I-VTEC: Intelligent - Variable Valve Timing & Lift Electronic Control - A Review

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Abstract— The most important challenge facing car manufacturers today is to offer vehicles that deliver excellent fuel efficiency and superb performance while maintaining cleaner emissions and driving comfort. This paper deals with i-VTEC(intelligent-Variable valve Timing and lift Electronic Control) engine technology which is one of the advanced technology in the IC engine. The automotive industry is continuously developing Technologies and strategies for increasing the efficiency in Fuel consumption and reducing the emission of pollutants. The Variable valve timing (VVT) system provides such a solution for internal combustion engines. Researches in this area are mainly devoted both to improved layouts and to new operation Control techniques.

Key words: valve timing control, two camshaft profile, increase volumetric efficiency

I. Introduction

Honda i-VTEC (intelligent-VTEC) has VTC continuously variable timing of camshaft phasing on the intake Camshaft of DOHC VTEC engines. The technology first appeared on Honda's K-series four-cylinder engine Family in 2001 (2002 in the U.S.). In the United States, the technology debuted on the 2002 Honda CR-V. VTC controls of valve lift and valve duration are still limited to distinct low- and high-RPM profiles, but the Intake camshaft is now capable of advancing between 25 and 50 degrees, depending upon engine Configuration. The electro-hydraulic actuated variable valve timing (VVT) System is a new powertrain technology that allows a fully Flexible control of the opening/closing transient phases of the intake valves in a diesel engine. In the conventional engine, the in-cylinder air flow is controlled by the rotation of the camshaft through a mechanical actuation and a throttle.

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II. Problem Statement

The problem statement as, to increase the volumetric efficiency of engine and optimize the mass of fuel consumption and it result into increase Power Output.

III. Objectives

There are two main objectives in this work,

- To investigate how i-vtec technology can be work
- To identify the engine is more preferable from i-vtec and normal working engine.

IV. Experimentation

Hosaka T and Hamazaki.M (1), as we know the price of fuel is increasing day by day, hence the proper fuel utilization in engine is very important. As in other cars, power with mileage is not possible but due to this technology it is possible to get both in one car. The latest and most sophisticated VTEC development is i-VTEC ("intelligent" VTEC), which Combines features of all the various previous VTEC systems for even greater power band width and cleaner emissions. The i-VTEC system utilizes Honda's proprietary VTEC system and adds VTC (Variable Timing Control), which allows for dynamic/continuous intake valve timing and overlap control. The demanding aspects of fuel economy, ample torque, and clean emissions can all be controlled and provided at a higher level with VTEC (intake valve timing and lift control) and VTC (valve overlap control) combined. VTEC (standing for Variable valve Timing and lift Electronic Control) does Honda Motor Co., Ltd. complete range of engine speed to provide good top-end output develop a system. The principle of the VTEC system is to optimize the amount of air-fuel charge entering, and the amount of exhaust gas leaving, the cylinders over the together with low and mid-range flexibility.

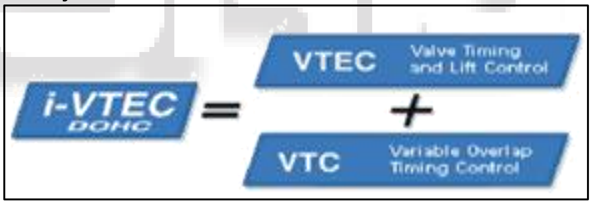

Fig. 1: i-VTEC constituents

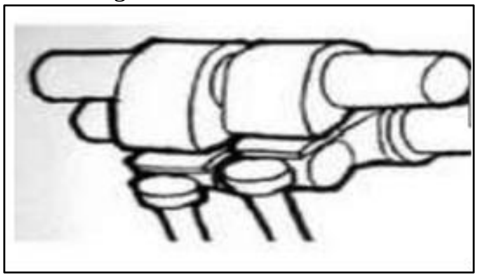

Fig. 2: cams and rocker arms

The basic mechanism used by the VTEC technology is a simple hydraulically actuated pin. This pin is hydraulically pushed horizontally to link up adjacent rocker arms. A spring mechanism is used to return the pin back to its original position. To start on the basic principle, examine the simple diagram below. It comprises a camshaft with two cam lobe side-by side. These lobes drive two side-by-side valve rocker arms. .

