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Pneumatic Vehicle with Air Suspension System

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Abstract – *The fuel prices rises rapidly due to limited resources of fuel. So alternative of fuels are used. Also the efficiency is tried to be optimized for all the machines. Pneumatic engine uses the compressed air to generate power for the vehicle. Here we are improving the efficiency by using air suspension system (ASS) to generate the compressed air. The air suspension system converts the jerks and bumps into pressure energy. By this pressure energy the air is compressed and stored in the pneumatic cylinder. This improves the efficiency of vehicle. By using air suspension system there are two advantages first one is optimized efficiency and second in cushion effect to driver for smooth driving.*

Key Words: **Pneumatic Engine, Air Suspension System, Jerks, Bumps, Cushion Effect**.

1. INTRODUCTION

Air is present in excess amount in our environment. This air is compressed and stored in cylinder at high pressure. This pressure is allowed to flow in pneumatic cylinder which produces reciprocating motion of piston. Reciprocating motion is converted into rotary motion to power the vehicle. As the vehicle runs due to road surface irregularity and road damage, unwanted energies are produced. This energy is absorbed by suspension system in normal vehicles. In this vehicle, air suspension system is used to absorb the energy produced due to jerks and bumps.

2. OBJECTIVES

As the name suggests 'Pneumatic' means it works from air except fuels. Following are the main objectives of this vehicle:

- To minimize the fuel usage
- To increase the pneumatic vehicle efficiency
- To decrease the pollution of environment
- To utilize the bump and jerk energy
- To reduce the running cost

3. VEHICLE WORKING PRINCIPLE

The vehicle as a pneumatic cylinder, air tank, air suspension system, rack and pinion and controller. Air tank contains compressed air at high pressure. This air is allowed to flow in pneumatic cylinder. In the pneumatic cylinder, the air starts to expand and pushes the piston rod. This expansion generates the reciprocating motion of piston rod. Piston rod is attached to rack which gives the reciprocating motion to pinion. Rack and pinion arrangement converts the reciprocating motion into rotary motion. This rotary motion is used to drive the vehicle wheels.

Fig: *Flow chart of vehicle working*

4. SUSPENSION SYSTEM WORKING PRINCIPLE

As the vehicle starts to run, due to road surface and road damage, some unwanted energies are produced and this energy gives uncomforting to driver. Due to suspension system these energies are absorbed and gives smooth driving. When the energy strikes the suspension system rod, piston attached to rod goes inward and starts compressing of air present in cylinder. The compressed air is stored in the cylinder attached for powering the pneumatic engine. The air suspension system gives the cushion effect as well as generate some energy to power the engine. There are more advantages of this system as it takes polluted air from environment and compressed to cylinder by filter. When the air passes from filter, pollutants are absorbed and fresh air is sent to cylinder. When this air exhaust to environment, it remains fresh and pollution free.

