VEHICLE SUSPENSION SUPERCHARGING SYSTEM

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ABSTRACT

The progress of automobiles for transportation has been intimately associated with the progress of civilization. The automobile of today is the result of the accumulation of many years of pioneering research and development. A supercharger is an air compressor used for forced injection of an internal combustion engine. The purpose of a supercharger is to increase the density of air entering the engine to create more power. Supercharging helps in achieving high power output of engine by increasing the density of air providing more oxygen for complete combustion. At present supercharging is used in four-wheeler and above for better performance. Different researchers in automotive field are working on how to increase the performance of the superchargers. But they are not so successful in implementing superchargers in miniature engines. Due to this reason the work related to supercharging a two wheeler is very few. Till now supercharger is being successfully employed in heavy engines but its use in smaller engine is still under development. However, a new supercharger of small size has been developed for supercharging two wheeler and testing had proved that there is an improvement in engine performance but this supercharger if implemented would drain a major part of the power output from the engine for it's working. So our aim is to study the possibility of freely compressing the air, i.e., a non-conventional method to do the task of supercharging. In this work, we try to increase the performance of a miniature engine equipped with air suspension and valves. An attempt has been made in this project; the suspension air is forced into the intake of the carburetor of the engine. It is also good with regard to economic considerations and efficiency.

Keywords: *Supercharger, miniature engine, non-conventional method, suspension*

1.INTRODUCTION

A supercharger is an air compressor that increases the pressure or density of air supplied to an internal combustion engine. This gives each intake cycle of the engine more oxygen, letting it burn more fuel and do more work, thus increasing power. It is known fact that the power output of an engine increases with an increase in amount of air or mixture in the cylinder at the beginning of compression stroke because it allows the burning of more quantity of fuel. The amount of air induced per unit time can be increased by increasing engine speed or increasing air density during suction stroke. The increase in engine speed requires rigid and robust engine as the inertia load increases rapidly with an increases speed. The engine friction and bearing loads also increase and volumetric efficiency falls with increasing speed of engine. Therefore this is not possible. Now another method in which we have to increase the suction pressure is called supercharging. Supercharging helps in achieving high power output of engine by increasing the density of air providing more oxygen for complete combustion than the conventional method where there is less volumetric efficiency.

A turbocharger, colloquially known as a turbo, is a turbine-driven, forced induction device that increases an internal combustion engine's efficiency and power output by forcing extra compressed air into the combustion chamber. The key difference between a turbocharger and a conventional supercharger is that a

supercharger is mechanically driven by the engine, often through a belt connected to the crankshaft, whereas a turbocharger is powered by a turbine driven by the engine's exhaust gas. The turbocharger is bolted to the exhaust manifold of the engine. The turbine is connected by a shaft to the compressor, which is located between the air filter and the intake manifold. The compressor pressurizes the air going into the pistons. The exhaust from the cylinders passes through the turbine blades, causing the turbine to spin.

2.PROBLEM IDENTIFICATION

The performance of the two wheeler miniature engine is not up to the capacity of the engine used in them. The volumetric efficiency of the engine is lower, thus the thermal efficiency gets reduced. For a particular volume of fuel, a portion of the fuel is left unburned because of incomplete combustion due to less availability of oxygen. There are harmful emissions from these engines which includes unburnt HC's, oxides of nitrogen, carbon dioxide, etc. All these problems can be rectified if you have any means to supercharge the engine. Supercharger or turbocharger is the only known system to solve this issue.

Supercharger uses power from engine to run, major part of engine's output power would be drained by this supercharger. So we need an exclusive setup to obtain the supercharging effect in miniature engines with minimum errors .In case of turbocharger there will be lack of response called the Turbo Lag. If the turbine is too big, the boost will be produced slowly because more exhaust pressure will be needed to overcome the rotational inertia on the larger turbine reducing throttle response but more peak power. If the turbine is too small, the turbo lag won't be as big but the peak power would be lesser. So the turbocharger size is an important consideration when designing it for a particular engine. A typical Turbocharger spins at very high revolutions (1 lakh per minute).So proper cooling and lubrication is an essential part to prevent engine destruction. There is less scope for implementing turbochargers in commercial two wheeler, i.e., for miniature engines (100cc to 250cc). Turbochargers if implemented, the whole system becomes complex and also the small engines, giving low velocity exhaust, is not capable of rotating large turbine. Even if the turbine rotates, the rotational will be varying. Thus non-linear power and torque will be the result, which is uneconomical. So, the only way to get pass this issue is to use small turbines, the design of which is very complex. Small turbines are difficult to construct and also it would not be able to impart the desired rotation to compressor blades to compress air to required pressure. So it is so difficult to implement turbochargers in miniature engines

