Two and Three Wheeler Technology

MODULE : 2

Contents:

- Working principle of two stroke and four stroke engines. Types of scavenging and relative merits and demerits with scavenging systems. Systems requirements for Engine lubrication and cooling.

- Basic cranking mechanism (Roller type ratchet, Lock pawl type ratchet and regular ratchet wheel). Kick start mechanism. Lay out of kick start mechanism (Transmission kick start layout, primary kick start layout) . Auto start mechanism.

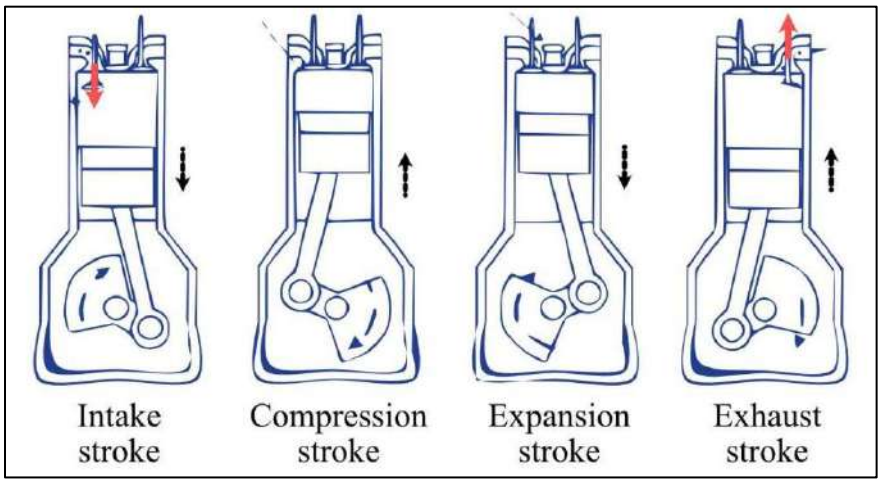
- Conventional ignition system- battery and magneto. Electronic Ignition System – Capacitor discharge ignition, ECU and various sensors used.

- Drivetrain layout of electric two wheeler Batteries, Electric motor, Motor controller, Charger and charging. Merits and demerits of electric two wheelers, High performance of electric wheelers

INTERNAL COMBUSTION ENGINES

Four-Stroke Engine

A four-stroke engine is an internal combustion (IC) engine in which the piston completes four separate strokes while turning the crankshaft. A stroke refers to the full travel of the piston along the cylinder, in either direction. The four separate strokes are Intake, Compression, Combustion and Exhaust.



Intake: Also known as suction. This stroke of the piston begins at top dead center (T.D.C.) and ends at bottom dead center (B.D.C.). In this stroke, the intake valves are in the open position while the piston pulls an air-fuel mixture into the cylinder by producing a partial vacuum (negative pressure) in the cylinder through its downward motion.

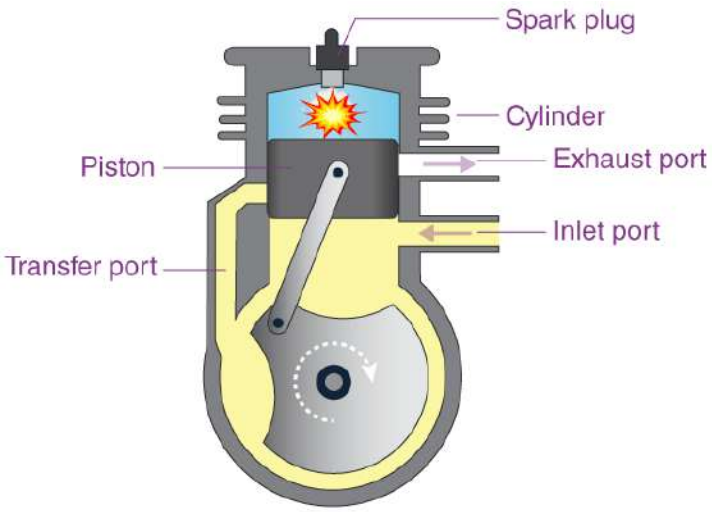
Compression: This stroke begins at B.D.C, or just at the end of the suction stroke, and ends at T.D.C. In this stroke the piston compresses the air-fuel mixture in preparation for ignition during the power stroke (below). Both the intake and exhaust valves are closed during this stage.

Combustion: Also known as power or ignition. This is the start of the second revolution of the four stroke cycle. At this point the crankshaft has completed a full 360 degree revolution. While the piston is at T.D.C. (the end of the compression stroke) the compressed air-fuel mixture is ignited by a spark plug (in a gasoline engine) or by heat generated by high compression (diesel engines), forcefully returning the piston to B.D.C. This stroke produces mechanical work from the engine to turn the crankshaft.

Exhaust: Also known as outlet. During the exhaust stroke, the piston, once again, returns from B.D.C. to T.D.C. while the exhaust valve is open. This action expels the spent air-fuel mixture through the exhaust port

Two-Stroke Engine

A two-stroke engine is a type of internal combustion engine that completes a power cycle with two strokes of the piston during only one crankshaft revolution



The piston moves from TDC (Top-Dead-Center) to BDC (Bottom-Dead-Center) allows the fresh air enter the combustion chamber. The fresh air-fuel mixture gets into the combustion chamber through the crankcase.

The piston is pushed from BDC to TDC. As a result, the fuel-air mixture gets compressed and the spark plug ignites the mixture. The mixture expands and the piston is pushed down. The inlet port is open during the upstroke. While the inlet port is opened, the mixture gets sucked inside the crankcase. When the mixture is pushed up into the combustion chamber during the previous upstroke, a partial vacuum is created as no mixture is left behind in the crankcase. This mixture is ready to go into the combustion chamber during downstroke but remains in the crankcase until the piston goes up to TDC.

From the 2nd downstroke onwards the exhaust gases get expelled out from one side while a fresh mixture enters into the combustion chamber simultaneously due to a partial vacuum created in the combustion chamber after the removal of exhaust gases.

The exhaust gases are expelled from the 2nd downstroke onwards from one side while simultaneously a fresh mixture of air and fuel is injected into the combustion chamber due to the partial vacuum created in the combustion chamber after the removal of exhaust gases.

SCAVENGING

The process of removing exhaust gases with the help of fresh charge is known as scavenging.

The scavenging process takes place during overlapping period of valves or ports, i.e. when both EV and IV remain open for a momentThe very fundamental requirement of scavenging system is to push out the exhaust gases from the cylinder without any loss of fresh charge. The exhaust removing process should take place without any mixing and without any heat transfer between fresh charge and exhaust gases

This ideal system is not possible in practice because of following three reasons.

