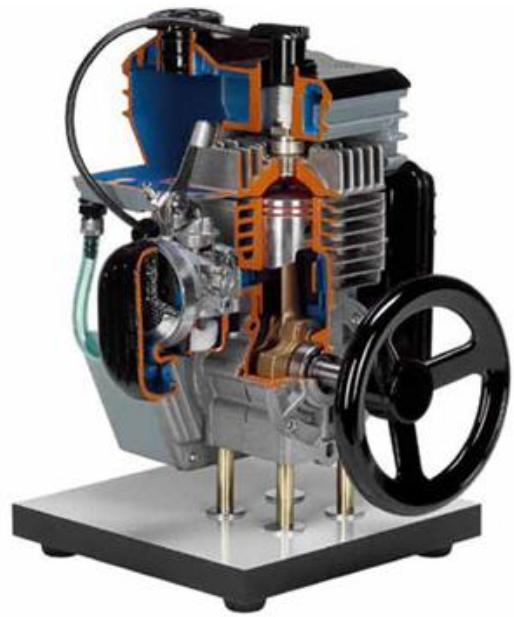
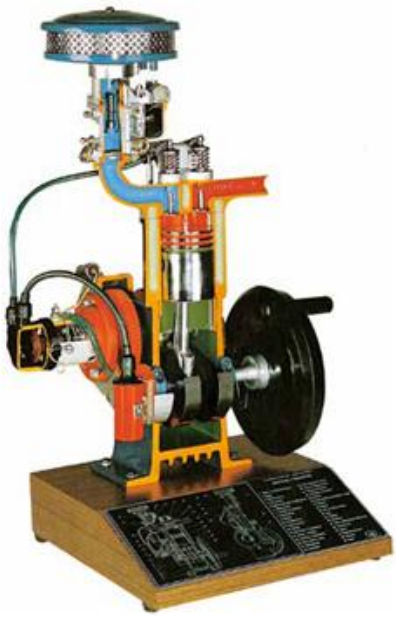
Auto farm and Farm machinery Lab Manual
of
ICD Programme (Automobile and IC Engines) (ME-321)
(6th Semester)





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GENERAL INSTRUCTION

1. All the students are instructed to wear protective uniform, Shoes and identity card before entering into the laboratory.
2. Before starting the exercise, students should have a clear idea about the principal of that exercise.
3. All the students are advised to come with completed record and corrected observation book of pervious experiment.
4. Do not operate any instrument/machine without getting staff member's prior permission.
5. The entire instrument is costly. Hence handle them carefully, to avoid fine for any breakage.
6. Utmost care must be taken to avert any possible injury while on Laboratory work. In case, anything occurs immediately report to the staff members.
7. One student from each batch should put his/her signature during receiving the instrument in instrument issue Register.

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List of Experiments

ME-321 ICD Programme

Automobile and IC Engines Lab (6th Semester)

Syllabus

Title of course	**:**	**Automobile and IC Engines Lab**
Subject code	**:**	**ME-321**
Weekly load	**:**	**4**
LT P	**:**	**0 0 4**

List of Experiments

1. Study and working principle of two strokes Petrol Engine.
2. To dismantle and assemble the given four stoke petrol engine used in bikes and to identify the parts.
3. To learn how to dismantle, clean, inspect, overhaul, and assemble the given SOLEX carburetor.
4. Study and operation and working of hydraulic brake system.
5. To dismantle, inspect and assemble of leaf and coil spring used in truck.
6. Study the working and operation of Steering system used in car.
7. Study the working, operation and maintenance of Ignition system.
8. Study the working, operation and maintenance of cooling system.
9. Study the various parts and working of lubrication system used in automobiles.
10. Study and maintenance of lighting system components used in automobiles.
11. Performance test of Internal Combustion engines.

	Sant Longowal Institute of Engineering & Technology Longowal-148106 (Govt of India)	**LAB MANUAL** Auto farm and Farm machinery Lab
	Practical Experiment Instruction sheet **Experiment No.01**	Subject Code: ME-321 Class: Automobile and IC Engines

AIM: - Study and working principle of two stroke Petrol Engine.

EQUIPMENT REQUIRED: - Model of two-stroke petrol engine.

THEORY: - The two-stroke engine was developed by Sir Duglad Clerk in 1881 and further improved by Joseph Day in 1891. The cycle of operations Viz. suction, compression, expansion and exhaust can be completed in two strokes of the piston or one revolution of the crankshaft
(Two strokes are overlapping with each other.)

CONSTRUCTION: - The main engine components are: -

i) Piston with a deflector
ii) Cylinder block with three ports – Intake, Transfer and exhaust ports.
iii) Crank case
iv) Connecting rod
v) Crank wheel and flywheel
vi) A carburetor
vii) Intake and Exhaust manifolds

WORKING PRINCIPLE OF TWO STROKE PETROL ENGINE: -

The working principle of a two-stroke petrol engine is discussed below: -

FIRST STROKE: -

To start with let us assume the piston to be at its bottom dead center position (BDC). The arrangement of ports is such that (Connected to crankcase) the piston performs two jobs simultaneously

As the piston starts rising from its dead center position, it closes the transfer port. The charge (Mixture of air and petrol), which is slightly compressed. At the same time with the upward movement of the piston, vacuum is created in the crank case (which is gas tight). As soon as the inlet port is uncovered. The fresh charge is sucked in the crankcase. The charging is continued until the crankcase and space in the cylinder beneath the piston is filled with the charge. At the end of this stroke, the piston reaches the Top Dead Center (TDC) position.

SECOND STROKE: -

Slightly before the completion of the compression stroke, the compressed charge is ignited by means of a spark plug.

Pressure is exerted on the crown of the piston due to the combustion of the charge and the piston is pushed in the downward direction producing some useful power. The downward movement of the piston will first close the inlet port and then it will compress the charge already sucked in the crankcase.

Just at the end of power stroke, the piston uncovers the exhaust port and the transfer port simultaneously. The expanded gases escaping through the exhaust port and at the same time the fresh charge which is already compressed in the crank case, rushes into the cylinder through the transfer port and thus the cycle is repeated again.

The fresh charge, coming into the cylinder also helps in the exhausting the burnt gases out of the cylinder through the exhaust port. This is known as scavenging. A little amount of fresh mixture also is lost in this process.

The scavenging of the brunt gases can be improved by providing a ridge in the piston crown, nearer to the transfer port. This ridge that it can sweep the brunt gases, near the cylinder head before driving them out through the exhaust port.

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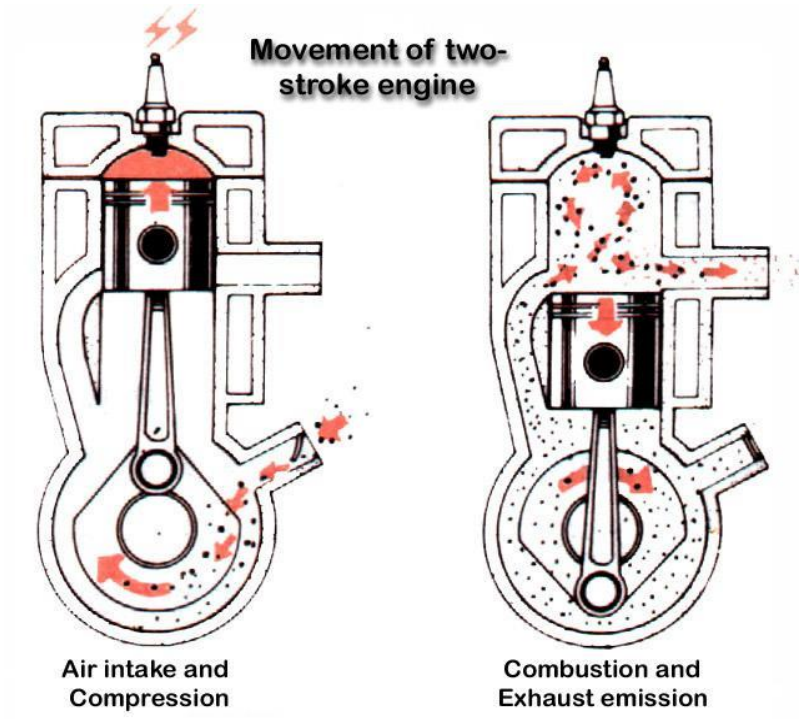

Fig. 1.1: Working of two stroke Engine.

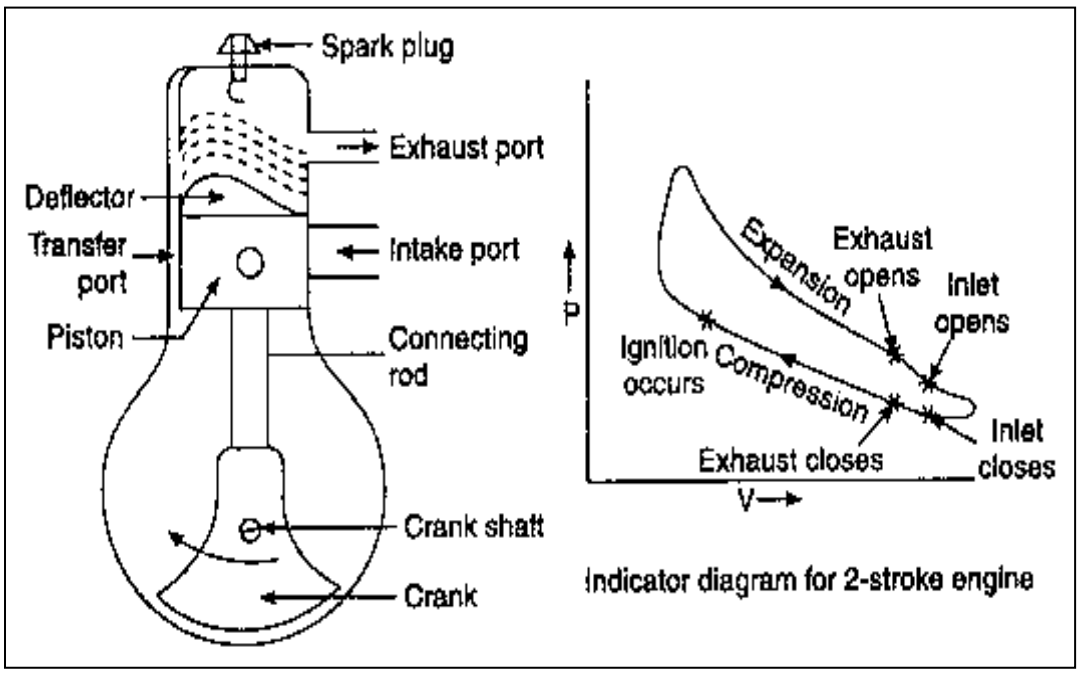

Fig.1.2: Two Stroke Petrol Engine.

