Laboratory Manual

Automobile Engineering Lab

Diploma

Six Semester

Mechanical Engineering

LIST OF THE EXPERIMENTS

To study and prepare report on the constructional details, working principles and operation of the following

(a) Engine cooling & lubricating Systems.

(b) Engine starting Systems

(c) Carburetors

(d) Coil-Spring Clutch

(e) Diaphragm – Spring Clutch.

(f) Double Disk Clutch.

(g) Hydraulic & Pneumatic break systems.

EXPERIMENT-1

Aim:

To study and prepare report on the constructional details, working principles and operation of the Automotive Engine Systems & Sub Systems.

(a) Engine cooling & lubricating Systems.

Engine Cooling Systems:

The cooling system removes excess heat to keep the inside of the engine at an efficient temperature, about 200oF (94oC). There are two types of cooling systems found on automotives, they are liquid cooling system and air cooling system.

Construction, Working Principle and Operation of Air Cooling System:

The air cooling system will have metal FINS on the outer perimeter of the engine. The heat is transferred from the engine, through these fins, into the atmosphere.

Fig: Air Cooling System

Construction, Working Principle and Operation of Liquid Cooling System:

The cooling system is made up of the passages inside the engine block and heads, a water pump to circulate the coolant, a thermostat to control the temperature of the coolant, a radiator to cool the coolant, a radiator cap to control the pressure in the system, and some plumbing consisting of interconnecting hoses to transfer the coolant from the engine to radiator and also to the car's heater system where hot coolant is used to warm up the vehicle's interior on a cold day.

A cooling system works by sending a liquid coolant through passages in the engine block and heads. As the coolant flows through these passages, it picks up heat from the engine. The heated fluid then makes its way through a rubber hose to the radiator in the front of the car. As it flows through the thin tubes in the radiator, the hot liquid is cooled by the air stream entering the engine compartment from the grill in front of the car. Once the fluid is cooled, it returns to the engine to absorb more heat. The water pump has the job of keeping the fluid moving through this system of plumbing and hidden passages. A thermostat is placed between the engine and the radiator to

make sure that the coolant stays above a certain preset temperature. If the coolant temperature falls below this temperature, the thermostat blocks the coolant flow to the radiator, forcing the fluid instead through a bypass directly back to the engine. The coolant will continue to circulate like this until it reaches the design temperature, at which
point, the thermostat will open a valve and allow the coolant back through the radiator. In order to prevent the coolant from boiling, the cooling system is designed to be pressurized. Under pressure, the boiling point of the coolant is raised considerably. However, too much pressure will cause hoses and other parts to burst, so a system is needed to relieve pressure if it exceeds a certain point. The job of maintaining the pressure in the cooling system belongs to the radiator cap. The cap is designed to release pressure if it reaches the specified

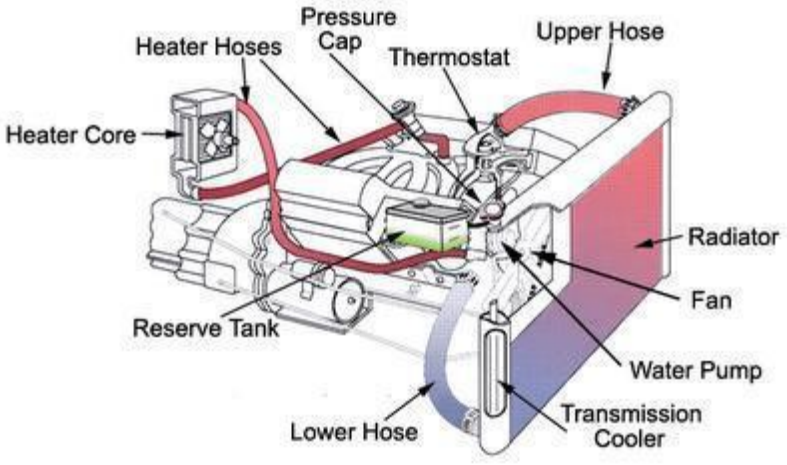


Fig**: Liquid Cooling System**

Engine Lubricating Systems:

The engine lubrication system includes the lubricating oil, oil pump, oil filter and the oil passages. Oil lubrication provides a barrier between rotating engine parts to prevent damage by friction. The engine oil provides a method of cooling engine parts that are not cooled by the engine cooling system. Engine oil helps to protect engine components from corrosion by neutralizing harmful chemicals that are the by-product of combustion.

