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A COMPARATIVE STUDY BETWEEN DTS-I ENGINE AND SINGLE SPARK IGNITION ENGINE

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ABSTRACT

Today's common trend is that people want strong performance and greater fuel efficiency but single spark ignition engines fail to satisfy these needs now-a-day's complete combustion is not at all possible in automobiles due to various losses in combustion chamber and due various other design parameters. Thus the process of combustion is not at all instantaneous and therefore alternate solution to it is by burning the fuel as quickly as possible by using two spark plugs instead of one. Objective of this paper is to compare single spark ignition engine and the DTS-i engine on various parameters such as specific fuel consumption, thermal efficiency, exhaust gas emission and engine performance.

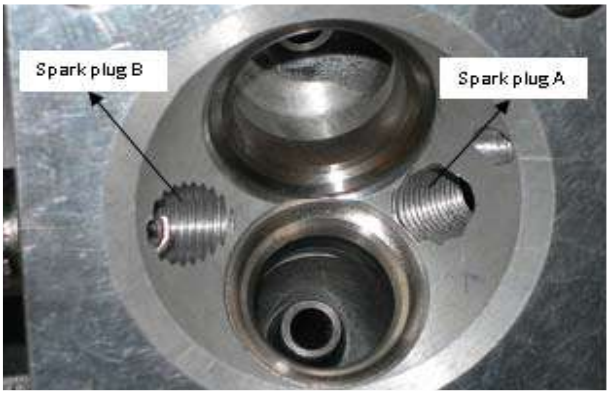
KEYWORDS: DTS-i ,Single Spark Ignition Engine, combustion , exhaust gas emissions, engine performance etc .

INTRODUCTION

A S.I.engine is a device which transforms the chemical energy of a fuel into thermal energy to produce mechanical work. In a spark-ignition engine a sufficiently homogeneous mixture of vapourized fuel, air and residual gases is ignited by a single intense and high temperature spark between the spark plug electrodes.

DTS-i has two Spark plugs located at opposite ends of the combustion chamber and hence fast and efficient combustion is obtained. The benefits of this efficient combustion process can be felt in terms of better fuel efficiency and lower emissions. The ignition system on the Twin spark is a digital system with static spark advance and no moving parts subject to wear. It is mapped by the integrated 4 digital electronic control box which also handles fuel injection and valve timing. It features two plugs per cylinder. This innovative solution, also entailing a special configuration of the hemispherical combustion chambers and piston heads, ensures a fast, wide flame front when the air-fuel mixture is ignited, and therefore less ignition advance, enabling, moreover, relatively lean mixtures to be used. This technology provides a combination of the light weight and twice the power offered by two-stroke engines with a significant power boost, i.e. a considerable "**power-to-weight ratio**" compared to quite a few four-stroke engines.

Figure:1



Details of spark positions in a DTS-i engine[3].

The actual picture of Bajaj Pulsar Bike is - Moreover, such a system can adjust idling speed & even cuts off fuel feed when the accelerator pedal is released, and meters the enrichment of the air-fuel mixture for cold starting and accelerating purposes; if necessary, it also prevents the upper rev limit from being exceeded. At low revs, the over boost is mostly used when overtaking, and this is why it cuts out automatically. At higher speeds the over boost will enhance full power delivery and will stay on as long as the driver exercises maximum pressure on the accelerator.

LITERATURE REVIEW

Several researchers have conducted their studies on the Performance of SI Engine ignition systems and DTS-i engine. Effect of parameters like fuel consumption, emissions, torque, load capacity etc has been analyzed. Number of reviews has been taken below to complete the present study.

Prabhkar et al. [1] carried the study on the conventional engines employed a single spark plug in its engine for igniting the mixture of fuel and air. But to have more effective burning of the mixture in order to increase the power output and reduce the wastage of this mixture as unburnt, the number of spark plug was doubled for efficient burning of the mixture. Two spark plugs helped in igniting the fuel from two directions rather than one, as in conventional engines. This new technology was termed as "Twin Spark Ignition System". Although this technological trend proved to be sufficient, a new well-improvised ignition system was given birth and named as "Triple Spark Technology" involving the use of three spark plugs rather than one or two. Syed Moizuddin et al. [2] highlighting the improvisation in the working of a two-wheeled four stroke internal combustion engines. The efficiency of these small engines were improved with increased power output just by increasing the number of fuel igniting element i.e. Spark Plug. Conventional engines employed a single spark plug in its engine for igniting the mixture of fuel and air. But to have more effective burning of the mixture in order to increase the power output and reduce the wastage of this mixture as unburnt, the number of spark plug was doubled for efficient burning of the mixture. Two spark plugs helped in igniting the fuel from two directions rather than one, as in conventional engines. This new technology was termed as "Twin Spark Ignition System". Although this technological trend proved to be sufficient, a new well-improvised ignition system was given birth and named as "Triple Spark Technology" involving the use of three spark plugs rather than one or two. Narasimha et al.[3] experimental investigation on multiple spark plug engines. A new dual spark ignition engine has been developed by introducing two spark plugs at different locations and the experiments are conducted at different load conditions and at three different compression ratios. The results are compared with that of a single plug operation. The results have shown that performance of dual plug engine is comparatively better than the conventional single plug ignition engine under all three compression ratios. The results have shown considerable improvement in thermal efficiency, and reduction in HC

