# UNIT-III

# ENGINE AUXILIARY SYSTEMS

## FUEL FEED SYSTEM

### REQUIREMENT OF AN IDEAL PETROL ENGINE FUEL:

Generally gasoline is used as a fuel in most of the petrol engine (S. I. engine). It is a mixture of many refinary products containing paraffins, naphthenes and aromatics in different ratios. The ratio depends upon the desired quality of the fuel. The important qualities of this fuel are as given under.

1. Antinock quality
2. Volatility
3. Gum deposits
4. Sulphur content

### *1.* ANTIKNOCK QUALITY:

Sometimes the last part of the compressed air fuel mixture explodes thereby producing a sudden and sharp pressure increase the knocking noise and produces a hard hammer blow on the piston. Therefore gasoline produces always tend to minimize the knocking tendencies of fuel.

### 2. VOLATILITY:

The quality with which a liquid vaporizes easily is called volatility. When a liquid vaporizes at relatively low temperature then it is called high volatile. If it vaporizes at a higher temperature its volatility is low. The most important aspects of volatility are as given under:

a) Easy starting
b) Freedom from vapour lock
c) Quick warming
d) Smooth accelaration
e) Good economy
f) Freedom from crank case dilution
g) The volatility blend.

### 3. GUM DEPOSITS:

Sometimes unsaturated hydrocarbons blended in the gasoline which acidize during storage and form a product known as gum. The gum is undesirable in the fuel. Because it deposits in carburetor, on intake valves, piston rings and other parts of the engine thereby restricting the regular supply of the fuel. Therefore, a good fuel must be of such a quality that neither it as gum content nor form gum during storage.

### 4. SULPHUR CONTENT:

It is an undesirable content in the gasoline. Because it tends to form corrosive compound which attacks various parts and thereby injuring the engine. Therefore, a fuel should contain a very limited or permissible quantity of sulphur in it.

### 2.1.1. OCTANE RATING:

Some fuel are more knock producing than others. The knocking tendencies are a I ways undesirable characteristics in an engine. Therefore chemicals are the fuel to reduce them. Thus, the Octane number rating in this is an expression which indicate the ability of a fuel to resist knock in an engine which is termed as Octane number. as well as clean fuel from the fuel tank. It can be conveniently used for the whole process of supplying continuously to the engine a suitable mixture of fuel vapour and air. It is not through any other means that the necessary air for complete combustion according to the chemical composition of the fuel can be supplied. Under all operating conditions, individual engine cylinders are supplied with correct proportions and quantities of fuel and air by this system. Different mixtures of fuel and air are required for performing different types of operations for meeting a wide range of speeds, loads and temperature conditions. Relatively rich mixture is required by the engine while accelerating or running at, high speed or pulling hard up hill. A linear mixture is sufficient while running on the level roads with a partly opened throttle since full power is not required under this condition. The carburetor is the device which meters, atomizes and as distributes the fuel through the air. It automatically adjusts both the amount and proportion of fuel and air to suit the operating conditions.

## 2 4 CARBURETTOR

The carburetor is a device for atomizing and vaporizing the fuel and mixing it with the air in varying proportions to suit the changing conditions of spark ignition engines. The air fuel mixture so obtained from the carburetor is called the combustible mixture.

The main functions of a carburetor are as given under.

i) It preserves fuel at a constant head.

ii) It vaporizes and atomizes the fuel and mixes it with the air. Vaporization means the change of fuel from a liquid to a vapour where as ‘atomization’ is the breaking up of fuel by mechanical system, so that every small particle of the fuel is surrounded by air.

iii) It provides and controls the amount and strength of air-fuel mixture under varying conditions of load and speed of the engine.

iv) It provides easy starting with the engine in cold

v) It ensures the engine to run slowly without missing and without undue wastage of fuel,

vi) It provides maximum acceleration without hesitation to pick up speed when the throttle is suddenly or slowly opened.

### 2.4. 2. CLASSIFICATION OF CARBURETTOR:

1. According to the arrangement of float chamber
   (a) Eccentric (b) Concentric

2. According to the direction air flow
   (a) Down draft (b) Side draft (c) Up draft
   (d) Semi-down draft.

3. According to the number of units
   (a) Simple (b) Dual (c) Four—barrel.

4. According to the type of metering system
   (a) Air bleed jet (b) Metering rod type

5. According to the type of venturi
   (a) Plain venturi (b) Double venturi (d) Nozzle bar venturi .

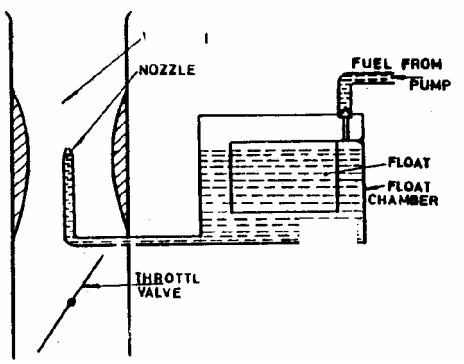
6. According to the pressure above the fuel in the float chamber.
   (a) Unbalanced (b) Balanced.

7. According to the typo of power system.
   **(a)** Manually operated (b) Vacuum controlled.

8. According to the method of varying mixture strength
   (a) Constant choke carburetor (b) Constant vacuum carburetor.

2.5. SIMPLE CARBURETTOR:

A simple carburettor shown in Fig. 24. Consists of the round cylinder with constricted section of a fuet nozzle, a throttle valve and e float chamber. The round cylinder' called air horn and 'constricted sectio is the venturi.




venturi and float chamber are connected by the fuel nozzle. The throttle valve can be tilted to open or close the air horn. The construction and function of each part of the carburettor are as:

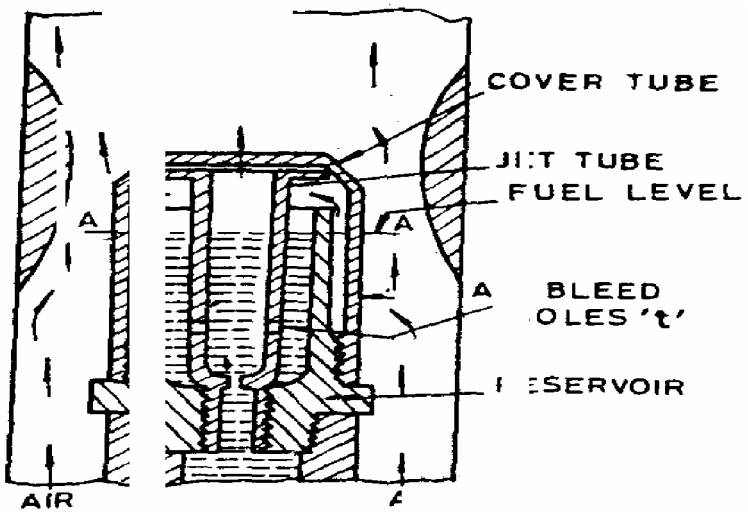
VENTURI:

A venturi is a narrow space in the cyilndrical air horn, through which the air passes. As the same amount of air must pass through every point in the air horn, its velocity will be the greatest at the narrowest point. The more this area is reduced, the greater will be the velocity of air. The opening of the discharge jet is usually located just below the narrowest section of the venturi so that the section is greatest.

