INTERNAL COMBUSTION ENGINE

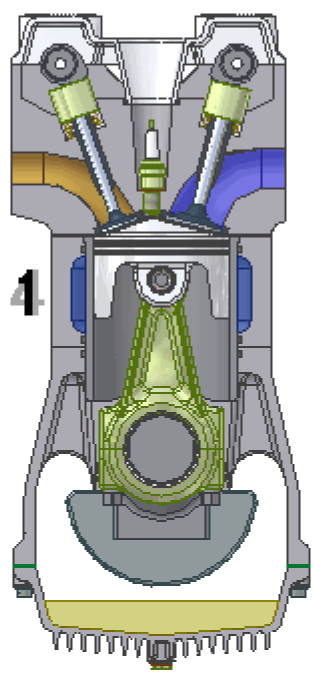
The internal combustion engine is a heat engine in which combustion occurs in a confined space called a combustion chamber. Combustion of a fuel creates high temperature/pressure gases, which are permitted to expand. The expanding gases are used to directly move a piston, turbine blades, rotor(s), or the engine itself thus doing useful work.

Characterstics

Internal combustion engines can be powered by any fuel that can be combined with an "oxidizer" in the chamber.

By way of contrast, an external combustion engine such as a steam engine does work when the combustion process heats a separate working fluid, such as water or steam, which then in turn does work.

Jet engines, most rockets and many gas turbines are strictly classed as internal combustion engines, but the term internal combustion engine is also used to refer specifically to reciprocating engines, Wankel engines and similar designs in which combustion is intermittent. Today, in some published discussions, internal combustion engine is abbreviated to the acronym ICE.



Four-stroke cycle (or Otto cycle)

Compression

The most significant distinction between modern internal combustion engines and the early designs is the use of compression and in particular of in-cylinder compression. The thermodynamic theory of idealized heat engines was established by Nicolas Léonard Sadi Carnot [[11]] in France in 1824. This scientifically established the need for compression to increase the difference between the upper and lower working temperatures, but it is not clear that engine designers were aware of this before compression was already commonly used. In fact it may have mislead designers who attempted to emulate the Carnot cycle in ways that were not useful.

The first recorded suggestion of in-cylinder compression was a patent granted to William Barnet (English) in 1838. He apparently did not realize its advantages, but his cycle would have been a great advance if sufficiently developed.

Otto working with Gottlieb Daimler [[12]] and Wilhelm Maybach [[13]] in the 1870s developed a practicalfour-stroke cycle (Otto cycle) engine. The German courts, however, did not hold his patent to cover all in-cylinder compression engines or even the four stroke cycle, and after this decision in-cylinder compression became universal.

Applications

Internal combustion engines are most commonly used for mobile propulsion systems. In mobile scenarios internal combustion is advantageous, since it can provide high power to weight ratios together with excellent fuel energy-density. These engines have appeared in almost all cars, motorbikes, many boats, and in a wide variety of aircraft and locomotives. Where very high power is required, such as jet aircraft, helicopters and large ships, they appear mostly in the form of gas turbines. They are also used for electric generators and by industry.

For low power mobile and many non-mobile applications an electric motor is a competitive alternative. In the future, electric motors may also become competitive for most mobile applications. However, the high cost, weight, and poor energy density of PbA and even NiMH batteries and lack of affordable on board electric generators such as fuel cells has largely restricted their use to specialist applications. However recent battery advancements in lightweight Li-ion and Li-poly chemistries are bringing safety, power density, lifespan, and cost to within acceptable or even desirable levels. For example recently battery electric vehicles began to demonstrated 300 miles of range on Lithium, now improved power makes them appealing for plug-in hybrid electric vehicles whose electric range is less critical having internal combustion for unlimited range.

Operation

All internal combustion engines depend on the exothermic chemical process of combustion: the reaction of a fuel, typically with air, although other oxidisers such as nitrous oxide may be employed. Also see stoichiometry [[14]] .

