

Governing System:

The engine control device is called a governor. The governor can be mechanical or an electronic device. In general, governors for IC engines are of the centrifugal-force, spring loaded type.

A good governor for agricultural tractor engines is taken to be one giving performance such that the difference between no load speed and maximum load speed is less than 100 rpm. The maximum load and no, load are at maximum governor settings on both sides. As with the increase of load the crankshaft torque rises to a peak and that maximum torque is developed at a speed well below governed speed and therefore well below the speed at which maximum power is obtained. It is an important phenomenon. When the engine is operating at the full throttle, its speed and power are controlled solely by load and some reserve is provided by governor in order to cope with sudden increase of load. If at any particular speed of engine set by the operator, the increase or decrease in load will decrease or increase the speed is regulated by the governor without changing the gear. But a tractor fitted with a suitable diesel engine having more than 500 rpm in reserve that is the difference in maximum power speed and maximum torque speed, will possess good slogging ability.

Need for governor:

Governor is the device used to control the speed in engines. It is observed that when load is applied on the engine, the speed tends to decrease which is known as rpm drop also, to compensate the speed, governor is used in all stationary or mobile engines which run on either single speed or variable speeds. In general, following are the two operating systems being used in engines governors.

i) Hit and Miss system

ii) Throttle system

In hit and miss system, the frequency of cycles for fuel supply is controlled in the fuel system. Whereas, in throttle system, the frequency remains the same but the quantity of fuel is being controlled as per the engine requirements. Throttle system is the most commonly governing system being used in modern engines these days. The extent of throttle opening controls the fuel supply and hence the engine speed.

Although, the governor is used to maintain the constant engine speed, but still some variation in engine speed can be observed at no load and maximum load. This variation can be expressed in terms of Governor Regulation (%).

$$\text{Governor Regulation} = \frac{(S_0 + S_1)}{2(S_0 - S_1)} * 100$$

Where, S_0 = No Load speed

S_1 = Maximum Load speed

The governors may be further classified as:

- i. Centrifugal/Mechanical governor
- ii. Pneumatic governor
- iii. Hydraulic governor

Mechanical governor

The centrifugal/mechanical governor is most commonly used governor in tractors. Two spring-loaded centrifugal weights are mounted on the governor shaft having sliding collar which further actuates the throttle and the fuel supply. As the engine speed increases, the weights fly apart with the centrifugal force against the spring tension to actuate fuel injection pump to reduce the amount of fuel delivered and hence decreases the engine speed. Similarly, the fuel supply is increased by the governor when the engine speed tends to decrease.

Pneumatic governor

A pneumatic governor consists of venturi unit and diaphragm unit which are connected by a vacuum pump. The venturi unit leads to the engine inlet manifold and the diaphragm unit is connected with the fuel injection pump. The position of the butterfly valve in the venturi unit is controlled by the accelerator pedal to control the amount of vacuum from the inlet manifold, to actuate the fuel pump through diaphragm unit and hence the amount of fuel injected.

Hydraulic governor

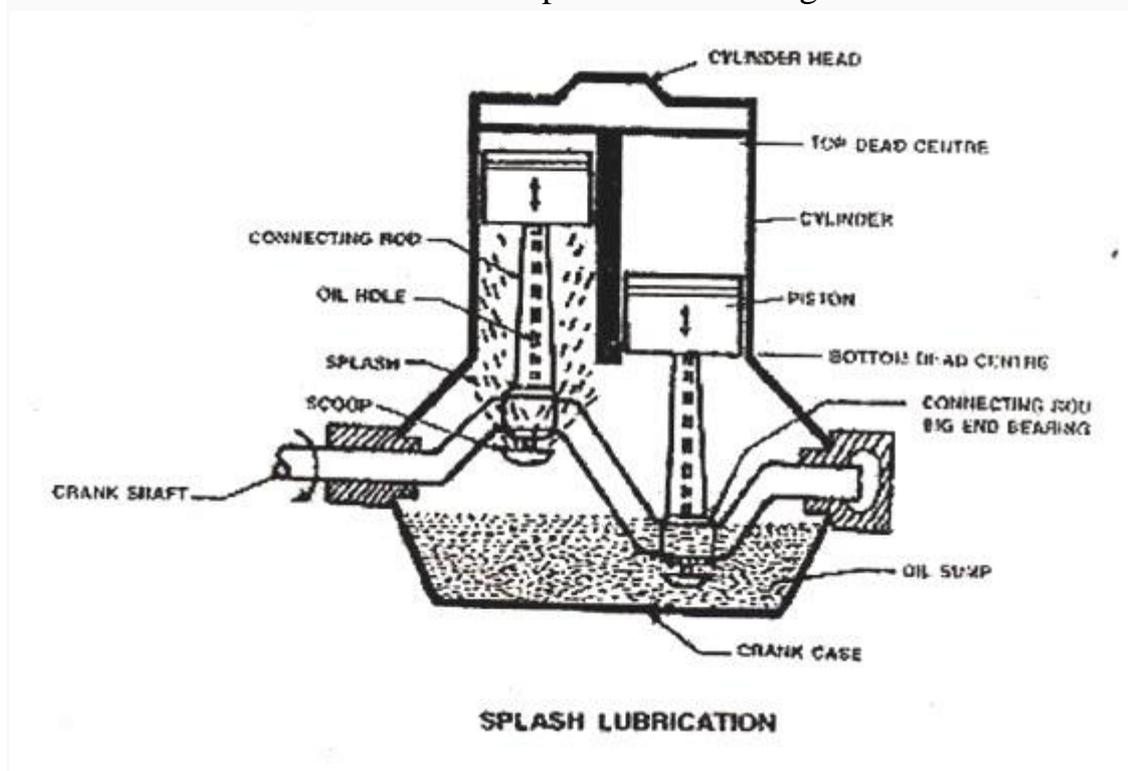
A hydraulic governor works on the principle of pressure change and receives the oil from the engine lubricating system which further act as controlling force to