The spray of gasoline from the nozzle and the air entering through the venturi are mixed together in the mixing chamber which is just below the discharge jet. In this chamber, the vaporization and atomization of the gasoline take place and it mixes with the air, so that the combustible mixture is produced. This mixture passes through the intake manifold into the cylinder.

THROTTLE VALVE: Fig. 2. 4 Simple Carburetor

The throttle valve is a circular disc, It is located in the mixing chamber of the air horn. It can be tilted
to proportions of air fuel mixture at different speeds. Different method for providing compensation are
(1) air valve regulation
(2) compensating jet
(3) air bleed compensation.
(4)Multi jet compensation
(5) Suction compensation.

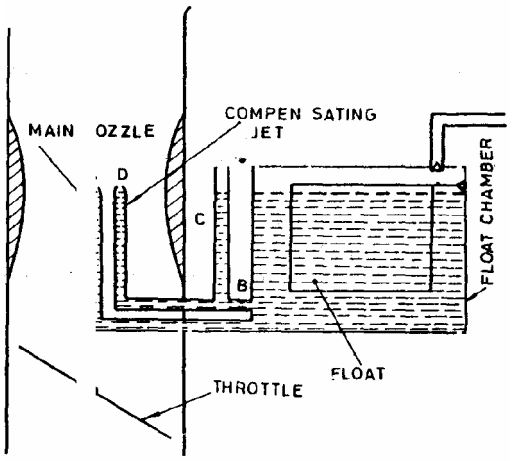



2. 6. 1. AIR BLEED COM PENSATION:

shows the detailed construction of a carburettor nozzle with provision of air bleed compenstaion. The jet tube is provided bleed hotes around its periphery.The jet tube is fixed in a reservoir and assembly is covered by another inverted tube. The reservoir is open to the atmosphere by means

holes provided in the tube. When engine is not running then fuel will maintain level A-A. In the begining the engine needs a richer mixture and after starting a weaker mix Air Bleed Comoensation ture. When engine is started then due to suction the nozzle tip supplies a sufficient quantity of fuel to start it. As the engine speed is increased more suction is developed ~t the nozzle thus nozzle tip becomes empty thus allowing the air run through the holes of and air bleed holes into the jet tube. Thus diverts part of the air suction through the jet tube and decreases the flow of the fuel. In this way with the help of air bleed compensation a desired quantity of fuel is supplied by the nozzle for a different speed of the engine.

6. 2. VARIABLE JET OR COMPENSATING JET




In a carburettor in addition to main nozzle, when an extra fuel supply nozzle restricted by an orifice is provided, then this circuit of fuel is known as compensating jet system. Refer Fig A is the main nozzle and B is the submerged or compensating jet. is the well which is open

to atmosphere When the engine is not running the fuel levelin the main nozzle compensating nozle and the well C will be available at the same level as in the float chamber.The main nozzle is connected directly to float chamber and it will supply richer mixture at larger throttle openings. But the case is different of the submerged Comoensating Jet. When the engine is just started and the throttle valve is open a bit, small engine suction is applied, which draws fuel from the well C through delivery tube D, till the well C becomes empty. Further opening the throttle, therefore, does not increases the fuel flow through the compensating jet; it remain constant. However, the air flow is nevertheless in creasing. As a result the higher speeds result in weaker mixtures through the compensating jet. The result is shown in In this way a uniform mixture of constant

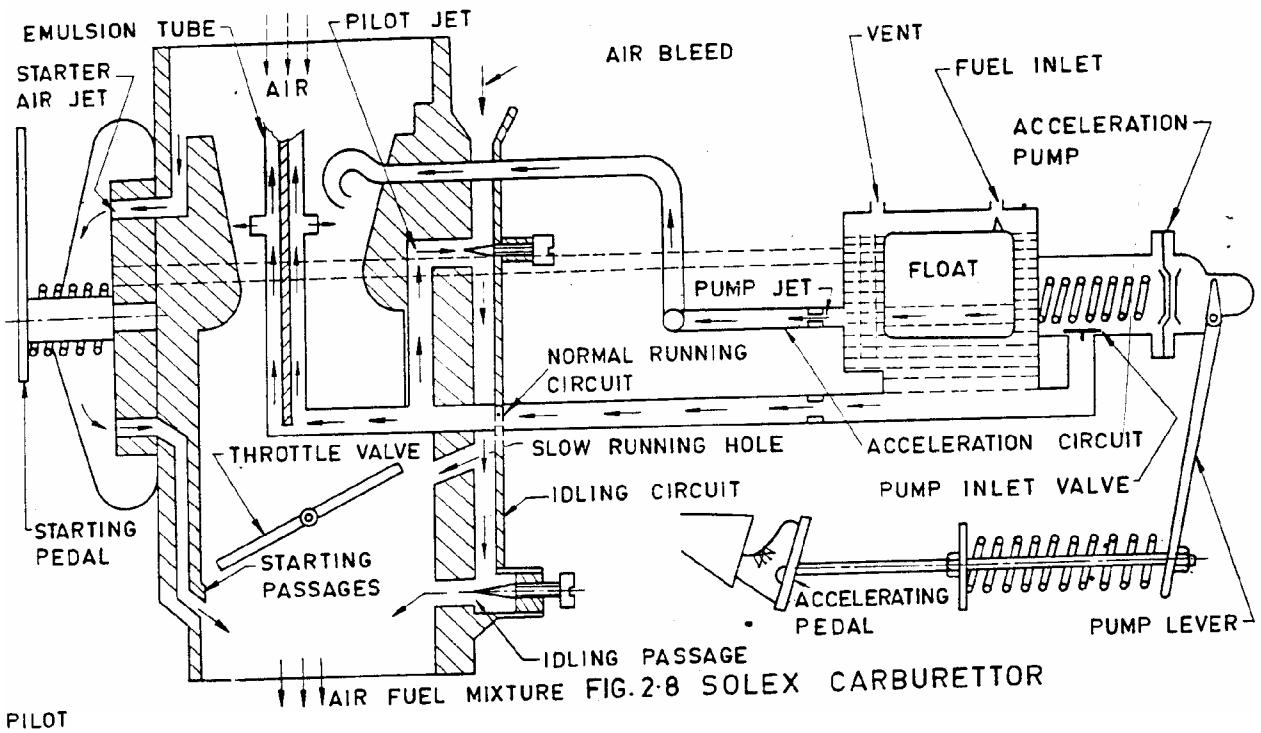
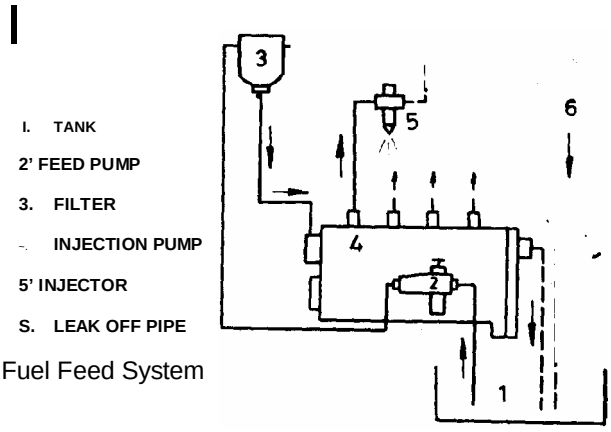



