AIR-CONDTIONING THROUGH SUSPENSION SYSTEM

#1Sandesh Panmand, #2Derrick Reed, #3Naseem Khan, #4Swetank Dubey.
#5Prof.K.K.Kshirsagar.

1sandeshpanmand@gmail.com

#12345Department of Mechanical Engineering
D Y Patil College of Engineering, Talegaon
Pune, India

ABSTRACT:

In this paper, designing a Suspension operated AC system in automobile cars. This idea comes out as efficiency of vehicle reduces because of compressor. After implementing this idea the efficiency of vehicle will increase by reducing compressor specification. The main concept is that the air conditioning effect will get on the basis of suspension system in vehicle. As a team, we designed the suspension operated AC system. This system runs on the suspension of vehicle and will make the air is compress that store in receiver. We began to the project by first attempting to come up with an original idea to fit the problem. After coming up with an idea, to increase the efficiency of vehicle. We followed the various design process to finalize our project. Vehicle air-conditioning can significantly impact fuel economy and tailpipe emissions of conventional and hybrid electric vehicles (HEV) and reduce electric vehicle (EV) range. For this project the conversion of the force energy in to air. The control mechanism carries the air cylinder (vehicle suspensor), quick exhaust valve, Non-return valve and spring arrangement. We have discussed the various applications and further extension also. The initial cost of this arrangement is high. 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 .The pneumatic single acting cylinder is used for this project to compress the air. The output air from the pneumatic cylinder is collected through quick exhaust valve and non return valve and this compressed air stored inside the storage tank. After this research we concluded in car there is a lot of fuel burn only for working of A.C.

Keywords: Air storage tank, Cooling tank, Foot pump, Heat exchanger, Cylinder, NRV.

I. INTRODUCTION:

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. However, the dissipated heat is from fuel or electrical power. In hybrid vehicle recapture some of the energy usually lost in braking system but the dissipation of vibration energy by shock absorbers in the vehicle suspension remains untapped. In the past, we pay little attention to energy loss of vehicle suspension. However, how much energy dissipated by the shock absorber of vehicle suspension? According to reference, only 10-20% the fuel energy is used for vehicle mobility. The linear motion of suspension system is also use for compress the air by using piston cylinder arrangement. By using this compress air we can run A.C. system in the car and save fuel. “Energy in motion when it is suddenly applied with a sort of obstacle means according to Newton’s law for every action there is an equal and opposite reaction. Utilisation of this reaction is the basic reason behind the selection of this project work. ” In the past around 4000 years from now, people in India and Egypt are known porous pots outside the home during the night period. The evaporation of water in almost cool dry air and radioactive heat to produce ice by keeping water in the transfer between the water and the deep sky that is at a very low temperature (much below the freezing point of ice) caused the formation of ice even though the surrounding air was at a higher temperature than the freezing point of water. There are a few accounts in China about the use of ice around

1000 BC for cooling the beverages. In 4th century A.D., East Indians were producing ice by dissolving salt in water. For specific applications, efficiencies of both living and nonliving beings depend to a great extent on the physical environment. The nature keeps conditions in the physical environment in the dynamic state ranging from one extreme to the other. Temperature, humidity, pressure and air motion are some of the important environment variables that at any location keep changing throughout the year. Adaptation to these many a times unpredictable variations are not possible and thus working efficiently is not feasible either for the living beings or the non-living ones. Thus for any specific purpose, control of the environment is essential. Refrigeration and air conditioning is the subject which deals with the techniques to control the environments of the living and non-living subjects and thus provide them comforts to enable them to perform better and have longer lives.

II. REVIEW OF LITERATURE

4.1AnirudhAddalaet.al.

Examines the performance of a car which takes air as the working medium. Air car is a car currently being developed which is still in the R&D stage all over the world. Review on the availability and the impact of the fossil fuels in the present and future generations led us to design a vehicle which runs by renewable energy sources. The laws of physics dictate that uncontained gases will fill any given space. The easiest way to see this in action is to inflate a balloon. The elastic skin of the balloon holds the air tightly inside, but the moment you use a pin to create a hole in the balloon's surface, the air expands outward with so much energy that the balloon explodes. Compressing a gas into a small space is a way to store energy. When the gas expands again, that energy is released to do work. That's the basic principle behind what makes an air car move. This air car will almost certainly use Compressed Air Motor (CAM)/ Pneumatic wrench. Air car propelled with this engine will have tanks that will probably hold compressed air to about 11.03 bar pressure. Its accelerator operates a valve on its tank that allows air to be released into the hoses and then into the motor, where the pressure of the air's expansion will push against the vanes and turn the rotor. This will produce enough power for speeds of about 15-20 kilometre per hour.

