World Journal of Engineering Research and Technology
WJERT
www.wjert.org
SJIF Impact Factor: 4.326

COMPARATIVE STUDY OF EMISSION CHARACTERISTICS FOR A MODIFIED CAM IN CARBURETTOR AND MPFI ENGINE

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Article Received on 24/02/2017 Article Revised on 17/03/2017 Article Accepted on 06/04/2017

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ABSTRACT

An internal combustion engine (ICE) is a heat engine where the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit. In an internal combustion engine the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine. The comparative study of Emission Characteristics has been made at different profiles of modified Cam for Carburettor and MPFI Engine An Emission qualities have been learned at 3 unique profiles of cam for carburettor and MPFI Engine and a significant reduction in discharges have been recorded in MPFI Engine is contrasted with carburettor Engine.

KEYWORDS: MPFI Engine, Carburettor, Variable Valve timing, TRI-LOBED-CAM, Valve dynamics.

INTRODUCTION

In conventional engine design, the camshaft uses a fixed or variable cam profile to achieve a reasonable compromise between idle speed stability, fuel economy, and torque performance. Significant improvements in engine performance can be achieved through individual control of the valve timing.

So In internal combustion engines, Variable valve timing (VVT), also known as Variable valve actuation (VVA), is a generalized term used to describe any mechanism or method that can alter the shape or timing of a valve lift event within an internal combustion engine. VVT allows the lift, duration or timing (in various combinations) of the intake and/or exhaust valves to be changed while the engine is in operation.

The automotive industry has been under continued pressure to improve the fuel efficiency owing to stringent pollution norms, global warming and rising petroleum prices. The largest part of most combustion gas is nitrogen (N_2), water vapor (H_2O) and carbon dioxide (CO_2) these are not toxic. A relatively small part of combustion gas is undesirable noxious or toxic substances, such as carbon monoxide (CO) from incomplete combustion, hydrocarbons (properly indicated as C_xH_y, but typically shown simply as "HC" on emissions-test slips) from unburnt fuel, nitrogen oxides (NO_x) from excessive combustion temperatures, and particulate matter (mostly soot).

Exhaust gas or flue gas is emitted as a result of the combustion of fuels such as natural gas, gasoline, petrol, biodiesel blends, fuel, fuel or coal. According to the type of engine, it is discharged into the atmosphere through an exhaust pipe, flue gas stack or propelling nozzle.

Fuel (hydrogen, carbon, sulphur) + Air (nitrogen, oxygen) = Carbon dioxide + water vapour + oxygen + carbon monoxide + hydrocarbon + oxides of nitrogen + sulphur oxides.

Carbon monoxide (CO) - A product of incomplete combustion, concentration of the exhaust in percent of the total sample. Partially Burned Petrol, This is the petrol that has combusted, but not completely. This gas is formed in the cylinders when there is incomplete combustion and an excess of fuel. Therefore excessive CO contents are always a sign of an overly rich mixture preparation. (The CO should have become CO_2 but did not have the time or enough O_2 to become real CO_2 so it is exhausted as CO instead.) CO is highly poisonous odorless gas. Carbon monoxide reduces the blood's ability to carry oxygen; overexposure (carbon monoxide poisoning) may be fatal. Carbon Monoxide poisoning is a killer in high concentrations.

Hydrocarbons - A class of burned or partially burned fuel, hydrocarbons are toxins. Hydrocarbons are a major contributor to smog, which can be a major problem in urban areas. Concentration of the exhaust in parts per million (ppm). Unburned Petrol, represents the amount of unburned fuel due to incomplete combustion exiting through the exhaust. Prolonged exposure to hydrocarbons contributes to asthma, liver disease, lung disease, and cancer.

Carbon dioxide is a greenhouse gas. Motor vehicle CO_2 emissions are part of the anthropogenic contribution to the growth of CO_2 concentrations in the atmosphere which is causing climate change. Concentration of the exhaust in percent of the total sample. = Completely Burned Petrol, represents how well the air/fuel mixture is burned in the engine (efficiency). This gas gives a direct indication of combustion efficiency. This is due to improved gas flow resulting in better combustion efficiency.

Particulate matter – Soot or smoke made up of particles in the micrometer size range, Particulate matter causes negative health effects, including but not limited to respiratory disease and cancer. An instrument exhaust gas analyzer is used to find the emissions CO, HC and $C0_2$.