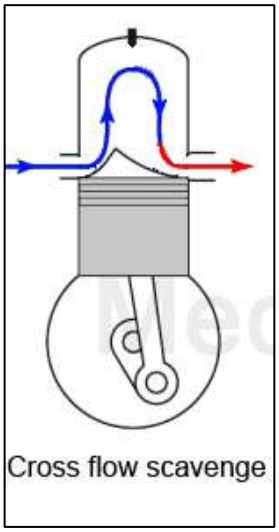
- *The mixing of fresh charge with exhaust gases cannot be avoided as the whole flow remains turbulent.*
- *The heat transfer always takes place between low temperature fresh charge and high temperature exhaust gases.*
- *Some amount of fresh charge always escapes due to developed flow path of high velocity exhaust gases.*

SCAVENGING METHODS

1. Cross Scavenging System
2. Loop Scavenging System
3. Uniflow scavenging

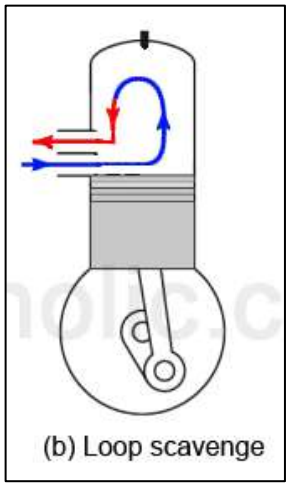
➢ Cross Scavenging System

It is the most common method of scavenging used for small capacity two-stroke engines. Exhaust port and transfer port are located on opposite sides of cylinder. The fresh charge is deflected upward in the cylinder with the help of crowned piston. The baffle of piston guides the fresh charge up and over the dome pushing the exhaust gases down the other side of dome. Exhaust gases are then removed from the exhaust port on the other side Advantages: simplicity and low manufacturing cost. Disadvantages : poor scavenging, heavy piston, poor combustion chamber design, high thermal stresses in piston, difficult to use water cooling system


Cross flow scavenge

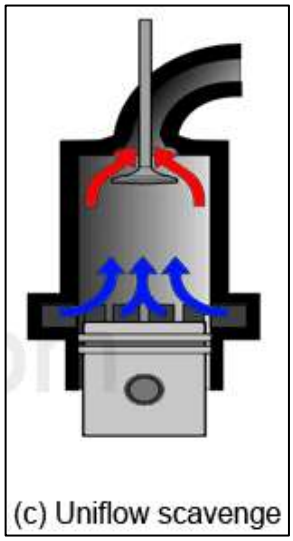
➢ Loop Scavenging System

The gas flow in this system completes a loop during its flow from inlet to exhaust. The transfer port may be located just below the exhaust port. The fresh charge is introduced into the cylinder from one end. It completes the loop and pushes the exhaust gases out from opposite direction. The exhaust gases are removed from throughout the cylinder with the help of three - dimensional loops. As a result, better scavenging is possible without much loss of fresh charge. The loop scavenging process is more effective than cross scavenging process due to flow path pattern


(b) Loop scavenge

➢ Uniflow scavenging

Uniflow scavenging is so called because fresh charge and exhaust gases do not change the direction of flow during scavenging process. As a result, the possibilities of mixing and short circuiting are significantly reduced. The transfer port is uncovered and fresh charge is supplied with the help of motion of piston. The exhaust port which is controlled by a poppet valve is located in the cylinder head. The poppet valve is operated with the help of camshaft The fresh charge comes inside the cylinder from the transfer port. The exhaust gases are pushed upward and drawn out from cylinder head. The direction of flow, like cross scavenging and loop scavenging, does not change because of which it is known as uniflow scavenging system.


(c) Uniflow scavenge

Comparison of Scavenging systems

Method	*Advantages*	*Disadvantages*
Cross scavenging	• Good scavenging at part throttling and at low speed • Simple in construction • Low manufacturing cost	• Poor scavenging at full throttle and high speed • High fuel consumption • High tendency to knock • Limits the compression ratio • Poor design of combustion chamber • High thermal stresses in piston • Water cooling is necessary
Loop scavenging	• Good scavenging at full throttle and at medium speed • Simple in construction • Low manufacturing cost • Water cooling is not necessary • Improved design of combustion chamber • Lower unbalanced forces	• Poor scavenging at part throttle and high speed • High fuel consumption at part throttle • High tendency to knock • Higher heat transfer rate between exhaust port and transfer port • Difficult to manufacture
Uniflow scavenging	• Good scavenging over all range of throttle position and speed Low fuel consumption • Reduced possibilities of • mixing and short circuiting • Simple and effective design of combustion chamber • Improved power output • Good balancing of reciprocating masses	• Complex in construction • High manufacturing cost • Difficulty in cooling piston • High turbulence in inlet flow

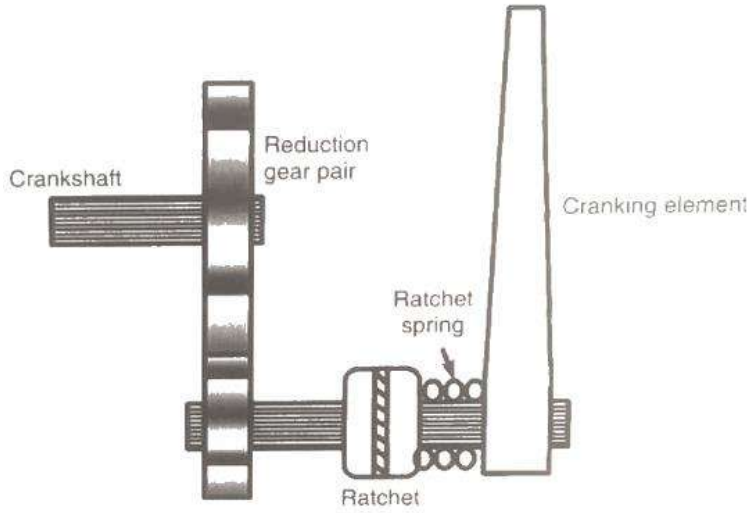
Requirements Of Engine Lubrication System

1. To reduce friction between moving parts
2. To reduce wear of moving parts
3. To provide cooling effect
4. To provide cushioning effect
5. To provide cleaning action
6. To provide sealing action

CRANKING MECHANISM

Turning the crankshaft is the easiest way to start the engine. Rotation of crankshaft generates reciprocating motion in the piston. It is very difficult to crank the crankshaft directly because of friction between various components of engine. Sufficient leverage must be provided to reduce the cranking effort and this is completed through the cranking mechanism

