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Research Paper

ADVANCED ENGINE MANAGEMENT SYSTEM

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An "AEMS" is changing of the displacement of the engine according to required condition. The engine is designed for the various functions, i.e., to increase fuel efficiency when moving in slow speeds and a punch of power when required through turbo charger and others developments. The electronic fuel injection engine is installed with a turbo charger, oil valve operating system Modified CRANK SHAFT and Custom ECM that operates system by "actuators" that which ON and OFF's the system (valves and fuel spray) in the required combustion chamber. As soon as the Engine is switched ON the ECM takes the readings 1000 times per second of (throttle position, vehicle speed, Engine RPM). When auto mode of the AEMS is activated. ECM collects the info of the vehicle speed when a suitable condition is obtained, i.e., vehicle in 50 to 70 kmph the C.ECM converts 4 cylinder engine to 2 cylinder by switching off the firing in 2-3 cylinders, i.e., 1-4 run the engine (actual 1-3-4-2) and hen full throttle is given takes the power from all the cylinders. AEMS system gets activated when vehicle moving in city traffic slow speeds, eco speeds.

Keywords: Advanced engine management system, Oil operated cam shaft, IC Engines

INTRODUCTION

The internal combustion engines are first introduced by the Benz automobile manufacturer in the year 1886 by German inventor Karl Benz later it took Many Advances in the Engines for the automobile point of view.

An engine is a device that transforms one form of energy in to another form. Normally most of the engines convert thermal energy in to mechanical work and therefore they are called "HEAT ENGINE".

The Internal Combustion Engine is engine in which the combustion of a fuel takes place in a closed chamber by a mixture of Air and fuel compression the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine. The force is applied to pistons, this force moves the

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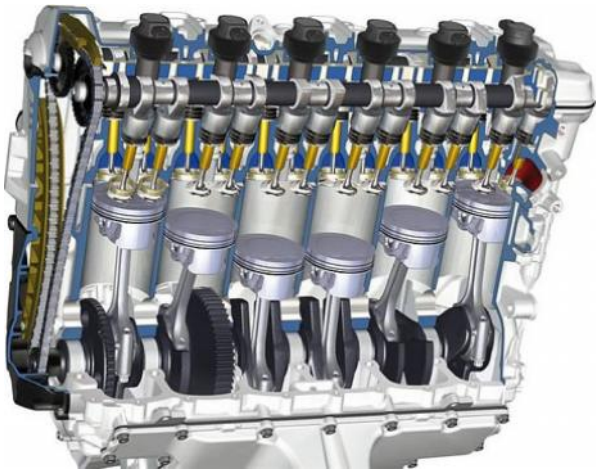
Figure 1: IC Engines



mechanical parts finally to output, i.e., fly wheel to rotate.

AEMS Introduction

Due to increase in fuel prices the automotive manufacturers are trying to developing new technologies which could provide high efficiency but there is some gap in between a customer and manufacturer.

The advanced engine management system is the development of a mid range 1000CC IC Engine. The 4 stroke IC Engine varies its power by the source of Mechanical and electronic systems to make the IC Engine work to the optimum level that which can result in the variable power and fuel efficiency. The engine gets modified in its Head block, fuel injection system; New Gen programmed ECM to control all the mechanisms and electronic systems in the correct time and order. The engine gets a mid range turbo charger to get a forced induction power in the low and high speeds. The AEMS Engine satisfies the customer with high efficient figures and a high horse power when acceleration was pedal to metal. The System holds the data of the speeds that vehicle is being driven and selects the suitable mode in which the engine has to be worked

The valve closing/opening and the fuel cut off to the required cylinder plays a vital role in this system to increase the engine efficiency and power.

IC ENGINE COMPONENTS AND THEIR DESCRIPTION

There are mainly two types of internal combustion engine:

1. SI sparks Ignition (Petrol)
2. CI Compression Ignition (Diesel)

The Strokes of the Engines can be classified by:

Two-stroke engine

Four-stroke engine

Two-Stroke Engine: The two stroke engine is the engine that which completes a power cycle in only one crankshaft revolution (360 degrees) and with two strokes.

Four-Stroke Engine: The four stroke engine completes a power cycle in two rotations of the crank shaft 720 degrees.

The 4 strokes of the engines are Suction, Compression, Combustion, and Exhaust

The engines work on the other main principles as the compression ratio, displacement and types of the fuel injections and fuels used.

Compression Ratio

The compression ratio of an IC Engine is a value that represents the ratio of the volume of its combustion chamber from its largest capacity to its smallest capacity.

In a piston engine, it is the ratio between the volume of the cylinder and combustion chamber when the piston is at the bottom of its stroke, and the volume of the combustion chamber when the piston is at the top of its stroke.

