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Air Cooling Effect through Vehicle Suspension System

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Abstract - *The paper presents Air Cooling effect through Vehicle Suspension System are shows the effective use of suspension system of vehicle for air conditioning and other applications. The vehicle suspension generates mechanical energy which having two types potential energy and kinetic energy. From this potential energy is stored by shock absorber and kinetic energy is generally wasted. This kinetic energy is used for various purpose. From that in this paper compressed air is produced by using pneumatic cylinder with swing type check valve arrangement. This output compressed air from pneumatic cylinder is used for air cooling effect in the cabinet of the automobile vehicle. Also, increase the mileage of vehicle and reduce the NOx nearly about 80% and CO by 70%.*

Key Words: Suspension System, Pneumatic Cylinder, Compressor Air, Swing type Check Valve, Air cooling effect.

1. INTRODUCTION

The air conditioning is that branch of engineering science which deals with the study of conditioning of air i.e. supplying and maintaining desirable internal atmospheric conditioning for human comfort, irrespective of external conditions. This topic in its broad sense, also deals with the conditioning of air for automobile purpose. The vehicle runs on the various road conditions. The frame of the vehicle and body is mounted on front axle and rear axle with shock absorbers and springs. The road shocks transmitted to the frame of vehicle creates discomfort to the travelers of the automobile vehicle. In under bad road conditions the traveler's experiences bounce and roll at the cornering and pitching of automobile vehicle. For obtaining human comfort and improve internal atmosphere in the cabinet with freshness of air and air conditioning effect in the automobile vehicle. In India, the road conditions are bad in village and city also. So, the air cooling effect by using suspension system has work efficiently.

1.1 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. So, for proper and effective utilization of ac system not to affect the fuel economy of vehicles and they're by reducing the hazardous emissions of air conditioning system we introduce air conditioning through vehicle suspension system.

We must achieve following conditions in vehicle cabinet: -

- Requirement of Air temperature should be 18-22degree Celsius in the cabinet of any automobile vehicle.
- Requirement of Air pressure in cabinet should be 1 to 1.5 bar.

1.2 LITERATURE REVIEW

Gaurang Tiwari, Dr. R.K. Saxena (April-2015) they have identified 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. [1]

Borse S.H. et al (April-2015) they have studied that 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. [2]

Abhijit Lendhe et al (June 2015) have studied to save the waste energy which can be compressed 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 there 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. [3]

Ninad A. Malpure, Sanket Bhansali (Nov-2015) they have studied generally compressed air is produced using different types of air compressors, which consumes lot of electric energy and is noisy. In this paper, an innovative idea is put forth for production of compressed air using movement of vehicle suspension which normal is wasted. The conversion of the force energy into the compressed air is carried out by the mechanism which consists of the vehicle suspension system, hydraulic cylinder, Non-return valve, air compressor and air receiver. We are collecting air in the cylinder and store this energy into the tank by simply driving the vehicle. This method is non-conventional as no fuel input is required and is least polluting. Consequently, the main objective module was to develop a mechanism for compressed air production using vehicle suspension. The module was concluded successfully and the result was a suitable design satisfying the earlier demands. [4]

1.2 OBJECTIVES

1. To show proper utilization of suspension system into compressed air, which is use in various purpose.
2. To obtain 18 to 22-degree Celsius temperature in the cabinet for the human comfort.
3. To save fuel this is burn for working of Air conditioning system.
4. To reduce the emission of hazardous gases like Nitrogen oxide, carbon monoxide, Hydro carbon.
5. To improve mileage of vehicle.

1.3 SCOPE

Generally, all the four wheelers are equipped with air conditioning system. The air conditioning system uses refrigerant which produces toxic gases such as Nitrogen Oxide which affects the engine performance and also causes ozone depletion. So, we have done further modifications by using water as a coolant and suspension system to produce compressed air. Water is recyclable, easy availability, free of cost and does not produce any harm to the environment. This system is applicable for all the four wheelers as suspension system works while turning, waviness of road, while applying brakes, speed breakers, on terrain roads etc.

1.4 METHODOLOGY

In this system, we will use suspension system, heat exchanger, pressure gauge and thermometer which will be an effective way to evaluate the effectiveness and air cooling effect. In this paper, we have to compare the effectiveness and air cooling effect in two seasons i.e. winter and summer by using parallel flow heat exchanger. The results will be based on the readings of the system and even if the system fails to give expected results it can be modified by changing the dimensions of heat exchanger and spring which is to be use for suspension.