AIM: To dismantle and assemble the given four stoke petrol engine used in bikes and to identify the parts.

TOOLS REQUIRED:

1. Double end spanner set. 2. Ring end spanner set.
3. Box spanner set. 4. Hammer
5. Cutting plier. 6. Torque wrench
7. Feeler gauge 8. Screw driver
9. Emery paper

PROCEDURE:

1. Remove the connection from the battery
2. Remove the drain cock from the radiator and drain the water.
3. Remove the drain plug from the oil sump and drain the oil.
4. Remove the air cleaner, valve, carburettor, rock arm assembly, push rod, and rocker arm lubrication tube.
5. Then loose the engine head bolts and remove the gaskets carefully. Then remove the engine head and place it on a workbench.
6. Punch the valves and with the help of lock washer valve spring compressor remove the valve spring, valve lock cup and remove the valves from the head.
7. Clean the valves, rocker arm, pushrod, tappet, valve guide, valve spring, valve lock cup etc. if any parts are damaged replace it with new one.
8. After removing the carburettor from the engine body, dismantle all the parts from the carburettor and clean it using petrol and compressed air.
9. Remove the inlet manifold and exhaust manifold from the engine block and remove the gaskets carefully.
10. Clean the inlet manifold using petrol and remove the carbon from the exhaust manifold with the help of wire brush and finally clean the manifold by kerosene.
11. Then assemble all the parts by reverse of dismantling procedure. And check timing and adjust the distributor for correct advance.
12. Then start the engine and correct the low speed screw, needle screw and fit the air filter.

RESULT: Thus the given four-stroke petrol engine was dismantled, parts are identified and assembled.

WEB LINK FOR REFENCE: https://www.youtube.com/watch?v=NbELVzHNeYI

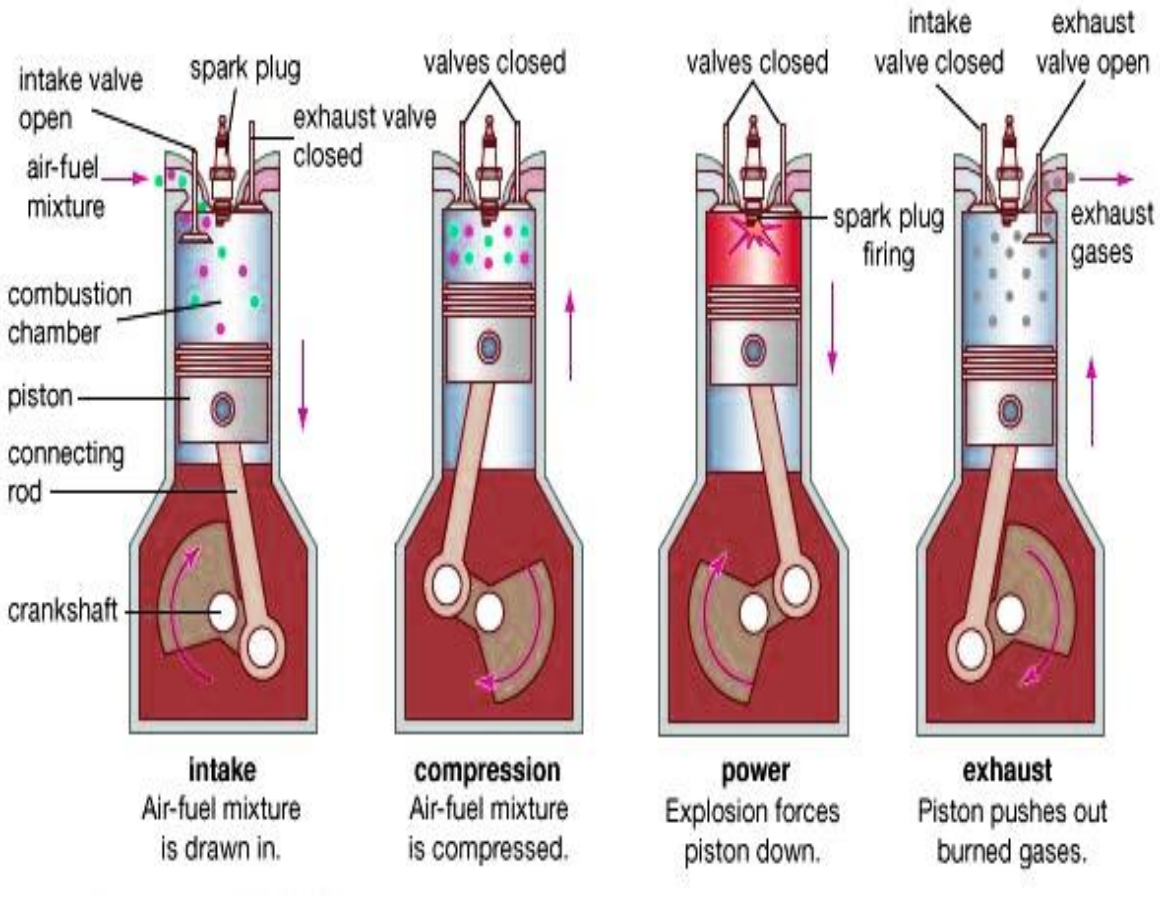

Fig.2.1: Working of four stroke Petrol Engine.

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	Practical Experiment Instruction sheet **Experiment No.03**	Subject Code: ME-321 Class: Automobile and IC Engines

AIM: To learn how to dismantle, clean, inspect, overhaul, and assemble the given SOLEX carburetor

TOOLS AND EQUIPMENTS:
1. Double end spanner set.
2. Ring spanner set.
3. Box spanner set.
4. Hammer.
5. Screwdriver.
6. Emery sheet.
7. Solex carburetor
8. carburetor tool kit

PROCEDURE:
1. Disconnect the fuel lines and remove the air cleaner.
2. Remove the carburetor and cover the manifold holes with proper covering.
3. Remove the accelerator jet.
4. Remove the float chamber cover and then remove the pilot jet.
5. Clean the needle valve, acceleration pump and the non-return valve by petrol and test for,
    5.1 Fuel leakage
    5.2 Broken gasket
    5.3 Proper vent in float chamber
    5.4 Leakage in needle valve
    5.5 Broken pump leather washer
6. Make sure the condition of the gasket while replacing.
7. Mount the carburetor in its place and re-connect the fuel lines and the air cleaner
8. Start the vehicle and check its performance.

RESULT:
Thus, the Solex carburetor is dismantled, inspected, overhauled and assembled.

WEB LINK FOR REFERENCE: https://www.youtube.com/watch?v=QOnHVExumjY

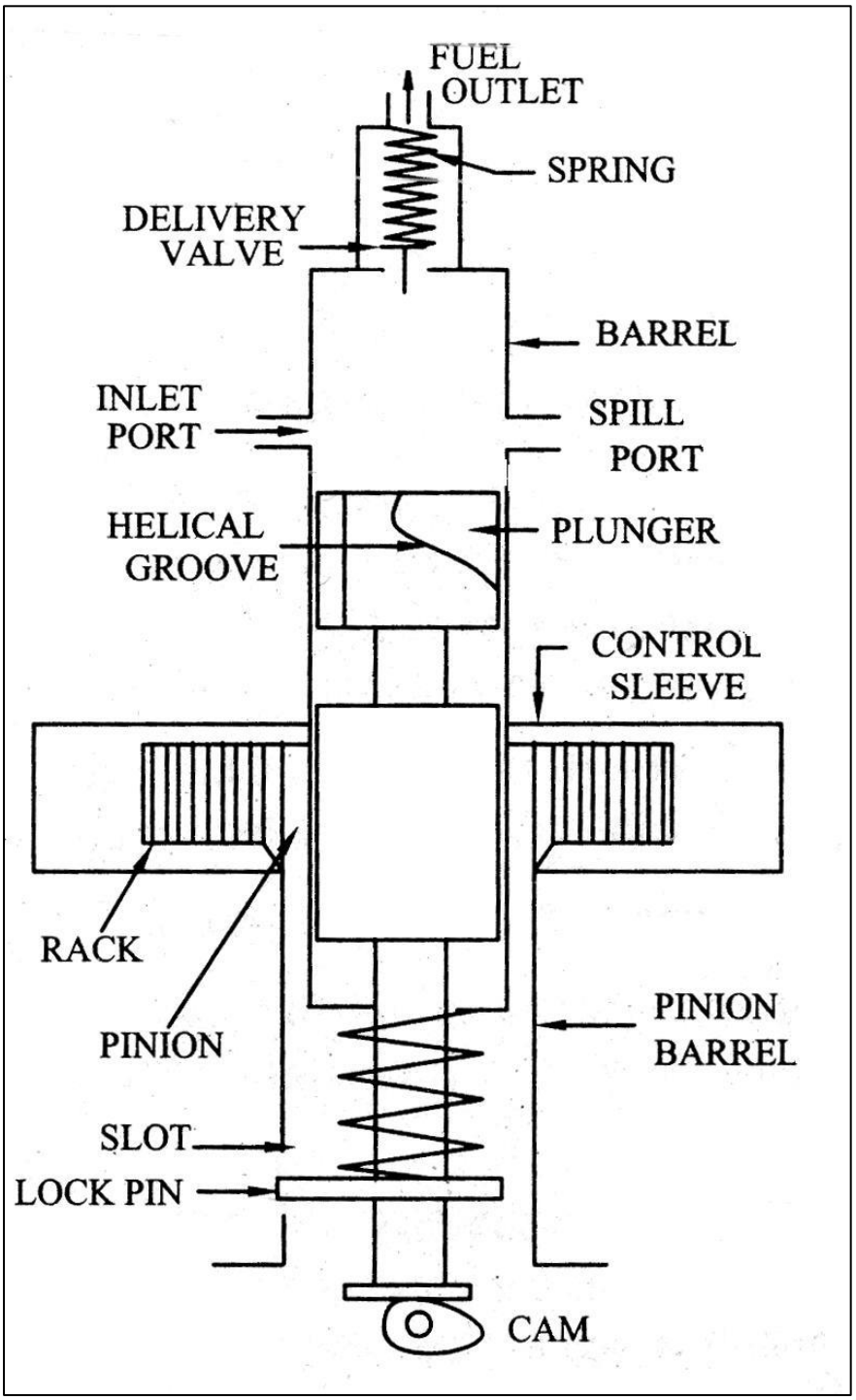

Fig.3.1: Line diagram of carburetor.

