Pneumatic Jack By Using Rack And Pinion

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Abstract- *The principle point of venture is to enhance variant of a pressure driven jack to small scale pneumatic jack. This will be more proficient for the client. This machine is pneumatic controlled which has low co-proficient of rubbing. A pneumatic chamber raised gives energy to lift up the Jack. This is a pneumatic fueled machine and requires no different methods for energy to work. The required segments are Compressor, Pneumatic chamber, Solenoid, Control circuit (Toggle switch), Jack, rack and pinion system.*

Keywords- Rack and Pinion Arrangement, Actuator, Solenoid Valve.

I. INTRODUCTION

Pneumatic frameworks work on a supply of compacted air which must be made accessible in adequate amount and at a strain to suit the limit of the framework. At the point when the pneumatic framework is being embraced out of the blue, anyway it wills undoubtedly the important to manage the topic of compacted air supply.

Jack Definition:

A jack is a mechanical gadget utilized as a lifting gadget to lift substantial loads or apply extraordinary powers. A mechanical jack utilizes a screw string for lifting overwhelming gear.The most well-known frame is an auto jack, floor jack or carport jack which lifts vehicles with the goal that upkeep can be performed.

PNEUMATICS:

"Pneuma" originates from Greek and means wind. The word pneumatics is the investigation of air development and its wonders is gotten from the word pneuma. Today pneumatics is for the most part comprehended to implies the utilization of air as a working medium in industry particularly the driving and controlling of machines and hardware.Pneumatics has for some extensive time between utilized for completing the least complex mechanical assignments in later circumstances has Played a more vital part in the improvement of pneumatic innovation for computerization.

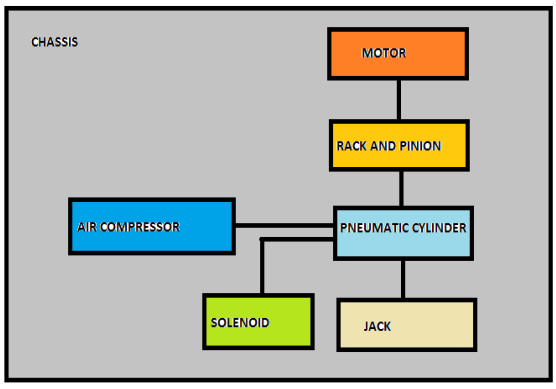
II. LITERARURE SURVEY

KamalaKkannan.A [1]: Here we are introducing the motorized screw jack. Weight after certain limits cannot be lifted by a person, in such cases we are in need of jack. When it is motorized it becomes more convenient. In order to implement this idea, we have designed and developed a system called motorized jack operating through switch by having full control of the jack, we can easily lift it up and down by using the on/off .this helps to reduce the burden of the worker. The main reason to fabricate the motorized screw jack is to avoid the fatigue of human during lifting of the load. The project is less cost and good efficient for operating.

Sourabh Savadatti, Amit Doddamani [2]: The concept of this work is to design and develop the automatic jack system using an android app. An automotive jack is a device used to raise all or part of a vehicle into the air in order to facilitate repairs. With the manually operated car jack most people are familiar with, that is still included as standard equipment with most new cars. Changing flat tire is not a very pleasant experience. Operating the manual car jack is quite difficult job. This purpose is to mainly encounter this problem. This paper presents the development of the car jack which is controlled by android app. A vehicle frame, also known as its chassis, is the supporting structure of a motor vehicle to which all the components are attached, comparable to the skeleton of an organism. Where the jack is placed in the middle of the chassis, to which the movement of the jack is control through the app. A car jack works on the 12V power supply which is obtained from the car battery itself.

III. SYSTEM DESCRIPTION

BLOCK DIAGRAM

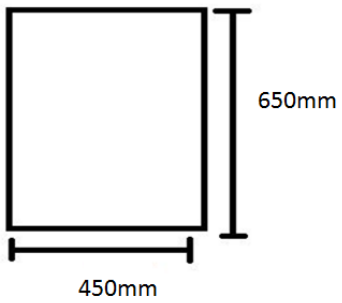


WORKING PRINCIPLE

The working medium embraced is compacted air. The packed air is transmitted through tubes to pneumatic barrel where control is changed over into responding movement. The responding movement is acquired by utilizing an electrically controlled solenoid valve. The contribution to the solenoid valve is given through the control unit. The responding movement transmitted to the jack through the cylinder which proceeds onward the barrel. The jack is set under the vehicle frame, where the vehicle to be lifted. The vehicle can be lifted when the solenoid valve is exchanged. The vehicle over the jack gets the responding movement through the cylinder which is associated with the jack. Subsequently utilizing a pneumatic jack the vehicle can be lifted effortlessly in task.

IV.CALCULATION

1. Design of Frame:



Frame design for safety FOR 25*25*3 L angle mild steel channel
b = 25 mm, d= 25 mm, t = 3 mm.
Consider the maximum load on the frame to be 20 kg.
Max. Bending moment = force*perpendicular distance
= 50*9.81*325
M = 159412.5Nmm
We know,
M / I = σb / y
M = Bending moment
I = Moment of Inertia about axis of bending that is; *Ixx*
y= Distance of the layer at which the bending stress is consider (We take always the maximum value of *y*, that is, distance of extreme fiber from N.A.)
E = Modulus of elasticity of beam material.
I = bd3 /12
= 25*25^3 / 12
I = 32552.08 mm4
σb = My / I
= 159412.5 *12.5 / 32552.08
σb = 61.214 N /mm2
The allowable shear stress for material is σallow = Syt / fos
Where Syt = yield stress = 210 MPa = 210 N/mm2
And fos is factor of safety = 2
So σallow= 210/2 = 105 Mpa = 105 N/mm2
Comparing above we get,
σb<σallowi.e
61.214< 105 N/mm 2
So design is safe.