Lancefield T,Gayler R,and Chattopadhay (2), The highest torque generated by active i-vtec system is 211.7 Nm at 4900 Rpm and the highest torque generated by non-active i-vtec is 202.8 Nm at 5350 Rpm. On low rotation and high rotation, torques has generated by active i-vtec system are higher than torques generated by non-active i-vtec system. As the result, the mean average value of torque that resulted from engine using active i-VTEC is 200.03 Nm. On other hand, the mean average value of torque that resulted from engine non-active i-VTEC is 192.69 Nm. The engine torque using active i-VTEC is 3.67% higher than non-active i-VTEC engine. This occurs because the active i-VTEC is advancing the intake valves closing time and opened the intake valves for longer duration based on engine loads. The volumetric efficiency is improved by increasing amount of air that inhaled to combustion chamber which resulting to increasing torque.The highest power generated by active i-vtec system is 181.5 Hp at 6910 Rpm and the highest power generated by non-active i-vtec is 167.7 Hp at 7020 Rpm. From the graphic, it shows at low and high rotation, active i-vtec system will resulting higher power than non-active i-vtec system.

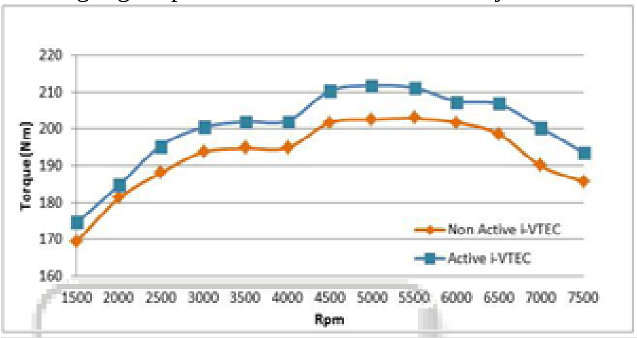

Fig. 3: Graphic comparison of analysis Torque between active i-VTEC system and non-active i-VTEC system

As the result, the mean average value of power that resulted from engine using active i-VTEC is 118.85 Hp. On other hand, the mean average value of power that resulted from engine non-active i-VTEC is 107.75 Hp. The engine power using active i-VTEC is 9.33% higher than non-active i-VTEC engine. This occurs because the active i-VTEC is advancing the intake valves closing time and opened the intake valves for longer duration based on engine loads. The volumetric efficiency is improved by increasing amount of air that inhaled to combustion chamber which resulting to increasing power. The highest power that can be achieved based on manual book is 190 PS or 187.4 Hp at 7000 Rpm. The testedengine give smaller power value than the torque based on manual book because the engine used for testing is not new engine so engine performance is decreasing.

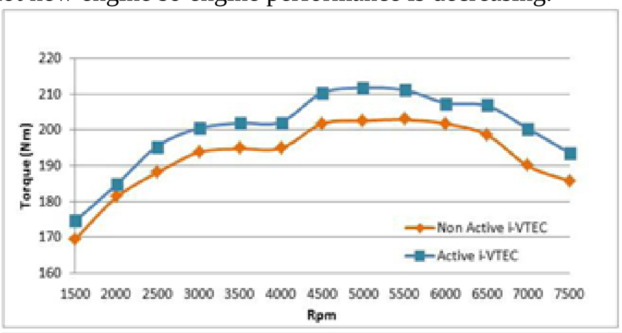

Fig. 4: Graphic comparison of analysis Power between active i-VTEC system and non-active i-VTEC system

Paolo Lino, Guido Maione and Fabrizio Saponaro (3) electro-hydraulic actuated variable valve timing (VVT) system is a new powertrain technology that allows a fully flexible control of the opening/closing transient phases of the intake valves in a diesel engine. In the conventional engine, the in-cylinder air flow is controlled by the rotation of the camshaft through a mechanical actuation and a throttle. This mode results in waste of energy and a non-optimal metering of the air mass trapped in the cylinders according to the rapid changes of the driving conditions, then to the power requests.

In the VVT system, the dynamics of the intake valves is decoupled from the cam profile by introducing a highpressure oil volume and a fast-acting solenoid switching valve, which is controlled by an electronic engine control unit (ECU). The timings of the intake valves can be controlled independently, cylinder by cylinder and stroke by stroke, by acting on the solenoid valve. This possibility involves several actuation strategies to improve the performance in terms of fuel consumption, emissions and available power. To achieve high performance, the optimization of the system and the design of accurate control can benefit from the availability of a suitable dynamic model. The model is useful for prediction in all the operating conditions and for optimization of the parameters strongly affecting the valve stroke.Moreover, the experimental validation of the control strategy via rapid prototyping hardware-in-the-loop (HIL), software-in the-loop (SIL), model-in-the-loop (MIL) tools, accurate prediction and reduced computational costs.and thus the reduction of the calibration efforts, determine a strong reduction of the development time. In general, an innovative modeling approach is necessary to obtain both an accurate prediction and reduced computational costs

