

Review of Low Temperature Air Generation from Vehicle Suspension System

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ABSTRACT : Nowadays we require fuel efficient car which is possible only when load on the system is less. Hence to reduce the load on the system we have to reduce the load on the engine using the kinetic energy generated in suspension system. Current air conditioning systems can reduce the fuel economy of high fuel economy vehicles. With the help of the piston-cylinder arrangement it is possible to convert the compression and expansion in suspension to reciprocating motion which will compress air at high pressure. The pneumatic single acting cylinder is used for this project to compress the air. The output air from the pneumatic cylinder is collected through temperature sensors and this compressed air is stored inside the storage tank. After this research we concluded in car there is a lot of fuel burnt only for working of A.C. while driving the car. By using this compressed air we can run the air conditioning system in the car and save the fuel.

KEYWORDS—Suspension, Air-conditioning, Compressed air, fuel efficient system

1. INTRODUCTION

Pneumatic systems are “fluid power control” which convert, transmit, distribute or control power through pressurized liquid or gas. Gas is compressed above atmospheric pressure to impart the energy to the molecules of the gas. Mostly working fluid is air due to its abundance and extremely low cost (almost negligible). Design is simple as minimum hardware is used and compact as well as durable which makes the system suitable for various applications like robotics, aerospace, CNC machine, food products, bomb development unit, fabrication process of plastic. Three main parts of air conditioning system are compressor, condenser and evaporator. The cooling system has to keep the engine safe from overheating and also to keep the engine at constant temperature. The principle according to which the air conditioning system works is that first the compressed air passes through heat exchanger and to the air conditioning system. The single acting cylinder is connected to suspension system and compressed air is stored in storage tank which then passes through the heat exchanger and then the car air conditioning system is run. This allows considerable reduction in dependence on exhaust system to increase the efficiency of car. Our project mainly focuses on increasing efficiency of car by using available improvement that can be made within available space and system.

2. PROBLEM STATEMENT

When the suspension system of a vehicle comes into work some kinetic energy is generated. This kinetic energy is normally wasted as there is no system which can make use of this energy. In this project we try to convert this kinetic energy into compressed air and further try to work air conditioning system of car on this air.

3. FINDINGS

In this system we will use sensors and pressure gauge which will be an effective way to decide accuracy and effectiveness of the system. The results will be based on the readings of the system and if the system fails to give expected results it can be modified by changing length of spring and capacity of other components.

4. LITERATURE REVIEW

“Regenerative Suspension System”, Abhijit Lendhe, Nikhil Mangvade, Prasad Naik, Pratik Jadhav, International Journal of Recent Research in Interdisciplinary Sciences (IJRRIS) Vol. 2, Issue 2, pp:(30-33), Month: April 2015 - June 2015. The aim of this paper is to save the waste energy which can be compressed by

using single acting cylinder by proper arrangement and the compressed air production using vehicle suspension is given to the air conditioning system. This paper has explained the different components and their working to obtain regenerative suspension system which can save fuel. The design of the system was critical part. The paper has paid little attention to energy loss of vehicle suspension. However energy dissipated by the shock absorber of vehicle suspension is considered only 10-20% the fuel energy is used for vehicle mobility. [1]

“The Regenerative Energy Suspension System”, Gaurang Tiwari, Dr. R.K. Saxena, International Journal of Scientific & Engineering Research, Volume 6, Issue 4, April-2015 1249. The paper revolves around the energy dissipated by the vehicle suspensions and factors affecting the energy harvested from vehicle suspension. The main idea proposed in this paper is that system depends on recovering this dissipated power by suspension and converts it into regulated power using the applications of power electronics and then uses it in battery charging or feeding some vehicle electric loads directly. The operating principle is derived from the Lenz law that states the change in flux in a coil produces an EMF. The paper has also discussed assembly of the suspension system. The challenges for this system are deterioration of magnetic strength, complexity in circuit and irregularities in the voltage profile.[2]

“Air Conditioning System Using Vehicle Suspension System”, Borse S.H., Satpute A.G., Mude J.M., Pokale R.S., Prof. Wabale A. D., Prof. Bhane A.B, International Journal of Recent Development in Engineering and Technology, (ISSN 2347-6435(Online) Volume 4, Issue 4, April 2015). The paper mainly discusses that in conventional vehicles there is wastage of energy in vehicle suspension that is kinetic energy. This kinetic energy is result of the movements of the suspension of the vehicle wheels. Also in vehicle the AC is essential parameter for human comfort. But for running AC it can create large load on vehicle, which can cause engine power to distribute and efficiency of vehicle to decrease. The AC effect can be produced by linear motion of suspension system. To overcome the power loss on compressor, the air by using piston-cylinder arrangement, by using this compressed air we can run AC system in the car and save fuel. This paper was very much useful for Indian conditions because of geographical sites. Taking into consideration other manmade sites like road it is well known fact that we have one of the best as well as worst road conditions available. [3]

