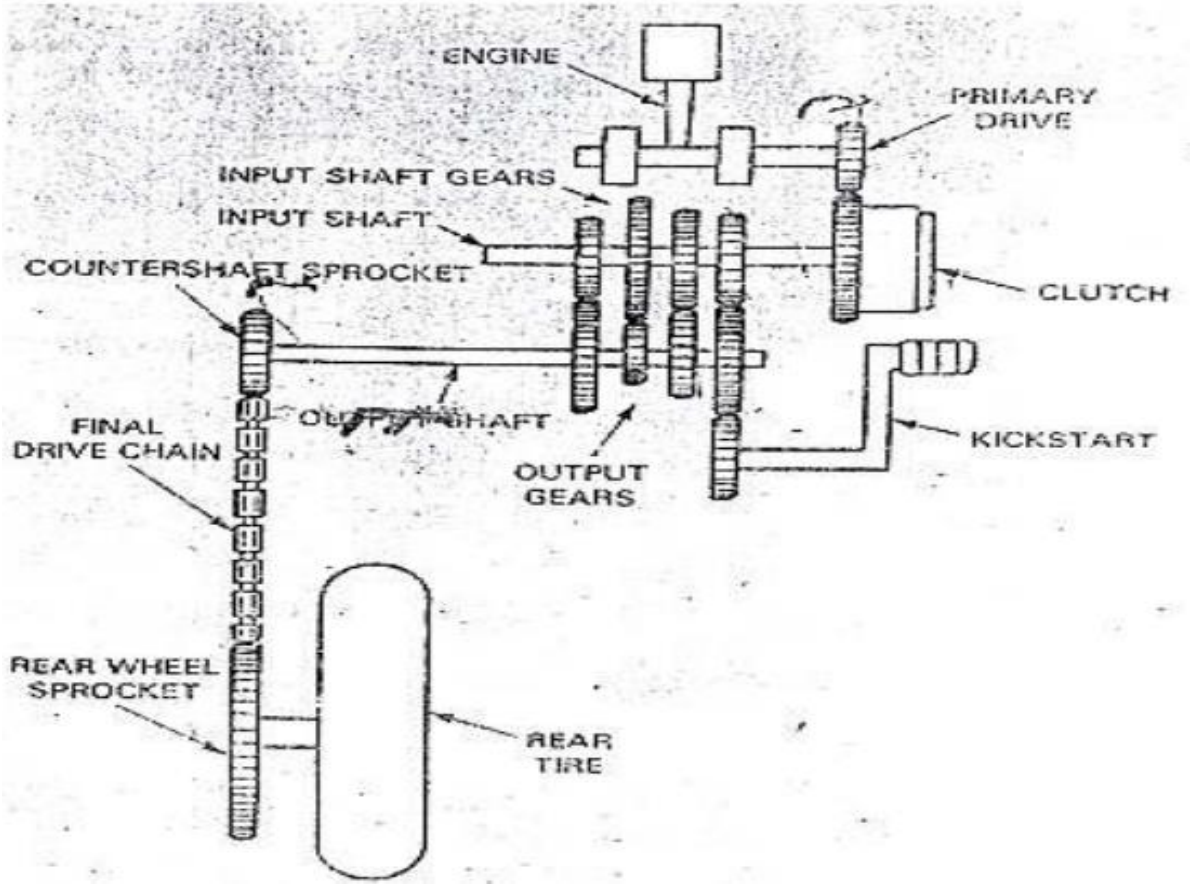


Figure 2.4 two wheeler gear box.

- **Dismantling of three wheeler steering system**

Introduction:

- ✓ Steering system is used to allow a driver to guide the vehicle along the road and turn it to either direction left or right.
- ✓ Steering arrangement is governed by steering geometry.
- ✓ Steering system consists of front suspension forks, steering stem, steering lock and handle bar.
- ✓ Front suspension forks carry the front wheel assembly. Steering stem is attached to the top of the front suspension forks.
- ✓ Steering stem permits turning of front wheel and hence the vehicle in the desired direction.

- **Study of three wheeler chassis frame and power transmission system**

- **Power transmission system:** The system by which the power from engine is transmitted to the wheels is called transmission system. Transmission system carries engine power to the rear wheel. Power at the rear wheels move the vehicle forward overcoming external forces. Clutch transmits engine power to the gearbox. In Three-wheeler, multiple clutches are used. When the clutch is in the disengaged position, the power transfer is interrupted. Gearbox provides different torque at the rear wheel according to the requirements by engaging different gear combination.

- **Propeller shaft drive:**

This system is mostly used in three-wheeler. Like four wheelers, the propeller shaft in this system also consists of a sliding joint at one end and universal joints at both the ends.

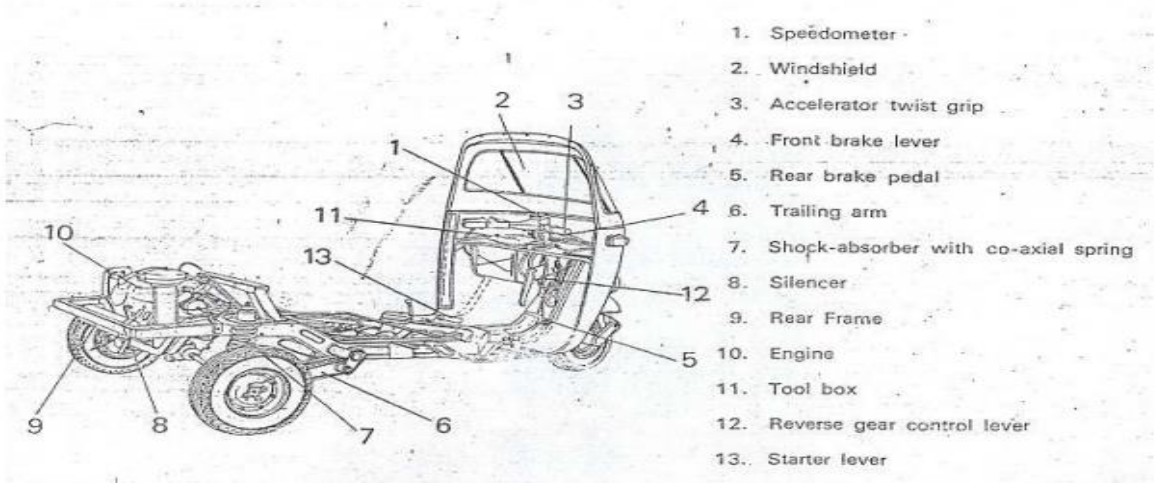


Figure 2.5 Three wheeler body frame

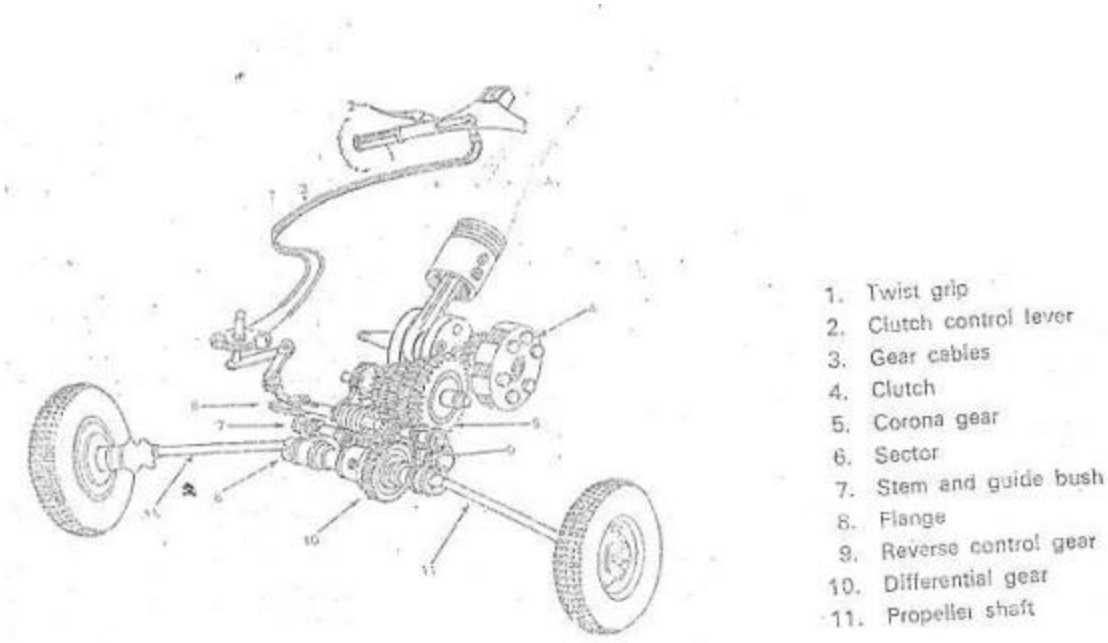


Figure 2.5 Transmission system

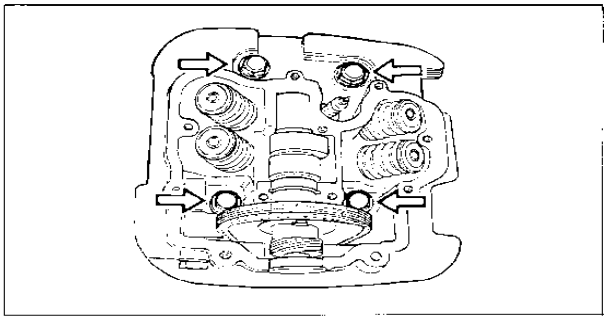
2.4.Calibrate and adjust settings

Calibration is the act of comparing a device under test (DUT) of an unknown value with a reference standard of a known value. A person typically performs a calibration to determine the error or verify the accuracy of the DUT's unknown value.

2.4.1. Mechanical aggregates

- **Maintenance Procedure**

This section describes the service procedures for each section of Periodic Maintenance.



CYLINDER HEAD NUTS, CYLINDER NUTS, EXHAUST PIPE BOLTS

Tighten Initially at 5 Hrs and Every 30 Hrs thereafter.

Cylinder head nuts

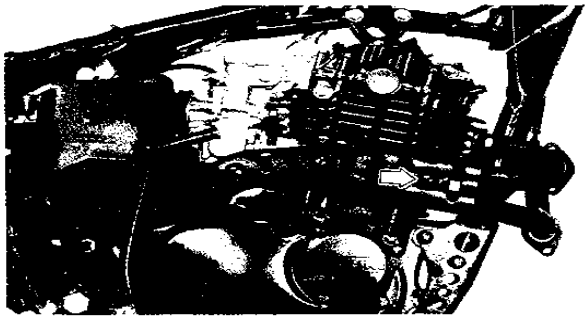
- Remove the fuel tank and seat. (Refer to page 3-2)
- Remove the cylinder head cover. (Refer to page 3-7)
- Tighten the four 10-mm nuts and two 6-mm nuts to the specified torque with a torque wrench, when engine is cold.

Tightening torque

Tightening torque	10 mm	35 — 40 N·m (3.5 — 4.0 kg-m, 25.5 — 29.0 lb-ft)
	6 mm	7 — 11 N·m (0.7 — 1.1 kg-m, 5.0 — 8.0 lb-ft)

- When installing cylinder head cover, apply Suzuki Bond No. 1207B to the mating surface. (Refer to page 3-31)

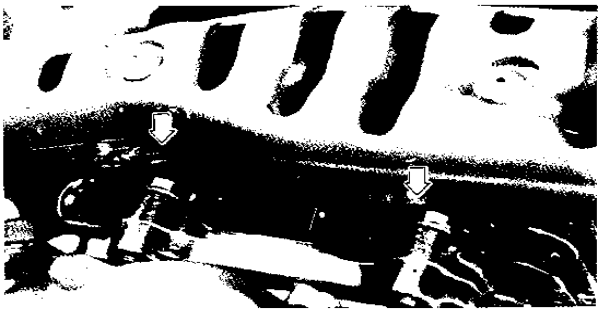
Suzuki Bond No. 1207B	99104-31140



Cylinder nuts

- Remove the four exhaust bolts and loosen the muffler clamp bolt.
- Slide the exhaust pipe forward.
- Tighten the two 6 mm nuts to the specified torque.

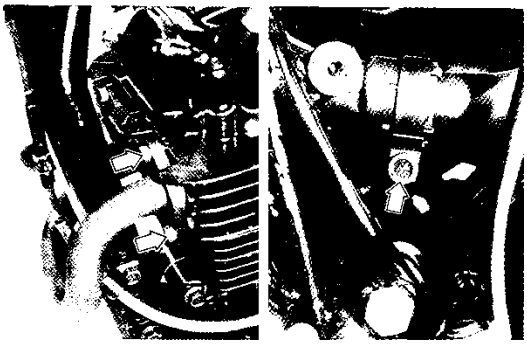
Tightening torque	7 — 11 N·m (0.7 — 1.1 kg-m, 5.0 — 8.0 lb-ft)



Exhaust pipe bolts and muffler clamp bolt
Tighten the exhaust pipe bolts and muffler clamp bolt to the specified torque.

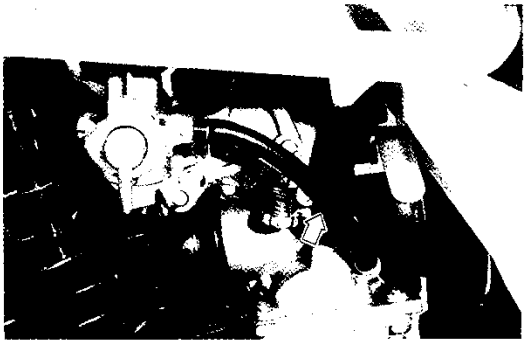
Tightening torque

Exhaust pipe bolts	9 – 12 N·m (0.9 – 1.2 kg-m, 6.5 – 8.5 lb-ft)



FUEL LINE

Inspect Initial 5 Hrs and Every 30 Hrs.
Replace Every four years.



FUEL STRAINER

Clean Every 60 Hrs

If the fuel strainer is dirty with sediment, fuel will not flow smoothly and loss in engine power may result.
Clean the strainer cup with non-flammable cleaning solvent.

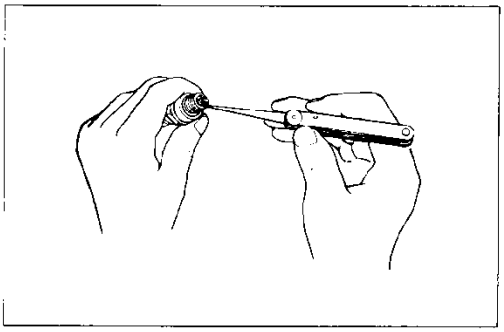
SPARK PLUG

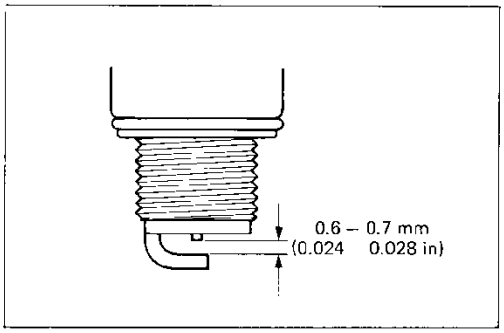
Clean Every 30 Hrs and Replace Every 60 Hrs

Remove the carbon deposits with a wire or pin and adjust the spark plug gap to 0.6 – 0.7 mm (0.024 – 0.028 in), measuring with a thickness gauge.

When removing carbon deposits, be sure to observe the appearance of the plug, noting the color of the carbon deposits. The color observed indicates whether the standard plug is suitable or not. If the standard plug is apt to get wet, a hotter plug should be used. If the standard plug is apt to overheat (porcelain is whitish in appearance), replace with a colder one.

Hot type spark plug	..... NGK D7EA or NIPPON DENSO X22ES-U
Standard spark plug	..... NGK D8EA or NIPPON DENSO X24ES-U
Cold type spark plug	..... NGK D9EA or NIPPON DENSO X27ES-U





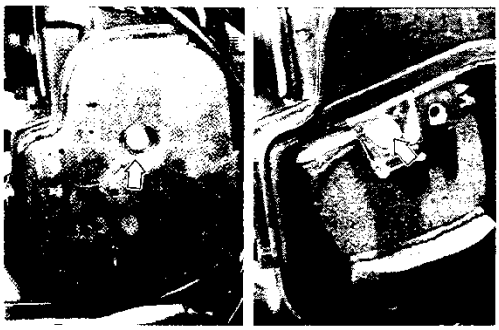
AIR CLEANER ELEMENT

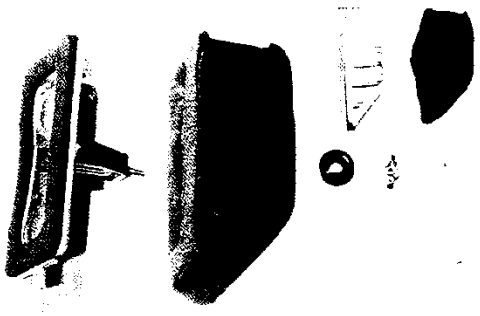
Clean and oil each time motorcycle is ridden

If the air cleaner is clogged with dust, intake resistance will be increased with a resultant decrease in power output and an increase in fuel consumption.

Check and clean the element in the following manner.

- Remove the left frame cover and air cleaner case cover.
- Remove the screw and take out the air cleaner element.
- Remove the nut and separate the air cleaner element.
- Separate the polyurethane foam element from the element frame.

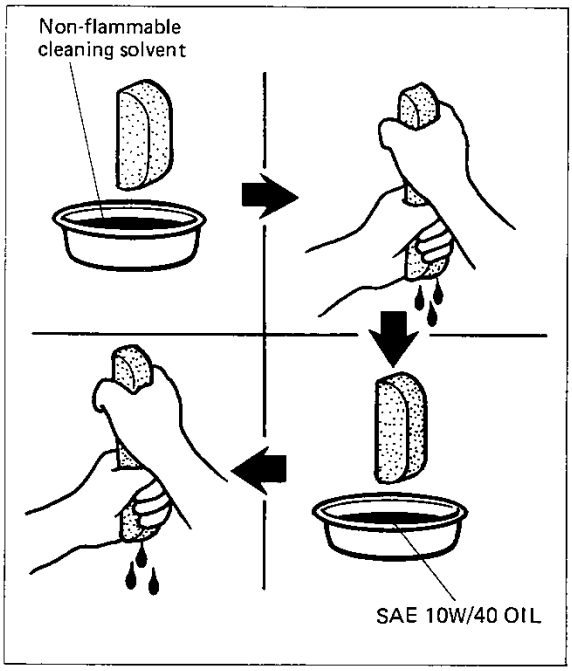




- Fill a washing pan of a proper size with non-flammable cleaning solvent. Immerse the element in the cleaning solvent and wash it clean.
- Squeeze the cleaning solvent out of the washed element by pressing it between the palms of both hands.
- Immerse the element in motor oil, and squeeze the oil out of the element leaving it slightly wet with oil.

NOTE:
Do not twist or wring the element because it will tear or the individual cells of the element will be damaged.

CAUTION:
Inspect the element carefully for rips, torn seams, etc. If any damage is noted, replace the element.



VALVE CLEARANCE

Inspect Initial 5 Hrs and Every 30 Hrs

Excessive valve clearance results in valve noise and insufficient valve clearance results in valve damage and reduced power. At the distances indicated above, check and adjust the clearance to the following specification.

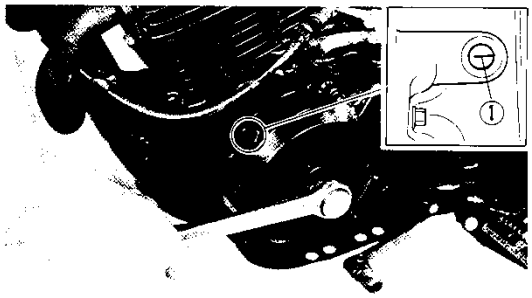
NOTE:
Valve clearance is to be checked when the engine is cold.
Both the intake and exhaust valves must be checked and adjusted when the piston is at Top—Dead—Center (TDC) of the compression stroke.

Valve clearance specifications

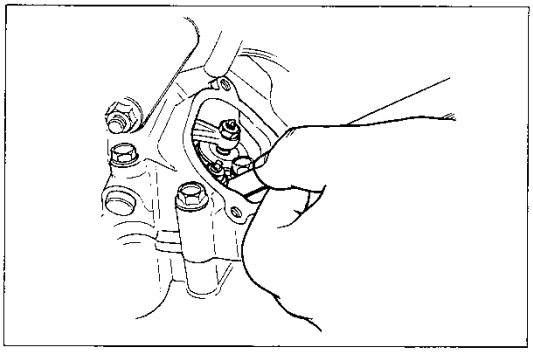
IN.	0.03 – 0.08 mm (0.001 – 0.003 in)
EX.	0.08 – 0.13 mm (0.003 – 0.005 in)

The procedure for adjusting the valve clearance is as follows:

- Remove the seat and fuel tank.
- Remove spark plug, valve inspection caps, and valve timing inspection plug.
- Remove the magneto cover cap and rotate the magneto rotor with the 22-mm box wrench to set the piston at (TDC) of the compression stroke.
  (Rotate the rotor until the "T" line ① on the rotor is aligned with the center of hole on the crankcase.)
- Insert the thickness gauge to the valve stem end and the adjusting screw on the rocker arm.



Thickness gauge	09900 – 20803

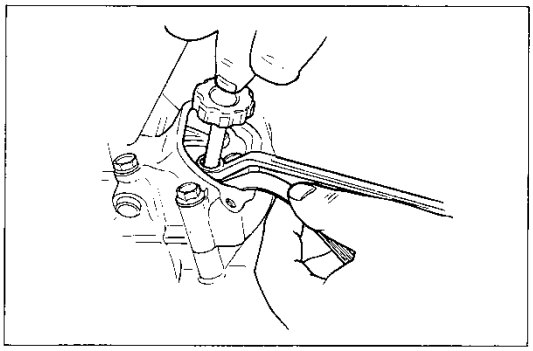


Valve clearance specifications

IN.	0.03 – 0.08 mm (0.001 – 0.003 in)
EX.	0.08 – 0.13 mm (0.003 – 0.005 in)

- If clearance is off the specification, bring it into the specified range by using the special tool.

Tappet adjust driver	09917 – 14910

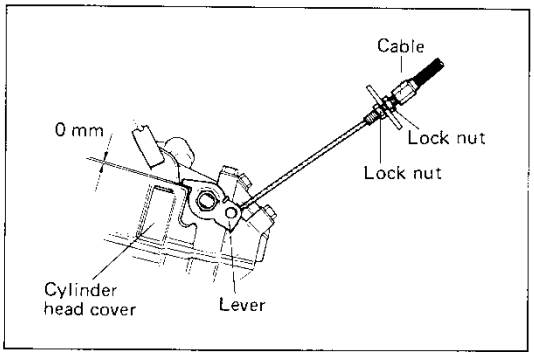


CAUTION.
Both of the valve clearances, right and left, should be as closely set as possible.

- Reinstall spark plug, valve inspection caps, valve timing inspection plug and magneto cover cap.

De-compression cable

- After adjusting the valve clearance, adjust the de-compression cable.
- With the de-compression lever squeezed.
- Loosen and adjust the two adjuster lock nuts so that the clearance between the lever on the engine and upper cylinder head cover becomes zero as indicated in Fig.
- After adjusting the cable correctly, tighten the two lock nuts.

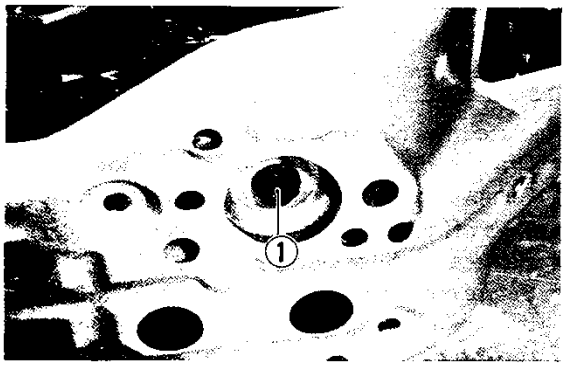


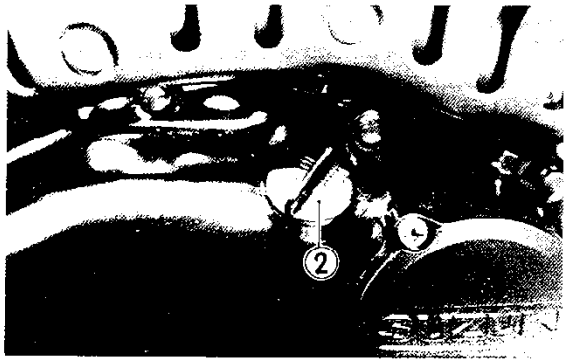
ENGINE OIL

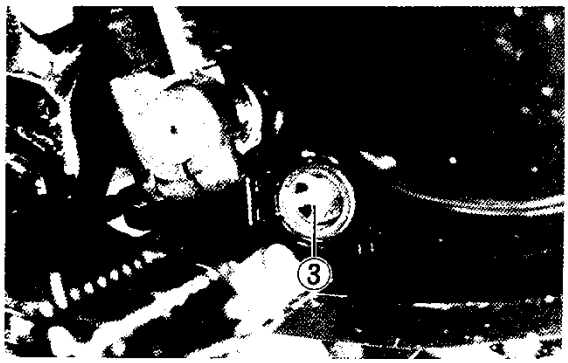
Replace Initial 5 Hrs and Every 30 Hrs (change)

The oil should be changed with the engine hot. The procedure is as follows:

- Support the motorcycle in an upright position by placing a jack or block on the frame under the engine. Both wheels must remain on the ground for the oil to drain completely.
- Drain the oil by removing the drain plug ① and filler cap ②.
- Fit drain plug ① securely and add fresh oil through the filler. The engine will hold about 1.2 L (1.3 US qt) of oil.
  Use 10W/40 viscosity of oil under API classification of SE or SF.
- Start up the engine and allow it to run for several seconds at idling speed.
- Shut down the engine and wait about one minute. Then check the oil level in the oil level window ③. The motorcycle must be in a level, upright position for accurate measurement. If the level is below the "F" mark, add oil until the level reaches the "F" mark.



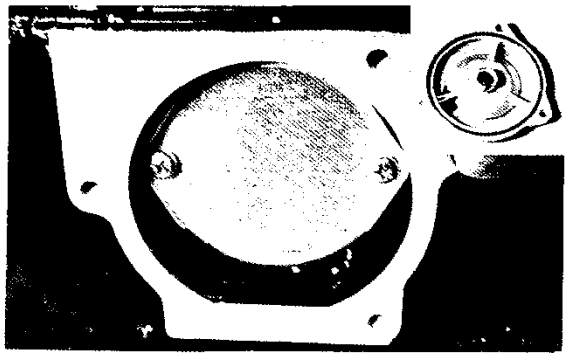




OIL SUMP FILTER

Clean Every 60 Hrs

Clean the sump filter screen to remove any foreign matter that may be collected there. Inspect the screen to insure that it is free of any sign of damage.



