INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY
ISSN: 0974 – 3154 Volume 6, Number 2 (2013), pp. 134 - 136

# EMERGING AUTOMOTIVE TECHNOLOGIES: CAMLESS ENGINES

Pariti Jamadagni
*Department of Mechanical Engineering, GITAM University*
*Seetammadhara, Visakhapatnam, INDIA*

## ABSTRACT

***The primary objectives of any engine research are to increase the efficiency, improve the power and reduce the emissions of engines. The camshaft of an automobile must rotate with a speed proportional to that of the engine. Because of this requirement, during the design of the engine, either of power or efficiency has to be compromised to the other, owing to the valve timings. To prevent any such compromise and to effectively provide both power and fuel efficiency to the automobile, camless engines are being made and tested.***

***In a camless engine, the opening, duration and closing of the valves of the engine are achieved by using hydraulic, electromagnetic, piezoelectric or pneumatic system actuators. In these engines, the lift and valve timing can be varied individually from valve to valve and cycle to cycle, or even switch off a cylinder completely. This enables the engine to provide higher power at increased fuel efficiency. Actuators placed at the end of the valves, receive the signals from the processing unit, which in turn is either an electromagnetic, hydraulic, pneumatic or piezoelectric system. The metal part attached to the actuator, moves from one end to the other, depending on the signal received by the actuator. This movement of the metal rod results in the lift and timings of the valves. Therefore, by varying the input signals, the lift and timing of the valves can be varied individually for each valve for each cycle. Hence there is no camshaft in the automobile. Since the valves are controlled by precise electrical circuits, their opening and closing becomes more flexible and accurate.***

***The major advantage of a camless valve train is that it offers a continuously variable and independent control of all the aspects of the valve motion. This freedom to optimize all the parameters of the valve movement results in better fuel economy, better torque and power, improved idling stability and lower emissions. One of the major disadvantages of camless valve train is its complexity. Camless valve trains are also expensive due to the use of highly accurate sensors and control system elements.***

***We can conclude from the present research that, use of camless valve trains results in engines having better fuel economy, and performance with very little emissions. This cannot be achieved with an engine with a camshaft due to the dependent control of different parameters of the valves motion.***

***Keywords: cam shaft, valve timing, camless engines, actuators.***

## 1. INTRODUCTION

The most important and necessary compromise made to the engine is the compromise between the speed and the efficiency of the engine, as it influences the rotation of camshaft which in turn influences the opening and closing of the engine valves.

In order to attain both power and efficiency, certain developments like, camshafts having multiple lobes have been made to attain variable valve timing. These were only able to bring in a limited change in the valve timings.

To achieve variable valve timing in engines, many techniques were employed. The best known example is the VTEC engine of Honda. It uses camshafts with multiple lobes, which switch between different lobes at different RPM's to attain variable valve timing. But the variation in timing achieved is limited and does not allow total independence to control valve timing.

In the initial trials at achieving camless engines, solenoids were used to control a fluid which would be used to control actuators to control the lift and fall of the valves. Even this had its own limitations which depend on the capacity of the solenoid taken.

These limitations can be overcome by using piezoelectric stacks or electromechanical systems or pneumatics to control the valves instead of solenoids to control the valves of the engines to achieve variable valve timing.

## 2. TYPES OF CAMLESS ENGINES

There are different types of camless engines, based on the type of control systems they use to control the actuator motion. They are classified into piezoelectric, pneumatic, hydraulic and electromechanical systems.

*2.1 Piezoelectric Camless Engine*

A camless engine using piezoelectric system to control the actuator motion consists of piezoelectric stacks, a spool valve, and a hydraulic amplifier to control the actuator motion which in turn controls the opening and closing of the valves.

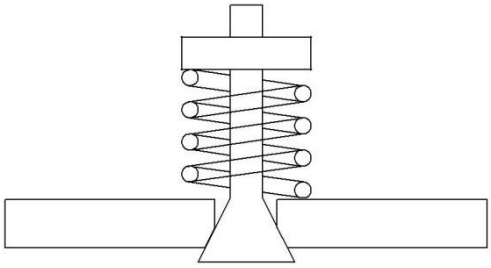

**Figure1.** *Schematic of a valve. This photo is the courtesy of [John Steven Brader 1990]*

*2.1.1 Working of piezoelectric system.* The system works on the property of the piezoelectric materials expanding or contracting due to voltage increase or decrease. The electric impulse from the control hardware will cause the piezoelectric stack to expand. This motion is transferred to the hydraulic spool valve. The slightest movement in the spool valve results in the diversion of the hydraulic fluid to one side of the hydraulic amplifier as shown in figure 2 below. The increase in pressure in the amplifier is transferred as motion to a piston. This movement of the piston acts as an actuator and is attached directly to the engine valve. Hence the valves are opened by the movement of the piston. The closing of the valves takes place by the action of a helical spring as shown in figure 1 above.

