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Air Car with Intelligent Braking system and Pneumatic Bumpers

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ABSTRACT In this modern era where we seek advancement in many fields, development is made in areas from Medicine to Infrastructure and from Food industry to Agriculture, automobile plays a big part in the development of the human society. Considering development of automobile from newly powered engines to better safety measures we came up with a developed automobile. We came up with a prearranged idea of combined knowledge of a car fitted with an air engine combined them with safety measures such as Intelligent braking system and Pneumatic bumper.

KEYWORDS :

1.Introduction:

Air cars can be explained as Light utility vehicles are becoming very popular means of independent transportation for short distances. Cost and pollution with petrol and diesel are leading vehicle manufacturers to develop vehicles fueled by alternative energies. Engineers are directing their efforts to make use of air as an energy source to run the light utility vehicles. The use of compressed air for storing energy is a method that is not only efficient and clean, but also economical. The major problem with compressed air cars was the lack of torque produced by the "engines" and the cost of compressing the air. Recently several companies have started to develop compressed air vehicles with many advantages and still many serious bottlenecks to tackle. This paper briefly summarize the principle of technology, latest developments, advantages and problems in using compressed air as a source of energy to run vehicles.

2. Design & Analysis:

PNEUMATIC CYLINDER

(i)Design of Piston Rod

Load due to air pressure,
Diameter of the piston (d) = 10mm
Piston Pressure acting (p) = 20psi
1 psi = 0.070307 kg/cm^2
So 20psi = 1.4061 kg/cm^2
Material Used = C45
Yield Stress (σ_y) = 304N/mm^2
Factor of Safety = 2 (Assumed)
Force acting on rod (P) = Pressure x Area

$= p \times (\pi d^2/4)$
$= 1.4061 \times \{\pi(10^2)/4\}$
P = 110.43N
Design Stress = σ_y/ Factor of Safety
= 304/2 = 152 N/mm^2
& Stress, σ= P/A => $P/(\pi d^2/4)$
$d = \sqrt{(4P/\pi(\sigma_y)}$
$= \sqrt{4 \times 110.43/\pi \times 152}$
= 0.96 mm ≈ 1 mm

Therefore, Minimum diameter of Piston rod required for load = 1mm fpr the project.

(ii)DESIGN OF CYLINDER THICKNESS

Assuming internal diameter of the cylinder = 30 mm
Ultimate tensile stress = 400 N/mm^2
(for carbon steel of grade 20)
Factor of Safety = 4
Working Stress (σ) = 400/4 = 100 N/mm^2
According to 'LAMES EQUATION'
Minimum thickness of cylinder (t),
$t = Ri\{\sqrt{(\sigma + P/\sigma - P)} - 1\}$
where, Ri = inner radius of cylinder in cm
σ = working stress
P = Working Pressure

Therefore , substituting the values we get,
$t = 30\{\sqrt{(100+1.4061/100-1.4061)} - 1$
t = 0.428 mm

So, we assume thickness = 2.5 mm
Inner diameter of barrel =30 mm
Outer diameter of barrel = 30+2t
=30+9(2*2.5)
=45 mm

(iii) Length of piston rod

Approach stroke =160 mm

Lengthofthreads=2*20=40mm
Extra length due to front cover =12mm
Extra length due to accommodate head =20mm
Total length of piston = 232mm
Assume standard length =240mm

(iv) Intelligent braking system

In this automated braking system the use of computer assisted systems is a major step towards improving the safety and performance of vehicles. This paper investigates one aspect of system design, the braking system. The design exercise is based upon a simulation of a car braking system enables several alternative control strategies to be assessed. The findings illustrate the problems involved and the opportunities available for the application of an 'intelligent' control strategy.

(v) Stopping distance calculation

The total stopping distance of a vehicle is made up of 4 components. They are—

Human perception time

Human reaction time
Vehicle reaction time
Vehicle braking time

Therefore braking distance ,$D_{braking} = v^2/2\mu g$

Where, v = velocity before sensor senses obstacle &brakes are applied.
μ=0.7 (coeff. Of friction for dry surface)
g= acceleration due to gravity (9.81 m/sec^2)
v = velocity of vehicle before supply is cut = 6 km /hr = 1.6m/sec
mass of vehicle = 16 kg

therefore $D_{braking} = (1.67^2/(2*0.7*9.81)) = 0.20$m
total braking distance = 0.20+ bumper actuation
=0.20+.20 = 0.4 m

Hence , sensor sensing range set at **0.5m**

(vi) Pneumatic Bumper

Pneumatic Technology is considered to be an important technology in the field of automation. The current system is no longer using the old technologies like coal mines and timber works. Everything is automated now. So that the Engineers have to learn a lot about **pneumatic technology.**

An **automatic pneumatic bumper** is an electronically controlled bumper system. It has several control circuits and sensors. This project is specially designed for four wheeler vehicles to control the speed limit. If any problem found, a bumper activation system automatically prevents from it.

- **Impact force calculation –**

Braking distance = 0.4 m
By equation of motion
$2as = v^2 - u^2$
$a = -3.48 m/s^2$(retardation)
force, f = mass*acceleration
f = -56 N
F=56N experienced by the bumper.

- **For Bumper**

(P) force acting on bumper= 56 N
Area of bumper force is acting =20.5*2.3 =47.15 cm^2
Stress (σ) = P/A = 56/47.15 =1.187 N/cm^2
And ultimate tensile stress for cast iron (σ)=47.1 kgf/mm^2
So, design is safe.

- **Now design for spring**

Force "F" acting on bumper is simply passed on to the spring .i.e. 56N
pring length = 7.5 cm
pring diameter = 2 cm
Diameter of spring coil = 3mm

- Torsional moment produced in spring

T = F*D/2
=56*2/2
=56 N

- Shear stress due to torque,

$\tau = 8FD/\pi d^3$
$\tau = 10.56\ KN/cm^2$

- Internal resisting moment-

$T = (\tau*\pi d^3)/16$
T= 55.98 N-cm

- Shear stress in helical spring,

$\tau = 8FDK/\pi d^3$
\`C=D/d
=2/0.3
= 6.67

K = (4C-1/4C-4) + (0.615/C)
K = 1.22
Substituting values in eqn.
$\tau = 12.93\ KN/cm^2$

- Wire diameter –

$d = \sqrt[3]{(8DFK/\pi\tau)}$
d = 0.164 cm

- Angular deflection in spring –

$\Theta = 16FDl/\pi g d^4$
$l = \pi Di$
l = 50.26 cm and on sub. Values we get ,
$\Theta = 6.9\Theta$

- Axial deflection-

$y = 8FD^3 i/Gd^4$
y = 40.05 cm

- Load acting along the axis –

$F = yGd^4/8d^3 i$
F = 56 N

HENCE, DESIGN IS SAFE.

3. Conclusion:

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries.

We are proud that we have completed the work with the limited time successfully. The **PNEUMATIC BUMPER FOR FOUR WHEELER** is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities.

In conclusion remarks of our project work, let us add a few more lines about our impression project work. Thus we have developed an ***"PNEUMATIC* 76 |** P a g e

BUMPER FOR FOUR WHEELER" which helps to know how to achieve low cost automation. The application of pneumatics produces smooth operation. By using more techniques, they can be modified and developed according to the applications.

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