“Development of Mechanism For Recovery Of Energy Of Suspension System,” Mr. Swapnil Kamthe, Mr. Rahul Kadam, Mr. Aniket Dhore, Mr. Shivkumar Falmari, Prof. Subhash Ghadve, Prof. Mukesh Chaudhari, IJPRET, 2014; Volume 2 (9): 169-178. This paper is divided in two systems. First part is about the Air-conditioning working and second is Electricity generation. The regenerative system can significantly impact fuel economy and hybrid electric vehicles (HEV) and reduce electric vehicle (EV) range. The paper presents an idea about fuel burned for working of A.C. while driving the car and it will lead to inefficiency. The Catia model was helpful to understand the location of the components. The paper also presented the modifications in model to generate electricity by gear-train arrangements. [4]

5. OBJECTIVE

1. To recover the waste energy of suspension system.
2. To save fuel which is, burnt for working of A.C.
3. To run A.C. on waste energy of suspension system.
4. To increase the mileage of vehicle.
5. To use the linear motion of suspension system for electricity generation.

6. VEHICLE SUSPENSION AIR CONDITIONING SYSTEM

The construction of Vehicle suspension Air Conditioning system is very simple & compact. Basically it is assembly of Base frame Wheel, Piston-Cylinder, and Air reservoir. The complete diagram of the compressed air production using vehicle suspension is given below. The pushing power is converted into compressed air energy by proper driving arrangement. The pneumatic single acting Cylinder is used for this project. The spring arrangement is fixed at the outside of the pneumatic cylinder. The spring is used to return the inclined L-angle window in same position by releasing the load. The temperature and pressure of the output air is digitally displayed by the temperature sensors.

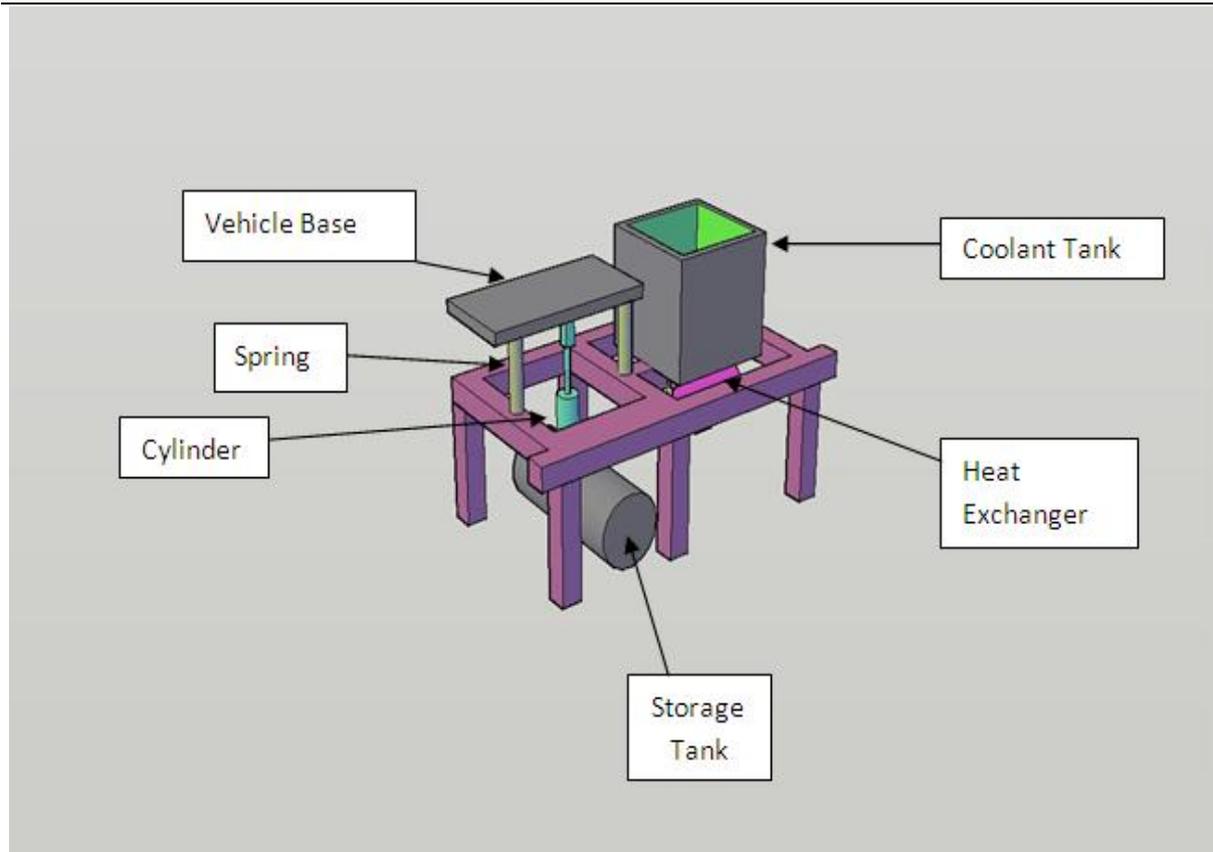


Fig.1 components used in vehicle suspension system

7. COMPONENTS

Table 1: List of the components used

SR. NO.	NAME	QUANTITY
1	SINGLE ACTING CYLINDER	1
2	SPRING	2
3	NON RETURN VALVE	1
4	AIR TANK	1
5	HEAT EXCHANGER	1
6	THERMO-COUPLES	2
7	PRESSURE GAUGE	1
8	NOZZLE	APROX.6

7.1 SPRING

Spring is elastic object used to store mechanical energy .The system will have two helical compression springs. We are using spring to store kinetic energy, which is not used by existing suspension system. We are using steel as material for spring. In this system we are using helical compression system which is generally used to store energy due to resilience and subsequently release it. Force applied by helical compression spring is directly proportional to its length.