BASIC CRANKING MECHANISM



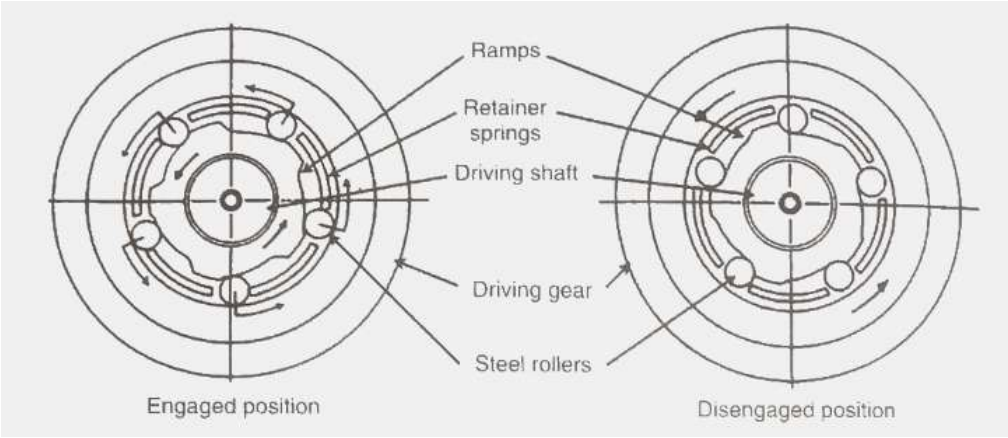
The cranking mechanism consists of a cranking element, one- way ratchet, ratchet spring and reduction gear pair.

The cranking element is one type of lever which is used to reduce the effort required to crank the engine. The leverage is generated either by pedal or by kick. The one-way ratchet is used to allow the engagement of cranking element with reduction gear pair. This ratcheting device helps to rotate the shaft in one direction, and allows it to turn freely in the other direction. Ratcheting spring is used to retain the engagement of ratchet, especially for the duration of cranking. Reduction gear pair is incorporated to connect the crankshaft and cranking element. It further reduces the cranking effort by providing correct torque ratio.

Some fundamental cranking mechanisms, which have been used in two wheelers, are discussed below

- Roller Type Ratchet
- Lock Pawl Type Ratchet
- Regular Ratchet Wheel

1. Roller Type Ratchet

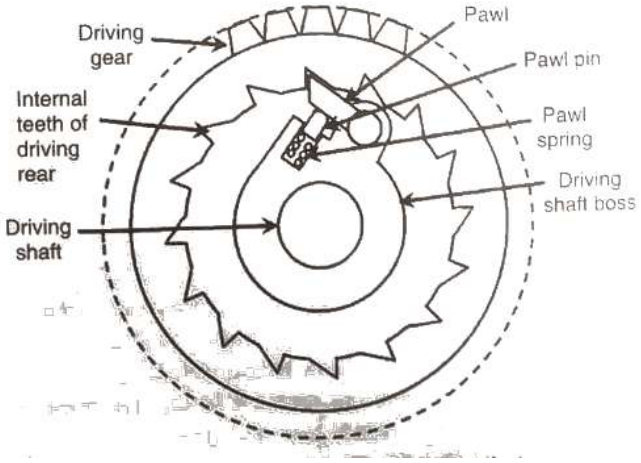


The roller type ratchet consists of a set of steel rollers rolling between driving shaft and driving gear. The driving shaft, usually known as kick shaft, has a splined boss. This boss contains ramps on the periphery. These ramps are used to secure the steel rollers between boss and driving gear. The springs help to limit the movement of rollers.

As the driving shaft is rotated by applying effort on cranking element, the steel rollers are blocked tightly in the narrow passages of the boss ramps. As a result, a positive engagement is produced between driving shaft and driving gear and both rotate in the same direction.

Therefore, motion is transferred from cranking element to engine crankshaft through driving shaft, boss, steel rollers, driving gear, and primary drive. As engine starts, the speed of driving gear is increased. The driving gear moves ahead by pushing the steel rollers into wider passages of ramps. This in turn breaks the contact between steel rollers and driving gear due to increased gap. The boss and driving shaft thus brought to stationary position.

2. Lock Pawl Type Ratchet

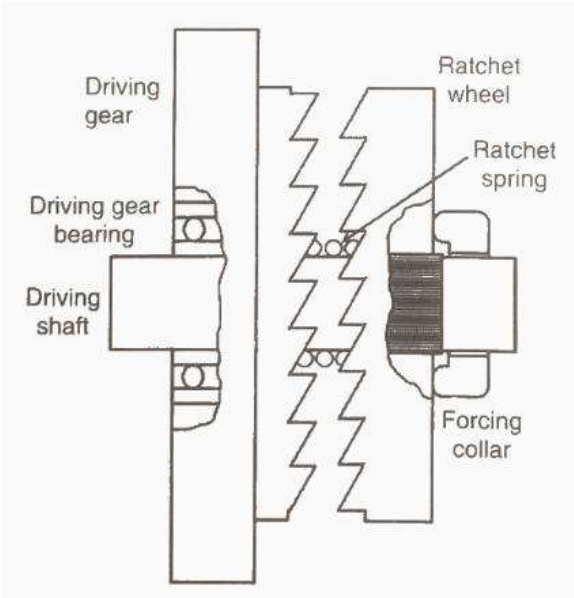


Lock pawl type arrangement also use ratcheting between driving shaft and driving gear. The driving gear can rotate freely on the driving shaft and has internal teeth. Driving shaft contains a boss on which the pawl is assembled. The boss is connected with the driving shaft. The pawl can oscillate with respect to hinge point on the boss. The motion of pawl is restricted with the help of pawl spring. A steel pin used to push the pawl towards the one-sided internal teeth of the driving gear.

As driving shaft is rotated by cranking element, the knife edge of the pawl gets wedged inside the tooth to generate positive engagement. As engine starts, the speed of driving gear is increased. The driving gear moves ahead by throwing the pawl out of the internal teeth. This in turn breaks the engagement between driving gear and driving shaft. The boss and driving shaft thus brought to stationary position.

3. Regular Ratchet Wheel

Both Roller and Pawl type ratchets are having complex construction as ratcheting is done within the driving gear.To avoid this complexity, modern two wheelers make use of regular ratchet wheel.



The driving gear is manufactured with ratchet teeth on one side. The driving gear is mounted on bearing and it is free to rotate on driving shaft. The rotation of driving shaft is transmitted to the ratchet wheel through splines. The forcing collar initially helps to engage the ratchet wheel with the driving gear when cranking element is brought to stroke. Sometimes, ratchet spring is used to disengage the ratchet wheel when engine starts.

