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Fabrication of Turbocharger

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ABSTRACT

Turbocharger is a device that increases the overall performance of engine by reusing the exhaust heat to drive the turbine. A two-wheeler engine with turbocharger increases the power of engine and with reusing of exhaust gas which results of less fuel consumption. The immediate objective of this report project is to develop and upgrade two-wheeler for commercial purpose as well as racing purpose. The emphasis today is to provide feasible engineering solution to manufacturing ecconomy and "greener" road vehical. It is because of this reason that turbocharger is now becoming more popular in automobile applications.

Keywords : Turbocharger, IC Engine, Volumetric Efficiency.

I. INTRODUCTION

A turbocharger or turbo is a forced induction device used to allow more power to be produced for an engine of a given size. The key difference between a turbocharger and a conventional supercharger is that the latter is mechanically driven from the engine often from a belt connected to the crankshaft, whereas a turbocharger is driven by the engine's exhaust gas turbine. A turbocharged engine can be more powerful and efficient than a naturally aspirated engine because the turbine forces more intake air, proportionately more fuel, into the combustion chamber than if atmospheric pressure alone is used. Turbos are commonly used on truck, car, train and construction equipment engines. Turbos are popularly used with otto cycle and diesel cycle internal combustion engines.

II. LITERATURE REVIEW

2.1 WORK DISCUSSION

Turbo chargers are used througout the automotive industry as they can enhance the output of an internal combustion (IC) engine without the need to increase its cylinder capacity. The emphasis today is to provide a feasible engineering solution to manufacturing economics and "greener" road vehicles. It is because of these reasons that turbochargers are now becoming more and more popular in automobile applications. The new turbocharger is coupled to an air-water intercooling system to decrease the inlet air temperatures. This project analysed the intercooling system and tested the final design in the vehicle. The results show that the cooling system components purchased are adequate for this system. The aim of this paper is to provide are view on the techniques used in turbocharging used in two stroke single cylinder petrol engine by this to increase the engine output and reduce the exhaust emission levels. This paper is to analyse a turbocharger system in a two stroke petrol engine. The ideal turbocharger design would be smaller than the system purchased. The paper will also create speed sheets for use in calculating the necessary parameters for another turbocharger system, or to modify the current system.

2.2. HISTORY OF TURBOCHARGER

Motorcycle Turbo Charger using turbochargers to gain performance without a large gain in weight was very appealing to the Japanese factories in the 1980s.

The first example of a turbocharged bike is the 1978 Kawasaki Z1R TC. It used a Ray jay ATP turbo kit to build 0.35 bar (5 lb) of boost, bringing power up from 90 hp (67 kW) to 105 hp (78 kW). However, it was only marginally faster than the standard model. In 1982, Honda released the CX500T featuring a carefully developed turbo (as opposed to the Z1-R's bolt-on approach). It has a rotation speed of 200,000 rpm. The development of the CX500T was riddled with problems; due to being a V-twin engine the intake periods in the engine rotation are staggered leading to periods of high intake and long periods of no intake at all.

III. CONSTRUCTION AND WORKING OF TURBOCHARGER

Turbo chargers are used throughout the automotive industry as they can enhance the output of an internal combustion (IC) engine without the need to increase its cylinder capacity. The application of such a mechanical device enables automotive manufacturers to adopt smaller displacement engines, commonly known as "engine downsizing". Historically, turbo chargers were often used to increase the potential of an already powerful IC engine. The emphasis today is to provide a feasible engineering solution to manufacturing economics and "greener" road vehicles. It is because of these reasons that turbochargers are now becoming more and more popular in automobile applications.

The aim of this paper is to provide a review on the techniques used in turbocharging to increase the engine output and reduce the exhaust emission levels. Due to the increase of motorcycles, petrol consumption and emission rate increases day by day. An attempt has been made in this project to use the exhaust gas to rotate a turbine thereby rotating a compressor for supplying compressed air to inlet. A turbocharger increases the pressure at the point where air enters the cylinder, thereby increasing the pressure gradient across the intake valves and thus more air enters the combustion chamber. It allows proper combustion of fuel and increases the efficiency of engine. A turbocharged engine can be more powerful and efficient than a naturally aspirated engine because of the increase in the quantity of intake air into the combustion chamber than if atmospheric pressure alone is used. In this project we used a 99cc engine for our analysis. In our work the turbocharger is mounted in front of the engine near the exhaust ports in order to minimize heat losses and improve turbo response. Front mounting of the turbocharger isolates the heat from the rider, removes the turbocharger from its conventional location behind the engine where it can get hot enough to boil the fuel in the fuel tank.

IV. DESIGN

4.1.1 DESIGN OF VENTURY METER :

Ventury meter is an apparatus used for finding out the discharge in the pipe if consist of following three types. There are three types of ventury meter they are as follows.