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	Practical Experiment Instruction sheet	Subject Code: ME-321 Class: Automobile and IC Engines
	Experiment No.04	

AIM: - Study and operation and working of hydraulic brake system.

REQUIREMENTS: - working model of a hydraulic brake system

INTRODUCTION:- brakes are an important safety system in all transport vehicle it may defined as that force which stops any motion brakes are apply to slow down or stop the motion of vehicles there are many types of brakes as hand brake, mechanical brake, hydraulic brake vacuum servo assisted hydraulic brake and air brake. Now a day's hydraulic and power brakes are mostly used in automobile.

CONSTRUCTION AND OPERATION OF MECHANICAL BRAKE SYSTEM: -

A fixed brake plate attached to the axle housing. A fulcrum is this fixed plate at the bottom. Two brake shoes are fixed to it these shoes are lined on the outer side asbestos or fiber material. A revolving cam is fixed to the top of the brake plate when the cam rotates these two brake shoes expand. A spring connects both the brake shoes and brings them closer. The cam is shown linked by mean of camshaft & a lever. The lever is operated with rod by mean of a pedal. When the pedal is pressed, the cam rotates by slight amount because of the links. This pushes the ends of the brake shoes outward. These brake shoes press against the inner portion of the brake drum thus the rotating wheel is fully stopped. When the brake pedal is released, the spring brings both shoes closer. The pressure on the inner portion of the brake drum is removed. The wheel is thus relieved of the grip of the brake shoes. This is how a mechanical brake is operates.

There is one fulcrum for each brake shoe. The mechanical brake linked to all the four wheel of the vehicle by means of proper links. When the pedal is operated the cam on all four wheels is simultaneously rotated. Now the brake shoes on all the four wheels are also in operation. These simultaneously grip the brake drum in all four wheels. When the brake pedal is released, the springs in these brake shoes bring the brake shoes closer the grip on the inner portion of the brake drum is thus relieved. The wheels are now free to rotate.

CONSTRUCTION AND OPERATION OF HYDRAULIC BRAKE SYSTEM: -

In the hydraulic brake system five cylinders filled with a liquid. The cross-section of each cylinder is 1 cm sq. A certain force say 10 kg is applied at the central main cylinder. The liquid in the entire cylinder supports these weights. This shows that the pressure at the central main cylinder is the same as that in the other entire four cylinders. This is the principle of hydraulic brake system.

In hydraulic brake system there is one master cylinder and four-wheel cylinders. Every wheel cylinder contains two pistons, which move outward. The hydraulic fluid flows from the master cylinder to the four-wheel cylinder with the help of suitable pipes.

Springs are used to hold the brake shoes on all four wheels. When the brake pedal is pressed the piston in the mater cylinder forces the liquid out of the cylinder. This liquid presses the two pistons in the wheel cylinder outward. These two pistons push the brake shoes outward. The brake shoes in turn press against the brake drums. The wheels are thus stopped.

When the brake pedal is released, the master cylinder is pushed backward. This is done by a spring fitted in the master cylinder. The springs of the brake shoes bring the shoe closer. At this time the two pistons in the wheel cylinder also comes closer. The liquid in the wheel cylinder pushed outwards through the pipes. It returns through the pipes to the master cylinder. This is how the hydraulic system of the four wheels operates.

WEB LINK FOR REFERENCE: https://www.youtube.com/watch?v=k5V4cSHkm0I

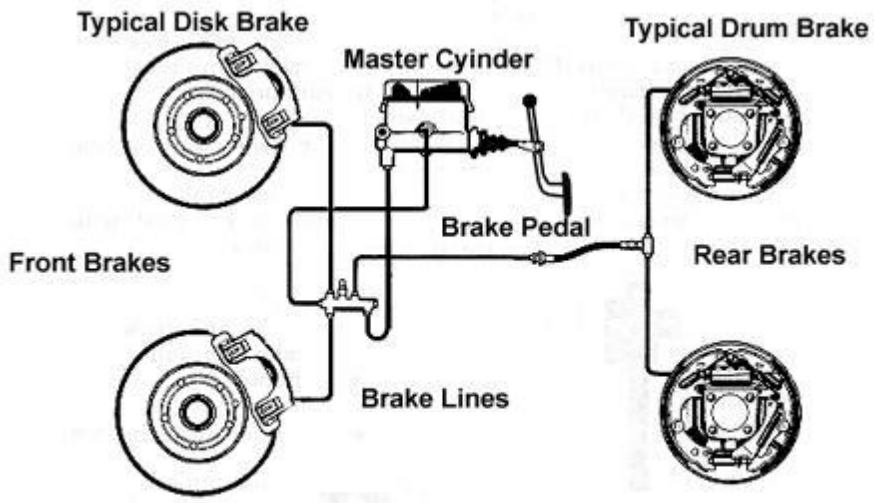

Fig.4.1: Hydraulic brake system.

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	Practical Experiment Instruction sheet **Experiment No.05**	Subject Code: ME-321 Class: Automobile and IC Engines

AIM:
To dismantle, inspect and assemble of leaf and coil spring used in truck

TOOLS AND EQUIPMENT:
Spanner sets, Screw jack, horse, vehicle.

PROCEDURE:

DISMANTLING AND ASSEMBLING OF LEAF SPRING:
1. Jack up the vehicle using screw jack. Horse stand is placed under the axle for support.
2. The leaf spring assembly is removed from the chassis by losing the bolts at two ends and U bolt. Remove the shackle, bush, pin.
3. All clips are removed. The spring plates are inspected separately for any breakage.
4. Due to continuous use, the spring assembly gets sagged or gets straightened.
5. Under these circumstances, the spring plate is hammered throughout is length by placing on a special fixture which will give designed cure. This operation is called re-cambering of spring.
6. Proper lubricant is applied and then all springs are assembled.
7. When the shape of spring is different from one another, the opposite spring must also be re-cambered.

DISMANTLING AND ASSEMBLING OF COIL SPRING:
1. Jack up the vehicle. The wheels are removed.
2. The shock absorber is removed.
3. Now, the upper and lower wish bone arms are free and so, the coil spring can be removed easily.
4. The coil spring is tested on compressive load, if change in length is found; it's deviated from the manufacture's specification. Spring is replaced with new one.
5. Rubber pad is checked for any damage. Then refit the coil spring in vehicle.

RESULT:
Thus, the Leaf and Coil spring is dismantled, inspected, and assembled.

WEB LINK FOR REFERENCE: https://www.youtube.com/watch?v=_gbSQuQlwhY

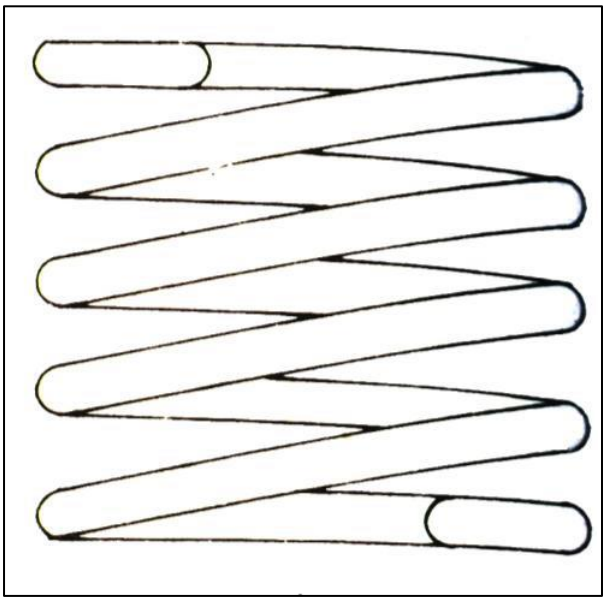

Fig. 5.1: Coil Spring.

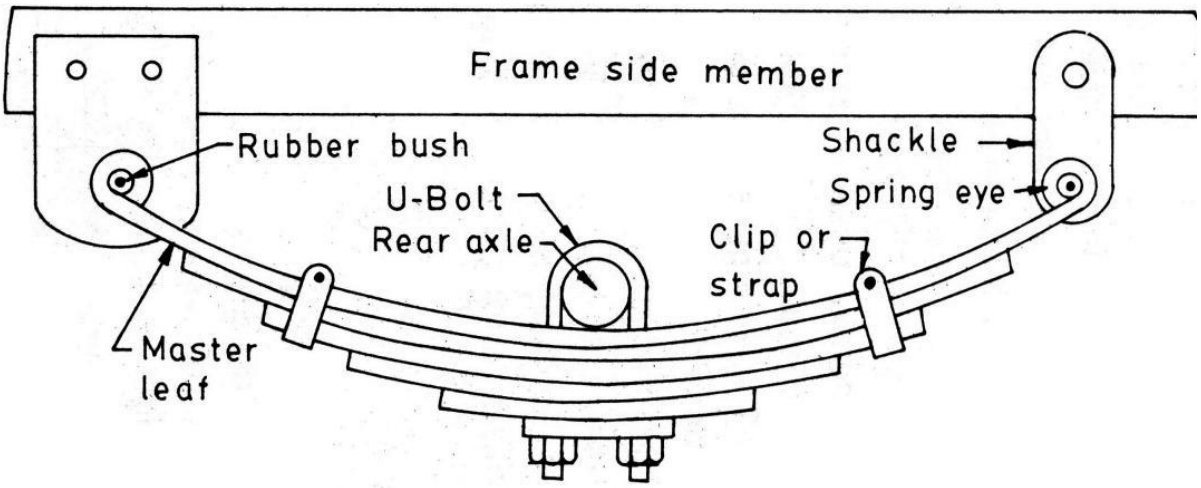

Fig. 5.2: Leaf Spring.

