



Suspension Operated Air Conditioning System for Vehicle

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Abstract :

The paper describes the Air Cooling Effect through Vehicle Suspension System and demonstrates the efficient use of the vehicle suspension system for applications such as air conditioning. Mechanical energy, which is divided into two types: potential energy and kinetic energy, is produced by the suspension of the vehicle. Shock absorbers store potential energy from this, whereas kinetic energy is typically lost. There are numerous uses for this kinetic energy. As a result, pneumatic cylinders with swing-type check valve arrangements are used in this research to produce compressed air. The pneumatic cylinder's output compressed air is employed to create an air-cooling effect in the vehicle's cabinet. Increase the vehicle's mileage while cutting CO by 70% and NOx by nearly 80%. Nowadays, we have required fuel-efficient cars. But the engine of the car is not run efficiently when the load on the engine is high. For this purpose, we have to reduce the load on the engine that is to run the AC and Compressor. To reduce the fuel economy of the vehicle, we used suspension system for producing the compressed air to run the air-conditioning system of the vehicle instead of taking power from the engine. And also in previous days, there is wastage of energy in the suspension system that is the linear motion of suspension system, which is also used to compress the air by using piston-cylinder arrangement. By using this compressed air, we can produce AC effect in the car and improve fuel economy. After this research, we find, in a car, there is a lot of fuel burn only for the working of AC, while driving the car. If AC effect will produce by using suspension system, then there is a lot of fuel save in car hence the efficiency of will also increases.

Keywords: Air Conditioning System, Pneumatic System, Suspension Ssystem

Introduction :

Compressed air is a gas, or a combination of gases, that has been put under greater pressure than the air in the general environment. Current applications using compressed air are numerous and diverse including jackhammers, tire pumps, air rifles, and aerosol cheese. According to proponents, compressed air also has a great deal of potential as a clean, inexpensive, and infinitely renewable energy source. Its use is currently being explored as an alternative to fossil fuels. Pneumatic energy is the readily available and low cost energy. Non-conventional energy system is very essential at this time to the world.

So in this project compressed air was produced with the help of vehicle suspension. Then this compressed air is used to operate the vehicle. Compressed air production using vehicle suspension does not require any input power to produce compressed air.

In automobile the suspension system is essential to absorb shocks, vibration and bumps etc. Vehicle is run on different type road conditions such as even, uneven, rough etc. The automobile frame and body are mounted on front and rear axle through springs and shock absorbers. This is essential to damp out road shocks transmitted to the frame by the wheels when they roll over uneven road. This creates discomfort to the passengers and produces stresses in the frame and other parts of the automobile. The passenger experiences the jolts by the forward movement of the vehicle and jerks due to uneven road conditions.

Even under good road condition the passenger are also subjected to bounce and roll when cornering and pitch when the front wheels are suddenly lifted or dropped in relation to rear wheels that means suspension system work continuously.

Due to varying conditions of heating, ventilating, cooling and dehumidification in the atmosphere at various places, the air conditioning of automobiles is very essential. To maintain human comfort and improve internal atmosphere in an enclosed space, proper control of freshness, temperature, humidity and cleanliness of the air is required. So, in this project we are using renewable energy of suspension system to produce air conditioning effect in automobile.

The VCR (Vapour Compression Refrigeration) and VAS (Vapour Absorption) cycle is use to air conditioning system. This is very expensive than another. Different types of method we are use in vehicle.

In our project, we introduce a new concept of air conditioning. In this type of AC system, no any type of engine power is used. It only works on the vehicle suspension.

