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Improvement of Overall Efficiency of Internal Combustion Engine

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Abstract: In this article was presented one idea of how to improve overall internal combustion engine efficiency. We try to make a brief description of most important and basic parts of a new internal combustion engine. Here we Described engine have severaladvantages over conventional IC engine.

***Index Terms* - IC engine, motor vehicle, CAD.**

I. INTRODUCTION

Today, there are a very large number of successful constructions of internal combustion engines, which are applied to various fields of science and technology. Insome areas IC engines are so dominant without concurrence of other types of engines. This fact suggest that today's internal combustion engines are at a high technical level. However, construction of piston stroke internal combustion engines that are now usedis based on inefficient thermodynamic and mechanical concept. It can be said that themain characteristics of today's engine is very small amount of work in relation to usedfuel, in other words, today's engines have a very low coefficient of efficiency. Realistically speaking Otto engines today use about 25% of input energy, while diesel construction about 30% (in some cases can be expected a little more). Approximately35% of the petrol engine and 30% of heat in the diesel engines goes through exhaust and around 33% goes for cooling the engine in both versions, other 7% is attributedto friction and radiation [1]. For illustration can be taken into account combustion of one liter of fuel in the classical combustion engines. Combustion of this amount of fuelfrees approximately 39 MJ of power, the engine output shaft is generated only around13 MJ, while with other 26 MJ engine heated environment (through exhaust and cooling system). Conventional IC engines are based on a relatively simple solution toachieve a thermodynamic cycle while providing mechanical power. While the performance, emissions, and reliability of IC engines have been improved significantly,the fundamental principle of crank-rod-piston slider mechanism still remains largely unaltered. In theory, the most efficient thermodynamic cycle for IC engines is the Ottocycle [1,2], which consists of isentropic compression and expansion processes and constant volume heat addition and rejection processes [3, 4]. It is generally known thatthe most important parts of the cycle which determine the efficiency are the constant volume heat addition at high compression ratios [5, 6].

This fact provides the highest thermal potential of the various possible thermodynamic cycles which are suitable forIC engines, and the subsequent expansion process, which converts the thermal potential into work. In reality, neither conventional spark ignition nor compression ignition or even the modern developed homogeneous charge compression ignition or controlled auto ignition combustion processes, can achieve the efficiency level suggested by the ideal thermodynamic cycles .

Only the Otto cycle delivers theoretical maximum thermal efficiency. The traditional design of internal combustion engines using a simple slide-crank mechanism gives no time for a constant volume combustionwhich significantly reduces the cycle efficiency.

2. Conventional I,C Engine

It is well known that ordinary IC engines are based on a slider-crank mechanism. This way of piston motion provides a relatively simple solution to achieve a thermodynamic cycle to produce mechanical power. As can be seen from theory, the most efficient thermodynamic cycle for IC engines is the Otto cycle [8- 12], because the constant volume heat addition is essential for high efficiencies. Common to most reciprocating engines is a linkage known as a crank- slider mechanism [12]. Slider-crank mechanism was shown in figure 1, this mechanism is one of several capable of producing the straight-line, backward-and- forward motion known as reciprocating. Fundamentally, the crank-slider converts rotational motion into linear motion, or vice-versa. With a piston as the slider moving inside a fixed cylinder, the mechanism provides the vital capability of a gas engine: theability to compress and expand a gas. One of the major disadvantages of the conventional linkage is the fact that this setting produces very limited motion of piston (large changes of volume during combustion) and high mechanical losses due to the friction between piston and cylinder liner. Friction between piston and cylinder is the biggest source of friction in ordinary engine, more than half of all mechanical losses came from contact between parts like piston, rings and cylinder.

3. New I.C Engine

Real engine is not able to make heat addition during constant volume. When the engine operating, the piston can only reciprocate continuously between top dead center (TDC) and bottom dead center (BDC) at a frequency proportional to the engine speed. The chemical reaction process associated with combustion events, however, essentially takes a fixed-time to complete, which is relatively independent of the engine speed. In order to maximize the work obtained from the heat energy released by combustion, the air/fuel mixture has to be ignited prior to the piston reaching TDC, and the ignition timing should be adjusted according to the engine speed and the quality of the air/fuel mixture. Clearly, the early stage of the heat release before the piston reaches TDC results in negative work. During the combustion event, the piston movement is defined by the crank rotation, so that truly constant volume heat release is not achievable.