Construction, Working Principle and Operation of Lubricating System:

To protect moving parts and reduce friction, automotive engine oil provides a barrier between the rotating or moving engine components. Ideally, a film of oil should exist between moving components. This is called full film lubrication. In order to achieve full film lubrication, a

constant supply of clean oil is required. The engine oil system constantly filters and circulates engine oil to ensure that all components are protected. The engine oil is stored in the crankcase. Most engines hold between 4 to 6 quarts of oil. The engine oil pump pressurizes and circulates the engine oil. The oil will flow from the pump to the oil filter, where it is cleaned. The cleaned engine oil then moves through passages, into the crankshaft where it circulates through the engine bearings. The crankshaft has passages bored into it that allows oil to travel to all the bearing surfaces. The cylinder walls and pistons are lubricated by the oil that is thrown from the crankshaft as it rotates. This is sometimes referred to as splash lubrication. Engine oil will leave the crankshaft, usually at a passage in one of the main bearings and is fed to the camshaft and lifters. On some overhead valve engines, oil will travel through the pushrods up to the valve train to lubricate the rocker arms. Other designs use a passage to feed oil through a rocker arm shaft to achieve the same purpose. The oil then returns to the crankcase by return holes in the cylinder heads. It is then picked up by the oil pump to be circulated again.

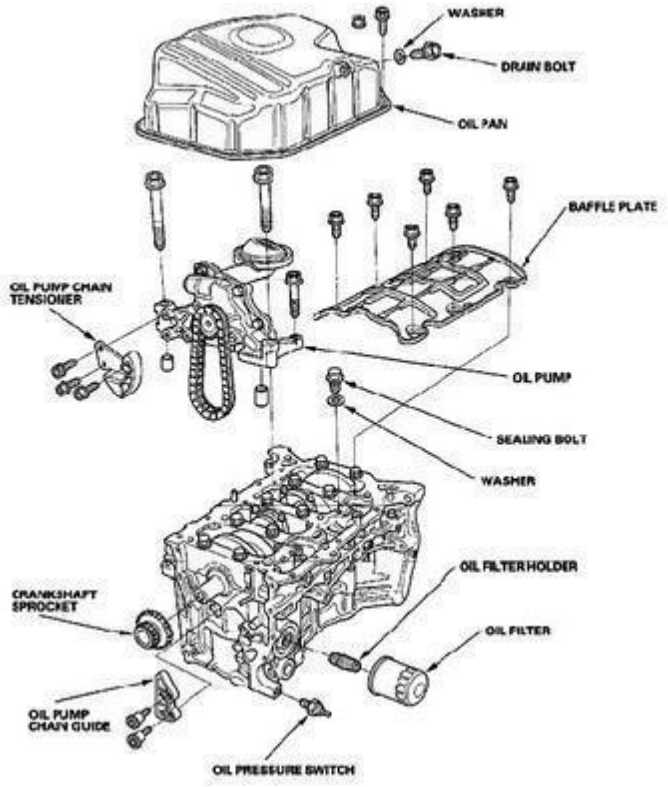


Fig: **Engine Lubrication System**

EXPERIMENT-2

Engine starting Systems:

The "starting system", is the heart of the electrical system in the engine. The starting system converts electrical energy from the batteries into mechanical energy to turn the engine over.

Construction, Working Principle and Operation of Engine starting System:

Engine starting system, begins with the Battery. The key is inserted into the Ignition Switch and then turned to the start position. A small amount of current then passes through the Neutral Safety Switch to a Starter Relay or Starter Solenoid which allows high current to flow through the Battery Cables to the Starter Motor. The starter motor then cranks the engine so that the piston, moving downward, can create a suction that will draw a Fuel/Air mixture into the cylinder,where a spark created by the Ignition System will ignite this mixture. If the Compression in the engine is high enough and all this happens at the right Time, the engine will start.

The starting system has five main components: the ignition switch or start button, a neutral safety switch (an option on some vehicles), the starter solenoid, the starter motor, and the batteries. When the key is turned in the ignition switch to the start position, or the start button is pushed, electricity flows from the batteries to the starter solenoid. Some vehicles are equipped with a neutral safety switch. If the vehicle is in gear when the key is turned, the neutral safety switch blocks the signal to the batteries, so the engine doesn't start cranking. Otherwise, the vehicle could jump forward or backward when the key is turned. The starter solenoid is an electromagnetic switch mounted on the starter motor. When coils inside the solenoid are energized by electricity, they create a magnetic field which attracts and pulls a plunger. Attached to one end of this plunger is a shift lever. The lever is connected to the drive pinion and clutch assembly of the starter motor. The starter motor is a small but powerful electric motor that delivers a high degree of power for a short period of time. When the starter motor is energized it engages the flywheel ring gear and produces torque, which turns the flywheel and cranks the engine. When the driver releases the ignition switch from the start position to the run position, the solenoid is deactivated. Its internal return springs cause the drive pinion to be pulled out of mesh with the flywheel, and the starter motor stops.