4.2 .A.Kesteet. al.

Describes the working of a vehicle which works on pneumatic power. In this system a double acting pneumatic cylinder is operated as a slider crank mechanism which converts the linear reciprocation of the cylinder piston rod into oscillatory motion of the driver crank about the pinion shaft. Compressed air technology allows engines that are both non-polluting and economical. This paper explores the effective application of pneumatic power. Pneumatic powered vehicle requires very less time for refuelling as compared to battery operated vehicle. This is totally clean, light weight circuit, can work in hazardous environment and requires less maintenance.

4.3 S. S. Verma S.L.I.E.T., Longowalet. Al

Introduce to the latest developments of a compressed-air vehicle along with an introduction to various problems associated with the technology and their solution. While developing of compressed air vehicle, control of compressed air parameters like temperature, energy density, requirement of input power, energy release and emission control have to be mastered for the development of a safe, light and cost effective compressed air vehicle in near future. Compressed air as a source of energy in different uses in general and as a non-polluting fuel in compressed air vehicles has attracted scientists and engineers for centuries. Efforts are being made by many developers and manufacturers to master the compressed air vehicle technology in all respects for its earliest use by the mankind. . Electric-powered cars and bikes already available on the market put a strong competition to compressed air car not only in terms of cost but also their environment friendly role.

4.4 Dr. S. Thipse et.al.

Describes the development of compressed air engine. MDI is one company that holds the international patents for the compressed air engine. Although it seems to be an environmentally-friendly solution, one must consider its well to wheel efficiency. The electricity requirement for compressing air has to be considered while computing overall efficiency. Nevertheless, the compressed air vehicle will contribute to reducing urban air pollution in the long run. The technology of compressed air vehicles is not new. In fact, it has been around for years. Compressed air technology allows for engines that are both non-polluting and economical.

4.5 B. R. Singh et.

Studied about alternative fuel for automobile engines with a special emphasis on compressed air driven engine. A proposal has been put forward for developing automobile running on compressed air engine. In view of the enormous potential of air as working fluid an engine is being designed to run on compressed air. Compressed air motor will be run using compressed air contained in a portable cylinder mounted on the motorbike. If test run is successful then it is going to be best alternate to the fossil fuel driven engine.

States the effective application of pneumatic power. Pneumatic vehicle will replace the battery operated vehicles used in industries. Pneumatic powered vehicle requires very less time for refuelling as compared to battery operated vehicle. On the whole, the technology is just about modifying the engine of any regular IC engine vehicle into an Air

Powered Engine. The Air Powered Engine technology is cheaper in cost and maintenance, can be easily adapted by the masses and it doesn't cause any kind of harm to the environment. Instead, it's wide spread use will help mankind in controlling the serious problem of global warming. At the end we conclude that the compressed air technology can be tested and developed using the Vane Type Novel Air Turbine as there are minimal losses and practically their efficiency varies from 72-97% which is very high when compared to a conventional IC engine. Future developments can be made by designing an ideal vehicle for this kind of engine.

4.6SaurabhPathak, KonthamSwethaet.al.

States the effective application of pneumatic power. Pneumatic vehicle will replace the battery operated vehicles used in industries. Pneumatic powered vehicle requires very less time for refuelling as compared to battery operated vehicle. On the whole, the technology is just about modifying the engine of any regular IC engine vehicle into an Air Powered Engine. The Air Powered Engine technology is cheaper in cost and maintenance, can be easily adapted by the masses and it doesn't cause any kind of harm to the environment. Instead, it's wide spread use will help mankind in controlling the serious problem of global warming. At the end we conclude that the compressed air technology can be tested and developed using the Vane Type Novel Air Turbine as there are minimal losses and practically their efficiency varies from 72-97% which is very high when compared to a conventional IC engine. Future developments can be made by designing an ideal vehicle for this kind of engine.