KICK START MECHANISM

The name "Kick Start" is derived with respect to its operating method. It makes use of oscillating cranking element. The oscillation in cranking element is generated by forcing it downward using foot.

The cranking element is known as kick. The complete rotation of crankshaft is achieved through appropriate gear ratios. The motion is transmitted from kick to crankshaft through kick shaft, ratchet, kick gear, kick idle gear, kick pinion gear, primary driven gear and primary driver gear.

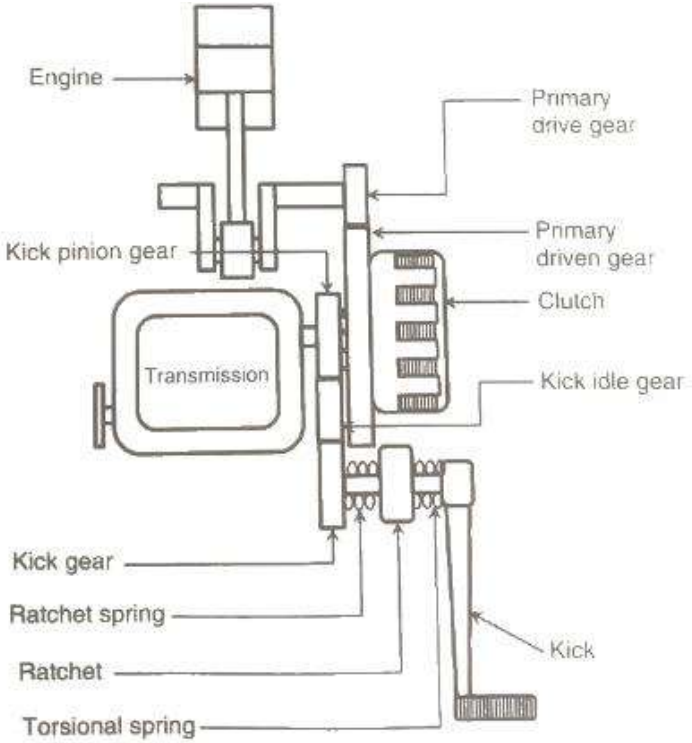
LAYOUT OF KICK START MECHANISM

There are two popular approaches used for kick start mechanism

1. Primary kick start.
2. Transmission kick start

➢ Primary Kick Start Layout

Primary transmission layout which facilitates cranking of engine without engaged clutch because drive is led to the crankshaft through primary reduction gear. Furthermore, ***engine can be cranked in any gear simply by disengaging the clutch***. This is a nice feature which avoids difficulty in finding neutral each and every time while cranking the engine.



KICK: It is a cranking lever which is pivoted at the end of kick shaft. It is manufactured from forged steel. The shape of lever body is designed for proper accommodation after cranking the engine. Locking bolt and washer is used to lock the kick

TORSION SPRING: Torsion spring helps to retain initial position of the kick. One end of the spring is hooked into the kick shaft while other end is attached with crankcase. The spring wounds and stores energy

RATCHET WHEEL: One-way ratchet is used to allow the engagement of kick with kick gear. This ratcheting device helps to rotate the kick shaft in one direction, but still allows it to turn freely in the other direction. This facilitates the spontaneous disengagement of kick form the crankshaft as soon as the engine starts.

RATCHET SPRING: Ratchet spring is used to retain the engagement of ratchet, especially for the duration of cranking. It is a simple compression spring mounted between ratchet wheel and crankcase wall.

KICK GEAR: Kick gear is used to convert an oscillated stroke of the kick into a rotary stroke. It provides rotational motion to the primary driven gear.

KICK SHAFT: Kick shaft is used to mount driving components of kick start mechanism. It contains two splined portions: one for kick mounting and other for ratchet wheel mounting. Kick gear can freely rotate on the kick shaft.

KICK IDLE GEAR: It is used to transmit the motion of kick gear to primary driven gear. The practice of including an idle gear depends upon space availability and design of drive train.

KICK PINION AND PRIMARY REDUCTION: The kick pinion and primary reduction gear pair is incorporated to connect the crankshaft and kick. It further reduces the cranking effort by providing correct torque ratio. Generally, the kick pinion is rigidly mounted with primary driven gear while primary driver gear is directly mounted on the crankshaft.

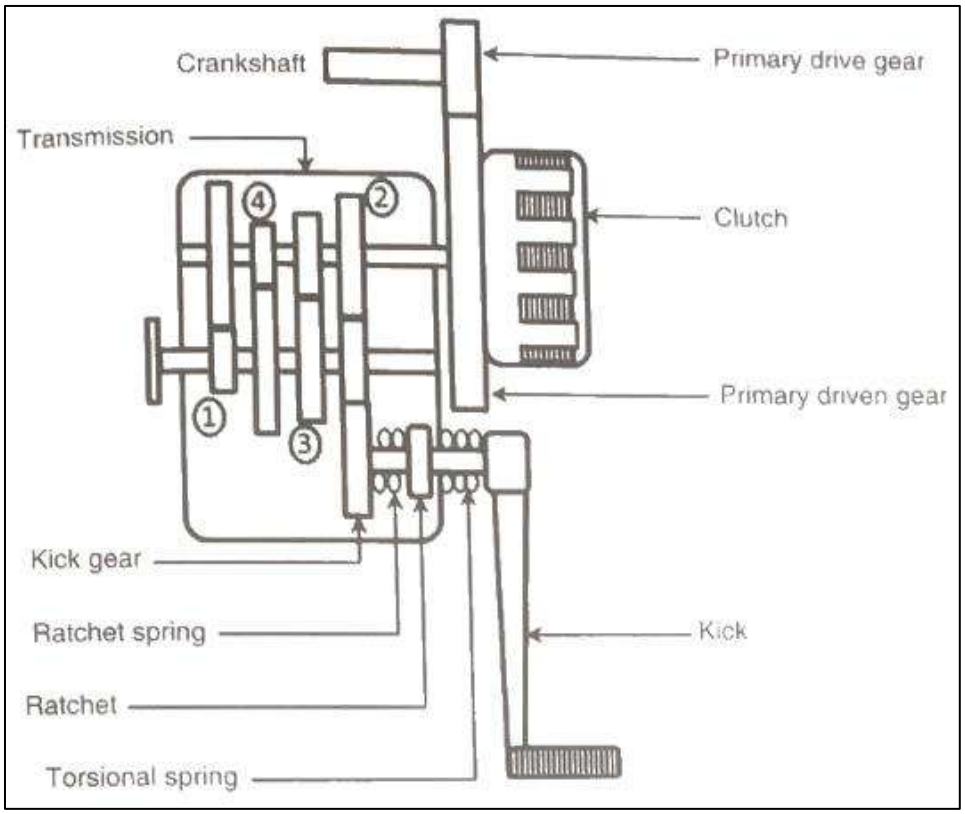
➢ Transmission Kick Start Layout

Almost all scooters and few economic motorcycles are using transmission kick start layout. The kick gear is located inside the gearbox and always remains in mesh with second gear.

