Design and Development of Torque Enhancer Intake Manifold for Maruti 800

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***Abstract* - This paper focuses on variation in engine parameter due to addition on Helmholtz chamber. The Helmholtz chamber uses the pressure pulse to resonate back to manifold allowing the air fuel change in manifold to be trapped inside the cylinder itself allowing to achieve the ram air effect which leads for engine to attain higher compression ratio and hence leads to increasing the torque and also a slight increment in fuel efficiency this provides the vehicle to be more economical**
Keywords: Dyno testing, Fuel efficiency, Maruti 800, Resonance chamber.

I. INTRODUCTION

The multi cylinder engine in cars are less efficient, in India people tend to move towards the vehicle which is more economical in fuel consumption , so there is more and more techniques for increasing the fuel economy of the engine. The traffic situation leads to start stop of vehicle so higher fuel is burned in this condition we need to rev the engine more or increase the throttle nut setting in carburetor so that engine does not stall The most carburetor engines the air and fuel mixture is created in carburetor and then passed in intake manifold and to the cylinder for the combustion but main problem in stalling of engine is due lesser availability of torque in initial range if rpm i.e. Up till 3000 rpm and vehicle is set for idling at 1000 rpm and in traffic condition it is between range on 1000 to 2500 rpm this lower torque leads to decrement in power and more fuel consumption in working of engine. This can be avoided if we harness the torque in lower rpm range, the increasing in the torque will lead to lesser fuel consumption and vehicle will be more economical in running

The vehicle selected for this is Maruti 800 as it is one of the commonly used car it can hold the additional stress generated during working

The four stroke engine while inlet valve opens due to lower pressure inside the chamber the pressure pulse is generated in manifold side and this pulse travels to air box. The Helmholtz resonance chamber is to be designed for an calculated length which will resonate the wave back to the intake manifold head so that the pressure wave traps the air fuel charge inside combustion chamber this leads to ram air effect inside cylinder achieving higher compression ratio and increment in torque

II. DESIGN AND CALCULATIONS

Engine Specifications are

Engine displacement	796 cc
Bore	68.5 mm
Stroke	72.0 mm
Inlet valve diameter	26 mm

Table 2.1 engine specifications

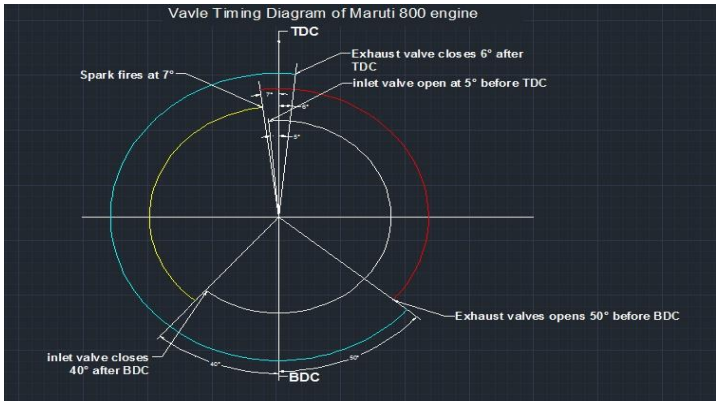

Figure 1 Valve timing diagram of Maruti 800 engine

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 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. 720 Therefore, Time for one

complete cycle (in seconds @ 1500 rpm) T = (2) * (1/25) = 0.08 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 We need to resonate the wave back to inlet valve to trap the charge 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) = 12.5Hz.

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

$$F^2 = \frac{1}{2\pi}\left\{\frac{(N+(L_1/L_2)+1) + \left((N+(L_1/L_2)+1)^2\right)-4)^{1/2}\right)}{2*L*V}\right\}$$

Where,

L1, L2 = Length of individual cylinder tracts, L = Desired Length of chamber V= Q/A, L1/L2 = 1 {for one chamber for one cylinder}, N= no. Of Cylinders= 3 Substituting the Values in equations we get the length

Thus, L = 1.5 m, For resonance is 1.5 m so length of chamber is 0.75 m Runner length available in engine is 0.15 m

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

III. RESULTS AND DISCUSSIONS

The chamber was fabricated for the selected engine using SS304 material the below image shows the original image of chamber the reed valve was used for perfect reflection of wave as reed valve is available in necessary sizes

Figure 3.1 fabricated torque enhancer manifold

Dyno testing can be considered as for laboratory testing for engine torque and power the chassis dynamometer the graph of rpm v/s horsepower and torque is obtained from Chassis Dynamometer test it was performed at K S MOTORSPORT at Fort, Mumbai.