However, a new supercharger of small size has been developed for supercharging two wheeler and testing had proved that there is an improvement in engine performance but this supercharger if implemented would drain a major part of the power output from the engine for it's working. So our aim is to study the possibility of freely compressing the air, i.e., a non-conventional method to do the task of supercharging. Here we are trying to study whether the requisite compressed air can be effectively produced from the two wheeler suspension system. This compressed air from the suspension is then used for supercharging purpose. In this work, we try to increase the performance of a miniature engine equipped with air suspension and valves

3.LITERATURE REVIEW

S. Jerome Ignatius et al [1]: In this project air is collected from the cylinder and store this energy to the compressor tank as non-conventional method by simply driving the vehicle. It needs no fuel input power to produce the output of the air .This energy is readily available and low cost energy. This system gives smooth operation smooth movement for vehicle. Suspension system during the time of vehicles running the rack slide up and down. Then this compressed air can be used for further applications and for many purpose especially cleaning, braking system. It is implementing pneumatic storage system in automobiles. This compressed air production using vehicle suspension and power generation system is designed with the hope that it is very much economical and helpful to all vehicles to produce the compressed air and power.

Rajesh Kumar Sahu et al [2]: This Paper includes how the compressed air is produced by using vehicle suspension. In this project compressed air can be produced with the help of vehicle suspension system. Then this compressed air is used to operate the vehicle. Compressed air production using suspension system does not require any fuel for its motion. This air operated vehicles are the new innovative concept to run vehicle by using the compressed air. The compressed air may be used for running the vehicle and for air conditioning purposes. The pneumatic operated vehicle is very useful to save the conventional type of fuel and after few years these things will play a very important role.

N. R. Karthik et al [3]: As a demand of new efficient and eco friendly engines is incrementing new technologies are developing. Due to the rich air fuel mixture combustion emission will increase hence by turbocharging and supercharging the engine more power can be obtained with low emission. In this paper review on various application of turbo charging and super charging technology is made. The behaviour of IC engine with application of turbocharger and super charger and need of turbocharger and supercharger installation is studied. It is observed that the existing study on turbo and super chargers shows positive influence of turbo and super charger on IC engine power characteristic and emission characteristic. The air fuel ratio is always constant. So there is scope to vary the air fuel ratio and obtain the best suited air fuel ratio and that can be optimized.

Rahul Kumar sharma et al [4]: There are many inventions aimed at increasing the performance of IC engines. In general, practical engines are always compromised by trade-offs between different properties such as efficiency, weight, power, heat, response, exhaust emissions, or noise. When power increases efficiency is always decreases. Presently, ethanol is prospective material for use in automobiles as an alternative to petroleum based fuels. The main reason for advocating ethanol is that it can be manufactured from natural products or waste materials, compared with gasoline, which is produced from non-renewable natural resources. Some methods and components are useful for increasing performance of engine. One such method is the use of supercharger in I.C. Engine. It is known that the power outputs of an engine increases with the increase in amount of air or mixture in the cylinder and supercharger plays an important role in increasing the amount or air. Till now supercharger is being successfully employed in heavy engines but its use with smaller engine is still under development. Thus this project employing a supercharger in small engine with capacity of nearly 100cc which used in two wheeler bike.

Prakash Kumar Sen et al [5]: In this paper study on performance of supercharging process on SI & CI engine and application of supercharger is done. In this parameters are studied to determine whether the mechanical action of a high speed supercharger improves engine performance. From the analysis of experimental results in papers reviewed, the effects of supercharging on the engine performance can be summarized. Experimentation and competition results have proven that the performance of downsized engines can match that of their larger counterparts, with the aid of intake boosting. However, the extent to which swept volume can be reduced in any downsized application is combustion limited. If the combustion in high speed, small bore engines could be better understood or even enhanced to promote faster burning, the severity of end-gas knock could be minimized. This would allow further increases in compression ratio and/or manifold absolute pressure, resulting in increased performance and efficiency.

Yashvir Singh et al [6]: The objective of this work is to increase the torque and power of the two wheeler by supercharging the vehicle. For this purpose LML freedom 125 cc is analyzed for the work and certain parameters like torque, power, and specific fuel consumption vs rpm are calculated. The data calculated is used in software Engine Analyzer for analysis purpose together with the data of supercharger. It can be seen that power and torque of the engine increases from 7 to 11 KW and 9 to 13 NM at 7500 and 9000 RPM respectively. It can be concluded that it is possible to install a supercharger in case of commercial two wheelers which increases their power on an average more than the original engine. So, supercharging can be done on those engines where maximum power and torque is desired on the verge of more fuel consumption. In this, the power and torque characteristics of the given engine and the modified engine is shown. It can be seen the torque of the modified engine is highest at 7000 rpm and after that there is decrement of torque due to the fast opening and closing of valves of the engine.

