Description of induction and exhaust system

Objectives: At the end of this lesson you shall be able to
- **state the function of induction system**
- **state the function of exhaust system**

Induction system

In diesel engine only air is drawn into the cylinder from atmosphere through air cleaner, turbocharger, induction manifold, intake port and inlet valve. The induction manifold provides passage for the flow of fresh air from air cleaner via turbo charger towards the engine cylinder. The intake value provides entrance for the fresh air charge into the combustion chamber and cylinder. The following air flow system is used in diesel induction system.

Air cleaner → Turbo charger → Induction manifold → Intake port → Inlet value → Combustion chamber and cylinder

Exhaust system

The diesel engine used gases go out of the cylinder and combustion chamber through exhaust valve, which act as gate to provide exit for the burnt gases. The gases flow out through exhaust valve mouth space to the connecting passage of exhaust port into the exhaust manifold. The used exhaust gases from the manifold are let out into the atmosphere through catalytic converter muffler and tail pipe. The catalytic converter reduced the emission from the exhaust gases and muffler silence the noise of exhaust gases by reducing the pressure of the exhaust gases by slow expansion and cooling.

Further exhaust gases used for exhaust brake system to control the vehicle speed and to drive the turbo charge's turbine unit. The flow of exhaust gases.

Engine cylinder → used exhaust gases → exhaust port-exhaust manifold → exhaust brake → Turbim → catalytic converter → muffler → tail pipe → atmosphere.

Aircompressor, exhauster and super charger

Objectives: At the end of this lesson you shall be able to
- **explain constructional features of an air compressor**
- **explain operation of an air compressor**
- **explain constructional features of an exhauster**
- **explain operation of an exhauster**
- **explain constructional features of a supercharger**
- **explain operation of a supercharger.**

Air Compressor

An air compressor is part of an engine. It is driven either from the timing gear or from the camshaft to maintain air pressure for different purposes.

Normally, it is of a single cylinder type consisting of a piston assembly, connected to the crankshaft by means of a connecting rod. It has an inlet valve and a delivery valve. An aircompressor is having an inbuilt air cooling system with fins on its head. Valves are automatic in action and consist of hardened and lapped spring loaded steel discs against removable seats. Engine lubricating oil is circulated to lubricate the parts of air compressor

Operation

During the downward stroke of piston partial vacuum is created in cylinder which opens the inlet valve, air to enter into the cylinder. During the upward stroke, the pressure closes the inlet valve. So air is compressed in the cylinder which opens the delivery valve sending compressed air to the reservoir.

Exhauster

Vane type exhauster

Exhausters are fitted on diesel engine to develop vacuum to assist the pneumatic governor of F.I.P. A vane type exhauster is held by bolt over an opening in the engine and consists of a rotor, keyed to a shaft. The rotor is mounted eccentrically to the barrel (body) of the exhauster. Vanes are fitted with sliding fit in the slots of the rotor. A shift valve fitted on the exhauster, limits the vacuum to a predetermined pressure.

Impeller type exhauster

The impeller type exhauster has two spindles. One has an impeller. It is driven by auxiliary driving shaft and the other spindle has rotor whose vanes engage with those on the driven rotor.

Operation of exhauster

The vane type exhauster unit works on the principle of centrifugal force. When the engine is running due to centrifugal action, the vanes which have a sliding fit, fit into the slots in the rotor, which come out to the interior surface of the body (barrel). Air is thus evacuated through out the section and is discharged into the crank case. Lubrication for vanes is provided by splash of oil from the crank case.

Supercharger

A supercharger is a device which increase the pressure of the airfuel mixture from the carburettor before it enters the engine. It is connected between the carburettor and the cylinder in the way of intake manifold. It is usually driven by the engine through suitable gears and shafts. There are three general types of superchargers:

1 Centrifugal type

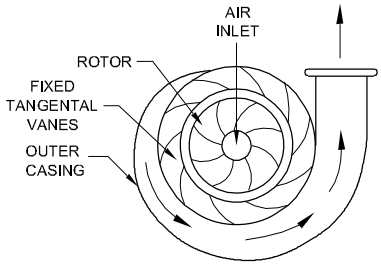
2 Vane type

3 Roots air-blower type

Centrifugal type supercharger (Fig 1)

It consists of an impeller which rotates at a very high speed, about 10,000 r.p.m. The air-fuel mixture enters the impeller at the centre and after passing through the impeller and diffuser vanes goes out of the casing to the engine cylinder. Due to the high speed of the impeller, the mixture is forced into the cylinder at a high pressure.