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	Practical Experiment Instruction sheet	Subject Code: ME-321 Class: Automobile and IC Engines
	Experiment No.06	

AIM: - Study the working and operation of Steering system used in car

REQUIREMENT: - An old working steering gear box of automobile.

FUNCTION: - It is the system, which provides directional change in the performance of an automobile. The function of a steering system is top convert the rotary movement of the steering wheel in to angular turn of the front wheels.

FIFTH WHEEL STEERING SYSTEM:-

It is single pivot steering system in which the front axle along with the wheels moves to right or left. The movement to the whole axle and wheel assembly is affected by mean of a steering and a wheel, which is placed between the chassis frame and axle. The fifth acts as a turntable. The axle assembly is connected with the frame by means of a pine, which serves as a pivot around which the axle assembly moves. The fifth wheel contains a ring gear mounted at its rim and is moved by means of a steering. Movement of the steering wheel tends the front axle and wheel assembly to move away.

ACKERMAN STEERING SYSTEM:-

It is double pivot steering system. This divided axle steering system works upon the Ackerman principle in which a line intersecting each steering king pine and tie rod end would intersect at or near the differential.

In this type of steering system the front axle is fixed with the frame through the springs in conventional suspension system. The stub axle are pivoted with the axle beam by means of king pines. The steering knuckle arm is attached to stub axle by means of which the wheel is turned through the steering. Steering knuckle arms on both stub axles are connected through tie rod.

COMPONENT OF STEERING SYSTEM: -

The steering system is composed of the following elements: -

1. Steering wheel
2. Steering column
3. Steering gear
4. Pitman or drop arm
5. Steering knuckle
6. Stub axle

STEERING WHEEL: -

It is circular wheel mounted at the steering shaft and acts as a control to steer the vehicle. A horn push bottom is fitted at its hub. In modern cars, the push bottom has been replaced by a push ring, which is placed inside

the steering wheel. The steering hub some times contain trafficator switch, lighting switch or selector lever for controlling automatic transmission.

STEERING COLUM: -

It is a hollow shaft enclosed by casing. At its upper end steering wheel is attached and at the lower end steering gear is employed.

STEERING GEAR: -

The steering box enable the driver to exert a large force on the road wheel with minimum effort applied at the steering wheel it also changes the rotary motion of the steering wheel into lateral movement of the tie rod.

Steering wheel ratio vary from 12:1 on the to 35:1 on heavy commercial vehicles

The steering gear can be classified as under.

1. Worm and wheel
2. Warm and sector
3. Warm and roller
4. Screw and nut
5. Cam and lever
6. Rack and pinion.

PITMAN OR DROP ARM: -

It is a lever, which is attached to the steering sector shaft. It converts rotary motion of steering shaft in to straight-line motion through the steering gear and sector shaft. It swings like the pendulum of a clock when the steering wheel is rotated. It creates a pulling and pushing effect at the steering knuckle through drag link or pull and push rod resulting in turning of the road wheels.

STEERING KNUCKLE -

It is the arm sometimes known as steering spindle, which is integrated with the stub axle of its movement around the pivot, which is known as the kingpin. The steering effort is conveyed to the steering knuckle by mean of steering linkage for turning the road wheel to the right or left direction. Each stub axle has its own steering knuckle arm, which is connected with each other through tie road.

POWER STEERING: -

The power steering system is operated by fluid under pressure. The fluid used is oil of viscosity rating SAE 5W or SAE10W or higher depending upon atmospheric condition.

The principle of working of all the power steering systems is same. The slight movement of the steering wheel actuates the valve so that the fluid under pressure from the reservoir enters on the appropriate side of the cylinder, thereby applying pressure on one side of piston to operate the steering linkage, which steers the wheel in the appropriate direction.

WHEEL ALIGNMENT: -

This relate to the relative position of the wheel for obtaining true and free rolling movement over the road. The smooth operation of steering depend much upon on the while alignment.

Wheel alignment is the mechanics of adjusting the interrelated factors, which influence steering. The important alignment factors are as under: -

1. Caster
2. Camber
3. Toe-in

CASTER: -

The king pin or the steering axis is tilted forwards or backward from the vertical. The backward tilt from the vertical is known as positive caster and forward tilt as negative caster. The caster measured in degrees is kept between 2 degree and 7 degree. Increased amount of caster and play in steering linkage leads to excessive front –wheel wobble.

CAMBER: -

To fulfill the condition for center ---point steering, the front wheel are generally tilted outward from the top and inwards at the bottom. This is done by making the stub axles pointing downwards. The angle between the vertical line and the tyre centerline is termed as camber. The camber is negative if the wheel tilts inwards at the top and is positive if it tilts outwards at the top. The camber is measured in degrees.

TOE: -

The adjustment for gathering the wheels inwards at the front is known as toe-in . It means that the distance between the front wheels at the front is less than the distance at the back. Toe-in wheel have the tendency to run inward. Positive cambered wheels have tendency to roll outward. When toe-in and camber are properly combined, it results in rolling the wheel in a straight line.

WEB LINK FOR REFERENCE: https://www.youtube.com/watch?v=n38xSyR828g

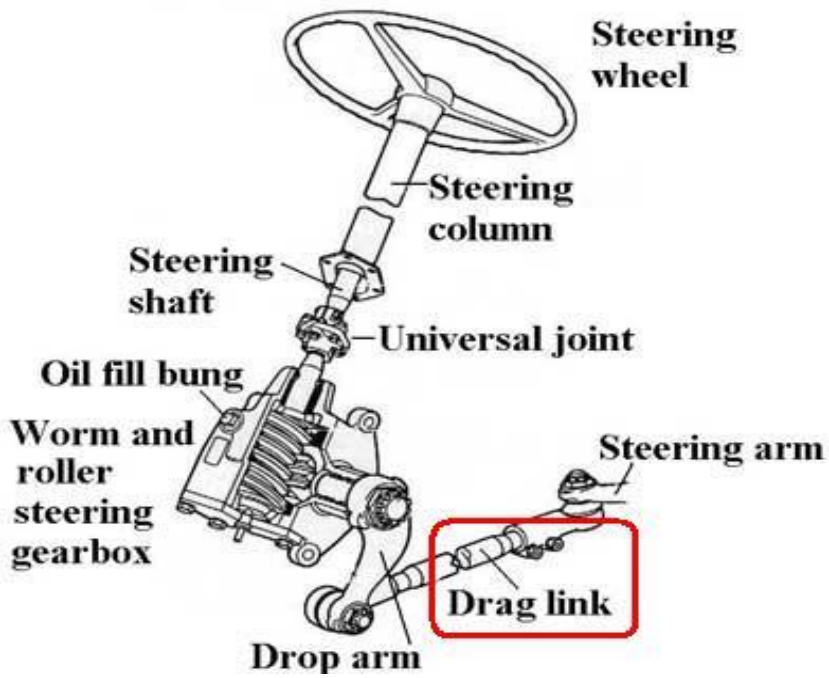

Fig.6.1: Steering system.

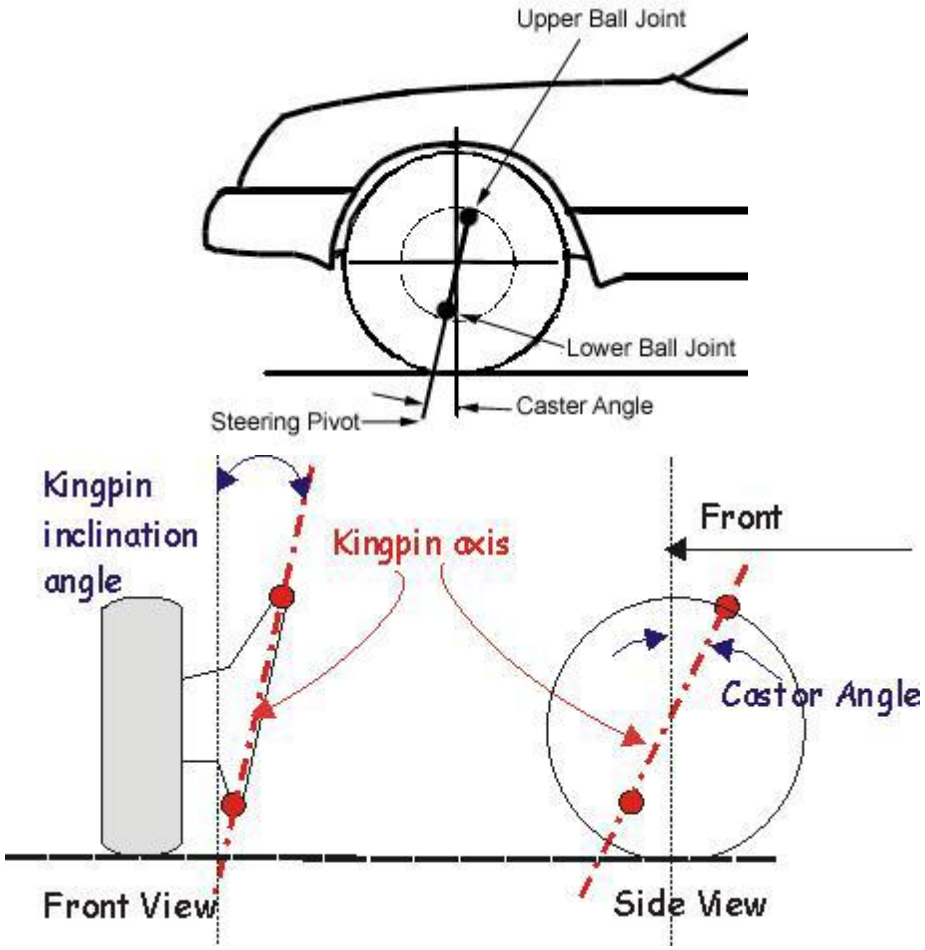

Fig.6.2: Caster Angle.