Convergent cone:- It is a short pipe, which converges from the pipe diameter To throttle diameter the slope of convergent side, is kept between in four or In five.

Throat: It is circular pipe having diameter equal to half or one third of pipe.

Divergent cone: It is diverging pipe 5 to 4 times longer then the convergent cone connects through diameter with the pipe dimensions. It is also known as outlet of ventury meter.

Diameter of convergent =35mm

Flow through the air =3.5m/s

By formula for calculation of Q = discharge through silencer.

$Q = ai \times vi$

$= \pi/4 \times d2 \times 3.5$

= π/4 × (35/1000)2 × 3.5

Q = 1.54 × 10 -4 m3/s

The discharge of the exhaust gas is 1.54 × 10 -4 m3/s.

Obtained from design assuming

V1= 3.5 m/s

V2 = 7 as d2 is ½ times of d1

By formula of energy theorem at that point we get

P1/ρg+V122g+Z1=P2ρg+V222g+Z2

As Z1 = Z2

P1−P2=V22−V122g

P1−P2 = 72−3.5220

P1−P2 = 2.45 – 0.6175

P1−P2= 1.833. But

P1 = 2 times P2

P1−2P1= 1.833.

P1 = 1.833 N/m2.

The pressure released from the ventury meter at the outlet fan is **1.83** N/m.

4.1.2 FRAME DESIGN

As per assumption, the wing is considered of L section.

The design dimension are as follows:

(50 x 40) as 10mm is welding the dimension are (50, 30) 25/2 = 12.5.

Y=a1Y1+a2Y2a1+a2.

Y=750×12.5+750×0.51500.

Y = 6.5 X =(0.5, 12.5)

X=a1X1+a2X2a1+a2.

X=750×0.5+750×12.51500.

= 6.5

The CG of each fan is at (6.5, 6.5) But the figure and MI is same on both side the CG of both wings comes on center.

4.1.3 DESIGN OF DRIVING FAN:

The outer radius of fan is 50mm the fan is made in such a way that the fan has 6 wing of dimension [4 ×4.5] cut at development of each fan the fan is designed in such a way that when the gas flowing through the ventury meter is dashed on the fans tins it most rotates faster. Design of driving fan Assumption made in design of driving fan

- The weight of the fan is 70 grams.
- The air traction has min force =0
- The force exerted by silencer is uniform.
- There is no bearing resistance considered in fan motion.
- There is no thermal expansion considered.

Design procedure for fan

The CG of circle is r hence it is at 5.5 at the center.

The moment of inertia of the circle is π/64 (d)2

The MI of the circle is at center = π/64 (100)4

MI = 490.87 mm4

Design of wings For designing of wing

the CG is calculated by the formula.

X axis X/2 = 40/2 = 20.

Y axis Y/2 = 35/2 =17.5.

The CG of the wings of fan are (20,17.5) respectively.

As the figure is symmetrical, hence the CG is at the center Calculate MI To Calculate MI the formula is-

= 1/12bd3

. =1/12 × 40 × 353

. = 142916.66 mm4

. = 143 × 103.

IPQ = I xx + Ah2.

= 143 × 103 + 1400 × 3

. =143 × 103 × 4200.

=147200.

Therefore the pressure exerted on each fan is about area of fan x

pressure of air

. =1400 × 3.67 =5138 N.

Due to this force the fan moves, as the force exerted is symmetric the force is unidirectional and the CG & MI is equal to the center.

4.1.4 DESIGN OF SHAFT:

The shaft is designed in such a way that the shaft should not fail in farcical failure. The dimension of shaft is given by following ways.

- Material: M.S.
- Fatigue strength = 40 N/mm.

Selection of material: -

The shaft is designed in such way to avoid failure plus the M.S is a good conductor of heat. The fatigue strength of MS is good as compared to other materials.

The assumption made in the shaft is as follows.

- The torque transmitted power of one KN, as there is no force expects air.
- The thermal expansion is not considered.
- The bearing failure is not considered.
- The crushing failure of shaft at bearing is not considered.
- The pitch of a screw are at inch and done by trial and error method.

Design of shaft :

$T = \pi/16$ fs d3.

$T = \pi/16 \times 40 \times (6)3$

. T =1996 N- mm

As it is more than assumed data. The design is safe.

4.1.5 DESIGN OF HUB:

The hub is the most important component it contains the entire assembly in it. The main function of the hub is to support the entire mechanism.

- Material: M.S.
- Diameter: 110mm.
- F centrifugal = 70 N/mm2

- The assumption made in the hub is as follows.
- The pressure exerted by exhaust is equal throughout the body.
- The heat disappeared by the engine is distributed uniformly.
- The thermal expansion by the body is negligible.
- There is no effect of temperature on body.

Selection of material: -

- The mild steel is good conductor of heat.
- It dissipates heat at a large quantity.
- The metal can resist high temperature.
- It is easily malleable.

