

The digital twin spark ignition technology



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The fresh charge (air – fuel mixture) that entered the cylinder during the suction stroke is compressed during the compression stroke resulting in the increase of spark plug, usually situated at one end of the combustion chamber, ignites the air-fuel mixture and the ensuing flame spreads like a slowly inflating balloon. There is an inevitable delay for this inflating balloon to reach the furthest part of the combustion chamber. So, there are pockets of poor combustion within the chamber and, overall, the combustion is slow and inefficient.

When it comes to higher capacity engines the distance to be traveled by the flame front is further increased resulting in still slower combustion. DIGITAL TWIN SPARK IGNITION TECHNOLOGY (DOTS-I) The Digital Twin Spark Ignition technology takes care of this slower combustion problem in a simple but a novel way. The cylinder head is equipped with two spark plugs, instead of the usual one. By generating two sparks at either ends of the combustion chamber, (approximately 90° to the valve axis) the air-fuel mixture gets ignited in a way that creates two flame fronts and, therefore, a reduction in flame travel of the order of 40 per cent is achieved.

A fast rate of combustion is achieved leading to faster rise in pressure. The obvious outcome of this is more torque, better fuel efficiency and lower emissions. An electronic device (microprocessor) controls the firing order of these twin spark plugs. Fig showing both conventional engine and a DOTS-I engine COMBUSTION PROCESS WITH DOTS-I TECHNOLOGY The fresh charge that entered the cylinder during the suction stroke is compressed during the compression stroke. Then a spark will be ignited by one of the twin spark plugs and the flame front begins to expand like an inflating balloon.

In the mean while another spark will be ignited by another spark plug as per controls to expand like an inflating balloon. Therefore the areas that are not covered by the first flame front will be covered by second flame front resulting in the complete & rapid combustion of the fuel. However, this technology even though proved as a successful one all bike manufacturing companies are not incorporating this technology in their models. Their idea is this faster rate of combustion can be achieved by employing a single spark plug with differential sparking cycles. ADVANCES OF DOTS-I TECHNOLOGY: DOTS-I. . Engine can be further tuned to deliver exhilarating performance or exceptional mileage. The further advances of DOTS-I technologies are – O Digital -rut spark – swirl Induction (DOTS Is) O Digital -rut spark – Fuel It-cocoon (DOTS F') DIGITAL TWIN SPARK – SWIRL INDUCTION (DOTS – SO: Need for Swirl Induction: The DOTS-I technology is the parent technology or this latest DOTS-Is technology. Even though a faster rate of combustion is achieved by incorporating the DOTS-I technology, there is a chance for further of improvement of rapid combustion process at lighter loads.

When there is a sufficient or heavy load on the engine, the 4 – stroke cycle completes at a faster rate resulting in the faster combustion because of the twin sparks produced by the twin plugs. But when there exists a lighter load on the engine, the 4 – stroke cycle will not complete at a faster rate.

Therefore even the incorporation of twin spark plugs cannot aid the faster combustion I. E. Till a better rate of combustion can be achieved at lighter loads.

Combustion efficiency in lean Airfield mixture conditions can be further improved by generating high turbulence in the having low turbulence give

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rise to propagation of a flame front, which is akin to that of a gradually expanding balloon. This results in a slower rate of combustion and thus slower rate of pressure rise. End result is lower efficiency. When high turbulence is generated and combustion takes place, the surface of the ballooning flame front fragments itself, with projection like fingers, which increases its surface area, thereby improving combustion further.

Here comes the Swirl Induction concept, which is meant for producing higher turbulence in the combustion chamber. Swirl Induction is nothing but imparting a swirling motion to the fresh charge that enters the combustion chamber. This can be done by making slight modifications in the ports positioning of engine. The actual DOTS-Is technology: Fig showing both DOTS-I & DOTS-Is engines The DOTS-Is engine will have two spark plugs but it differs from the parent DOTS-I engine in the design of position of the ports.

The straight ports used in conventional engines have limitations in generating high swirl values due to their geometry. One of the ways to generate more swirl is to have a port configuration that promotes this phenomena. An offset port configuration was arrived upon and optimized to generate the required swirl numbers. Incorporated in the new engine, this results in a swirling motion of the incoming charge, which decays itself into turbulence as the piston moves in the Induction and Compression strokes.

This results in the Air-Fuel mixture being more thoroughly mixed and spread around the combustion chamber. Sparks provided by the twin spark plugs ignite this highly turbulent and rent with high surface area, resulting in a rapid rise of pressure due to rapid combustion. The values of turbulence

achieved now, are substantially higher than that of a straight port cylinder head, such as in DOTS-I. A combination of DOTS-I and Swirl induction thus provides extremely rapid combustion, resulting in high efficiency.

This technology is applied by Baja] Auto Ltd in its latest model CD-125 that delivers an outstanding mileage of 109 Kemp under ideal conditions, which is the best of Indian motorbikes. The Didst engine is far superior to the conventional 4-stroke engines, which dominate the ICC segment at resent. With the new DOTS-Is engine the consumer now would not have to compromise between power and mileage – he gets the best of both. DIGITAL TWIN SPARK – FUEL INJECTION (DOTS – If): DOTS – If is another advancement of the parent DOTS – I technology.

This technology is the combination of both DOTS- I and fuel injection. This technology is meant for increasing the fuel efficiency in power bikes. Need for Fuel Injection: Generally in conventional 4-stroke engines, which uses petrol as fuel, makes use of carburetor, which mixes the fuel and fresh air in required ratio and supplies the same to the combustion chamber. The process is similar for all loads. But the fuel consumption will be more when there is a heavy load on the engine and it is less when there is a light load on the engine.

It is impossible for a conventional carburetor to take care of the fuel supply for these varying loads. There fore there is a need for some intelligent device varying loads. The DOTS – If Technology: Fig showing the sectional view of an DOTS-If engine That so wanted intelligent device is nothing but the Electronic Control Unit (CEO). The Electronic Control Unit is a microprocessor

based system and can be regarded as the brain of the fuel injection system. It processes information sent by various sensors and instantly determines optimum fueling and spark timing for various misinterpreting conditions.

The SEC contains detailed information of the engine's characteristics from which it picks the necessary data for commanding both fueling & spark timing. Advantages of DOTS – If Technology: Increased power output for the same C Better low end torque Lower fuel delivery and optimization of spark timing Improved cold start, quick warm up and excellent response to the sudden acceleration Lower emission levels Self detection and communication of fuel system malfunctioning if any STATISTICS:

The following are the various statistics showing the advantages of application of DOTS – I & its derived technologies: Fig 1 Fig 2 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.