Components on kick shaft are Kick, Torsion Spring, Ratchet Wheel, Ratchet Spring, Kick Gear, Kick Shaft and Primary Reduction. This arrangement eliminates idle gear and kick pinion gear, resulting as overall weight reduction.

As power is transmitted through gearbox, it becomes essential to crank the engine with clutch engaged position, i.e. kick comes to be free if clutch lever is pressed. Moreover, vehicle moves forward if kick is applied with engaged gear and with disengaged clutch because foot power is then transmitted to the driving wheels through output shaft of the gearbox.

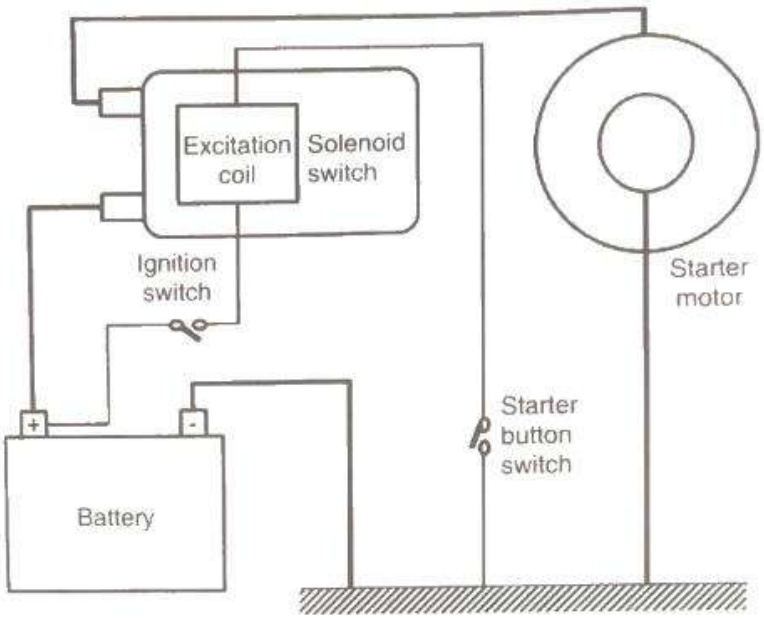
Therefore, it is not possible to crank the engine without neutral position of transmission. To sum up, ***this type of kick starter drive can be used only with the clutch engaged and the transmission in neutral***.



AUTO-START MECHANISM (Push button start)

Auto -start mechanism simplifies the cranking procedure and starts the engine on one push of a button. Therefore, it is also known as push button start system.

Auto-start system generally consists of two separate circuits the **power circuit** and the **control circuit**. The power circuit contains *battery, cables, main current side of the solenoid switch, starter motor and drive mechanism* while the control circuit involves *starter button switch, ignition switch, energizing side of solenoid switch and safety switch*.



STARTER MOTOR: A starter motor uses electromagnetic principles to convert electrical energy from the battery to mechanical power to crank the engine. The starter is normally an electric motor that can develop nearly 8 hp for a very short time when used to crank the a cold engine. Current for the starter motor or power circuit is controlled by a solenoid or relay

BATTERY: The primary purpose of an automotive battery is to provide a source of electrical power for starting the engine. The battery also acts as a voltage stabilizer because it forms a reservoir where large amounts of current can be removed quickly during starting and replaced gradually by the alternator during charging.

STARTER SOLENOID: *The high current required by the starter must be able to be turned on and off*. A small ignition switch operates a relay that controls the high current to the starter.

STARTER DRIVE: The starter drive uses a small pinion gear that contacts the engine, flywheel gear teeth and transmits starter motor power to rotate the engine.

IGNITION SWITCH: The ignition switch controls the starter motor operation. As mentioned earlier, auto-start system uses two different circuits. Both the circuits have different functions but works together while cranking the engine.

CONTROL CIRCUIT: The control circuit involves starter button switch, ignition switch, energizing side of solenoid switch and engine stop switch. This circuit allows current to flow from battery to ignition switch, then to solenoid and then through starter switch to ground. The flow of current from battery to solenoid takes place after putting the ignition switch to ON position. The ignition switch is operated by turning the key. The starter button given on the handle bar allows completion of circuit. Modern two wheelers also use various safety switches to ensure safety of driver and passengers before starting the engine

IGNITION SYSTEMS

The ignition system is a system used to generate a very high voltage and to send it to each sparkplug to igniting the fuel-air mixture in the combustion chamber of the engine

Types of Ignition System:

1. Conventional ignition systems
    - **a.** Battery coil ignition systems
    - **b.** Magneto ignition systems
2. Electronic ignition system

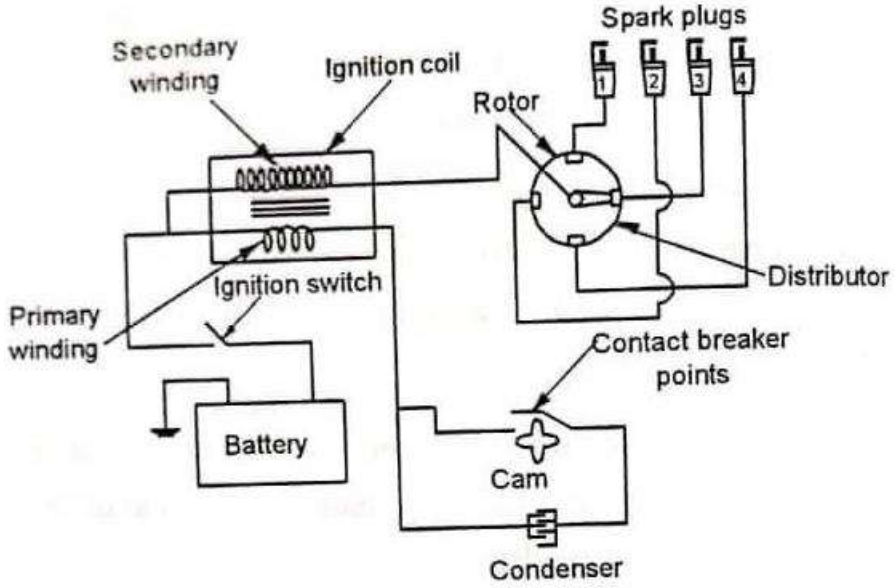
➢ Battery coil ignition systems

The ignition system is divided into 2-circuits namely the Primary Circuit and Secondary Circuit.

