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COMPRESSED AIR PRODUCTION THROUGH VEHICLE SUSPENSION

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ABSTRACT

Nowadays we need fuel efficient car. Also in previous years there is wastage of energy in suspension system while driving the vehicle. But in this project we compressed that kinetic energy produced while driving in the form of air with the help of the piston-cylinder arrangement and convert it into reciprocating motion.We used pneumatic single acting cylinder for compressing the air. The air coming out from pneumatic cylinder is stored into the storage tank. Non return valve is also used to avoid backflow of compressed air.In car there is a lot of fuel burnt only for working of A.C. while driving the car. By using this compress air we can run AC system in the car and save fuel economy.In our research we have used only non-conventional energy sources and which are least polluting.

Air Conditioning, Compressed Air, Non-conventional Energy, Suspension System

I. INTRODUCTION

In this project "compressed air production using vehicle suspension".We used working fluid as air due to its easy availability therefore our system cost decreased. We used non return valve, heat exchanger,air cylinder and storage tank as less hardware and also used non-conventional energy which is generally wasted through suspension their overall cost of system is less.

Mainly vehicles like car runs on different types of road condition like rough, smooth during this energy generated through suspension is utilised by compressing that air by using piston cylinder arrangement in single acting cylinder. Then this compressed air is passed to the storage tank for storage in between cylinder and storage tank non return valve is used to avoid backflow of that compressed air. Then this compressed air is passes through the heat exchanger for running AC in cars.

Due different conditions of environment like heating, cooling in the atmosphere at different places the air conditioning of automobile is necessary. For maintaining the human comfort within a car freshness and cleanliness of air is important. In this project we are using non-conventional energy to produce air conditioning effect in car.

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II. PROBLEM STATEMENT

While driving the vehicle, due to suspension system in vehicle energy is generated this is normally kinetic energy. This energy is previously wasted but in our project we are converting that kinetic energy into compressed air by using piston-cylinder arrangement in single acting cylinder.

As Air conditioning is an important parameter for human comfort but for running AC we require more fuel therefore load on the engine is get distributed and therefore efficiency of vehicle decreased.

Therefore for solving these problem we are using that compressed air to run AC system in car and save fuel. The following objectives are satisfied due running AC system by using suspension

1 It saves fuel which was burn for running Air conditioning.
2 Run AC on waste output energy from suspension system.
3 To recover the waste energy of suspension system.
4 Mileage of car is increased.

III. CONSTRUCTION

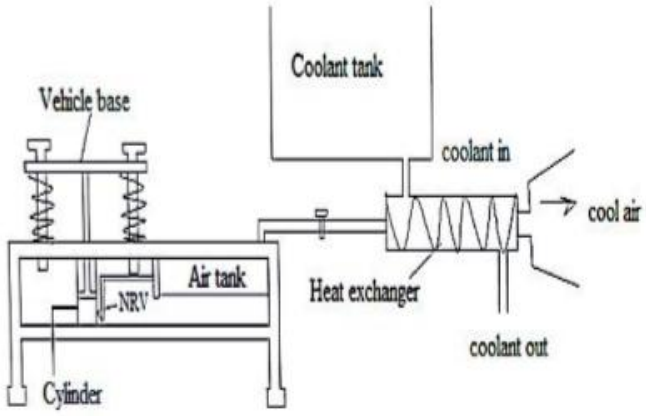

Fig.1 :AC system through vehicle suspension system

IV. ACTUAL WORKING MODEL

fig.2:Actual working model

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V. WORKING

The complete diagram ofcompressed air using vehicle suspension is shown above. The construction of this project is very simple and also it is compact. This working model is a combination of air cylinder, storage tank, non-return valveand frame. In our project springs are used to show the base of vehicle i.e. suspension Springs are used to store mechanical energy. Below the springs there is a pneumatic single acting cylinder which is used for compression of air which is produced due to pushing of springs.This pushing power is supplied to the pneumatic piston-cylinder arrangement to compresses the air. This compressed air is then supplied to the air tank through non-return valve.Non-return valve is placed in between air tank and cylinder to avoid return flow of compressed air to the cylinder. This non-return valve only permits only one directional flow. This compressed air is then stored in a tank. This compressed air is used for many applications while we are using it for AC then we transmitting that air from parallel flow heat exchanger and from the other side we passing water from heat exchanger. While passing this water and compressed air simultaneously there is heat exchange occurs between this two and air gets cool up to 15-20 degree which be used for cooling purpose

VI. EQUIPMENTS REQUIRED

1. SPRINGS

Fig.3:Springs

Springs are used to store mechanical energy. They are made of steel. we are using springs to store kinetic energy produced from suspension. We are using compression springs in our project.

