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ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Vol 2, Issue 2, February 2017

Turbocharged Single Cylinder S I Engine

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Abstract- **Turbochargers can enhance the efficiency of an internal combustion engine without increasing the existing engine cylinder capacity; this will help for engine downsizing. Energy from the exhaust gas itself utilized to compress air. In this experimentation HERO HONDA CD 100 SS engine (100 cc) was used. This single cylinder SI engine was turbocharged with BEAT vehicle Turbocharger. In order to reduce temperature of compressed air it was cooled in cooling chamber, then outlet was attached to the carburetor air inlet. This gives more amount of air in combustion chamber for complete combustion of fuel. Comparison of naturally aspired engine and turbocharged engine with respect to fuel consumption were estimated.**

Index Terms: **-compressor, emissions, fuel consumption, naturally aspired engine, single cylinder SI engine, turbine, turbocharger.**

I. INTRODUCTION

In modern IC engine downsizing is playing important role. Downsizing can be achieved with the help of boosting inlet pressure of the air. In naturally aspired engine the downward (TDC to BDC) movement creates suction in combustion chamber which causes atmospheric air to flow. Two conventional methods to boost inlet pressure are superchargers and turbocharger. Supercharger gets power from engine itself to run compressor while turbocharger works on exhaust gas. Turbocharger is more effective way to boost inlet pressure, as it uses energy of exhaust gases to run compressor. Turbocharger increases the volumetric efficiency i.e. breathing ability of engine. Two wheeler SI engines (single cylinder SI engine) generally operate on ambient pressure. In this experimentation we are using 100cc single cylinder SI engine with turbocharger.

II. TURBOCHARGER

A single stage compressor in communication with a single stage centrifugal turbine compresses the ambient air which supplies to the engine. The exhaust gases from the combustion chamber during exhaust stroke causes turbine to rotate, now this turbine is coupled with compressor impeller. Compressor impeller will rotate at the same speed as that of the turbine result in compressing atmospheric air. The compressed air should passes through the air cooler to decrease temperature.

III. WORKING OF TURBOCHARGER SYSTEM

Amount of air and fuel entering in combustion chamber defines power develop. From the same engine if anyone want more power then he has to supply more air and fuel inside the combustion chamber during induction stroke. In turbocharger atmospheric air passes through filter followed by compressor in which the pressure and temperature of inlet air increases. Then it passes through the air cooler to further increase in density and to eliminate possibility of knocking. This cooled air then goes to the combustion chamber, as it is compressed the mass flow rate of air increases. On the other hand mass flow rate of fuel also increases which result in the forming more power for same displacement engine.

After the combustion of air fuel mixture, during exhaust stroke high pressure and temperature exhaust gases enters in to the exhaust manifold. This high pressure exhaust gas continues to the turbine. At this power developed in turbine to run compressor. The turbine creates back pressure to the engine which reflects in slightly increased pumping loss.

IV. LITERATURE REVIEW

Bangwansighn vishwakarma (2005) has done experimentation on modification in two wheeler silencer by using concept of turbocharger and heat exchanger. He found increasers in mileage about 20 to 25% when part of exhaust gas used to preheat the air.

P Balashanmugam et al (2013) measures exhaust gas emissions of Suzuki two stroke engine by turbocharging and found lower emissions as compared with natural aspired engine at each throttle positions.

Mohammad israr et al (2015)use to analyses performance of two stoke scooty engine with turbocharger and concluded that maximum power can be developed with this arrangement.

ISSN (Online) 2456-1290
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(IJERMCE)
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Yogesh Gaikwad et al.(2015) experimented with single cylinder two stroke petrol engine with turbocharging. With the turbocharger they were found 6 to 8% milage enhancement.

Abhishek saini et al (2014) examined Honda stunner 125 cc engine with and without turbocharging, found turbocharged engine more efficient as compared with naturaly aspired engine.

V. TURBOCHARGING IN TWO WHEELERS

The exhaust gases coming out from combustion chamber having two types of energies

1. Pressure energy
2. Heat energy

In two wheeler engines these energies are unutilized. To utilize this waste energy one may use turbocharger either to improve volumetric efficiency or to decrease fuel consumption. In turbocharger, Turbine runs solely by the exhaust gases and cause to run compressor. This means we need not to provide any other power system to run turbocharger.