Primary Circuit : It consists of 12 V battery, ignition switch, primary winding, contact breaker, capacitor.

Secondary Circuit : It consists of secondary winding. Distributor and spark plug.
Secondary winding consists of about 20000 turns of wire. Distributor rotors rotate and make contacts with contact points and are connected to spark plugs which are fitted in cylinder heads

Working



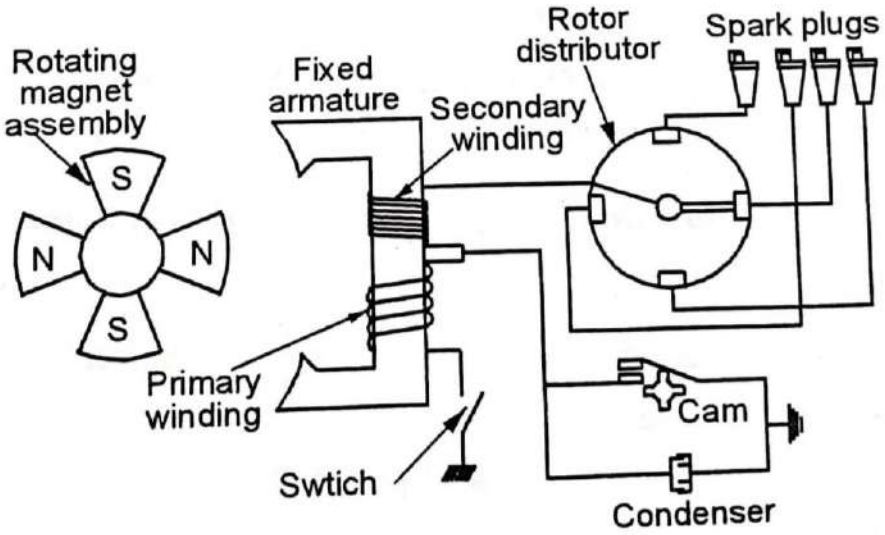
When the ignition switch is closed and engine in cranked, as soon as the contact breaker closes, a low voltage current will flow through the primary winding. When the contact breaker opens, the magnetic field begins to collapse. Because of this collapsing magnetic field, current will be induced in the secondary winding. And because of more turns in secondary, voltage goes upto 20000-22000 volts. This high voltage current is brought to centre of the distributor rotor. Distributor rotor rotates and supplies this high voltage current to proper spark plug depending upon the engine firing order. When the high voltage current jumps the spark plug gap, it produces the spark

The Function of the capacitor is to reduce arcing at the contact breaker (CB) points. Also when the CB opens the magnetic field in the primary winding begins to collapse. When the magnetic field is collapsing capacitor gets fully charged and then its tarts discharging and helps in building up of voltage in secondary winding.

Contact breaker cam and distributor rotor are mounted on the same shaft. -In 2-stroke cycle engines these are rotate at the same engine speed. And in 4-stroke cycle engines they are rotate at half the engine speed.

➢ Magneto ignition systems

The Magneto Ignition system does not require a battery. It generates its own voltage for the primary. It is widely used in mopeds, scooters, motorcycles, stationary engines. The magneto Ignition system with main components is shown in figure



Magneto Ignition System Construction

The following main parts or components of the Magneto Ignition system are:

- Rotating Magnets
- Primary Winding
- Secondary Winding
- Fixed Armature
- Condenser
- Breaker-points or Contact Breaker
- Distributor
- Ignition Switch and
- Spark plug

Working

When the engine starts, the cam rotates which also rotates the magnet connected on the other end of the shaft. When the magnet rotates, the magnetic flux is generated and current will be produced in the primary winding.

As the secondary winding is connected with the primary winding, the current also travels in the secondary winding.

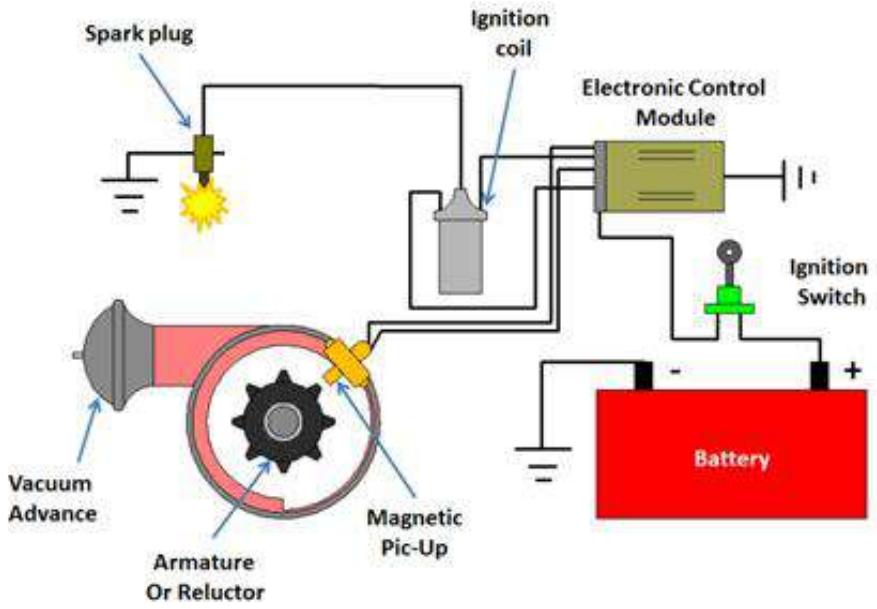
When the contact breakers open, the current from primary winding will enter into the capacitor and charges it. Due to this, the primary current falls and the magnetic field collapses. A large amount of current from the capacitor enters into the secondary winding which will step up the voltage. The voltage generated is sent to the distributor for distributing to individual spark plugs in the correct sequence with respect to the firing order.

At the start, as the engine speed is low, the current generated by the magneto is quite small. As the engine speed increases the flow of current also increases. Thus there is always a starting problem with the magneto ignition system and sometimes there is a need for a separate battery for stating.

Types of Magneto Ignition System

1. Rotating Armature type
2. Rotating Magnet Type.

➢ Electronic Ignition System



In Electronic Ignition (EI) systems, the coil is wired directly to the spark plug. An ignition control module, connect into the vehicle's ECU, controls the spark timing and advance. In El systems, a crank sensor located at the front of the crankshaft is used to trigger the ignition system.

In EI systems there is no contact breaker point, ignition timing remains more stable over the life of the engine.

The ECU, ignition module, and position sensors combine to control spark timing and advance.