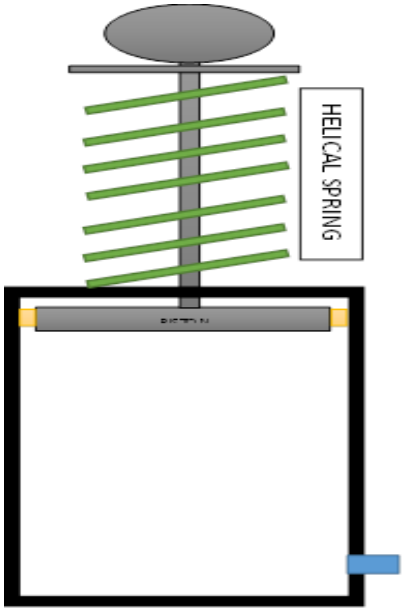

Fig: *Schematic diagram of air suspension system*

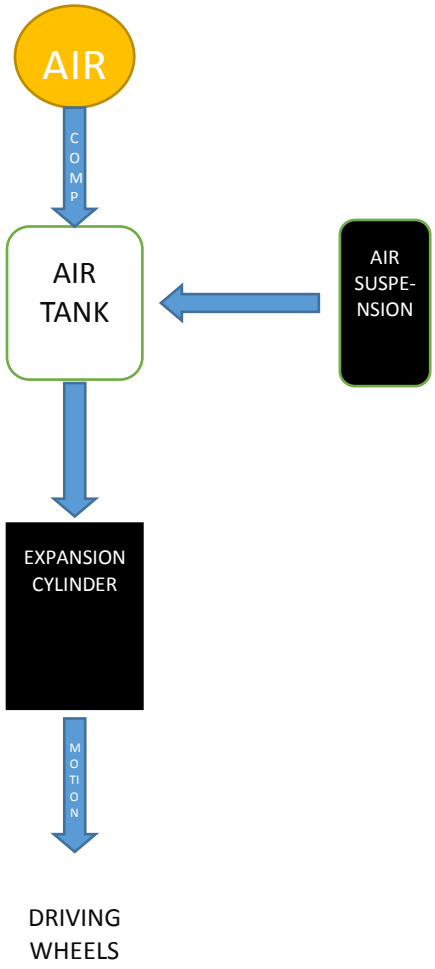

Fig: *Working diagram of pneumatic vehicle with ASS*

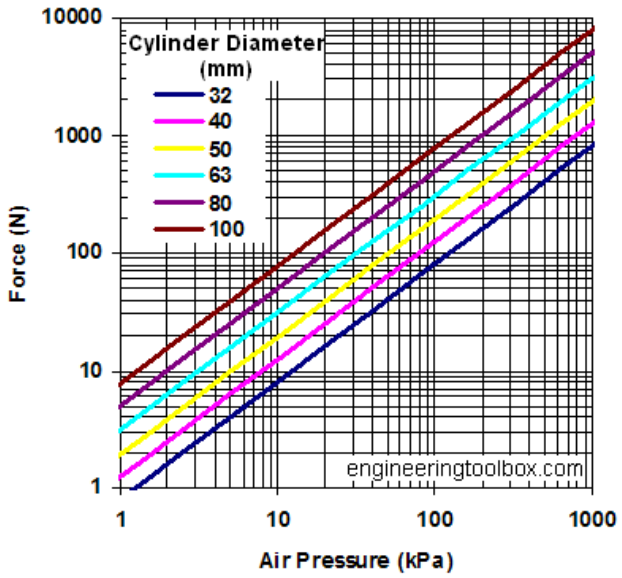

Fig: *Force vs Air pressure chart*

5. CONTROLLER

The compressed air is sent to pneumatic cylinder for power of vehicle. But the flow rate should not be constant. As during after half expansion the flow rate should be zero that means the valve should be closed and no air should pass to pneumatic cylinder. For this purpose an electromagnetic flow rate controller is used to provide the required flow at required time. A small 12 volt battery is used to make the controller. Controller takes a small amount of electric energy so the battery gives a long time backup.

6. OBSERVATION

Pulling force calculation for pneumatic cylinder

$$F = \frac{P \times \pi \times (D_1^2 - D_2^2)}{4}$$

Where,

P = Air pressure at inlet
D1 = Bore Diameter
D2 = Piston Rod Diameter

$$\text{Air Consumption} = \frac{\pi \times (D_1^2 - D_2^2)}{4} \times l \times P \times s$$

Where,

l= stroke length
s= storke/sec

$$\textbf{Power} = F_t \frac{\pi \times d \times N}{60} \text{ (Jule/Sec)}$$

Where,

F_t = Thrust force
d= wheel diameter
N = Revolution per minute

7. CONCLUSION

The air driven vehicle is designed and developed which runs with the help of compressed air as the fuel. Unwanted energies produced during running is also utilized for the energy generation. Thus the efficiency improves. Also the pneumatic vehicle reduces the environmental pollution as polluted air is taken and compressed by filter which removes the pollutants and releases fresh air to atmosphere.

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