Fig 1



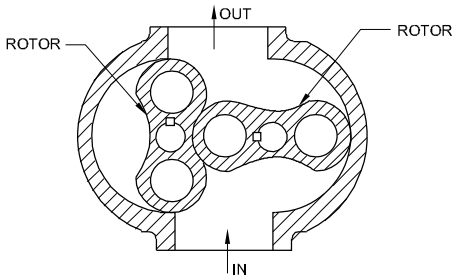
CENTRIFUGAL TYPE
SUPERCHARGER

MVN197111

Roots air-blower type supercharger (Fig 2)

It consists of two rotors of epicycloid shape. Each rotor is fixed to a shaft by a key. The two shafts are connected whether by means of gears of equal size the two rotors rotate at the same speed. The working action of such a supercharger is just like a gear pump, so that the mixture at outlet side is at a high pressure.

Fig 2



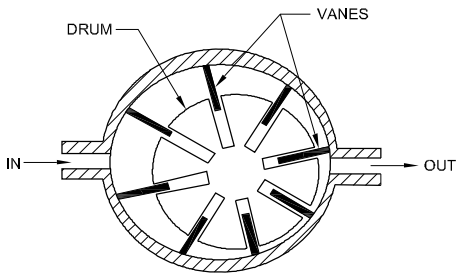
ROOTS AIR-BLOWER TYPE SUPERCHARGE

MVN197112

Vane type supercharger (Fig 3)

It consists of a drum on which a number of vanes are mounted in such a manner that they can slide in or out against some spring force, so that all the times they are in contact with the inner surface of the surpercharger body. The space between the body and the drum goes on decreasing from the inlet to the outlet side. Thus, the air-fuel mixture entrapped between any two vane at inlet goes

Fig 3



VANE TYPE SUPERCHARGER

MVN197113

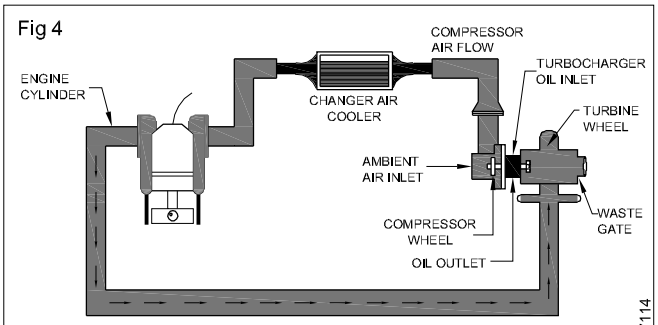
on decreasing in volume and increasing in pressure as in reaches the outlet.

The roots supercharger is simpler in construction and requires least maintenance. It has comparatively long life. It works well even at lower speed ranges. Centrifugal type supercharger has poor working characteristics at lower speeds. Vane type supercharger has the problem of wear of vane tips.

Turbo charger passes compressed hot air into inter cooler and it heats up expands air the pressure increase from a turbocharger is the result of heating the air before it goes into the engine. In order to increase the power of the engine and get more air molecules into the cylinder.

Intercooler (Fig 4)

Fig 4



INTERCOOLER

MVN197114

The intercooler (Fig 4) is an additional component that looks like a radiator, except that air passes through the inside as well as the outside of the intercooler. The intake air passes through sealed passageways inside the cooler, while cooler air from outside is blown across fins by the engine cooling fan.

Charge air cooler and turbo charger

Charge air cooler and turbo charge are part of a high tech induction system that increases engine combustion efficiency. The turbo charger uses exhaust gases to compress air before it entire the charge - air cooler.

The compressed air going through the charge-air cooler is then cooled by the ambient air flowing across the cooler fins. The cooled air is more dense than warm air. So when it flow into the intake side of the engine, the increased density improves horse power, fuel economy and reduce the emissions.

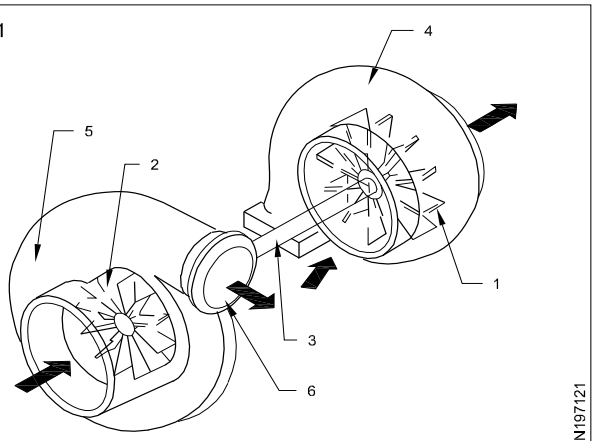
Turbocharger

Objectives: At the end of this lesson you shall be able to
- **explain constructional features of a turbocharger**
- **explain operation of turbo charger**
- **explain types of turbocharger.**

Turbocharger (Fig 1)

Turbo charger is mounted on the engine. It increases the amount of air delivered to the engine cylinder, thereby more fuel can be burnt which increases engine power. Whenever the density of air is less than the density at atmospheric pressure specially at higher altitudes, turbo charges helps the engine to get the sufficient air. An engine may have one or more turbo chargers.