control the fuel supply and hence the engine speed. The loss of oil pressure cuts the supply of oil to the governor and cause the governor to shut down the engine.

Lubrication system:

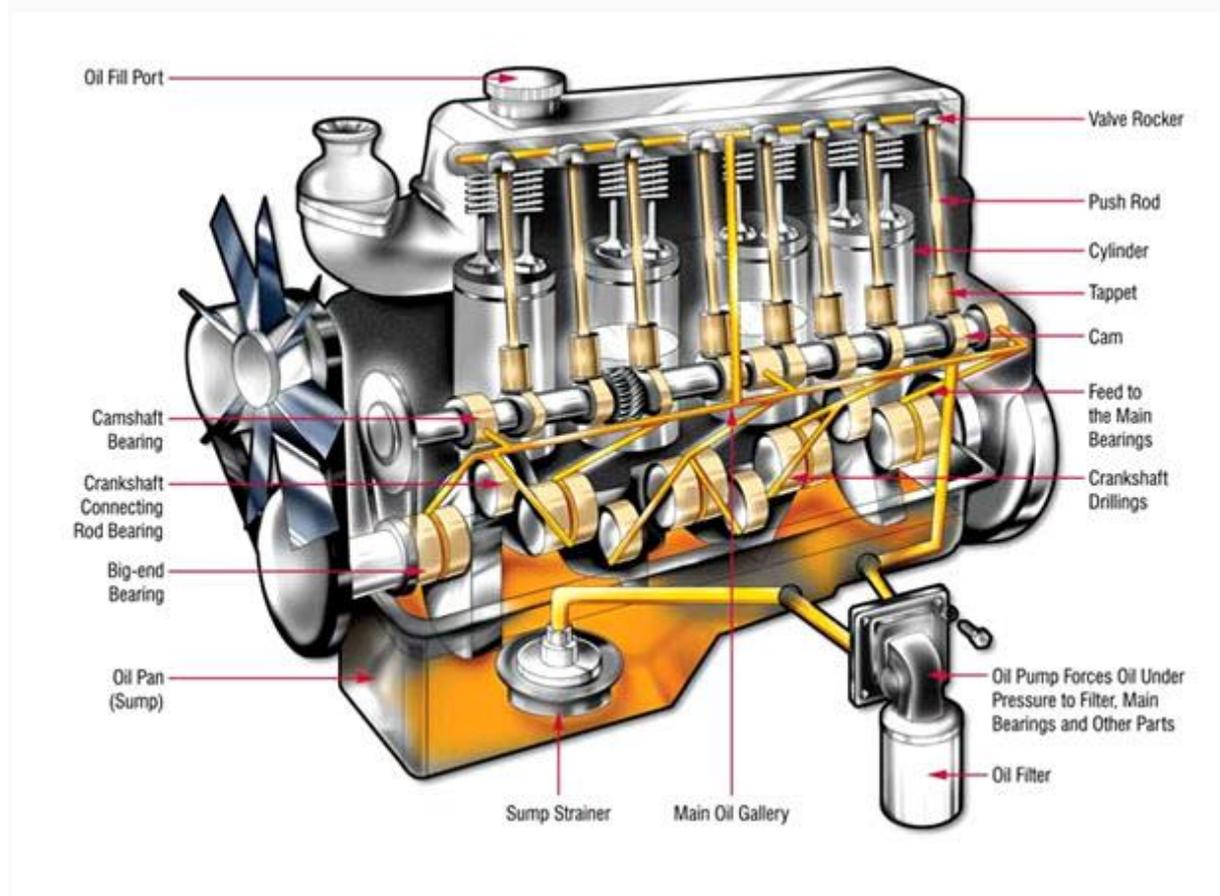
Splash lubrication system

In splash lubrication system the lubrication oil is picked from the oil sump or a pan by a dipper provided at the bottom of the connecting rod for piston in each cylinder. The connecting rod picks the oil from the bottom and moves upward to the engine components. Some oils is also reached to different components like bearings, connecting rod through splash as mechanical turbulence is generated in the crankcase by the moving components which further makes the oil spread in the form of mist in the crankcase. This mist further reaches to other engine components like piston, piston pin and cylinder walls. The camshaft and valve mechanism is also lubricated by the oil. Although the splash type lubrication system is still being used in the engines these days but its usage has been found to be limited to small or single cylinder engines as the splash only is not sufficient to make oil to reach all critical components of the engine.



Force feed lubrication system

As splash system has limitations to lubricate all the critical components in an engine, force feed system is used to generate additional pressure to ensure oil reaching to all essential and desired components for lubrication purposes. Generally, a gear type pump driven by the camshaft generates the pressure in oil to move from the crankcase to crankshaft, connecting rod, bearings pistons and valves. As the lubricating oil is supplied to the engine components under pressure, hence the reach of oil is enhanced to lubricate the remote and farthest points. This helps in efficient lubrication of engine components and hence in achieving better engine performance.



Properties of lubricant:

For smooth functioning of engine components, the efficient function of engine lubrication is must and for efficient functioning of lubrication system, the lubricants should also have the following properties.