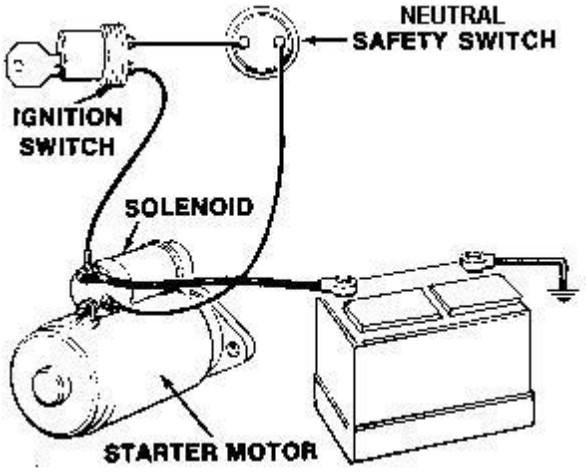


Fig: **Engine Starting System**

EXPERIMENT NO. 3

Aim:

To study and prepare report on the constructional details, working principles and operation of the Fuels supply system

(a) **Carburetors**

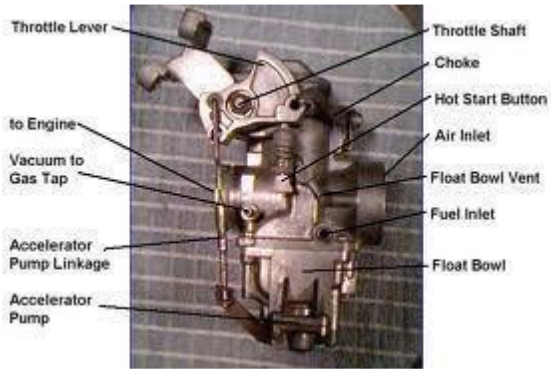
Theory:

(a) Carburetors: A carburetor is a mechanical device on an internal combustion engine, for the purpose of mixing air and gasoline into a combustible fine vapor, in automatically changing proportions, depending on the operating conditions of the engine.

Construction, Working Principle and Operation of Carburetors:

In the part of the carburetor known as the body is located the float bowl or chamber. This chamber is used for the storage of a certain quantity of gasoline. It serves two purposes, namely, to keep all the other circuits of the carburetor supplied with the amount of fuel they need and to absorb the pulsation of the fuel pump, as it delivers the gasoline to the carburetor. Though its construction is simple, it plays a very important part in the proper functioning of the engine.

Fig: **Carburetor parts**



To provide a means to adjust maximum fuel flow, a needle valve was added to the orifice in the emulsion tube. A carburetor with this design would function well under varying loads and speeds. Starting is a different condition; an engine needs a richer fuel-air mixture. This was accomplished by adding a choke. Closing the choke increases the pressure difference between the fuel bowel and the venturi. Once engine starts the choke must be opened to prevent the engine from running too rich. The addition of a choke/primer improved engine starting, but this carburetor still has a problem if the engine needs to idle. When the throttle is in the idle position, almost closed, the

area with greatest restriction, and greatest pressure difference, moves from the venturi to the area between the throttle plate and the wall of the tube. This problem was solved with the addition of an idle circuit and idle needle valve. To have constant fuel flow with constant pressure difference the lift, distance from the top of the fuel to the top of the main nozzle, must remain constant. A constant level of fuel is maintained in the fuel bowel by the float, float needle valve and float needle valve seat.