ENGINE OIL FILTER

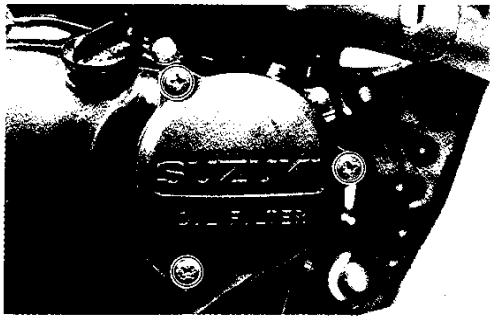
Replace Every 30 Hrs

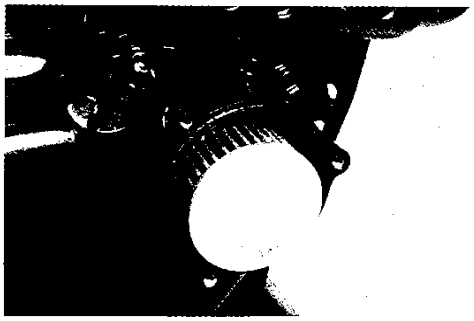
Replace the oil filter in the following manner:

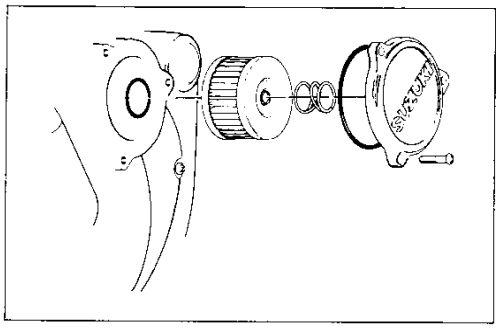
- Drain engine oil by removing the drain plug.
- Remove the three screws securing the filter cap.
- Take off the cap, and pull out the filter.
- Replace the filter with a new one.
- Before putting on the filter cap, check to be sure that the filter spring and the O-ring are installed correctly.
- Replace the filter cap and tighten the screws securely.
- Pour in engine oil and check the level.

NOTE:
Pour about 1.3 L (1.4 US qt) of engine oil into the engine only when changing oil and replacing oil filter at the same time.
When performing engine overhaul, the amount of oil to be replenished is 1.7 L (1.8 US qt).

CAUTION:
When reassembling the oil filter, make sure to check the oil filter installed as shown in illustration. If the filter is installed improperly, the serious engine damage may result.







ENGINE IDLE SPEED

Adjust Initial 5 Hrs and Every 30 Hrs

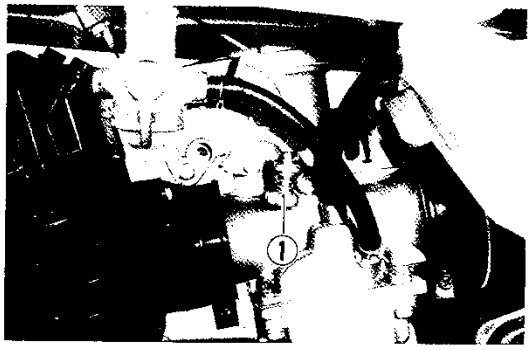
Idling adjustment

NOTE:
Make this adjustment when the engine is hot.

- Carefully turn in the pilot screw until it bottoms.
- From that position, turn out the pilot screw 1½ turn.

NOTE:
Be careful not to overtighten the screw.

- Connect a tachometer.
- Start up the engine and set its speed between 1 200 and 1 300 r/min by turning throttle stop screw ①.
- Turn in and out the pilot screw within ¼ turn from the standard setting. When the engine speed is at the highest possible level, the mixture is correct.
- After this adjustment, recheck the idling speed and adjust to between 1 200 and 1 300 r/min with throttle stop adjusting screw if necessary.
- Finally readjust the throttle cable play. (Refer to page 4-9).



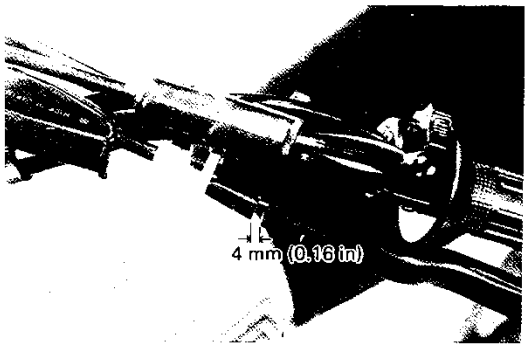
CLUTCH

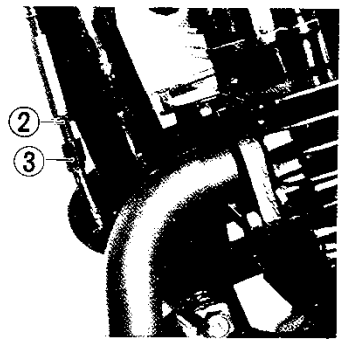
Adjust Initial 5 Hrs and Every 30 Hrs

Clutch play should be 4 mm (0.16 in) as measured at the clutch lever holder before the clutch begins to disengage. If the play in the clutch is incorrect, adjust it in the following way:

- Loosen the lock nut on the lever adjuster screw.
- Screw the adjuster on the clutch lever holder all the way in.
- Loosen clutch cable adjuster lock nut ②.
- Turn the clutch cable adjuster ③ in or out to acquire the specified play.
- Tighten lock nut while holding the adjuster in position.

The clutch cable should be lubricated with a light weight oil whenever it is adjusted.



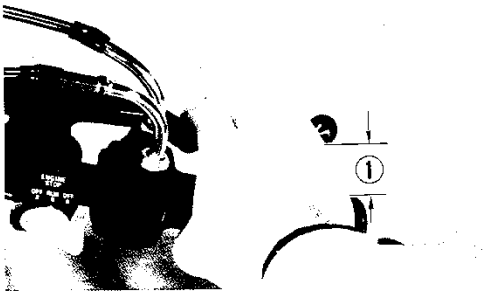


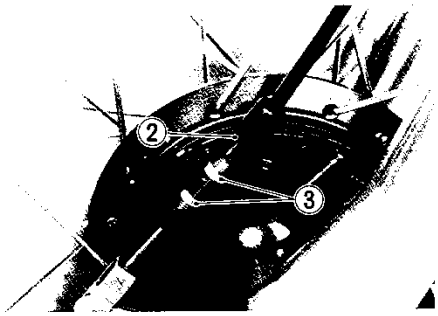
BRAKES

Adjust Initial 5 Hrs and Every 30 Hrs

Front brake

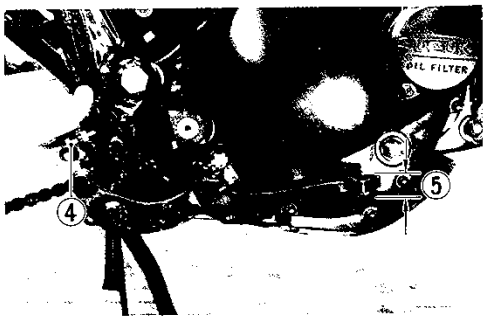
Squeeze the front brake lever firmly and measure the distance between the lever and the throttle grip. The distance ① should be 20 – 30 mm (0.8 – 1.2 in). If adjustment is necessary, slacken the cable by loosening the lock nut and screwing the adjuster on the front brake lever holder all the way in. Then loosen the lock nuts ③ and slide the front brake adjuster ② rising or falling to acquire the specified distance. While holding the adjuster in position, tighten the lock nuts.

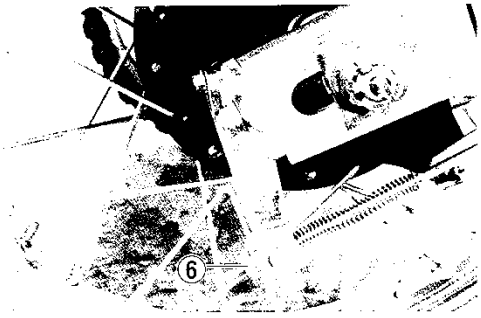




Rear brake

To adjust brake pedal travel, first set the pedal at a position for comfortable riding by turning the brake pedal stopper ④, and then adjust the free travel ⑤ to 20 – 30 mm (0.8 – 1.2 in).
If adjustment is necessary, turn the rear brake adjuster ⑥.

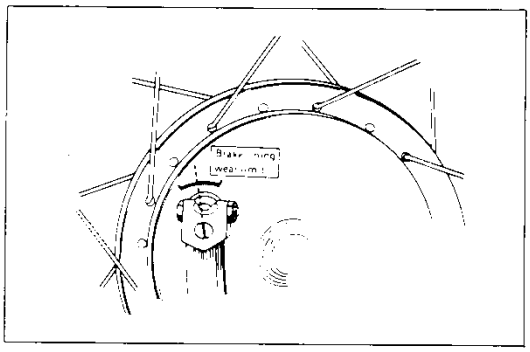




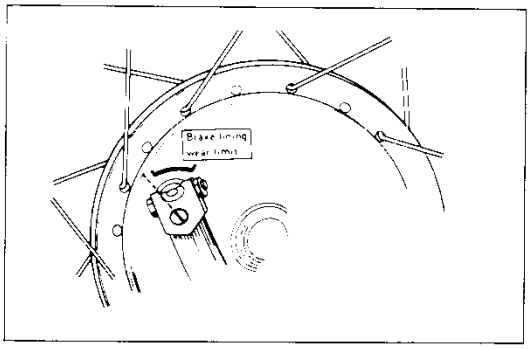
Brake lining wear limit

This motorcycle is equipped with brake lining wear limit indicators on both front and rear brakes. As shown in the illustration at right, at the condition of normal lining wear, an extended line from the index mark on the brake camshaft should be within the range embossed on the brake panel with the brake on. To check wear of the brake lining, follow the steps below.

- First check if the brake system is properly adjusted.
- While operating the brake, check to see that the extension line from the index mark is within the range on the brake panel.
- If the index mark is outside the range as shown in the illustration at right, the brake shoe assembly should be replaced to ensure safe operation.



The extension line of the index mark is within the range.



The extension line of the index mark is outside of the range.

DRIVE CHAIN AND GUIDE ROLLERS

Clean, oil, and inspect each time motorcycle is ridden.

Drive chain

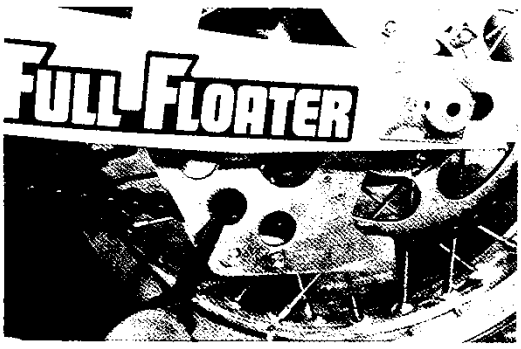
Visually inspect the drive chain for the below - listed possible malconditions. (Lift the rear wheel and place a jack or block under the engine, and turn the rear wheel slowly by hand, with the transmission in NEUTRAL.)

Inspect for:

1. Loose pins
2. Damaged rollers
3. Rusted links
4. Twisted or seized links
5. Excessive wear

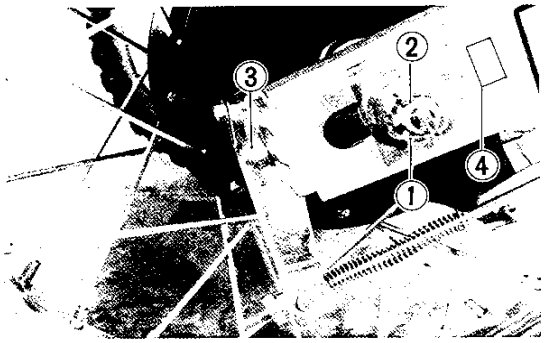
If any defects are found, the driven chain must be replaced.

- Wash the chain with kerosene. If the chain tends to rust faster, the interval must be shortened.
- After washing and drying the chain, lubricate it with chain lube or gear oil SAE90.



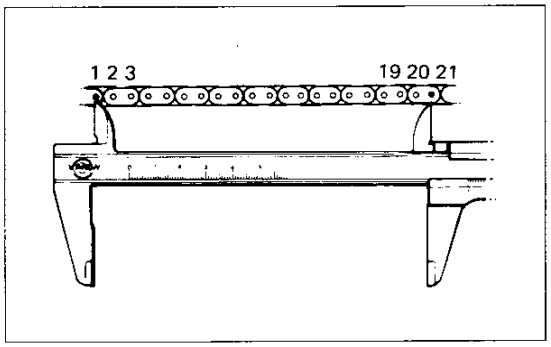
Check the drive chain for wear and adjust the chain tension as follows:

- Loosen axle nut ① after pulling out cotter pin ②.
- Adjust the drive chain carefully by tightening the adjusters ③.

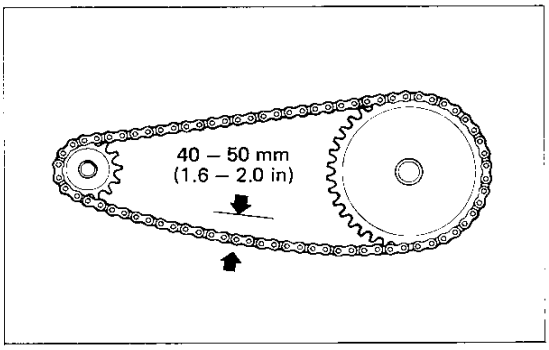


Chain wear

- Count out 21 pins on the chain and measure the distance between. If the distance exceeds 324.2 mm (12.76 in), the chain must be replaced.

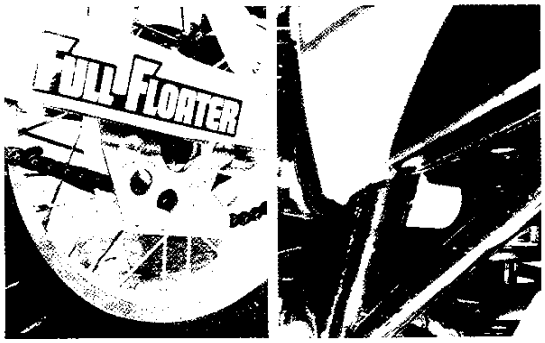


- Loosen the adjuster ③ until the chain has 40 – 50 mm (1.6 – 2.0 in) of sag at the middle between engine and rear sprockets.
  The mark ④ on both chain adjusters must be at the same position on the scale to ensure that the front and rear wheels are correctly aligned.
- After adjusting the drive chain, tighten the axle nut ① securely and lock with cotter pin ②. Always use a new cotter pin.



Guide rollers

Inspect the chain guide rollers for wear or damage. Replace any worn or damaged parts.



2.4.2. Gear shifting and control systems

If you are a totally new rider, here are the basic actions of proper shifting technique.

From a stop

- With the engine running and the throttle closed, pull the clutch in all the way with your left hand. Shift down into first gear with your left foot. You should feel and hear the transmission click into gear.
- Slowly release the clutch with your left hand while simultaneously (but gently) rolling the throttle open with your right hand until the motorcycle begins to roll forward
- .As you continue to open the throttle with your right hand and the bike picks up speed, gradually and fully release the clutch with your left hand. You're on your way!

Up shifting while moving

- Roll the throttle closed with your right hand.
- Pull the clutch lever in with your left hand.
- Shift down into the next lower gear with your left foot.
- Slowly release the clutch lever with your left hand. If you are downshifting for a hill or to enable faster acceleration, roll the throttle open as you release the clutch. However, if you're downshifting in preparation for coming to a stop, you only need to add enough throttle to match engine revs to your road speed so the bike slows down smoothly

At first, coordinating these actions will take deliberate thought and may feel a little clumsy, and often riders are overzealous with their movements. Remember that throttle control comes from your wrist alone (and not your whole arm), and that shift actions should execute with a quick and deliberate shove from your foot. Rest assured that with practice all of these movements will become smoother, and in time shifting will become so natural that you won't even think about it

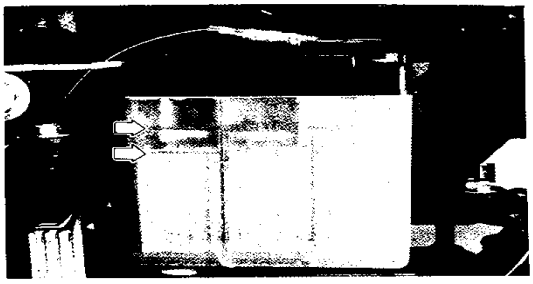
2.4.3. Electrical/electronic systems

- Maintenance procedure

BATTERY

Inspect every 3 000 mi (5 000 km)

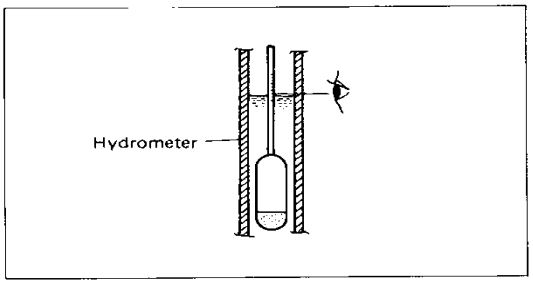
- Remove left side frame cover to check battery.
- Check level and specific gravity of electrolyte. Add distilled water, if necessary, to keep the surface of the electrolyte above the LOWER level line and below the UPPER level line. To determine state of charge, check specific gravity with a hydrometer.



Hydrometer	09900-28403

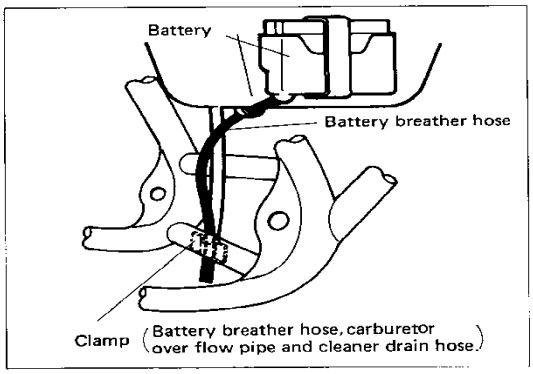
Standard specific gravity	1.26 at 20°C

A specific gravity reading of 1.20 (at 20°C) or under means that the battery needs recharging.

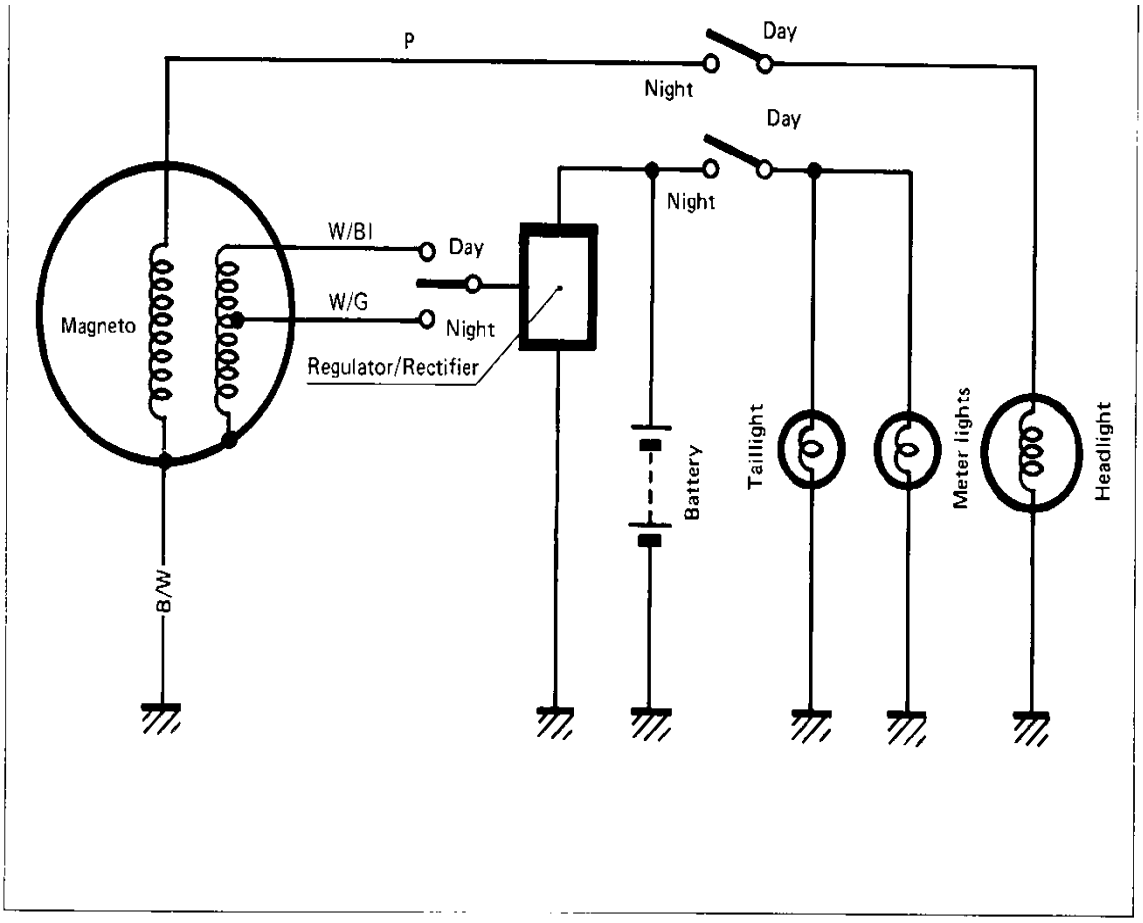


CAUTION:
Do not charge the battery while connected to the motorcycle. Charging the battery while connected into the circuit may damage the rectifier or other components.

- Confirm that the battery breather hose is routed properly, as shown in the Fig. and that it is not kinked or pinched.



- Electrical charging and lighting system



SERVICING

Charging coil check

- Using the pocket tester (RX1Ω range), measure the resistance between the lead wires in the following chart.

Pocket tester	09900-25002

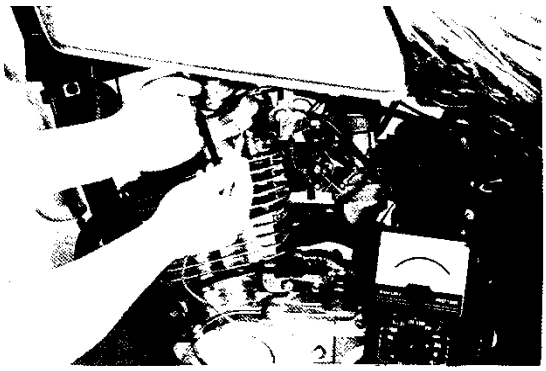
WIRE COLOR

W: White
R: Red
Br: Brown
P: Pink
W/Bl: White with Blue tracer
W/G: White with Green tracer
B/W: Black with White tracer

Magneto coil resistance		
Pick up		W – B/W Approx. 50 – 90Ω
Power source		R – B/W Approx. 5 – 9Ω
		Br – B/W Approx. 3 – 6Ω
Lighting		P – B/W Approx. 1 – 4Ω
* Charging	Day:	W/Bl – B/W Approx. 1 – 2Ω
	Night:	W/G – B/W Approx. 0.5 – 1.5Ω

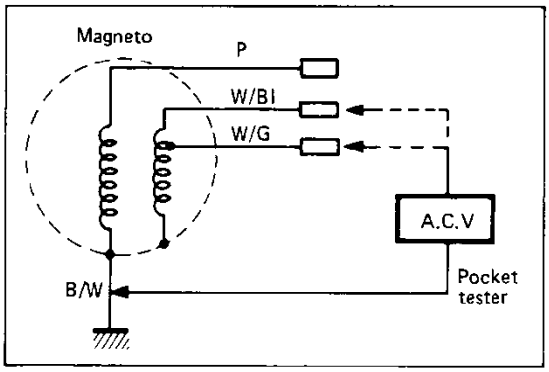
Charging coil performance check

- Disconnect lead wires coupler, (P, W/Bl and W/G) from the magneto.
- Connect a tachometer.
- Start the engine and keep it running at 5 000 r/min.
- Set the pocket tester (range: AC 250V), measure the AC voltage between W/Bl – B/W and W/G – B/W.



No-load voltage	More than 50 V (AC) at 5 000 r/min.

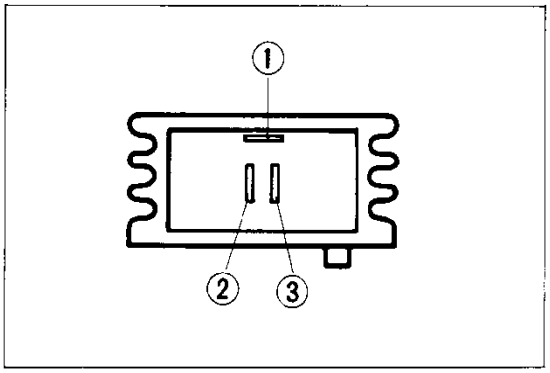
CAUTION:
Voltage measurement should be done as quickly as possible to prevent engine overheat.



Regulator/Rectifier check

- Using the pocket tester (X1Ω range), measure the resistance between the terminals in the following table.
- If the resistance checked is incorrect, replace the regulator/rectifier.

⊖ Probe of tester	⊕ Probe of tester ①	②	③
①		OFF	Approx. 4 – 8 Ω
②	OFF		OFF
③	OFF	OFF	



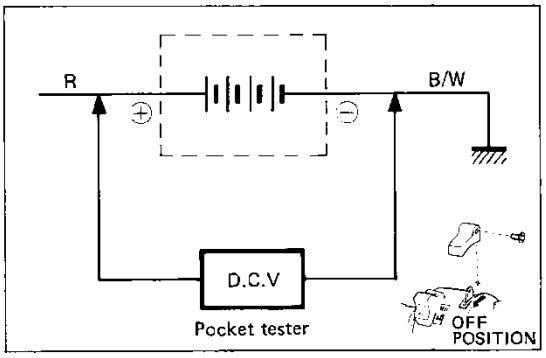
Regulator check

- Connect a tachometer.
- Start the engine and keep it running at 5 000 r/min with the lighting switch turned OFF position.
- Set the pocket tester (range: DC 10V)
- Contact the ⊕ lead probe of the tester to the ⊕ terminal of the battery, and contact the ⊖ lead probe to the ⊖ terminal, then measure the DC voltage.

NOTE:
The plastic switch cover must be removed to turn the light switch to the OFF position.

7.0 – 8.5V at 5 000 r/min.

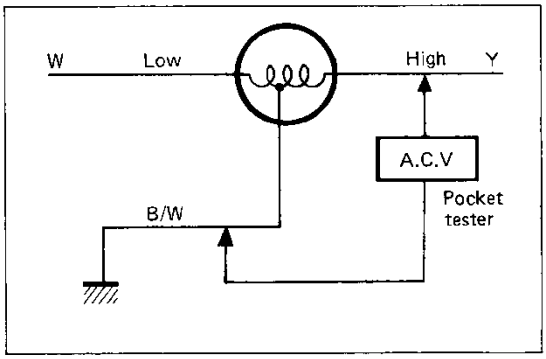
NOTE:
When making this test, be sure the battery is in a fully-charged condition.



Lighting coil performance check

- Set the pocket tester (range: AC 10V).
- Remove the headlight unit and connect the ⊕ probe of the tester to high or low beam lead wire and ⊖ probe to the ground while turning on the lighting switch.
- Connect a tachometer.
- Start the engine.
- Check that the voltmeter reads as follows.

Above 6.0V at 2 000 r/min.
Below 9.0V at 8 000 r/min.



BATTERY

- Visually inspect the surface of the battery container. If any signs of cracking or electrolyte leakage from the sides of the battery have occurred, replace the battery with a new one.
- If the battery terminals are found to be coated with rust or an acidic white powdery substance, then this can be cleaned away with sandpaper.
- Check the electrolyte level and add distilled water, as necessary, to raise the electrolyte to each cell's upper level.
- Check the battery for proper charge by taking an electrolyte S.G. reading. If the reading is 1.20 or less, as corrected to 20°C (68°F), it means that the battery is still in a run-down condition and needs recharging.

Hydrometer	09900-28403

- Check the reading (as corrected to 20°C) with Chart to determine the recharging time in hours by constant-current charging at a charging rate of 0.4 amperes (which is a tenth of the capacity of the present battery).

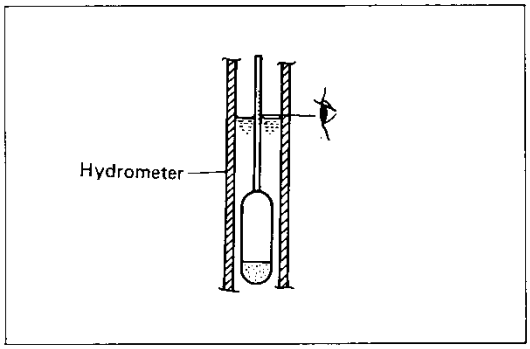
CAUTION:
Be careful not to permit the electrolyte temperature to exceed 45°C (113°F), at any time, during the recharging operation. Interrupt the operation, as necessary, to let the electrolyte cool down.