The ratio is calculated by the following formula:

$$CR = \frac{\frac{®}{4} b^2 s + V_c}{V_c}$$

Compression ratio of diesel engine 14:1 and 16:1 for direct injection and 18:1 and 23:1 for indirect injection.

Compression ratio of gasoline engine is 6:1 to 10:1.

Engine Displacement

Engine displacement is the volume swept by all the pistons inside the cylinders of a reciprocating engine in a single movement from Top Dead Centre (TDC) to Bottom Dead Centre (BDC). It is commonly specified in cubic centimeters (cc or cm3), liters (l).

Displacement = bore2 X 0.7854 X stroke X number of Cylinders

The Engines are designed to run on the fuels like petrol, Diesel, LPG, CNG and other bio fuels

The internal combustion engines posses combustion chambers where the combustion takes place in each cylinder at once at a high speeds the speeds varying from the 1000 rpm to 10000 rpm (street legal cars) and can be increased to high figures for the track and performance oriented cars.

Fuel Injections

Direct Injection, Indirect Fuel Injections

Direct Injection: The direct injection is that the fuel is highly pressurized, and injected via a common rail fuel line directly into the combustion chamber of each cylinder, as opposed to In direct multi-point fuel injection that happens in the intake time.

Example

MPFI: Multi port fuel Injection (for petrol)

CRDI: Common Rail Direct Injection (for Diesel)

Indirect Fuel Injections: The indirect fuel injection refers to fuel injection where fuel is not directly injected into the combustion chamber. Indirect engines are usually equipped with indirect injection systems, where in a Nozzle delivers the fuel at some point before the intake valve. An indirect injection in diesel engine sprays fuel into a prechamber, where combustion begins and then spreads into the main combustion chamber.

Carburetor (Petrol)

Bosch pump (Diesel)

Firing Orders

The firing order is determined as the sequence of firing of power in each cylinder in a multi-cylinder engine. This is done by sparking of the spark plugs in a Petrol engine in the correct order, or by the sequence of fuel injection in a Diesel engine.

The firing order of the 3 cylinder IC Engine is 1-2-3 or 1-3-2

The firing order of the 4 cylinder IC Engine is 1-3-4-2 or 1-2-4-3

The firing order of the 5 cylinder IC Engine is 1-2-4-5-3

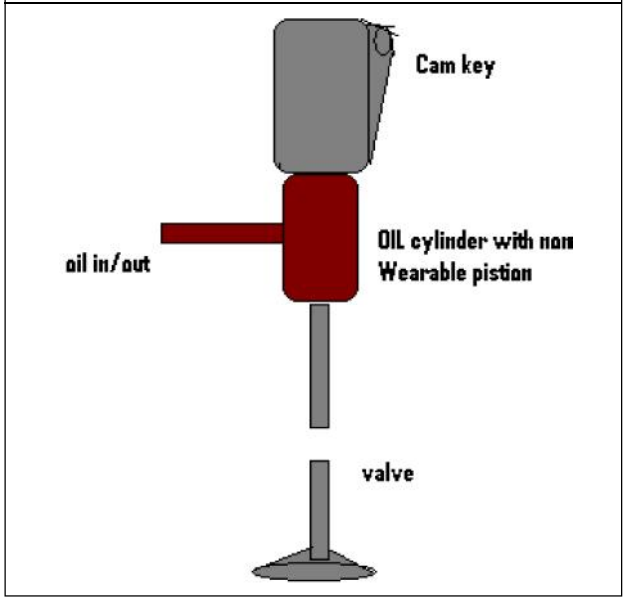
The firing order of the 6 cylinder IC Engine is 1-5-3-6-2-4 or 1-4-3-6-2-5

The firing order may or may not be in serial to minimize the vibrations of the engine.

Oil Operating Valve System

This is the simple new mechanism that is designed for the AEMS engine that which mainly posses a oil cylinder that which will be filled with the oil and can be removed by a means of actuator pump. Cylinder is placed in between the valve and the cam shaft whenever the mechanism need to be worked in full power the all the 16 oil cylinders are filled with the oil and the allow the 16 valve mechanism normally and when the two cylinders functioning is required the oil from the concerned oil cylinders are removed and the cam operates but the valves doesn't move from the position. So that the fluid functioning operates the values accurately in the functioning and also posse's independent valve closing operation when required for the required combustion chamber.