4.COMPONENTS

1. IC Engine

Internal combustion engines are the heat engines where the combustion of fuel takes place inside the engine cylinder and heat is generated within the cylinder. This heat is added to the air inside the cylinder and thus the pressure of the air is increased tremendously. This high pressure air moves the piston which rotates the crank shaft and thus mechanical work is done. IC engine converts the reciprocating motion of a piston into rotary motion of crankshaft by means of a connecting rod. A carburetor is a device that mixes air and fuel for internal combustion engines in the proper air–fuel ratio for combustion. A petrol engine is an internal combustion engine with spark-ignition, designed to run on petrol (gasoline) and similar volatile fuels. Since ignition in these engines is due to a spark, therefore they are also called spark ignition engines

2. Suspension System

Suspension is the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Suspension systems must support both road holding/handling and ride quality. The suspension also protects the vehicle itself and any cargo or luggage from damage and wear. The automobile chassis is mounted on the axles not direct but through some form of springs. This is done to isolate the vehicle body from the road shocks which may be in the form of bounce, pitch, roll or sway. A springing device must be a compromise between flexibility and stiffness. A spring is a flexible elastic object used to store mechanical energy. Springs are usually made out of hardened steel. Here a single acting pneumatic cylinder with a spring attachment is used as suspension system

3. PU Tube

Polyurethane Tube is also known as PU Tubes. It has rubber like flexibility. Polyurethane Tube has high degree of resilience and durability. Polyurethane tube has best combined properties of both plastic and rubber. The PU tube offers high abrasion and tear resistance, good elongation values and high tensile. This tube exhibits virtually unlimited flexural abilities and is naturally flexible. Polyurethane Tube is better from most other thermoplastics tubes due to its excellent weathering characteristics with good chemical resistance. It shows exceptional resistance to most oils, gasoline, kerosene, and such other petroleum-based chemicals.

4. Air Tank

A pressure vessel or storage tank is a closed container designed to hold gases or liquids at a pressure different from the ambient pressure. The compressed air produced is grabbed and stored in a tightly sealed tank. The pressure differential is potentially dangerous and many fatal accidents have occurred in the history of their development and operation. Consequently, their design, manufacture, and operation are regulated by engineering authorities backed up by laws. Since the storage of compressed air is a delicate process, special design meetings and safety precautions is to be made

5. Control Unit

In automotive electronics, Electronic Control Unit (ECU) is a generic term for any embedded system that controls one or more of the electrical system or subsystems in a motor vehicle. Managing the increasing complexity and number of ECUs in a vehicle has become a key challenge for original equipment manufacturers. Here a control unit is provided to regulate and control the flow of compressed air.

6. Pressure Gauge

Pressure measurement is the analysis of an applied force by a fluid (liquid or gas) on a surface. Pressure is typically measured in units of force per unit of surface area. Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure and display pressure in an integral unit are called pressure gauges or vacuum gauges.

7. Valves

The compressed air produced inside the suspension system has to be extracted completely with maximum effectiveness. So certain valves like non return valve , quick exhaust valve, solenoid valve are used. A non-return valve or one-way valve is a valve that normally allows fluid (liquid or gas) to flow through it in only one direction. A solenoid valve is an efficient method of converting electrical signals into pneumatic functions. Applying electricity to the solenoid quickly directs air through the valve and into the circuit. Quick exhaust valves are valves that are designed to allow direct exhaust or expulsion of compressed air. These valves helps in regulation and control of flow of air into the engine.

8. Fuel Tank

A fuel tank or petrol tank is a safe container for flammable fluids. Though any storage tank for fuel may be so called, the term is typically applied to part of an engine system in which the fuel is stored and propelled (fuel pump) or released (pressurized gas) into an engine. Fuel tanks range in size and complexity from the small plastic tank of a butane lighter to the multi-chambered cryogenic Space shuttle external tank

9. Frame

This is made of mild steel material. The whole parts are mounted on this frame structure with the suitable arrangement. Boring of bearing sizes and open bores done in one setting so as to align the bearings properly while assembling. Provisions are made to cover the bearings with grease.

5.WORKING

The project consists of the setups of the suspension system, quick exhaust valve, non-return valve, solenoid valve and air tank for the super charging of the vehicle. The fluid displacement due to the pushing power inside the air cylinder by the piston is causing the compressing action inside the cylinder when acted upon by external forces. The pneumatic single acting cylinder is used for this process. The suspension system will cancel the external shock by piston displacement, where the shock energy is converted to heat energy and dissipated to atmosphere through air . A spring arrangement is fixed on the cylinder for the smooth retraction of the piston after each shock.

