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A Comparative Study between DTS-I Engine and Single Spark Ignition Engine

K. Bhanu Prakash Reddy

Branch: Mechanical Engineering, Sanskrithi School of Engineering

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. An internal combustion (IC) engine has a predominant role in a low power generation and a virtual monopoly in mobile applications today. One of the best methods to improve the engine performance and reduce the exhaust emission in a SI engine is by using introduction of twin spark into the combustion chamber. 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.***

1. 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.

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.

A. Twin Spark Benefits

In case of twin spark, two spark-plugs fire at the same time. These are simultaneous firing and swirl of the air-fuel mixture results in complete combustion. This action is digitally controlled by the DTS-I System (namely the twin spark plugs, TRICS III and intelligent CDI).

B. Triic-iii

Power and torque requirements constantly change, depending on whether the rider is cruising, accelerating or is at high speeds/max speed. Throttle Responsive Ignition Control System - III is an intelligent system which can quickly adapt ignition timing to suit different riding characteristics.

C. Intelligent CDI

The Intelligent Capacitor Discharge Ignition contains a microprocessor, which continuously senses different speeds and load on engine and responds by altering ignition timing. Working together with the TRICSIII system, the microprocessor's memory provides optimum ignition timings for any given engine rpm, thereby obtaining the best combustion performance. As CNG has lean combustion effect on the SI engine ignition system has to be modified for the batter performance and to optimize the power loss

and drivability problems are reduced by conversions. The Performance of an existing single spark engine has been improved by DTS-I CNG engine

2. Experimental Setup

Table 1: Engine Specifications

Maker's Name	Bajaj Auto Limited
Model Name	Bajaj pulsar 150 DTS-i
Type of Engine	Four Stroke Single Cylinder, Air Cooled Engine
Bore	57 mm
Displacement Volume	149.01 cc.
Compression Ratio	9.5 : 1
Maximum power	13.55bhp @ 9000rpm
Maximum Torque	11.25 Nm @ 6500rpm
Carburetor	Ukal Mikuni
Ignition system	Electronic CDI system
Idle Speed	1300 rpm
Lubricating Oil	SAE 20W40

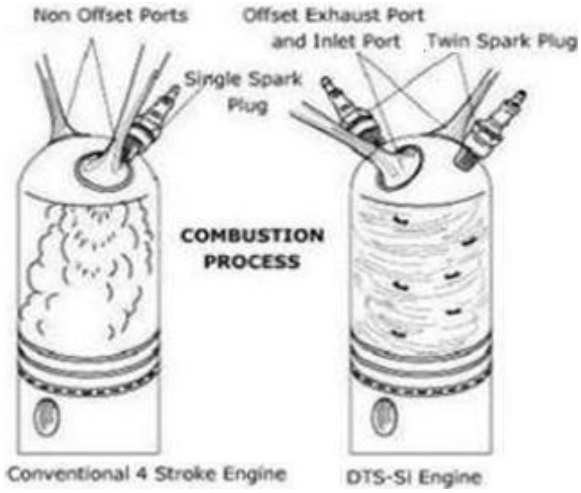
3. Literature Review

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 etc, 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 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 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 HCand 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 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 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:

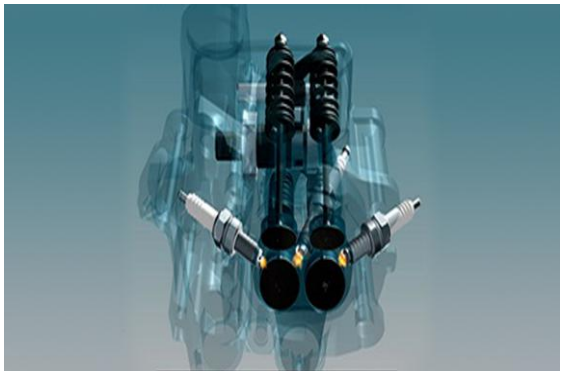
Both the conventional Single Spark-Ignition engine and the Digital Twin Spark Ignition engine are compared based on the three performance parameters such as:

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



Digital Triple Spark Ignition

At the heart of the new Pulsar is its cutting-edge engine which sets new benchmarks in performance, emission and incidentally also fuel efficiency. The DTS-i (Digital Twin Spark-ignition) technology launched in 2003 marked a unique first in the history of Indian Motoring. The new Pulsar takes this technology altogether to another level with a SOHC 4-valve Triple Spark engine controlled by an advanced Electronic Control Unit foran absolutely unmatched performance. To support this exhilarating heart-pumping performance the bike comes with liquid cooling and a six speed gear box. The Pulsar 200NS chassis comprises a pressed steel perimeter frame and a Rectangular tube section swing arm delivering over three times the lateral stiffness of a P220 frame. These deliver outstanding high speed handling and cornering stability. The centrally located muffler and the unique gas filled Nitrox mono suspension further improve the ride and handling of the bike due to low & centralized CG position. The Pulsar design character has evolved with the performance & dynamics. It's become stronger, more aggressive with a street fighter stance. The look just begs you to ride it. Once astride, the sporty Speedo console, triple-tree clip-ons, the signature clips and the illuminated switches evoke the design, fit and finish so far exclusively reserved for much more expensive super sports bikes. The new 200cc Pulsar is probably the most stunning sports bike in its class oozing raw muscular appeal. To make use of 3 spark plugs, the pulsar engine houses a pent roof combustion chamber which in turn allows housing 3 spark plugs in the engine chamber. Out of the three plugs, the primary plug is the center one and is mounted in an angle and enters the chamber at the top-center. The other two secondary plugs are mounted below, each opposite each other and one of them being vertically underneath the primary plug. The secondary plugs fires a bit after the primary one has fired and the timings are controlled by the ECU depending on various parameters like throttle position, engine revs,load on engine and many other stuffs. According to Bajaj, these plugs gain a advantage in low-rev riding condition where it extracts the best economy.



4. 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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