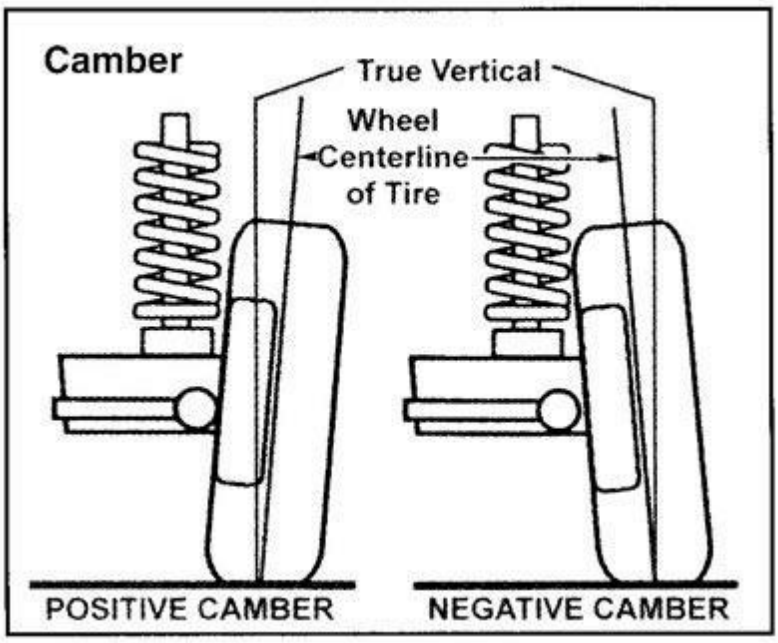

Fig.6.3: camber angle.

Toe

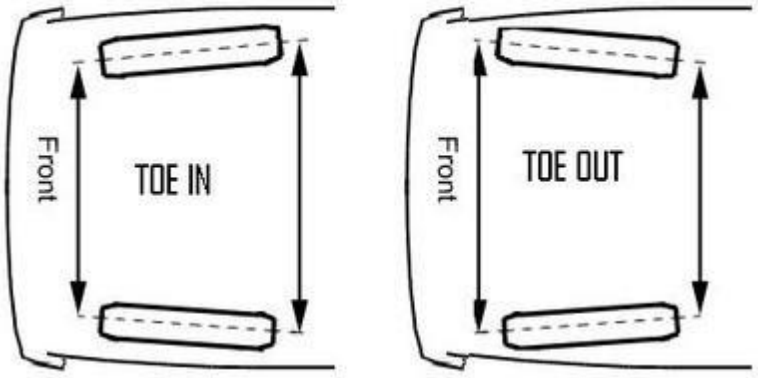

Fig.6.4: Toe in and toe out.

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	Practical Experiment Instruction sheet	Subject Code: ME-321 Class: Automobile and IC Engines
	Experiment No.07	

AIM: - Study the working, operation and maintenance of Ignition system.

REQUIREMENT: - Model of ignition system.

INTRODUCTION: -The internal combustion engine generates power by burning a mixture of air and fuel in its cylinders. In the gasoline engine, electric sparks must be generated to ignite the air-fuel mixture after the pistons in the cylinders have compressed it. In the diesel engine, on the other hand, the air in the cylinders is highly compressed. This causes it to become so hot, that when the fuel is sprayed into they cylinders, it ignites spontaneously.

Since, in the gasoline engine, the combustion process is started by the high-tension sparks generated at the spark plugs, some method must be used to provide the plugs with the necessary high-voltage current. This is done in one of two ways:

1) Magneto ignition.
2) Battery ignition.

Since the magneto both generates the necessary EMF (electro- magnetic force) and raises it to a higher voltage, no battery is necessary in a magneto ignition system. For this reason, the magneto ignition system is widely used in small gasoline engines, such as those for motorcycles and lawn movers, portable engines and scooters etc.

The battery ignition system raises the battery voltage to 10 kV or more by means of an ignition coil, and supplies this high voltage to the spark plugs via a distributor and high-tension cords for spark generation. Modern automotive gasoline engines use this battery ignition system.

FUNCTIONS OF COMPONENT PARTS: -

1. **BATTERY: -**
   Supplies low-voltage current (usually 12V) to the ignition coil.

2. **IGNITION COIL: -**
   Converts the battery voltage to the high voltage required for ignition.

3. **DISTRIBUTOR: -**
   i) **Cam**: Opens the breaker points depending on the crankshaft angle for each cylinder.
   ii) **Breaker points:** Interrupt the current flowing through the primary winding of the ignition coil in order to generate high-tension current in the secondary winding by electromagnetic induction.
   iii) **Condenser (capacitor**): Suppresses the spark generated between breaker points upon their opening to increase the secondary coil voltage.

iv) **Centrifugal governor advancer**: Advances the ignition timing according to the engine speed.
v) **Vacuum advancer**: Advances the ignition timing according to the engine load (intake manifold vacuum).
vi) **Rotor**: Distributes the high-tension current generated by the ignition coil to each spark plug.
vii) **Distributor cap:** Distributes high-tension current from the rotor to the high-tension cord of each cylinder.

4. **HIGH-TENSION CORDS: -**
   Carry the high-tension current from the ignition coil to the spark plugs.

5. **SPARK PLUGS: -**
   Discharge the high voltage applied to the electrodes for spark generation.

CONSTRUCTION: -

The spark plug consists mainly of the insulator, casing and center electrode.

CERAMIC INSULATOR: -

The ceramic insulator holds the center electrode and serves as the insulation between the center electrode and casing.Corrugations are provided on the ceramic insulator surface to extend the surface to distance between the terminal and casing for prevention of high-voltage flashover.

The insulator is made of high-purity alumina porcelain having excellent heat resistance, mechanical strength, dielectric strength at high temperatures and thermal conductivity.

CASING: -

The casing supports the ceramic insulator while at the same time serving as the means for mounting the spark plug to the engine.

CENTER ELECTRODE: -

The center electrode consists of the following parts:

(i) Center shaft. Conducts the current and radiates away the heat produced by the electrodes.

(ii) Glass seal. Provides air tightness between the center shaft and ceramic insulator and bonds the center shafts and center electrode.

(iii) Resistor. Reduces ignition noise to reduce radio interference.

(iv) Copper core. Conducts heat from the electrode and insulator nose for quicker radiation.

(v) Center electrode. Generates the spark with the earth electrode.

(vi) Earth electrode. The earth electrode is made of the same material as the center electrode.U-groove, V-groove and other special electrodes have been developing for easier sparking to improve the ignition performance. (Details are explained later).

6. **IGNITION COIL: -**
   Description: - The ignition coil receives 12 V from the battery and generates a voltage sufficiently high (10 kV or more) to generate a strong spark at the spark plug gap.

In the ignition coil, the primary and secondary windings are wound around the core. These coils step up (increase) the battery voltage to a much higher voltage by electromagnetic induction (self-induction and mutual induction).

The initial ignition timing is the timing during engine idling when the ignition advancer mechanisms are not operating. The crankshaft angle at which this occurs is called the "basic crankshaft angle", and refers to the proper moment during a certain stage of the compression cycle of the No.1 cylinder when ignition takes place.

The initial ignition timing is adjusted by physically changing the distributor mounting position relative to the engine: to do this, turn the distributor until the match mark on the crankshaft pulley lines up with the mark on the engine timing cover (this is checked using timing light).

WEB LINK FOR REFERENCE: **https://www.youtube.com/watch?v=s_gI6ovMqIQ**

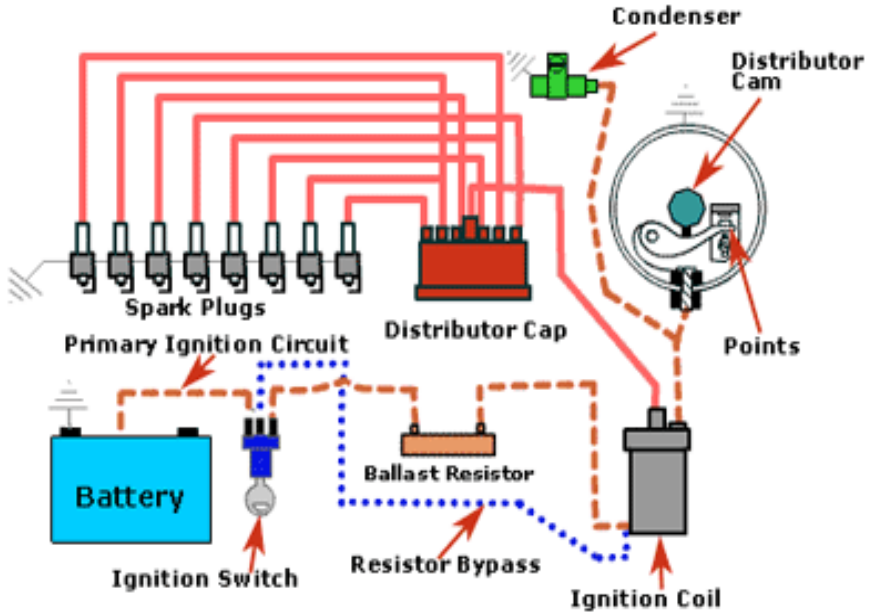

Fig.7.1: Battery Ignition system.

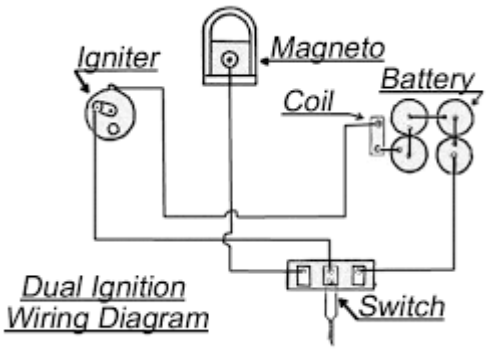

Fig.7.2: Magneto Ignition System.

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	Practical Experiment Instruction sheet	Subject Code: ME-321 Class: Automobile and IC Engines
	Experiment No.08	

AIM: - Study the working, operation and maintenance of cooling system.

INTRODUCTION: - Fuel is burnt inside the cylinder of an internal combustion engine to produce power. The temperature produced on the power stroke of an engine can be as high as 1600 degree Celsius and this is greater than the melting point of engine parts.

For example, melting point of cast iron is 1100 degree Celsius, of steel 1450 degree Celsius and that of aluminum alloy 660 degree Celsius. The cylinder and cylinder head are made of caste iron and piston in most cases is made of aluminum alloy. It is estimated that about 40% of the total heat produced is passed to the atmosphere via the exhaust, 30% is removed by cooling system and only about 30% is used to produce useful power.