4.7 S.S.Vermaet.al

Briefly summarize the principle of technology, latest developments, advantages and problems in using compressed air as a source of energy to run vehicles. Compressed air for vehicle propulsion is already being explored and now air powered vehicles are being developed as a more fuel-efficient means of transportation. Some automobile companies are further exploring compressed air hybrids and compressed fluids to store energy for vehicles which might point the way for the development of a cost effective air powered vehicles design. Unfortunately there are still serious problems to be sorted out before air powered vehicles become a reality for common use but there is a hope that with the development in science & technology well supported by the environmental conscious attitude and need to replace costly transportation methods, air-powered vehicles will definitely see the light of the day.

4.8 D. Ravi et.al.

Analyzed the Climate change and energy security requires a reduction in travel demand, a model shift and technological innovation in the transport sector. Through a series of press releases and demonstrations, a car using energy stored in compressed air produced by a compressor has been suggested as an environmental friendly vehicle of the future. Analysis the thermodynamic efficiency of a compressed-air car powered by a pneumatic engine and considers the merits of compressed air versus chemical storage of potential energy. Even under highly optimistic assumptions the compressed-air car is significantly less efficient than a battery electric vehicle and produces more greenhouse gas emissions than a conventional gas-powered car with a coal intensive power mix. However, a pneumatic-combustion hybrid is technologically feasible, inexpensive and could eventually compete with hybrid electric vehicles. Combined with the other types of alternate fuels in the next few years, it is possible that we could primarily be free of our reliance on the internal combustion engine.

III. EXPERIMENTATION

Vehicle suspension AC system :

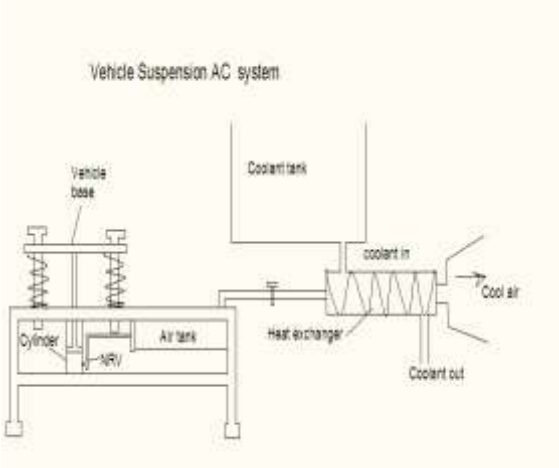

Figure no.1 Vehicle suspension AC system

The construction of Vehicle suspension AC system is very simple & compact. Basically it is assembly of Base frame Wheel, Piston-Cylinder, and Air reservoir. 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 output air from the pneumatic cylinder is collected through quick exhaust valve and non-return valve and Stored inside the air tank.

IV.EQUATIONS:

Wire Diameter

Wahl Factor shear stress factor =

$K_w = \frac{4C-1}{4C-4} + \frac{0615}{C}$

$\tau = \frac{Kw*F*8*C}{\pi d^2}$

- **Mean Coil diameter**

Mean Coil diameter =D = C * d

- **Number of Coils**

Spring Stiffness = K = $\frac{Fmax}{\delta max}$

K = $\frac{Gd}{8C*C*C*n}$

- **Solid length**

Ls = nd

- **Free length**

Lf = Solid Length + Maximum Deflection + Total Clearance

= Ls + δ_{max} + 15 % of δ_{max}

- **Pitch of coil**

Free length = Lf = pn + 2d

Volume of cylinder = Stroke × Area of Piston.

Volume of tank –

V = $\pi/4 \times D^2 \times L$

V. PART NAME AND SPECIFICATIONS

PART NO: 01

PART NAME : <u>AIR TANK CYLINDER</u>

MATERIAL SIZE : Ø150mm X 300mm

MATERIAL : Mild Steel

WEIGHT : 3Kg.

QUANTITY : 1

Sr. Number	OPERATION	MACHINE	TIME
1)	Turning	Lathe	30 Minute
2)	Drilling	Drill	10 Minute

PART NO: 02

PART NAME : <u>BASE FRAME</u>

MATERIAL SIZE : 320mm X 450mm X 500mm

MATERIAL : Mild Steel

WEIGHT : 20Kg.

QUANTITY : 1

Sr. Number	OPERATION	MACHINE	TIME
1)	Cutting material as per required size.	Power hack-Saw	50 Minute
2)	Welding	Welding	120 Minute

PART NO: 03

PART NAME : <u>Heat Exchanger</u>

MATERIAL SIZE : Ø30mm X 17690mm

MATERIAL : Mild Steel

WEIGHT : 3Kg.