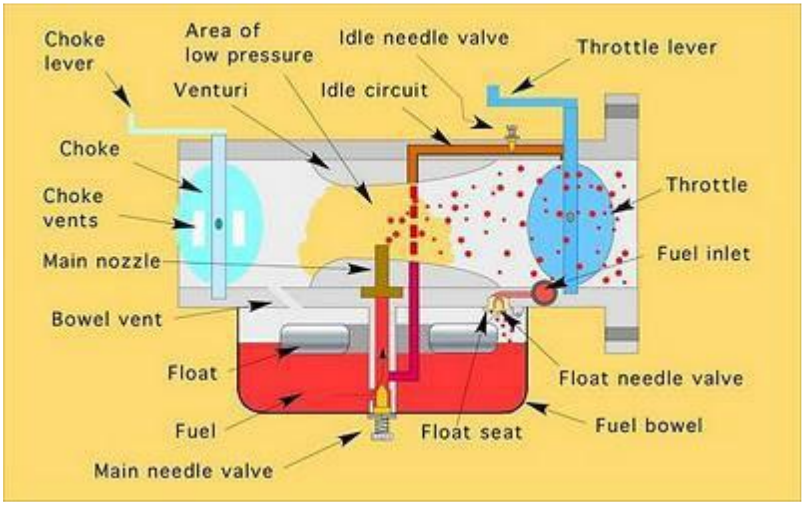


Fig: **Carburetor Operation**

EXPERIMENT 4

Aim: To study and prepare report on the constructional details, working principles and operation of the Automotive Clutches.

Apparatus: Models of
(a) Coil-Spring Clutch
(b) Diaphragm – Spring Clutch.
(c) Double Disk Clutch.

Theory:
A Clutch is a machine member used to connect the driving shaft to a driven shaft, so that the driven shaft may be started or stopped at will, without stopping the driving shaft. A clutch thus provides an interruptible connection between two rotating shafts. Clutches allow a high inertia load to be stated with a small power. A popularly known application of clutch is in automotive vehicles where it is used to connect the engine and the gear box. Here the clutch enables to crank and start the engine disengaging the transmission and change the gear to alter the torque on the wheels.

(**a) Coil-Spring Clutch:** The coil spring clutch shown in figure uses coil springs as pressure springs (only two pressure spring is shown). The coil-spring clutch has a series of coil springs set in a circle. At high rotational speeds, problems can arise with multi coil spring clutches owing to the effects of centrifugal forces both on the spring themselves and the lever of the release mechanism.

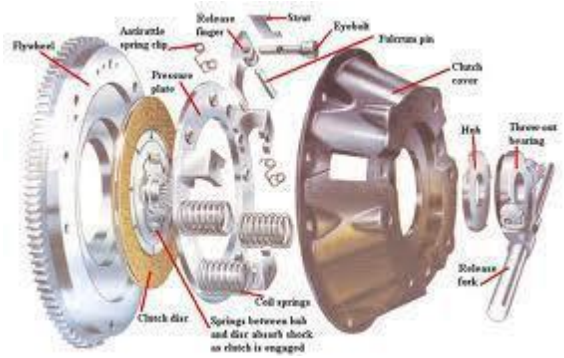


Fig**: Coil Spring Clutch**

(b) Diaphragm – Spring Clutch: The diaphragm spring clutch shown in figure. The diaphragm spring clutch has consistently eliminated bolt springs which means it very from coil spring clutch by type of spring used.

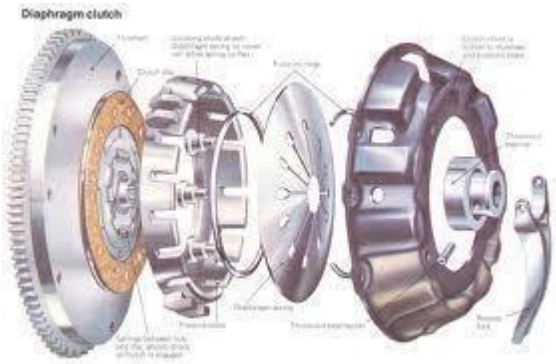


Fig: **Diaphragm Spring Clutch**

(c) Double Disk Clutch: Basically, the clutch needs three parts. These are the engine flywheel, a friction disc called the clutch plate and a pressure plate. When the engine is running and the flywheel is rotating, the pressure plate also rotates as the pressure plate is attached to the flywheel. The friction disc is located between the two. When the driver has pushed down the clutch pedal the clutch is released. This action forces the pressure plate to move away from the friction disc. There are now air gaps between the flywheel and the friction disc, and between the friction disc and the pressure plate. No power can be transmitted through the clutch.