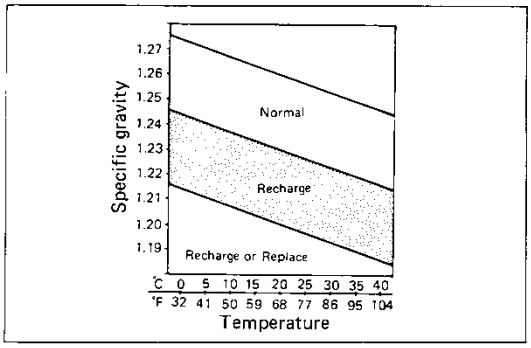
CAUTION:
Constant-voltage charging, otherwise called "quick" charging, is not recommendable for it could shorten the life of the battery.

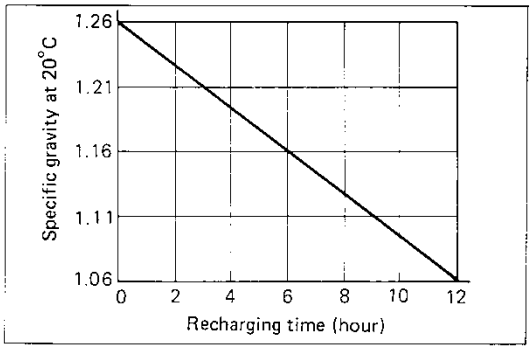
WARNING:
- Before charging a battery, remove the seal cap from each cell.
- Keep fire and sparks away from a battery being charged.
- When removing a battery from the motorcycle, be sure to remove the ⊖ terminal first.

Battery specification

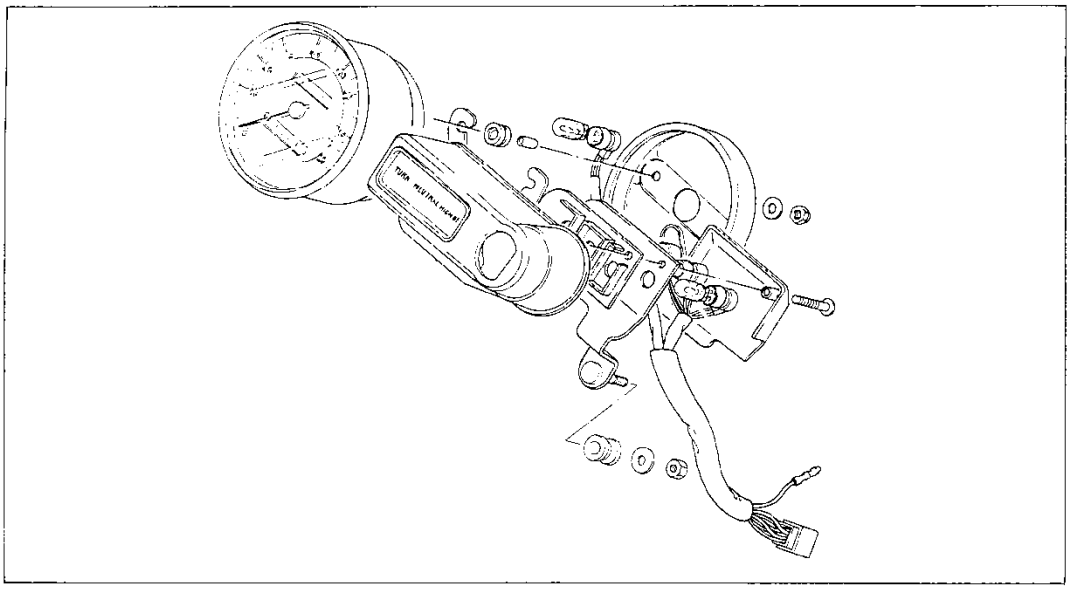
Type designation	6N4B-2A
Capacity	6V 14.4 kC (4 Ah)/10HR
Standard electrolyte S.G.	1.26 at 20°C (68°F)

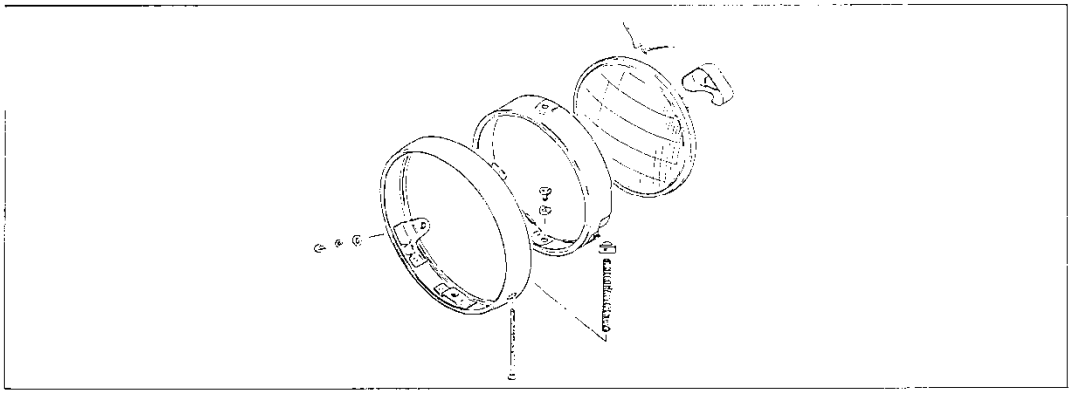


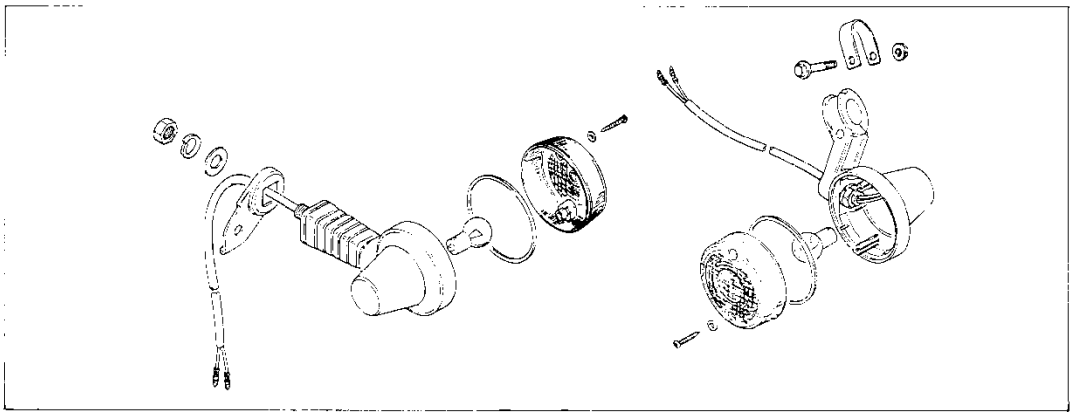


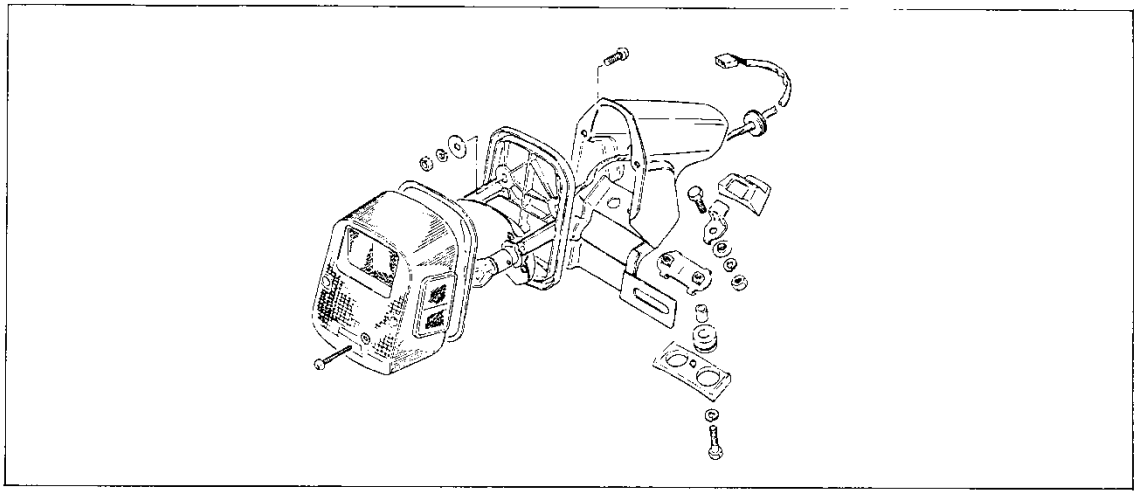


COMBINATION METER AND LIGHTS









LIGHT BULB REPLACEMENT AND INSPECTION

- After installing a new bulb, check for continuity. If the bulb does not light, inspect the wiring for open or short circuits.

NOTE:
When removing the lower cover from the speedometer, be careful so that the meter cushions and nuts are not losts.

CAUTION:
Do not overtighten the lens fitting screws.

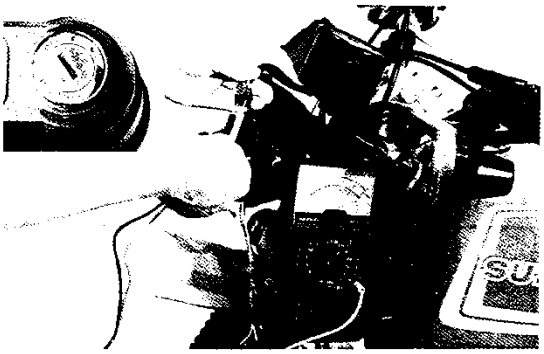
SWITCHES

Inspect each switch for continuity with the pocket tester referring to the chart.

Pocket tester	09900-25002

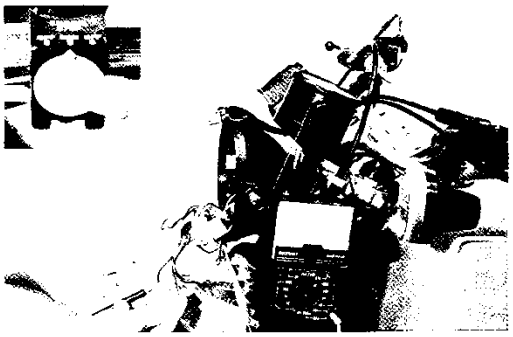
IGNITION SWITCH

COLOR / POSITION	B/Y	B/W	R	O	Gr	Br	R/W	O/W	Br/R
OFF	O	O							
ON			O	O	O		O	O	
P	O	O	O			O			O



ENGINE STOP SWITCH

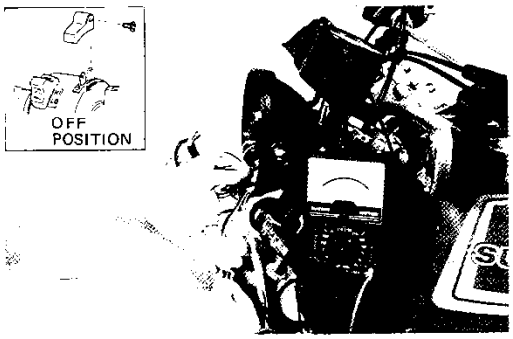
POSITION \ COLOR	B/Y	B/W
OFF	○——	——○
RUN		
OFF	○——	——○



LIGHTING SWITCH

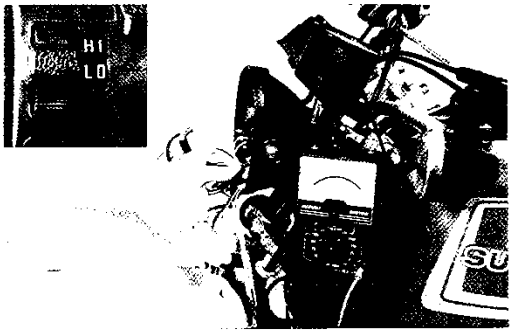
POSITION \ COLOR	Y/W	W/R	G/W	Y/R	Gr	O	Br
ON	○——	——○		○——	——○	○——	——○
OFF		○——	——○				

NOTE:
Switch cover must be removed to turn the light switch to the OFF position.



DIMMER SWITCH

POSITION \ COLOR	W	Y	Gr
HI		○——	——○
LO	○——	——	——○

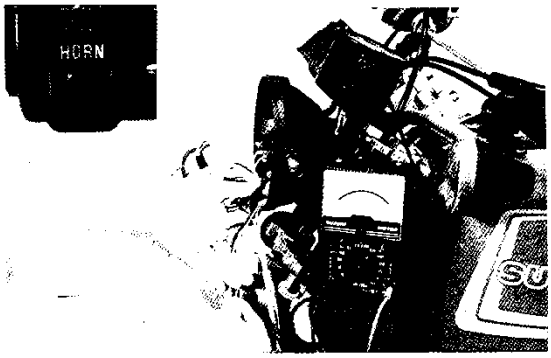


TURN SIGNAL SWITCH

POSITION \ COLOR	B	Lbl	Lg
R		○——	——○
•			
L	○——	——○	

HORN SWITCH

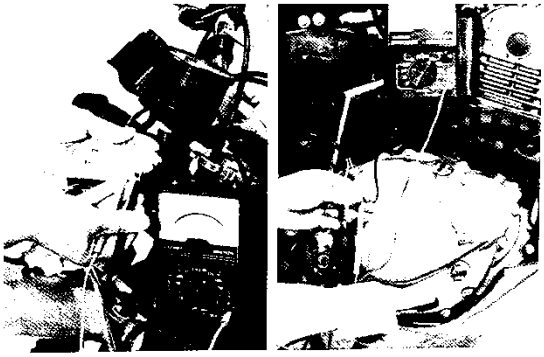
POSITION \ COLOR	G	B/W
ON (Push)	○———	———○
OFF		



BRAKE LIGHT SWITCH

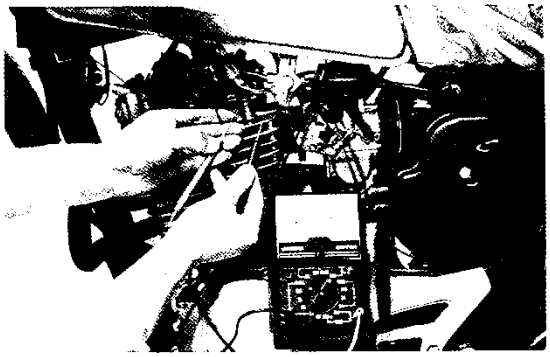
Front and Rear

POSITION \ COLOR	O	W or W/B
ON	○	---○
OFF		



NEUTRAL INDICATOR LIGHT SWITCH

POSITION \ COLOR	Bl	Ground
ON	○———	———○
OFF		



WIRE COLOR

B/Y	.....	Black with Yellow tracer
B/W	.....	Black with White tracer
Gr	.....	Gray
O	.....	Orange
G	.....	Green
B	.....	Black
Lg	.....	Light green
R	.....	Red
W	.....	White
Lbl	.....	Light blue
P	.....	Pink
Y	.....	Yellow
W/R	.....	White with Red tracer
W/G	.....	White with Green tracer
Br	.....	Brown
R/W	.....	Red with White tracer
O/W	.....	Orange with White tracer
Br/R	.....	Brown with Red tracer
Y/W	.....	Yellow with White tracer
G/W	.....	Green with White tracer
Y/R	.....	Yellow with Red tracer
W/B	.....	White with Black tracer
Bl	.....	Blue

Self check- 2.1

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Test I: -choose the best answer

1. Which one of the following is the cause of the Hard Pedal (3 mark)

a. Poor Braking caused by incorrect or glazed linings

b. Servo inoperative

c. Seized calliper pistons

d. None

2. Which one of the following is the cause of the Lights dim (3 mark)

a. High resistance in the circuit c. Low alternator output

b. Discoloured lenses or reflectors d. all of the above

Operation sheet-2.1

OPERATION TITLE: - Dismantling two wheeler gear box.

PURPOSE: - in order to replace damaged parts.

Conditions or situations for the operations

- ✓ Safe working area
- ✓ Properly operated tools and equipment's
- ✓ Appropriate working cloths fit with the body

Equipment, tools and materials

- ✓ **Hand tools-** screw driver, wrenches, hammers etc.
- ✓ **Equipment's**- floor jack, hydraulic crane etc.
- ✓ Special tools- **puller**

Procedure:

Step 1: Remove main gear assembly

Step 2: Remove counter gear assembly

Step 3: Remove the lay out assembly

Step 4: Remove all the gears are removed and count the number of teeth

Step 5: Fix lay shaft assembly

Step 6: Fix counter shaft gear assembly & bearings

Step 7: Fix the main gear assembly

Precautions

- ✓ Wear working cloths which properly fit with your body
- ✓ Make working area hazard free
- ✓ Read and interpret manual which guide you
- ✓ Do not use a screwdriver as a pry bar.

Operation sheet-2.2

OPERATION TITLE: -Dismantling of three wheeler steering system.

PURPOSE: - for lubricating the components by applying greasing.

Conditions or situations for the operations

- ✓ Safe working area
- ✓ Properly operated tools and equipment's
- ✓ Appropriate working cloths fit with the body

Equipment, tools and materials

- ✓ **Hand tools-** screw driver, wrenches, hammers etc.
- ✓ **Equipment's-** floor jack, hydraulic crane etc.

Procedure:

Step 1: Remove the pinch bolt.

Step 2: Remove the crown retaining bolt/ nut.

Step 3: Remove the steering stem nut.

Step 4: Remove the bearing.

Step 5: Remove the steering stem.

Precautions

- ✓ Wear working cloths which properly fit with your body
- ✓ Make working area hazard free
- ✓ Read and interpret manual which guide you
- ✓ Do not use a screwdriver as a pry bar.

Operation sheet 2.3

OPERATION TITLE: - Removal and cleaning Air filter

PURPOSE: - to clean the inner filter paper

Conditions or situations for the operations

- ✓ Safe working area
- ✓ Properly operated tools and equipment's
- ✓ Appropriate working cloths fit with the body

Equipment, tools and materials

- ✓ **Hand tools-** screw driver, wrenches, hammers etc.
- ✓ **Equipment's-** floor jack, hydraulic crane etc.

Procedure:

Step 1: Open the rear tail door.

Step 2: Clean the Outer Surface of the air filter

Step 3: Loosen the three lock clip provided of the cover air filter, and take out the cover air filter.

Step 4: Take out the paper filter cartridge.

Step 5: Blow the compressed air from inside out of the filter element

Step 6: Replace the Paper filter element every 40000 km. or found damaged for better performance of the vehicle and engine life.

Step 7: Clean the cover air filter and case air filter.

Step 8: Re-assemble the air filter element in the reverse order of removal.

Note:

- Cleaning the Paper filter element Every 5000 km
- Replacement of Paper filter element Every 40000 km

Operation sheet 2.4

OPERATION TITLE: - Removal and replacement Gear cable

PURPOSE: - to replace the broken cable

Conditions or situations for the operations

- ✓ Safe working area
- ✓ Properly operated tools and equipment's
- ✓ Appropriate working cloths fit with the body

Equipment, tools and materials

- ✓ **Hand tools-** screw driver, wrenches, hammers etc.
- ✓ **Equipment's**- floor jack, hydraulic crane etc.

Procedure:

Step 1: Loosen lock nut and adjuster nut near pulley at engine end

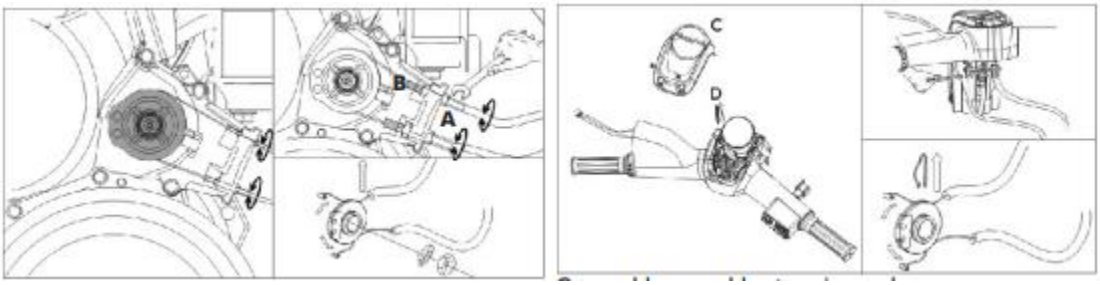
Step 2: Remove cover handle bar (C) by loosening two screws

Step 3: Remove the lock clip (D)

Step 4: Remove the handle bar sleeve and take out pulley gear shift.

Step 5: Pull out cable inner gear shift

Step 6: Loosen pulley gear shift nut at engine end and take the pulley out



Precautions

- ✓ Read and interpret manual which guide you
- ✓ Do not use a screwdriver as a pry bar.

Lap Test 2.1

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 2 hours.

Task 1 Dismantle two wheeler gear box.

Task 2 Dismantle three wheeler steering system

Task 3 Remove and clean Air filter

Task 4 Remove and replace Gear cable

Unit Three: Overhauling Two And Three-Wheeler

This learning unit is developed to provide the trainees the necessary information regarding the following content coverage and topics:

- Carry out Minor adjustments
- procedures for assembling
- Fitting System assembly

This unit will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- Carry out Minor adjustments
- Implement procedures for assembling
- Fit System assembly

3.1.Carry out Minor adjustments

- Engine Overhaul

Before beginning engine overhaul, observe engine conditions for the following:

- Cleanliness
- Compression pressure
- Any abnormal noise
- Oil leak, seepage if any

To overhaul the gears, balancer shaft, shaft complete counter, shaft complete drive and crankshaft assembly, the crank cases need to be separated.

- **Compression Pressure**

1. Warm-up the engine to normal operating temperature before checking the compression pressure.
2. Stop the engine and remove the spark plug. By using Plug spanner
3. Mount the compression gauge adaptor to the plug hole, taking care to make the connection leak proof. (Fig. 3.1) Compression gauge and special adopter Caution: Before mounting the gauge, ensure that the gauge is calibrated. Similarly, after mounting the gauge ensures that there is no leakage in the line.
4. With the fuel cock knob in ‘OFF’ position, switch ‘OFF’ the ignition, open the throttle fully and crank the engine five to six times with the electric starter, until the maximum reading achieved in the compression gauge. Example (TVS APACHE RTR 200 SERVICE MANUAL) Compression pressure Standard 6.3 ~ 8.4 kg/cm (90 ~ 120 psi)
5. If the compression pressure is high, it indicates that high carbon deposit on the combustion chamber and the piston crown.
6. If the compression pressure is low, pour 3 to 5 cc of clean engine oil into the cylinder through the sparkplug hole and re-check the compression pressure. If the compression pressure increases from the previous value, then check the following.

- ✓ Leaking cylinder head gasket.
- ✓ Worn piston rings.

- ✓ Worn cylinder and piston.
- ✓ Piston ring stuck in the grooves.

7. If the compression pressure is the same as the previous value, check the valves for leakage and carburettor piston valve opening

- **Motorcycle compression Test**
  - Low Compression Test Symptom
    - Misfire
    - Backfire
    - Fouled plugs
    - No Start

- ✓ Remove spark plug
- ✓ Ignition Coil
- ✓ Fuel off

Connect pressure gauge in to first cylinder

- ✓ throttle open
- ✓ turn over the engine until gauge stops
- ✓ take reading

Figure 3.1 Motorcycle Compression Test

- Repeat For each cylinder

- All should be written 10 psi
- 15-20% + variation indicate problem

➢ **How to do a Leak down Test**

To perform a leak down test, you'll need:

- An air compressor.
- A leak down tester, which consists of a pressure regulator and pressure reading gauges.

Leak down tests should be performed when the motorcycle engine is cold.

To perform the leak down test:

- Bring the cylinder you're testing to TDC position
- Remove the spark plug.
- Hook up the air pressure supply and the leak test unit to the spark plug hole.
- Regulate the air pressure to 100 PSI
- Listen and observe for any leaks
- Record the pressure

Leakage results can be measured as a percentage of: supplied air pressure – recorded air pressure, divided by supplied air pressure.

Leak Down Test Results

✓ Results less than 5% leakage indicate that your engine is in near perfect condition.

✓ Results up to 10-15% should still be good and serviceable.

✓ Leakage percentage above 15% indicates that components are likely worn past serviceable limits. Unfortunately, your job just got a little bigger.

✓ If you've recently rebuilt the engine, make sure you've torqued down the cylinder and⎫ head to the proper values in the proper sequence

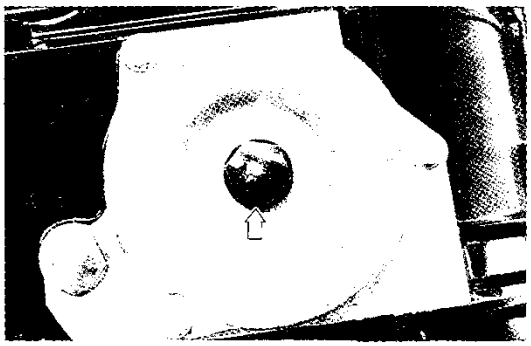
3.2.Disassembling electrical and mechanical aggregates

3.2.1. Upper end component disassemble

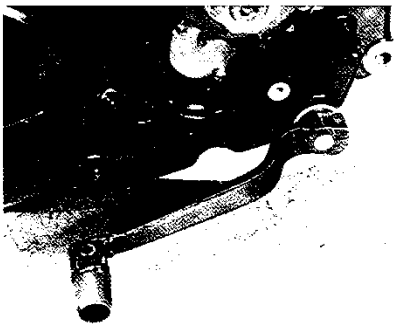
CYLINDER HEAD COVER AND CYLINDER HEAD

NOTE:
* If top end repair only is being performed, it is not necessary to remove the engine from the frame.
* As already noted, seat, fuel tank, side covers etc. must be removed.

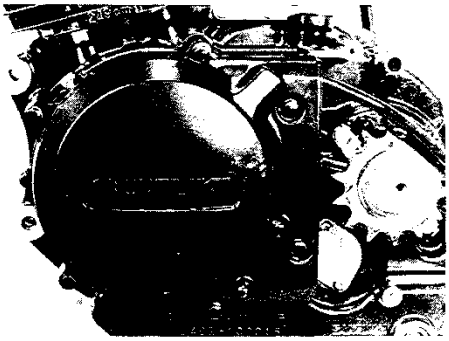
- Drain engine oil.



- Remove gear shift lever.

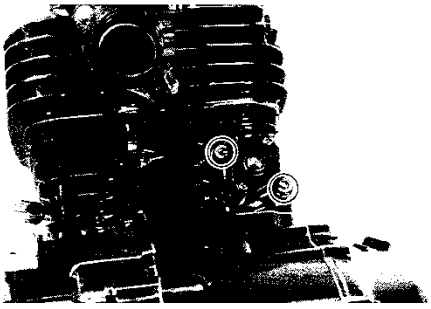


- Remove magneto cover.

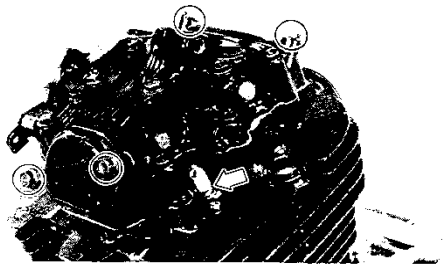


- Remove chain tensioner.

"T" type hexagon wrench (5 mm)	09911-73730



- Remove valve inspection caps and spark plug.

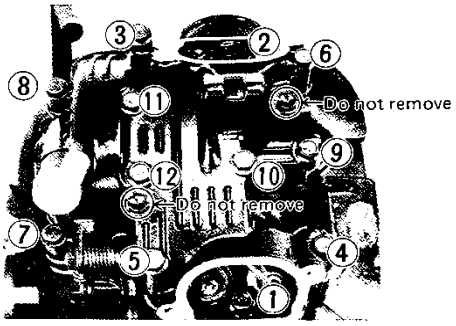


- Bring the piston to top dead center.

NOTE:
When removing cylinder head cover, piston must be at top dead center on compression stroke.

