

SOLENOID OPERATED D.I. DIESEL ENGINE: A REVIEW

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ABSTRACT

Internal Combustion Engine (ICE) occupies a major place in automobile industries. With latest design modifications in various components being put forth to improve the efficiency and overall performance, one component has been kept untouched i.e. Camshafts. Cams control the breathing channels of the engine i.e. the timing of valves through which fuel air mixtures enters and exhaust is driven out. With help of camshafts, pushrods, rocker arms, stiff springs. With increasing performance demands, motor engineers and scientists across the world are pursuing radial camless design which promises to give ICE'S a bigger improvement in efficiency. The dream of achieving camless technology is closing reality at rapid rate. With camless technology put into repetition, the engine power can be enhanced, emissions could be measured and better fuel economy is obtained. The aim of this paper is to provide a review on the techniques used in camless technology to increase quick respond to the valve motion with the help of electromagnetic valve actuating solenoid.

KEYWORDS: camless engine, solenoid valve, valve lift, diesel engine.

INTRODUCTION

A Solenoid Operated D.I. Diesel Engine" which deals with new technology in the development of IC engine to increases the performance by infinitely varying valve timing. An engine or motor is a machine intended to convert one form of energy into mechanical energy. Heat engines burn a fuel to create heat, which is then used to do work. In Motorcycles commonly have from one to four cylinders, with a few high-performance models. Compare with cam engine and camless engine. In many replacements has been made of camless operated engine such as gas actuators and electrical moving

electromagnetic systems and also by water pressurize hydraulic method. Actuators can be used to both open and close valves, or to open valves closed by springs.

HOW A ELECTRIC SOLENOID WORKS

The electric solenoid camless valve train, (ECV) provides continuously variable control of engine valve timing, lift, and velocity. It uses neither cams nor springs. It exploits the elastic properties of a compressed magnetic force, which, acting as trigger to accelerates and decelerates each engine valve during its opening and closing

motions. This is the principle of the electric solenoid. Like a mechanical force, “the electric solenoid involves conversion of electrical energy into mechanical energy.

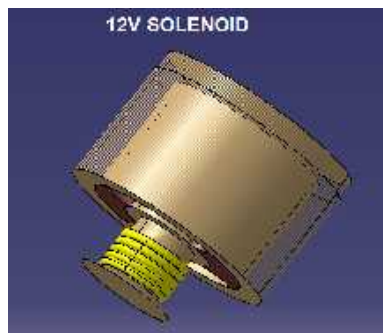


Figure 1-working of electric solenoid

In **fig 1** camless engine the solenoid valve is used instead of the conventional camshaft, cams, gears, rocker arms combination. Solenoid valves are driven electronically allowing completely freedom of valve control. A computer controls the opening and closing of the valves instead of cam lobes actuating rocker arms. The absence of all that mechanical bulk allows for a lighter and more compact valve train package. There is no need of timing belt anymore. The concept of Free Valve offers an independent control over individual valve. Be it Intake or Exhaust valve the Free Valve system offers flexibility of controlling them individually in different engine load conditions. Based on the riding condition the system decides to open or close the individual valve for a specific time, making the entire operation more efficient and environment friendly at the same time.

LITERATURE REVIEW

Yan Wang et. al., [2001] analyzed Inherent limitations and control design for camless

engine found that their analysis on the relative pole/zero locations can help future decision about the minimum idle speed, the maximum vehicle inertia and the computational resources in camless engine powered vehicles. The system instability, coupled with potentially large delay, requires a detailed analysis and formal ways of testing software interrupts and priorities among tasks. Although non-trivial, these implementation issues have been successfully addressed in the production of diesel fuel governors and injection systems.

W. Magner et. al., [2002] found that Variable cam timing systems, used in modern automotive engines to improve fuel economy, emissions, torque, and power, present a challenging problem to engine control designers. In this paper we have analyzed different VCT systems and their effects on engine air intake, charge dilution with the exhaust gas, and the torque production.

D. Anderson et. Al., [2002] worked on an adaptive Lift Control of an Electrohydraulic Camless Valvetrain System devised that In the adaptive control experiment, the tests underwent a scheduled cycle of lift and engine speed changes. The two parameters for the projection estimation method: the adaptation gain a , and the dead zone δ were tuned first. Each parameter is chosen with the goal being minimization of output estimation errors.

Thomas et. al., [2005] proposed an adaptive control for electromagnetic camless engine the adaptive control approach to this problem is for the adjustment of the relationship between the signal duration and GEV displacement suits the need of the system to

be able to adapt to a wide range of system operating conditions. Its capabilities could be expanded with the addition of a second algorithm to alter the assumed parameter of slope, a map of parameters with respect to system condition to increase initial guesses, or a higher order approximation for the relationship.

Hiroiyuki et. al., [2005] worked on the Valve timing and valve lift control mechanism. A new valve control system is presented for internal combustion engines, in which the valve timing and the lift are continuously controlled. The valve timing control system consists of a planetary gears, worm mechanism and control motor. The controlled results correspond to the objective curves, even when the objective values of the valve timing and the valve lifts vary continuously. The time delay was less than 0.3 s in this case, which will be in practical use. Although there are friction losses for cams, the present system has some advantages on the valve response stability, sound noise, control energy, prices, weight, and controllability.

Liang et. al., [2011] in this paper the seating performance of EMVT is analyzed and improved. The advantage of the EMVT is its flexibility and simplicity of system. Low seating velocity has been achieved by applying inverse system method to track a velocity-position profile in seating process. The desired holding force has been provided by applying certain current. The EMVT shows excellent seating performance in the experiments.

T. Leroy et. al., [2013] modelled the cylinder filling process on variable-valve-actuation equipped spark-ignition engines following a

general formulation of the breathing phenomenon, a versatile model is proposed for any type of variable valve gear device. Two particular cases of variable valve-timing and camless equipped engines are detailed. The model is calibrated using experimental data obtained at test bench it is readily invertible thanks to its analytical form and thus can be used in any torque control strategy for air management. In addition, burned gas modelling can be used for burned gas as control purpose.

I.B. Zibani et. al., [2014] proposed that with the valve turning freely, no feedback sensing is necessary and the proposed ECU has been designed, successfully tested and implemented on ALTERA's UP1 prototyping board. Because of its reliability and safe operation, the ECRV concept can be extended to more sensitive industrial applications like aircraft engines.

Gill et. al., [2014] used magnetic sensor for designing a camless engine instead of the conventional software. And found out that the camless worked better with the disk driving software more than the conventional software and they concluded that create, test and tune any desired valve, they can store thousands of disks using a personal computer, it can also change valve profiles, fuel injection timing and spark ignition for an engine.

CONCLUSION

From this literature review it has been reviewed that from various attempts were made to improve the performance of the engine and to increase better valve timing by making some changes and installing some additional accessories like electrical actuator

in the camless technology. This will carry on in the future because in coming days there will be increase in the demand of free valve and better efficiency.

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