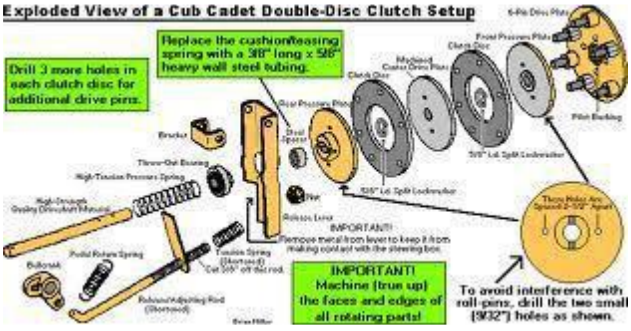


Fig: **Double Disk Clutch**

Experiment No:5

Aim: To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.
Apparatus: Models of

(a) Hydraulic & Pneumatic Brake systems

Theory:

(a) Constructional details, working principles and operation of the Hydraulic & Pneumatic Brake systems:

The **Hydraulic brake system** is a braking system which uses brake fluid usually includes ethylene glycol, to transmit pressure from the controlling unit, which is usually near the driver, to the actual brake mechanism, which is near the wheel of the vehicle. The most common arrangement of hydraulic brakes for passenger vehicles, motorcycles, scooters, and mopeds, consists of the following:
Brake pedal or Brake lever
Pushrod, also called an actuating rod Reinforced hydraulic lines
Rotor or a brake disc or a drum attached to a wheel Master cylinder assembly includes: Piston assembly is made up of one or two pistons, a return spring, a series of gaskets or O-rings and fluid reservoir.

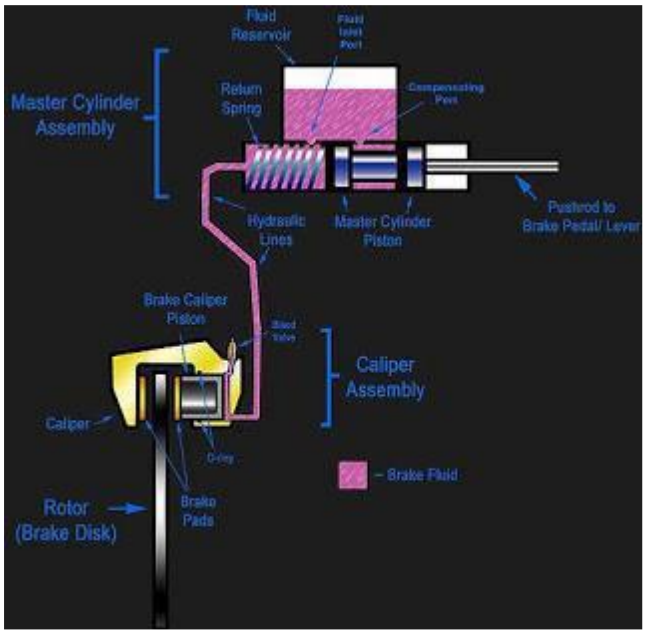


Fig: **Hydraylic-Brake**

In Hydraulic brake system when the brake pedal or brake lever is pressed, a pushrod applies force on the piston in the master cylinder causing fluid from the brake fluid tank to run into a pressure chamber through a balancing port which results in increase in the pressure of whole hydraulic system. This forces fluid through the hydraulic lines to one or more calipers where it works upon one or two extra caliper pistons protected by one or more seated O-rings which prevent the escape of any fluid from around the piston. The brake caliper piston then apply force to the brake pads. This causes them to be pushed against the rotating rotor, and the friction between pads and rotor causes a braking torque to be generated, slowing the vehicle. Heat created from this friction is dispersed through vents and channels

in rotor and through the pads themselves which are made of particular heat-tolerant materials like kevlar, sintered glass. The consequent discharge of the brake pedal or brake lever lets the spring(s) within the master cylinder assembly to return that assembly piston(s) back into position. This reduces the hydraulic pressure on the caliper lets the brake piston in the caliper assembly to slide back into its lodging and the brake pads to discharge the rotor. If there is any leak in the system, at no point does any of the brake fluid enter or leave.

Pneumatic or Air Brake System is the brake system used in automobiles such as buses, trailers, trucks, and semi-trailers. The Compressed Air Brake System is a different air brake used in trucks which contains a standard disc or drum brake using compressed air instead of hydraulic fluid. The compressed air brake system works by drawing clean air from the environment, compressing it, and hold it in high pressure tanks at around 120 PSI. Whenever the air is needed for braking, this air is directed to the functioning cylinders on brakes to activate the braking hardware and slow the vehicle. Air brakes use compressed air to increase braking forces.

Fig: **Air Break**