- First, remove the welch plug.
- Next, loosen the cylinder head cover bolts in the order indicated in the illustration and detach the cylinder head cover.

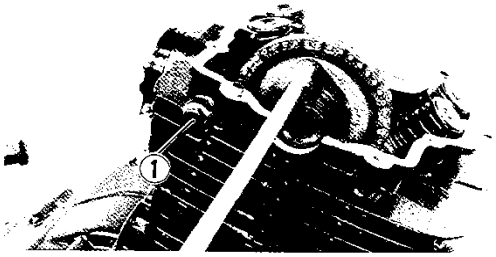
NOTE:
When removing cylinder head cover, do not remove conically recessed top bolts.



- Detach the camshaft end cap.
- Flatten camshaft sprocket lock washer.
- Remove camshaft sprocket bolts and detach the camshaft.

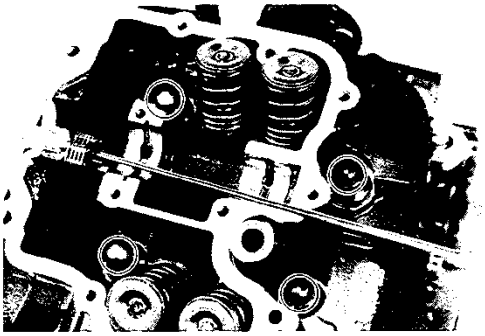
NOTE:
The cam chain tensioner bolt ① is to be removed only when disassembling the engine.

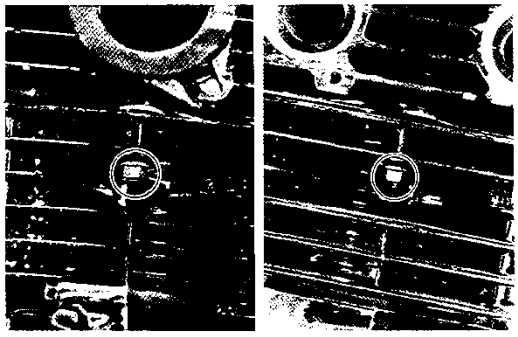
CAUTION:
Do not drop camshaft drive chain, pin and sprocket into the crankcase.



- Loosen the six cylinder head nuts diagonally, then detach the cylinder head.

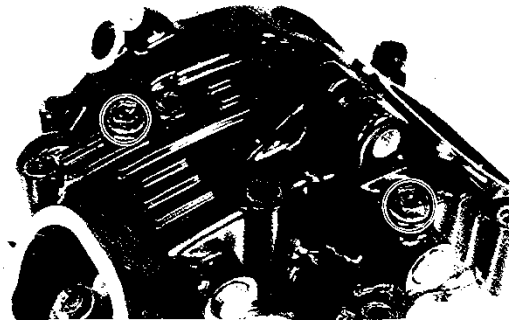
NOTE:
If it is difficult to remove the cylinder head, gently pry it off while tapping the finless portion of the cylinder head with a plastic hammer. Be careful not to break the fins.



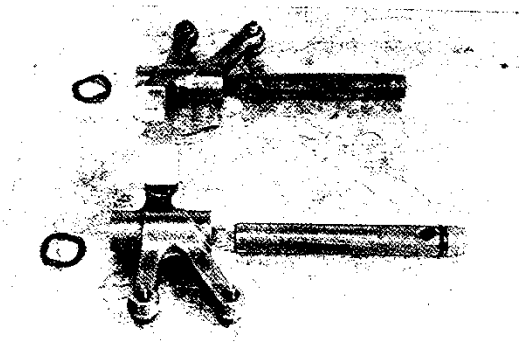


- Pull out the de-compression shaft.

- Remove rocker arm shaft set bolts.

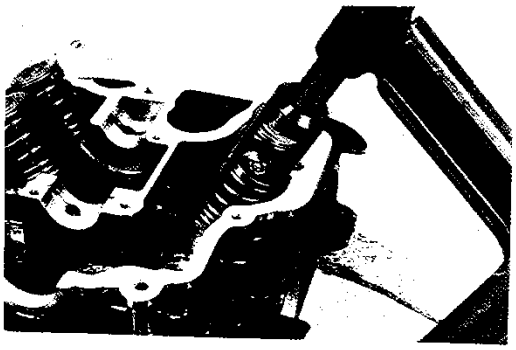


- Pull out the rocker arm shafts with pliers.



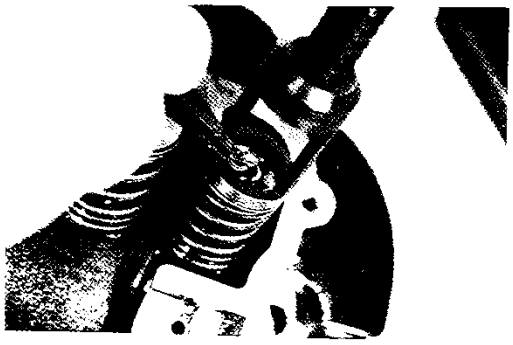
- Compress the valve spring.

Valve lifter	09916-14510

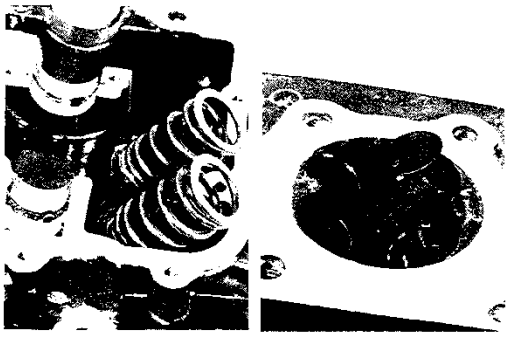


- Take off the valve cotters from valve stem.

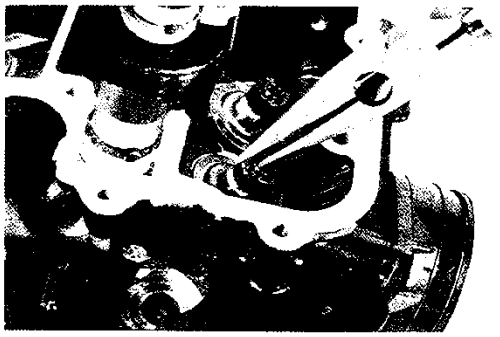
Tweezers	09916-84510



- Take out the valve spring retainer and spring.
- Pull out the valve from the other side.

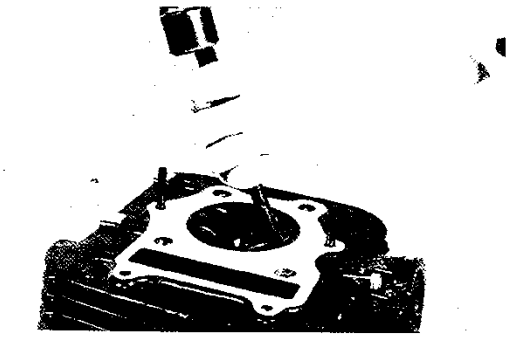


- Remove oil seal, using long-nose pliers.
- Take out the spring seat.

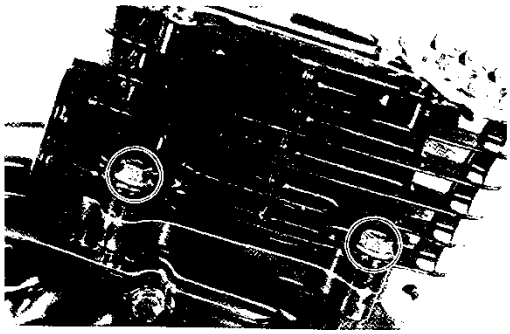


- Remove valve guide.

Valve guide remover	09916-44910



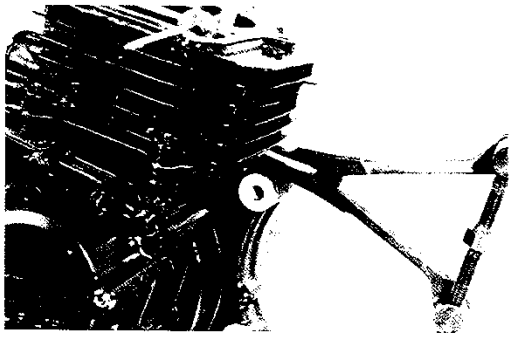
- Remove cylinder base nuts.



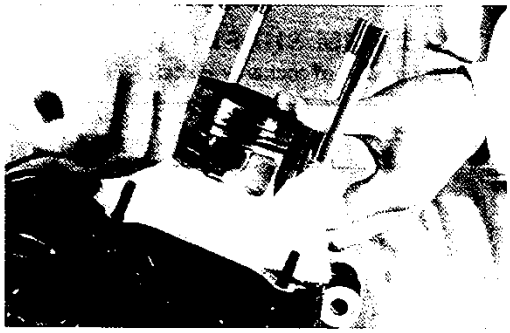
- Remove cylinder.

Cylinder disassembling tool	09912-34510

CAUTION:
If tapping with plastic hammer is necessary, do not break the fins.

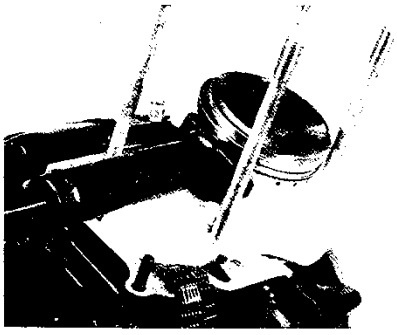


- Place a clean rag over the cylinder base to prevent piston pin circlip from dropping into crankcase and then, remove the piston pin circlip with long-nose pliers.



- Remove piston pin.

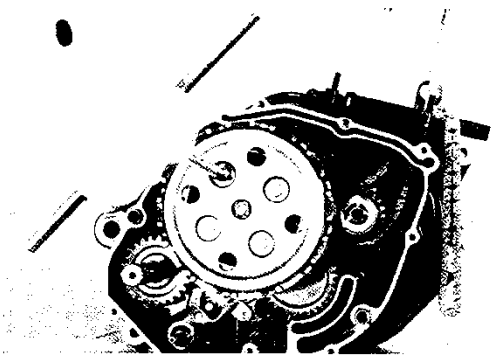
Piston pin puller	09910-34510



- Remove clutch spring mounting bolts diagonally while holding the primary driven gear, and remove clutch pressure plate.

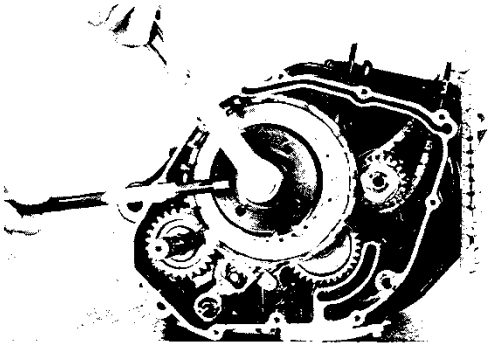
Conrod holder	09910-20116

NOTE:
Do not allow camshaft drive chain to be caught between crankcase and camshaft drive sprocket.

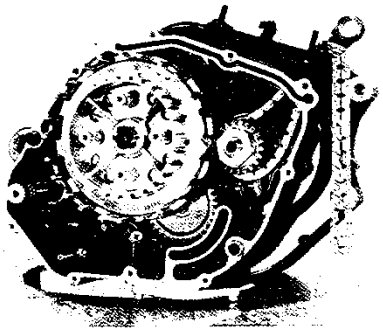


- After removal of clutch drive and driven plates, flatten the lock washer and remove the clutch sleeve hub nut by using the special tool.

Clutch sleeve hub holder	09920-53721



- Take off the sleeve hub with the primary driven gear ass'y.

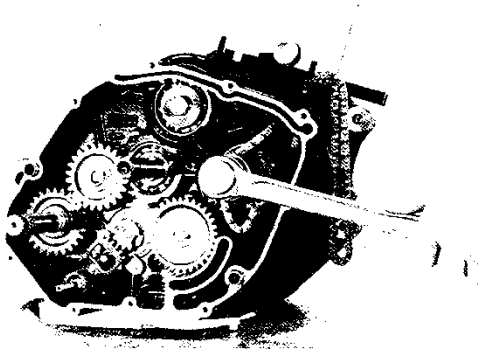


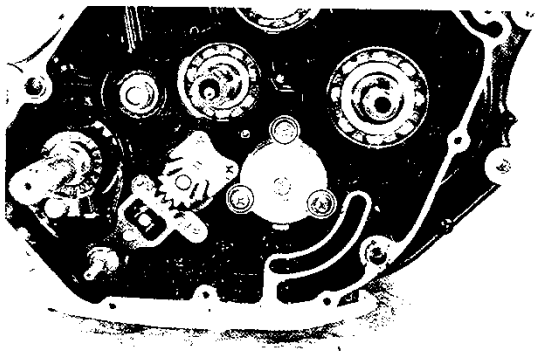
PRIMARY DRIVE GEAR AND CAMSHAFT DRIVE CHAIN

- Remove primary drive gear nut, then remove wave washer, primary drive gear and key.

Conrod holder	09910-20116

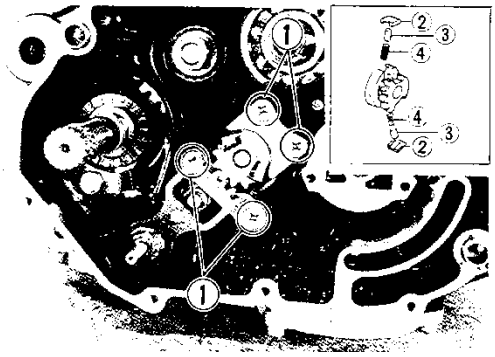
CAUTION:
This is a left-hand thread nut.





GEAR SHIFTER

- To remove cam driven gear, first remove gear shifting shaft and loosen pawl lifter and cam guide screws 1 with a impact driver.

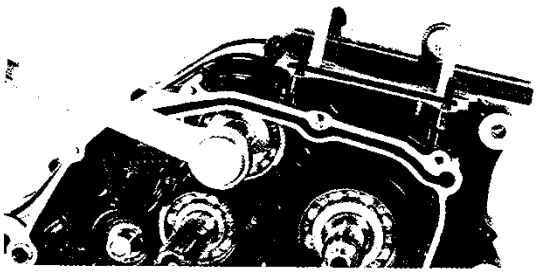


NOTE:
When removing cam driven gear, do not lose gear shifting pawl 2, pin 3 and spring 4.

BALANCER

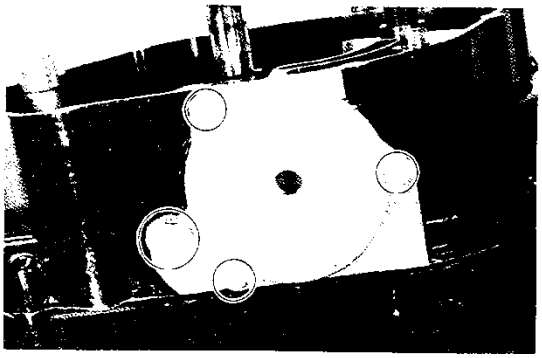
- Remove balancer setting bolt.

Conrod holder	09910-20116

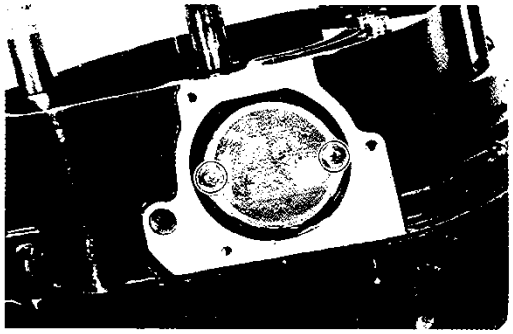


CRANKCASE

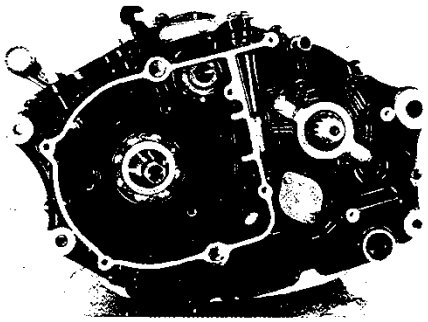
- Remove sump filter cap and neutral cam stopper.



- Remove sump filter.

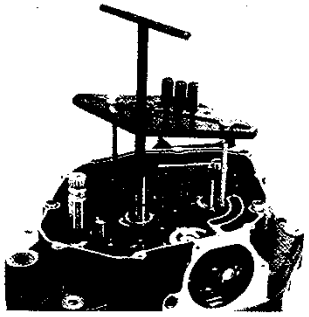


- Remove crankcase set bolts.



- Separate the crankcase into 2 parts, right and left with crankcase separating tool.

Crankcase separating tool	09920-13111

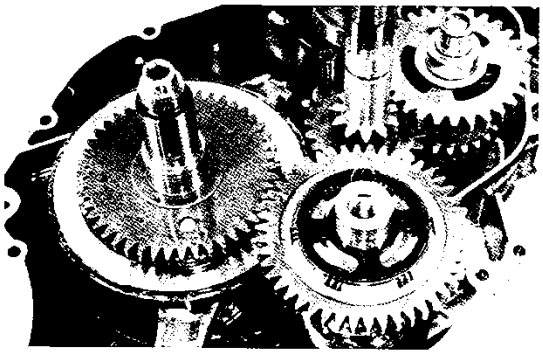


- Fit the crankcase separating tool, so that the tool plate is parallel with the end face of the crankcase.

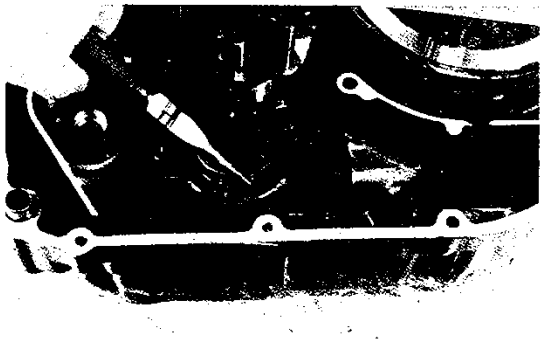
CAUTION:
The crankshaft and transmission components must remain in the left crankcase half. This is necessary because the gear shifting cam stopper is mounted on the left crankcase half and will be damaged if the transmission components remain in the right half.

TRANSMISSION AND BALANCERSHAFT

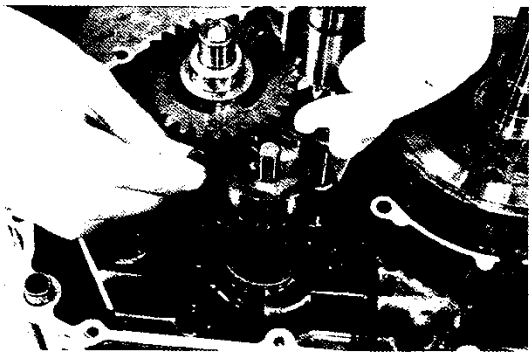
- Remove balancer drive gear.
- Remove balancer driven gear ass'y with balancer driven gear plates, outer and inner, then remove key.



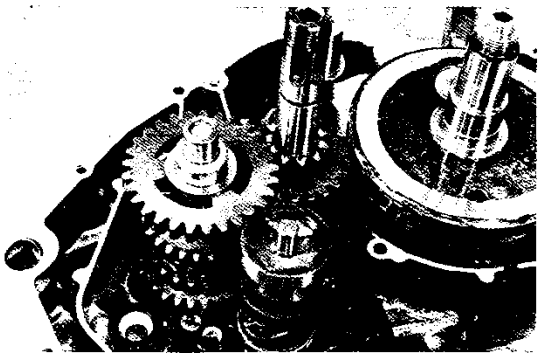
- Remove gear shifting cam stopper spring.



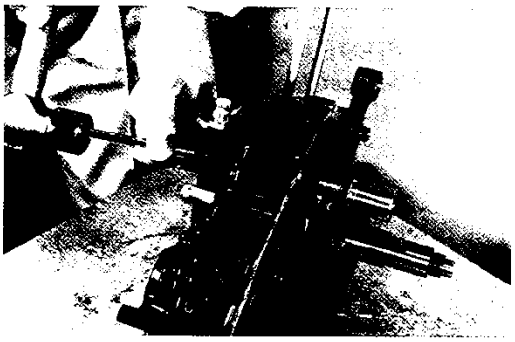
- Draw out gear shifting fork shafts and take off forks.



- Remove clusters of gears and gear shifting cam.

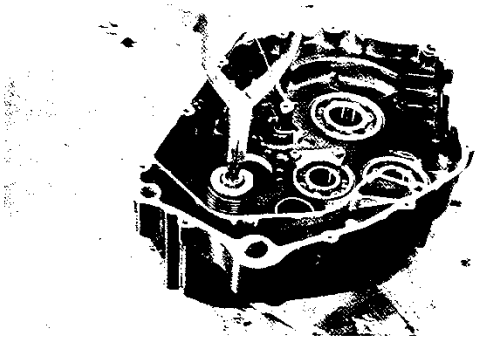


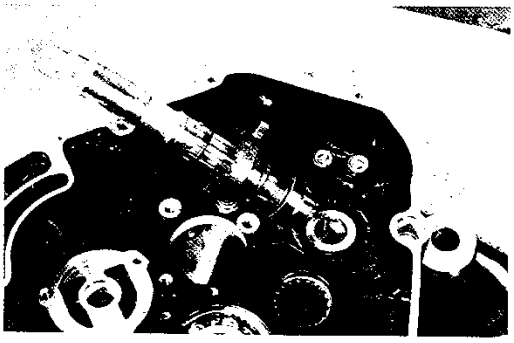
- Knock out balancershaft by using a soft drift.



KICK STARTER SHAFT

- Remove circlip, spring guide and return spring.
- Then, pull out the kick starter shaft from other side.

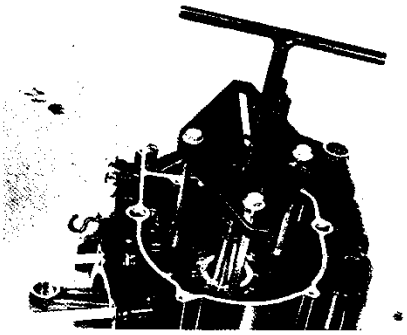




CRANKSHAFT

- Remove crankshaft by using crankshaft remover.

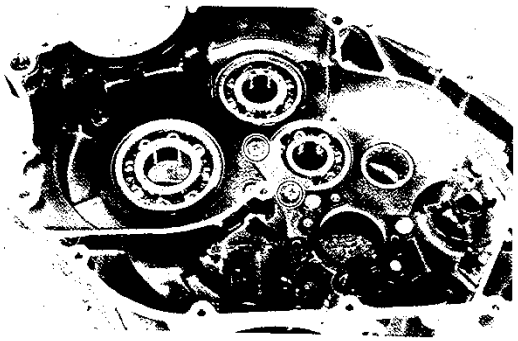
Crankshaft remover	09920-13111

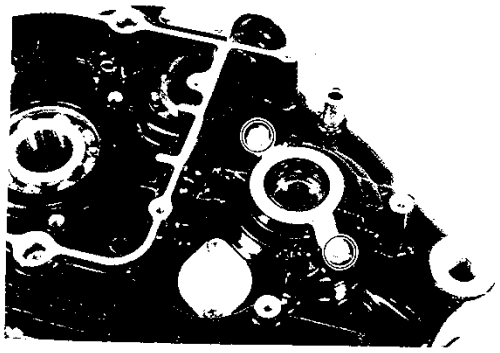


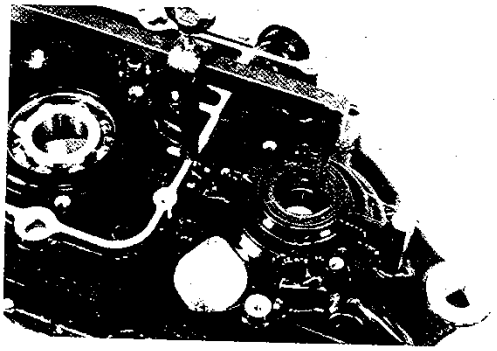
OIL SEAL AND BEARING

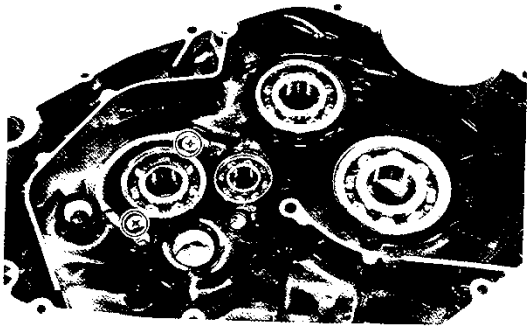
- Using the special tools, remove retainers, oil seals and bearings.

Oil seal remover	09913-50121









3.3.Inspecting electrical and mechanical aggregates

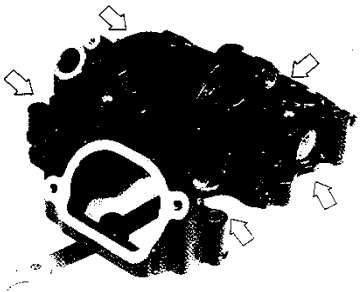
Upper end components inspecting and service

CYLINDER HEAD COVER DISTORTION

After removing sealant (SUZUKI BOND No. 1207B) from the fitting surface of the cylinder head cover, place the cylinder head cover on a surface plate and check for distortion with a thickness gauge. Check points are shown in illustration.

Service limit	0.05 mm (0.002 in)

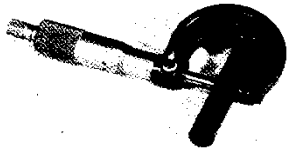
If the distortion exceeds the limit, replace the cylinder head cover.



ROCKER ARM SHAFT O.D.

Measure diameter of rocker arm shaft.

Standard	11.966 – 11.984 mm (0.4711 – 0.4718 in)



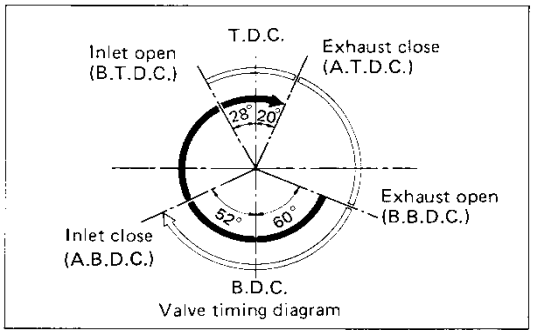
ROCKER ARM I.D.

When checking the valve rocker arm, the inside diameter of the valve rocker arm and wear of the camshaft contacting surface should be checked.

Standard	12.000 – 12.018 mm (0.4724 – 0.4731 in)

CAMSHAFT

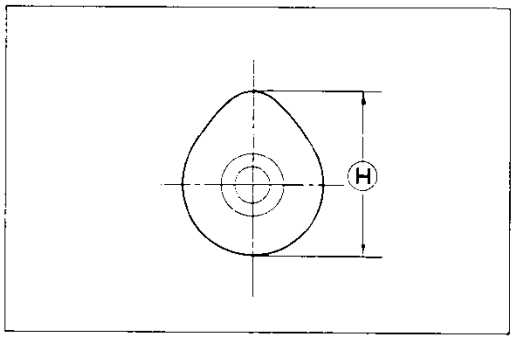
The camshaft should be checked for runout and also for wear of cams and journals if the engine has been noted to give abnormal noise or vibration or to lack output power. Any of these malconditions could be caused by camshaft worn down or distorted to the service limit.



Valve timing diagram

CAMSHAFT CAM WEAR

Worn-down cams are often the cause of mistimed valve operation resulting in reduced output power. The limit of cam wear is specified for both intake and exhaust cams in terms of cam height (H), which is to be measured with a micrometer. Replace camshafts if found it worn down to the limit.