The ECU collects and processes information to determine spark timing. The ignition module uses crank/cam sensor data to control the timing of the primary circuit in the coils. Primary current is controlled by transistors in the control module. When primary current flow is interrupted, secondary voltage is induced in the coil and spark plug fire.

Advantages of Electronic Ignition System

1. Moving parts are absent-so no maintenance.
2. Contact breaker points are absent-so no arcing.
3. Spark plug life increases by 50% and they can be used for about 60000 km without any problem.
4. Better combustion in combustion chamber, about 90-95% of air fuel mixture is burnt.
5. More power output.
6. More fuel efficiency.

➢ Capacitor Discharge Ignition System (CD ignition)

It is also known as the thyristor ignition system. It mainly consists of a battery, ignition switch, DC to DC convertor, charging resistance, tank capacitor, Silicon Controlled Rectifier (SCR), SCR-triggering device, step up transformer, spark plugs.

A battery is connected to DC to DC converter i.e. power circuit through the ignition switch, which is designed to give or increase the voltage to 250-350 volts. This high voltage is used to charge the tank capacitor (or condenser) to this voltage through the charging resistance. The charging resistance is also so designed that it controls the required current in the SCR.

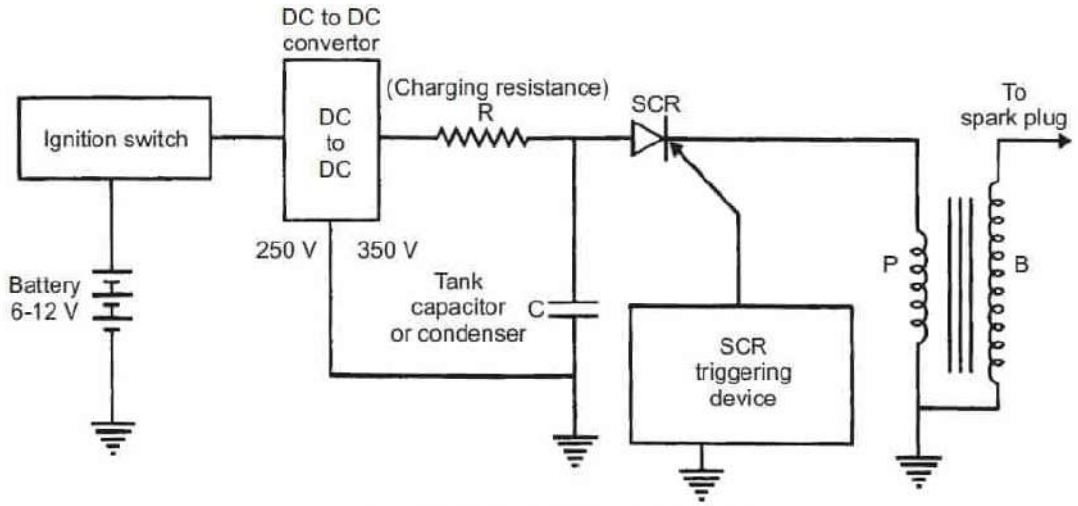


Figure : Capacitance Discharge Ignition System

Depending upon the engine firing order, whenever the SCR triggering device, sends a pulse, then the current flowing through the primary winding is stopped. And the magnetic field begins to collapse. This collapsing magnetic field will induce or step up high voltage current in the secondary, which while jumping the spark plug gap produces the spark.

ECU AND VARIOUS SENSORS

Electronic Control Unit (ECU) is also known as the Electronic Control Module (ECM). The ECU coordinates for various engine processes, maintains communications, and makes the control decisions needed to keep the vehicle operating. The operation of every ECU can be divided into four basic functions.

Input: *Receives voltage signals from various sensors*

Processing: *Performs mathematical calculations*

Storage: *Includes short-term and long-term memory*

Output: *Controls an output device by either turning it on or off*

First, the ECU receives a voltage signal (input) from a sensor. These input voltage signals received by ECU are handled through a series of electronic logic circuits in its programmed instructions. These logic circuits change the input voltage signals into output voltage signals or commands. Storage is the place where the program instructions for ECU are stored in electronic memory. After the ECU has processed the input signals, it sends voltage signals or commands to other devices in the system, such as actuators. An actuator is an electrical or mechanical output device that converts electrical energy into mechanical actions.

DIFFERENT SENSORS

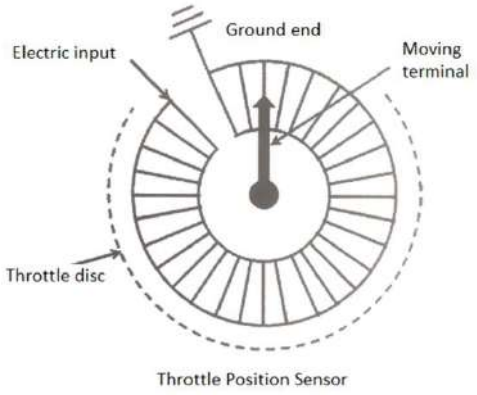
1. Manifold Absolute Pressure (MAP) Sensor

Pressure in the intake manifold varies with different opening positions of throttle. Quantity of fuel supplied to the engine should be changed accordingly to avoid wastage of fuel. To accomplish this, fuel injection system use MAP sensors to measure the value of manifold pressure. This sensor uses vacuum as a reference and diaphragm as a sensing device. Sensor housing is equipped with the electric circuit to generate input and output. There are four resistors attached to the diaphragm, which changes in resistance when pressure is applied to the diaphragm. As the air pressure increases, the MAP sensor generates a higher frequency return signal to the ECU.

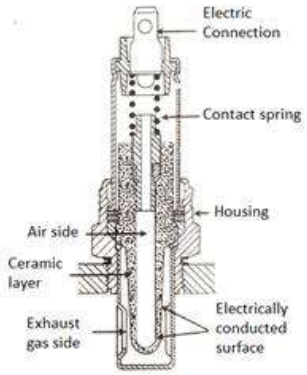
2. Throttle Position (TP) Sensor

A throttle position (TP) sensor is used to send a signal about position of the throttle to the ECU. It consists of a variable resistor known as a potentiometer. Potentiometer has three terminals. One terminal receives input voltage, Second terminal is grounded and the third terminal slides across the resistor to change its resistance. This third terminal is attached with throttle operating rod and moves across the resistor and cause change in output

voltage. The ECU uses this varying voltage as an input to determine the amount of throttle opening. The ECU senses any change in throttle position and changes the fuel mixture.