CONSTRUCTION: - The main parts of the cooling system are as follows:

1) **Water pump**: - It is a centrifugal type pump. It has a casing and an impeller, mounted on a shaft. The casing is usually made of caste iron. Water pump is mounted on a front end of the cylinder block between the block and the radiator. When the Impeller rotates, the water between the impeller blades is thrown outward by centrifugal force and thus water goes to the cylinder under pressure. The pump outlet is connected by a hosepipe to the bottom of the radiator. The impeller shaft is supported on one or more bearings. There is seal, which prevents the leakage of water.

2) **Radiator**: - Radiator is a device for cooling the circulating water in the engine. It holds a large volume of water in close contact of large volume of air, so that heat is transferred from the water to the air easily. Hot water flows into the radiator at the top and cold water flows out from the bottom tubes or passages carry the water from the top to the bottom, passing it over a large metal surface. Air flows between the tubes or through the cells at right angle to the downward flowing water. This helps in transferring the heat from the water to the atmosphere.

3) **Thermostat valve**: - It is a control valve used in the cooling system to control the flow of water when activated by a temperature signal. It is special types of valve, which closes the inlet passage of water connected to the radiator. The thermostat is placed in the water passage between the cylinder head and the top of radiator. Its purpose is to close this passage when the engine is cold, so that water circulation is restricted.

4) **Water jackets**: - Water jackets are cored out around the engine cylinder so that water can circulate freely around the cylinder as well as around the valve opening.

5) **Fan: -** The fan is usually mounted on the water pump shaft. The same belt that drives the pump and the dynamo drives it. The purpose of the fan is to provide strong draft of air through the radiator to improve engine cooling.

AIR-COOLING: -

Air-cooled engine are engines are those engines, in which heat is conducted from the working components of the engine to the atmosphere directly. In such engines, cylinders are generally are not grouped in a block.

The cylinder of air-cooled engines has fins to increase the area of contact of air for speedy cooling. The cylinder is normally enclosed in a sheet metal casing called cowling. The flywheel has blades projecting from its face, so that it acts like a fan drawing air through a hole in the cowling and directing it around the finned cylinder.

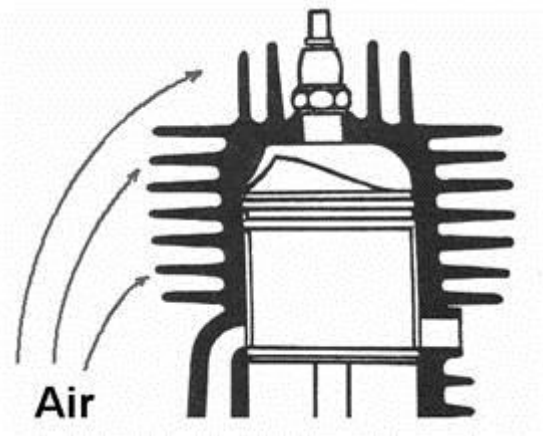

Fig.8.1: Air-cooling System.

WATER-COOLING: -

Engines, using water as cooling medium is called water-cooled engines. The liquid is circulated round the cylinder to absorb heat from the cylinder walls. In general, water is used as cooling liquid. The heated water is conducted through a radiator, which helps in cooling the water.

COOLING SYSTEM TROUBLES: -

Due to defective cooling system, several adverse effects are noticed such as
1) Over heating
2) Slow warm-up of the engine.

OVERHEATING IS MOSTLY DUE TO: -

a) Accumulation of rust and scale in the radiator and water jacket
b) Defective hosepipe
c) Defective thermostat
d) Loose fan belt
e) Defective water pump.

CARE AND MAINTENANCE OF COOLING SYSTEM: -

1) Clean and fresh water should be filled in the radiator.
2) Lime free water should be used in radiator as far as possible for prevention of scale formation.
3) Rotten or soft hose pipe should not be used in the system
4) Oil and grease should always be kept away from the belt. Greasy belts should be wiped clean with a rag.
5) The bearing of the water pump should be lubricated regularly.

6) Very hot engines should never be filled with cold water, to avoid fracture in the cylinder wall and the cylinder head.

WEB LINK FOR REFERENCE: https://www.youtube.com/watch?v=vSJB5vEdTtk

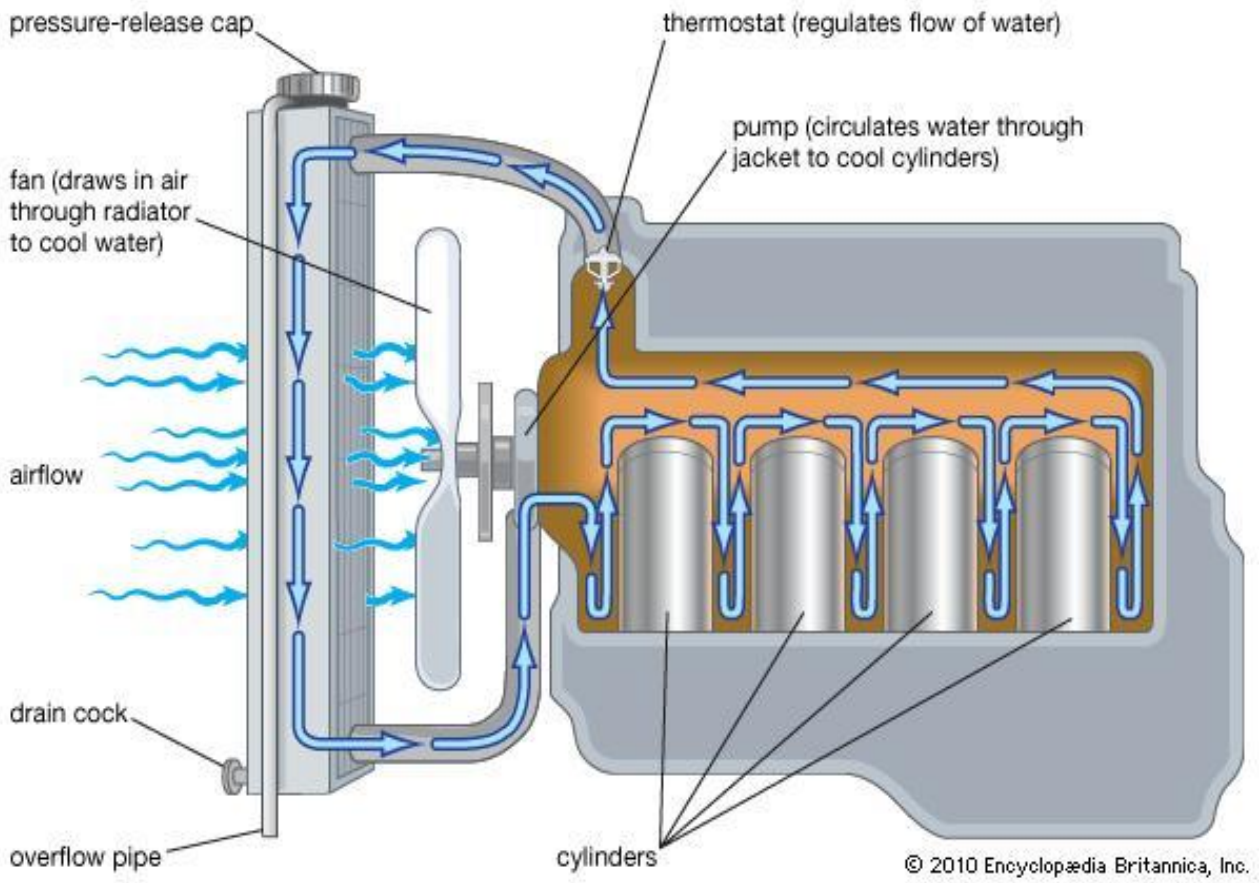

Fig.8.2: Water Cooling System in IC Engine.

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		Auto farm and Farm machinery Lab
	Practical Experiment Instruction sheet	Subject Code: ME-321
	Experiment No.09	Class: Automobile and IC Engines

AIM: -Study the various parts and working of lubrication system used in automobiles.

REQUIREMENT: - Cutting model of four-stroke diesel Engine.

PURPOSE OF LUBRICATION: - when a metal surface is made to slide over another surface friction take place. If all parts (surface) are allowed to work with each other enormous amount of friction will be produced. With the increase in friction, temperature will rise and if allowed to run like that the parts will seize.

As such some arrangement has to be made to control friction and temperature so that engine keeps on running. Adding lubricating oil in between surface does this.

MAIN PARTS OF LUBRICATING SYSTEMS: -

a) Oil pump
b) Oil filter
c) Pressure regulating valve
d) Oil level indicator
e) Oil sump
f) Oil strainer
g) Oil pressure gauge

a) **OIL PUMP**: - There are various types of oil pumps used in engines. These are as under:

i) **Plunger type**: - This pump works as a hand pump. The plunger moves up and down in the barrel. When the plunger moving up partial, vacuum is created in the cylinder. Due to this the inlet valve opens and oil gets sucked in. On the return stroke when the plunger moves down, the pressure in the barrel built up which classes the inlet valve and opens the outlet valves and oil goes in engine galleries.

ii) **Rotor type**: - This type of oil pump is now widely used in automobiles .It is similar to gear pump except that in this to two gears mesh internally. The oil enters the pump through inlet port, as pump in the spaces between rotor lobes .The rotation reduces the clearance between the lobes and the oil is discharged under pressure as the lobes of the rotor lobes are moving out of mesh. The oil is then transported from inlet to the outlet of the rotors move into mesh at the outlet port. This type of pump is about 25% more efficient and compact than the gear type pump. This is also quieter running since there are comparatively lesser teeth in mesh for each revolution. Because of these advantages, its uses are on increase in the automobile engines.

b) **GEAR PUMP: -** This is the type once almost universally used in the automotive engines. Its construction is very simple in that it consists of two spurs, or for quieter running, helical gears only which are in mesh with each other. One gear mounted on a stub shaft and is driven on the where as the

other gear is the driving gear, itself being driven directly by the cam shaft through the same gear which drives the distributor shaft. The oil is transported from the inlet to the outlet side in gear spaces between the gear teeth and is discharged through the out-let port. Since the teeth start to mesh at the outlet port, the oil is driven out under pressure.

c) **OIL FILTER**: - It is used to clean the oil, different types of filter are used as cartridge type (it consists of metallic casing and a filter in it) oil passes through it, edge type (it consists of number of disks and centrifugal type filters cleans the oil by passing the oil through centrifugal jets.

d) **PRESSURE REGULATING VALVE**: - It is the safety valve, which maintains the constant pressure as fixed by the manufacturer.

e) **OIL LEVEL INDICATOR**: - It shows the level of oil in engine, a dip is used to check the level of oil; it has three marks for full, half and lowers level of oil.

f) **OIL SUMP**: - It is the lowest parts of crankcase. It contains oil; it is made of steel pressing.

g) **OIL STRAINER**: - It is simply a wire mess screen to filter the oil preliminary.

h) **OIL PRESSURE GAUGE: -** It shows the pressure of oil on the parts where lubrication takes place.

