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4-Stroke Double Piston IC-Engines Compression Ignition Engines

K. Krishna Das[1], Bineesh Madhu[2]

[1]*Student, Department of Mechanical Engineering, SRM University, Vadapalani*
[2]*Department of Mechanical Engineering, SRM University, Vadapalani*

Abstract: **It is time for us to bring changes in the existing system of internal combustion engines, so as to increase its efficiency and make innovations in this field. When we speak of efficiency of internal combustion engines we are reminded of fuel consumption and its cost. That is the reason why I have come up with this model of a 4-stroke double piston engine. When we say about a cheap and efficient engine we talk about diesel engines. Through the model that I intend to introduce here, we can gain more power and also obtain a smaller sized compression ignition engine.**

1. INTRODUCTION

An engine is a machine designed to convert energy into useful mechanical motion.[1]. An engine can be of two types: intern combustion engines or external combustion engines. What we are dealing with here are only internal combustion engines. The internal combustion engine (ICE) is an engine where the combustion of a fuel (normally a fossil fuel) occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit.

In an internal combustion engine the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine. The force is applied typically to pistons, turbine blades, or a nozzle. This force moves the component over a distance, transforming chemical energy into useful mechanical energy.[2] Basically there are two classifications of internal combustion engines, they are: spark ignition engines and compression ignition engines. In simple words a spark ignition engine uses gasoline (or) petrol as the fuel while a compression ignition engine uses diesel as the fuel.

2. COMPRESSION IGNITION ENGINES

The diesel engine (also known as a compression-ignition engine) is an internal combustion engine that uses the heat of compression to initiate ignition and burn the fuel that has been injected into the combustion chamber. This contrasts with spark-ignition engines such as a petrol engine (gasoline engine) or gas engine (using a gaseous fuel as opposed to gasoline), which use a spark plug to ignite an air-fuel mixture. The diesel engine has the highest thermal efficiency of any standard internal or external combustion engine due to its very high compression ratio. Low-speed diesel engines (as used in ships and other applications where overall engine weight is relatively unimportant) can have a thermal efficiency that exceeds 50%.[3] Going in depth a diesel engine can be of two types: 4-stroke engine or 2-stroke engine.

3. FOUR STROKE ENGINE

A four-stroke engine (also known as four-cycle) is an internal combustion engine in which the piston completes four separate strokes which comprise a single thermodynamic cycle. A stroke refers to the full travel of the piston along the cylinder, in either direction. The four separate strokes are termed:

- INTAKE: this stroke of the piston begins at top dead center. The piston descends from the top of the cylinder to the bottom of the cylinder, increasing the volume of the cylinder. A mixture of fuel and air is forced by atmospheric (or greater) pressure into the cylinder through the intake port.
- COMPRESSION: with both intake and exhaust valves closed, the piston returns to the top of the cylinder compressing the air or fuel-air mixture into the cylinder head.
- POWER: this is the start of the second revolution of the cycle. While the piston is close to Top Dead Centre, the compressed air–fuel mixture in a gasoline engine is ignited, by a spark plug in gasoline engines, or which ignites due to the heat generated by compression in a diesel engine. The resulting pressure from the combustion of the compressed fuel-air mixture forces the piston back down toward bottom dead cater.
- EXHAUST: during the exhaust stroke, the piston once again returns to top dead center while the exhaust valve is

open. This action expels the spent fuel-air mixture through the exhaust valve(s).[4]

4. FOUR STROKE DIESEL ENGINE

The primary differences between a diesel engine and a gasoline engine are as follows:

- The fuel and air mixture is ignited by the heat generated by the compression stroke in a diesel engine versus the use of a spark ignition system on a gasoline engine.
- The fuel and air mixture in a diesel engine is compressed to about one twentieth of its original volume, while in a gasoline engine the fuel and air mixture is only compressed to about one eighth of its original volume. The diesel engine must compress the mixture more tightly to generate enough heat to ignite the fuel and air mixture.
- The gasoline engine mixes the fuel and air before it reaches the combustion chamber. A diesel engine takes in only air through the intake port. Fuel is put into the combustion chamber directly through an injection system. The air and fuel then mix in the combustion chamber.
- The engine speed and the power output of a diesel engine are controlled by the quantity of fuel admitted to the combustion chamber. The amount of air is constant. On the gasoline engine, the speed and power output is regulated by limiting the air and fuel mixture entering the engine.