FIG. 2-8 SOLEX CARBURETTOR

2.9 DIESEL FUEL FEED SYSTEM:

The diesel fuel feed system ensures that the diesel oil is injected into the cylinders at the correct time. It consists of a diesel tank, feed pump, filter, injection pump, injector and connecting lines FIG.2. 17 shows the fuel feed system for a four cylinder diesel engine. The diesel fuel is first sucked by the feed pump. This is forced through

filter to injection pump. The filter filters all the miniute Ist particles. When the prsssure in the filter increases, a ~rtain amount of fuel is released. This released fuel returns




F1G.2.17 Diesel Fuel Feed System

to the tank. The injection pump get the fuel from the feed pump. In injection pump there are plungers. By the operation of plunger the fuel reaches the injector. The fuel is Sprayed' through the injector into cylinder. A certain amount of fuel which is not injected returns to the tank.

2.9.1FUEL INJECTOR:

The purposes of the fuel injector is to injector a small volume of fuel in a fine spray and, to assists in bringing each droplet into contact with a sufficient oxygen to give quick and complete combustion.

FIG.2.18 shows a fuel injector. It consists of a needle valve is pressed on its seat in the nozzle by a plunger or spindle. A compression spring controls the pressure upon the plunger by which the needle opens.

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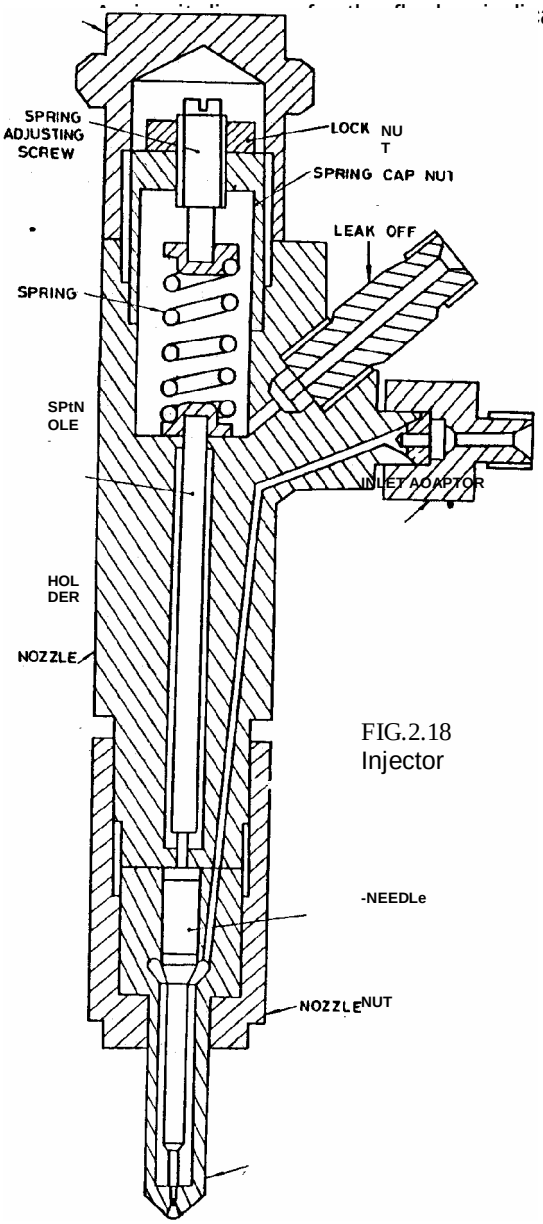


FIG.2.18 Fuel Injector

A circuit diagram for the flasher indicator is shown in

nozzle is attached to the bo!y of the injector by capnut, The fuel enters the nozzle through drillings in the injector body. The fuel may pass from a gallery down the sides of the lower parts of the needle valve, or it may through an annUlar groove in the' nozzle and pass through drillings to a point just above the nozzle seat. The body of the nozzle holder provides access for the fuel and an outlet for the fuel that leaks into the area occupied by the spring.

When the needle valve is raised from its seat by the pressure of the fuel acting on the conical or stepped face of the valve, the injection of the fuel takes place. When the injection pressure falls below the spring pressure, the valve closes. This action tends to setup an oscillation of the valve during each injection and consequently breaks the fuels into small particles. Fuel leakage past the needle valve stem enters the upper part of the injector and is returned to the pump suction chamber or to the fuel tank. Fuel leakage provides lubrication for the valve stem.

(a) SINGLE HOLE

2.9.2 TYPES OF FUEL INJECTION NOZZLES:

For adequate mixing of fuel particles with sufficient air for complete combustion of the fuel it is necessary thai the correct shape of spray suitable to the combustion chamber as well as proper penetration of the air change should be provided. There are in general four types of nozzles used in injection.

(1) Single hole (2) Multihole (3) Pintle type and
(4) Pintux type

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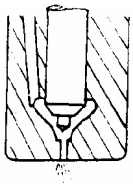
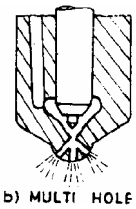
SINGLE HOLE:



A single hole nozzle FIG2.l9a has one hole at centre. The fuel is sprayed through this nozzle.

MULTI-HOLE:



(b) MULTI HOLE

PINTLE NOZZLE

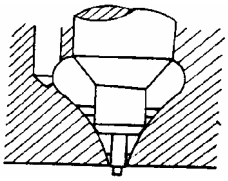
These nozzles have many holes arrani around the nozzle in a circle. The number, size, and angle of the holes may vary according to the engine.

The nozzic FJG.2.19c provides a soft form of spray operatiny at a low injection pressure of 80-100

A circuit diagram for the flasher indicator is shown in

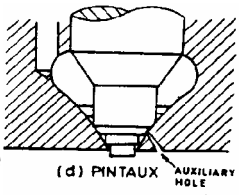
atmosphere or 8-10 KN/Sq. met. This seif clearing nozzle having a small cone extension at the end of the needle produces a conical spray pattern. As it leaves the injector, the

Nozzles



velocity of fuel increases. The emission of the conical spray between the needle pin and the orifice wall due to the pin on lower end of the needle being tapered inward, the spray cone in this type is generally kept at 600 angle.