2. PNEUMATIC CYLINDER

Fig.4:Pneumatic cylinder

Due to compression of springs due shocks at rough road, springs transmit energy to the cylinder. In cylinder it converts kinetic energy into the compressed air at high pressure. For compression it uses piston-cylinder arrangement. Then itdelivers this compressed air to the air receiver for storage, which is further utilized for operation of pneumatic system

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3. AIR RECEIVER

Fig.5:Air Receiver

Air tank is used for storing the compressed air.it is a closed container. This tank consists of two holes one for air input and second is for removal or exhaust of air.

Air receiver is provided with various mountings as follows:

1) Water separator:-It removes the water particles from the compressed air.
2) Air inlet pipe:-The compressor delivers high pressure air and allows to enter in the inlet pipe of receiver.
3) Pressure gauge: - It is provide to indicate the pressure of compressed air which is stored.
4) Air outlet pipe: - It is provided with outlet valve to supply compressed air to the pneumatic system.

4. NON-RETURN VALVE

Fig.6:Non-Return valve

Non-return valve is also known as check valve or one way valve. The main function of this valve is to allow only one directional flow. This valve prevents backflow of fluid.it consist of two opening from one fluid enters and exits through another.it transmits fluid from air cylinder to air storage tank.

5. HEAT EXCHANGER

Fig.7:Heat Exchanger

Heat exchangers are used to transmit heat from one fluid to another separated by a solid boundary to avoid mixing of fluid. We are using parallel flow heat exchanger. In this type two fluids are flow in same direction simultaneously, while travelling they exchanges heat.

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DESIGN

Volume of air exhaust from piston and cylinder**: -** Stroke X Area of Piston.

$= 100 \times 4x\ d2 \times L$

$= 196349.54 mm^3$

Volume of tank: - L = 350

D =180

$= \pi/4 \times 180^2 \times 350$

$= 8906.41 \times 10^3\ mm^3$

Time required filling the air tank**: -** Volume of tank / Volume of Piston Exhaust

$= 8906.41 \times 10^3 / 196349.5 = 45.36$

Torque required overcoming friction**: -** F x r

$= 6 \times 10/2$ T= 30N- MM

Design of angles:-

Due to the load of flywheel, machine structure and tortional force, and the angle-link may buckle in two planes at right angle to each other. For buckling in the vertical plane, the links are assumed as fixed at the middles and for buckling in a plane perpendicular to the vertical plane, then this are assumed to be fixed at the both the ends.

Therefore , The maximum load due factors = 20 kg

F= 20kg = 20 x 9.81 = 196 N.

We know that he load on each link, F1 = 196/4 = 49N.

Assuming a factor of safety as 2, the links must be designed for a buckling load of

Wcr = 49 x 2 = 98 N

Let t1= Thickness of the link

b_1= width of the link

So, cross sectional area of the link = A = width X breadth.

Let we assume that width is thrice that of link thickness.

Therefore

$A = t_1 x\ 3\ t_1 = 3\ t_1^2$

And M.I. of the cross section of the link,

$I = 1/12\ t_1 b_1^3$

$= 2.25\ t_1^4$

$I = A \times K^2$

$K^2 = I/A = 2.25 t_1^4 / 3\ t_1^2 = 0.75\ t_1^2$

Since for the buckling of the link in the vertical plane, the ends are considered as hinged, therefore, the equivalent length of the link

L = l = 610 mm.

And Rankin's constant, a = 1/ 7500

Now using the relation,

$$Wcr = \frac{f \times A}{1 + a\,(L / K)^2}$$ with usual notation,

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Here f = 100 N / mm^2

$$98 = \left(\frac{100 \times 3 \times t_1^2}{1 + 1/7500 \quad 610^2/0.75t_1^2} \right)$$

$$98 = \frac{300\, t_1^2}{1 + 66/t_1^2}$$

$$300\, t_1^4 - 98t_1^2 - 64680 = 0$$

$$t_1^2 - 3.26\, t_1^2 - 215.6 = 0$$

$$t_1^2 = \frac{3.26 \pm \sqrt{(3.26)^2 + 4 \times 215.6}}{2}$$

t_1 = 4 mm

$b_1 = 3 \times t_1 = 3 \times 4 = 12$ mm.