Figure 3.2 Dyno performed on test vehicle

The procedure for Dyno test was followed as The vehicle was fired and started to run on roller and speed was increased gradually for 0 to 30 kmph Then was rapidly accelerated to 80 kmph and hold constant for some time speed was deceased to 40 kmph again

hold constant this Process was again repeated after fitting resonance chamber and both the resulted are depicted graphically and in tabular form The set of results show the representation of Dyno test of engine with the original intake manifold and designed chamber assembled to the engine and the vehicle was subjected to run on Dyno for a test duration of 10 mins and the graphical and tabular results are depicted below

RPM (RPM)	Original manifold		Designed Chamber	
	Hp (Hp)	Torque (ft-lb)	Hp (Hp)	Torque (ft-lb)
2800	10.74	19.8	12.31	22.9
2900	16.05	29.1	16.44	29.8
3000	16.51	28.9	17.14	30
3100	16.82	28.5	18.02	30.5
3200	17.64	28.9	18.51	30.4

Table 3.1 results of Dyno for rpm v/s HP and torque

The graphical representation of power is shown as below

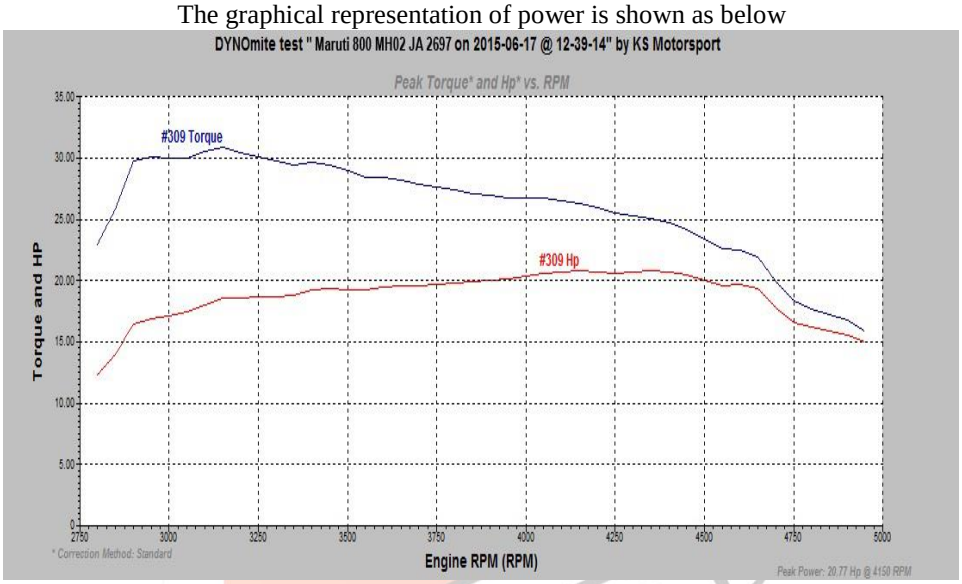

Figure 3.3 graph for rpm v/s torque and HP

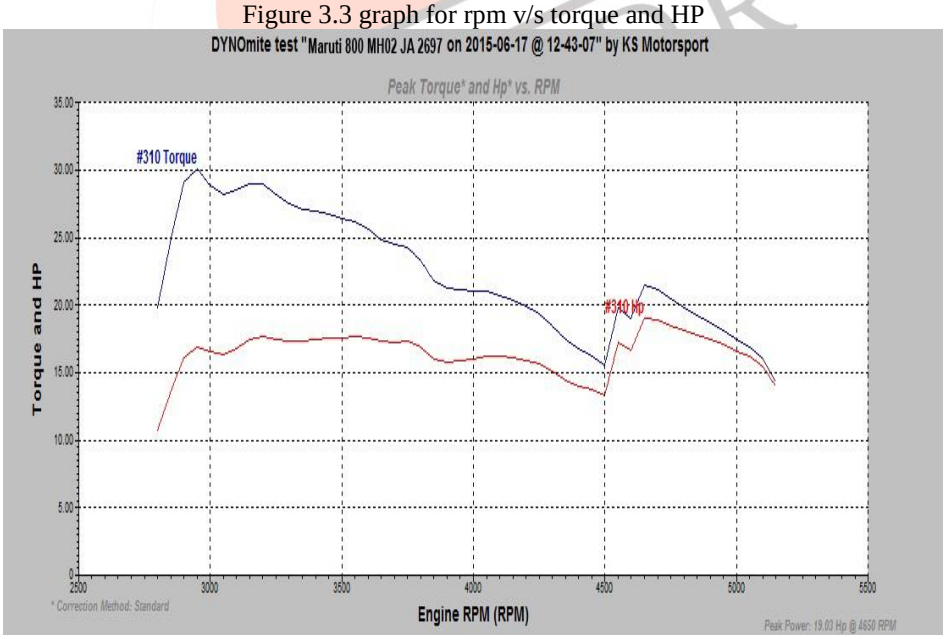

Figure 3.3 graph for rpm v/s torque and HP

Comparing above both the graphs and values obtained in tabular form shows that there is an increase in torque and power when the chamber is attached to the engine There is a torque increment of 1.4 ft-lb in initial lower range of rpm which was the target area of the project. Power increment was seen of 2 Hp in overall range

IV. CONCLUSIONS

The Dyno testing shows the torque increment in lower range of rpm

- No problems were seen with the designed chamber with respect to working of engine
- The effect of chamber can be seen on fuel efficiency Average Torque increment of 2 ft. /lb. Is seen
- Average horsepower increment of 1bhp is seen
- This phenomena can also be combined with electronic devices and more efficient engine design can be achieved And torque of the engine

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