

Design and Development of intake Pulse Resonance Chamber For Four Stroke Multi Cylinder engine



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ABSTRACT

This Paper discusses the problem of four stroke multi cylinder engines that suffer from low torque at low rpm range. The fuel consumption of a four stroke four wheeler engine is the least in its midrange due to the availability of the torque in that range of rpm. Most engines do not return good fuel efficiency in traffic conditions. Due to lower torque of the engines, disengaging the clutch fully at lower engine speeds may cause engine to stall, hence it becomes necessary to revise the engine higher level than the required. This increases the running cost of the vehicle because extra fuel is to be burned to ensure that engine does not stall. The objective of the project is to increase the torque at low engine speeds without reducing the fuel efficiency of engine by achieving a ram air effect. To achieve the objective we have to design a chamber which uses the negative pressure pulses generated during the intake stroke. However we can use the concept of resonance chamber without redesigning engine which is not only cost saving but also an aftermarket add-on to existing vehicles

Keywords— four stroke engine, helmholtz chamber, resonance chamber.

ARTICLE INFO

Article History

Received :

Received in revised form :

Accepted :

Published online :

I. INTRODUCTION

The engines found in most regular Indian Cars suffer from low torque at low rpm. The availability of the torque in its midrange of rpm helps to return highest fuel efficiency of a multicylinder engine in that range but in low rpm range multi cylinder engine do not return good fuel efficiency which is most necessary in daily commute due to traffic and lower torque of the engine leads it to stall when we disengage the clutch fully, it requires to revise the engine higher than the required. And increases the running cost of the vehicle. We have to design a chamber to use the negative pressure pulses generated during the intake stroke and achieve a ram air effect for intake air fuel mixture. Methods to increase the fuel efficiency are Increase the stroke length, Supercharging, Turbocharging, Ceramic

coating of engine, Increase the Displacement Running with lean mixture, We can overcome the above problem by of torque and fuel efficiency with help of intake pulse resonance chamber. The advantages of above system is No need to alter the current Design of engine, Can be adapted with Existing engines as add-on

When the intake stroke of the four stroke engine begins the intake poppet valve opens and causes a negative pressure pulse to travel up the intake manifold. It is harnessed by providing a resonance chamber up in the intake manifold where it is made to reflect back into the intake valve. The return pulse is timed to just reach the intake port just before it closes by using a calculated effective length for the pulse to travel through the resonance chamber. This causes a higher effective compression ratio as little extra air-fuel charge enters the combustion chamber every cycle and

hence leads to thereby increasing the volumetric efficiency of the engine.

Vehicle selected is Maruti 800 DX

The primary reason for the selection of the said vehicle is that I own the vehicle. It is hence at disposal for the project Related work at all times. Required Technical specifications of engine are

TABLE I

Engine Specifications

Engine displacement	796 cc
Displacement of each cylinder	265.33cc
Bore	68.5 mm
Stroke	72.0 mm
Inlet valve diameter	26 mm

The valve timing of the engine is as follows:

- Inlet valve opens 5 degrees before T.D.C.
- Inlet valve closes 40 degrees after B.D.C.
- Exhaust valve opens 50 degrees before B.D.C.
- Exhaust valve closes 6 degrees after T.D.C.

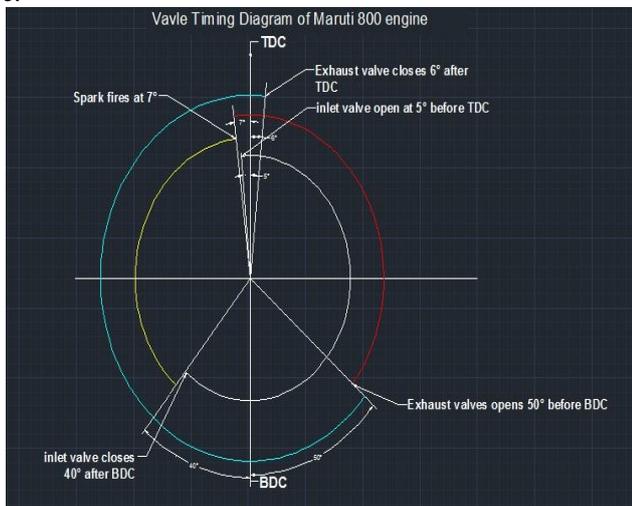


Figure 1 Valve timing diagram of Maruti 800 engine

II. DESIGN CALCULATIONS

The target vehicle will be ridden in start stop traffic to estimate the optimum engine speed to design the chamber to provide the boost. It was then noted that the maximum benefit would be achieved if the boost is provided for the engine between 1500 rpm.