Micrometer (25 – 50 mm)	09900 – 20202

Cam height

Height (H)	Service limit
Intake cam	34.690 mm (1.3657 in)
Exhaust cam	34.730 mm (1.3673 in)

CAMSHAFT JOURNAL WEAR

Determine whether each journal is worn down to the limit or not by measuring camshaft journal oil clearance with the camshaft installed. Use plastigauge to read the clearance, which is specified as follows:

Camshaft journal oil clearance

Service limit	0.15 mm (0.006 in)

Cylinder head cover tightening torque

Tightening Torque	9 – 10 N·m (0.9 – 1.0 kg-m) (6.5 – 7.0 lb-ft)

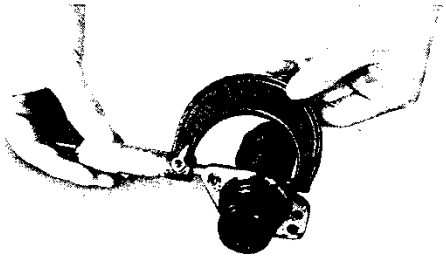
NOTE:
At the stage when gasket material has been removed from fitting surfaces of cylinder head and cover, and before SUZUKI BOND No.1207B has been applied, fit the cylinder head cover and tighten to the torque specified.

If the camshaft journal oil clearance measured exceeds the limit, measure the outside diameter of camshaft.
Replace either the cylinder head set or the cam shaft, if the clearance is incorrect.

Micrometer (0 – 25 mm)	09900 – 20205

Camshaft journal O. D. (R. side)	24.959 – 24.980 mm (0.9826 – 0.9835 in)

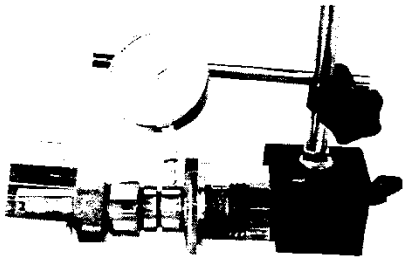
Camshaft journal O. D. (L. side)	19.959 – 19.980 mm (0.7858 – 0.7866 in)



CAMSHAFT RUNOUT

Measure the runout with a dial gauge. Replace the camshaft if the runout exceeds the limit.

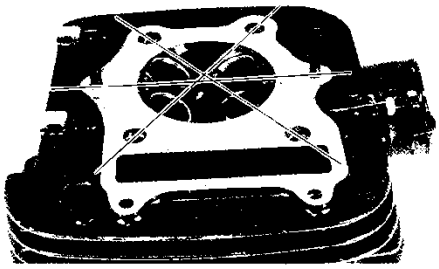
Service limit	0.10 mm (0.004 in)



CYLINDER HEAD DISTORTION

Decarbon combustion chamber.
Check the gasketed surface of the cylinder head for distortion with a straightedge and thickness gauge, taking a clearance reading at several places as indicated. If the largest reading at any position of the straightedge exceeds the limit, replace the cylinder head.

Service limit	0.05 mm (0.002 in)

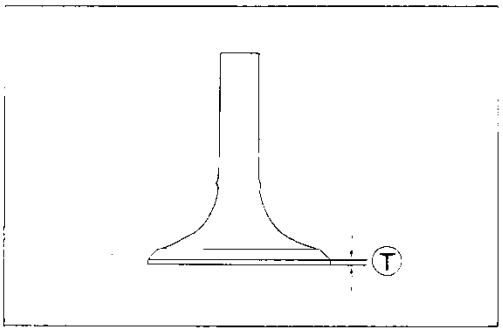


VALVE FACE WEAR

Measure the thickness Ⓣ and, if the thickness is found to have been reduced to the limit, replace the valve.

NOTE:
Visually inspect each valve for wear of its seating face. Replace any valve with an abnormally worn face.

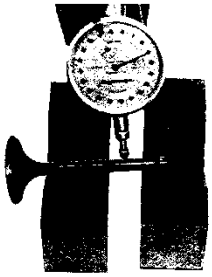
Service limit	0.5 mm (0.02 in)



VALVE STEM RUNOUT

Support the valve with "V" blocks, as shown, and check its runout with a dial gauge. The valve must be replaced if the runout exceeds the limit.

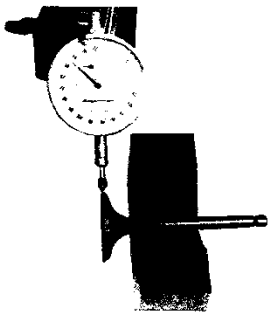
Service limit	0.05 mm (0.002 in)



VALVE HEAD RADIAL RUNOUT

Place the dial gauge at right angles to the valve head, and measure the valve head radial runout. If it measures more than limit, replace the valve.

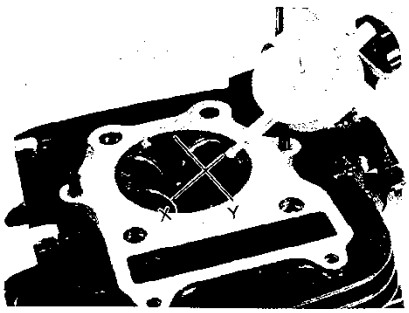
Service limit	0.03 mm (0.001 in)



VALVE GUIDE-VALVE STEM CLEARANCE

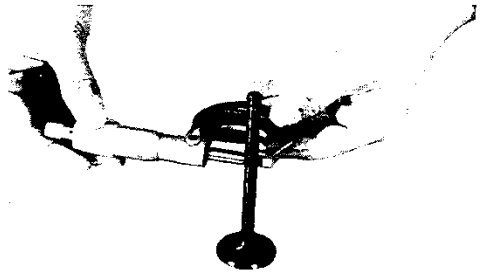
Measure the clearance in two directions, "X" and "Y", perpendicular to each other, by rigging up the dial gauge as shown. If the clearance measured exceeds the limit specified below, then determine whether the valve or the guide should be replaced to reduce the clearance to within the standard range:

	Standard	Service limit
IN.	0.025 – 0.052 mm (0.0010 – 0.0020 in)	0.35 mm (0.014 in)
EX.	0.040 – 0.067 mm (0.0016 – 0.0026 in)	0.35 mm (0.014 in)



VALVE STEM WEAR

If the valve stem is worn down to the limit, when measured with a micrometer, and the clearance is found to be in excess of the limit indicated above, replace the valve, if the stem is within the limit, then replace the guide. After replacing valve or guide, be sure to recheck the clearance.



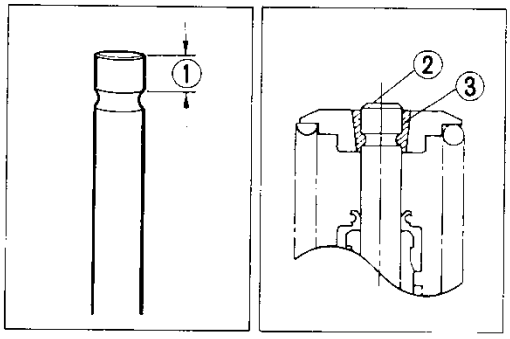
Micrometer (0 – 25 mm)	09900-20205

Valve stem O. D.

	Standard
IN.	5.460 – 5.475 mm (0.2150 – 0.2156 in)
EX.	5.445 – 5.460 mm (0.2144 – 0.2150 in)

VALVE STEM CONDITION

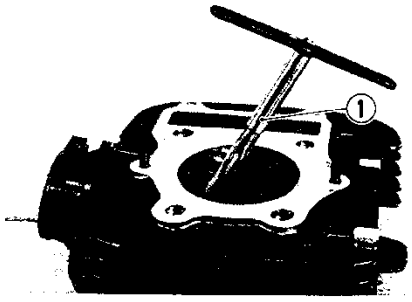
Inspect the valve stem end face for pitting and wear. If pitting or wear of the stem end face are present, the valve stem end may be resurfaced, providing that the length ① will not be reduced to less than 3.8 mm (0.15 in). If this length becomes less than 3.8 mm (0.15 in), the valve must be replaced. After installing a valve whose stem end has been ground off as above, check to ensure that the face ② of the valve stem end is above the cotters ③.



VALVE GUIDE INSTALLATION

- Re-finish the valve guide holes in cylinder head with a 11.3 mm reamer ① and handle.

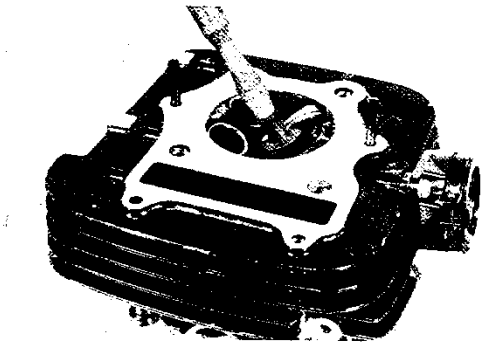
11.3 mm reamer	09916-34561
Handle	09916-34541



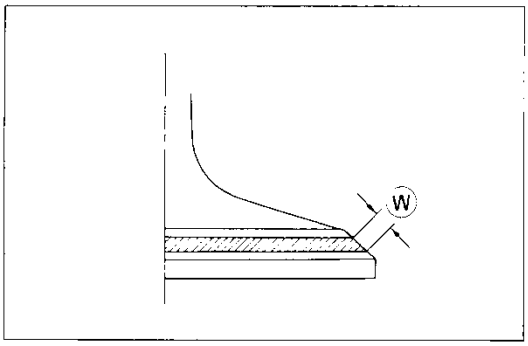
- Fit a ring to each valve guide. Be sure to use new rings and valve guides. Use of rings and valve guides removed in disassembly must be avoided.

VALVE SEAT WIDTH

- Coat the valve seat with prussian blue uniformly. Fit the valve and tap the coated seat with the valve face in a rotating manner, in order to obtain a clear impression of the seating contact. In this operation, use the valve lapper to hold the valve head.



- The ring-like dye impression left on the valve face must be continuous-without any break. In addition, the width of the dye ring, which is the visualized seat "width", must be within the specification.



Valve seat width

STD. Ⓦ	0.9 – 1.1 mm (0.035 – 0.043 in)

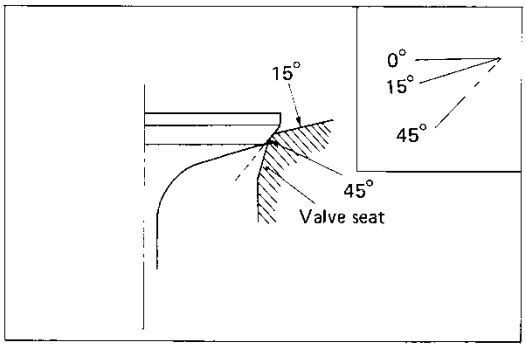
If either requirement is not met, correct the seat by servicing it as follows.

VALVE SEAT SERVICING

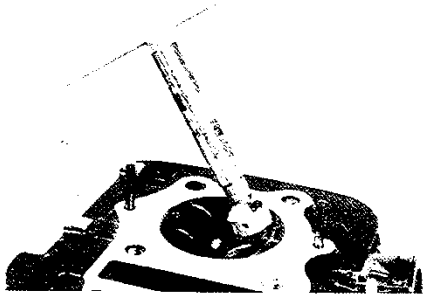
The valve seats for both intake and exhaust valves are angled to present two bevels, 15° and 45°.

15° X45° cutter (N-116)	99103-45012-003

NOTE:
The valve seat contact area must be inspected after each cut.



1. Insert with a slight rotation, the solid pilot that gives a snug fit. The shoulder on the pilot should be about 10 mm (0.39 in) from the valve guide.
2. Using the 45° cutter, descale and cleanup the seat with one or two turns.
3. Inspect the seat by the previous seat width measurement procedure. If the seat is pitted or burned, additional seat conditioning with the 45° cutter is required.

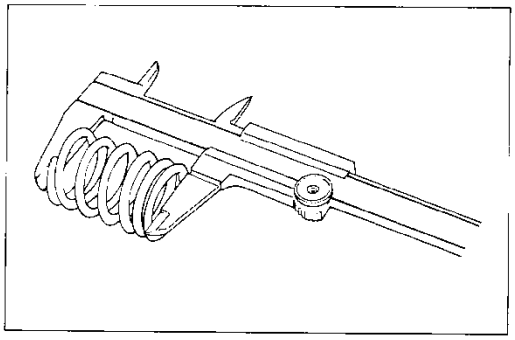


VALVE SPRINGS

Check the springs for strength by measuring their free lengths and also the force required to compress them. If the limit indicated below is exceeded by the free length reading or if the measured force does not fall within the range specified, replace with a SUZUKI spring.

Valve spring free length

Service limit	39.8 mm (1.57 in)



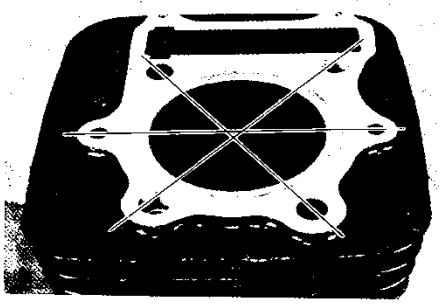
Valve spring tension

STD.	16.2 – 19.8 kg/35 mm (35.7 – 43.7 lbs/1.4 in)

CYLINDER DISTORTION

Check the gasketed surface of the cylinder for distortion with a straightedge and thickness gauge, taking a clearance reading at several places as indicated. If the largest reading at any position of the straightedge exceeds the limit, replace the cylinder.

Service limit	0.05 mm (0.002 in)

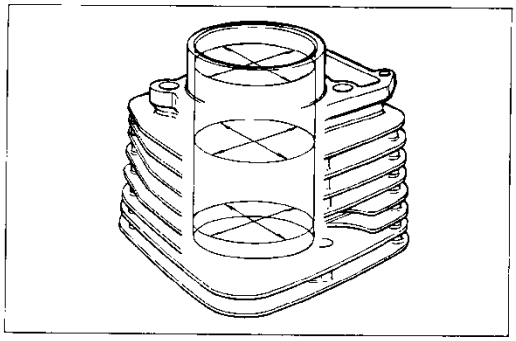


CYLINDER BORE

Measure the cylinder bore diameter at six places. If any one of the measurements exceeds the limit, overhaul the cylinder and replace the piston with an oversize, or replace the cylinder.

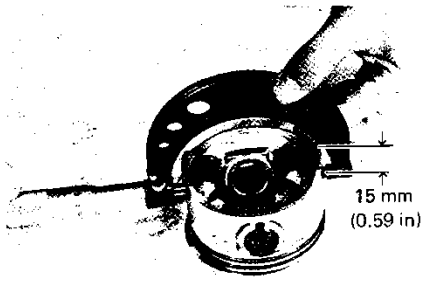
Cylinder gauge set	09900-20508

Service limit	72.085 mm (2.8380 in)



PISTON DIAMETER

Using a micrometer, measure the piston outside diameter at the place 15 mm (0.59 in) from the skirt end as shown in illustration. If the measurement is less than the limit, replace the piston.



Micrometer (50 – 75 mm)	09900-20203

Service limit	71.880 mm (2.8299 in)

Piston oversize	0.5, 1.0 mm

NOTE:
Using a soft-metal scraper, decarbon the crown of the piston. Clean the ring grooves similarly.

PISTON-CYLINDER CLEARANCE

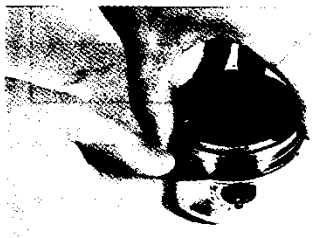
As a result of the above measurement, if the piston to cylinder clearance exceeds the limit shown in the table below, overhaul the cylinder and use an oversize piston, or replace both cylinder and piston.

Service limit	0.120 mm (0.0047 in)

PISTON RING-GROOVE CLEARANCE

Using a thickness gauge, measure the side clearance of the 1st and 2nd rings. If any of the clearances exceeds the limit, replace both piston and piston rings.

Thickness gauge	09900-20803



Piston ring-groove clearance

Piston ring	Service limit
1st	0.18 mm (0.007 in)
2nd	0.15 mm (0.006 in)

Piston ring groove width

Piston ring	Standard
1st	1.01 – 1.03 mm (0.039 – 0.040 in)
2nd	1.21 – 1.23 mm (0.047 – 0.048 in)
Oil	2.51 – 2.53 mm (0.099 – 0.100 in)

Piston ring thickness

Piston ring	Standard
1st	0.975 – 0.990 mm (0.0384 – 0.0390 in)
2nd	1.170 – 1.190 mm (0.0461 – 0.0469 in)

PISTON RING FREE END GAP AND PISTON RING END GAP

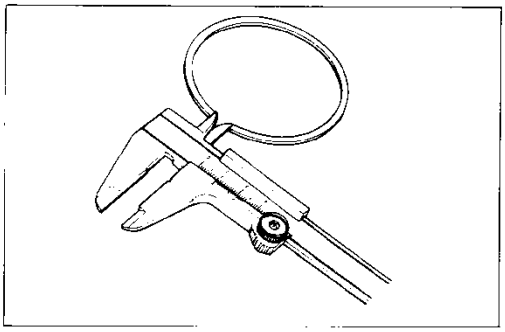
Before installing piston rings, measure the free end gap of each ring using vernier calipers.
Next, fit the ring in the cylinder, and measure each ring end gap using a thickness gauge.
If any ring has an excess end gap, replace the ring.

Piston ring free end gap

N: (NIPPON)
R: (RIKEN)

Piston ring		Service limit
1st	N	7.6 mm (0.30 in)
	R	8.4 mm (0.33 in)
2nd	N	8.8 mm (0.35 in)
	R	8.8 mm (0.35 in)

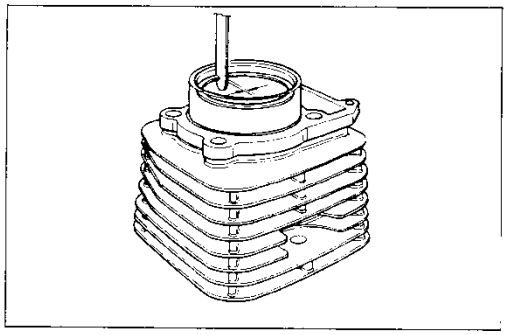
Vernier calipers (150 mm)	09900-20101



Piston ring end gap

Piston ring	Service limit
1st and 2nd	0.7 mm (0.03 in)

Thickness gauge	09900-20803



OVERSIZE RINGS

- **Oversize piston rings**
  The following two types of oversize piston rings are used. They bear the following identification numbers.

Piston ring	1st	2nd
0.5 mm	50	50
1.0 mm	100	100

- **Oversize oil rings**
  The following two types of oversize oil rings are used. They bear the following identification marks.

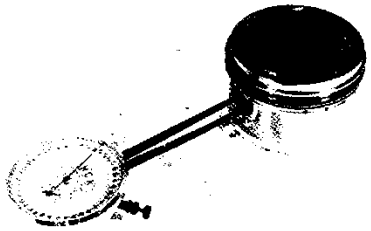
0.5 mm	Painted blue
1.0 mm	Painted yellow

- **Oversize side rail**
  Just measure outside diameter to distinguish the standard size from oversize.

PISTON PIN—PIN BORE

Using a caliper gauge, measure the piston pin bore inside diameter, and using a micrometer measure the piston pin outside diameter. If the difference between these two measurements is more than the limits, replace both piston and piston pin.

Micrometer (0 – 25 mm)	09900-20205



Piston pin bore

Service limit	18.030 mm (0.7098 in)

Piston pin O.D.

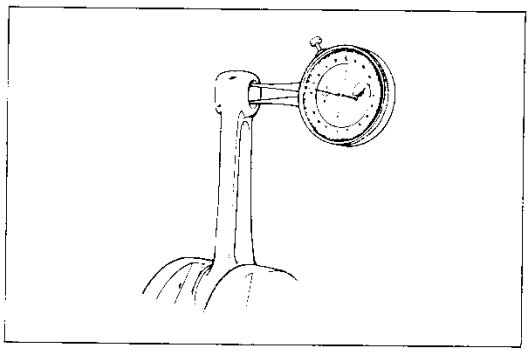
Service limit	17.980 mm (0.7079 in)

CONROD SMALL END I.D.

Using a caliper gauge, measure the conrod small end inside diameter.

Service limit	18.040 mm (0.7102 in)

- If the conrod small end bore inside diameter exceeds the limit, replace conrod.

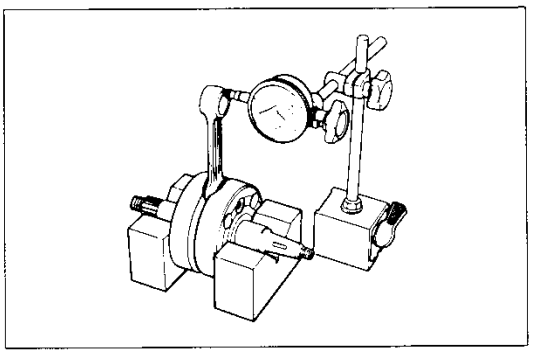


LOWER END COMPONENTS INSPECTION AND SERVICING

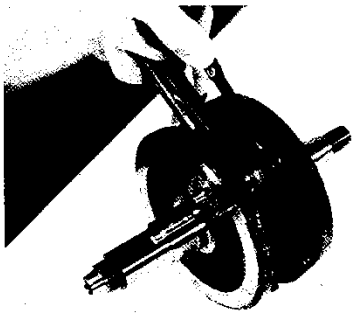
CONROD DEFLECTION AND CONROD BIG END SIDE CLEARANCE

Wear on the big end of the conrod can be estimated by checking the movement of the small end of the rod. This method can also check the extent of wear on the parts of the conrod's big end.

Service limit	3.0 mm (0.12 in)



Push the big end of the conrod to one side and measure its side clearance with a thickness gauge.



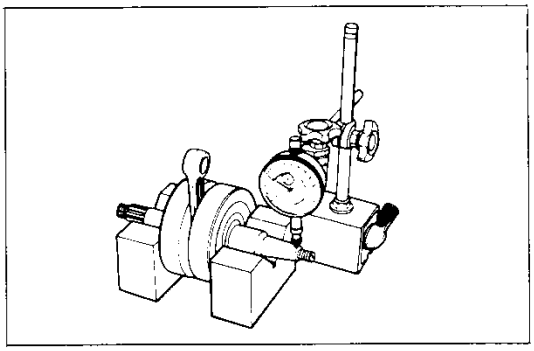
Standard	Service limit
0.10 – 0.65 mm (0.004 – 0.026 in)	1.00 mm (0.039 in)

Where the limit is exceeded, replace crankshaft assembly or reduce the deflection and the side clearance to within the limit by replacing the worn parts – conrod, big end bearing, crankpin and thrust washers, etc. (Refer to the SERVICE DATA)

CRANKSHAFT RUNOUT

Support the crankshaft with "V" blocks as shown, with the two end journals resting on the blocks. Position the dial gauge, as shown, and rotate the crankshaft slowly to read the runout.

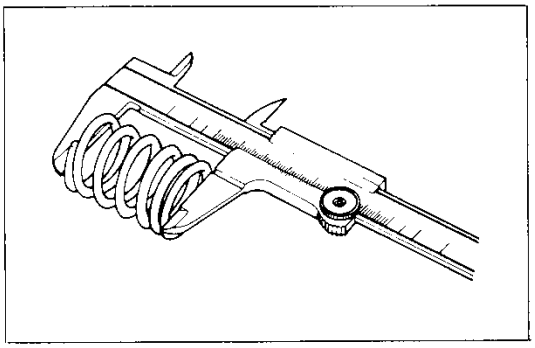
Correct or replace the crankshaft if the runout is greater than the limit.



Service limit	0.05 mm (0.002 in)

BALANCER SPRING FREE LENGTH

Measure the free length of each coil spring with a vernier calipers, and determine the elastic strength of each. Replace any spring not within the limit.



Vernier calipers	09900-20101

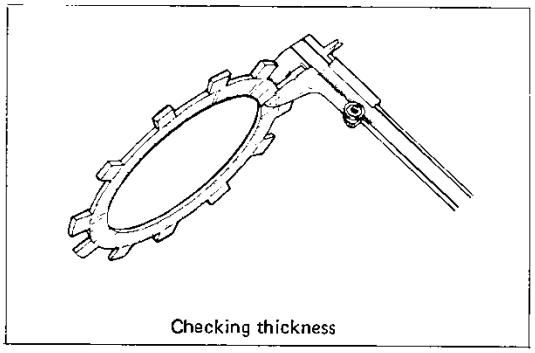
Service limit	9.9 mm (0.39 in)

CLUTCH DRIVE PLATE

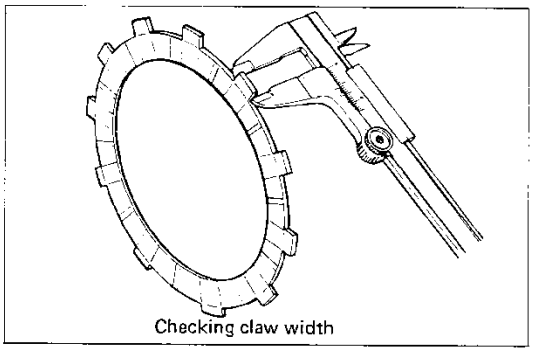
Measure the thickness and claw width of each drive plate with vernier calipers. Replace drive plates found to have worn down to the limit.

Vernier calipers	09900-20101

Item		Standard	Limit
Thickness	No. 1	2.90 – 3.10 mm (0.114 – 0.122 in)	2.60 mm (0.102 in)
	No. 2	3.45 – 3.55 mm (0.136 – 0.140 in)	3.15 mm (0.124 in)
Claw width		15.8 – 16.0 mm (0.62 – 0.63 in)	15.0 mm (0.59 in)



Checking thickness



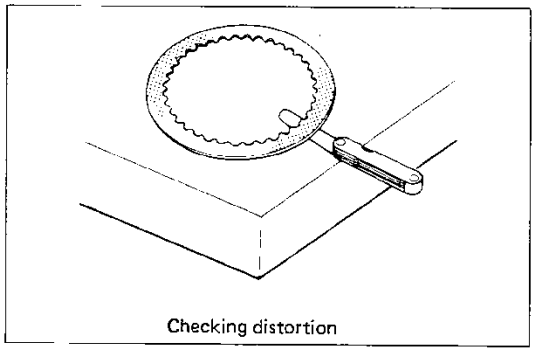
Checking claw width

CLUTCH DRIVEN PLATE

Measure each driven plate for distortion with a thickness gauge. Replace driven plates which exceed the limit.

Thickness gauge	09900-20803

Service limit	0.1 mm (0.004 in)



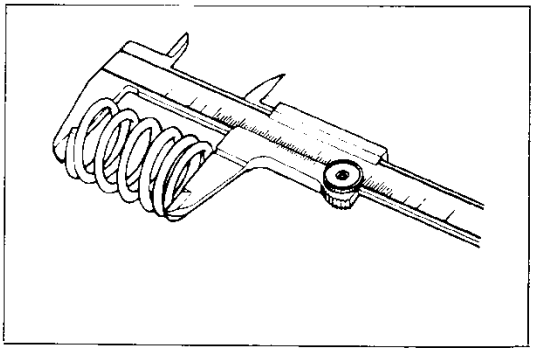
Checking distortion

CLUTCH SPRING FREE LENGTH

Measure the free length of each coil spring with a vernier calipers, and determine the elastic strength of each. Replace any spring not within the limit.

Vernier calipers	09900-20101

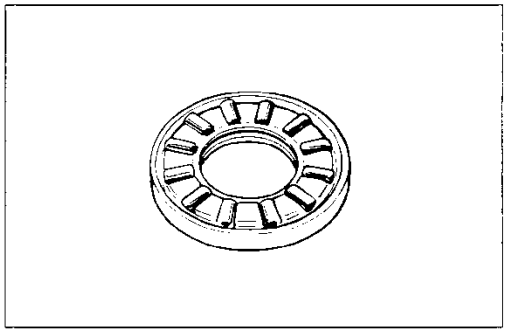
Service limit	34.0 mm (1.34 in)



CLUTCH RELEASE BEARING

Inspect the release bearing for any abnormality, particularly cracks, to decide whether it can be reused or should be replaced.

