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Design of Multi-Input Jack System

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Abstract*——** *An hybrid jack could also be operated by exploitation of gas and hydraulic cylinder that's operated by compressed gas and fluid. A hydraulic jack may be a tool that uses force to elevate very important a full ton. Hydraulic jacks suppose this principle to elevate very important loads: they use pump plungers to maneuver oil through cylinders. The plunger is initial drawn back, that opens the suction valve ball at intervals and attracts oil into the pump chamber. As a results of the plunger is pushed progressive, the oil pass over degree outer discharge check valve into the cylinder chamber, and collectively the suction valve closes, that ends in pressure building at intervals the cylinder. A mechanics jack that deals with the study and application of controlled air to provide mechanical motion. A jack can be a tool that lifts vital instrumentality. The foremost common kind can be an automobile jack, floor jack or garage jack that lifts vehicles so as that maintenance could also be performed. We've an inclination to make instrumentality that is ready to elevate the vehicle that's exclusively operated by driver and as per our demand we've an inclination to elevate the wheel.

Keywords*—Air compressor, pneumatic cylinder, hydraulic cylinder, check valve, power pack, control switch.*

I. Introduction

Modification to be created in system of the jacks offered in more one system a concept is generated that there are often a mix of assorted system in one altogether jack that's the explanation we are able to place forth idea of hydraulic and pneumatic jack.

A. HYDRAULIC:

The fluid used for hydraulic jack is viscous than air i.e. oil or viscous fluids thanks to that hydraulic jack is used for work. Though the speed of lifting is moderate than gas jack and additionally the quantity of fluid needed is a smaller amount. A hydraulic jack makes use of a liquid that is incompressible, that's compelled into a cylinder with the aid of a pump plunger. Oil is hired since it's self lubricating and stable. As before long because the plunger pulls lower back, it attracts oil out of the reservoir via a suction take a look valve into the pump chamber. As before long because the plunger movements ahead, it press the oil via a release check valve into the cylinder. The suction valve ball is into the chamber and opens with every pull of the plunger. The discharge valve ball is exit of doors the chamber and opens as soon as the oil pushed into the cylinder. At now the suction ball in the chamber is pressured locked and strain degree construct in the cylinder.

B. PNEUMATIC:

Pneumatic jack is also a jack that used for lifting object at a faster speed .The fluid used for gas jack is clean air. That is why it'll operate at high speed. The word "pneumatic" comes from Greek and implies that wind. The word mechanics is that the study of air movement and it's pneumatic comes from the word pneumatic. Today mechanics is principally understood to implies that the applying of air as an operational medium in business particularly the driving and dominant of machines and instrumentality. Gas systems use controlled gases to transmit and management power. gas systems usually use air as a result of the fluid medium as a results of air is safe, low value and promptly accessible. Gas cylinders impart a force by dynamic the P.E. of propellant into K.E... this is {often this can be} often achieved by the propellant having the power to expand, whereas not external energy input, that itself happens thanks to the pressure established by the propellant being a bigger pressure than the gas pressure. This air growth forces a piston to maneuver inside the specified direction.

II. Objectives

Our objective is to join two jack system i.e. pneumatic and hydraulic jack in such a way that a single system can be used to operate in hydraulic as well as in pneumatic mode or both in combine.

- Use of two powers i.e. hydraulic & pneumatic in a single system
- Explaining the design process of hydraulic & pneumatic jack.
- Information about capacity generated by combination of hydraulic and pneumatic power in single actuator.

III. Methodology

Design consists of applications of scientific principles and technical information for invention of new mechanism to perform specific function with more efficiency and less cost. The design methodology depends on two types;

- Hydraulic System
- Pneumatic system

The course of our work begin with planning phase involving initial research, literature survey and background study. Basically we all know that what jack is used for. Jack is a device which is used for lifting heavy objects which cannot be lift easily using human strength.

IV. Working

When the load is raised we are able to used mechanism furthermore as gas system for lifting. The fluid is offer within the hydraulic cylinder thanks to that the load is raised. The mechanism is reached to its extreme position. And if we have a tendency to offer compressed controlled air within gas cylinder then additionally load is raised. It suggests that within the absence of anyone energy (either hydraulic or pneumatic), still we have a tendency to are ready to carry the load. Now, by victimization hydraulic energy if we have a tendency to carry the load and a lot of some more height is needed at that point we are able to use gas energy for carry the load, it suggests that we are able to used each hydraulic furthermore as gas energy at a time within the jack.

So, in this way we can used this jack in following conditions,

1. When only hydraulic energy is available.
2. When only pneumatic energy is available.
3. When both hydraulic and pneumatic energy is available.

Design Of Hydraulic And Pneumatic

4.1 Material Selection

a) Piston rod –SAE 1030(plain carbon steel)
b) Piston- SAE 1030(plain carbon steel)
c) inner cylinder (hydraulic) - SAE 1030 (plain carbon steel)
d) outer cylinder (pneumatic) - SAE 1030(plain carbon steel)

4.2 Specification

a) Load to be lifted (F)-100 kg (981 N)
b) Material

i. Ultimate tensile strength , S_{ut} = 527 mPa
ii. Yield strength in compression and tension , S_{yc} , S_{yt} =296 mPa
iii. Yield strength in shear , S_{ys} = 183 mPa
iv. Modulus of elasticity , E = 204 GPa
v. Percentage elongation , e = 26%
vi. factor of safety = 5 (assumed)