The ideal scenario is to initiate and complete the combustion event while the piston remains at the TDC position. A practical method is to reduce the engine crank rotation velocity at the TDC position to provide extra time for completing the combustion. This will then generate a new combustion cycle, quasi-constant volume (QCV), that sit between conventional IC engine combustion cycle and ideal Otto constant volume combustion cycle. Such unconventional SI engine is presented on fig. 2. As can be seen from the described . illustration pistons make a movement conditioned by the mechanism consisting of crankshaft and connecting disc. In this article will not be presented detailed description of this concept, since it is not the intention of the authors to propose a kinematic analysis of a new internal combustion engine design but only brief features and advantages over ordinary SI engines.

Dwell time or dwell angle is important fact during combustion process. In conventional engine this dwell angle can be changed due to variations of ratio between connecting rod and crank radius. Piston dwell at TDC and at BDC are often mentioned, it should be noted that strictly, there is no dwell period inordinary mechanism. The piston comes to rest at precisely the crank angle that the crank and rod are in line (TDC and BDC), and is moving at all other crank angles. At crank angles which are very close to the TDC and BDC angles, the piston is moving slowly. It is this slow movement in the vicinity of TDC and BDC that give rise to the term piston dwell. In this described concept there is also no piston dwell in classical sense, there is only very small changes of volume near TDC. If the piston dwells longer near TDC and ignition is initiated properly, there will actually be a longer period of time for the pressure created during combustion to press against the top of the piston. Also, if the dwell period is too long, there is a possibility for unfavorable energy conversion. In real engine ideal Otto cycle have certain disadvantages because there are a lot of heat losses in case when full combustion is obtained in TDC. Optimal heat addition should be found somewhere between pure constant volume combustion and combustion at variable volume-quasiconstant volume combustion.

4. Main Engine Parts

Main engine parts of a new concept are shown in next figures. As can be seen from Fmain parts are: 1- engine block, 2- engine head (with valves and camshaft), 3-flywheel, 4-crankshaft, 5-double acting piston, 6-piston rings, 7-piston disc and 8- cylinder liner. Main engine parts Basic engine design is very similar to well known boxer or flat engine or even rare V-180o . These similarities can be seen where is presented flat engine with several parts: 1-engine block, 2-engine head and 3- flywheel.. View on new flat engine Many engine parts are almost the same as we can see in today's internal combustion engine. For example engine block and engine head are basically the same as in ordinary boxer engine or V-180o engine. In this paper will not be presented parts like camshaft and valves because these parts are completely identical like in ordinary IC engine. Focus will be placed only on parts and assemblies which are significant different than in conventional piston engines.

Engine block and engine head One of the most important parts in every engine is the crankshaft. In this engine design crankshaft is shaped in such way that is able to connect with piston via gear teeth. As an ordinary crankshaft this one also have journal bearing which is necessarybecause of connection with piston disc. presented new crankshaft with gears and flywheel. Gears and crankshaft have rigid connection. Crankshaft of new IC engine Double acting piston is one of the most important features of new engine design. Oneof the possible ways for piston design. As can be seen besides two piston head these pistons also have inner gearing. Teeth on the inner gearing are coupled with gearing on crankshaft. On the top of the both piston side are mounted piston rings (compression and oil). Flywheel is mounted on one side of the crankshaft like in ordinary engine and has exactly the same functions (accumulation of kinetic energy, engine starting, torque, power and motion transfer.

Double acting piston is one of the most important features of new engine design. Oneof the possible ways for piston design is described in the following Fig. 6. As can be seen besides two piston head these pistons also have inner gearing. Teeth on the inner gearing are coupled with gearing on crankshaft. Assembly of piston, piston discand crankshaft is described with Fig. 7. On the top of the both piston side are mountedpiston rings (compression and oil). Flywheel is mounted on one side of the crankshaft like in ordinary engine and has exactly the same functions (accumulation of kinetic energy, engine starting, torque, power and motion transfer).