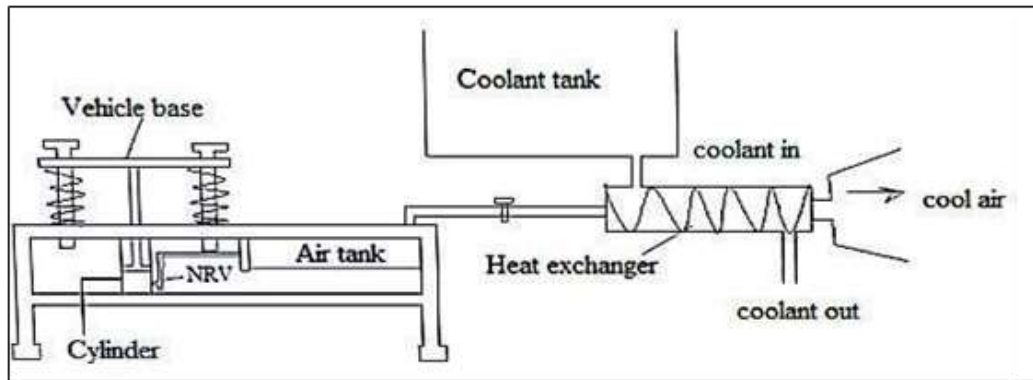


Fig.1 Working principle diagram

Shock absorber consist of two parts first is spring and second is damper, where spring is a elastic member or device which store mechanical energy is to made by spring steel when a spring stretched or compressed it exerts a apposing force. There are different types of spring used in automobile discussed below mostly springs are obeying hooks law. Mainly, shock absorbers are also known as oil pumps, a piston is installed at the end of piston rod and it runs hydraulically.

When a vehicle travels on rough terrain, it moves or rolls up and down as a result of the jerks or dampness in the road. As a result, hydraulic fluid is forced through orifices in the piston, which only allow a small amount of fluid to enter. As a result, the piston becomes restricted, which in turn slows the movement of the springs and suspension. Main component of shock absorbers is:

- Piston rod
 - Main bearing
 - Piston rings
 - Pressure chamber
 - Outer body
1. Piston and piston rod is most necessary part of whole mechanical device mainly made up of high tensile steel has long life. piston rod attached one end of piston rod.
 2. The function of main bearing is providing lubrication to whole shock absorber.
 3. Main function of rings is seal the lubrication oil or maintain pressure. mainly two types of piston rings are pressure ring and lubrication ring. pressure ring maintain pressure and other ring restricts lubrication oil.
 4. It is made by hard alloy steel and can with stand up to internal pressure about 1000 bar.
 5. Outer body covers whole components and protect them from dust and foreign material like dust particles.

Therefore, so called regenerative suspensions arise as the times require.

Literature Survey:

Abhijit Lendhe et.al (April 2015), This paper included that the function of vehicle suspension system is to support the weight of the vehicle body, to isolate the vehicle chassis form road disturbances, to enable the wheels to hold the road surface. Two main elements in suspension systems are spring and damper. The damper is designed to dissipate vibration energy into the heat to attenuate the vibration which is transmitted from road excitation.

The conventional vehicle suspension dissipates the mechanical energy i.e. potential and kinetic energy. In spring potential energy is stored and kinetic energy is wasted. The aim of paper is this wasted energy is compressed by using single acting cylinder by proper arrangement. The main aim of this paper is the compressed air production using vehicle suspension is given to the air conditioning system. The pushing power is converted into compressed air energy by proper arrangement.

Rajesh Kumar Sahu et.al (April 2016), we know that pneumatic energy is the readily available and low cost energy. Now-a-days Non-conventional energy system is very essential to the world. So here we are focusing on pneumatic type of energy for this project. 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. So in this paper we are making one type of device that is used for producing compressed air for different purposes by using vehicle suspension. The compressed air may be used for running the vehicle and for air conditioning purposes. Current applications using compressed air are numerous and

diverse, including jack hammers, tire pumps, air rifles, and aerosol cheese. According to proponents, compressed air also has a great deal of potential as a clean,.

Tajane Sunil Triambak et.al (2016) have concluded that current air conditioning system can reduce the fuel economy of vehicle by about 50 percentages and reduce fuel economy of today mid-size Vehicle by more than 20 percentages. This idea comes out as efficiency of vehicle decreases because of compressor. The main concept is that the air conditioning effect will get on the basis of suspension system in vehicle. In this paper introduce a new concept of air conditioning. In this type of AC system, no any type of engine power is used. It only works on the vehicle suspension. This project is made with pre planning that it provides flexibility in operation. This innovation has made the more desirable and economical. This project using vehicle suspension ac system is designed with the hope that it is very much economical and helps full to all vehicles to produce the compressed air. In this way we increase the efficiency of vehicle and also reduce the global warming and harmful gases which can affect for the human, animal and plant. The VCS and VAS cycle is use to air conditioning system. This is very expensive than another. Different types of method we are use in vehicle. In our project we introduce a new concept of air conditioning. In this type of AC system, no any type of engine power is used. It only works on the vehicle suspension.