PINTAUX NOZZLE:




With normal design of the pintle or single hole nozzle the fuel is sprayed tangentially in to the spherical chamber, of the engine. In this way the fuel is not sprayed in to the hottest zone or towards the centre of the chamber. And for cold starting the engine needs heater plugs. Therefore to overcome the heating difficulty of the engine the nozzles are designed of pintaux type as shown in

At starting the nozzle valve is lifted slightly thus the pintle hole is not cleared and the fuel is only discharged through the auxiliary hole into the central hot zone there by obtaining better cold starting performance. When engine reaches to its normal speed then the needle valve is lifted from the pintle hole of the nozzle to pass the fuel through the pintle hole and entering the chamber tangentially. In this way this type of nozzle provides both the advantage of cold starting as well as of normal runnin9 of the engine.

FUEL INJECTION PUMP -

PLUNGER TYPE:

The purpose of the injection pump is to deliver the metered amount of fuel exactly at the correct moment to the spring loaded fuel injector. The delivery pressure of this pump is of 150 to 175 atmospheres, which is sufficient to open the spring loaded valve of the fuel injector. There by allowing the high pressure fuel to spray into the combustion chambers.

CONSTRUCTION:

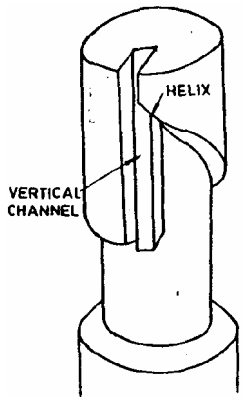
The mechanism and the most important parts of the single element pump is shown in the figure. .2.20 'It comprises a plunger and barrel; delivery valve and its seating; which are always kept together and the individual components of which are not interchangeable. The barrel consists of two inlet ports, through which the fuel enters from the gallery to the barrel. The plunger of the pump

A circuit diagram for the flasher indicator is shown in

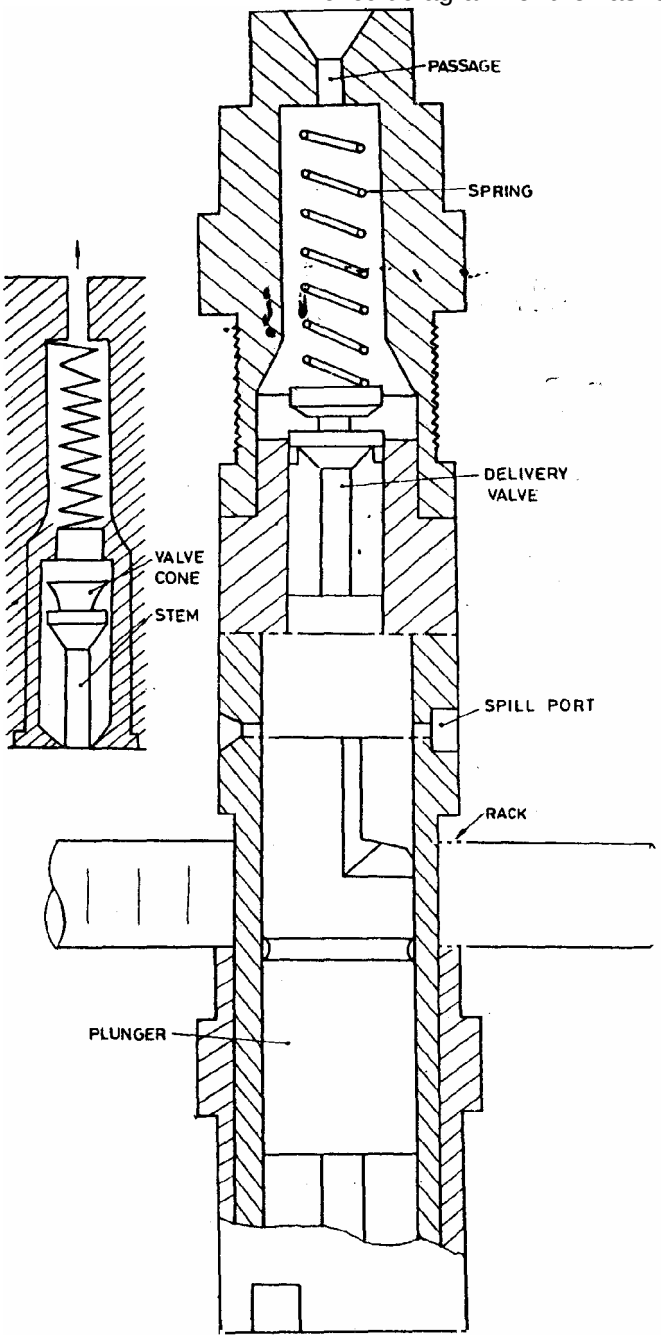
consists of a vertical channel extending from it upper edge to an annular groove, the top edge of which is cut in the form of a helix as shown in the figure. 2.20a

~ In recent designs a plunger consists of a cen:ral hole instead of the channel and a helical groove instead of helix and annualar groove. The lug or lower part of the plunger is engaged in the slot of the toothed sleeve. The rotary movement of the toothed sleeve with the plunger is con. trolled by means of sliding movement of the toothed rack,. A spring loaded delivery valve is fitted on its seating provided at the top of the pump barrel. Referring the fig. 2.20.b the force of the valve spring always presses the

delivery valve on its seat. The delivery valve is guided through its stem in the valve holder.It acts as a one



A circuit diagram for the flasher indicator is shown in




way valve and during the fuel delivery stroke it is lifted from its seat so that the fuel can flow along the longitudinal grooves and over the valve face into the delivery pipes

OPERATION:

For the working principle of the pump, say the plunger is at itE bottom dead centre start~ng

A circuit diagram for the flasher indicator is shown in

position Under this position the two fuel inlet ports are uncovered from the sides of the plunger thei~a by allowing the fuel to enter the barrel under feed pump pressure. As the plunger moves upwards the edge of it cuts-off the fuel supply. Now the space above the plunger is full of fuel. Further upward movement of plunger tends to lift the delivery valve against the pressure of its spring and hence entering the fual through the pipe to the injector. This delivery of the fuel from injection pump .remains continue till the helix of the plunger opens the port in the barrel, thus communicating the fuel above the plunger to the gallery, via the vertical slot and than cutting-off fuel delivery to the injector. The fuel delivery to the injector is increased or decreased by the rack and pinion mechanism. The movement of fuel cut-off by the plunger can be carried to any desired extent. Similarly if the plunger is rotated in such a way that vertical groove is opposite the right port, then there will be no pumping action because under this position the top of the plunger remains connected with the inlet port. This corresponds to the zero delivery and this position is called stop' position of the pump.

FIG.2.20c shows how the rotation of the plunger affects the quantity of the fuel injected.

FIGURE A:

(i) The plunger has been rotated into shut off

position.

(ii) The slot connecting the top of the plunger will the recess, is in line with the port.