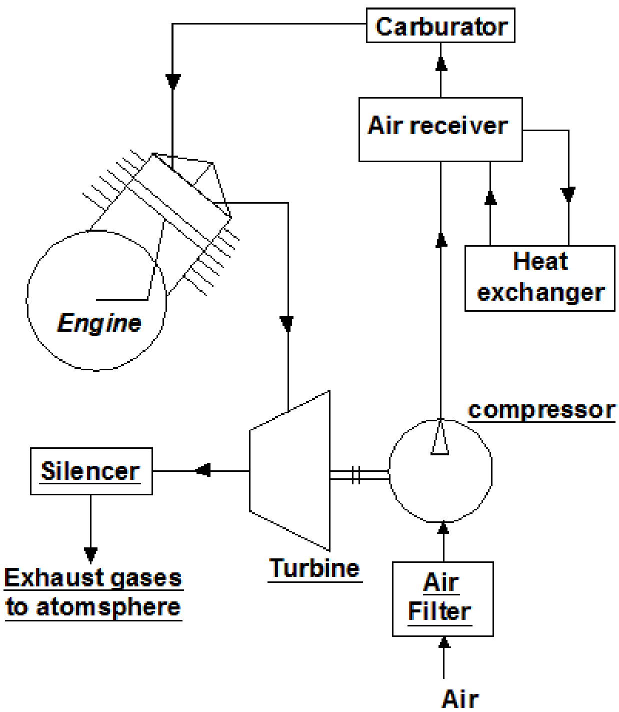
Altitude compensation in carburetor is also the major point of view. At high altitude carbureted engine get lean mixture because of the lower density of air, on the other hand at lower altitude it will get rich mixture. To compensate this we may use turbocharger in two wheelers. Main hurdle to use turbocharger for two wheelers is operating range of existing turbocharger. As currently only big and multi cylinder engines only having turbochargers. In case of single cylinder 4 stroke engine for two crank revolutions there will be only one exhaust stroke. This will give discontinues flow to the turbine, which ultimately results in generating pulses at turbine end (Turbine Lag). Still if we pass low pressurized exhaust gases to the turbine it will exert a back pressure on the engine, results in a high pumping loss.

VI. EXPERIMENTAL SETUP

In this experiment we have used Honda CD100SS bike engine for turbocharging.

Experimental setup consist of,

1. Air filter
2. Turbine
3. Compressor
4. Air receiver
5. Copper tubes (Coolant tubes)
6. Heat Exchanger
7. Coolant tank
8. Linkage for turbo waste gate



VII. METHODOLOGY

Turbine and compressor we have taken as it is from beat vehicle.

Air Receiver: - This is mainly for receiving pressurized air from compressor. Air receiver also cools the pressurized air to ensure increase in density of air. The material used for making of air receiver is Mild Steel. The length of copper tube which is coiled inside the air receiver is approx. up to 2 feet. The air receiver is fabricated in triangular shape to fit at extra space of vehicle.

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Length of receiver =20cm
Base of receiver =11cm
Height of receiver =11cm

Air cooler: - In air receiver copper coil is fitted which communicate with cooling water storage tank. Tank has mixture of coolant and water in proportion 4:1. Coolant is allowed to flow from air receiver, followed by heat exchanger and again enters in to the tank

Heat Exchanger: - Heat Exchanger is made up with copper coils, which are wounded on the front guard with mesh like structure. It is air cooled heat exchanger and works on the principle of Syphon effect.

Linkage for turbo waste gate: - At the slow speeds we cannot pass exhaust gases through turbine. At lower pressure of the exhaust gases it is unable to rotate turbine blades. To overcome this difficulty here bicycle wire linkage is connected to waste gate (bypass gate of turbine). Initially for slow speed we need to open waste gate. When engine get the constant running speed say 40 km/hr we have to close the waste get. After closing waste gate turbocharger actuates, this utilizes waste heat energy from exhaust gas. Again for low speed we need to open the turbo waste gate manually.

VIII. CALCULATIONS

1. Overall Engine mileage without turbo 50 km per liter
2. Analysis of engine and turbocharger

Sr. No	Parameter	Analysis
1	Engine Displacement	100 cc
2	Engine Type	Single cylinder, 4-stroke, air cooled
3	Inlet Temperature of turbine	Tti = 443K
4	Outlet temperature of turbine	Tto = 335K
5	Inlet temperature of compressor	Tci = 305K
6	Outlet temperature of compressor	Tco = 309K