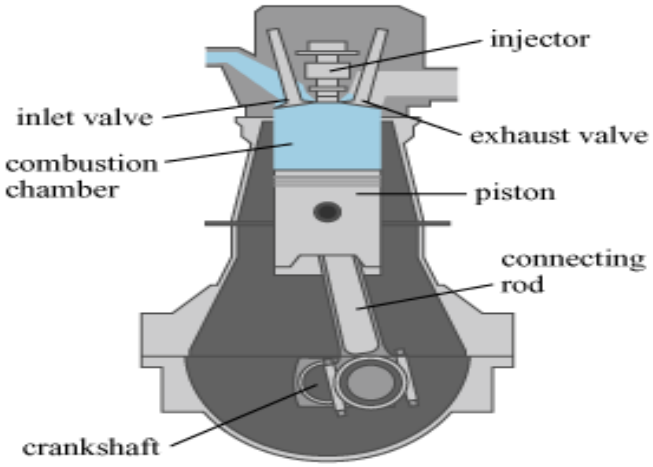
  A diesel engine is much more efficient than a gasoline engine, such as the diesel engine does not require an ignition system due to the heat generated by the higher compression, the diesel engine has a better fuel economy due to the complete burning of the fuel, and the diesel engine develops greater torque due to the power developed from the high-compression ratio.[5]

5. THE CONCEPT OF DOUBLE PISTON ENGINE

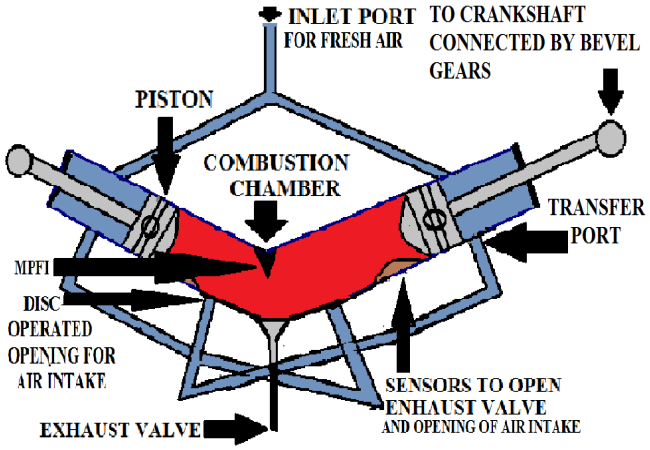
In this concept of diesel engine we have a v-shaped engine with two pistons facing each other between which the combustion takes place. There is MPFI (multiport fuel injector) installed in this set-up. There are two air-intakes for the combustion chamber and a single exhaust valve. The air-intakes are disc operated and sensors controlled. Even the exhaust valve is sensors controlled.

The shape of the piston is a cylindrical shape with a hemisphere on the top that carries out the scavenging process more effectively. The strokes are similar to that of a four stroke engine. As the pistons move backward the air supply is opened or closed based on the stroke and is stored in it and opens and closes in every alternate strokes.