But the standard angle available of 25x25x4 hence for safer side we have selected it. Which can bear the impact load. Hence our design is safe.

Design of welded joint:-

Checking the strength of the welded joints for safety purpose.

Transverse fillet welds all edges with all sides,

The maximum load that transverse fillet weld is

P = 0.707 x S x L x ft.

Where, S = weld size, L = length of contact = 35mm(10 mm at the start and end of weld)

The shear load considering the friction is 200 kg = 1962N

Hence, 1962 = 0.707 x 5 x 35 x ft.

Hence we have to find the safe value of ft.

$$\text{Therefore ft} = \frac{1962}{0.707 \times 5 \times 35}$$

ft = 15.85 N/mm^2

hence calculated tensile load is very less than

The permissible value as ft=56 N/mm^2. Hence welded joint is safe.

Design of spring: -

The spring is mounted on frame to make initial position of rack. The outer diameter of spring is restricted which is 22mm.

For avg service life 422N/mm^2.

Wire diameter range is 4.5 to 8 mm

We get wire diameter d = 5 mm from range

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Calculating the load bearing capacity of spring

Spring index = C = D/d = 22/5= 4.4

C = 4.4

K = [4C – 1 / 4C-4] - 0.615 / C

For C =4.4 K= 1.08

We know

Shear stress = $\frac{8K\ P\ D}{3.14\ d^3}$

$P=\frac{422\times3.14\times5^3}{8\times1.08\times22}$

P = 870.74 N

Applied load is limited to 200N

So the design of spring is safe.

As we required deflection of spring in the range of 125 to 150 mm

Spring rate = P/δ = 870.74 / 150 = 5.8 N /mm

K = 5.8 N/mm.

Calculation of number of turn of Spring

We know

$\delta = \frac{8P\ Do^3 N}{G\ d^4}$

$150=\frac{8\times870.74\times22^3\times N}{0.007845\times10^6\times5^4}$

N = 10.68 Turns

N = 11 Turns

Solid length of spring Ls = N x d

= 11 x 5

= 55 mm

Free length of spring = Ls + δmax + 0.015 x δ

= 55 + 150 + 0.15 x 150

Lf = 227.5 mm

Pitch of spring = $\frac{\text{free length}}{N}$

Pitch = 20 mm

SUMMARY OF SPRING

wiredia d = 5 mm

coildia D = 22mm

Solid length = Ls = 55 mm

Free length = Lf = 227.5 mm

Pitch = P = 20 mm

No of turns = 11

Deflection δ = 150 N / mm

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ADVANTAGES

1. Pollution free system as there is use of renewable energy.
2. External power supply is not required.
3. This is a non-conventional system.
4. We are using water as coolant therefore maintenance cost is low.
5. Air is used as fuel input which is easily available.
6. No moving parts
7. No lubricating oil required

DISADVANTAGES

1. Initial cost of the system is high.
2. There may be a leakage problem in the system.

APPLICATION

1. This compressed air is used for Air Conditioning.
2. Compressed air can be used for cleaning the vehicle.
3. It can be used for pneumatic braking system.

VII. CONCLUSION

In this project we are collecting air from the air cylinder and store this energy to air tank as non-conventional method by simply driving the vehicle. Our paper focuses on energy saving mechanism by using vehicle suspension system. This project mostly useful in developing countries like India because in our country there are both types of road conditions best as well as worst. Air is the working substance of our machine. This system gives smooth operation and smooth movement vehicle. This project helped us to know the periodic steps in completing a project work. Thus we have completed the project successfully

VIII. ACKNOLEDGEMENT

First and foremost we would like to thank SavitribaiPhule Pune University and GenbaSopanraoMoze College of Engineering, Balewadi for providing a course where we could learn all about Mechanical Engineering .We also sincerely thank to our Project guide Prof. M.R.Jagadale for his valuable guideline and showing for faith on us and rendering unwavering support.We are thankful to all our teachers and professors of our department for giving us their expertise in the related topic. We take knowledge about many practical applications while doing this project.We had an opportunityto learn how project are been done. We received a lot of practical experience while working.

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