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COMPRESSED AIR PRODUCTION USING VEHICLE SUSPENSION AND POWER GENERATION SYSTEM

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***Abstract*—** Pneumatic energy is the readily available and low cost energy. Nonconventional energy system is very essential at this time to our nation. So that the pneumatic type of energy is considered for our project. In this project compressed air can be produced with the help of motion of wheel. Then this compressed air can be used for further applications. Compressed air production using vehicle wheel needs no fuel input power to produce the output of the air.
The control mechanism carries the air cylinder, quick exhaust valve, non-return valve, rack and pinion, foot pump, and dynamo and spring arrangement and spring arrangement. We have discussed the various applications and further extension also. Suspension system during the time of vehicles running, the rack slide up and down; it helps to rotate gear attached the dynamo smoothly. While the dynamo rotation it generates the electric DC power, we can store it in battery. The aim of this project is generation of power and production of compressed air using foot pump and rack and pinion gear setup in vehicle suspension.

Keywords — Pneumatic Cylinder, Compressor, Battery.

I. INTRODUCTION

The suspension systems are used in vehicle to support weight of vehicle body and to isolate the vehicle chassis from road disturbances. The dampers are designed to dissipate vibration energy into heat so as to reduce the vibration transmitted from road excitation. It is feasible to harvest this vibration energy from the vehicle suspension system to improve the efficiency of the vehicle. The suspension system used for the regeneration of vibration energy is called regenerative suspension system. One of the important losses is the energy dissipation from the vibration of suspension system**.**

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II. EXISTING METHOD:

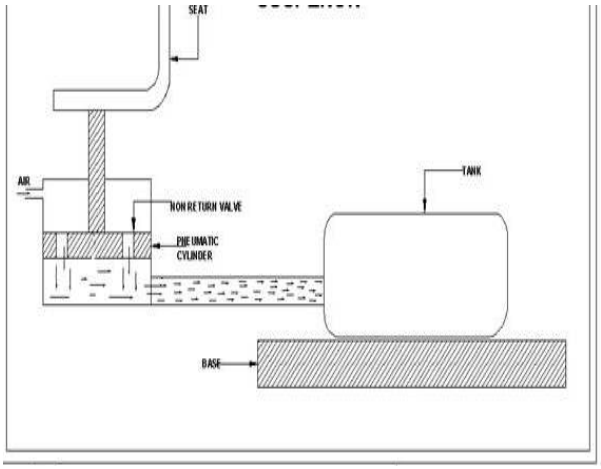


Fig.1 Existing Method Design

In this method air is collected and stored in the compressor tank as non-conventional method.
Compressed air production needs no fuel input power to produce the output of the air.

In this project the conversion of force energy in to air is done. The control mechanism carries the air cylinder, quick exhaust valve, and air tank and gate valve.

The pushing power from the seat is converted into compressed air energy by proper driving arrangement. The pneumatic single acting cylinder is used in 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 inside spring arrangement.

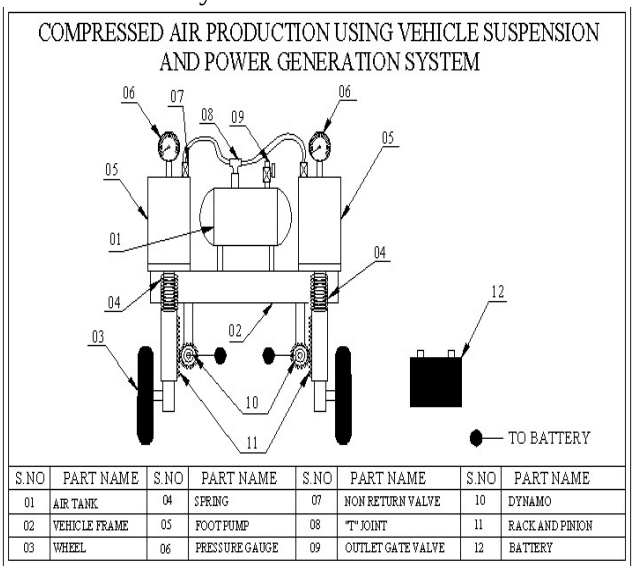
III. WORKING PRINCIPLE

The main components involve in this project consists of foot pump, air tank, hoses and connectors, pressure

gauge, spring, non-return valve, wheel, battery, dynamo, rack and pinion and vehicle setup.

When the vehicle runs on the irregular roads then the wheel goes to up and down motion. The cylinder arrangement is attached on the wheel axle. This motion is used to suck the air from the atmosphere. Thus the piston inside the cylinder creates the internal pressure which results in storage of air to the tank at certain pressure. This pressurized air is saved inside the tank. The outlet of tank consists of four valves which are used to supply the air to other pneumatic applications. Here the non-return valve is used to avoid the reversing of air flow to the atmosphere. That compressed air is used to run the vehicle using pneumatic gun. Pneumatic gun is coupled to the rear axle using worm drive for vehicle wheel rotation.

Simultaneously generate the electrical power using rack and pinion setup. Rack is welded to the foot pump cylinder. If the vehicle runs on the irregular roads, suspension occurs. On that time foot pump cylinder welded with the rack goes up and down, If rack moves attached to the pinion gives rotational motion. Dynamo is coupled to pinion for power generation. That power is stored in the battery.