(iii) No fuel can trapped and injected in this position

The starting motor or the cranking motor is direct current motor which cranks the engine for starting. Cranking the engine means to rotate the crank shaft by applying torque on it so that the piston may get reciprocating motion. The starting motor is mounted on the engine flywheel housing. It is series wound and designed to operate on large currents at low voltage. I: must be capable of ex erting a very high torque when starting and at low speeds$_4$ The armature and fields are built with thick wire to keep the resistance low and to enable them to carry large currents with out over heating. The faster it turns, the less current it draws, the slower it turns, the more torque it develops. The starting motor voltage is generally 12 volt on passenger cars.

The operation of the motor is that when the current passes through the armature then it acts as an electromagnet produced in the motor fields As soon as the armature is turned by half rotation the segments of the commutator charge brush thereby changing the direction of the current flowing through the armature winding and reversing its polarity. This action forces the armature to rotate another half revolution. This process remains Continue and thereby rotating the motor armature.

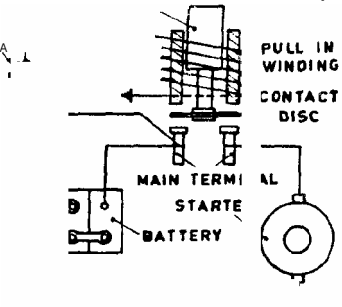
Certain forms of drive mechanism is usually provided at the end of the armature shaft. It helps the m3tor to start the engine. The starter drive is mainly concerned with the method of linking the starting motors to the engine flywheel for cranking the engine until it starts and disconnecting it automatically when the ertgine has started running. For this purpose a set of gears or a friction drive such as a gear :eduction system is generally used to engage

engage the starting motor with the engine flywheel. To provide the most efficient working condition, gear reduction of the order of 15:1 is most suitable.

5~2.1 DIFFERENT TYPES OF STARTING MOTOR:

A circuit diagram for the flasher indicator is shown in

The starting motors use U SLIDING PLUI~GER. either two pole windng or four pole winding.

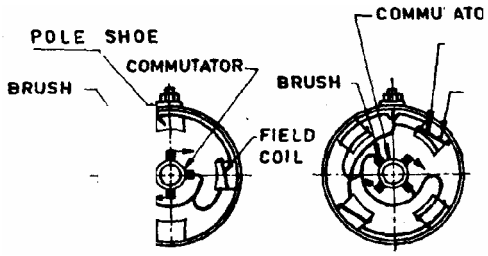



TWO POLE WINDING For light duty the motor~s are made with two pole field winding as shown in Fig 5.2. The current from the battery divides when it enters the motor, each branch leading to separate field winding from the fields the current is led to the commutator of the armature through the two insulated brushes. The current in the armature creates simultaneously *four* poles that adjacent to the face field poles to produce the attractive and repulsive forces that turns the armature. The armature current returns to the battery throught the *two* grounded brushes.

T, •R

-FIELD COIL

POLE SHOE




POUR POLE FIELD WINDING: For large engines the starting motors are made with four—pole field winding as shown in Fig. 5.3. It is used in large engine in order to develop motor torque. It operates in the same manner as the two-winding type.

5.2.2 STARTING MOTOR SWITCHE: Different types switches used to connect the starting motor with the

Two Pole

A circuit diagram for the flasher indicator is shown in

Solenoid Switch

A heavy duty foot operated switch was used in some early models. A magnetic switch, also known as solenoid switch or starter relay is used in many present day models, It consi3ts of a plunger, contact disc, winding terminals and necessary connecting cables. The switch is connected between the starting motor and the battery. The current from the battery passes through the pull in winding to form a strong electromagnet; when the Switch is on and circuit is completed to ground. The electromagnet attracts the plunger against the spring, which causes the two terminals connected by the contact disc. This makes the circuit complete between the, battery and the starting motor.

When the switch is off, the circuit through the electromagnet winding is broken. The spring moves the Plunger and the disc back to open the connection between the battery and the starting motor.

The manual switch is operated by hand. When the 2lunger is pressed, it makes contact between the two connect the battery from the starring motor.

3.2.3 STARTER MOTOR DRIVE MECHANISM:

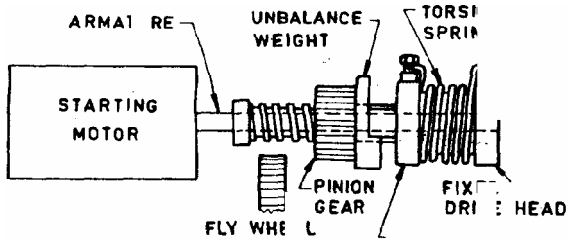
The starting motor is linked to the engine flywheel through set of gears. A pinion gear is attached fo the Starter armaure which drives a ring gear attached to the flywheel. The irrangement is so made that the two gears engage ro crank he engine until it starts and then disengage automatically

A circuit diagram for the flasher indicator is shown in

when the engine is running. The gear ratios about 15 1. The armature rotates. 1 5 times to cause the flywheel to rotate once. Thus the cranking motor requires only one fifteenth as much power as would an electric motor directly coupled to the crank shaft. The armature may revolve at about 2000 to 3000 rpm when the cranking motor is operated and hence the flywheel will rotate as high as 200rpm.

When the engine, starts, its speed may increase to about 3000 rpm. If the pinion is still in mesh with the fly wheel, it will revolve the armature at about 45000 rpm, which is very high speed. At this speed, the centrifugal force would cause the conductors and commutator segments to be thrown out to the armature damaging the motor. Hence the pinion must be disengaged from the flywheel, after the engine has started The automatic engagement and disengagement of the motor with the engine flywheel and is obtained with the help of drive arrangement.

BENDIX DRIVE:




Bendix Drive

The bendix drive is shown in Fig 5.5. The drive head is keyed to the end of that armature shaft. The pinion gear, having internal threads, is mounted on the threaded sleeve, just like a nut on a bolt. The sleeve is not connected directly to the shaft of the starting motor but uses it only as a bearing. A spring is attached to the drive head and also to the sleeve. it is fastened to the armature shaft of the starting motor

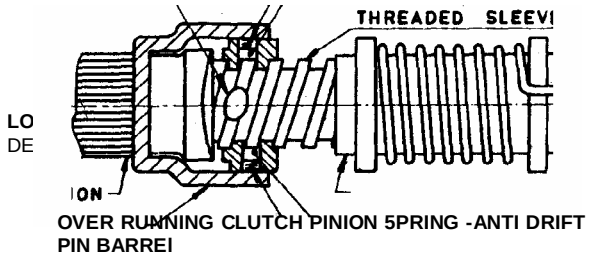
A circuit diagram for the flasher indicator is shown in

wnen we staring motor Is at rest, the pinion gear is not engaged with the flywheel. When the starting motor is switched on, the armature begins to rotate. This causes the sleeve to rotate also because the sleeve is fastened to the armature shaft through a spring. The pinion because of its inertia of rest and its unbalanced weight, turns very little, but it moves forward on the revolving bolt, until it engages with the teeth of the flywheel. The slight turning of the pinion gear helps to engage it propery with the flywheel. When the pinion gear strikes with the collar, it begins to turn the sleeve, causing the flywheel to turn with it. When the fly wheel turns, the crank shaft also turns and the engine starts. The sprinb between the armature shaft and the threaded sleeve takes the shock of the start.