4.3 Nomenclature

1. Force to be lifted , F =981 N
2. Diameter of piston rod , d_0 = 20 mm
3. Area of piston rod , a_0 = 315 mm^2
4. Thickness of piston head , t_0 = 10 mm
5. Diameter of piston head , D_0 = 60 mm
6. Area of piston head , A_0 = 2828 mm^2
7. Inner diameter of inner cylinder, $(D_1)_i$ = 60 mm
8. Outer diameter of inner cylinder, $(D_1)_o$ = 70 mm
9. Inner area of inner cylinder, $(A_1)_i$, = 2828 mm^2

10. Outer area of inner cylinder, $(A_1)_o$ = 3849 mm^2
11. Inner diameter of outer cylinder, $(D_2)_i$ = 70 mm
12. Outer diameter of outer cylinder, $(D_2)_o$ = 80 mm
13. Inner area of outer cylinder, $(A_2)_i$, = 3849 mm^2
14. Outer area of outer cylinder, $(A_2)_o$ = 5027 mm^2
15. Thickness of inner cylinder wall , $(t_1)_w$ = 10 mm
16. Thickness of inner cylinder bottom, $(t_1)_b$= 10 mm
17. Thickness of outer cylinder wall , $(t_2)_w$ = 10 mm
18. Thickness of outer cylinder bottom, $(t_2)_b$ = 10 mm
19. Length of piston rod ,L_0 = 140 mm
20. Length of inner cylinder , L_1= 90 mm
21. Length of outer cylinder, L_2 = 170 mm
22. Length of lift in hydraulic cylinder ,L_h = 60 mm
23. Length of lift in pneumatic cylinder ,L_p = 60 mm
24. Pressure inside inner cylinder ,. P_1
25. Pressure inside outer cylinder , P_2
26. Permissible tensile stress , σ_t
27. Permissible compressive stress , σ_c
28. Permissible shear stress , τ

4.4 Permissible stresses in jack

i. Permissible tensile stress

$\sigma_t = S_{yt}$ / F.S.
= 296 /5
= 59.2 MPa

ii. Permissible compressive stress

$\sigma_c = S_{yc}$ / F.S.
= 296 /5
= 59.2 MPa

iii. Permissible shear stress

$\tau = S_{ys}$ / F.S.
= 183 /5
= 36.6 MPa

4.5 Design of Jack Component

4.5.1 Design of Piston and Piston Rod

a. Compressive stress in piston rod
$(\sigma_{cr})_0=F/a_0$
=981/315
=3.11 MPa < σ_c

b. shear stress at piston head
$\tau_0=F/\pi*d_0*t_0$
=981/3.14*20*10
=1.5621 MPa < σ_t

4.5.2 Design of inner cylinder

a. Crushing stress of inner cylinder
$(\Sigma_{cr})_1=F/A_0$
=981/2828
=0.3468 Mpa < c_u

B. shear stress of inner cylinder
$\tau_1=F/\pi*(D_1)i*(t_1)_b$
=981/3.14*60*10
=0.2603 < τ

c. pressure inside the inner cylinder
Assume co-efficient of friction=μ=0.3
Therefore, total upward force required for lifting by hydraulic pressure
F_{t1}=F+μF
=1.3F
=1.3*981
=1275 N
Therefore, total pressure required for lifting the load of 100 kg by hydraulic pump
$P_1=F_{t1}/A_0$
=1275/2828
=4.50 bar

D. tensile stress in wall of inner cylinder due to pressure P_1
$(\sigma_t)_{1w}=P_1(D_1)_i/2*(t_1)_w$ =1.35 <σ_t
Design is safe.
E. tensile stress in bottom cover of inner cylinder due to pressure P_1
$(\sigma_t)_{1B}=k_{12}\ (D_1)P_1/(t_1)_{B2}$
Taking k_1=0.44
=0.442*602*0.450/102
$(\sigma_t)_{1B}$=3.1363< σ_t
Design is safe.

4.5.3. Design of outer cylinder
a. Crushing stress of outer cylinder
$(\Sigma_{cr})\ _2=F/\ (A_2)\ _i$
=981/3849
=0.2548 < σ_{cr}
Design is safe.

b. Shear stress of outer cylinder
$\tau_2=F/\pi*(d_2)\ _i*t_2$
=981/π*70*10
=0.44 < τ
Design is safe.

c. Pressure inside the outer cylinder
Assume coefficient of friction μ=0.3
Total upward force required for lifting by pneumatic pressure
F_{t2}=F+μF
=1275 N
Total pressure required for lifting 130 kg load by pneumatic pump
$P_2=F_{t2}/(A_2)_i$
=1275/3848.45
=0.331 MPa
= 3.31 bar
d. Tensile stress in wall of outer cylinder due to pressure P2
$(\Sigma_t)\ _{2W}=\ P_2*(D_2)_i/2*(t_2)_w$
=1.1585 < σ_t
Design is safe.

e. Tensile stress in bottom of outer cylinder due to pressure P2
$(\sigma_t)_{2B}$ = $k_{12}*(D_1)_{i2}*P_2/(t_2)_{B2}$
= 0.44*(702*0.331/102
= 4.41 < σ_t
Design is safe.

V. Conclusion

The multi input jack here we tend to conclude all the system operating with the pneumatic and hydraulic however the system we created is that the hybrid jack system who work on the each the input. The overall we tend study from the start on each aspects to beat on no mandatory system once alternative system fail and got facilitate with alternative system and therefore the system perpetually facilitate within the elevate the vehicle. The project perpetually here conclude that the system that useful with each system is that the ideal system for the longer term, longer term scope for the lifting the vehicle is superior and advantageous. The project including as we tend toll as together with all the aspects we conclude altogether elements area unit operating simply.

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