Smooth engagement and disengagement of the clutch depends much on the condition of this bearing.



SHIFTING FORK AND GEAR

Using a thickness gauge, check the shifting fork clearance in the groove of its gear. If the clearance limit is exceeded by any of the three gears, determine whether the gear or the gear shifting fork should be replaced by measuring the thickness and groove width.

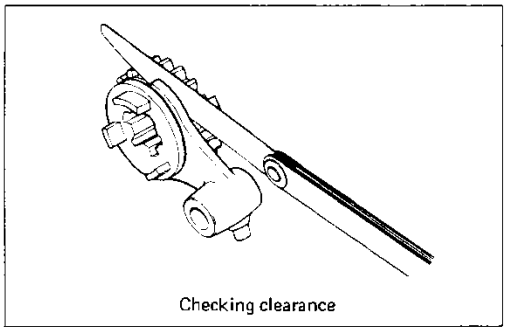
Thickness gauge	09900-20803

Vernier calipers	09900-20101

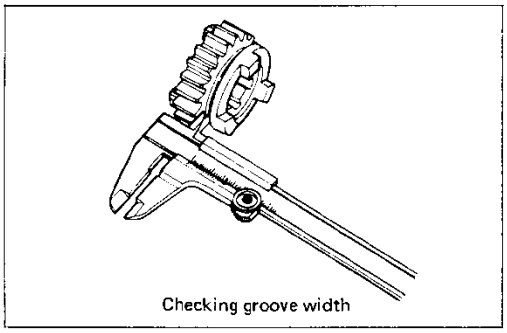
Item	Standard	Limit
Shifting fork to groove clearance	0.20 – 0.40 mm (0.008 – 0.016 in)	0.60 mm (0.023 in)

Shifting fork groove width	
Standard	4.25 – 4.35 mm (0.167 – 0.171 in)

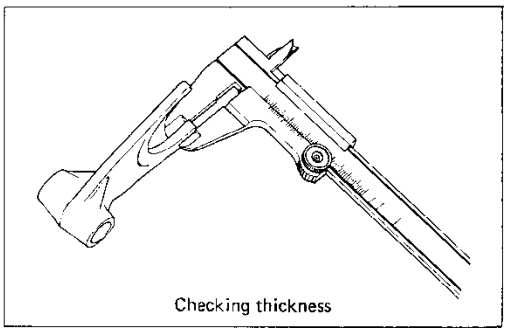
Shifting fork thickness	
Standard	3.95 – 4.05 mm (0.156 – 0.159 in)



Checking clearance



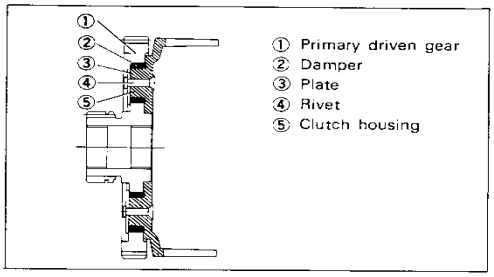
Checking groove width



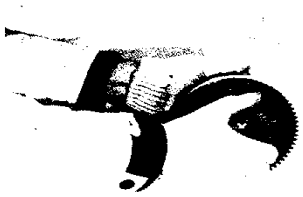
Checking thickness

PRIMARY DRIVEN GEAR

Primary driven gear is composed as shown.



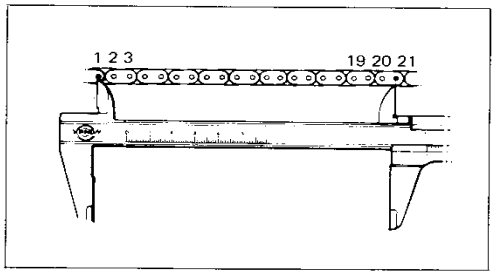
If the internal damper wears, play is generated between gear and housing, causing abnormal noise. If the play is extreme, replace the primary driven gear ass'y with a new one.



CAM CHAIN 20-PITCH LENGTH

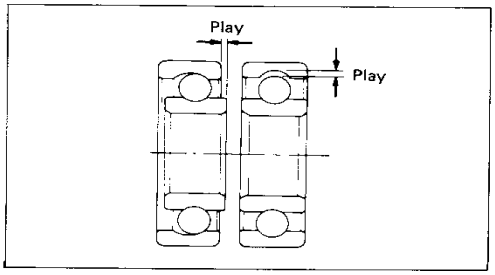
Pull the chain tight to remove any slack, then using vernier calipers, measure the 20-pitch (21 pins) length of cam chain. If it measures more than the limit, replace the cam chain.

Service limit	128.90 mm (5.075 in)



CRANKCASE BEARING

Inspect the play of crankcase bearing inner race by hand while fixing it in the case.
Rotate the inner race by hand to inspect for an abnormal noise and a smooth rotation. Replace the bearing if there is something unusual.

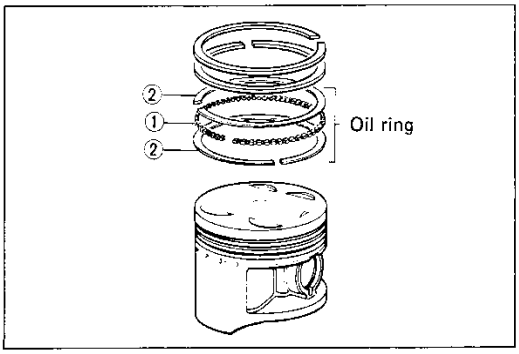


3.4. Assembling electrical and mechanical aggregates

3.4.1. Upper end components reassembly

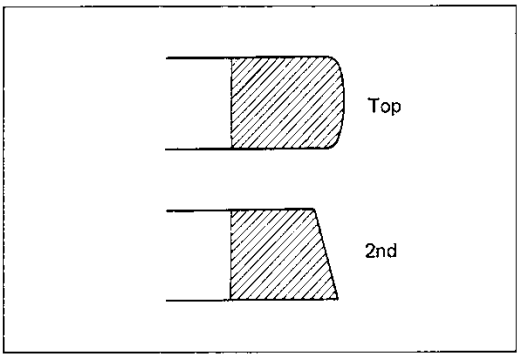
OIL RING

Install spacer ① into the bottom ring groove first. Then install both side rails ②, one on each side of the spacer. The spacer and side rails do not have a specific top or bottom when they are new. When reassembling used parts, install them in their original place and direction.

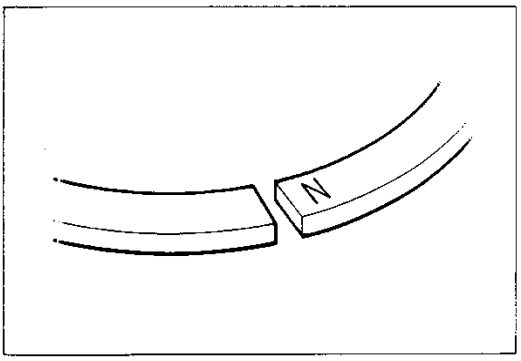


TOP RING AND 2ND RING

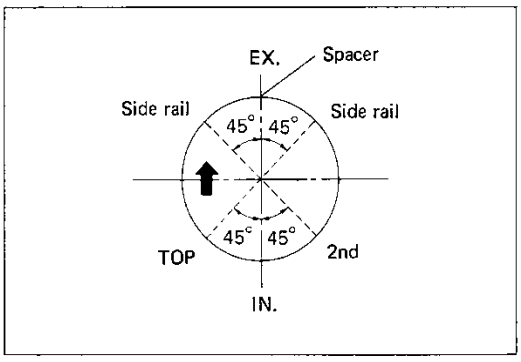
Top ring and 2nd ring differ in the shape of ring face and the face of top ring is chrome-plated whereas that of 2nd ring is not. The color of 2nd ring appears darker than that of the top one.



Top and 2nd rings have the letter "N" or "R" marked on the top. Be sure to bring the marked side to the top when fitting them to the piston.



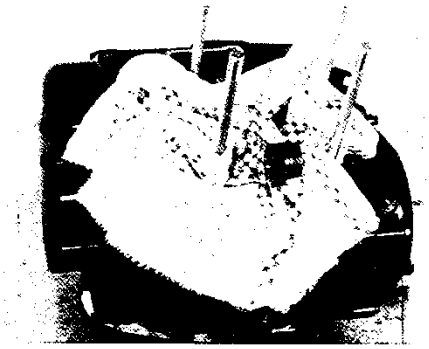
Position the gaps of the three rings as shown.
Before inserting piston into the cylinder, check that the gaps are so located.



PISTON

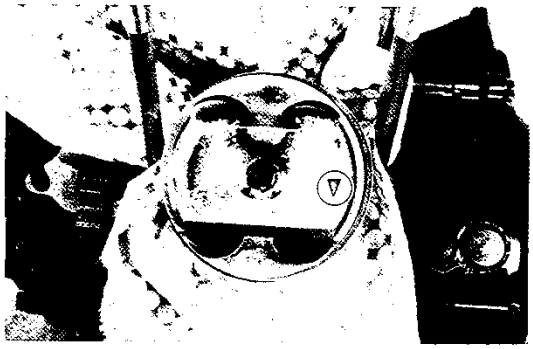
The following are reminders for piston installation:

- Rub a small quantity of SUZUKI MOLY PASTE onto the piston pin.
- Place a clean rag over the cylinder base to prevent piston pin circlip from dropping into crankcase, and then fit the piston pin circlip with long-nose pliers.



CAUTION:
Use a new piston pin circlip to prevent circlip failure which will occur with a bent one.

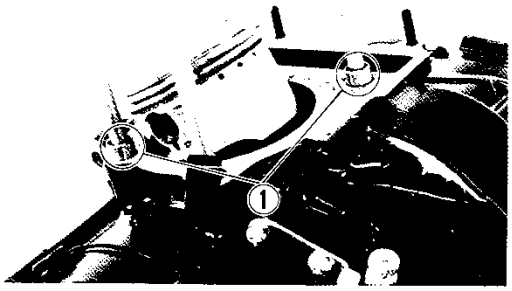
- When fitting the piston, face the triangle mark on the piston head to exhaust side.



CYLINDER

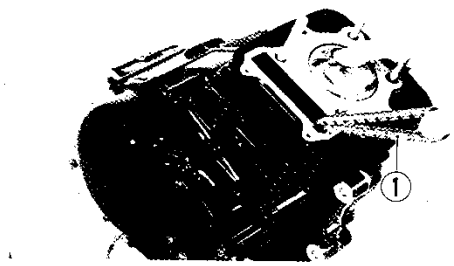
Before mounting the cylinder block, oil the big end and small end of the conrod and also the sliding surface of the piston.

- Fit dowel pins ① to crankcase and then fit gasket.



CAUTION:
To prevent oil leakage, do not use the old gasket again, always use new one.

- Hold each piston ring with the piston ring sections properly positioned and insert them into the cylinder.
  Check to insure that the piston rings are properly inserted into the cylinder skirt.



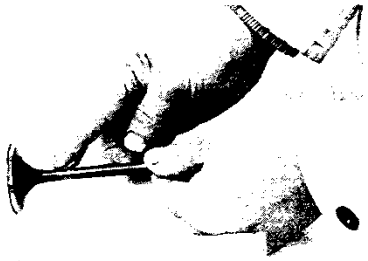
NOTE:
When mounting the cylinder, after attaching camshaft drive chain ①, keep the camshaft drive chain taut. The camshaft drive chain must not be caught between cam drive chain sprocket and crankcase when crankshaft is rotated.

NOTE:
There is a holder for the bottom end of the cam chain guide cast in the crankcase. Be sure that the guide is inserted properly or binding of the cam chain and guide may result.

VALVE AND SPRING

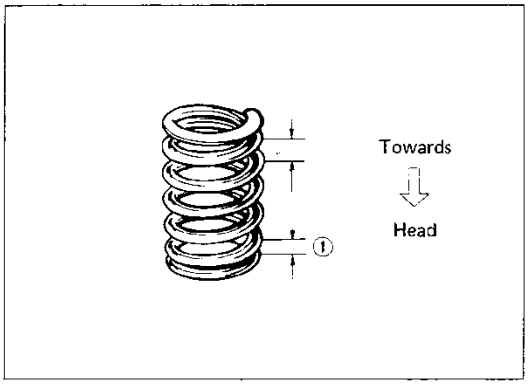
- Insert the valves, with their stems coated with (SUZUKI MOLY PASTE) all around and along the full stem length without any break.
  Similarly oil the lip of the stem seal.

Suzuki moly paste	99000-25140

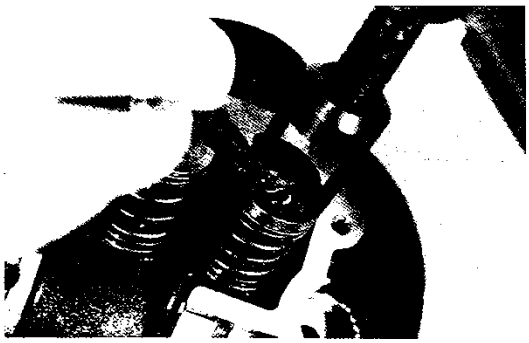


CAUTION:
When inserting each valve, take care not to damage the lip of the stem seal.

- Install valve springs, making sure that the close-pitch end ① of each spring goes in first to rest on the head. The coil pitch decreases from top to bottom, as shown below.

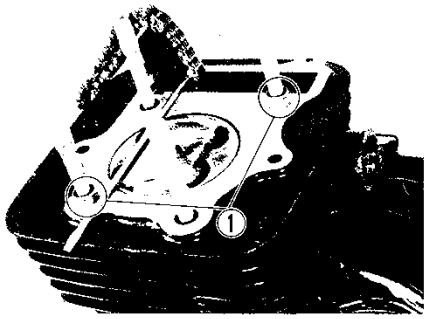


- Fit valve spring retainer, compress spring with a valve lifter and insert cotters.



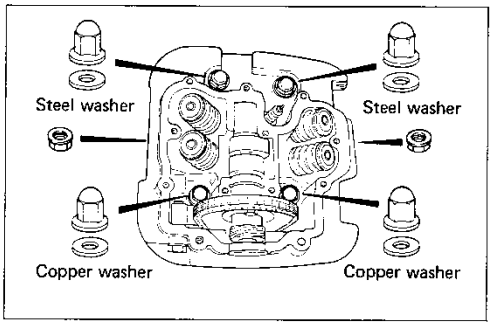
CYLINDER HEAD

- Fit dowel pins ① to cylinder head and then, attach new gasket to cylinder head.



CAUTION:
Use a new cylinder head gasket to prevent oil leakage. Do not use the old gasket.

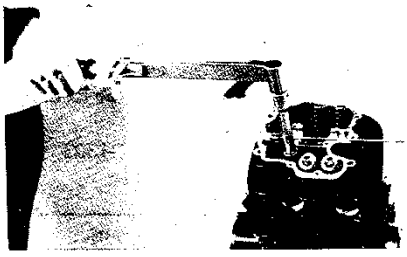
- Copper washers and cap nuts are used to secure the cylinder head. These parts must be fitted in the correct position.



- With the head snugly seated on the cylinder, secure it by tightening the nuts diagonally. Tighten each nut to the torque value specified below:

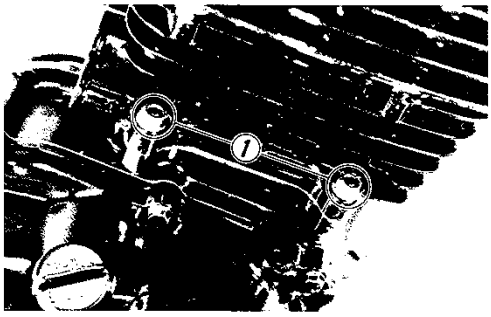
Cylinder head nuts tightening torque

10 mm Diam.	35 – 40 N·m (3.5 – 4.0 kg-m) (25.5 – 29.0 lb-ft)
6 mm Diam.	7 – 11 N·m (0.7 – 1.1 kg-m) (5.0 – 8.0 lb-ft)



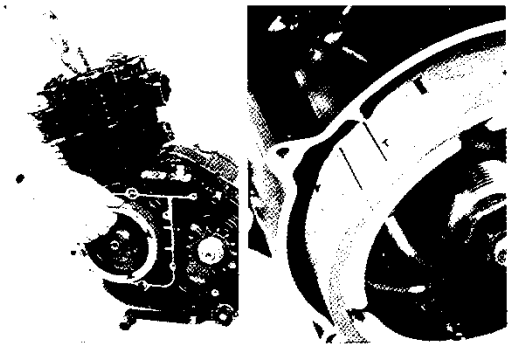
- After tightening the cylinder head nuts to the specified torque, tighten the cylinder base nuts ①.

Cylinder base nuts tightening torque	7 – 11 N·m (0.7 – 1.1 kg-m) (5.0 – 8.0 lb-ft)



CAMSHAFT

- Align "T" mark on magneto rotor with the index mark on the crankcase keeping the camshaft drive chain pulled upward.



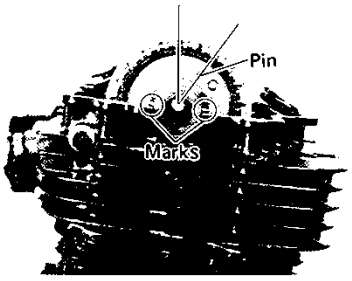
NOTE:
If the crankshaft is turned without drawing the camshaft drive chain upward, the chain will be caught between crankcase and cam chain drive sprocket.

NOTE:
Apply grease on the cam sprocket locating pin and install the pin into the camshaft.

- Engage the chain on the cam sprocket with the locating pin hole at the one o'clock position.

NOTE:
Do not rotate magneto rotor while doing this. When the sprocket is not positioned correctly, turn the sprocket. When installing the camshaft into the cam sprocket, pay attention not to dislodge the locating pin or it may fall into the crankcase.

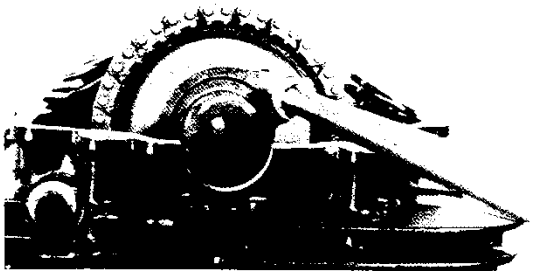
- Align the marks on the camshaft so it is parallel with the surface of the cylinder head.



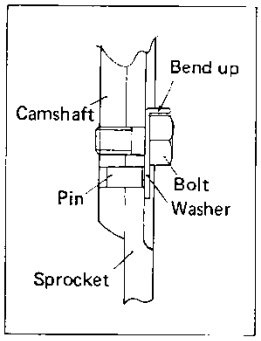
- Fit lock washer so that it is covering the locating pin.
- Apply THREAD LOCK SUPER "1303" to the bolts and tighten the cam sprocket.

Tightening torque	10 – 13 N·m (1.0 – 1.3 kg-m) (7.0 – 9.0 lb-ft)

Thread lock super "1303"	99000-32030



- Bend up the washer tongue positively to lock the bolts.



- Apply SUZUKI MOLY PASTE to the camshaft journal and place camshaft on cylinder head.

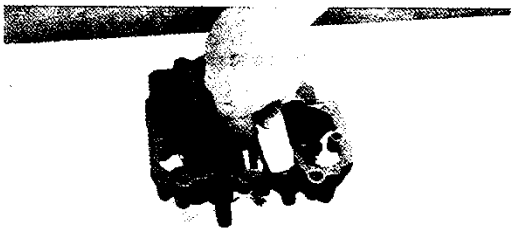
Suzuki moly paste	99000-25140

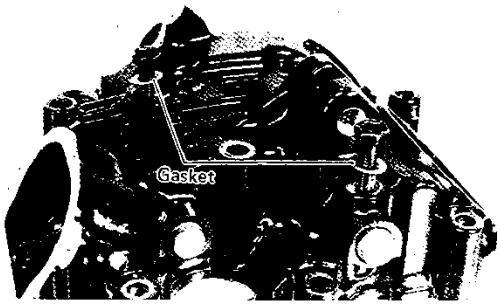
VALVE ROCKER ARM AND SHAFT

- Apply SUZUKI MOLY PASTE to the rocker arms and shafts.
- After inserting the shafts, tighten the set bolts.

NOTE:
Use a conically recessed top bolt to retain the shaft.

CAUTION:
* **Use a new O-ring on the rocker arm shafts to prevent oil leakage.**
* **Use a new gasket on the set bolts to prevent oil leakage.**





DE-COMPRESSION SHAFT

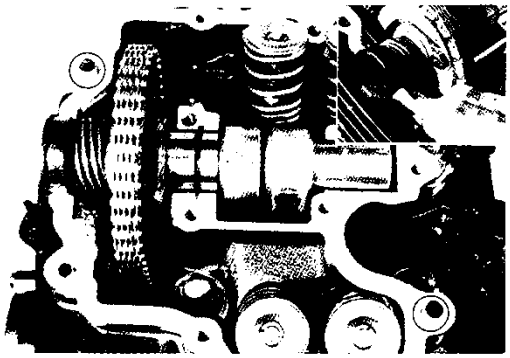
- Apply SUZUKI MOLY PASTE to the de-compression shaft, and then insert the de-compression shaft.

CYLINDER HEAD COVER

- Thoroughly wipe off oil from the fitting surfaces of cylinder head and cover.
- Fit the two dowel pins to the cylinder head side.
- Uniformly apply SUZUKI BOND No. 1207B to the cylinder head surface.

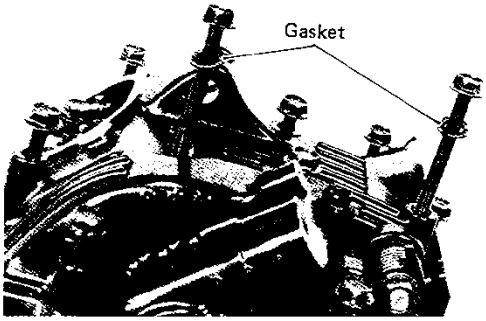
SUZUKI Bond No. 1207B	99104-31140

NOTE:
Do not apply SUZUKI BOND No. 1207B to the camshaft end cap.



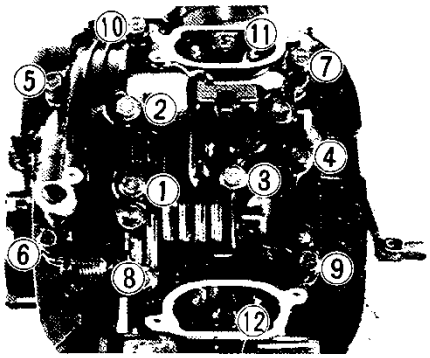
- Fit a gasket to each head cover bolt as shown in the illustration.

CAUTION:
To prevent oil leakage use only new gaskets.



- Lightly tighten the cylinder head cover bolts diagonally and then, if everything is satisfactory, tighten securely with a torque wrench to the specified torque.

Tightening torque	9 – 10 N·m (0.9 – 1.0 kg-m 6.5 – 7.0 lb-ft)

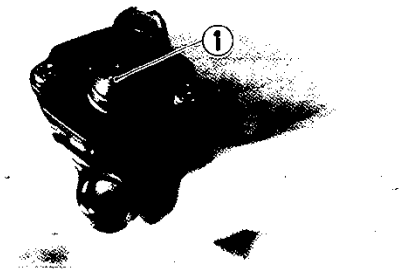


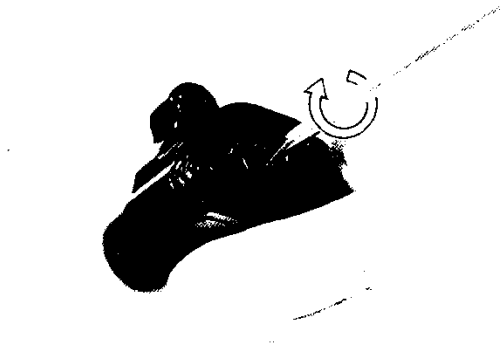
- After tightening the cylinder head cover bolts, insert the welch plug and tighten set screw.

CAM DRIVE CHAIN TENSIONER

Install cam drive chain tensioner following the procedure below.

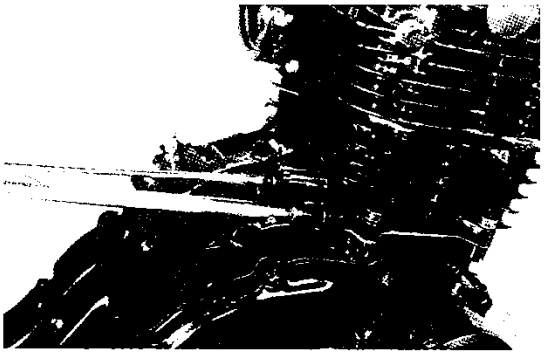
- Remove the cap ① and turn the slotted end of the cylinder shaft with a screw driver in the clockwise direction.





- Mount the chain tensioner on the cylinder.

"T" type hexagon wrench (5 mm)	09911-73730



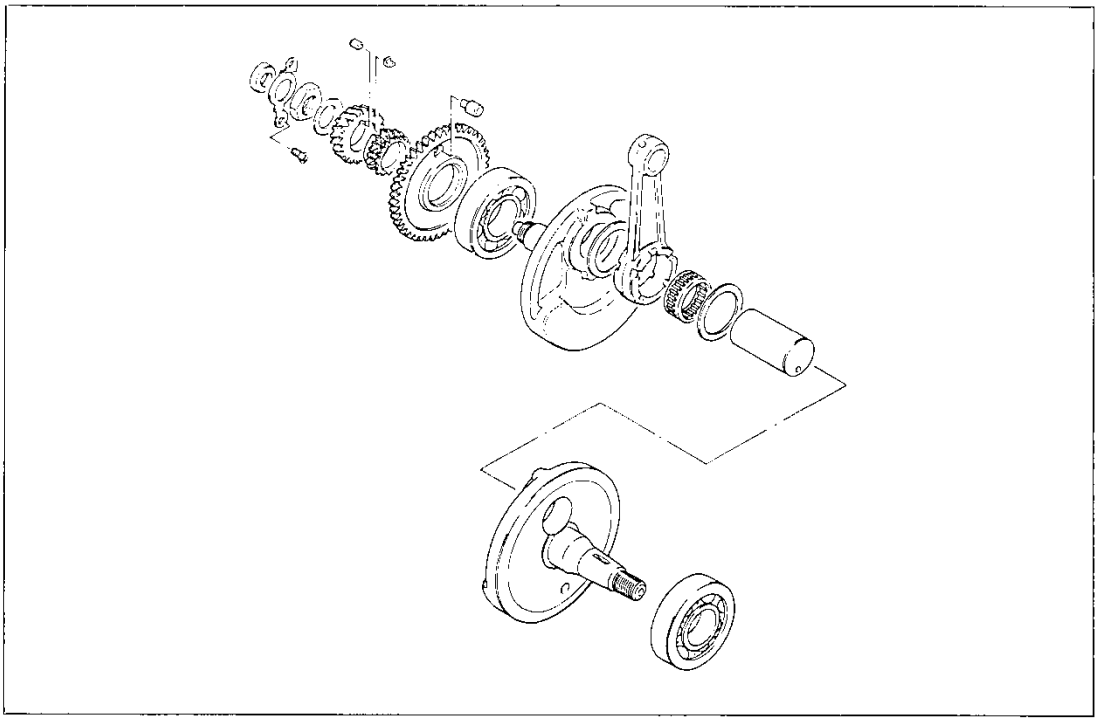
- Remove the screw driver from the cylinder shaft. As the spring tension forces the cylinder to rotate, the tensioner rod pushes the tensioner blade against the cam drive chain.

VALVE CLEARANCE

- After tightening the head cover bolts, check and adjust the valve clearance. Refer to page 2 – 6 for procedures.