The most common fuels in use today are made up of hydrocarbons and are derived from petroleum. These include the fuels known as diesel, gasoline and liquified petroleum gas. Most internal combustion engines designed for gasoline can run on natural gas or liquified petroleum gases without modifications except for the fuel delivery components. Liquid and gaseous biofuels of adequate formulation can also be used.

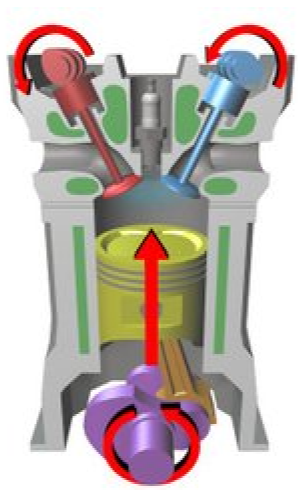
Some have theorized that in the future hydrogen might replace such fuels. Furthermore, with the introduction of hydrogen fuel cell technology, the use of internal combustion engines may be phased out. The advantage of hydrogen is that its combustion produces only water. This is unlike the combustion of hydrocarbons, which also produces carbon dioxide, a major cause of global warming, as well as carbon monoxide, resulting from incomplete combustion. The big disadvantage of hydrogen in many situations is its storage. Liquid hydrogen has extremely low density- 14 times lower than water and requires extensive insulation, whilst gaseous hydrogen requires very heavy tankage. While hydrogen is light and therefore has a higher specific energy, the volumetric efficiency is still roughly five times lower than petrol. This is why hydrogen must be compressed if there is to be a useful amount of stored energy.

All internal combustion engines must have a means of ignition to promote combustion. Most engines use either an electrical or a compression heating ignition system. Electrical ignition systems generally rely on alead-acid battery and an induction coil to provide a high voltage electrical spark to ignite the air-fuel mix in the engine's cylinders. This battery can be recharged during operation using an alternator driven by the engine. Compression heating ignition systems (Diesel engines and HCCI engines) rely on the heat created in the air by compression in the engine's cylinders to ignite the fuel.

Once successfully ignited and burnt, the combustion products (hot gases) have more available energy than the original compressed fuel/air mixture (which had higher chemical energy). The available energy is manifested as high temperature and pressure which can be translated into work by the engine. In a reciprocating engine, the high pressure product gases inside the cylinders drive the engine's pistons.

Once the available energy has been removed the remaining hot gases are vented (often by opening a valve or exposing the exhaust outlet) and this allows the piston to return to its previous position (Top Dead Center - TDC). The piston can then proceed to the next phase of its cycle (which varies between engines). Any heat not translated into work is a waste product and is removed from the engine either by an air or liquid cooling system.

Parts



An illustration of several key components in a typical four-stroke engine

The parts of an engine vary depending on the engine's type. For a four-strokeengine, key parts of the engine include the crankshaft (purple), one or morecamshafts (red and blue) and valves. For a two-stroke engine, there may simply be an exhaust outlet and fuel inlet instead of a valve system. In both types of engines, there are one or more cylinders (grey and green) and for each cylinder there is a spark plug (darker-grey), a piston (yellow) and a crank(purple). A single sweep of the cylinder by the piston in an upward or downward motion is known as a stroke and the downward stroke that occurs directly after the air-fuel mix in the cylinder is ignited is known as a power stroke.

A Wankel engine has a triangular rotor that orbits in an epitroichoidal (figure 8 shape) chamber around an eccentric shaft. The four phases of operation (intake, compression, power, exhaust) take place in separate locations, instead of one single location as in a reciprocating engine.

A Bourke Engine uses a pair of pistons integrated to a Scotch Yoke that transmits reciprocating force through a specially designed bearing assembly to turn a crank mechanism. Intake, compression, power, and exhaust all occur in each stroke of this yoke.

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