and CO emissions in dual plug mode of operation. However, there is a small increase in NOX emission. Effect of compression ratio in dual plug engine system has not been investigated in detail so far with respect to engine performance and exhaust emissions. Optimum compression ratio which gives the best performance with respect to the above parameters due to ill effects of combustion knock at higher compression ratios. Imran and. Jani [4] investigates the effects of twin spark using CNG fuel in SI engine. The performance and emission analysis of an engine are investigated by experiment with CNG kit and gas analyzer. From this study the fuel consumption is reduce in twin spark arrangement for the same power output as compare to single spark using both of the fuel gasoline as well as CNG. Engine emission is considerably reduced using twin spark plug. A Ramtilak et al. [5] design and development of the Digital Twin Spark Ignition (DTS-i) is a concept for small bore four stroke engines with two valves. Two spark plugs placed diametrically opposite to each other in the combustion chamber fire simultaneously igniting the charge. The benefit of this concept is improved fuel economy, better drivability, and reduced engine on a emissions. The DTS-i concept helps the products meet the India 2005-emission standard without the use of secondary air injection and exhaust after treatment. The power, torque and specific output per liter were increased, while the fuel consumption and emissions were reduced due to the rapid combustion brought about by the twin spark plugs.

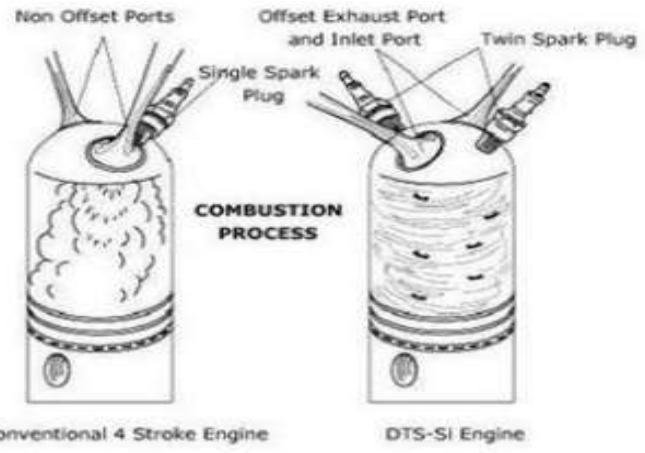
Multiple ignition system is one of the techniques to achieve rapid combustion. Multiple spark plug engines often use the initiation of flame propagation at two or more number of points in the combustion chamber depending on the number of spark plugs employed. If two plugs are employed the flame front travels from two points in the cylinder and the effective distance to be travelled by each flame is reduced. The concept of dual plug spark ignition is under consideration for more than last three decades.

Comparison between DTSi engine and Single Spark engine

Both the conventional Single Spark-Ignition engine and the Digital Twin Spark Ignition engine are compared based on the three performance parameters such as :

- Brake Thermal Efficiency (BTE)
- Brake Specific Fuel Consumption (BSFC)
- Variation of CO emission with load

Figure:2



Comparison between DTSi engine and Single Spark engine[1]

1. **Brake Thermal Efficiency (BTE)**

The variation of brake thermal efficiency with load and the three ignition timings is shown in for the twin plug mode of operation observations can be made,

- BTE increased with load for all the three ignition timings.
- It was observed that, BTE was maximum at simultaneous ignition timing of both the plugs (260-260 bTDC).

As the ignition timing of plug B was advanced (260-310 bTDC)BTE reduced and as it was retarded, (260-210 bTDC) BTE reduced. This is due to the fact that the combustion of the unburned mixture is equally sharedby the two plugs at the optimumignition timings of 260-260 bTDC. Also the initiation of the spark at two places simultaneously reduces the flame travel distance ensuring faster and more complete combustion[3].

2. **Brake Specific Fuel Consumption (BSFC)**

The variation of BSFC with load as well as with three ignition timings for twin plug mode of operation and shows the comparison with single plug mode of operation.

- BSFC decreased with load and was minimum at full load in both modes of operation, which confirms the maximum efficiency in this condition.
- As BSFC curve is mirror image of efficiency curve, it is slowest for the simultaneous ignition timing of 260-260 bTDC at full load.
- wider gap in BSFC values between single and twin plug modes at lower loads. This indicates that mixture required at lower loads in twin plug mode is fairly lean[3].

3. **Variation of CO emission with load**

the variation of CO emission with load as well as with three ignition timings for twin plug mode of operation and the comparison with single plug mode of operation. The following observations are made.

- Minimum CO emission was observed for the ignition timing of 260-260 bTDC. This is due to requirement of leanest mixture at this ignition timing.
- CO emission decreased with increase in load and reached minimum at 75% load and then again increased in all three cases.
- At lower loads higher CO emission was observed due to incomplete combustion. As the load increased, CO emission decreased due to more complete combustion of fuel. At full load, combustion requires rich mixture, hence CO emission was increased.
- CO emission in twin plug mode is considerably reduced both at lower loads and higher loads, as compared with single plug mode. It clearly indicates better part load performance in twin plug mode of operation. Rapid rate of combustion in twin plug mode resulted in higher combustion temperature, which promoted oxidation of CO, hence CO emission was found to be less[3].

CONCLUSION

Hence it can be concluded that the application of these technologies in the present day automobiles will give the present generation what they want i.e power bikes with fuel efficiency. Since these technologies also minimize the fuel consumption and harmful emission levels, they can be considered also be considered as one of the solutions for increasing effect of global warming the digital spark ignition is the best alternative for conventional ignition control.

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