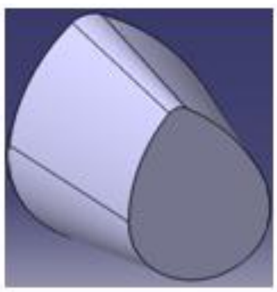
OBJECTIVE

The proposed new design of the valve actuator mechanism is expected to overcome the inherent limitations of the fixed cam valve actuation mechanisms as well as the deficiencies of the VVT cam systems marginally.

A new “TRI-LOBED-CAM” mechanism used in conjunction with a conventional cam operating mechanism that axially shifts the camshaft through a small displacement depending on the operating conditions of the engine

The emission characteristics for carburettor and MPFI engine is studied at 3 different locations of the modified CAM where the valve movement is varied and controlled by using the modified CAM Shaft.

Experimentation using Modified Cam



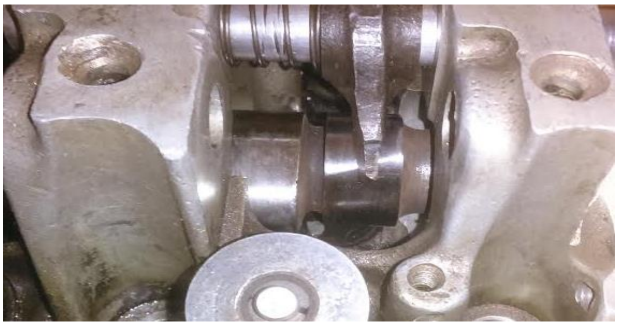


Fig 1: Tri Lobed CAM.

Modified Camshaft

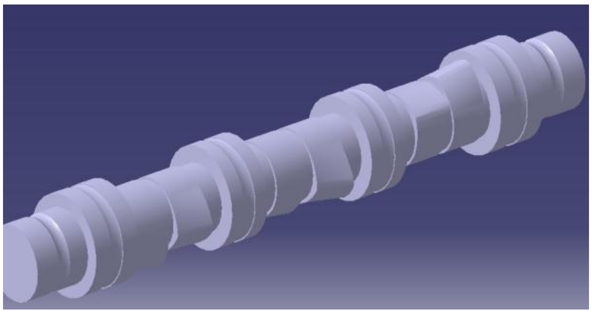


Fig 2: MODIFIED Iso-metric view of CAM SHAFT.

The changed camshaft conveys one decreased cam for every valve to be worked. The camshaft is driven by the crankshaft by method for timing gears. It comprises of round and hollow bar with various decreased flaps projecting from it, one for every valve. The profile of the altered camshaft is upgrade with falt surface to tapered(slope) shape.

Modified Rocker

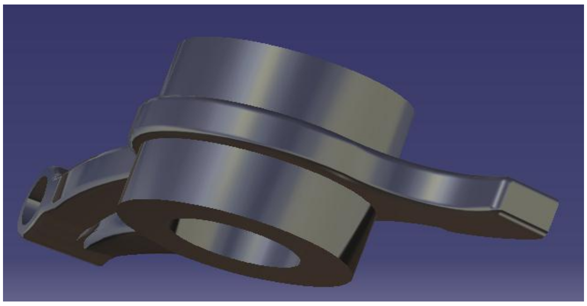


Fig 3: MODIFIED ROCKER with Edges.

The modified rocker arm conveys radial movement from the cam lobe into linear movement at the poppet valve to open it. One end is raised and lowered by a rotating of the camshaft that is reduced their width while the other end acts on the valve stem. The modified rocker having point contact with the respective cam and it is made of forged steel or cast iron.

Emission Characteristics

Emissions of many air pollutants have been shown to have variety of negative effects on public health and the natural environment.

Fuel (hydrogen, carbon, sulphur) + Air (nitrogen, oxygen) = Carbon dioxide + water vapour + oxygen + carbon monoxide + hydrocarbon + oxides of nitrogen + sulphur oxides.

A standard 5 series exhaust gas analyzer has been used to measure the exhaust emissions from the engine. The instrument which is used to find the emissions is shown below

Fig 4: Emission Testing Machine.

An exhaust gas analyzer or exhaust CO analyzer is an instrument for the measurement of carbon monoxide among other gases in the exhaust, caused by an incorrect combustion. Measuring the exhaust gas is an excellent way to optimize fuel and air input. Efficient combustion also reduces emission of pollutants such as nitric oxide (NO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter. A gas analyzer will help measure various gas pollutants in the exhaust for environmental reasons.