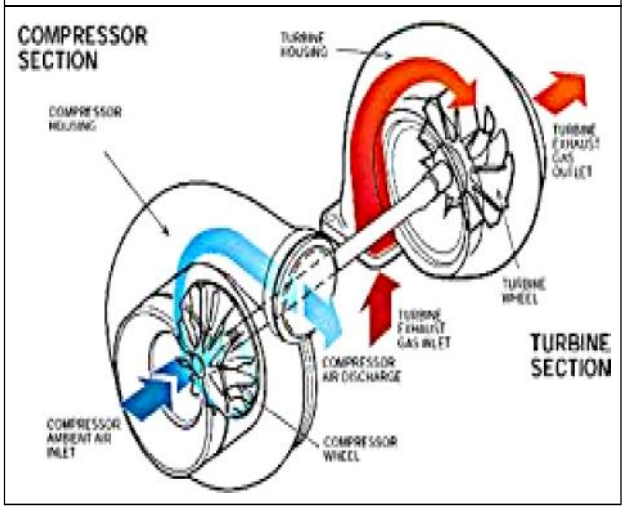
Figure 2: Oil Cushioned Cylinder Valve Operation



Turbo Charger

The turbo Charger is generally used for the forced induction of air inflow to increase the power without applying load on the engine and runs on the exhaust gases.

Figure 3: Working of Turbo Charger



Here the turbo Charger also plays vital role in the system amid range Turbo Charger is installed to the engine and it balances the power from minimum to maximum and increases torque even the displacement of the engine is varied by a vacuum actuator of the waste gate valve which is linked with the ECM varies the different flows of air into the engine in different modes of the AEMS engine and reduces turbo lag.

ECM

The Electronic Control Module (ECM) or machine is the Electronic Chip that which logically controls the various operations of the engine system like Fuel Injection, Coil Heating ON/OFF, Spark ignition, etc., that which takes the signal input from the sensors connected to various parts of the Engine and makes a suitable decision and gives the command to the actuator to function.

Figure 4: ECM for Automobile Engines

Here the AEMS ECM is specially designed ECM the coding deals with the all moving non moving and functional parts of the engine that which is programmed to take the readings of the engine speed vehicle speed, Throttle Position, and calculates them for every second as soon as it receives a suitable input it just operates the engine in more than three modes like SPORT, ECONOMY, AUTO.

Sport Mode: Operates by high throttle response with all cylinder active and it spills the more air and fuel into the combustion chamber and the turbo also gets more active in this stage.

Economy Mode: That which operates in the nullified throttle responses by only half of the cylinders are active and other moving blankly in this mode the valves of the other non functioning cylinders gets closed and the fuel injection also stopped for the closed combustion chambers the turbo spillage will be reduced and air is throwed to only cylinders that which are active.

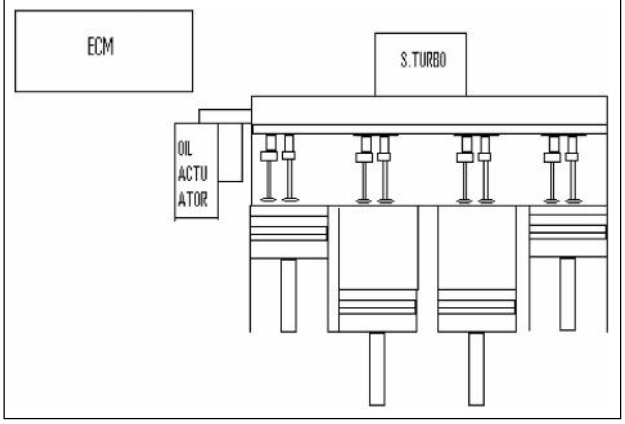
The economy mode mainly gets functioned when the vehicle is in the idling condition moving in very low speeds and also makes some conditions such as making the vehicle a speed limiter just to cruise in the city roads.

Auto Mode: This makes the ECM to make own decisions such that the suitable power mode shall be used in the engine by ECM by the way of driving and the driving conditions.

Experimental Methods

A 1000cc Foure cylinders, 4 stroke turbo charged FUEL Injection system Engine with Oil Operated Valve system (Head block) is developed for the implementation of high fuel saving techniques that which uses a variable Engine Displacement Technique.

Figure 5: General Outline Diagram for the Parts and Assembly of Engine in AEMS



As soon as the ignition is activated the AEMS ECM gets activated and continuously takes the readings of the engine working and also the vehicle speed from different sensors that which are fitted in different parts of the engine and the ECM gives the suggestions to the driver regarding the good driving habits and asks for permission to activate the ECO mode through MID or voice assistance as soon as the ECO Mode is Accepted the ECM switches on the ECO mode Program and makes the Engine to work in the 2 cylinder mode, i.e., working in the 1-4 cylinders and 3-

2 pistons will move blankly in this mode It can be altered also, ECM closes the two cylinders valve mechanisms and operates the other two cylinders by oil operated valve. And the fuel injection is also modified to give more torque from the engine at low speeds and high power at high speeds.