QUANTITY : 1

Sr. Number	OPERATION	MACHINE	TIME
1)	Cutting	Power hack-saw	60 Minute
2)	Bending	bending	30 Minute

PART NO: 04

PART NAME : <u>AIR TANK CYLINDER END</u>

MATERIAL SIZE : Ø150mm X 5mm

MATERIAL : Mild Steel

WEIGHT : 2 Kg.

QUANTITY : 2

Sr. Number	OPERATION	MACHINE	TIME
1)	Cutting	Power hack-	60

		saw	Minute
2)	Drill at centre	Drill and tapping	20 Minute

PART NO: 05

NAME : Heat Exchanger END

MATERIAL SIZE : 100mmX100mmX 500mm

MATERIAL : Mild Steel

WEIGHT : 1Kg.

QUANTITY : 2

Sr. Number	OPERATION	MACHINE	TIME
1)	Cutting	Power hack-saw	60 Minute
2)	Drill at centre	Drill and tapping	20 Minute

VI. PARTS AND FUNCTION

6.1. SINGLE ACTING CYLINDER:

Fig No.2. Single acting cylinder

In a single acting cylinder, the compressed is fed only in one direction. Hence this cylinder can produce work in only one direction. The return movement of the piston is effected by a built-in spring or by application of an external force.

When a single-acting cylinder outstrokes, it produces a force. The size of the force produced by the cylinder as it outstrokes depends on two things – the air pressure supplied to the cylinder and the surface area of the piston. This means that if we want a bigger force we can either use a larger piston or increase the air pressure. However, it is not a good idea to increase the air pressure because this can damage components.

Single acting cylinder are pneumatic devices used for unidirectional extension or retraction of a rod or piston through the introduction of a rod or piston through the introduction of varied amount of compressed air into closed air system .single acting cylinders operate using only compressed air ,they offer an economically friendly source of mechanical power that is popular in wide range of industrial, commercial and even domestic application .It contains a cylinder barrel is shut from every end with the cylinder bottom and cylinder head. Where piston is connected to a piston rod that moves back and forth.

A single acting cylinder is an engine where the fluid works one side only .it function basis of weight of other cylinders, or the movement of wheel ,which enables to drive the piston back in other direction.

6.2. Spring:

Spring is elastic object used to store mechanical energy. Springs are usually made out of spring steel. There are large number of spring designs; in everyday usage the term obtain refers to coil springs. Small spring can be wound from prehardened stock, will larger ones are made from annealed steel and hardened after fabrication. When coil spring is compressed or stretched slightly from rest, from the force it exerts is approximately proportional to its change in length. Depending on the design and required operating environment, any material can be used to construct a spring, so long as material has the required combination of rigidity and elasticity.
Most common type of spring is:

1. Cantilever spring
2. Leaf spring.
3. V spring.
4. Coil spring.

6.2.1. Coil spring:

Fig No.3 Coil spring

In our project coil spring is used. The coil spring made by winding a wire around a cylinder and conical spring. A coil spring, also known as helical spring, in mechanical device, which is typically used to store energy due to resilience and subsequently release it. They are made of an elastic material formed into the shape of helix which returns to its natural length when unloaded the quality of is judged from the energy it can absorb. The spring which is capable of absorbing the greatest amount of energy for the given stress is best one.

6.3. Pressure gauge:

Many techniques have been developed for the measurement of pressure and vacuum. Instrument used to measure pressure are called pressure gauges or vacuum gauges. A manometer is an instrument that use a column of liquid to measure pressure, the term is obtains now a day to mean any pressure measuring instrument.

6.4. Condenser

Fig No.4 Condenser

This system involving heat transfer, a condenser is device or unit used to condenser a substance from its gaseous to its liquid state, typically by cooling it. In so doing latent heat is given up by the substance, and will transfer to the condenser coolant. Condenser are typically heat exchanger which have various design and come many sizes ranging from rather small to very large industrial scale units used in plant process. For example, a refrigerator used condenser to get rid of it extracted from the interior of the unit to the outside air. Condenser is used in air conditioning, industrial chemical process such as distillation, steam power plant in and other heat exchange system.

The most popular type of type of condenser

1. Air cooling condenser.
2. Water cooling condenser.
3. Evaporator condenser.

6.5. Heat Exchanger :

Fig No.5 Heat exchanger

A heat exchanger is a piece of equipment built for efficient heat transfer from one medium to another. The media may be separated by a solid wall.