Fig 5: Modified Cam Shaft in MPFI Engine.

Modified Cam Shaft with rocker is placed in the engine head and emission of CO, HC and CO_2 is noted for different profiles of CAM ploted wrt to valve movement.

Emission characteristics for MPFI Engine is studied at 3 different locations of Cam Shaft which is shown below.

Emission characteristics at 3 different locations for 8^0 & 9^0 degree of taper turn in CAM for Carburettor engine

For 8^0 of Taper turn in CAM

Table 5: Exhaust emission at Maximum, Centre and Minimum for 8^0 of Taper turn in CAM in carburettor engine.

SL NO	Diameter of the CAM (mm)	Valve lift in mm	Exhaust Emission of CO	Exhaust Emission of HC	Exhaust Emission of CO_2
1	35.74(Maximum)	7.319	3.640	501	11.24
2	34.62(Centre)	6.022	2.291	402	8.02
3	33.6(Minimum)	4.396	1.680	314	6.13

Table 6: Exhaust emission at Maximum, Centre and Minimum for 8^0 of Taper turn in CAM in MPFI engine.

SL NO	Diameter of the CAM (mm)	Valve lift in mm	Exhaust Emission of CO	Exhaust Emission of HC	Exhaust Emission of CO_2
1	35.74(Maximum)	7.319	0.648	346	11.62
2	34.62(Centre)	6.022	0.445	90	10.84
3	33.6(Minimum)	4.396	0.280	58	10.02

Exhaust emission at Maximum, Centre and Minimum for 8^0 of Taper turn in CAM in MPFI engine

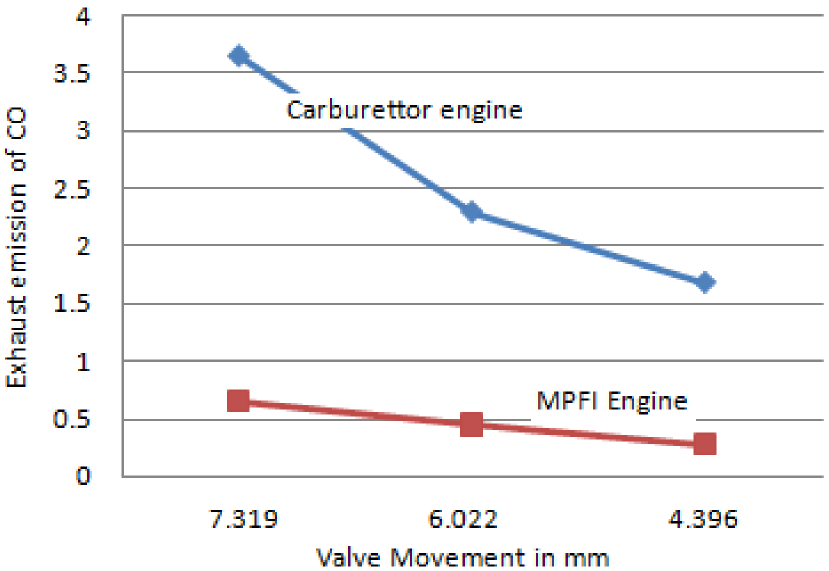


Fig 6: Valve Movement V/S Exhaust emission of CO

When the rocker is placed on the maximum, centre and minimum diameter of the Cam Shaft then the valve movement is decreased so that the exhaust emission CO is reduced.