After the engine starts, the pinion gear is turned by the engine much faster than when rotated by the starting motor. This causes the pinion gear to turn back on the sleeve, making it disengaged with the flywheel,

2.FOLO THRU DRIVE:

The folo-thru drive is very similar to the Bendix drive. The difference is the Folo-thru drive keeps the starting motor engaged with the flywheel untill a predetermined engine speed is reached but in Bendix drive it is not so. In the Folo-thru drive, Fig 5.6 the threaded sleeve is attached to the armature shaft through a sprral spring. A pinion is mounted on the



Fob Thru Drive

threaded sleeve. The pinion base has two small spring loaded pins, a lock pin and an anti drift pin. ‘he anti drift pin is similar to the lock

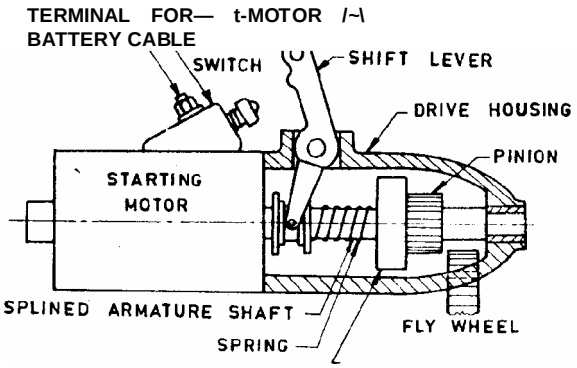
A circuit diagram for the flasher indicator is shown in

stronger spring. The anti drift pin rides on the anti drift slope on the threaded sleeve and keeps the pinion from drifting into the ring gear, when the starter is not in use. It imposes a friction drag that holds the pinion in the dissented position The lock pin drops into -a detent in the sleeve thread as the pinion moves out of the cranking position. This holds the pinion engaged with the fly wheel during cranking . It prevents the pinion from being disengaged by a false start, during which the engine might fire few times and then die. the pin Jon is thus held in engaged position, and cranking continues until the engine really gets started.

After the engine has started and the engine speed increases, the centrifugal force on the lock pin moves it out of detent, and the pinion disengaged from the flywheel.

The overrunning clutch prevents the starting from being. damaged, when the engine speed is greater than the starting motor speed. In this condition, the pinion, still engaged by the lock pin, over runs the threaded sleeve and ratchets over the clutch teeth. If the engine speed slows down the pinion automatically resumes driving the flywheel as soon as the speed of the overrunning parts decrease to the starting motor method. This int6rrnediate operation will continue until the engine speed increases to disengage the pinion from the flywheel.

3 OVER RUNNING CLUTCH DRIVE:



A circuit diagram for the flasher indicator is shown in

Fig Shows the overrunning clutch drive. The starter lever is linked to a starter pedal which extends into the driver's compartment and is operated by the foot pressure. When the starter pedal is pressed, the shift lever compresses the drive sleeves and spring which ultimately pushes to overrunning clutch and pinion gear assembly toward -the flywheel. The starter switch is closed by the shift lever when the starter pedal is fully pressed. As soon as the starter switch is closed, the pinion gear will turn and engage with the flywheel, thus starting the engine. When the engine starts, the over running clutch comes into action. The unit is so designed that, as the starting motor turns the pinion is driven through the over running clutch. But as soon as the engine starts the pinion turns much faster then the starting motor, due to which it slips back wards into the over running clutch. When the starting switch is opened, the engaging lever releases the pinion from the flywheel gear.

The over running clutch (Fig ) consists of an outer shell and the pinion collar assembly. The outer shell has fair hardened steel rollers fitted into four notches. The notches are concentric, but are smaller in the end opposite to the plunger springs. When the clutch shell is turned by the armature shaft, the rollers are wedged in the notches to force the
collar to turn wlth the shell. Since the collar drives the pinion gear, this action enables the armature to rotate the pinion cranking the engine.

After the engine starts, it turns the pinion gear faster than the armature, so that the rollers are rotated into the larger sections of the notches, where they are free. This allows the penion to over run thd remainder of the clutch. When the shift lever is released, a spring on the shift lever pulls pinion back out of engagement.

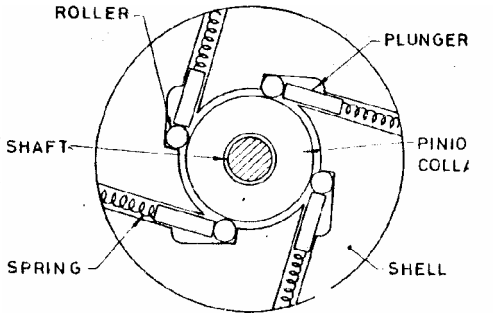



Fig Over Running Clutch

4. SOLENOID SHIFt

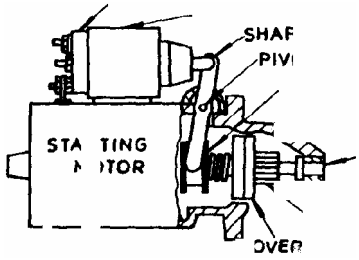



Fig.Solenoid Shift

In this system the starting motor consists of a solenoid unit provided with a soft iron plunger. When current is passed through the solenoid winding then it attracts the plunger thereby operating the shift lever thus to engage the pinion with the flywheel gear.

A circuit diagram for the flasher indicator is shown in

Tlw moment of the plunger also operates the contact disc of the direct switch. the circuits of which are shown in Fig. 5.8 The solenoid unit is provided with two windings. a shunt and a series. When the starter switch is closed then the battery current flows to both the coils. Thus due to

electromagnetic force plunger is attracted to shift the pinion *gear.* As soon as the pinion is engaged the plunger pushes the contact disc thereby connecting the motor with the batteries Under this position of the disc, the battery current also passes through the series coil which is connected parallel to the terminals. When the engine is started the current following

IGNITION SYSTEM:

The spark ignition engines require some device to ignite the compressed air-fuel mixture inside the cylinder at the end of the compression stroke. Ignition system serves this purpose. It is a part of electrical system which carries the electrical
current to spark plug which gives spark to ignite the air fuel mixture at the correct time. Some systems use transistors to reduce the load on the distributor contact points. Other systems use a combination of transistors and a magnetic pickup in the distributor. There are two types of ignition systems Used in petrol engines.

1. Battery ignition system (or coil ignition system)

2. Magneto ignition system.

Both the ignition systems are based on the principle of mutual electromagnetic induction. The battery ignition system is mostly used in passenger cars and light trucks. In the battery ignition system, the current in the primary winding is supplied by the battery whereas in magneto ignition system, the magneto produces and supplies current to the primary winding.