WEB LINK FOR REFERENCE: https://www.youtube.com/watch?v=llNS9rJSm9w

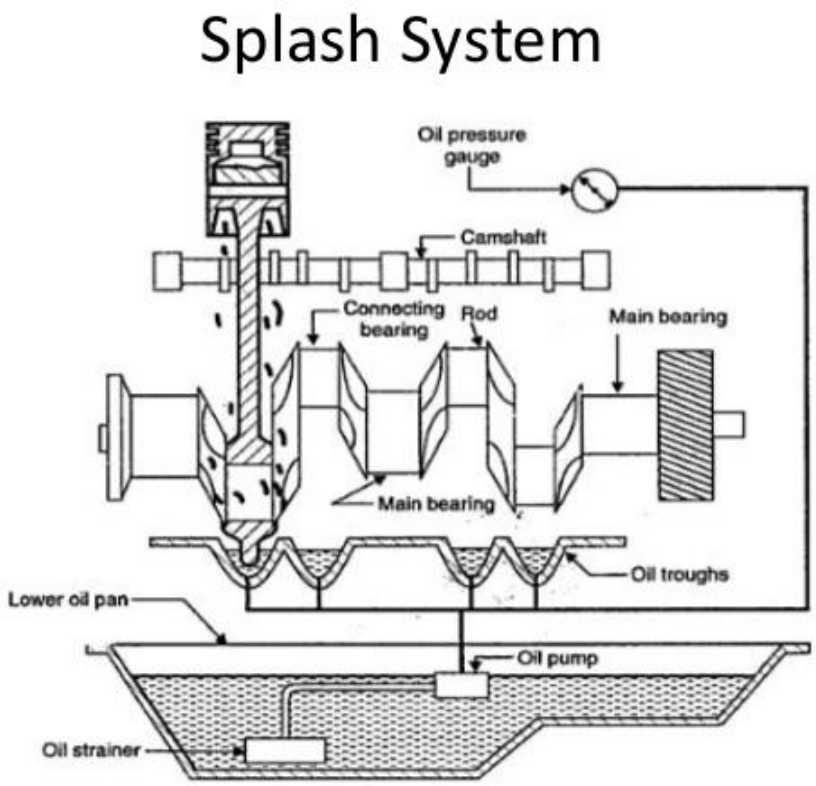

Fig.9.1: Splash system of engine lubrication.

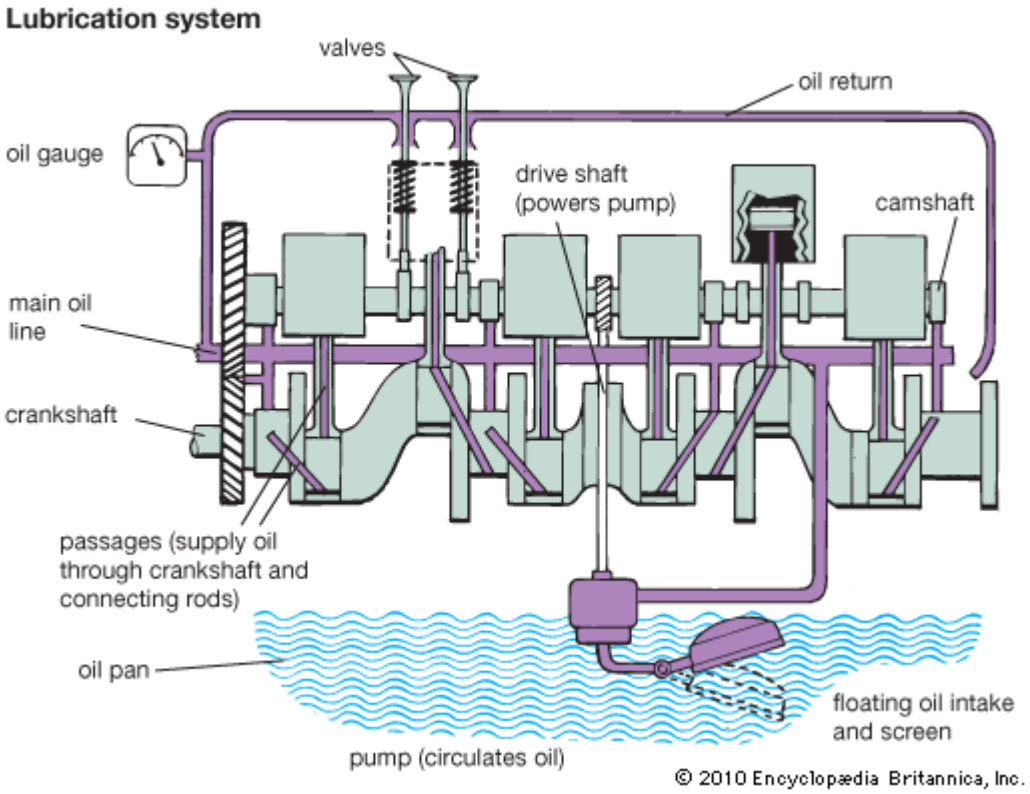

Fig.9.2: Full pressure lubrication system.

	Sant Longowal Institute of Engineering & Technology Longowal-148106 (Govt of India)	**LAB MANUAL** Auto farm and Farm machinery Lab
	Practical Experiment Instruction sheet **Experiment No. 10**	Subject Code: ME-321 Class: Automobile and IC Engines

AIM: - Study and maintenance of lighting system components used in automobiles.

REQUIREMENT: - A working model of electrical system of an automobile.

THE COMPONENTS OF THE LIGHTING SYSTEM ARE: -

1. Head lamps
2. Side or parking lamps
3. Rear red lamps
4. Flashing indicator front lamps
5. Flashing indicator rear lamps
6. Brake signal lamp
7. Interior lighting lamp
8. Instruments panel lamp
9. Oil pressure low warning indicator lamp
10. Lamp for battery discharge (red)
11. Lamp for turn indicators or flashing lamps
12. Lamp for head light (high beam indicator)
13. Lamp for electrical type oil pressure gauge
14. Lamp for rear number plate illuminator

AND THE OTHER COMPONENTS OPERATED BY ELECTRICITY: -

1. Electric horn
2. Wind screen spray equipment
3. Wind screen wipers
4. Flashing light actuating unit
5. Radio equipment
6. Fuel level gauge
7. Cooling water temperature gauge
8. Oil-pressure warning light
9. Cigarette lighter
10. Lubricating engine oil level indicator

ELECTRIC CIRCUIT: - The electric circuit diagram with typical switches. The current is taken from battery through the ammeter and passes through a fuse. Finally it goes to the distribution board. From the board the lead from C is taken to the lamp. Between the lamp and point C there is a switch. The switch (5)

controls the lamp. Similarly the connection taken from E has a separate parallel connection for the horn. Once the switch (7) is on, the horn produces sound. In the electrical connection for a car, the wires are in various colures. These colors are recognized internationally in the motorcar industry.

FUSES: -

The dynamo, ignition system and lamp wiring system have cables of different sizes. The different sizes take the full working current for this system. The fuse protects the short circuit against excessive currents.

The fuses are of the cartridge type. It made of very fine lead alloy .it fuses at a lower current value than that of the circuit system. The fuse wire is soldered with nickel-plated bras end caps. The whole unit is enclosed in a glass tube.

CABLE COLOURS: -

Brown (battery circuit):- The lines from the battery to the ammeter and to control box; connection to the lighting and ignition switches.

White (ignition circuit):-- When the ignition is switched on, the electric petrol pump, solenoid starter switch, etc., all come into operation. All these wires are in white colors.

Yellow (dynamo circuit):- The line from the terminal to the regular unit control box terminal and to the ignition warning light is yellow in colors. This applies to the complete dynamo circuit.

Green (auxiliary circuits):- Auxiliary circuits such as the stop lamp, fuel gauge, direction indicators wind screen wipers, etc. all are green.

Blue (head lamp circuit): - The lines connecting the headlamps from the lighting switch are all blue in colors.

Red (side and tail lamp circuit):- The line from the panel light switch to the side head light and the dipswitch control is red. The line connecting the sidelights and rear lights is also red.

Black (earth circuits):- if a component is not earthed internally a cable is connected out side the metal chassis. The cable is given a black colors. The earthlings of the fuel tank, fuel gauge, cigarette lighter, and control box and ignition warning light are all black in colors.

HEAD LAMP: -

When a vehicle is moving, the headlamp provides light on the road; the headlamp is in shape of parabola. A mirror is placed along the parabola from the inside. The source of light is placed at the point of focus of parabola. Then the lights are reflected in the parabolic mirror these lights travel parallel to the symmetrical axis.

In practice the horizontal rays of the parabolic mirror are modified to cover the road width. For this a circular glass lens is molded such that it has a series of vertical flutings. These flutings refract and disperse the light beam side ways. They produce a flat oval-shaped beam on the road.

ELECTRIC HORN: -

In a simple type of high frequency horn, there is laminated magnet core the winding is over this core .the armature is attached to a central spindle. The spindle is supported at one end by a guide spring. The spring I s supported at the other end by a diaphragm. There is a second diaphragm called the tone disc. This disc is fixed only at it center.

There is a contact breaker is in a series with the solenoid. When the horn switch is pressed the current flows through the contact breaker and solenoid. The circuit is completed through an earthed terminal. When this circuit is completed, laminated core is magnetized. The magnet attracts armature. The armature then moves towards the magnet. There is a protruding plate on the armature. This plate separates the contact points. Immediately after, magnetic flux collapses. The armature then returns to its normal position due to the action of spring. This cycle of operation is takes place at a high frequency. Therefore vibrations develop in the armature and diaphragm. This develops the sound of the horn.

WINDSCREEN WIPERS: -

Windscreen wipers are operated by a small electric motor. This motor is mounted on the engine side of the bulkhead. The armature shaft has a

Worm thread, which is cut on the driving end. The worn thread is connected with the speed reduction gear this arrangement reduces the speed of the armature shaft to the usable limit .