Fig 1



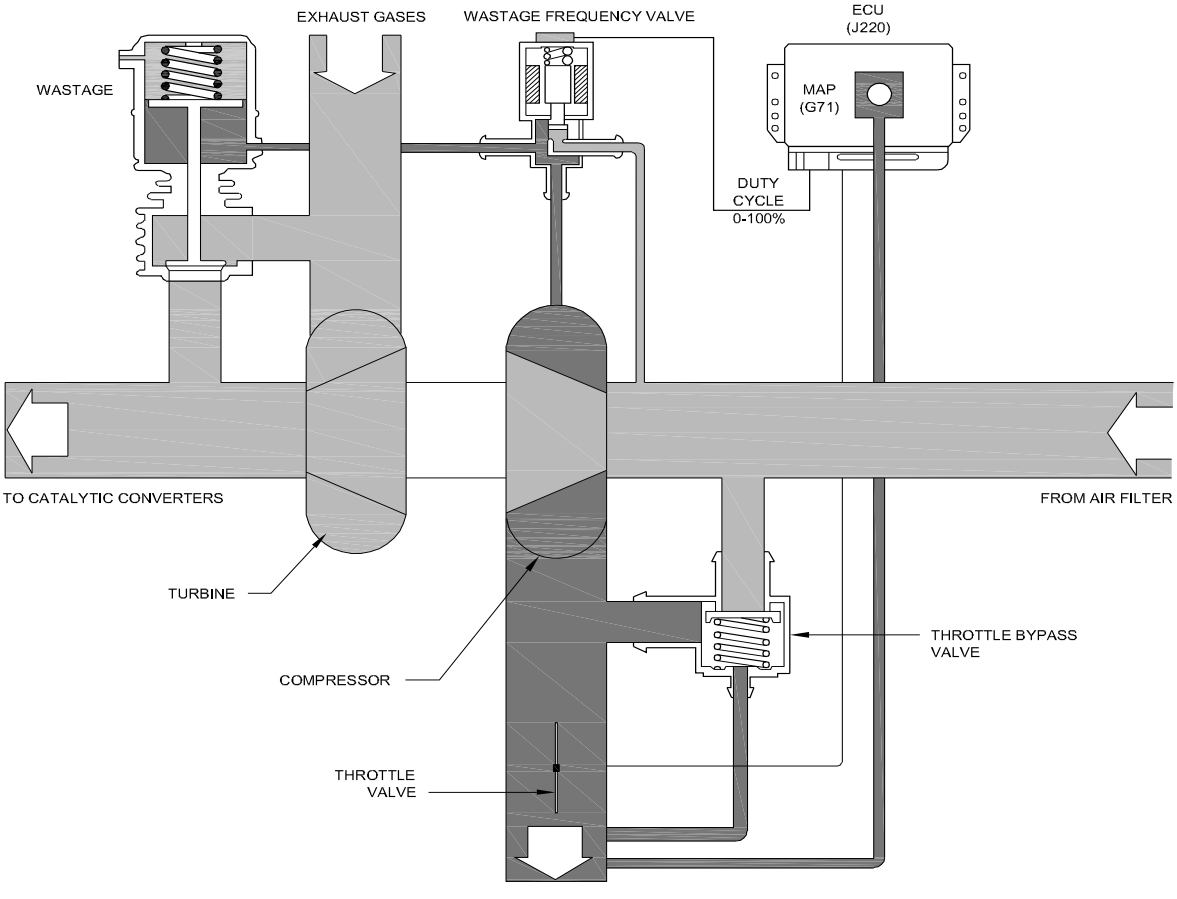
A turbocharger is mounted on the exhaust manifold. It has a turbine wheel (1) and a compressor wheel (2) on the same shaft (3). Exhaust gases enter in turbine housing (4) and rotate the turbine wheel (1). Compressor housing's (5) inlet is connected to the air cleaner and compressed air is discharged to inlet manifold through the outlet (6).

Turbocharger

Fixed Geometry Turbochargers (FGT)

A turbocharger consists of a turbine and a compressor linked by a shared axle. The turbine inlet receives exhaust gases from the engine exhaust manifold causing the turbine wheel to rotate. This rotation drives the compressor, compressing ambient air and delivering it to the air intake manifold of the engine at higher pressure, resulting in a greater amount of the air and fuel entering the cylinder. In FGT, (Fig 2) the amount of compressed air which has to be entered in the engine is controlled by a waste gate valve which regulates the turbo output depending on engine's speed.