5. 6. 1, BATTERY COIL IGNITION SYSTEM:

Fig. 5.12 Battery Coil Ignition System

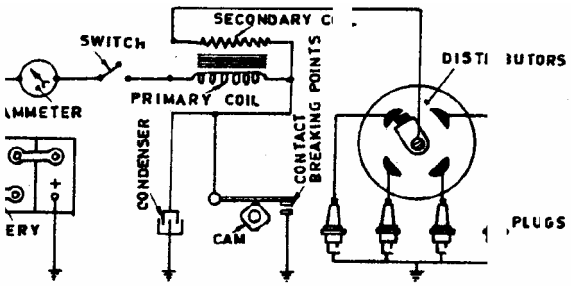



Fig. 6. 12 shows the battery coil ignition Systems. It consists of a battery, ammeter, switch, ignition coil, condenser, contact breaker, distributor and sparkplug.

The primary ignition circuit starts at the battery and passes through the switch, ammeter, primary winding contact breaker points to the ground. A condenser is also connected in parallel to the contact breaker points. One end of the condenser is connected to the contact breaker arm and

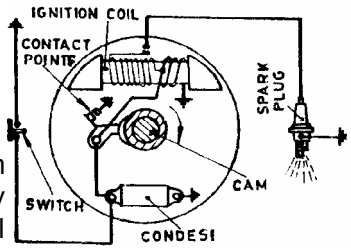
A circuit diagram for the flasher indicator is shown in

the end is surrounded. condary ignition circuit is not connected electrically to the primary ignition circuit. It starts from the ground and passes through the secondary winding, distributors, spark plug to the ground.

The ignition coil steps up 6 to 12 volts from the battery at the high tension volta9e of about 20000 to 30000 Volts required to jump the spark at the sparkplug gap, which ignites the combustible charge in the cylinder. The rotor of the distributor revolves and distributes the current to the four seg~nents which inturn, send it to the spark plugs. The purpose of the condenser is to reduce arcing at the breaker points and thereby prolong their life. Because the ignition system is four cylinder engine, the cam of the contact breaker has four lobes. It makes and breaks the contact of the primary .circuit four times in every revolution of the cam.

When the ignition switch is on, the current will flow from the battery through the primary winding. It produces magnetic field in the coil When the contact points open, the magnetic field collapses and the movement of the magnetic field induces current in the secondary winding coil. Because the secondary winding has many more turns of fine wire, the voltage increases unto 30000 volts. The primary winding consists of 200-300w turns of thick wire. About 1 5000 Volts are necessary to make the spark jump at 1 mm gap. The distributor then directs the high voltage to the proper spark plug when it jumps the gap, producing a spark which ignites the combustion mixture in the cylinder.

5.6. 2. FLY WHEEL MAGNETO OF TWO WHEELERS:




The magneto ignition system generates the ignition current on its own. It does not depend on any battery or generator, This system is used in motor cycles. It is also still being used in a few vehicles such as tractors and fire engines.

A circuit diagram for the flasher indicator is shown in

Figure  shows the fly wheel magneto of two wheelers. When the fly wheel is rotating, the cam also rotates.This cam breaks the contact points. There is acondenser,contact breaking points and an inductioncoil.The induction coil,contact breaking point sand condenser do not rotate The horse shoe magnet which fitted with the Fig. Fly Wheel flywheel is also rotated.Magneto of Two Wheelers

5. 7. IGNITION COIL:

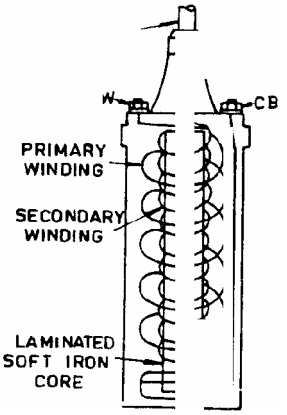



Fig Ignition Coil

The ignition coil is a transformer which steps up 6 td' 12 volts of the battery to the 6,000 to 20,000 volts, thereby obtaining a spark at the electrodes of the plug.

Referring fig. 5. 14 the ignition coil consists of a metallic clad or case in which an iron core is placed. The inner cylindrical surface of the case is HIGH TENSION provided with a magnetic yoke. The coil consists of two 'Windings the primary and the secondary. The primary winding contains about 200-300 turn of copper wire of about 20 SWG and the secondary winding contains about 15,000 . 20,000 turns of copper wire about 40 SWG. The winding wires are provide with a thin coat of enameled insulation.

First the secondary coil is wound over the core and then the primary winding is done over it. The two terminal so the primary winding are taken out from the case, one of which connected to the battery and the other with the contact breaker arm as shown in the Fig Out of two ends of the secondary winding one is connected to the spark plugs through the distributor while the other end is starthned by means of interconnection with the primary winding. The lower end of the iron core is

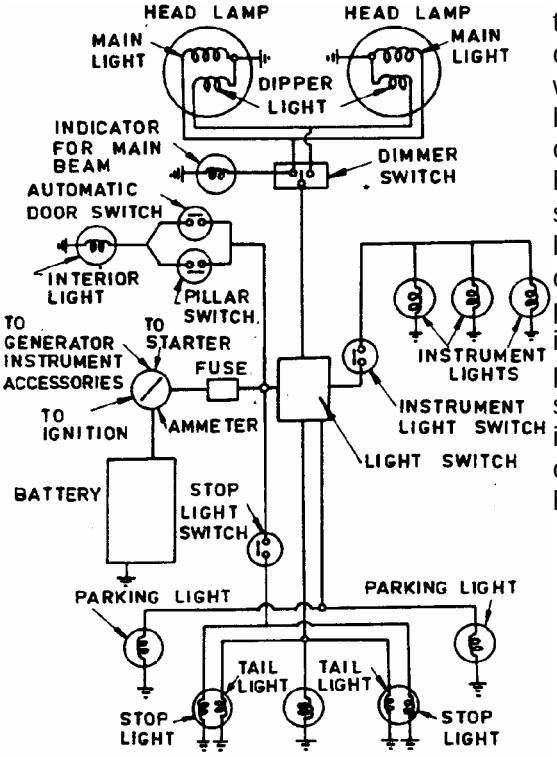
A circuit diagram for the flasher indicator is shown in
installed in the porcelain base while the upper end is supported in a bakelite cap provided at the top of the case.

In primary circuit the contact breaker points are opened and closed by means of rotating cam provided in the distributor. When the ignition switch is on and the contact breaker points are closed then the current from battery flows through the primary winding and which builds up a magnetic field. When the breaker points are in open position and this magnetic field collapses, cuts across the secondary winding and induces a high voltage. The induction of the voltage depends upon the rate of collapse of the magnetic field as well as the ratio of secondary to primary turns on the coil windings. This high voltage intern when supplied to the spark plugs then it produces spark across them which ignites the fuel air mixture already compressed in the engine cylinder.

