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Inbuilt Automatic Pneumatic Jack for Four-Wheeler

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Abstract: **This project work titled "INBUILT AUTOMATIC PNEUMATIC JACK FOR FOUR WHEELERS" has been conceived having studied the difficulty in lifting the any passenger and light moving vehicle type of light vehicle. Our survey in the regard in several automobile garages, revealed the facts that some difficult methods involving physical efforts were adopted in lifting the vehicles for reconditioning. Our project is mainly concentrated on this difficulty; hence a suitable arrangement has been designed by the combination of two main stages. Compressed air production using vehicles suspensor: in this project, the atmospheric air is sucked using our experimental setup and get compressed by non-conventional method just by driving vehicle air is stored in the storage tank. Automatic pneumatic jack for four wheelers: by utilizing the compressed air, the pneumatic jack which is mounted on the chassis can be operated in order to lift the vehicle for the purpose of changing tyre or for wheel alignment etc.**

Keywords — Compressor, Safety Valves, Non return Valves, Conventional operated jack, Pneumatic double acting cylinder.

I. INTRODUCTION

From the evolution of Vehicles, the common problem when tire goes flat is changing of tires by lifting the vehicle using Jack and lever and it's a tedious job for any person in that case. Generally to operate it a person must bent down to squatting position which may lead a back pain. Especially for Senior citizens, female drivers and physically challenged drivers it is an impossible task. The work input on the jack completely depends on the weight of the vehicle that is to be lifted. In this project an inbuilt automatic pneumatic jack are built and placed in each of the wheel. Now a day we are using automated hydraulic jack which consists of spring, compressor, pressure gauge, storage, single acting cylinder etc. This automated jack doesn't require any kind of human effort and can be operated by anyone like children, women, and old people. It does not make a person to bend or to be in squat position to operate.

Present Vehicle lifting Mechanism:

1. Scissor Jack
2. Screw Jack
3. Hydraulic Jack
4. Air – hydraulic Jack
5. Inflatable Jack

The major drawback in all the above mentioned Jacks are, few type of jacks are portable but difficult to operate and few are easy to operate but it's not portable. This made s to develop a model which can become a real time solution.

II. EXPERIMENTAL SETUP

Project consist of

a. Pneumatic double acting cylinder
b. Safety Valve
c. Non-Return Valve
d. Compressed air storage tank

COMPRESSED AIR PRODUCTION USING VEHICLE'S SUSPENSOR:

The frame is connected to a double acting pneumatic cylinder. As the vehicle suspends while running these double acting pneumatic cylinder will suck the atmospheric air and compress it to the 7.8 bar pressure and stores it in the compressed air storage tank.

DESIGN CALCULATION & TECHNICAL SPECIFICATION

In order to build the required pressure for the operation of pneumatic jack with the help of vehicle suspension one need to understand the minimum requirement of suspensor to be used and the respective design calculations are as follows:

III. DESIGN OF PISTON ROD

- Material = C45
- Diameter of the piston(d) = 40mm
- Pressure applied = 6 kgf/cm^2
- Yield Stress(σ_y) = 36 kgf/mm^2
- FOS (Assume) = 2

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- Force acting on the rod (P) = Pressure x area
  = 7Kgf
- Design Stress(σ_n) = 18kgf/mm^2
- Therefore minimum diameter required = $\sqrt{\frac{4P}{\pi(\sigma_y)}}$
  = $\sqrt{\frac{4\times75.36}{\pi\times18}}$ = 2.3mm (Minimum diameter of the rod required for the load)
- Considered diameter = 15mm.