2. CONSTRUCTION AND WORKING

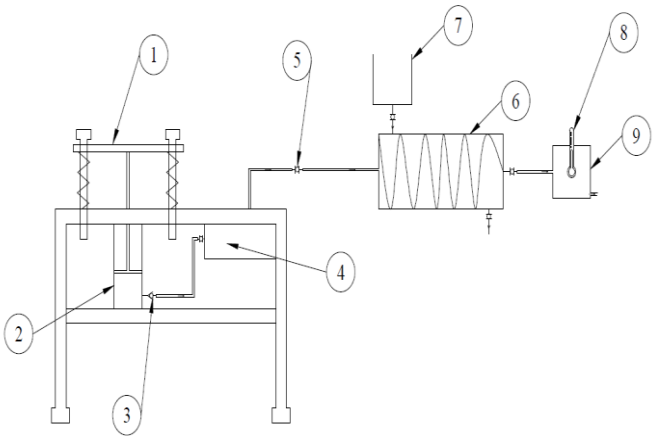

Fig-1: Working diagram of air cooling system

2.1 CONSTRUCTION

The project consisting of following components:

1. Vehicle base & Spring
2. Pneumatic cylinder
3. Swing check valve (NRV)
4. Air storage tank
5. Ball valve
6. Heat exchanger
7. Water tank
8. Thermometer
9. Temperature measuring box.

1. **Vehicle Base Frame and Spring:** Base frame is supporting angles, where the cylinder& valve is located. Then piston supporter is mounted and springs are mounted on the base. 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.

Technical specification of spring:

Parameters	Dimension
Material	EN42, Grade-2
Internal diameter	20 mm
Outer diameter	24mm
Pitch	6.5mm
Solid length	60 mm
Free length	175 mm
Wire diameter	2 mm

Table-1: Technical specification of spring

Fig-2: Base frame & spring

2. **Pneumatic cylinder:** piston and cylinder is used to convert the atmospheric air into the compressed air to perform different appications by using it.the consist of single acting cylinder.

Fig -3 : Pneumatic cylinder

Technical specification of Pneumatic cylinder:

Parameters	Dimension
Model	DGS
Bore size	25 mm
Stroke length	160mm
Cushioning	Adjustable cushioning on both ends
Barrel	Aluminium
Piston rod material	EN8 with hard chrome plated
Piston & end cover material	Aluminium
Piston rod diameter	10 mm
Seals	Polyurethene

Table-2 : Technical specification of pnematic cylinder

3. Swing type check valve (NRV) : The swing type check valve is used for supply the air from cylinder to the air tank for the storage purpose. It allows the fluid flow in only one direction. The main advantage of swing type check valve is it operates on minimum upstream pressure.

Fig -4: Swing type check valve

4. Air Storage Tank with Pressure Gauge: Air Tank is store pressurize compressed air & supply this pressurize air for various use when required. The tank is made up of Galvanized iron it will have two ports for inlet and outlet. And also, one port for pressure gauge. Pressure Gauge is an indicating device which is connected to the storage tank to indicate the pressure.

Fig -5: Pressure gauge

5. Ball Valve: A ball valve is a form of quarter-turn valve which uses a hollow, perforated and pivoting ball to control flow through it. It is open when the ball's hole is in line with the flow and closed when it is pivoted 90-degrees by the valve handle.

6. Heat exchanger: The heat exchanger is used for exchanging heat from one medium to another working medium. It will have copper coil which is used for flow the compressed air which is to be cooled by exchanging the heat from water.

7. Water tank: In this paper the water tank is used to storage of water which is work as a coolant for the purpose of cooling of air.

8. Thermometer: A thermometer is a device that measures temperature or a temperature gradient. A thermometer has two important elements: one is a temperature sensor (mercury bulb) and second is the visible scale that is marked on a mercury-in-glass thermometer.

9. Temperature measuring box: The insulated thermocol box which is used for measured the temperature by using the thermometer. The box is fitted after the heat exchanger to the system.