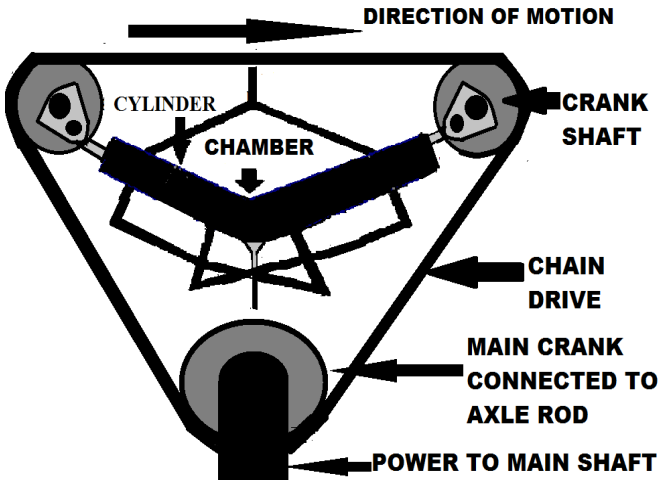
6. DIAGRAMS



4-stroke diesel engine



THE CONCEPT ENGINE



TRANSMISSION SYSTEM

7. DEFINITIONS

- **Bevel gears:** Bevel gears are gears where the axes of the two shafts intersect and the tooth-bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of bevel gears is a cone. [6]
- **Combustion chamber:** A combustion chamber is the part of an engine in which fuel is burned. [7]
- **Combustion:** Combustion or burning is the sequence of exothermic chemical reactions between a fuel and an oxidant accompanied by the production of heat and conversion of chemical species. The release of heat can produce light in the form of either glowing or a flame. In a complete combustion reaction, a compound reacts with an oxidizing element, such as oxygen or fluorine, and the products are compounds of each element in the fuel with the oxidizing element. [8]
- **Compression ignition:** The concept behind compression ignition involves using the latent heat built up by highly compressing air inside a combustion chamber as the means for igniting fuel. [9]
- **Compression ratio:** The compression ratio of an internal-combustion engine or external combustion engine is a value that represents the ratio of the volume of its combustion chamber from its largest capacity to its smallest capacity. It is a fundamental specification for many common combustion engines. In a piston engine, it is the ratio between the volume of the cylinder and combustion chamber when the piston is at the bottom of its stroke, and the volume of the combustion chamber when the piston is at the top of its stroke. [10]
- **Crankshaft:** The crankshaft, sometimes abbreviated to crank, is responsible for conversion between reciprocating motion and rotational motion. In a reciprocating engine, it translates reciprocating linear piston motion into rotational motion, whereas in a reciprocating compressor, it converts the rotational motion into reciprocating motion.[11]
- **Cylinder**: A cylinder is the central working part of a reciprocating engine or pump, the space in which a piston travels.[12]
- **Exhaust:** An exhaust system is usually piping used to guide reaction exhaust gases away from a controlled combustion inside an engine or stove. The entire system conveys burnt gases from the engine and includes one or more exhaust pipes.[13]
- **Gasoline:** Gasoline or petrol is a transparent, petroleum-derived liquid that is used primarily as a fuel in internal combustion engines. [14]
- **Ignition:** An ignition system is a system for igniting a fuel-air mixture. Ignition systems are well known in the field of internal combustion engines such as those used in petrol (gasoline) engines used to power the majority of motor vehicles, but they are also used in many other applications such as in oil-fired and gas-fired boilers, rocket engines, etc. [15]
- **MPFI:** MPFI means Multi Point Fuel Injection system. In this system each cylinder has number of injectors to supply or spray fuel in the cylinders as compared to one injector located centrally to supply or spray fuel in case of single point injection system.[16]
- **Nozzle:** A nozzle is a device designed to control the direction or characteristics of a fluid flow (especially to increase velocity) as it exits (or enters) an enclosed chamber or pipe.[17]
- **Piston:** A piston is a component of reciprocating engines, reciprocating pumps, gas compressors and pneumatic cylinders, among other similar mechanisms. It is the moving component that is contained by a cylinder and is made gas-tight by piston rings. In an engine, its purpose is to transfer force from expanding gas in the cylinder to the crankshaft via a piston rod and/or connecting rod. In a pump, the function is reversed and force is transferred from the crankshaft to the piston for the purpose of compressing or ejecting the fluid in the cylinder. In some engines, the piston also acts as a valve by covering and uncovering ports in the cylinder wall. [18]
- **Scavenging:** In automotive usage, scavenging is the process of pushing exhausted gas-charge out of the cylinder and drawing in a fresh draught of air or fuel/air mixture for the next cycle. This process is essential in having a smooth-running internal combustion engine. If scavenging is incomplete, the following stroke will begin with a mix of exhaust fumes rather than clean air. [19]
- **Sensors:** A sensor is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an (today mostly electronic) instrument.[20]
- **Stroke:** Reciprocating motion, used in reciprocating engines and other mechanisms, is back-and-forth motion. Each cycle of reciprocation consists of two opposite motions: there is a motion in one direction, and then a motion back in the opposite direction. Each of these is called a **stroke**. The term is also used to mean the length of the stroke.[21]
- **Thermal efficiency:** In thermodynamics, the thermal efficiency is a dimensionless performance measure of a device that uses thermal energy, such as an internal combustion engine, a steam turbine or a steam engine, a boiler, a furnace, or a refrigerator for example. In other

words, efficiency indicates how well an energy conversion or transfer process is accomplished.[22]