3. Turbine power,

$$\text{Turbine power} = \text{mg} \times \text{Cpg} \times (\text{Tti} - \text{Tto})$$

$$\text{Turbine power} = \text{mg} \times 1.005 \times (443 - 335)$$

Here we assume air fuel ratio 18:1,
mg = ma + mf
mg = ma+(ma/18)

$$\text{Turbine power} = \text{ma} + \frac{\text{ma}}{18} \times 1.005 \times (443 - 335)$$

$$\text{Turbine power} = 119.7 \times \text{ma}$$

4. Compressor power,

$$\text{compressor power} = \text{ma} \times \text{Cpa} \times (\text{Tco} - \text{Tci})$$

$$\text{compressor power} = \text{ma} \times 1 \times (309 - 305)$$

$$\text{compressor power} = 4 \times \text{ma}$$

5. Power of Turbocharger

$$\text{Power of turbocharger} = \frac{(\text{turbine power} - \text{compressor power})}{\text{turbine power}}$$

$$\text{Power of turbocharger} = \frac{(119.7\text{ma} - 4\text{ma})}{119.7\text{ma}}$$

$$\text{Power of turbocharger} = 966.58 \frac{\text{J}}{\text{Kg}}$$

6. Calculation of mass flow rate of fuel-

We have taken all the reading for the fuel consumption of 12.5ml.
Now, Mass flow rate is calculated in kg/hr is as follows,
Density of fuel is 0.75 $kg/m3$
As we know,
$mass{=}density{\times}volume$
$mass{=}0.75{\times}12.5{\times}10{-}3$
$mass{=}9.37{\times}10{-}3\ kg$
$mass\ flow\ rate{=}mass/time$
Mass flow rate at different speed

Speed in rpm	Without turbo		With turbo	
	Time req. for 12.5ml fuel consumption in sec	Mass flow rate in Kg/hr	Time req. for 12.5ml fuel consumption in sec	Mass flow rate in Kg/hr
3600	49.10	0.6873	60.20	0.5606
7500	32.39	1.0400	56.79	0.5942
9100	23.32	1.4400	38.10	0.8858

7. Trials and Testing

Fuel Quantity	Without turbocharger	With turbocharger	% increase
50ml	2.34	2.62	11.96
50ml	2.42	2.71	11.98
50ml	2.35	2.67	13.61

CONCLUSION

With the use of turbocharger we have 30% increased fuel efficiency.Based on the trials and testing it is very much cleared that about 11% to 13% increase in mileage with turbocharger. At the starting and idling of an engine it is very difficult to operate turbocharger. Fabrication of turbine and compressor with respect to engine size, may achieve high fuel efficiency with improved emissions.

REFERENCES

[1] Abhishek Saini, Prakash Shakti, Himanshu Kulshrestha, “Turbocharged single cylinder SI engine” , International Journal of Advanced Technology & Engineering Research (IJATER) 1st International Conference on Research in Science, Engineering & Management (IOCRSEM 2014)

[2] Mohammad Israr, Amit Tiwari, Mahendra Labana, Anshul Gangele, “Performance Analysis and Fabrication on a Turbocharger in Two Stroke Single Cylinder Petrol Engine”, IJETI International Journal of Engineering & Technology Innovations, Vol. 2 Issue 2, March 2015 ISSN (Online): 2348-0866.

[3] P Balashanmugam, E Elakiya and Sunayana Sharma, “Performance analysis on a turbocharged two wheeler engine”, ISSN 2319-5991, Vol. 2, No. 4, November 2013.

[4] Amos Greene Winter, “Turbocharged single cylinder internal combustion engine using an air capacitor” US 2015/0007560 A1, UNITED STATE, Jan. 8, 2015.

[5] Prashant.N.Pakale, S.U.Patel, “Performance analysis of IC engine supercharger and turbocharger”, IJRET, eISSN: 2319-1163 pISSN: 2321-7308, Volume: 04 Issue: 02 | Feb-2015.

[6] Yogesh Gaikwad, Rohit Jadhav, Abhishek Shinde, Pradeep Mane, Sager patil, “Fabrication And Implementation Of Turbocharger On Two Stroke Vehicle” International Journal Of Innovations In Engineering Research And Technology [IJIERT] ISSN: 2394-3696 VOLUME 2, ISSUE 4, APR.-2015

[7] Amalorpava Dass. J , Mr.Sankarlal.P, “Fabrication And Implementation Of Turbo Charger In Two-Wheeler” International Journal Of Computational Engineering Research (ijceronline.com) Vol. 3 Issue. 3.MARCH 2013.

[8] I.C.Engine by M.L.Mathur & R.P.Sharma ,Dhanpat Rai Publication, supercharging turbocharging ,page no.595 to 610.