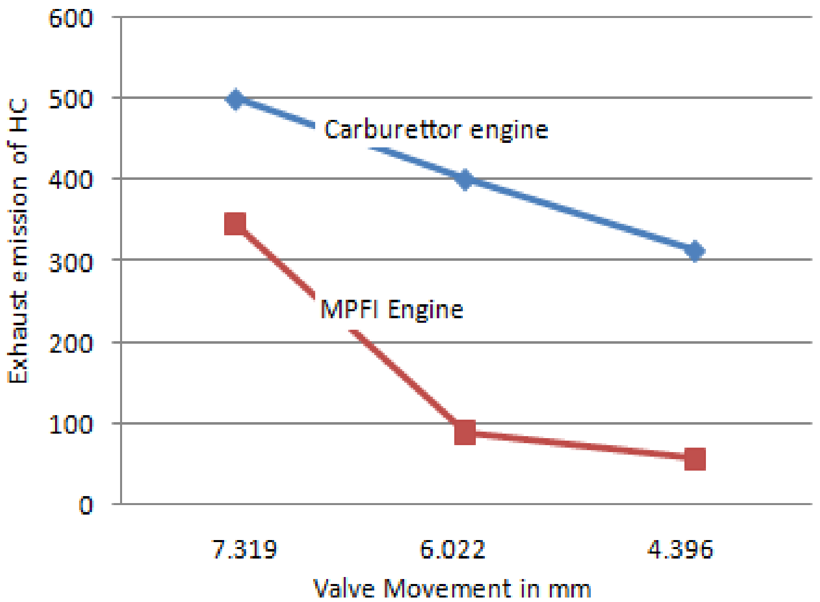


Fig 7: Valve Movement V/S Exhaust emission of HC

When the rocker is placed on the maximum, centre and minimum diameter of the Cam Shaft then the valve movement is decreased so that the exhaust emission HC is reduced.

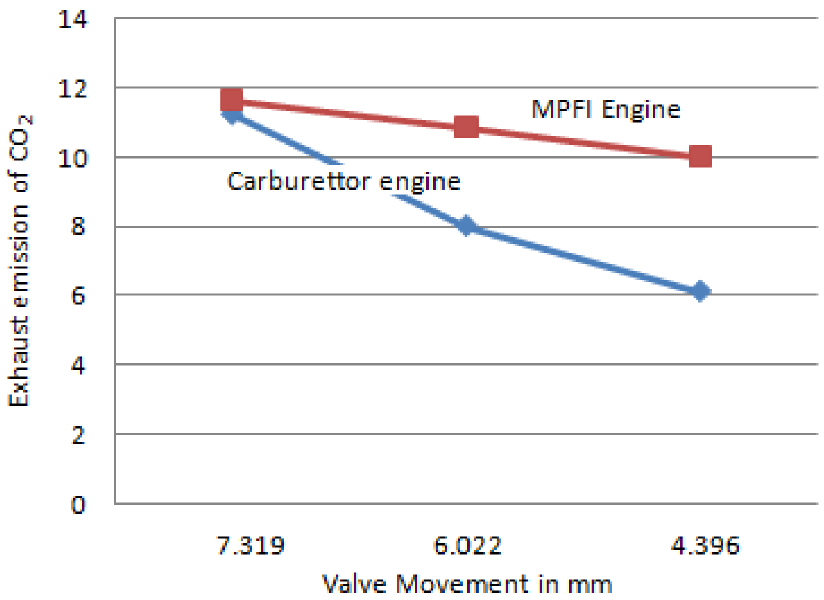


Fig 8: Valve Movement V/S Exhaust emission of CO_2

When the rocker is placed on the maximum, centre and minimum diameter of the Cam Shaft then the valve movement is decreased so that the exhaust emission CO_2 is reduced.

For 9^0 of Taper turn in CAM

Table 7: Exhaust emission at Maximum, Centre and Minimum for 9^0 of Taper turn in CAM in carburettor engine.

SL NO	Diameter of the CAM (mm)	Valve lift in mm	Exhaust Emission of CO	Exhaust Emission of HC	Exhaust Emission of CO_2
1	35.74(Maximum)	7.319	3.640	501	11.24
2	34.47(Centre)	5.925	1.863	491	7.65
3	33.45(Minimum)	3.961	1.460	103	2.77

Table 8: Exhaust emission at Maximum, Centre and Minimum for 9^0 of Taper turn in CAM in MPFI engine.

SL NO	Diameter of the CAM (mm)	Valve lift in mm	Exhaust Emission of CO	Exhaust Emission of HC	Exhaust Emission of CO_2
1	35.74(Maximum)	7.319	0.648	346	11.62
2	34.47(Centre)	5.925	0.398	136	11.30
3	33.45(Minimum)	3.961	0.247	85	10.43