- Viscosity
- Clean and stable
- Pour point

- Flashpoint
- Corrosion resistant

Viscosity

Viscosity is the property of the oil which refers to the resistance it has to flow due which two surfaces are kept apart from each other. The viscosity of the lubricants oil should be sufficient to ensure hydrodynamic lubrication. Higher viscosity is also not desirable as it increases the friction and power loss. The oil viscosity decreases at higher temperature and loses its efficacy, so the lubricants should have resistance against the temperature. High viscosity lubricating oils also hampers the initial starting of the engine. Viscosity Index (VI) is a measure of the change of viscosity of oil with temperature. A high viscosity index means less change of oil viscosity with temperature rise. Petroleum lubricating oils generally have viscosity index from 100 to 110, which may be increased to 120 to 130 by means of additives.

Clean and stable

The lubricating oils should be sufficiently clean and stable for the smooth and prolonged trouble free operation of the engine. Lubricating oils should be stable at lowest and highest temperature as the oil particles should not get separated at low temperature and get vaporised at high temperature. Generally, it is observed that at high temperature oils get oxidized which become sticky and damages the engine components, sometimes form carbon, which damages the piston rings causing compression loss. So the lubricating oils should be chemically stable also which do not change their properties at high temperature.

Pour Point

It is the minimum temperature at which the fluid/oil pour and the liquid/oil below this temperature will not be able to flow. Hence the lubricants below this temperature can not be used and function for its desired purpose. Thus, the lubricating oil with pour point less than the lowest temperature encountered in the engine is selected.

Flash Point

The flash point of the fluid/oil refers to the temperature at which it gets sparked and it should be sufficiently high so as to avoid flashing of oil vapours.