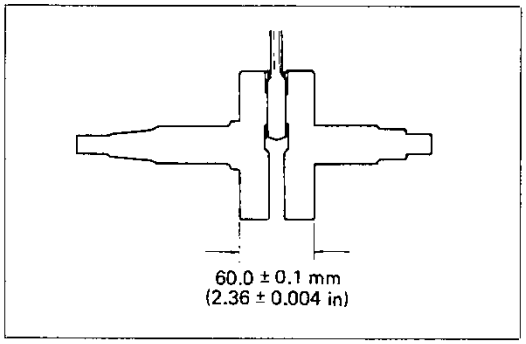
3.4.2. Lower end components reassembly

CRANKSHAFT



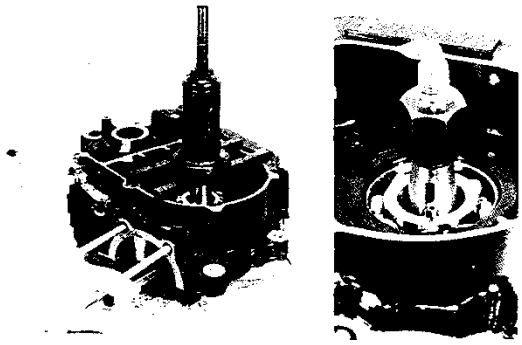
- Decide the width between the webs referring to the figure below when rebuilding the crankshaft.

STD width between webs	60.0 ± 0.1 mm (2.36 ± 0.004 in)

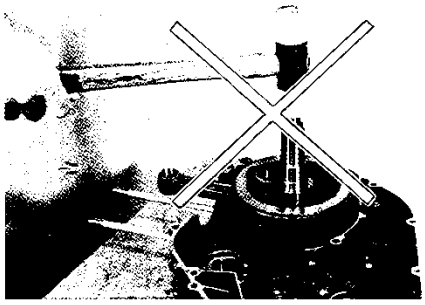


- When mounting the crankshaft in the crankcase, it is necessary to pull its left end into the crankcase.

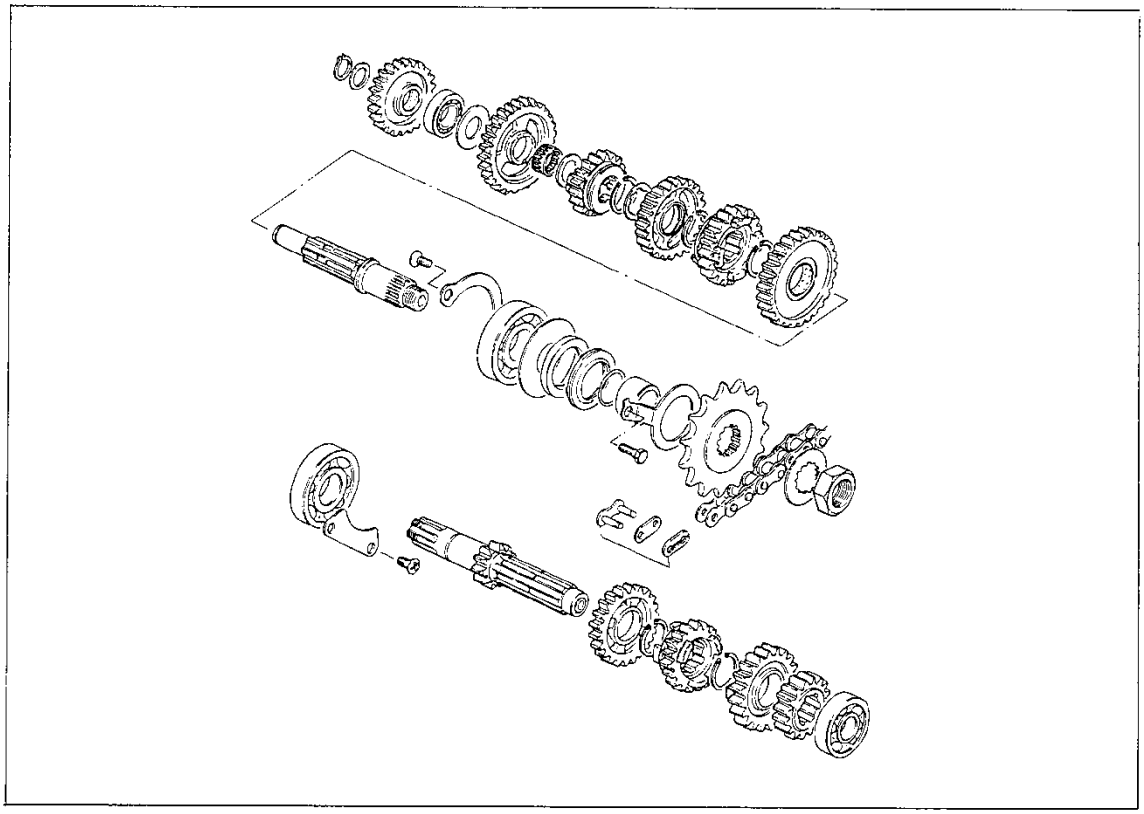
Crankshaft installer	09910-32812
Conrod holder	09910-20116
Attachment	09930-33710



CAUTION:
Never fit the crankshaft into the crankcase by striking it with a plastic hammer.
Always use the special tool, otherwise crankshaft alignment accuracy will be affected.

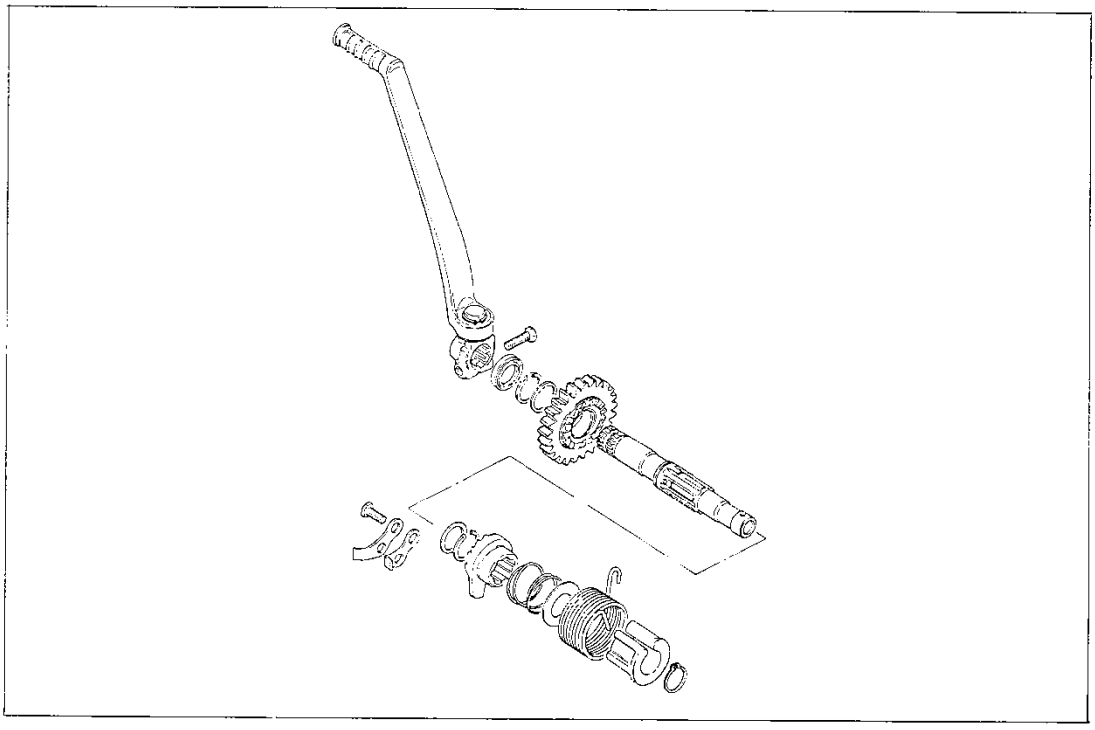


TRANSMISSION

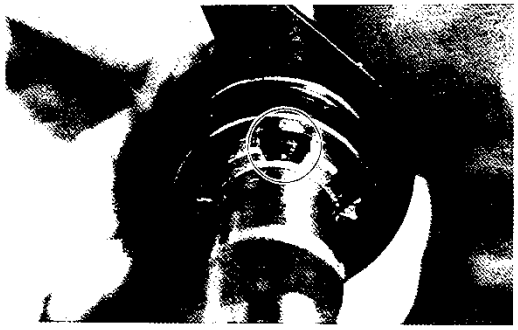


CAUTION:
* Never reuse a circlip. After a circlip has been removed from a shaft, it should be discarded and a new circlip must be installed.
* When installing a new circlip, care must be taken not to expand the end gap larger than required to slip the circlip over the shaft.
* After installing a circlip, always insure that it is completely seated in its groove and securely fitted.

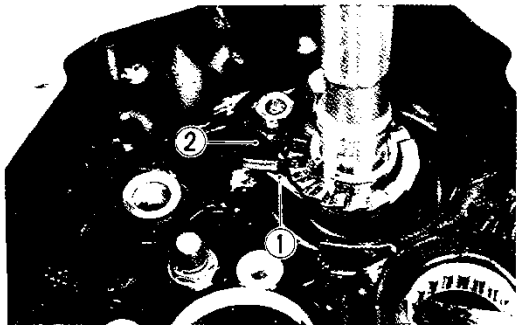
KICK STARTER



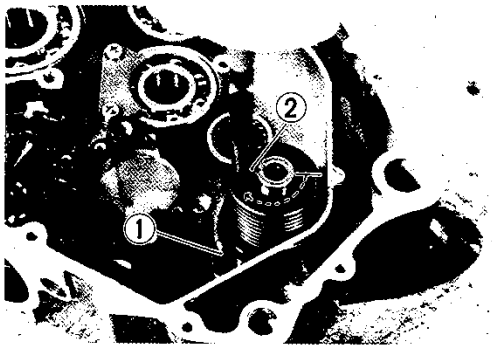
- When fitting the kick starter, be sure to align the punched marks.



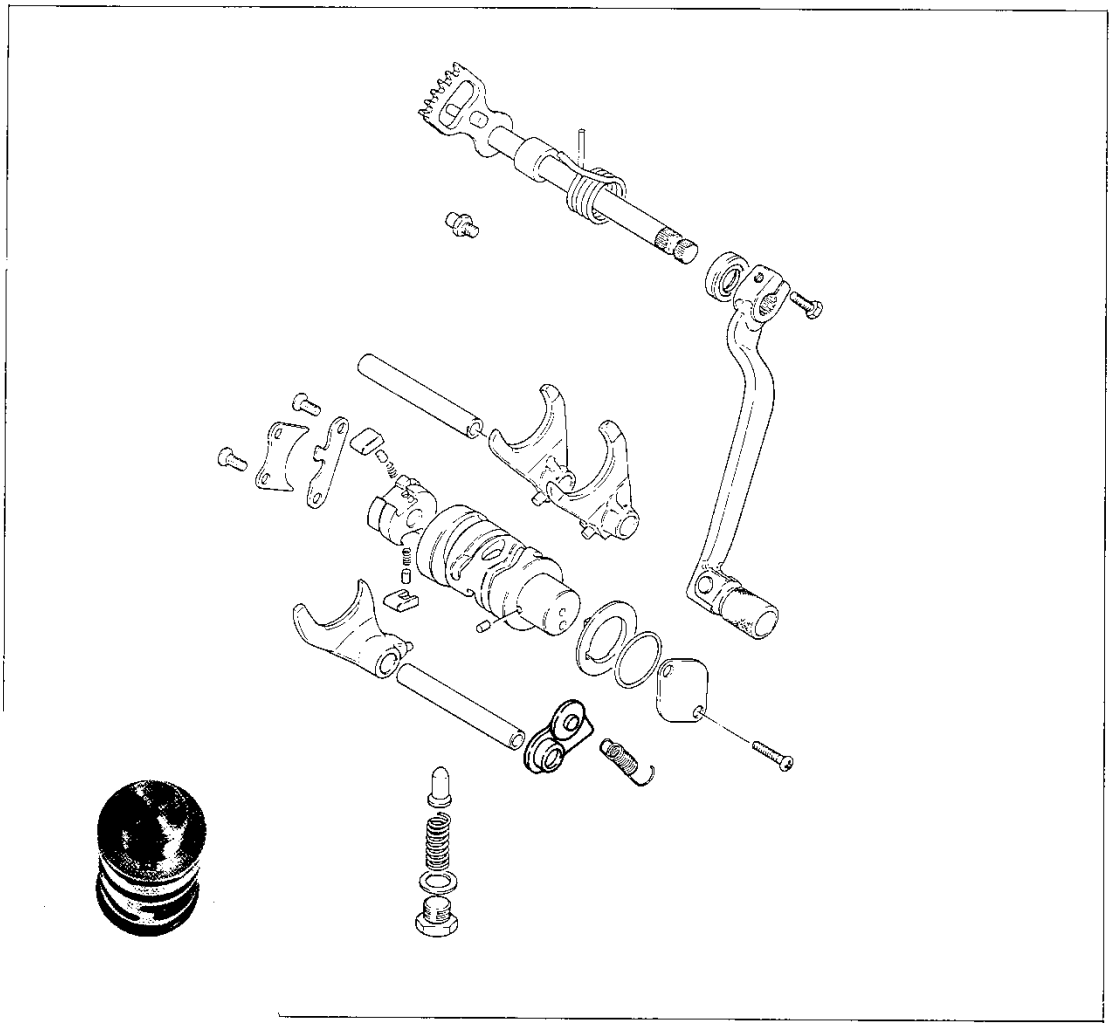
- Fit spring and washer. Then, insert the kick starter shaft into crankcase. Engage pawl (1) of kick starter on starter guide (2).



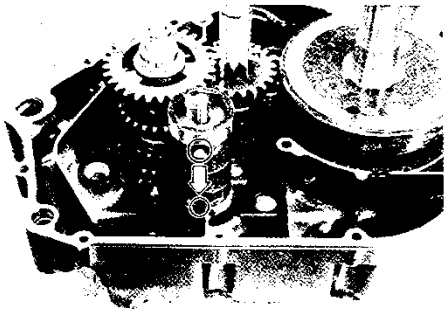
- When fitting kick return spring, hook part ① of return spring onto crankcase, turn it ½ a turn clockwise with pliers and fit part ② of return spring into hole of kick shaft. Then, fit spring guide and circlip.



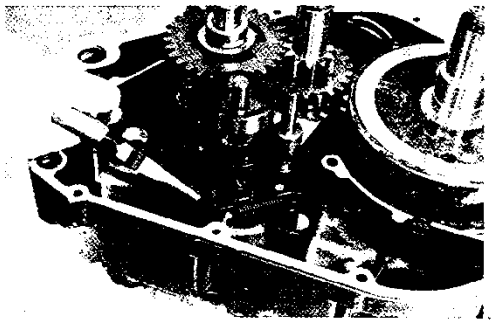
GEAR SHIFTING CAM AND FORK



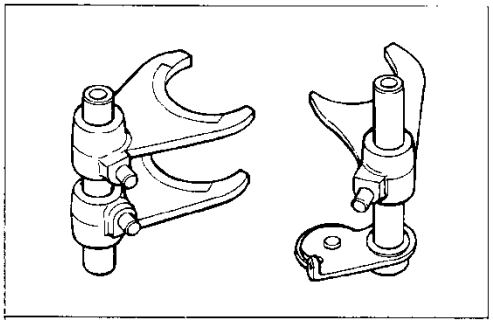
- Fit the gear shifting cam on the crankcase. Position the cam as shown in the illustration so that the gear shifting fork can be installed easily.



- After cam stopper and gear shifting forks have been fitted, hook cam stopper spring onto the crankcase.

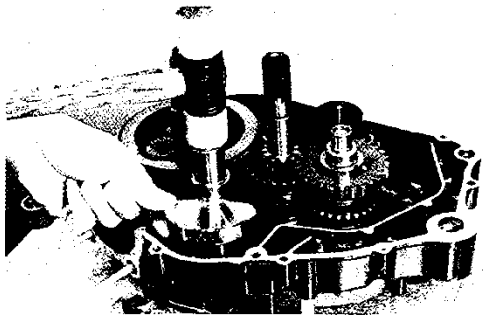


NOTE:
Three gear shifting forks are used. They resemble each other very closely in external appearance and configuration.
Carefully examine the illustration for correct installing positions and directions.

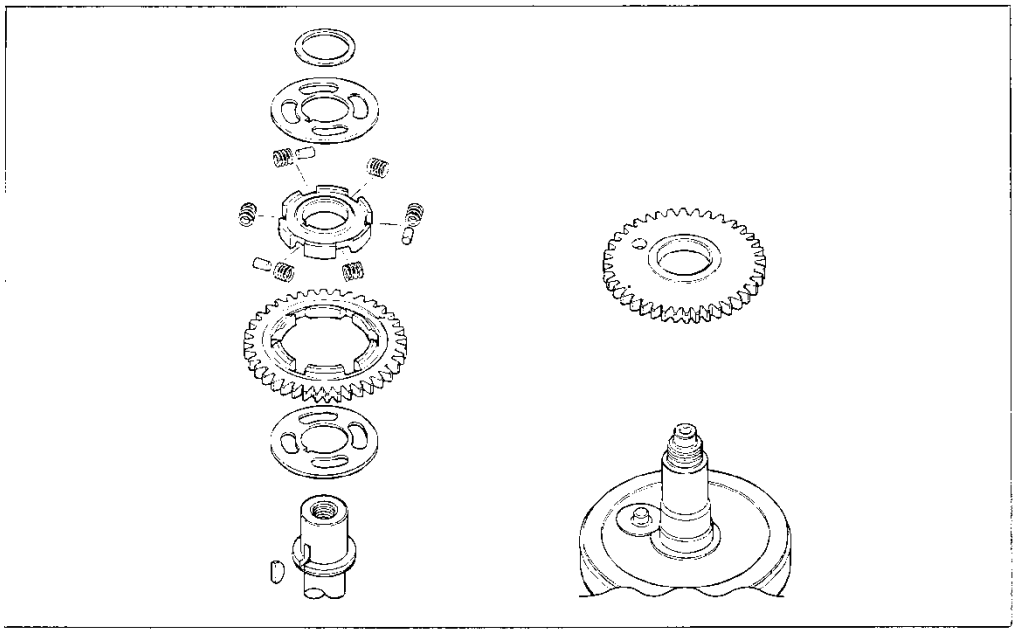


BALANCERSHAFT

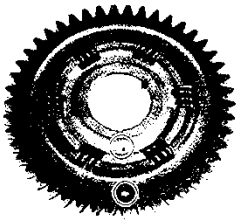
- Install the balancershaft into the left crankcase by plastic hammer, then fit the key.



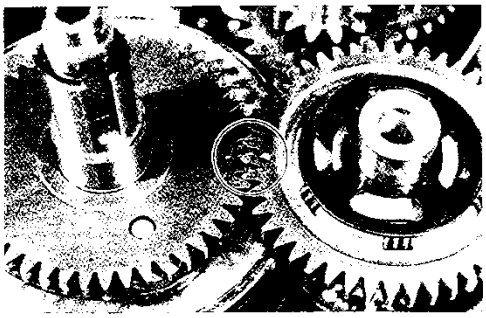
BALANCER DRIVE GEAR AND DRIVEN GEAR



- Align the punch mark shown on the driven gear with the punch mark shown on the inner race, then fit the damper springs and pins.
- Install the driven gear plates and driven gear ass'y onto the balancershaft.



- Install the drive gear onto the crankshaft, align the punch mark shown on the drive gear with the punch mark shown on the driven gear.



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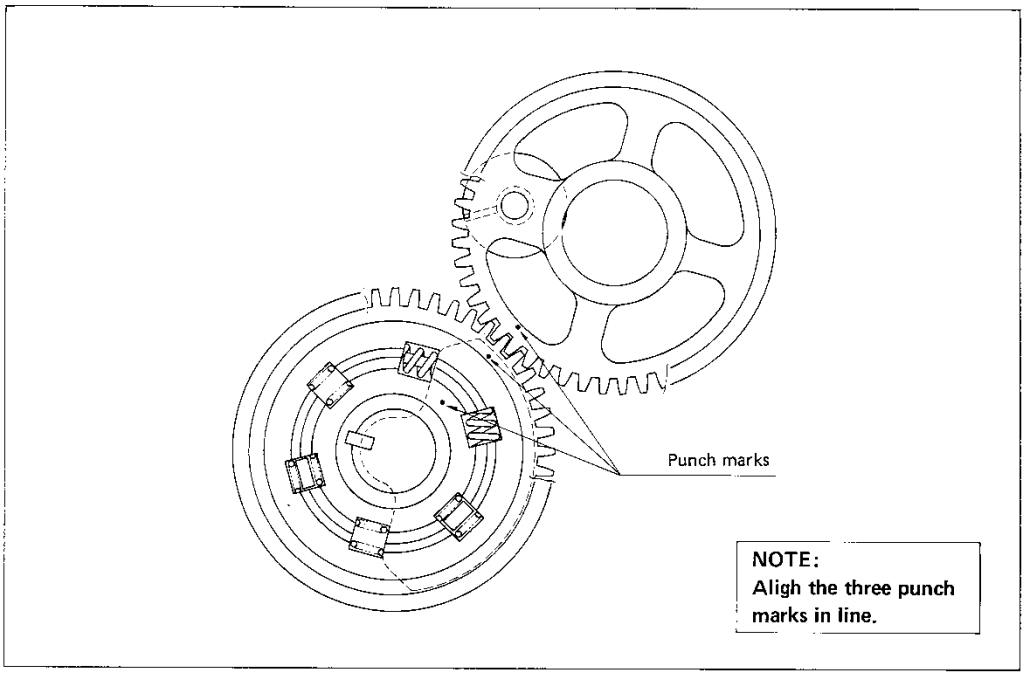
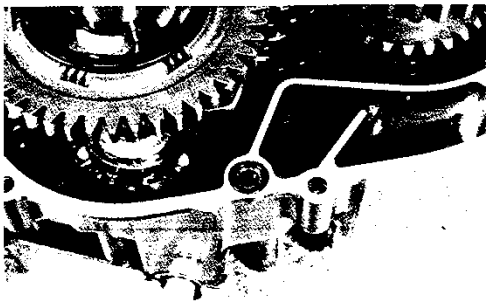
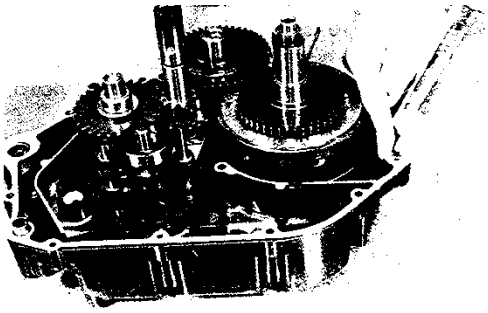


CRANKCASE

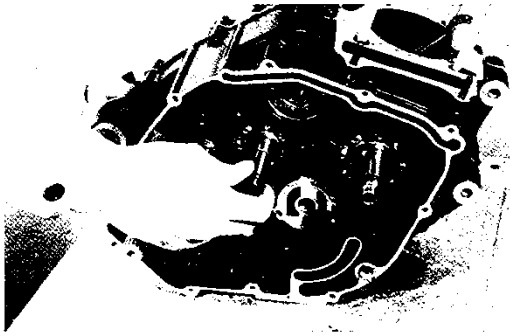
When reassembling the crankcase pay attention to the following.

- Coat SUPER GREASE "A" to the lip of oil seals.
- Remove sealant material on the fitting surfaces of right and left halves of crankcase and thoroughly remove oil stains.
- Fit dowel pins on the left half.
- Fit O-ring the left half as shown in Fig.
- Apply engine oil to the big end of the crankshaft conrod and all parts of the transmission gears.
- Apply SUZUKI BOND No. 1207B (99104-31140) uniformly to the fitting surface of the left half of the crankcase, and after waiting a few minutes, fit the right half on the left half.

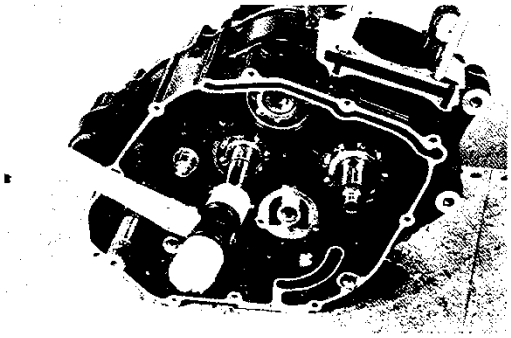




- After the crankcase bolts have been tightened, check if driveshaft and countershaft rotate smoothly.

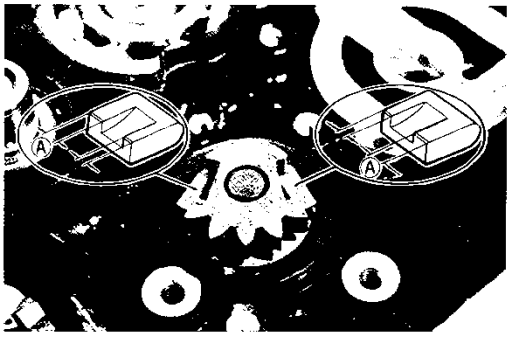


- If a large resistance is felt to rotation, try to free the shafts by tapping the driveshaft or countershaft with a plastic hammer as shown in Fig.



GEAR SHIFTING CAM DRIVEN GEAR

When installing the gear shifting pawls into the cam driven gear. The large shoulder Ⓐ must face to the outside.

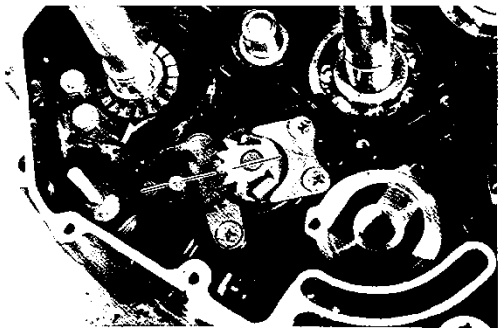


- Next, install cam guide and pawl lifter. Apply a small quantity of THREAD LOCK "1342" to the threaded parts of the securing screws.

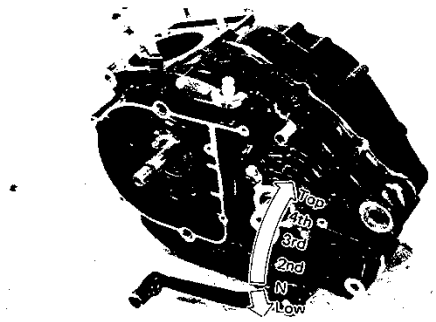
Thread lock "1342"	99000-32050

GEAR SHIFTING SHAFT

- Install the gear shifting shaft. Match the center teeth of the gear on the shifting shaft with the center teeth on the shifting driven gear as shown.



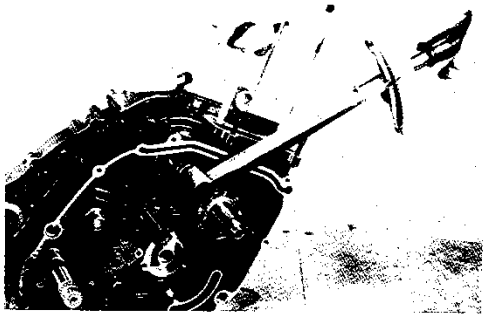
NOTE:
After the cam driven gear, cam guide, gear shifting shaft and neutral cam stopper have been fitted, confirm that gear change is normal while turning the countershaft and driveshaft. If gear change is not obtained, it means that assembly of gears or installation of gear shifting fork is incorrect. If this is the case, disassemble and trace the mistake.



BALANCER

- Tighten balancer setting bolt to the specified torque.