Christian Graf et. al (Sept 2010) resulted that while the damping of a common cabin of a commercial vehicle is realized with hydraulic based dampers integrated into the air springs of the suspension, the damping forces of the force-controlled air spring are generated by varying the mass of air inside the air spring volume. To achieve a high Bandwidth of vibration suppression, the mass flow of compressed air is controlled using fast switching valves. These are relatively cheap, airtight in the off-state and obtain a switching time of less than 3ms. To design the force controller, an averaged model of the valve is derived first and then integrated in the nonlinear behavior of an air spring. This comprehensive model is linearized afterwards by compensating the nonlinearities using their inverse functions. The force controller is designed based on the linearized air spring model. Using a force-controlled air spring in the suspension of a cabin, a superimposed vibration control can be designed, which reduces the cabin accelerations by applying optimal damping forces. By test on a hydraulic test bench, the meaningful capability of the vibration isolation is proofed by measurements.

Manpreet Singh et.al (April 2017) have known that the shock absorber is an essential part of suspension system in vehicles. There are different types of springs used in shock absorbers such as helical, leaf, coil, etc. Shock absorbers used in auto mobiles, industries in machines, robots, etc. A spring in shock absorbers absorbs or store energy so that it called mechanical devices.

METHODOLOGY:

Using the suspension system, heat exchanger, pressure gauge, and thermometer in this system will be a useful approach to assess the efficiency and impact of air cooling. In this project, we will use a parallel flow heat exchanger to assess the efficiency and air cooling impact in the winter and summer. The outcomes will be dependent on the system readings, and even if the system doesn't produce the desired results, it may still be modified by altering the heat exchanger and suspension spring's dimensions.

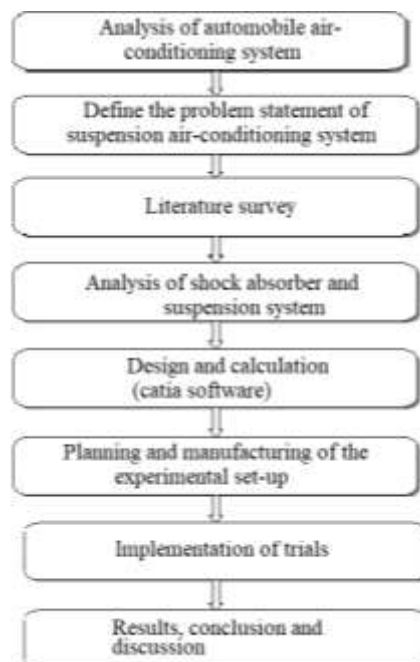


Figure 2 Block Diagram of Methodology

The project aims to construct and manufacture an entirely unique Air Conditioning System that fuses both form and function into a cost-effective and convenient solution. The methodology of the project is as follows:

- Make a model diagram as per dimensions in CAD software.
- At first the frame of the setup is build which is also called as the body of the setup which consists of all the major components of the model.
- Make Heat Exchanger and Air Tank and setup on the frame.
- Select a pneumatic cylinder used as shock absorber and to generate air and it compressed in the air tank.
- Select a non-return valve and connected in between pneumatic cylinder and an air tank.
- Select a flow control valve and is connected after air tank at outlet side of tank.
- Air output from tank is connected to heat exchanger.
- Parallel/Counter flow type HE are used here air to water heat is exchange.
- At one side of HE water is flow from water tank and extract heat from air and again collect it in water tank. Water is circulating continuously in close loop system through HE.
- Cool air from HE is supply to vehicle cabin for cooling.

WORKING PRINCIPLE:



Fig.3 Working principle model

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.

SYSTEM DEVELOPMENT:

Design is the creation of a plan or convection for the construction of an object or a system. System working is as follow-

Experimental Work

The complete diagram of vehicle suspension AC system is shown in fig. When vehicle is run on bumpy road or uneven road then suspension spring move continuously up and down. The pneumatic cylinder is installed below this spring arrangement. This pushing power is supplied to pneumatic piston and cylinder arrangement which compresses the air. This compressed air is supplied to air tank through non- return valve. By the placement of non-return valve stops the back flow of pressurized air into cylinder again. That high pressurized compressed air is stored in air tank. When we want to turn on A.C. system the pressurized compressed air is supplied to parallel flow heat exchanger through nylon pipe by using knob.