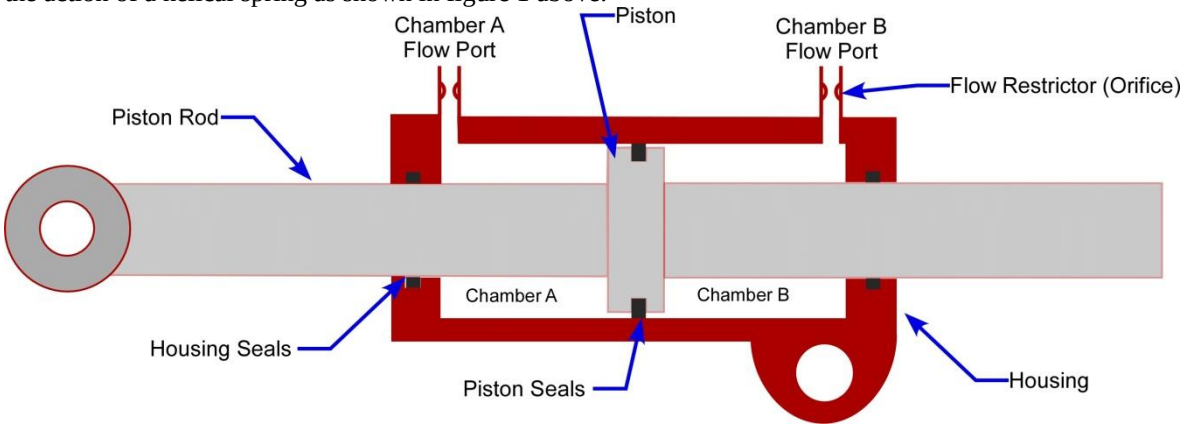


**Figure2.** *Hydraulic actuator.*

*2.2 Electromechanical Camless Engine*

This system consists of two opposing electromagnets, an armature, an engine valve and two springs. This utilizes the principle of electromagnetic induction.

*2.2.1 Working of Electromechanical Camless Engine.* When neither of the electromagnets is energized, the armature is held at the middle by the means of the two mechanical springs. When either of the electromagnets is energized, the armature starts rotating between the springs. The engine valves are directly connected to the armature, which results in the rotation of the armature to cause a lift in the engine valve. Using this technique, variable valve timing may be achieved. This actuator is showin in figure 3 below.

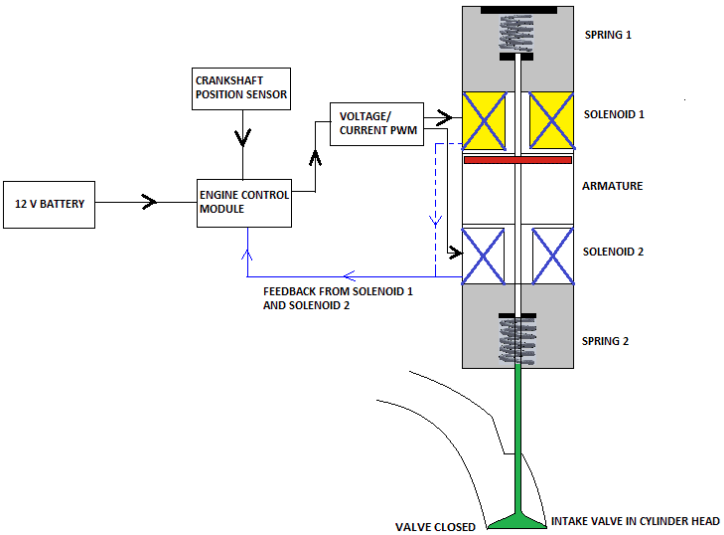


**Figure3.** *Schematic of an electromechanical actuator.*

## 3. CONCLUSION

The only goal of any automobile manufacturer is to make a vehicle with high power and equally good fuel efficiency with very less emissions. This goal is achieved by the use of variable valve trains.

Camless engines are used to achieve variable valve timing, or sometimes even switch off a cylinder when there is no requirement for the working of all the cylinders. This technology when completely developed will be the pinnacle of automobile engineering as it fulfills the dream of every automobile engineer, i.e. automobiles with high power, high efficiency and low emissions.

## 4. REFERENCES

John Steven Brader (1990), thesis on Development of a Piezoelectric Controlled Hydraulic Actuator for a Camless Engine, pp. 1-7.
www.wikipedia.com, article on camless engines
www.wikianswers.com, article on the working of electromechanical actuator