Pneumatic cylinder

Assumption:-
Suppose the jack should lift 195hurmi195. 25kg
Maximum force acting on actuator=250 N
Factor of Safety =1.25
Pressure= 6bar
Total force acting on bumper=
250*1.25 = 312.5 N
For outstroke
F = P*A
312.5 = 0.6 *A
A = 520.833mm2
We know that
A =π/4*D^2
520.833= π/4*D^2
D=25.75mm
Consider standard diameter is equal to 26mm
Instroke force = Outstroke force
Effective area = π/4*(26^2 –d^2)
Where d= Piston rod area
F = P* A
416.67=0.6* π/4*(26^2 –d^2)
d =14.43 mm
Select standard diameter= 15 mm

Rack And Pinion Calculation: …(195hurmi –reference book)

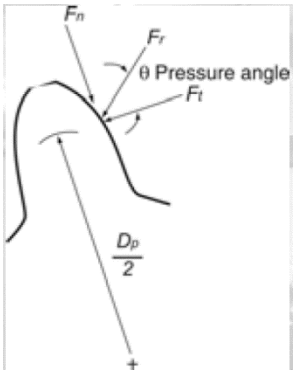


Fig. Gear Tooth diagram

f_t= transmitted force
f_n = normal force
f_r = resultant force
θ = pressure angle
Pressure angle = 20^0

1. Fn = Ft tan θ ……(1)

f_t= tangential force (weight of human)= 60 kg
f_t= 60 x 9.81
f_t= 588.6 N
the above value of $f_t$is used in equation no (1)
therefore;
f_n = 588.6 x tan 20^0

f_n = 214.23 N

2. $f_r = \frac{f_t}{\cos\theta}$……(2)

$= \frac{588.6}{\cos 20}$

f_r= 626.38 N

3. Power (P) = $\frac{Work}{time}$ ……(3)

$P = \frac{Force \times displacement}{time}$

$P = \frac{588.6 \times 0.050}{1}$

p= 29.43 watt

4. $P = \frac{2\pi NT}{60}$ ……(4)

$T = \frac{Px60}{2xN}$

$T = \frac{29.43 \times 60}{2 \times 3.142 \times 30}$

T = 9.3 N.m.

5. Find the torque:
T = f_t x r ……(5)

$r = \frac{T}{f_t}$

$= \frac{9.3}{588.6}$

r = 0.015 mm

r = 15 m So D = 30 m

6. Using Lewis form factor:

$\sigma_t = \frac{f_t x P_d}{y.b}$ ……(6)
Let,
P_d = diametrical pitch
$P_d = \frac{T}{D}$
$= \frac{18}{30}$

P_d = 0.6 mm^{-1}

Then, using equation (6)
$\sigma_t = \frac{f_t \times P_d}{y.b}$
$= \frac{588.6 \text{ X } 0.6}{30 \text{ X } 0.308}$

σ_t = 38.22 N/mm^2

6. $\sigma_{allow} = \frac{S_{ut}}{fos}$……(7)

$= \frac{210}{2}$

σ_{allow}= 105N/mm^2

So $\sigma_t << \sigma_{allow}$
So design is safe.
M = $\frac{D}{T}$……(8)
$= \frac{30}{18}$

m= 1.66

Then the module of pinion = 1.66
Also The module of rack = 1.66

Pinion dimension,

Outer Dia. = d_0 = 2m + D ……(9)
= 2 x 1.66 + 30

d_0 = 33.32 mm

Root dia. (d_r) = D – (2m + 2C) ……(10)
= 30 – (2 x 1.66 + 2 x 0.25)

d_r= 26.18 mm

Addendum, Ad = m…….(10.1)

Ad= 1.66

Dedendum, D_d = m + c …….(10.2)

= 1.66 + 0.25

D_d = 1.91 = 2 mm

Linear displacement of rack for one rotation of piston:

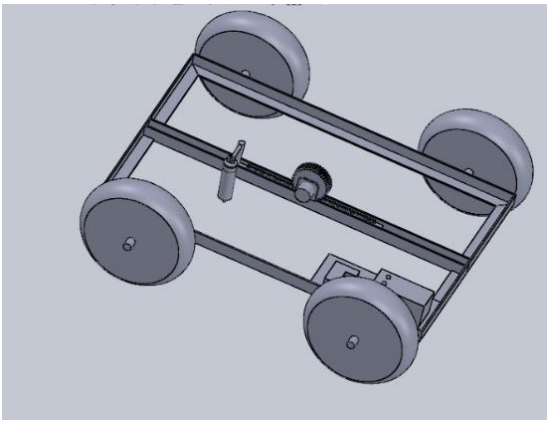
- **L = πm x T ……..(11)**

= π x 1.66 x 18

L= 94.44 = 100 mm

Maximum length of rack is 100 mm.
Width of rack is 10 mm.

V. CAD MODEL



VI. CONCLUSION

The venture completed by us influenced an inspiring to errand in the field of car and car workshops. It is conveniently for the laborers to work in the car workshop are in the administration station.This project has likewise decreased the cost engaged with the worry. Venture has been intended to play out the whole necessity assignment which has additionally been given.

VII. ACKNOWLEDGMENT

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