The design of hub has following procedure:-

Design for longitudinal stress

$\sigma t = Pd/4$

$= 3.67 \times 110/4 \times 1$

. $\sigma t = 100.9$ N/mm2.

The design is safe.

Design for circumferential stress:

$\sigma c = Pd/2t$.

$= 3.67 \times 110/2 \times 1$.

$\sigma c = 201.8$ N/mm2.

The design is safe.

4.1.6 BEARING SELECTION:

Bearing is one of the important components in turbo charger because the bearing the component in which the rotation of smooth fan takes place the bearing used in the project is of SKF company. This company is well know at the manufacturing of bearing.

- Material: - carbon steel.
- Bearing No : - 627 no.
- Size : - outer diameter 19mm.
    - Inner diameter 6mm

4.1.7 SELECTION OF BUSH:

The bush is also such of that type that the outer diameter of the bush must be of 19mm and the inner dia must be of 7mm. the bush helps to prevent bearing from dust.

- Material :- rubber bus

4.1.8 DESGIN OF A CIRCULAR RIB FOR FIXING BEARING :

Rib is also made of mild steel to the following reasons.

1. Good conductor of heat.
2. Easy to machining.
3. The finishing is good.
4. Good for welding purpose.

Design of rib:

The assumption ;made for fan:

1. There are no forces on rib.

2. The rib holds only the bearing and bush.
3. It is made only because the thickness of hub is not so much to have grip in bearing and bushes it is done to support it.
4. The thickness of rib is assumed as 5mm. without any calculation.

4.1.9 DESIGN OF COMPRESSION FAN:

The fan is designed to compress the air in the hub it is just like a air blower the basic principle of fan is to compress air it work on the principle of air blower.

- Material: - M.S.
- Diameter :- 90mm.
- The fan like L shape.

Selection of material: -

1. Good conductor of heat.
2. Good malleable or machinablity.
3. Soft to mold.
4. Good strength.
5. No variation due to temperature.

The calculation of CG on both sides:
The dimension of fan diameter is 90mm
The CG of circle is at made at d/2.
CG = d/2 = 90/2= 45.
As the plate, CG is at center.

4.1.10 DESIGN OF FAN WING:

As per assumption, the wing is considered of L section.
The design dimension are as follows:
(50 x 40) as 10mm is welding the dimension are (50, 30) 25/2 = 12.5.
Y=a1Y1+a2Y2a1+a2.
Y=750×12.5+750×0.51500.
Y = 6.5 X =(0.5, 12.5)
X=a1X1+a2X2a1+a2.
X=750×0.5+750×12.51500. = 6.5
The CG of each fan is at (6.5, 6.5) But the figure and MI is same on both side the CG of both wings comes on center.

V. ADVANTAGES AND DISADVANTAGES

ADVANTAGE:

- More power compared to the same size naturally aspirated engine.
- Better thermal efficiency over naturally aspirated engine and supercharged engine, because the engine exhaust is being used to do the useful work which otherwise would have been wasted.
- Better Fuel Economy by the way of more power and torque from the same sized engine. A century of development and refinement—For the last century the SI engine has been developed and used widely in automobiles.
- Continual development of this technology has produced an engine that easily meets emissions and fuel economy standards. With current computer controls and reformulated gasoline, today's engines are much more efficient and less polluting than those built 20 years ago.
- Low cost – The SI engine is the lowest cost engine because of the huge volume currently produced.

DISADVANTAGES:

- The SI engine has a few weaknesses that have not been significant problems in the past, but may become problems in the future.
- Difficulty in meeting future emissions and fuel economy standards at a reasonable cost. Technology has progressed and will enable the SI engine to meet current standards, but as requirements become tougher to meet, the associated engine cost will continue to rise.
- Throttling loss lowers the efficiency – To control an SI engine, the air allowed into the engine is restricted using a throttling plate.

VI. APPLICATIONS AND FUTURE SCOPE APPLICATIONS:

- ✓ It used in modern vehicles.

VII. FUTURE SCOPE

- ✓ More Fuel Economy.
- ✓ Reduce emission
- ✓ More power output

VIII. CONCLUSION

We have designed and fabricated a prototype of the Turbocharger was implemented in Twowheeler, In which the efficiency of the Engine can be increased. Thus, we have developed a method to increase the efficiency of the engine and at the same time to control the Emissions from the engine. The experimental setup of block diagram is showing the arrangement of turbocharger in two-wheeler. This type of engine will be more efficient than existing engines. This work is an attempt to reduce our dependency on foreign oil and reduce the tailpipe emission from automobiles and this was an attempt to design and implement this new technology that will drive us into the future. Use of production turbo charger will reduce smog forming pollutants over the current national average. The first hybrid on the market will cut emissions of global-warming pollutants by a third to a half and later modes may cut emissions by even more.

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