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Effect of Knocking in Spark Ignition in a Four-Stroke Engine

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ABSTRACT

In present steady, A spark ignition and a compression ignition engine with inflow valve knocking of the cylinder and a transfer valve in the piston crown have been described. Under ideal conditions the common internal combustion engine burns the fuel/air mixture in the cylinder in an orderly and controlled fashion, the thermal extension of the range in proximity of the valve and other valve of the cylinder is different and so the distortion of the geometry of the cylinder liner surface force the designer to make the clearance between the piston and the cylinder liner bigger. This paper presents the review to the knocking using petrol on the combustion and emission characteristics of a single cylinder, four stroke, air cooled direct injection SI engine. It is well known that injection strategies including the injection timing and pressure play the most important role in determining engine performance, especially in knocking emissions. However, the injection timing and pressure quantitatively affect the performance of the SI engine. Knocking is due to auto ignition of end portion unburned charge in combustion chamber. Certain chemical changes must first occur for knock to happen; hence fuels with certain structures tend to knock easier than others. `in spark ignition internal combustion engines, knocking occurs when combustion of the air fuel mixture in the cylinder start off correctly in response to ignition by the spark plug, but one or more pockets of air fuel mixture combust outside the involve of the internal combustion process.

Keywords: *knocking, four stroke engine, Valve, Injection timing*

1. INTRODUCTION

In normal combustion, the flame initiated by the spark travels occurs the combustion chamber in a fairly uniform manner under certain operating condition the combustion deviates from its normal course leading to loss of performances and possible damage to the engine. Knocking is due to auto ignition of end portion of unbrunt charge in combustion chamber. As the normal flame proceed across the chamber, pressure and temperature of unburned charge increase due to compression by burned portion of charge. This unburned compressed charge may auto-ignite under certain temperature and release the energy at every rapid compared to normal combustion process in cylinder. This rapid released of energy during auto ignition causes a high pressure differential in combustions chamber and a high pressure wave is released from auto ignition region. The motion of high pressure compression waves inside the cylinder causes vibration of engine parts and pinging noise and it is known as knocking or detonation. [1] In a conventional SI engine, fuel and air are mixed together in the intake system, inducted through the intake valve into the cylinder where mixing with residual gas takes place, and then compressed during the compression stroke. Under normal operating conditions, combustion is initiated towards the end of compression stroke at the spark plug by an electric discharge. Spark ignition engines take a mixture of fuel and air, compress it, and ignite it using a spark plug. Figure-1 shows a piston and some of its basic components.

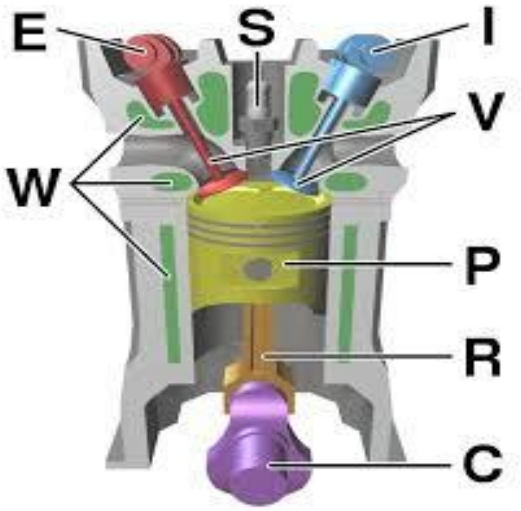

Fig.1. Piston and some of its basic components

S- Spark plug
I-intake
E- Exhaust
V- Valve
P- Piston
R- Connecting rod
C- Crank
W- Water cooling.

The name `reciprocating' is given because of the motion that the crank mechanism goes through. The piston-cylinder engine is basically a crank-slider mechanism, where the slider is the piston in this case. The piston is moved up and down by the rotary motion of the two arms or links. The crankshaft rotates which makes the two links rotate. The piston is encapsulated within a combustion chamber. The bore is the diameter of the chamber. The valves on top represent induction and exhaust valves necessary for the intake of an air-fuel mixture and exhaust of chamber residuals. In a spark ignition engine a spark plug is required to transfer an electrical discharge to ignite the mixture. In compression ignition engines the mixture ignites at high temperatures and pressures. The lowest point where the piston reaches is called bottom dead center. The highest point where the piston reaches is called top dead center. The ratio of bottom dead center to top dead center is called the compression ratio. The compression ratio is very important in many aspects of both compression and spark ignition engines, by defining the efficiency of engines. [2] Knocking in four stroke engine with primary flame front and secondary (unwanted) flame front as shows in figure-2. [3]