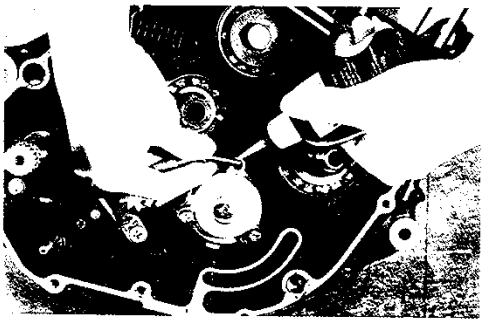
Tightening torque	34 – 45 N·m (3.4 – 4.5 kg-m 24.5 – 32.5 lb-ft)



OIL PUMP

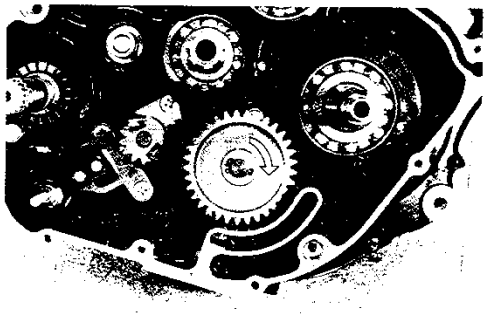
- Before mounting the oil pump, apply engine oil to the sliding surfaces of the case, outer rotor, inner rotor and shaft.
- Apply a small quantity of THREAD LOCK "1342" to the threaded parts of oil pump mounting screws.

Thread lock "1342"	99000-32050



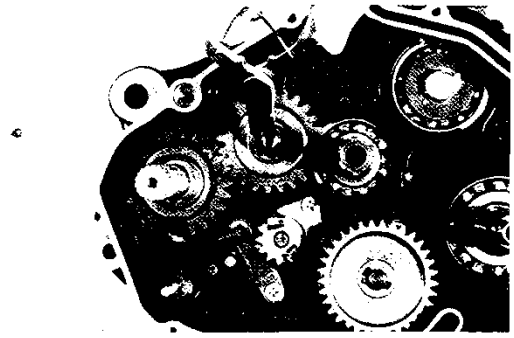
- Tighten the oil pump mounting screws.

NOTE:
After mounting the oil pump in the crankcase, rotate the pump gear by hand to see if it turns smoothly.



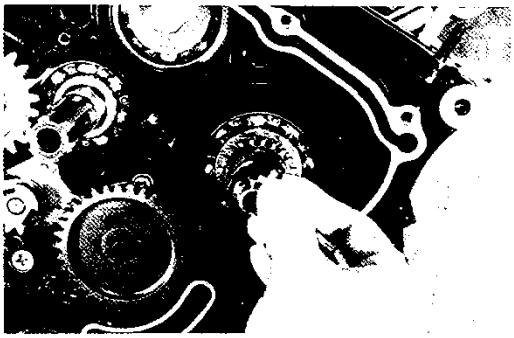
KICK STARTER DRIVE GEAR AND IDLE GEAR

- Install the kick idle gear and drive gear.

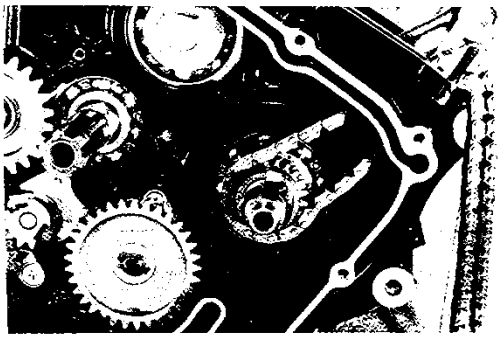


CHAIN DRIVE SPROCKET

- Install the sprocket and fit the keys.



- Engage the chain on the sprocket.



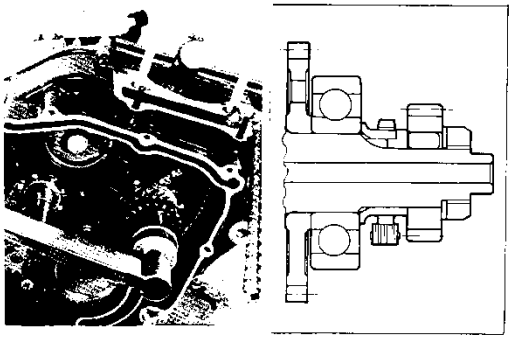
PRIMARY DRIVE GEAR

- Install the primary drive gear and wave washer, and tighten it with a torque wrench to the specified torque.

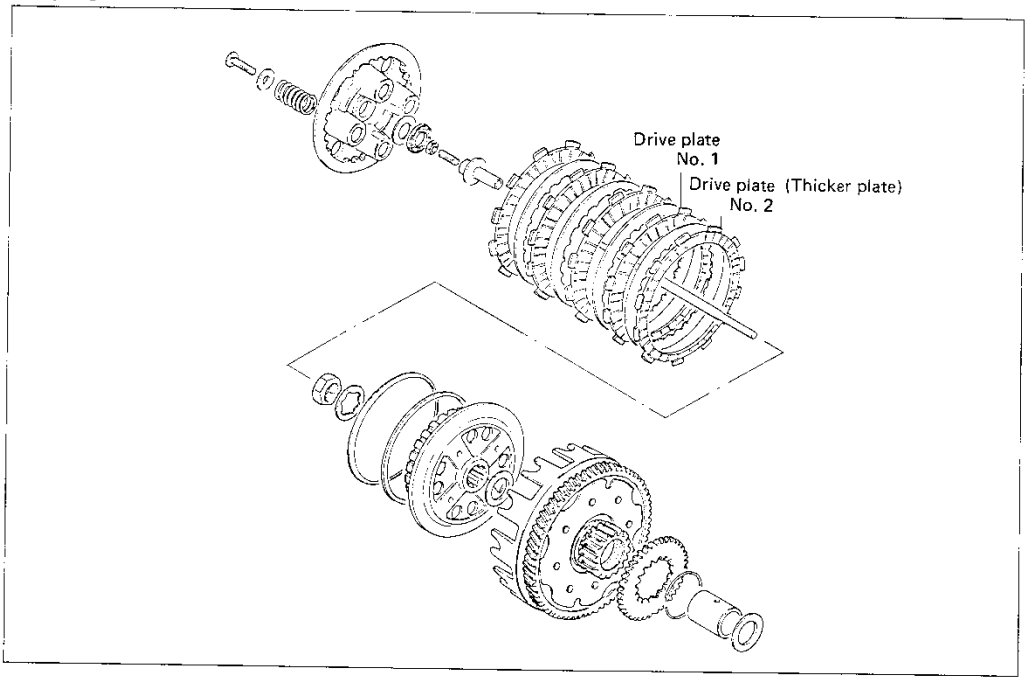
Conrod holder	09910-20116

NOTE:
This is a left-hand thread nut.

Tightening torque	90 – 110 N·m (9.0 – 11.0 kg-m 65.0 – 79.5 lb-ft)



CLUTCH



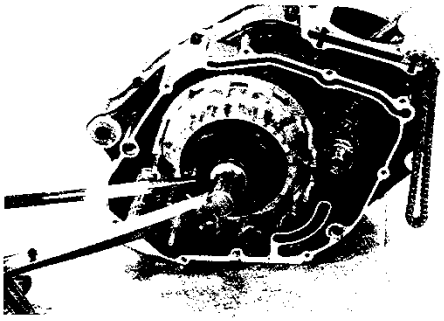
Assemble the clutch, in the reverse order of disassembly. Pay attention to the following points.

- When inserting spacer on countershaft, apply a small quantity of engine oil to both inside and outside of the spacer.
- Tighten clutch sleeve hub nut using the special tool to the specified torque.

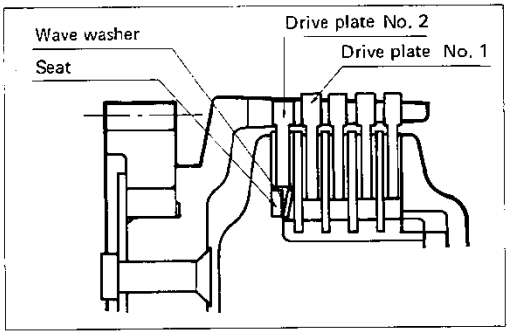
Clutch sleeve hub holder	09920-53721

Tightening torque	40 – 60 N·m (4.0 – 6.0 kg-m 29.0 – 43.5 lb-ft)

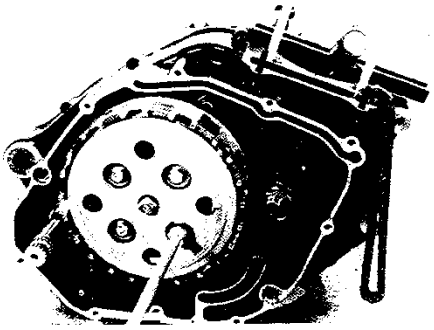
- Be sure to lock the nut by firmly bending the tongue of the washer.



- Install wave washer seat, wave washer, drive plates and driven plates to the sleeve hub.
- Insert push rod into the countershaft.

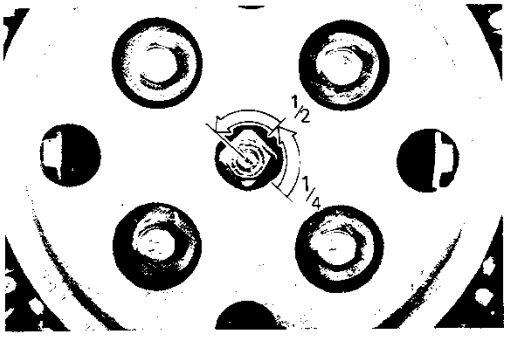


- Tighten clutch spring bolts diagonally.



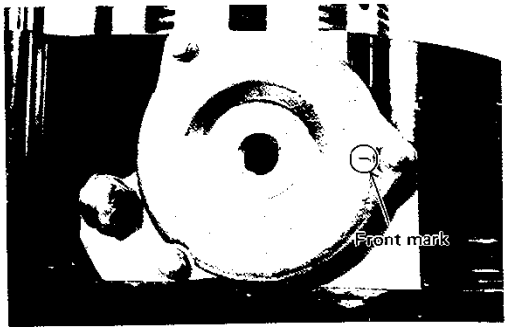
Clutch release screw adjustment

- Loosen the lock nut, and turn in the release screw to feel high resistance.
- From that position, turn out the release screw ¼ – ½ turn, and tighten the lock nut.



OIL SUMP FILTER

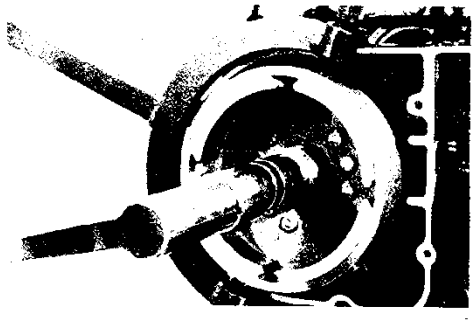
- Wash the sump filter with cleaning solvent, and then blow compressed air through it to dry off solvent.
- After mounting the sump filter, fit the cap and tighten it.



MAGNETO ROTOR

- Fit key in the key slot on the crankshaft.
- Install the magneto rotor.
- Apply a small quantity of THREAD LOCK SUPER "1303" to the threaded parts of crankshaft.
- Tighten magneto rotor nut to the specified torque.

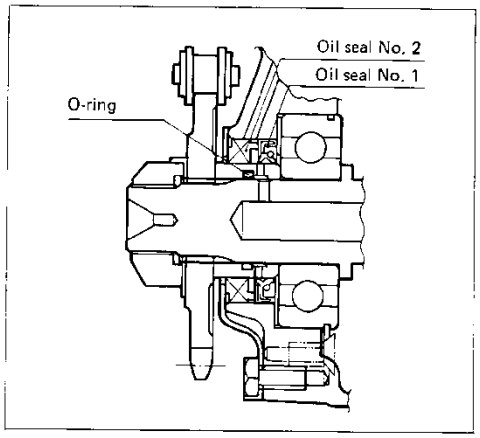
Thread lock super "1303"	99000-32030
Rotor holder	09930-44911
Tightening torque	95 – 100 N·m (9.5 – 10.0 kg-m, 68.5 – 72.5 lb-ft)



DRIVESHAFT OIL SEAL AND ENGINE SPROCKET

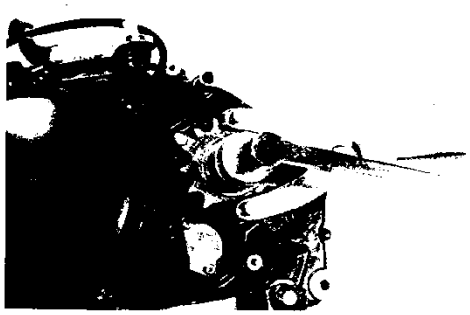
CAUTION:
* Always replace the driveshaft oil seal with a new one every disassembly to prevent oil leakage. Also grease the oil seal lip. On installation, refer to Fig. for correct positions and directions.
* Replace "O" ring with a new one every disassembly.

NOTE:
After reassembling the LOWER END COMPONENTS, install the O-ring and spacer.



- Tighten the engine sprocket nut to the specified torque and bend up the washer.

Tightening torque	80 – 100 N·m (8.0 – 10.0 kg-m, 58.0 - 72.5 lb-ft)



ENGINE REMOUNTING

The engine can be mounted in the reverse order of removal.

- Temporarily fasten the engine mounting bracket before inserting the engine mounting bolts.

> **NOTE:**
> **The engine mounting nuts are self-lock nuts. Once the nut has been removed, it is no longer of any use. Be sure to use new nuts and tighten them to the specified torque.**

Tightening torque for engine mounting bolts

Tightening torque	37 – 45 N·m (3.7 – 4.5 kg-m, 27.0 – 32.5 lb-ft)

- Tightening the exhaust pipe bolts and muffler clamp to specified torque.

Tightening Torque	9 – 12 N·m (0.9 – 1.2 kg-m, 6.5 – 8.5 lb-ft)

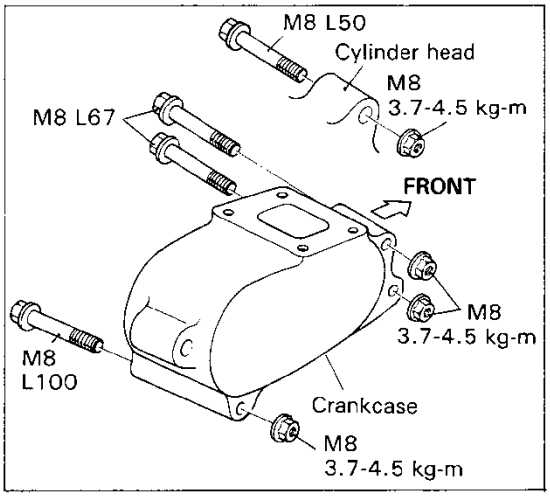
- Pour 1.7 L (1.8/1.5 US/Imp qt) of engine oil SAE 10W/40 graded SE or SF into the engine after overhauling engine.
- Start up the engine and allow it run for several seconds at idle speed. About one minute after stopping engine, check oil level.
  If the level is below the "F" mark, add oil until the level reaches the "F" mark.

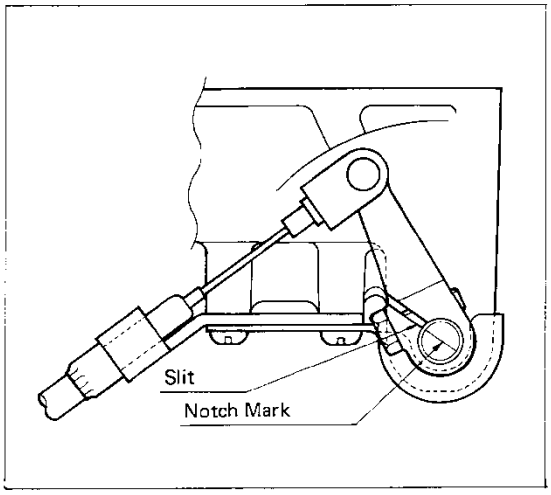
Installing position for clutch release arm

- Align the release arm slit surface with the notch mark on the release cam shaft.

- After remounting the engine, following adjustments are necessary.

*	Throttle cable	(Page: 4 – 9)
*	Clutch cable	(Page: 2 – 10)
*	De-compression cable	(Page: 2 – 7)
*	Drive chain	(Page: 2 – 12)
*	Rear brake pedal	(Page: 2 – 11)
*	Idling speed	(Page: 2 – 9)





After the engine mount, check the following activity

- ✓ **Check fluid levels** for the brake, clutch, coolant and engine oil via sight windows or dipsticks. Your manual will show you where to find each and how to top them up.
- ✓ **Checking the engine oil level** is as straightforward as removing the dipstick or checking the sight glass. A warm engine will give a better indication of oil level- make sure bike is level.
- ✓ **Check brake pads for thickness/wear-** Look at the thinnest/ most worn area.
- ✓ **Inspect chain:** Cleaning the chain is a great way to inspect it too. See below for more details.
- ✓ **Check filters**, especially air filter, which can get choked up. Oil filters are generally changed when oil is changed.
- ✓ **Inspect cables**; they should be well attached and not coming loose anywhere.
- ✓ **Check pivot points and moving parts:** Do they need greasing? These include kickstand, swinging arms and bearings.
- ✓ **Check battery**-Check terminals for corrosion, check connections are secure and check levels if it's been stood for a while.
- ✓ **Check nuts, bolts and screws:** Check regularly to ensure nothing needs to be tightened up. This includes handlebars, mirrors, mudguards, luggage racks, wheel nuts, panels and anything else that uses fasteners.
- ✓ **Check on the tire:** Apart from pressure, look for tread depth and examine the rubber for

3.5 Proper Maintenance two and three wheeler

Proper maintenance involves four basic activities:

- The inspection of components for wear or damage
- Changing oils (and other fluids)
- Replacing certain components (such as filters
- Adjusting mechanisms to compensate for wear and tear.

1. The inspection of components for wear or damage

A motorcycle or three-wheeler needs to be inspected or checked regularly in order to ensure it remains safe and efficient to use at all times. Things break or wear out and they need to be identified and the necessary action taken. The rider should conduct basic pre-ride inspections

each day to ensure everything operates correctly, wear and tear is monitored and parts are replaced at the appropriate time. An inspection only takes a few minutes and should be conducted daily. Table 1 provides guidance on carrying out daily inspections.

Area of Inspection	
Fuel	Ensure there is enough fuel for planned distance of travel. Also check whether there is any fuel leakage from the fuel lines.
Tyres	Check for and remove foreign material lodged in the tyres. The tyre tread on each wheel should be the depth of at least 2 mm. Check that the tyres' air pressure is correct as recommended in the vehicle manual.
Wheels	Ensure that the axle nuts are in place and properly secured and that the cotter pin is in place.
Cables and Controls	The throttle cable should have play of 3-4 mm. Confirm that the throttle is fully functional and do the same with the gear shift pedal.
Lights & Mirrors (Incl. turning signals)	Check these are in good working condition and positioned correctly.
Engine oil	The engine oil level should be checked, and the engine inspected for leakages and general condition.
Suspension	Suspension should be functional to ensure a smooth ride for rider and passenger, make adjustments if necessary and check for leaks.
Stands	Check that the stand retracts securely, that the cut-out switch operates and that the spring is intact.
Brakes	Check there is wheel movement when the brake lever is fully pulled in or depressed. The brake fluid level should be as per recommended in the vehicle manual. There should be 15-20 mm play on the brake pedal. Also check that the brakes are binding.
Drive Chain	Ensure that the drive chain is slack (25-30 mm) and is well lubricated.
Battery	The terminals should be clean and the cables tight. The battery must be secure and the vent tube clear.
Clutch	Clutch lever play should be 2-3 mm, and the clutch fluids level should be checked.
Steering	Ensure that the steering is fully functional and aligned correctly.

1. Changing Oils (and other fluids)

Engine oil performs the following functions:

Reduces friction Cleans the moving components to remove carbon, dirt and dust

Cools moving components

Provides a seal between piston rings and cylinder walls Coats the components with residue oil to prevent rust. Oil deteriorates over a period of time; therefore it is very important to change the oil as per the manufacturer's recommendations. As a guide, engine oil should be changed every 5,000 km travelled.

2. Component Replacement

Replacing certain components should be done in accordance with the manufacturer's recommendations. These components are to be replaced before failure in order to enhance

safety. For example, oil filters should be replaced after every 5,000 km and fuel pipes replaced after every 10,000 km.

3. Adjustment of Mechanisms

Adjustment of mechanisms is performed in order to compensate for wear. Examples of mechanisms that need regular adjustment are brakes and the clutch. As pads are worn down there needs to be adjustment to account for this wear. Without adjustment, the brakes and clutch will cease to operate effectively and so the vehicle will become unsafe and dangerous to use. However making adjustments will only go so far. Once the mechanisms parts, such as brake pads and discs, have worn down to near minimum levels then replacement is required

Self-check- 3.1

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1: Say true or false for the following questions.

1. _____ The automotive service technician first obtains a description of the problem from the owner writing an estimate (3 point)

2: Give short answer for the following questions.

1. Write the nature and scope of work to remove and tag components? (5 points)_____
   _____

Operation Sheet: 3.1

Operation Title: Cleaning the spark plug

Instruction:

- ✓ Safe working area
- ✓ Properly operated tools and equipment
- ✓ Appropriate working cloths fit with the body

Purpose: Ensure a correct inspection to check condition of suspension systems

Required tools and equipment: Work area, spark plug wrench, wire brush,

Consumable Materials: Safety poster, first aid kit, waste bin, grease,

Precautions:

- ✓ Wearing proper clothes, eye glass, glove
- ✓ Make working area hazard free
- ✓ Read and interpret manual which guide you how to use tools and equipment

Procedure:

Step 1: Pull out the suppressor cap from the spark plug.
Step 2: Remove the spark plug by using plug spanner provided in the tool kit.
Step 3: Clean carbon from the electrodes and around the base with the help of spark plug cleaner.
Step 4: Adjust the gap to the specified limit if incorrect
Step 5: Spark plug should be replaced at every 10000km.

Quality criteria:

Perform all activities to clean the spark plug in accordance with the given task.

Operation Sheet: 3.2

Operation Title: Test the fuel pump

Instruction:

- ✓ Safe working area
- ✓ Properly operated tools and equipment
- ✓ Appropriate working cloths fit with the body

Purpose: Ensure a correct inspection to check condition of suspension systems

Required tools and equipment: Work area, tire pressure gauge, wheel wrench, combination wrench, hammer, compressor, wire brush, screw driver

Consumable Materials: Safety poster, first aid kit, waste bin, grease,

Precautions:

- ✓ Wearing proper clothes, eye glass, glove
- ✓ Make working area hazard free
- ✓ Read and interpret manual which guide you how to use tools and equipment

Procedure:

Step 1: Locate the fuel pump**.**

Step 2: Listen for buzzing from the pump**.**

Step 3: Place the amp clamp over the positive wire**.**

Step 4: Record amperage reading.

Step 5: Remove electrical connector**.**

Step 6: Place meter leads on proper terminals**.**

Step 7: Monitor the voltage reading**.**

Quality criteria:
Perform all activities to test the fuel pump in accordance with the given task

Operation Sheet: 3.3

Operation Title: Checking Engine Oil level

Instruction:

- ✓ Safe working area
- ✓ Properly operated tools and equipment
- ✓ Appropriate working cloths fit with the body

Purpose: Ensure a correct inspection to check condition of suspension systems

Required tools and equipment: Work area, tire pressure gauge, wheel wrench, combination wrench, hammer, compressor, wire brush, screw driver

Consumable Materials: Safety poster, first aid kit, waste bin, grease,

Precautions:

- ✓ Wearing proper clothes, eye glass, glove
- ✓ Make working area hazard free
- ✓ Read and interpret manual which guide you how to use tools and equipment

Procedure:

Step 1: Park the vehicle on level surface to check the oil level.

Step 2: Remove the dip stick & wipe it clean.

Step 3: Insert the dipstick tighten it till the face 'R' rest completely on the seating face of clutch cover.

Step 4: Remove the dipstick & check the oil level.

- This should be between the two marks 'C' and 'D' as shown.

A. Oil filler hole/dipstick
B. Oil level dipstick
C. Upper level (Max level)
D. Lower level (Min level)

Operation Sheet: 3.4

Operation Title: Check Differential Oil level

Instruction:

- ✓ Safe working area
- ✓ Properly operated tools and equipment
- ✓ Appropriate working cloths fit with the body

Purpose: Ensure a correct inspection to check condition of suspension systems

Required tools and equipment: Work area, tire pressure gauge, wheel wrench, combination wrench, hammer, compressor, wire brush, screw driver

Consumable Materials: Safety poster, first aid kit, waste bin, grease,

Precautions:

- ✓ Wearing proper clothes, eye glass, glove
- ✓ Make working area hazard free
- ✓ Read and interpret manual which guide you how to use tools and equipment

Procedure:

Step 1: Place the vehicle on a level ground.

Step 2: Let the oil settle for a few minutes.

Step 3: Remove differential oil level bolt.

Step 4:Top up oil level with specified oil till the oil starts flowing out.

Step 5: Fit back oil level bolt.

Quality criteria:

Perform all activities to check differential oil level in accordance with the given task

Operation Sheet: 3.5
Operation Title: Adjusting triple clamp forks aligning front axles

Instruction:

- ✓ Safe working area
- ✓ Properly operated tools and equipment
- ✓ Appropriate working cloths fit with the body

Purpose: Ensure a correct inspection to check condition of suspension systems

Required tools and equipment: Work area, tire pressure gauge, wheel wrench, combination wrench, hammer, compressor, wire brush, screw driver

Consumable Materials: Safety poster, first aid kit, waste bin, grease,

Precautions:

- ✓ Wearing proper clothes, eye glass, glove
- ✓ Make working area hazard free
- ✓ Read and interpret manual which guide you how to use tools and equipment

Procedures:

Step 1: Grease the steering head bearing on the pre-assembled triple clamp with suitable bearing grease.
Step 2: Slide the lower triple clamp into the steering head, holding the upper steering head bearing and the sealing washer in place.
Step 3: Mount the seal for the steering head bearing (sealing washer or O–ring)
Step 4: Mount the upper triple clamp and screw the adjusting nut on by hand.
Step : Position the fork, front wheel and brake system in the triple clamp.
Step 6: Use the adjusting nut to adjust the desired bearing clearance.
Step 7: Screw the counter screw in the adjusting nut and tighten to 10 Nm.
Step 8: Tighten the collar screw to clamp the shaft tube to 20 Nm.
Step 9: Tighten the clamp screws on the lower triple clamp to 15 Nm. Mount the front fender and brake line guide.

Quality criteria:
Perform all activities to adjust triple clamp forks aligning front axlesin accordance with the given task

Operation Sheet: 3.6
Operation Title: Measure rider sag and Adjust the rebound

Instruction:

- ✓ Safe working area
- ✓ Properly operated tools and equipment
- ✓ Appropriate working cloths fit with the body

Purpose: Ensure a correct inspection to check condition of suspension systems

Required tools and equipment: Work area, tire pressure gauge, wheel wrench, combination wrench, hammer, compressor, wire brush, screw driver

Consumable Materials: Safety poster, first aid kit, waste bin, grease,

Precautions:

- ✓ Wearing proper clothes, eye glass, glove
- ✓ Make working area hazard free
- ✓ Read and interpret manual which guide you how to use tools and equipment

Procedures:

Step 1: Start by getting the bike off the ground

Step 2: Take a measurement straight up from the rear axle bolt.

Step 3: Return the bike to the ground and get on it.

Step 4: Adjust the rebound

- ✓ Turn the rebound clickers on your forks.

- Wind clockwise toward "H" (hard) for a slower rebound.
- Wind counter-clockwise toward "S" (soft) for a faster rebound.

Step 5: Adjust the shock rebound clicker

Now look for a similar screw at the rear of your bike, almost always on the bottom of the shock.

Step 6: Change your rebound if your bike bucks or skips

Quality criteria:

Perform all activities to measure rider sag and Adjust the rebound in accordance with the given task

LAP Test Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 10 hours.

Task 1:Cleaning the spark plug

Task 2:Test the fuel pump

Task 3: Checking Engine Oil level

Task 4:Check Differential Oil level

Task 5: Adjusting triple clamp forks aligning front axles

Task 6: Measure rider sag and Adjust the rebound

Reference

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