IV. DESIGN OF CYLINDER THICKNESS

- Material Used = Cast Iron
- Assuming internal diameter of the cylinder = 40mm
- Ultimate tensile stress = 250N/mm^2
- FOS (Assumption) = 4
- Working Stress (F_t) = 625kgf/cm^2 (by Lames Equation)
- Minimum Thickness of Cylinder (t) = $R_i\left\{\sqrt{\frac{(ft+p)}{(ft-p)}}\right\}$
  t = 0.19mm
  Considered thickness of the cylinder = 2.5mm
- Inner diameter of the cylinder = 40mm
- Outer diameter of the cylinder = 40 + (2x2.5)
  = 45mm

1. *LENGTH OF PISTON ROD:*

- Approach Stroke = 160mm
- Length of thread = 2 x 20 = 40mm
- Extra length due to front cover = 12mm
- Extra length for accommodate head = 20mm
- Total length of piston rod = 160+40+12+20 = 232 mm
- Standardized length of piston rod = 230 mm

2. *COMPRESSED AIR PRODUCTION*

- Diameter of the cylinder = 40mm
- Pressure $P = \frac{F}{A}$ = 7.96 Kg/cm^2

(Minimum pressure that can be built by the proposed setup by assuming the minimum force of the vehicle applied on the suspensor as 100kg)

TECHNICAL SPECIFICATION
Based on the design calculations, Technical Specification of the selected components for building up our experimental setup are as follows:

1) Single acting pneumatic cylinder
- Quantity = 1No's.
- Stroke length = 170mm
- Seals = Nitride (Buna – N) Elastomer
- End cones = Cast Iron
- Piston = EN8
- Media = Air
- Temperature = 0 – 8 ^oC
- Pressure Range = 8N/mm^2

2) Non – Return Valve
- Quantity = 1No's.
- Media = Air
- Temperature = 0 – 80 ^oC
- Pressure range = 8N/m^2
- Size = ¼

3) Connectors
- Max working pressure = 10 X 10 N/mm^2
- Temperature range = 0 – 100^oC
- Fluid Media = Air
- Material = Brass

4) Hoses
- Max Pressure = 10 X 10 N/mm^2
- Outer Diameter = 6mm
- Inner Diameter = 3.5mm

AUTOMATIC PNEUMATIC JACK FOR FOUR WHEELERS:

By utilizing the compressed air, the pneumatic jack which is mounted on the chassis can be operated by switching on the valve and toggling the switch in order to lift the vehicle for the purpose of changing tires or for wheel alignment and for any kind of maintenance work.

V. RESULTS & DISCUSSION

- We can lift the weight of 25 kg at 327 KPa.
- Volume of the air can be stored in the storage tank is 66.05m^3.
- Pneumatics working fluid is also widely available and most factories are pre- plumbed for compressed air distribution, hence pneumatic equipment is easier to set-up then hydraulics.
- To control the system, only ON and OFF toggle switch are used and the system consists only of standard cylinders and other components, making it simpler than hydraulics.
- The working fluid of the pneumatic system absorbs excessive force, leading to less frequent damage to equipment.
- In case of excess pressure built-in, a pressure relief valve can be installed to release the excessive pressure when it cross the required pressure limit.

Advantages:
- Air production is simply running the vehicle
- No need fuel input and Electrical Power input
- This is a Non-conventional system.
- It requires simple maintenance cares
- The loaded light vehicles can be easily lifted.
- Checking and cleaning are easy, because of the main parts are screwed.
- Handling is easy.
- Manual power not required
- Repairing is easy.
- Replacement of parts is easy.
- Maximum height up to 1.5 feet can be reached.

VI. CONCLUSION

- We have combined the inbuilt jack with applications of the compressed air production using vehicle suspensor,

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- The compressed air production using vehicle suspensor get its energy requirements from the mobility of the vehicle, there is no need of depending on external source for air compression.
- The Inbuilt automatic pneumatic jack can be operated using the compressed air in order to lift the vehicle for changing of tires, wheel alignment, under chassis repair work etc.
- Our project is an experimental setup in which there is no engine or gearbox assembly to run and compress the air but the methodology used in our work can be implemented which is practically possible.
- Thus, the development of an Inbuilt Automatic Pneumatic Jack for passenger vehicle or any LMV's is a low cost automation. The operating procedure of this system is very simple, so any person can operate. By using more techniques, they can be modified and developed according to the applications. As we know that our jack is inbuilt this has less chances of fatigue.

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