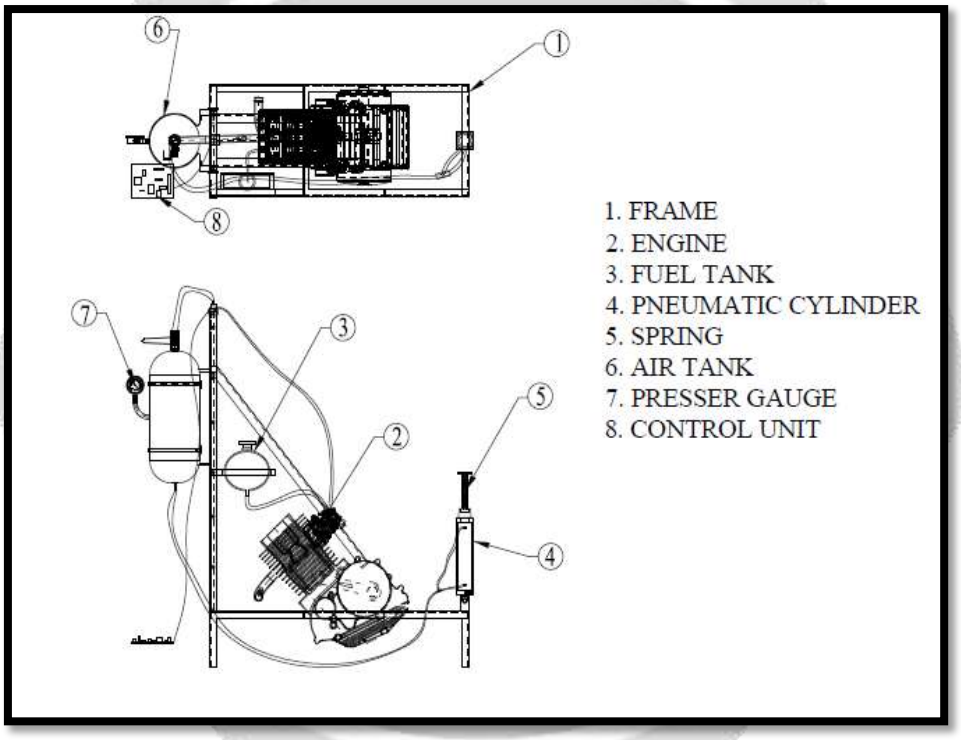

Fig-1: Design drawing

The exhaust valve employed would extract the compressed air every time the compressed air is formed. A spring arrangement is fixed on the cylinder for the smooth retraction of the piston after each shock. The cylinder arrangement is attached on the wheel axle. The pressurized air from the cylinder is stored inside the tank. The air is forced into the air tank and this forced air does not return to the suspension since it is controlled by the non-return valve. The non-return valve makes the passage for the air through it in only one direction and blocks it from the other direction. Then the air is sent to the carburetor of the vehicle through the solenoid valve and control unit. Hence the engine will mix up this air with that of the fuel from the fuel tank and the combustion process takes place. Thus supercharging effect can be attained. Thus an efficient engine can be fabricated compared to that of the conventional engines

Fig-2: Fabricated setup

6.ADVANTAGES AND DISADVANTAGES

1. Advantages

- Efficiency of the vehicle is improved
- Small modification is done in the vehicle
- Air production is simple
- Non-conventional free energy is utilized
- Less pollution
- Less cost compared to other superchargers

2. Disadvantages

- Additional cost is required
- Additional space is required to install this arrangement in vehicles.
- Leakage problems may occur
- For smooth & even road ,less compressed air is produced

7.RESULT

Non-conventional energy system is very essential to the world. Pneumatic energy is readily available and low cost energy. So here we focused on pneumatic type of energy. In our project, compressed air is produced from vehicle suspension. Then this air is stored in an air tank and used for supercharging with the help of valves. Supercharging increase the pressure of the air before letting it get into cylinder of the internal combustion engine. This gives each intake cycle of the engine more oxygen, letting it burn more fuel and do more work, thus increasing power and efficiency. As this project utilises free pneumatic energy, this supercharging method from vehicle suspension can be implemented in light and heavy vehicles using advanced technologies. Hence our project is implementing a pneumatic storage system the compressed air stored can be used for other applications also

8.CONCLUSION

This project work has provided us an excellent opportunity and experience to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries.

We are proud that we have completed the work with the limited time successfully. VEHICLE SUSPENSION SUPERCHARGING SYSTEM is working with satisfactory conditions. We can able to

understand the difficulties in maintaining the tolerances and also the quality. We have done to our ability and skill making maximum use of available facilities.

In conclusion remarks of our project work, we have developed a "VEHICLE SUSPENSION SUPERCHARGING SYSTEM**"** which helps to achieve more efficient engines with simple mechanisms and low cost. This system does not involves complex designs and slight modification is enough. By using more techniques, they can be modified and developed according to the applications.

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