7.2 VEHICLE BASE

Base frame is made of fabrication angle. Use of base frame is to provide support and stability to all system components. Piston-supporter and springs are mounted on the base. The valve and motor are located on joints of frame. Another advantage of this frame is that it provides vibration isolation caused by piston-cylinder moment.

7.3 CYLINDER

The cylinder contains barrel, it shut from every end with the cinder bottom and cylinder head where piston is connected to piston rod that moves back and forth. The cylinders are used to compress the fluid. The system will have single acting cylinder which allows feed in only one direction and return stroke provided due the compression spring. The amount of the force produced by cylinder is depends on the air pressure supplied to cylinder and surface area of piston. In this system the function of cylinder is based on movement of wheel which allows piston arrangement to drive back in other direction.

7.4 NON-RETURN VALVE

The basic function of this valve is to allow fluid to flow in only one direction. It is also known as check valve or one way valve. These are two port valve means they have two opening one from which fluid enters and other to leave the fluid. Non return valves works automatically. Mostly NVR are plastic or metallic externally. The important aspect of check valve is it operates on minimum upstream pressure.

7.5 AIR TANK

Air tank is a closed container designed to hold fluids at pressure other than atmospheric pressure. Air receiver is used to provide compressed air to tank. They are dangerous to handle hence regulated time to time. The system will have the cylinder made up of mild steel and it will have two holes which may be used to pass input and output air. The air tank is used for following purposes

1. Equalization of pressure difference from start stop and modulating sequence of the compressor
2. Storage of air volume based on consumption and demand as requirements.
3. Collecting condensed water in the air after the compression
4. Additional storage capacity made to compensate for surges in compressed usage.
5. Extra storage capacity alone outweighs the additional cost of this component.

7.6 HEAT EXCHANGER

Heat exchanger is device which provides the heat transfer from one medium to other. These two fluids are generally separated by the solid boundaries to prevent direct contact between them or mixing between them. They are used in many systems like refrigeration, air conditioning, power plants etc. We are using heat exchanger for maximum efficiency and some advantages mentioned below

1. Recovery of waste heat
2. For condensation
3. Inter Cooler and after cooler

We choose shell and tube type of heat exchanger because of its high rate of transfer, compact size, and use of gases fluid is possible and large range of temperature difference.

7.7 THERMOCOUPLES

Thermocouples are created by two different metals joining at two different points known as junctions. If one end of this junction is connected to known temperature or reference temperature other to whose temperature is to be found, the output will be displayed directly on digital (LED) screen. The system will have two thermocouples. One will be placed before and another will be placed after the heat exchanger. This will provide the temperature difference of fluid and then fluid can supply to air conditioning system.

7.8 PRESSURE GAUGE

The pressure gauge is device which shows the pressure of fluid under pressure. The pressure gauge is used to indicate the pressure on air tank containing the compressed air by single stroke cylinder. This will identify the excess of pressure and avoid accidents.

8. ADVANTAGES AND DISADVANTAGES

8.1 ADVANTAGES

1. Pollution free system.
2. It is cheap and its maintenance is low.
3. External power supply is not required.
4. Immediate results are obtained.

8.2 DISADVANTAGES

1. There might be some leakage problems.
2. Thermal stresses might affect the system.

9. CONCLUDING REMARK

This project has been designed with a vision of saving energy to its maximum level and develops an economical and helpful system. Literature review depicts that Air Conditioning system can be run on kinetic energy generated by suspension system. System uses the linear motion of suspension system for electricity generation. We can recover the waste energy of suspension system by using pneumatic cylinders and display it using temperature sensors and pressure gauge for the safety purposes which were not used earlier.

10. RECOMMENDATION

Following are the suggestions given while working on this system

1. Welding and other operation can cause the leakage.
2. It is possible to generate electricity for small electric components by adding simple gear mechanisms.
3. For better performance it is recommended to use liquid nitrogen as coolant in heat exchanger.
4. We can use screw compressor instead of cylinder and large storage tank for better efficiency.

11. SCOPE:

Conventionally, the vibration energy of vehicle suspension is dissipated as heat by shock absorber, which wastes a considerable number of resources. Regenerative suspensions bring hope for recycling the wasted energy. Systems require further research to develop a better system that will capture more energy. In future, designers and engineers will perfectly design the regenerative suspension systems, so these systems will become more and more common. All vehicles in motion can benefit from these systems by recapturing energy that would have been lost during compression and expansion of suspension.

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