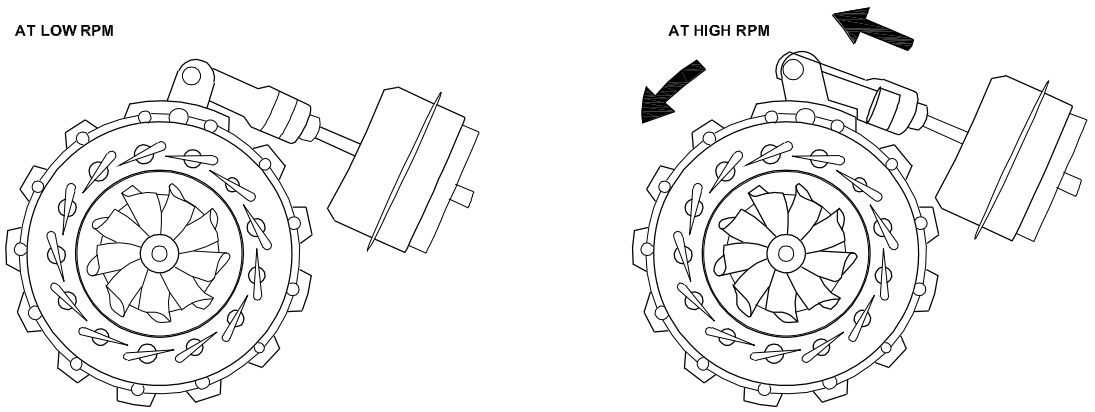
Fig 2



Variable Geometry Turbochargers (VGT)

Variable geometry turbochargers (VGTs) (Fig 3) are a family of turbochargers, usually designed to allow the effective aspect ratio of the turbo to be altered as conditions change. This is done because optimum aspect ratio at low engine speeds is very different from that at high engine speeds. If the aspect ratio is too large, the turbo will fall to create boost at low speeds; if the aspect ratio is too small, the turbo will choke the engine at high speeds, leading to high exhaust manifold pressures, high pumping losses and ultimately lower power output. By altering the geometry of the turbine housing as the engine accelerates, the turbo's aspect ratio can be maintained at its optimum. Because of this, VGTs have a minimal amount of lag, have a low boost threshold, and are very efficient at higher engine speeds.

Fig 3



Air cleaner and air cooler

Objectives : At the end of this lesson you shall be able to

- **state the need of an air cleaner**
- **state the different types of air cleaners**
- **state the function of induction manifold**
- **state the function of an air cleaner.**

Atmospheric air consists of a large quantity of dirt and dust. Uncleaned air will cause faster wear of and damage to the engine parts, so air is filtered before entering inside the cylinder bore.

Purpose of air cleaner

- It cleans the intake air.
- It reduces the noise of the intake air.
- It acts as a flame arrester during engine backfire.

Location

It is mounted on the top of the air inlet manifold.

Types

- Wet-type (Fig 1)
- Dry-type (Fig 2)

Fig 1

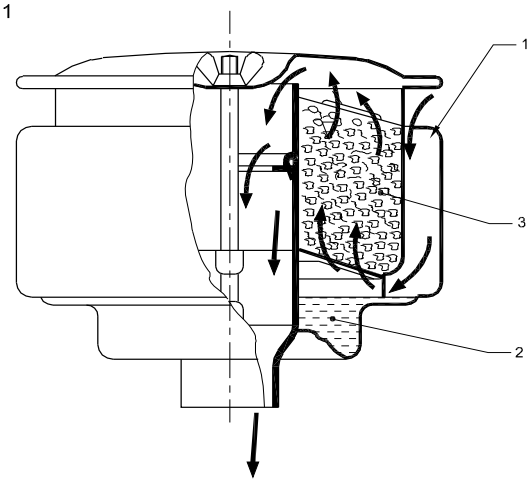
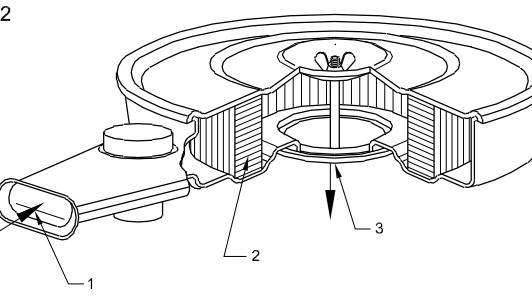


Fig 2



Wet type air cleaner

The atmospheric air enters the air cleaner through the side passage (1) and strikes on the surface of the oil (2). Heavy dust particles are absorbed by the oil. The partially filtered air, along with oil particles, moves upward through the filter element (3). Fine particles and oil particles are collected by the filtering element (3). Cleaned air then passes through the passage to the inlet manifold.