Storage tank is mounted at the top of the heat exchanger. In storage tank the nitrogen gas is used as refrigerant. This cold nitrogen gas refrigerant is supplied to heat exchanger. Low temperature coolant passes through the heat exchanger & also high pressurized air pass through it. Here heat exchange occurs and air temperature becomes 15° C to 30° C which is further send at the required place which is to be cooled.

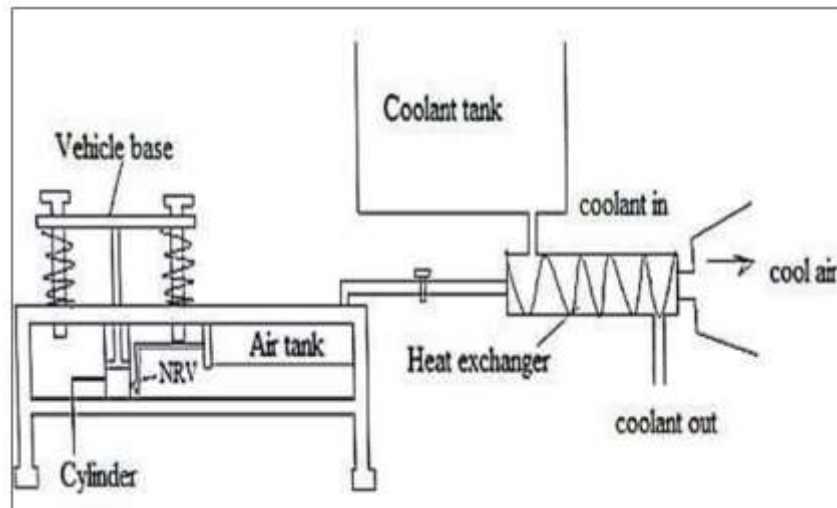


Figure 4 Experimental Setup

When vehicle is run on the rough or bumpy road surface then suspension spring continuously move up and down. We attach piston to the vehicle frame because of linear motion of piston, high pressure air comes out from cylinder. This high pressure air provides to air tank. In air tank high pressurized air is stored and when we want to turn on

A.C. system this high pressurized air send to the heat exchanger by using knob. Low temperature coolant i.e. water (3.24°c) pass through the heat exchanger and also high temperature air pass through the heat exchanger by using knob (pipe). Here heat exchange occurs and air temperature becomes 15 °c-30 °c which is further send at the required place which is to be cooled.

In these system actuator placed along with suspension system of a vehicle. When vehicle run over a road because of uneven road surface vehicle suspension accordingly suspension of vehicle move in up and down manner. As actuator is placed along with suspension actuator gets actuating force.

In this way we get compressed air and then this air is passed to the pressure vessel for storage. The Compressed air from pressure vessel now passes to the system through port. 'T' connectors distribute compressed air to different ports. It has also provision for bypassing an excess air to the atmosphere.

A Non-return valve is used for allowing compressed air only in one direction. The high temperature and high pressurized air is passing to the condenser where temperature and pressure of air reduces, then cool air is to the cabinet of the vehicle. We can use water as a coolant in a condenser. Supply of coolants can be done either by pump or by natural convection.

The condenser is used in shell and tube type. The air is supplied inside tube and coolant is supplied in outside of tube for the purpose to produce cooling effect.

This cooling liquid is store in air tank and supply the cooling liquid in inlet port of condenser. Then hot water is drain to condenser from outlet port and the cool of air also cooling effect is produced. This cooling air is passing to vehicle cabin for the purpose of comfort air conditioning.

Main components of system

- Spring
- Piston cylinder arrangement
- Non-return valve
- Air tank

- Heat exchanger
- Pressure gauge
- Digital temperature sensor

Advantages

- This is a non-conventional system.
- No need fuel input.
- Air is available free of cost.
- No external supply is required.
- This system is clean.
- Low cost of maintenance.
- Instead of nitrogen gas we can use water for cooling.
- Air production is simply by running the vehicle.

Disadvantages

- Leakage problems.
- For smooth & even road less compress air produced.
- System may affect by Thermal stresses.
- Initial cost of this arrangement is high.

Applications

- Applicable in all vehicles.
- For cleaning & inflation of tubes.
- Swing machine.
- Compress air can use for pneumatic braking system.
- In stair cases.

Conclusion:

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.

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