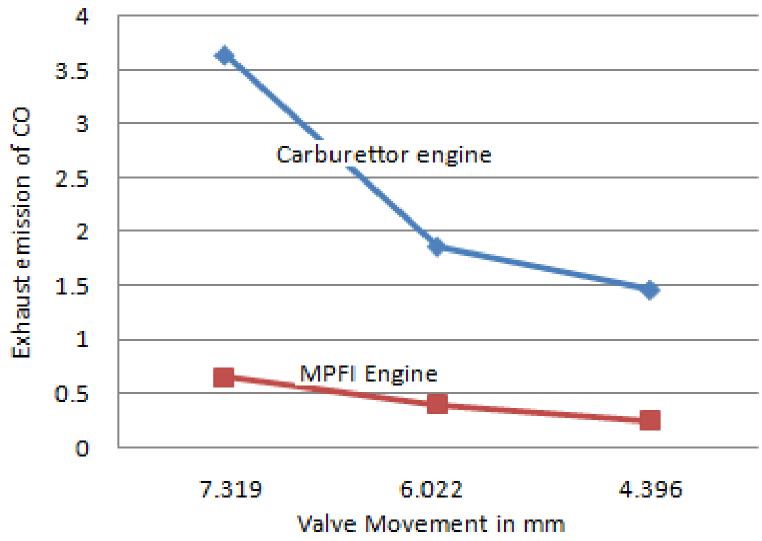


Fig 10: Valve Movement V/S Exhaust emission of CO

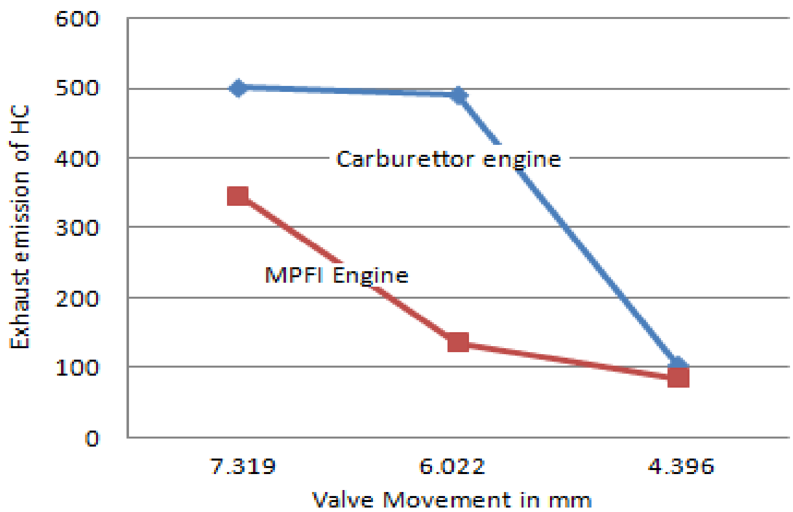


Fig 11: Valve Movement V/S Exhaust emission of HC

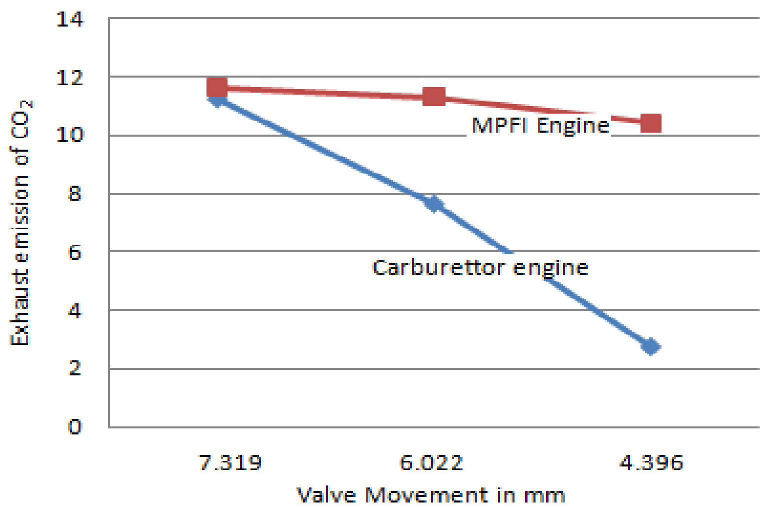


Fig 12: Valve Movement V/S Exhaust emission of CO_2

The above figures clearly point out the exhaust gas emissions are reduced for the MPFI engine is compared to the carburettor engine with the use of flexible valve actuation mechanism.

CONCLUSION

A fully flexible valve actuation system of 8^0 and 9^0 taper turn in CAM is conceived and designed. So as to give variable valve displacement, flexibility and can be controlled.

Emission characteristics for a modified cam have been studied at variable valve displacement depending on the operating conditions of the engine viz., minimum value displacement at lean loads/low engine speeds, medium valve displacement at intermediate loads and maximum valve displacement at high loads/high engine speeds.

Emission characteristics can be also controlled since the fuel efficiency is increased. So the emission is reduced at 3 different locations of the CAM Shaft as the valve movement is varied and controlled by using the modified CAM Shaft.

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