2.2 WORKING:

The vehicle frame is bounce per suspension of vehicle. In figure the frame is push manually by hand. The suspension mechanism is connected to the piston rod end and move the piston inside the cylinder mounted on the base frame and this movement of piston causes the suction of air from the atmospheric air when piston moves from Bottom dead centre to Top dead centre and compresses the air when piston moves from Top dead centre to Bottom dead centre. The outlet port of cylinder is connected the T connector, this connector two port is connecting the non-return valve one valve is open to atmosphere and another is connecting the hoses pipe and supply the compressed air in air receiver. All pressurized air come in tank from cylinder through the pipe connection. The air tank having two ports one is for pressurized air coming from cylinder and other one is supplied the compressed air as per requirement. The ball valve is fitted to the inlet and outlet of the air tank to control the flow of the pressurized air. And pressure gauge is fitted at other side to show the pressure of the compressed air stored into the air tank. This ball valve is connected to hoses and air is supplied to Heat Exchanger. The heat exchanger is used for exchanging heat from one medium to another working medium. The heat exchanger used is tube and tube type. The air is supplied inside tube and cooling liquid (water) is supplied outside of tube for producing cooling effect. This cooling liquid is store in air tank which is shown in figure. And supply the cooling liquid in inlet port of heat exchanger which is located at the top side of the heat exchanger. Then used water is drain from outlet port which is located at the bottom side of the heat exchanger.

Fig-6: Air cooling system through vehicle suspension

3. CALCULATION

In winter season,
The readings are obtained by thermometer,
T (air) in=15°C
T (air) out=11°C
T (water) in= 7°C

T (water) out= 9℃
Effectiveness (∈) = (Th1-Th2)/ (Th1-Tc1
= (15-11)/ (15-7) = 0.5.

Effectiveness (∈) = 0.5.
In summer season,
The readings are obtained by thermometer,
T (air) in=32℃
T (air) out=25℃
T (water) in= 10℃
T (water) out= 14℃
Effectiveness (∈) = (Th1-Th2)/ (Th1-Tc1)
= (32-25)/ (32-10) = 0.32

Effectiveness (∈) = 0.32.

3. RESULT

Winter	Summer
Th1= 15℃	Th1= 32℃
Th2=11℃	Th2=25℃
Tc1= 7℃	Tc1= 10℃
Tc2= 9 ℃	Tc2=14℃
∈= 0.5	∈= 0.32

Table-2: Winter and summer results

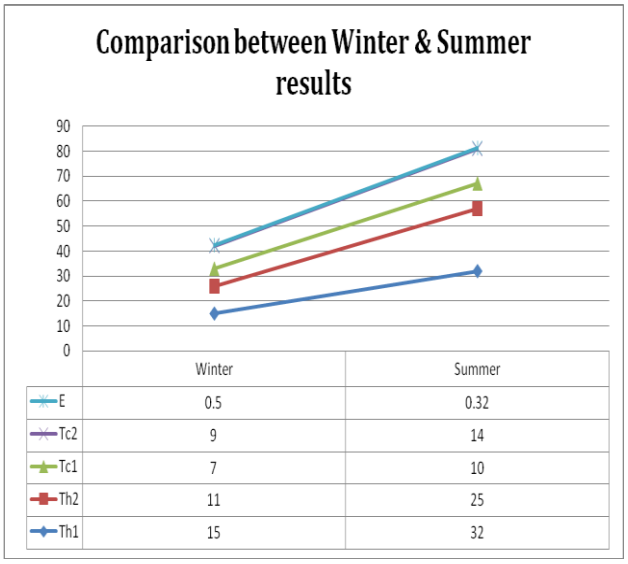

Chart -1 : Comparison between Winter and Summer result

5. CONCLUSIONS

From results and chart, we can have concluded that the Effectiveness of heat exchanger and Air cooling effect is more in winter season as compare summer season. And medium in rainy season. This project "AIR COOLING EFFECT THROUGH VEHICLE SUSPENSION SYSTEM" is designed with the hope that it is very much economical and help full to all vehicles to produce the compressed air. This project helped us to know the step by step completion of a project work. It has been a great experience while completing our project we come across the lot of problems and practical issues. And after solving the all complications we got practical knowledge as well as experience. We had an opportunity to learn how project are been done. We received a lot of practical experience while working on this project as well as got enough freedom to our ideas for the improvement in our assigned project and check whether ideas are fruitful. Therefore, the design must be as perfect as possible and special attention is given during each manufacturing activity.

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