Diameter of engine head valve opening 26 mm

Displacement of engine is 796 CCSo displacement for each cylinder as it has 3 cylinders

Displacement of each cylinder = $796/3 = 265.33$ CC

Now, 1500 RPM = $(1500) / (60) = 25$ RPS

The four stroke engine requires two complete rotations of the crank for one cycle i.e. 720Therefore, Time for one complete cycle (in seconds @ 1500 rpm)

$$T = (2) * (1/25) = 0.08 \text{ seconds}$$

From the earlier data, total angle of crank rotations for which intake valve remains open, at = $(5 + 180 + 40) = 225$ degrees, the total time for which the intake valve remains open: $T = \{(0.08)/720\} * (225) = 0.025$ seconds

The, pressure pulse is generated when the intake valve opens. We need to reflect pressure wave pulse back to ports. When piston moves from BDC the air-fuel is pushed back in manifold so to avoid it and save the air fuel. Thus, the pulse wave needs to return to the intake valve after 185° degrees of crank rotation. Total wave travelling time = 0.0205 seconds

Hence, the frequency of the operation for calculating the length of travel $F = \{(1500)/2\} * (1/60) = 12.5$ Hz.

Now, for a tuned length Helmholtz chamber [1], Equation(1)

$$F^2 = \frac{1}{4\pi} \left\{ \frac{(\alpha + \alpha\beta + 1) + ((\alpha + \alpha\beta + 1)^2 - 4)^{1/2}}{2 * L * V} \right\}$$

Where, $\alpha = L_1/L_2$, $\beta = v_1/v_2$, $v_1, v_2 =$ volume of individual cylinder tracts

$\alpha = L_1/L_2$, $\beta = V_1/V_2$, $L_1, L_2 =$ Length of individual cylinder tracts, $L =$ Desired Length of chamber

$V_1/V_2 = 1, L_1/L_2 = 1$ {for one chamber for one cylinder},

Substituting the Values in equations we get the length

Thus, $L = 1.5$ m

As it is total length for resonance the length of chamber will be half which is 0.75m as the runner length of engine block to valve head is 0.15m which is already available so length of chamber will be $0.75 - 0.15 = 0.65$ m

So, we have to provide a total of 0.65 m effective length to have resonance.

III. RESULTS

As the designed chamber length we have manufactured the resonance chamber, the material used was Stainless Steel SS304 as the material was easily available in required size and cheaper and it was also easier to fabricate



Figure 2 Top View of Fabricated Chamber

The test runs were performed for designed chamber, the fuel efficiency of engine was found by using acalibrated plastic petrol tank the results were as follows

TABLE II
Results

Conditions (engine @ 1500 rpm)	Fuel Consumed	Without chamber (kmpl)	With designed chamber (kmpl)
Traffic	1 liter	11	13
Highways	1 liter	14	15
Ghats (Mountain Pass)	1 liter	9	9.5
Idling (standstill)	100 ml	120s	130s

IV. CONCLUSION

- We can see from results that the maximum efficiency is increased in lower rpm range of traffic conditions which is required.
- Thus we can see that replacement of original manifold with our designed resonance chamber leads to increase the fuel efficiency on different road conditions.
- As the chamber is an engine add on it avoids changes in engine design can be directly added to new engines also.
- Increased fuel efficiency of vehicle will make it more economical for use.

REFERENCES

- [1] Vignesh.V, Ashish.M, "Design and Development of Intake Pulse Resonance Chamber For Four Stroke Engine" 2014, IJEDR, Volume 2, Issue 1, ISSN: 2321-9939
- [2] Falcão, C E, G Wildner, F D, Mello, P B, Vielmo, H A "Experimental Measurements Of Pressure Waves In Intake System Of A Cfr Engine" 14th Brazilian Congress of Thermal Sciences and Engineering.,(2012)
- [3] John B Heywood, "Internal Combustion Engine Fundamentals" McGraw Hill, Inc., series TJ755.H45, 1988.
- [4] www.team-bhp.com/forum/technical-stuff/99827-maruti-800-technical-specifications-feature-list.html