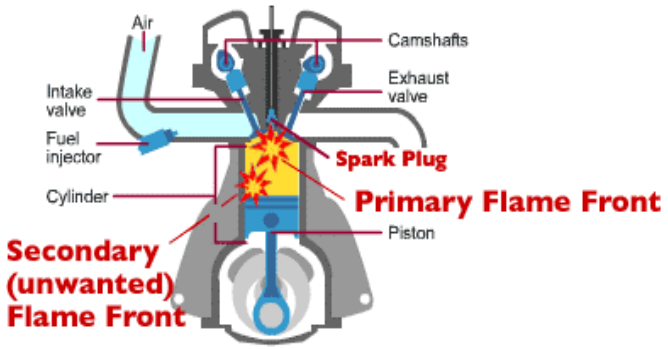

Fig. 2. Knocking in four stroke engine with primary flame front and secondary (unwanted) flame front

2.THE PHENOMENON OF KNOCK IN SI ENGINE

2.1.Normal combition

In normal combustion, the flame initiated by the spark travels across the combustion chamber in a fairly uniform manner. Under certain operating condition the combustion deviates from its normal course leading to loss of performance and possible damage to the engine. The phenomenon of knock may be explained by referring to fig.3 which shows the cross-section of the combustion chamber with flame advancing from the spark plug location. In the normal combustion the flame travels A-D and compressed the end charge BB'D and raises its temperature. Temperatures also increase due to heat transfer from the flame front. Now, if the final temperature is less than the auto-ignition temperature, normal combustion occurs and charge BB'D is consumed by the flame itself.

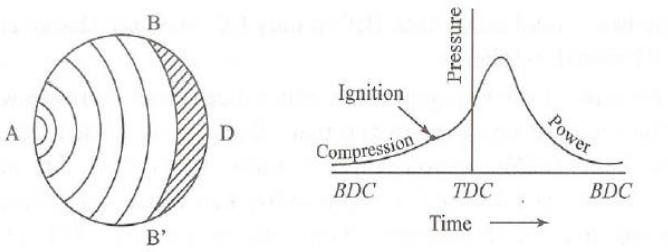

Fig. 3 Normal combustion

2.2.Abnormal combustion

This type of combustion may be termed as an abnormal combustion or knocking combustion. The order of this abnormal process is the loss of power, recurring preignition and mechanical damage to the

engine. Now, if the final temperature is greater then and equal to the auto-ignition temperature, the charge BB'D auto ignition (knocking). A second flame front develops and moves in opposite direction, where the collision occurs between the flames.

This causes severe pressure pulsation and leads to engine failure/damage. [4]

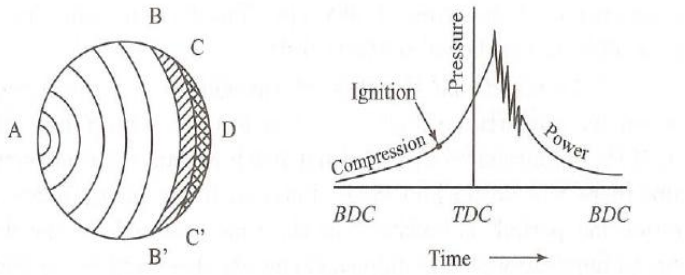

Fig. 4 Abnormal combustion with detonation

3. EFFECT OF KNOCKING IN PISTON

In four stroke spark ignition engine may be knocking occurs due to the incorrect fuel injection timing and the temperature, pressure, density of the unbrount charge. The effect of knocking in piston and piston cylinder is crack and defect in piston head as shown in fig. 5. The piston is bourn due to high temperature of the unbrount charge in knocking. The air/fuel charge is meant to be ignited by the spark plug only, and at a specified time during the normal cycle of the piston. The peak of the combustion process no longer occurs at the optimum moment in which the air/fuel mixture was intended to ignite. The shock wave creates the characteristic metallic "pinging" sound, and cylinder pressure increases dramatically. Effects of engine knocking can be significant. However, it should not be confused with pre-ignition as the two are separate events. [5]

Fig.5. Effect of knocking in piston

4. PARAMETERS OF KNOCK LIMIETD

The aim of the designer to reduce the tendency of knocking in the engine, certain knock limited parameter are explained.

4.1 Knock limited compresser ratio

The knock limited compressor ratio is obtained by increasing the compressor ratio on a variable compressor ratio engine until incipient knocking is observed. Any change in operating condition such as fuel air ratio or in the engine designed that increases the knock limited compression ratio is said to reduce the tendency towards knocking.

4.2 Inlet presser on nock limited

The inlet presser is increase by opening the throttle are increasing supercharger delivery pressure until incipient knock is observed, knock limited inlet presser in increase the indicate a reduction in the knocking tendency.

4.3 Knock limited inicated mean effective presser

The indicated mean effective presser measured at incipient knock is usually abbreviated as klimep. This parameter and the corresponding fuel consumption are obviously of great practical interest. [6]

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