DIESEL ENGINE

The diesel engine is one type of internal combustion engine; more specifically, it is a compression ignition engine, in which the fuel is ignited by being suddenly exposed to the high temperature and pressure of a compressed gas, rather than by a separate source of ignition, such as a spark plug, as is the case in of the gasoline engine.

Diesel cycle

[[1]] , after German engineer Rudolf Diesel [[2]], who invented it in 1892 and received the patent on February 23, 1893. Diesel intended the engine to use a variety of fuels including coal dust. He demonstrated it in the 1900 Exposition Universelle (1900) (World's Fair) using peanut oil (see biodiesel [[3]]).

How diesel engines work

When a gas is compressed, its temperature rises (see the combined gas law); a diesel engine uses this property to ignite the fuel. Air is drawn into the cylinder of a diesel engine and compressed by the rising pistonat a much higher compression ratio than for a spark-ignition engine, up to 25:1. The air temperature reaches 700–900 °C, or 1300–1650 °F. At the top of the piston Stroke diesel fuel is injected into the combustion chamber at high pressure, through an atomising nozzle, mixing with the hot, high-pressure air. The mixture ignites and burns very rapidly. This contained

explosion causes the gas in the chamber to heat up rapidly, which increases its pressure, which in turn forces the piston downwards. The connecting rod transmits this motion to the crankshaft, which is forced to turn, delivering rotary power at the output end of the crankshaft.Scavenging (pushing the exhausted gas-charge out of the cylinder, and drawing in a fresh draught of air) of the engine is done either by ports or valves. To fully realize the capabilities of a diesel engine, use of aturbocharger to compress the intake air is necessary; use of an aftercooler/intercooler to cool the intake air after compression by the turbocharger further increases efficiency.

In very cold weather, diesel fuel thickens and increases in viscosity and forms wax crystals or a gel. This can make it difficult for the fuel injector to get fuel into the cylinder in an effective manner, making cold weather starts difficult at times, though recent advances in diesel fuel technology have made these difficulties rare. A commonly applied advance is to electrically heat the fuel filter and fuel lines. Other engines utilize small electric heaters called glow plugs inside the cylinder to warm the cylinders prior to starting. A small number use resistive grid heaters in the intake manifold to warm the inlet air until the engine reaches operating temperature. Engine block heaters (electric resistive heaters in the engine block) plugged into the utility grid are often used when an engine is shut down for extended periods (more than an hour) in cold weather to reduce startup time and engine wear.

A vital component of any diesel engine system is the governor, which limits the speed of the engine by controlling the rate of fuel delivery. Unlike a petrol (gasoline) engine, the incoming air is not throttled, so the engine would overspeed if this was not done. Older governors were driven by a gear system from the engine (and thus supplied fuel only linearly with engine speed). Modern electronically-controlled engines achieve this through the electronic control module (ECM) or electronic control unit (ECU) - the engine-mounted "computer". The ECM/ECU receives an engine speed signal from a sensor and then using its algorithms [[1]] and look-up calibration tables stored in the ECM/ECU, it controls the amount of fuel and its timing (the "start of injection") through electric or hydraulic actuators to maintain engine speed.

Controlling the timing of the start of injection of fuel into the pistons is key to minimising their emissions and maximising the fuel economy (efficiency) or the engine. The exact timing of starting this fuel injection into the cylinder is controlled electronically in most of today's modern engines. The timing is usually measured in units of crank angle of the piston before Top Dead Center (TDC). For example, if the ECM/ECU initiates fuel injection when the piston is 10 degrees before TDC, the start of injection or "timing" is said to be 10 deg BTDC. The optimal timing will depend on both the engine design as well as its speed and load.

Advancing (injecting when the piston is further away from TDC) the start of injection results in higher in-cylinder pressure and higher efficiency but also results in higher Nitrous Oxide (NOx[[2]]) emissions. At the other extreme, very retarded start of injection or timing causes incomplete combustion. This results in higher Particulate Matter (PM) emissions and higher smoke.

Fuel injection in diesel engines

Early diesels often employed indirect injection in order to use simple, flat-top pistons, and made the positioning of the early, bulky diesel injectors easier, but all modern diesel engines employ some form of direct injection, coupled with more complicated bowl-in-piston designs. Modern engines also use a very highly pressurised fuel supply line, which replaces the older, noisier, and mechanically more complicated combined pump and selector valve assembly (see below).

Indirect Injection

Main article: Indirect injection

An indirect injection diesel engine delivers fuel into a chamber off the combustion chamber, called a prechamber, where combustion begins and then spreads into the main combustion chamber. The prechamber is carefully designed to ensure adequate mixing of the atomized fuel with the compression-heated air. This has the effect of slowing the rate of combustion, which tends to reduce audible noise. It also softens the shock of combustion and produces lower stresses on the engine components. The

addition of a prechamber, however, increases heat loss to the cooling system and thereby lowers engine efficiency.

Direct injection

Modern diesel engines make use of one of the following direct injection methods:

Common rail direct injection

In older diesel engines, a distributor-type injection pump, regulated by the engine, supplies bursts of fuel to injectors which are simply nozzles through which the diesel is sprayed into the engine's combustion chamber. As the fuel is at low pressure and there cannot be precise control of fuel delivery, the spray is relatively coarse and the combustion process is relatively crude and inefficient.

In common rail systems, the distributor injection pump is eliminated. Instead an extremely high pressure pump stores a reservoir of fuel at high pressure - up to 1,800 bar (180 MPa) - in a "common rail", basically a tube which in turn branches off to computer-controlled injector valves, each of which contains a precision-machined nozzle and a plunger driven by a solenoid. Driven by a computer (which also controls the amount of fuel to the pump), the valves, rather than pump timing, control the precise moment when the fuel injection into the cylinder occurs and also allow the pressure at which the fuel is injected into the cylinders to be increased. As a result, the fuel that is injected atomises easily and burns cleanly, reducing exhaust emissions and increasing efficiency.

In addition, the engine's Electronic Control Unit (ECU) can inject a small amount of diesel just before the main injection event ("pilot" injection) that reduces noise and vibration, as well as optimises injection timing and quantity for variations in fuel quality, cold starting, and so on.

Most European automakers have common rail diesels in their model lineups, even for commercial vehicles. Some Japanese manufacturers, such as Toyota, Nissan and recently Honda, have also developed common rail diesel engines.

Unit direct injection

This also injects fuel directly into the cylinder of the engine. However, in this system the injector and the pump are combined into one unit positioned over each cylinder. Each cylinder thus has its own pump, feeding its own injector, which prevents pressure fluctuations and allows more consistent injection to be achieved. This type of injection system, also developed by Bosch, is used by Volkswagen AG in cars (where it is called Pumpe Düse - literally "pump nozzle"), and most major diesel engine manufacturers, in large commercial engines (Cat, Cummins, Detroit Diesel). With recent advancements, the pump pressure has been raised to 2,050 bar (205MPa), allowing injection parameters similar to common rail systems.

== Types of diesel engines: There are two classes of diesel engines: two-stroke and four-stroke. Most diesels generally use the four-stroke cycle, with some larger diesels operating on the two-stroke cycle. ==

Normally, banks of cylinders are used in multiples of two, although any number of cylinders can be used as long as the load on the crankshaft is counterbalanced to prevent excessive vibration. The inline-6 is the most prolific in medium- to heavy-duty engines, though the V8 and straight-4 are also common.

Source : http://engineering.wikia.com/wiki/Diesel_engine