5 Advantages

A major source of engine wear is the sideways force exerted on the piston through theconnecting rod by the crankshaft, which typically wears the cylinder into an oval cross-section rather than circular, making it impossible for piston rings to correctly seal against the cylinder walls. Geometrically, it can be seen that longer connecting rods will reduce the amount of this sideways force, and therefore lead to longer engine life.However, for a given engine block, the sum of the length of the connecting rod plus the piston stroke is a fixed number, determined by the fixed distance between the crankshaft axis and the top of the cylinder block where the cylinder head fastens. Thus, for a given cylinder block longer stroke giving greater engine displacement and power, requires a shorter connecting rod (or a piston with smaller compression height), resulting in accelerated cylinder wear. Idea is to eliminate normal force at all, in this engine design it is possible to reduce mechanical losses with transfer normal force oncylinder wall into the force on gear teeth and force on piston disc which have hydrodynamic lubrication (very low friction). Also such engine design is able to provide such piston motion where heat addition can be done during smaller changes of volume when combustion occurs.

6. Conclusions

In this article was presented one approach for improvement of spark ignition engine efficiency. Described concept has several advantages over ordinary SI engines. All ofthese mentioned advantages show that the potential to increase the efficiency of the SI engine conditions is not yet exhausted. The engine used for most contemporary motor vehicles is the four-stroke SI internal combustion engine, in that sense in this paper is presented such engine. A novel Otto cycle engine concept in which intake and compression are carried out through unconventional piston mechanism is presented in this paper. With longer piston dwell near TDC and eliminating normal force on cylinder wall it can be expected that thermal efficiency and mechanical efficiency will be increased. It can be noted that this engine concept have lower number of parts than ordinary boxer engine. It is clear that the efficiency of modern IC engine can not be much increased, which is also one of the reasons for the development of new propulsion systems. However, at the time in which every year world produces a large number of vehicles, where there is still no real alternative, a minimum improvement of any segment of today`s engines will certainly be felt on a global level.

7. References

[1] Dorić, J, Internal combustion engine theory, Faculty of technical sciences, Novi Sad, 2015

[2] Heywood, J. B., Internal Combustion Engines Fundamentals, McGraw-Hill Book Company, New York, USA, 1988

[3] Andresen, B., et al., Thermodynamics in Finite Time, Physics Today, 9 (1984), 37, pp. 62-70

[4] Orlov, V. N., Berry, R. S., Power and Efficiency Limits for Internal-Combustion Engines via Methods of Finite- Time Thermodynamics, Journal of Applied Physics, 74 (1993), 10, pp. 4317-4322

[5] Chen, L., et al., Effects of Heat Transfer, Friction and Variable Specific Heats of Working Fluid on Performance of an Irreversible Dual Cycle, Energy Conversion Management, 47 (2006), 18/19, pp. 3224-3234

[6] Klinar, I., Internal Combustion Engines, Faculty of Technical Sciences, Novi Sad, Serbia, 2008

[7] Chen, R., et al., Quasi-Constant Volume (QCV) Spark Ignition Combustion, SAE technical paper 2009-01-0700, 2009

[8] Wu, C., Puzinauskas, P.V., Tsai, J.S., Performance analysis and optimization of a supercharged Miller cycle Otto engine, Applied Thermal Engineering,23 (2003), pp. 511-521

[9] Mozurkewich, M., Berry, R., Optimal paths for thermodynamic systems: the ideal Otto cycle, J Appl Phys, 53 (1) (1982), pp. 34–42

[6] Klinar, I., Internal Combustion Engines, Faculty of Technical Sciences, Novi Sad, Serbia, 2008

[7] Chen, R., et al., Quasi-Constant Volume (QCV) Spark Ignition Combustion, SAE technical paper 2009-01-0700, 2009

[8] Wu, C., Puzinauskas, P.V., Tsai, J.S., Performance analysis and optimization of a supercharged Miller cycle Otto engine, Applied Thermal Engineering,23 (2003), pp. 511-521

[9] Mozurkewich, M., Berry, R., Optimal paths for thermodynamic systems: the ideal Otto cycle, J Appl Phys, 53 (1) (1982), pp. 34–42