- **Transfer port:** These passages transport fresh fuel/air mixture supplied by the intake from the crankcase to the area of the cylinder currently above the piston. The transfer ports also play a vital role in cooling the cylinder and scavenging gases.[23]
- **Valve:** A valve is a device that regulates, directs or controls the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways. Valves are technically valves fittings, but are usually discussed as a separate category. In an open valve, fluid flows in a direction from higher pressure to lower pressure.[24]

8. DEFECTS OF THE EXISTING SYSTEM

Though it is an engine whose running cost is lower, a diesel engine has many disadvantages. Some of them are:

1. The air fuel mixture does not get enough time to mix well for efficient combustion to take place.
2. Due to inefficient combustion taking place, it produces toxic gaseous particles such as black carbon.
3. A diesel engine is costlier to be manufactured as it is bigger in size compared to the engines of the same capacity using other fuels like gasoline.

9. ADVANTAGES OF THE NEW CONCEPT

The new concept has the following merits over the existing system:

1. Fuel is compressed from both the sides, hence there is much more efficiency in the mixing of the air-fuel mixture.
2. More efficient mixing of the air-fuel mixture leads to emission of lesser amount of toxic gaseous particles.
3. Size of the whole engine is reduced, thereby reducing the volume but increasing the power as there are two crankshafts that are rotated separately.
4. The two separate cranks can connected to two separate wheels using bevel gears and an apt gear box.

10. DISADVANTAGES OF THE NEW CONCEPT

As every coin has two sides, this concept has advantages as well as a disadvantage. The only significant disadvantage of this concept engine is that the fuel consumption is higher as two pistons have to be pushed unlike the existing engine.

11. CONCLUSION

Thus we have come across a new concept of a 4-stroke double piston internal combustion compression ignition engine. This may pave way for a new generation of engines yet to be designed and prototyped.

REFERENCES

[1] http://en.wikipedia.org/wiki/Engine
[2] http://en.wikipedia.org/wiki/Internal_combustion_engine
[3] Low Speed Engines Tech Paper, MAN Diesel and "Mitsubishi Heavy Industries Technical Review Vol.45 No.1 (2008)" (PDF).Archived from the original on October 4, 2010. Retrieved October 3, 2010.
[4] http://en.wikipedia.org/wiki/Four-stroke_engine
[5] http://www.emt-india.net/process/automobile/pdf/FourStrokeDieselEngine.pdf
[6] http://en.wikipedia.org/wiki/Bevel_gear
[7] http://en.wikipedia.org/wiki/Combustion_chamber
[8] http://en.wikipedia.org/wiki/Combustion
[9] http://alternativefuels.about.com/od/glossary/g/compignition.htm
[10] Encyclopædia Britannica, Compression ratio, retrieved 2009-07-21
[11] http://en.wikipedia.org/wiki/Crankshaft
[12] Brain, Marshall. "HowStuffWorks "Basic Engine Parts"". HowStuffWorks, Inc. Retrieved 3 May 2012.
[13] http://en.wikipedia.org/wiki/Exhaust_system
[14] http://en.wikipedia.org/wiki/Gasoline
[15] http://en.wikipedia.org/wiki/Ignition_system
[16] http://toostep.com/question/what-is-mpfi-system
[17] http://en.wikipedia.org/wiki/Nozzle
[18] http://en.wikipedia.org/wiki/Piston
[19] http://en.wikipedia.org/wiki/Scavenging_(automotive)
[20] http://en.wikipedia.org/wiki/Sensor
[21] http://en.wikipedia.org/wiki/Stroke_(engine)
[22] http://en.wikipedia.org/wiki/Thermal_efficiency
[23] http://www.mopedarmy.com/wiki/Transfer_port
[24] http://en.wikipedia.org/wiki/Valve