S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME
01	AIR TANK	04	SPRING	07	NON RETURN VALVE	10	DYNAMO
02	VEHICLE FRAME	05	FOOT PUMP	08	"T" JOINT	11	RACK AND PINION
03	WHEEL	06	PRESSURE GAUGE	09	OUTLET GATE VALVE	12	BATTERY

Fig.2 Compressed Air Production System And Power Generation System

IV. DESCRIPTION OF EQUIPMENTS

A.FOOT PUMP:

A bicycle pump is a type of positive-displacement pumps specifically designed for inflating bicycle tyres. It has a connection or adapter for use with one or both of the two most common types of valves used on bicycles, Schrader or Presta. A third type of valve called the Woods valve exists, but tubes with these valves can be filled using a Presta pump.

B. AIR TANK:

A pressure vessel or storage tank is a closed container designed to hold gases or liquids at a pressure different from the ambient pressure. The pressure differential is potentially dangerous and many fatal accidents have occurred in the history of their development and operation.

C. HOSES & CONNECTORS:

Hoses used in this pneumatic system are made up of polyurethane. These hose can with stand at a maximum pressure level of 10 x105N/m2. In our system there are two type of connectors used. One is the Hose connector and the other is the reducer. Hose connectors normally comprise an adopt hose nipple and cap nut.

D. PRESSURE GAUGE:

Many techniques have been developed for the measurement of pressure and vacuum Instruments used to measure pressure are called **pressure gauges** or **vacuum gauges**. A manometer is an instrument that uses a column of liquid to measure pressure, although the term is currently often used to mean any pressure measuring instrument.

E.SPRING:

The automobile chassis is mounted on the axles not direct but through some form of springs. This is done to isolate the vehicle body from the road shocks which may be in the form of bounce, pitch, roll or sway. These tendencies give rise to an uncomfortable ride and also cause additional stress in the automobile frame and body.

F. NON-RETURN VALVE:

A check valve, clack valve, non-return valve or one-way valve is a mechanical device, a valve, which normally allows fluid (liquid or gas) to flow through it in only one direction.

G. WHEEL:

A wheel is a circular device that is capable of rotating on its axis, facilitating movement or transportation or performing labour in machines. A wheel together with an axle overcomes friction by facilitating motion by rolling.

H. BATTERY:

The battery used is a lead-acid type and has a capacity of 12v; 2.5A.The most inexpensive secondary cell is the lead acid cell and is widely used for commercial

purposes. A lead acid cell when ready for use contains two plates immersed in a dilute sulphuric acid (H2SO4) of specific gravity about 1.28.the positive plate (anode) is of Lead –peroxide (PbO2) which has chocolate brown colour and the negative plate (cathode) is lead (Pb) which is of grey colour.

I. DYNAMO:

Dynamo is an electrical generator. This dynamo produces direct current with the use of a commutator. Dynamo were the first generator capable of the power industries.

J. RACK AND PINION

A rack and pinion is a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a flat bar - the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel.

V. DESIGN CALCULATION OF SPRING

1) Parameters Known:

Spring Outer diameter Do =12 mm
Wire diameter (d) = 1.5 mm
Number of coils in the spring=31
Free length of the spring = 75mm
Axial Load W = 5kg = 5 x 9.81 = 49.05 N
E= Young's Modulus of mild steel = 210 GPa
v = Poisson's ratio = 0.3
Density of mild steel= 7850 kg/m3

2) Mean diameter of the spring:

D = DO – d = 12 – 1.5 = 10.5 mm
Spring index:
C = D / d = 10.5 / 1.5 = 7
Solid length of the spring:
LS = n x d = 31 x 1.5 = 46.5 mm
Shear stress factor:
K = 1 + (1 / 2C) = 1 + (1 / 2 x 7) = 1.07

3) Maximum Shear Stress occurs on the spring:

ζ = (1.07 x 8 x 49.05 x 10.5) / (3.14 x (1.5)3)
ζ = 415.79 N/mm2
Shear Modulus of Material
G=E/2(1+v)
=210x 109 / 2(1+0.3)
***G* = 8.08 x104 M Pa**
Modulus of Rigidity G = 80.8 x 103 N/mm2
Deflection of the spring

$$\delta = \frac{8\,W.D^3.n}{G.d^4}$$

= [8 x 49.05 x (10.5)3 x 31] / [(80.8 x 103) (1.5)4]
= 34.42 mm (Deflection active per turn)

4) Pitch of the coil

y = Free length / (n-1)
y = 75/ (31-1)
y = 2.5 mm
Spring Rate (or) Stiffness of the spring
k = W / γ = 49.05 / 2.5
k = 19.62 N/mm
Buckling of compression Spring
WCR = k x KB x LF
k = Spring Rate
KB = Buckling Factor = LF / D = 75/10.5 = 7.14
WCR = Critical Load
WCR = k x KB x LF
= 29.43 x 7.14 x 75
WCR = 15759.76 N
DYNAMO
Speed = 1000 rpm
Volts = 12 v
Watts = 18 w

If the dynamo rotates at 1000 rpm it will produce 6- 8 v

5) Battery Calculation:

To find the Current
Watt = 18 w
Volt = 12v
Current =?
P= V x I
18 =12 x I
I = 18/12
= 1.5 AMPS
BATTERY USAGE WITH 1.5 AMPS
BAH /I
8/1.5 = 5.3 hrs

6) ADVANTAGES

✓ Air production is done simply by running the vehicle
✓ No need fuel input
✓ No need of electrical power input
✓ A non-conventional system

APPLICATIONS

✓ Light vehicle
✓ Heavy vehicles

VI. CONCLUSION

This project is made with pre planning, that it provides flexibility in operation. This innovation has made the more desirable and economical. This project "compressed air production using vehicle suspension and power generation system" is designed with the hope that it is very much economical and help full to all vehicles to produce the compressed air and power. This project helped us to know the periodic steps in completing a project work. Thus we have completed the project successfully.

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