In order to illuminate the roads and highways sufficiently for safe night driving a lighting system is generally used in motor vehicles.

LIGHTING SYSTEM

As shown in Fig the circuit starts from battery. After passing through the ammeter or charge indicator and a fuse or circuit breaker it reaches the particular light switch. The brake system controls the stoplight circuit by stoplight switch which is closed when brakes are applied. The light switches provided on the instrument panel control all other lights. Three positions parking, head lamp and *off* positions are provided in this switch: The circuit to the parking' lights, tail lights license plate light and instrument light is completed when this switch comes in the parking position. In the head lamp positions, the current is sent to all the head lamps, tail light, license plate light and instrument plate by the light switch. A foot operated dimmer switch which indicates whether the current goes to the upper or lower beam fil aments is also provided in the head lamp circuit.



A circuit diagram for the flasher indicator is shown in

In order to protect those lights from over loads and short circuiting, a common fuse or circuit breaker or separate set off fuses for each individual light are provided~

DIRECTION INDICATING SYSTEM:

Directional signals are used in most cars to indicate the in which 'the driver intends to turn his car. The lighting circuit of directional signals is connected to that at Fig. of the parking lights in the front and rear of the car, so that the attention of the other drivers, coming from the front or rear is carefully attracted while the car has to take a turn. It actually prevents the accidents. The light of the directional signal flashes about 80 times per minute to attract the other drivers. The directional signals are attached on each side of the car and the flashing light is visible from both the front and rear sides.

The direction signal lights are operated either manually or automatically. The switch lever for operating the mechanism is located under the steering wheel or opposite to the gear shift lever, and is flipped down for left turns and up for right turn. The automatic turn off is accomplished by a mechanism that breais the circuit when whell turns to straight ahead position. The right and left pivot lamps on the instrument board in the form of arrows flash when the directional signals on the corrosponding sides in operation.

FLASHER UNIT

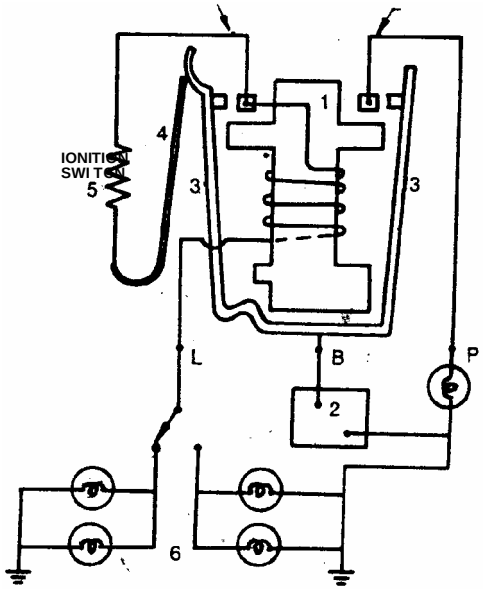


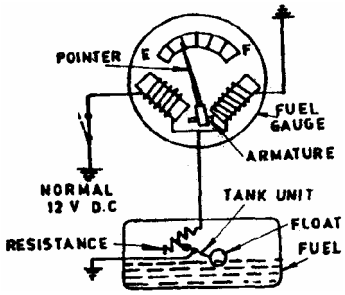

Fig In this there is an electromagnet coil winding. One main armature and contacts, and other secondary armature and pilot contacts. The actuating wire has a special property. ie its length increases when it is heated by a current and decreases when it cools down.

In the figure the current flows from the battery to terminal(B). norm this point the current flows to point (L) through blade, the left open contact, actuating wire, ballast resistor and fixed contact

Further it goes around the electromagnet coil winding and reaches point(L). From (L) the current flows to the two indicator lamps. (right or left) In this stage the reduced current flows in the cfrcuit. This reduced current is not sufficient to illuminate the lamps. When the current flows through the actutating wire it expands. There is a contact at the end of the left hand blade. This contact meets

A circuit diagram for the flasher indicator is shown in
other fixed contact. This happens due to the attraction of the electromagnet pole prece. Now the actuating wire and ballast resistance cut out of the circuit. So full current flows from terminal (B) to terminal (L) along the closed contact round the coil winding. Thus the lamps get illuminated. When the actuating wire cool down, it break the contact. Full current is then cut out from lamp. Thus, the full current flow and much reduced flow take place alternately. This series causes the periodical flashes at flasher lamps.

FUEL GAUGES:




FuelGauge

The fuel gauging system consists of a fuel gauge mounted on the dashboard and tank unit in the fuel tank, the circuit diagram being shown in Fig The fuel gauge indicates the level of fuel in the tank according to the position of the tank unit float, a limited reserve of fuel being present in the tank when the gauge shows 'empty'. The hinged float rises and falls according to the level of the fuel, and moves a contact arm over a resistance coil. In this way the current following in the circuit is varied. and the variation is communicated to a meter mounted on the facial the meter being calibrated to indicate the quantity of fuel in the tank.

OIL PRESSURE GAUGE:

An oil pressure gauge mounted on the instrument panel of all cars equipped with pressure lubricating system to- tell the driver what the oil pressure is in the engine. shows balancing coil type pressure gauge. It consists of two separate units the engine unit and the indicating unit. The engine unit consists of a moving contact Pressure Gauge that moves over resistance according to the varying oil pressure against a diaphragm. As the pressure increases, the diaphragm moves inward which the contact moves along the resistance so that more resistance is placed in the circuit between the engine and indicating unit. This reduces the amount of current flowing in the circuit. The indicating unit consists of two coils that balance the movement of the pointer on a scale, in a manner similar to electrically operated fuel gauge.

5. 16. TEMPERATURE GAUGES:

To know the temperature of the engine while it is running, is an important consideration because a slight negligence may cause a serious engine accident. The engine temperature is indicated by means of a gauge mounted on the dash board of the drivers Cab. If the temperature goes too high than the
driver at once stops the vehicles and gets the engine to be coded.

shown electrically operated temperature guago. It consists of two units, engine unit and

A circuit diagram for the flasher indicator is shown in

dash unit. The dash unit consists of two coils, pointer, armature and a dial. The engine unit consists of a resistance which is effected with the variations of engine temperatures. Engine unit is connected to the coil A of dash unit with the help of a metallic wire. The coil B of the dash unit is connected through an ignition switch to battery. As the temperature of the engine increases, the value of the resistance decrease thereby flowing more current through the A, and increasing the e.m.f. built up there, Under this condition a magnetic pull towards coil A is developed on the armature. This action moves the pointer attached with the armature to show the higher temperature on the dial.

## 5. 17. WIRING CABLES:

In order to carry current to the various electrical units and components, cables are used. For easy identification, the cables having different colored covers should be used for different circuits particularly the cables emerging from a protective joint or junction box. Many simple circuits involve the component, its switch and three wires, feed, switch wire and return are considered to be included in the electric system of a motor vehicle. Generally feed wires as