Throttle Position Sensor



Oxygen sensor

3. Oxygen Sensor

It is also known as lambda sensor. The main function of this sensor is to sense change of the air ratio from required standard ratio, by determining the oxygen content coming out in the exhaust gas. The oxygen searching element is a thimble shaped piece of zirconium oxide, with its inner and outer surfaces coated with a thin layer of platinum. The thimble behaves like an electric cell. When the concentration of oxygen inside differs from that outside, an electric potential develops between the inner and outer platinum coatings. Thus, the voltage between the outer coating and the inner is taken.

4. Crankshaft Position Sensor

CP sensors use the changing in strength of the magnetic field surrounding a coil of wire to generate input signals for ECU. This signal is used by the ECU to determine piston position and engine speed (RPM). The rotating crankshaft has teeth on the periphery that trigger the magnetic position sensor. A change in the strength of the magnetic field occurs as the teeth pass by the position sensor, creating a signal which is sent to ECU.

5. Intake Air Temperature Sensor

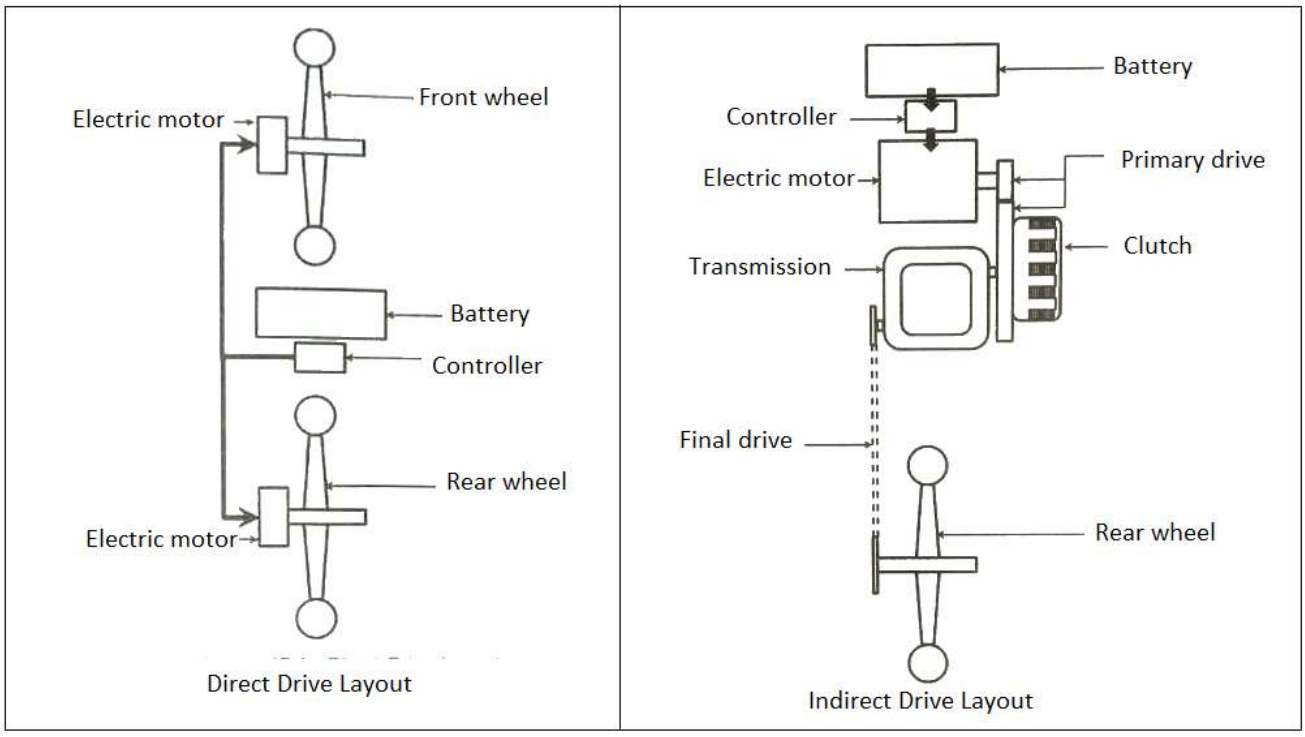
The purpose and function of this sensor is to provide the temperature of the air entering the engine to the ECU. It has a thermistor that decreases the resistance as the temperature of the sensor increases. The sensor information is used to control the quantity of fuel depending on the temperature of incoming air. If the air temperature is low, the ECU modifies the amount of fuel delivery and adds fuel. If the air temperature is high, the ECU subtracts the calculated amount of fuel. Moreover, cold air is denser and contains more oxygen, therefore it requires a richer mixture to achieve the proper air-fuel mixture. Hot air is less dense and contains less oxygen, therefore it requires less fuel to achieve the proper air-fuel mixture.

DRIVETRAIN LAYOUT OF ELECTRIC TWO WHEELER

The obvious mission of the drivetrain is to apply the engine's power to driving the wheel and tyre with the least loss.

The drivetrain layout are of two types

- **Direct drive** which is used most widely to drive small electric scooters
- **Indirect drive** mostly used on electric motorcycles.



Transmission, a chain or belt drive are used on high capacity electric vehicles.

The function of each component of the drivetrain is as follows

BATTERY: The basic function of batteries is to generate the maximum storage possible in a limited space, allowing the vehicle to be driven as much as possible. It provides necessary electric current to the electric motor. Battery discharges after predefined time period therefore charging of battery becomes necessary after certain run.

ELECTRIC MOTOR: The electric motor replaces the engine and provides mechanical output by working on the principle of mutual induction. *The electric motor is directly installed inside the wheels when used on direct drive layout. The electric motor drives the driving wheel through the conventional drive train when used on indirect drive layout*.

CONTROLLER: The controller is the device by which the speed and power output of the electric motor are controlled. It is just like the throttle of a carburetor which controls the power output of an engine. The controller is usually interlinked with the accelerator.

CLUTCH: Just like an ordinary two-wheeler, it disengages the power flow from the motor so that transmission gears can be shifted and, once engaged, the vehicle can be driven from standstill to top speed.

MANUAL TRANSMISSION: It provides a number of alternative gear ratios to the motor to meet vehicle needs maximum torque for hill climbing or minimum speed to economical cruising

CHAIN OR BELT DRIVE: It conventionally connects the motor to the drive wheel.

MERITS AND DEMERITS OF ELECTRIC TWO WHEELERS

Merits

- It does not require fuel.
- Charging can be made from any source of electricity.
- It reduces hydrocarbon and carbon monoxide, responsible for many environmental problems
- Electricity can be generated by renewable energy.
- Operating cost is very low as it hardly requires any maintenance.
- It also reduces noise pollution.

Demerits

- Limited distance can be driven.
- Vehicle becomes heavier due to the electric motors, batteries, chargers, and controllers.
- Battery charging takes time.
- Limited access to charging location.