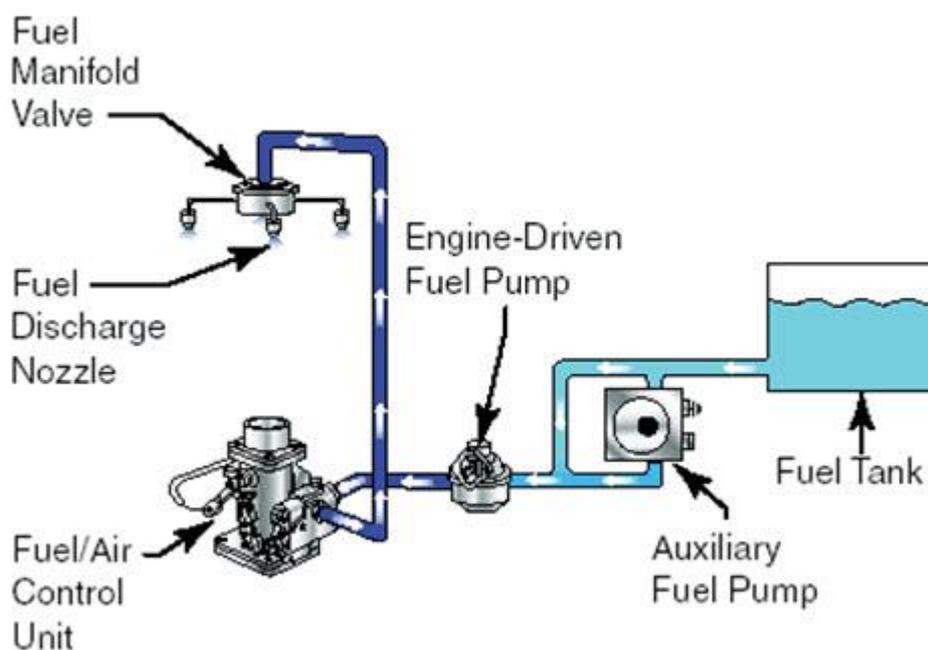
Corrosion Resistance

The lubricating oil used in the automobile engines should have sufficient resistance to corrosion of the engine components like pipe lines, crank case etc. which are in regular contact with each other.

Fuel system:

Fuel line and air supply :

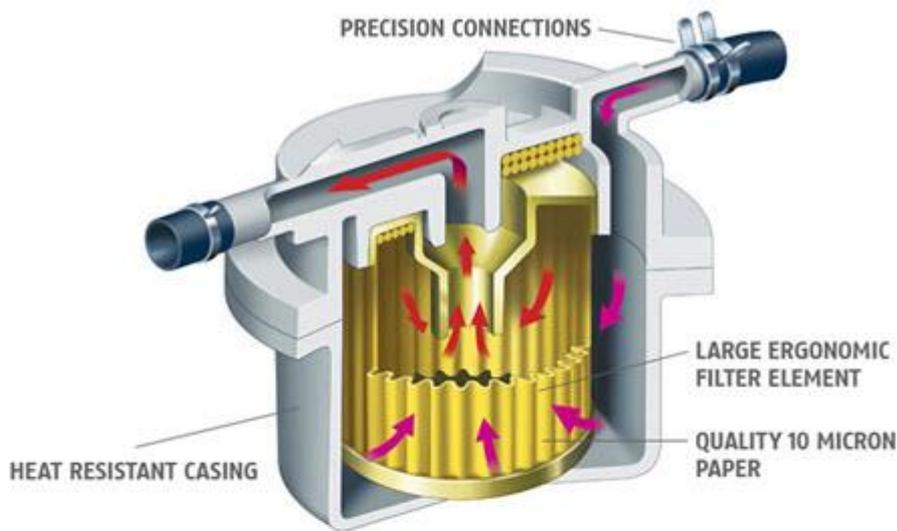
Engine fuel supply system covers the quality and quantity of fuel, air and air fuel mixture flow and combustion aspects in efficient operation of an engine by performing following functions. The fuel system covers the travel of fuel from the fuel tank to injection of atomized fuel into the combustion chamber/cylinder where the burning of fuel takes place to generate mechanical work output. Various components like fuel tank, fuel feed pump, fuel pipes, fuel filters, fuel pump, high pressure pipes, injecting nozzles are the components of fuel line to be discussed in this module.



Fuel storage : Fuel tank is usually made up of metal or fibre sheet having anti rust and better heat and shock resistant properties. Fuel tank should prevent fuel to get contaminated with dust, water or any other foreign material. These impurities in the fuel can block the passage of fuel through the pump and nozzles which further stop the engine.



Fuel Filtering : Fuel filters (primary & secondary) are provided to remove the impurities (water or dust) from the fuel while flowing from tank to reach fuel injection pump. Primary filter is usually made of wire mesh and used for removing the coarse particles. It is attached to the fuel feed pump.



Further to remove the fine particles and abrasive material in the fuel, secondary filter is used which is made of fine pores and it is placed after the fuel feed pump. These smallest impurities are retained to protect the extremely sensitive parts like fuel pump and injectors to get damaged. These filters are generally made of two sections/stages in which first stage is made of cloth and second is of paper through which the fuel passes to leave impurities behind in the fuel line.