To prevent mixing or they may be in direct contact. They are widely used in space heating, refrigeration, air conditioning, power plant, chemical plant, petrochemical plant, petroleum refiners, natural gas processing, and sewage treatment. The classic example of a heat exchanger is found in an internal combustion engine in which a circulating fluid known as engine coolant flows through or coils and air flows past the coils, which cools the coolant and heats the incoming air.

A heat exchanger is specialized device that assists in the transfer of heat from one fluid to other. In some cases a solid wall may separate the fluids and prevent them from mixing. In most efficient heat exchangers , the surface area of the wall between the fluid is maximized while simultaneously minimizing the fluid flow resistance .heat exchanger is device that is use to transfer thermal energy between two or more fluid, between solid surface a fluid or between solid particulate and a fluid , between different temperature and thermal contact. The other object recover or reject heat ,or sterilize ,pasteurize, fractionate, distil, crystallize or control a process fluid.

The two most common types of heat exchanger are shell and tube and plate /fin heat exchanger. In this prototype we used tube and tube type heat exchanger.

VII. ADVANTAGES AND DISADVANTAGES:

Advantages:

- Air is available free of cost.
- No. external supply is required.
- Low Cost

- No pollution & less Noise system.
- Easy construction & Very compact.
- Low Maintenances.
- Air production is simply running the vehicle
- No need fuel input and electrical power input

Disadvantages:

- Leakage problems;
- Clogging May occurs.
- System may affect by Thermal stresses.
- Due to working burring of material occurs.
- Initial cost of this arrangement is high

VIII. CONCLUSION

In this paper, designing a Suspension operated AC system in automobile cars. This idea comes out as efficiency of vehicle reduces because of compressor. After implementing this idea the efficiency of vehicle will increase by reducing compressor specification. The main concept is that the air conditioning effect will get on the basis of suspension system in vehicle. As a team, we designed the suspension operated AC system. This system runs on the suspension of vehicle and will make the air is compress that store in receiver. We began to the project by first attempting to come up with an original idea to fit the problem. After coming up with an idea, to increase the efficiency of vehicle. We followed the various design process to finalize our project. Vehicle air-conditioning can significantly impact fuel economy and tailpipe emissions of conventional and hybrid electric vehicles (HEV) and reduce electric vehicle (EV) range. In addition current air-conditioning systems can reduce the fuel economy of high fuel-economy vehicles by about 50% and reduce the fuel economy of today is mid-sized vehicles by more than 20% while increasing NOx by nearly 80% and CO by 70%.

REFERENCE

1.“ Fabrication of a Device Used For Producing Compressed Air Using Vehicle Suspension” by “ Rajesh Kumar Sahu, Rajkishor Das, Jitendra Sahu & Akash Satapathy”+

2.“To produce compressed air using single acting cylinder (auto-pneumatic system) by using two wheeler front wheel shock absorber” by “Mr.Dinesh Jadhav, Mr.Kiranpatil, Mr.Shriharisavdatti, Mr.Maruti done”

3.“Compressed Air Production Using Vehicle Suspension” by “ NinadArunMalpure, SanketNandlalBhansali”

4.“Compressed Air Production Using Vehicle Suspension” by “S.Vigneswari, V.Vinodhini”

5. Papson, A.; Creutzig, F.; Schipper, Low Compressed air vehicles: Drive-cycle analysis of vehicle performance, environmental impacts, and economic costs. Transp. Res. Rec. J. Transp. Res. Board 2010, 2191, 67–74.s

6. Atkinson, J., and Postle O., ―The Effect of Vehicle Maintenance on Fuel Economy,‖ in Fuel Economy of the Gasoline Engine edited by Blackmore D. R. and Thomas A., Shell Research Limited, Thornton Research Center, Chester, United Kingdom, 1977.

7. Noritsugu T. ―Energy Saving of a Pneumatic System (2). Energy Regenerative Control of a Pneumatic Drive System. Application to Active Air Suspension‖, Hydraulics& Pneumatics, 1999, 38(4), pp.1-4.

8. Bugli, N., ―Automotive Engine Air Cleaners - Performance Trends,‖ SAE Technical Paper 2001-01-1356,2001, doi:10.4271/2001-01-1356.

9. Zhang Jin-qiu, Peng Zhi-zhao, Zhang Lei, Zhang Yu, ―A Review on Energy-Regenerative Suspension Systems for Vehicles‖ Proceedings of the World Congress on Engineering 2013 Vol III, WCE 2013, July 3 - 5, 2013, London, U.K.