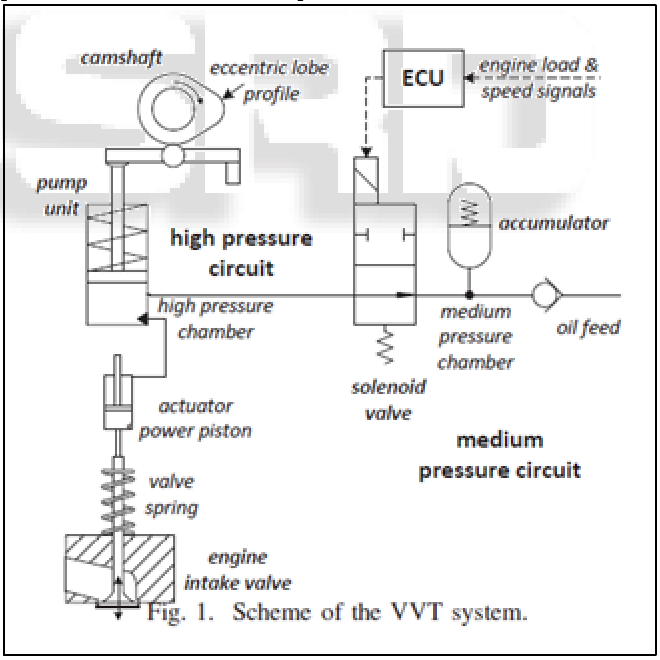

Fig. 5: Scheme of the VVT system

Fukuo.K,Iwata.T,Sakamoto.Y,Imai.Y(4) for a 1997 model year passenger car honada has realesed an all new 3.0 liter,transversely mounted,SOHC VTEC (variable valve timing and lift electronic control) V6 engine.This compact,light weight,state of the art V6 engine achive 147 KW @5500 rpm improves fuel economy and uses regular unleaded fuel.This is the worlds first SOHC VTEC V6 engine and the first V6 to be manufactured in the united state by Honda.

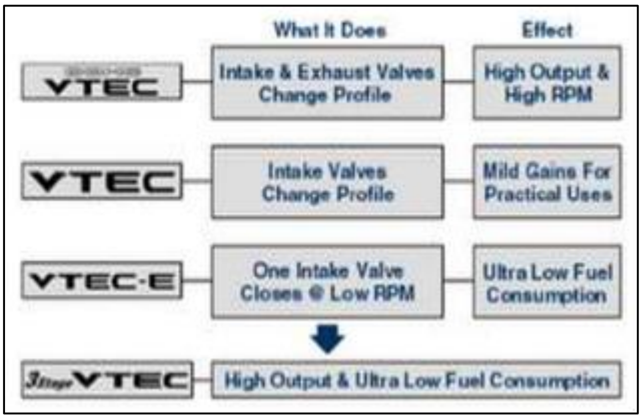

Fig. 6: Different variants of VTEC

VTC operating principle is basically that of the generic variable valve timing implementation (this generic implementation is also used by Toyota in their VVT-i and BMW in their VANOS/double-VANOS system). The generic variable valve timing implementation makes use of a mechanism attached between the cam sprocket and the camshaft

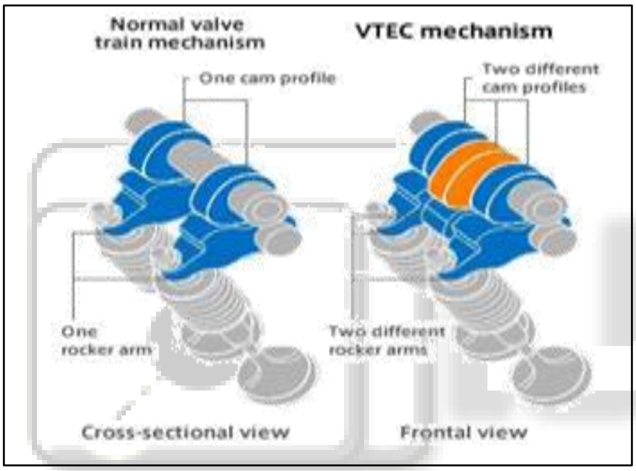

Fig. 7: comparison of conventional & i-VTEC engines

The last evolution of Honda's VTEC system was back in 1995 where they introduced the now-famous 3- stage VTEC system. The 3-stage VTEC was then designed for an optimum balance of super fuel economy and high power with drivability. For the next 5 years, Honda still used the regular DOHC VTEC system for their top power models, from the B16B right up to the F20C in the S2000. Now Honda has announced the next evolution of their legendary VTEC system, the i-VTEC. The i stands for intelligent: i-VTEC is intelligent-VTEC. Honda introduced many new innovations in i-VTEC, but the most significant one is the addition of a variable valve opening overlap mechanism to the VTEC system. Named VTC for Variable Timing Control, the current (initial) implementation is on the intake camshaft and allows the valve opening overlap between the intake and exhaust valves to be continuously varied during engine operation. This allows for a further refinement to the power delivery characteristics of VTEC, permitting fine-tuning of the mid-band power delivery of the engine.

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