



EXPLORING THE WORKING PRINCIPLES OF SPARK IGNITION AND COMPRESSION IGNITION ENGINES

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Abstract: The study is comprehensive with major focus to ascertain the holistic working principles of a cylinder engine. It illuminates into understanding the working principles of spark ignition (SI) engine and compression ignition (CI) engines, the types of fuel they used and their combustion methods for ignition in the automotive systems.

Keywords: Working principles of cylinder engines, spark ignition, compression ignition and combustion method.

Introduction

A heat engine is a machine, which converts heat energy into mechanical energy. The combustion of fuel such as coal, petrol, and diesel generates heat. This heat is supplied to a working substance at high temperature. By the expansion of this substance in suitable machines, heat energy is converted into useful work. Heat engines can be further divided into two types: (i) External combustion and (ii) Internal combustion. In a steam engine the combustion of fuel takes place outside the engine and the steam thus formed is used to run the engine. Thus, it is known as external combustion engine. In the case of internal combustion engine, the combustion of fuel takes place inside the engine cylinder itself. The IC engine can be further classified as: (i) stationary or mobile, (ii) horizontal or vertical and (iii) low, medium or high speed. The two distinct types of IC engines used for either mobile or stationary operations are: (i) diesel and (ii) carburettor. Though both are internal combustion engine, the spark and compression ignitions are totally different mechanical technologies that are used in engines. Engines that used spark ignition technology are called as spark ignition engine (SI engines), and the others are known as compression ignition engines (CI engines). These two methods of ignition are used in engines in of internal combustion with their combustion strokes in order to ignites the fuel and get the thermal energy; the ignition that take place in SI technology, electric spark plug is used to provided the ignition with a properly mixed air fuel mixture, but in CI technology, the air is compressed to a higher temperature and that high temperature causes an ignition.

WORKING PRINCIPLES OF A SPARK IGNITION ENGINE (SI) AND COMPRESSION IGNITION ENGINE (CI)

The spark ignition (SI) engines work on the principle of cycle of operations invented by Niculaus A. Otto in the year 1876, while the compression ignition (CI) engines work on the principle founded by Rodolf Diesel in the year 1892. For the engine to work properly, it has to perform some cycle of operations continuously. The principle of operation of the spark ignition (SI) engines was invented by Niculaus A. Otto in the 1876; hence SI engine is called the Otto engine. The principle of the workings of compression ignition engine (CI) was founded by Rodolf Diesel in the year 1892; hence, CI engine is also called the Diesel engine. The principles of working of both SI and CI engines are almost the same; except in the process of the fuel combustion that occurs in both engines. In SI engines, the burning of fuel occurs by a spark plug located on the cylinder head. The spark ignition engine usually runs on liquid fuel such as gasoline or an alcohol blend. The fuel must be highly volatile so that it vaporizes quickly. The fuel vapor mixes with air before entering the engine cylinders. This forms the highly combustible air fuel mixture that burns easily. The mixture then entered the cylinders and is compressed. Heat from an electric spark produced by the ignition system sets fire to, or ignites the air fuel mixtures. As the mixtures burns (combustion), high temperature and pressure are produced in the cylinder. This high pressure applied to the top of the piston, forces it to move down the cylinder. The motion is carried by gears and shafts to the wheels that drive the car, the wheel turn and the car moves. While in the compression ignition engines (CI) the burning of fuel occurs due to compression of the fuel to excessively high pressures which does not require any spark to initiate the ignition of fuel. In this case, the combustion of fuel occurs at constant pressures. The compression ignition engine, the fuel mixes with air after it enters the engine cylinders. The piston compresses the air to as $\frac{1}{22}$ of its original volume. Compressing the air this much raises its temperature to 1000⁰f (538⁰C) or higher. Light oil called diesel fuel is then sprayed or injected into the hot air, the host air or heat of compression ignites the fuel. The method of ignition by heat of compression-engines gives the diesel engine the name compression ignition engine.

THE DIFFERENT TYPES OF FUELS USED FOR A SPARK IGNITION ENGINE (SI) AND THE COMPRESSION ENGINE (CI)

Compression ignition engines generally used diesel fuel. Natural gas or evaporated gasoline is more difficult to ignite with compression engine and depends on spark plugs to ignite the fuel and create the combustion that leads to the power stroke. Dual fuel engines can operate in the pure oil injection mode, but can burn up to 9% natural gas. In spark ignition (SI) engines, petrol is gasoline used as fuel, while in compression ignition (CI) engines, diesel is used as fuel. Petrol engines are lightweight and achieve higher speed. Diesel engines, on the other hand, are heavy engines and achieve lesser speeds. The most prominent difference between spark ignition (SI) and compression ignition (CI) engines is in the type of fuel used by each. In SI engines, petrol or gasoline is used as fuel and these engines are also called petrol engines, more so, CI engines, diesel is used as fuel; hence they are also called diesel engines.

THE WAY FUEL IGNITES/COMBUSTION PROCESSES OF SI and CI ENGINES.

In the case of SI engines, the Otto cycle is used, in this cycle, addition of heat of fuel combustion occurs at a constant volume. The basis of working of CI engines is the Diesel cycle. In this cycle, the addition of heat or fuel combustion occurs at constant pressure. In the case of SI engines, during the piston's suction stroke, a mixture of air and fuel is injected via the carburetor that controls the quantity and the quality of injected mixture. In the case of the compression stroke, the fuel starts burning instantly due to the high pressure. To inject diesel in CI engines, a fuel pump and injector are required. In CI engines, the quantity of fuel to be injected is controlled but the quality of air to be injected is not controlled.

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