The rotaing gears acts as a crank unit. This unit is connected by a flexible cable the crank unit converts the rotary movement of the motor in ti a push –pull movement. This movement operates wiper blade .

WEB LINK FOR REFERENCE: https://www.youtube.com/watch?v=LaclcZjH_Cw&t=5s

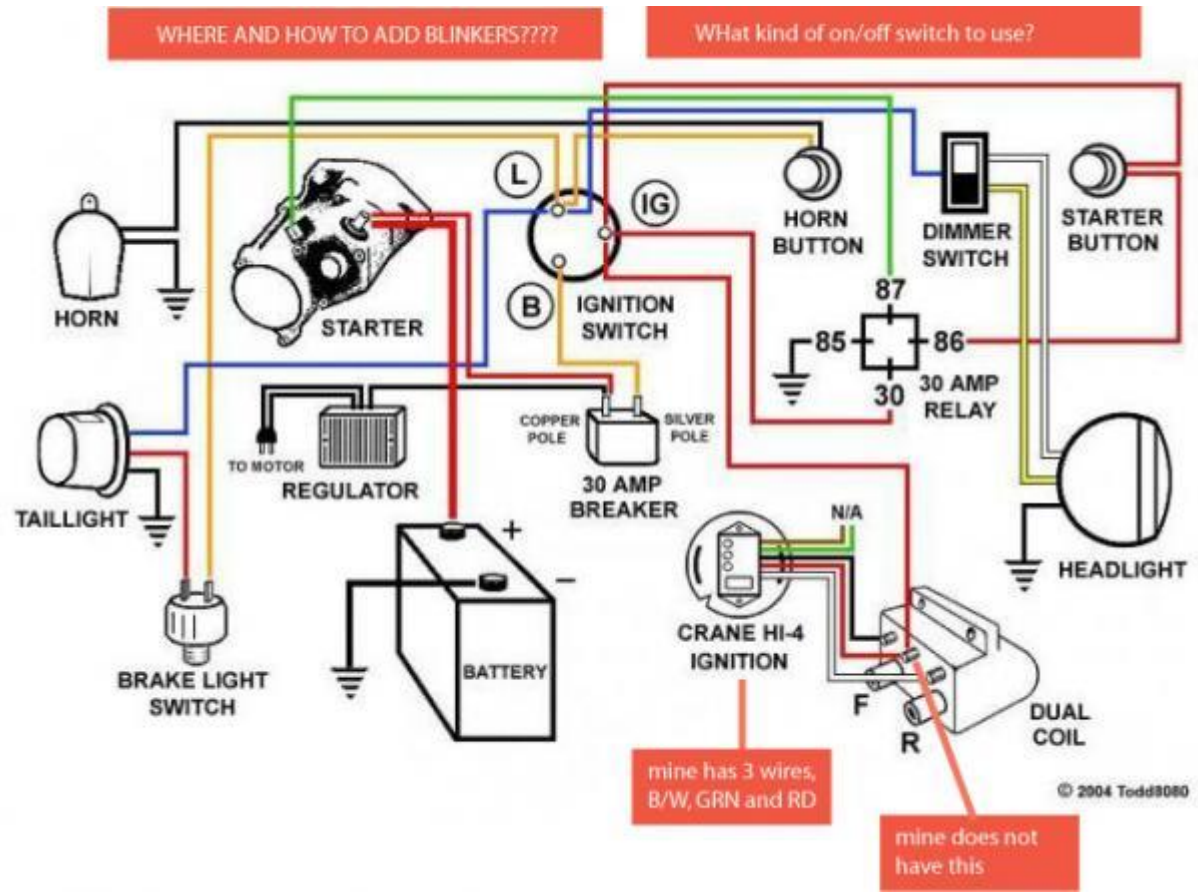

Fig.10.1: Lighting system in automobile.

AIM:- Performance test of Internal Combustion engines.

OBJECTIVES:-

To plot performance curves of I.C. engines.

a) Power Vs. engine speed
b) Hourly fuel consumption Vs engine speed
c) Specific fuel consumption Vs. engine speed
d) Specific fuel consumption Vs power
e) Equivalent crankshaft, torque Vs engine speed

APPARATUS:-

I.C. engine, balance, measuring cylinder, stop watch, Hydraulic dynamometer, Tacho-meter, barometer, dry & wet bulb thermometer, psychometric chart.

PROCEDURE:-

Engine test set-up is shown in Fig. 11.6

1) Engine should be run before starting the actual test and general observations should be made regarding the proper running conditions of the engine.
2) Engine should have reached steady working conditions before taking any reading.
3) Record fuel consumption every 30 minutes by balance method.
4) Record brake load as a function of engine speed.
5) Calculate BHP using equation (11.1).
6) Calculate specific fuel consumption in terms of g/bhp – h.
7) Calculate equivalent crank shaft torque using equation (11.2)

THEORY:-

The performance curves of I.C. engines are represented by:-

i) Power as a function of engine speed (Fig. 11.1)
ii) Equivalent crankshaft torque as a function of engine speed (Fig. 11.2)
iii) Hourly fuel consumption as a function of engine speed (Fig. 11.3)
iv) Specific fuel consumption as a function of engine speed (Fig. 11.4)
v) Specific fuel consumption as a function of power (Fig.11.5)

Engine power can be calculated by:

$$BHP = \frac{WN}{2000} \quad \text{..... (11.1)}$$

Where,

W = brake load, kg.

N = engine, rpm

BHP = brake horse power

Equivalent torque can be calculated:

$$hp = \frac{2\pi NT}{4500}$$

$$\text{or} \quad T = \frac{4500\ hp}{2\pi N} \quad \text{..... (11.2)}$$

Where,

T = Torque, kg-m

NOTE:Correction factors for power & fuel consumption are not considered in this test because of limited time. However, these factors must be used to find corrected powers & fuel consumption in actual engine tests.

PRECAUTIONS :-

i) Keep away from all the moving parts of the equipment.
ii) Make certain that all the connections are tight to prevent any leakage of fuel etc.
iii) Fill the water & fuel to proper level before starting

DRAW THE GRAPHICAL REPRESENTATION:-

i) BHP Vs engine rpm
ii) Fuel consumption Vs. engine rpm
iii) Specific fuel consumption Vs. engine speed
iv) Specific fuel consumption Vs. BHP
v) Torque Vs. engine speed

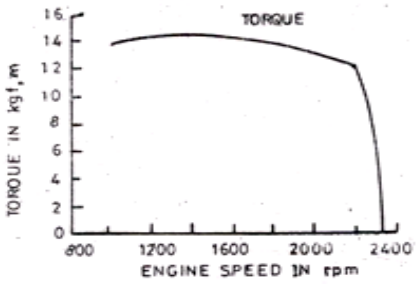

Fig. 11.1

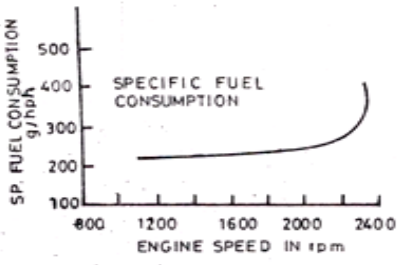

Fig. 11.2

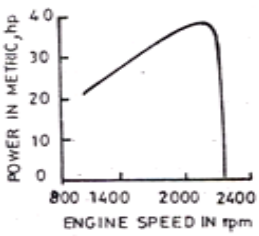

Fig. 11.3

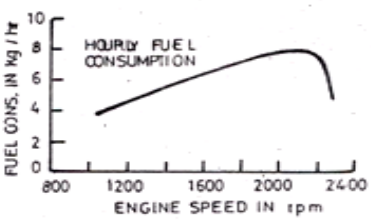

Fig. 11.4

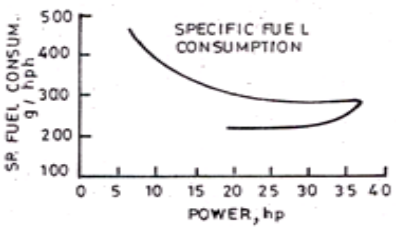

Fig. 11.5

Fig. 11(1-5) Performance Curves of Internal Combustion Engine

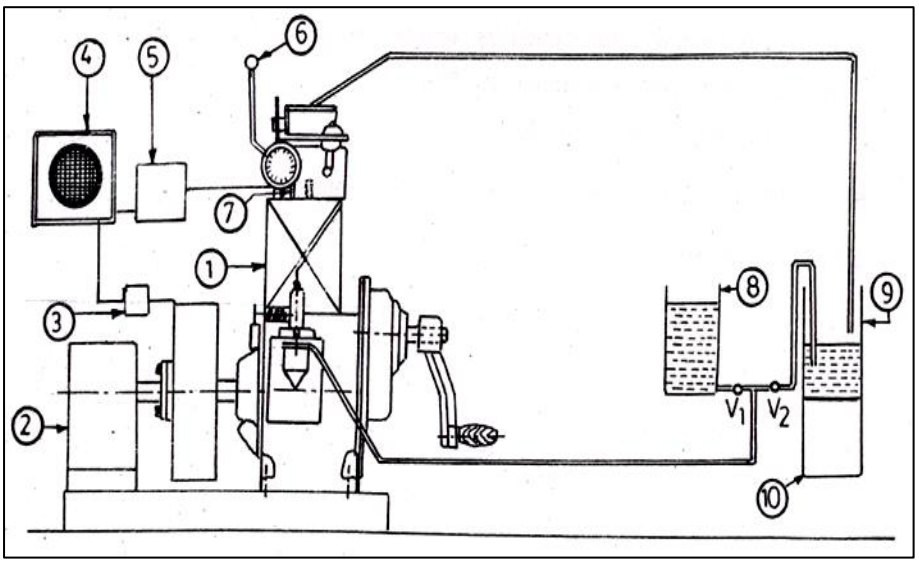

Fig. 13.6 Engine Testing Set-Up

1. Engine
2. Hydraulic Dynamometer
3. Photo pick-up
4. Oscilloscope
5. Strain indicater
6. Thermo couple
7. Strain gauges
8. Main jar of diesel
9. Beaker
10. Balance
11. V1 valve for direct diesel supply to engine
12. V2 valve for diesel supply from beaker to engine