The sport mode shall be activated when the driver specially activates the Mode in the MID and it increases the power by activating all the 4 cylinders and increases the power from the Turbo and sharpens the throttle responses and sharpens the EPS.

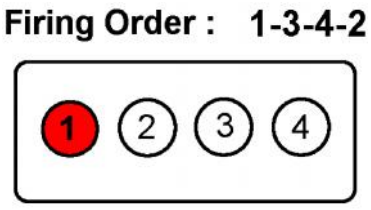
The Auto mode shall make the ECM to activate its own program according to ongoing driving conditions and gives the result of driving and suggests regarding gear shift and vehicles speed.

WORKING OF THE AEMS ENGINE IN SPORT MODE

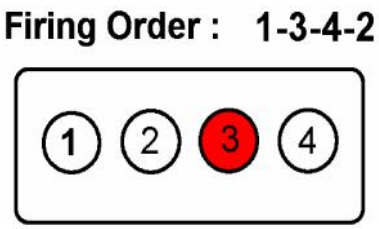
All Combustion Chambers working as a normal car

RED Indicates Power stroke

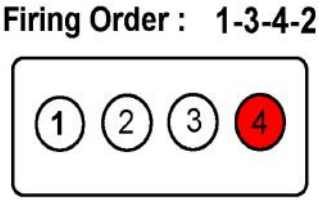
1. Combustion in 1st chamber



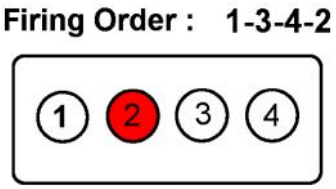
2. Combustion in 3rd chamber



3. Combustion in 4th chamber



4. Combustion in 2nd chamber



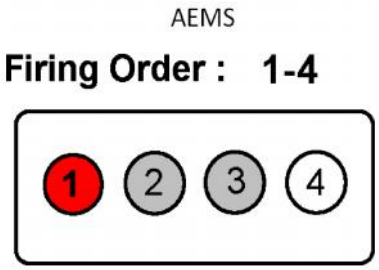
WORKING OF THE AEMS ENGINE IN ECO MODE

RED: Indicates power stroke

GREY: Indicates combustion chamber closed

The cylinders as soon as the 1 takes the firing order 3 gets skipped and the 4 takes the combustion and again the 2nd cylinder gets skipped and comes the cycle to 1.

1. Combustion in cylinder 1



2. Combustion in cylinder 4

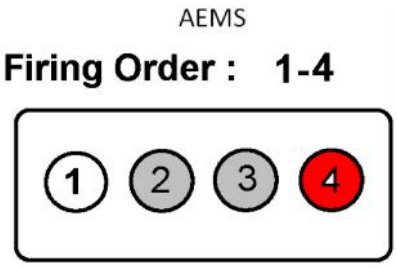


Table 1: Comparison of AEMS Engine Car and Normal Car Engine

Equipment	AEMS IC Engine	Normal IC Engine
Engine power	Varied from 36 hp to 80 hp @5500 rpm	Limited to 75 hp @5500 rpm
OIL operated valve system	Special and simple technique unique in AEMS	Manual Valve mechanisam
Fuel efficiency	Extra Increase in fuel efficiency by 40%	As per company standard
Control through ECM	Every new component installed controlled by ECM	Only engine functioning controlled by the ECM
Drivability	More drivability providing 3 modes of driving	No Modes Standardized Programming
NVH	Comparatively increased vibrations when 2 cylinders are activated but can be minimized by balancing the Crank shaft	As per vehicle standard
Turbo Charger	MID powered to reduce turbo lag and increase power in low and high revs	As per vehicle standard
Cost	Very little increase in the cost of development could be reduced when used in vast production	As per Auto manufacturer

Note: By the development of the AEMS engine there will be a lot of advantages with very less disadvantages.

RESULTS AND DISCUSSION

The Engine proves to be a latest and Reliable technology that which having a ability to provide a high efficiency at low speeds (50 to 70 kmph) and great drivability in the function.

There may be some vibrations involved in the vehicle when running in the two cylinder but could be controlled by redesigning the Crank with parallel support and also by weight balancers redesigning.

Vibration Dampers Beds could be provided to reduce engine vibrations contact to body.

The Engine technology can be used in suitable for the both Petrol and Diesel engines.

CONCLUSION

The engine is just a stimulation idea and could be implemented 100% to production which could revolutionize the automotive industries especially in India. The AEMS engine is suitable in the city's and crowded areas resulting in high power and fuel efficiency.

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