

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

A DESIGN OF THREE AXIS MODERN PNEUMATIC TROLLEY

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Abstract

This project work title “THREE AXIS MODERN PNEUMATIC TROLLEY” has been conceived having studied the difficulty in uploading the material in space restricted areas. Our survey in this regard several automobile dumper and trolley revealed fact that mostly titled trolley is directional and use for unloading the material only a single side of trolley. Now the project has been concentrated on this difficulty, and hence suitable arrangement has been designed for three directional unloading trolley. The dumped material can be unloaded from the trolley in three directions with the help of pneumatic cylinder, the compressed air goes to pneumatic cylinder through the valve the ram of pneumatic cylinder help in lifting the dump tray .a pneumatic cylinder attached to the rotating frame is then operated and the trolley tray mounted on the rotating frame is lifted up and is able to dump the material in whatever direction the dumping is to be done

Index Terms: Rotating frame, pneumatic cylinder, D.C motor, compressor etc.

1. INTRODUCTION

In this modern era, as the world is progressing faster, there is more advanced unloading vehicles in construction areas there are problem of material unloading which point out to the advancement in the area of dumping of material according to current need, there is only one system of dumping of material which is already use in convectional dumping on which dumping is possible only at rear and side end. The dumping becomes restricted due to the lack of space handling and unloading the material from the dumper, trucks and excavator. Therefore by using the hydraulically cylinder arrangement the model become simple but robust in construction and highly effective in heavy work. In our case we use pneumatic cylinder for lifting the dump tray and rotating frame which is to be rotated in any direction with the help of gear and pinion arrangement which is rotated with the help of rotary actuator (DC Motor)

In the chassis, the whole system weight is distributed and it form a vase for the complete project there is shaft is mounted axially on centre of chassis on which here mounted rotate freely on the shaft with the help of ball bearing. The gear is driven by the pinion and rotated by the dc motor powered externally. A rotating frame is mounted on gear axially and rotate freely in the direction the gear rotates. The rotating frame consist of few fitting mainly one end of pneumatic cylinder is fitted on rotating frame and acts supports to the pneumatic cylinder for lifting. The other end of

rotating frame is consisting of hinged joint for the free movement of the dumping tray for easy dumping of material.

2. DESIGN PROCEDURE

Major components:

The major components of “PNEUMATIC THREE AXIS MODERN TROLLEY” are described below:

1. Pneumatic cylinder
 - I. Design of cylinder thickness
 - II. Design of piston rod
 - III. Length of piston rod:
2. Connectors
3. Hose pipe
4. Design of ball bearing
5. Flow control valve
6. Wahls stress factor
7. Air compressor
8. Trolley body
9. Wheel arrangement

2.1. Pneumatic Cylinder

Design of piston rod:

$$\begin{aligned} \text{Diameter of the piston (D)} &= 40\text{mm} \\ \text{Pressure acting (P)} &= 6\text{kgf/cm}^2 \\ &= 6 \times 0.981 \\ &= 5.886\text{bar} \\ &= 0.5886\text{N/mm}^2 \end{aligned}$$

Material used for rod =C45
 Yield stress(σ_y) =36kgf/mm²
 =36*9.81
 =353.16N/mm²
 Force acting on the rod(F) = pressure * area
 = p*($\pi d^2/4$)
 = 0.5886 * {(π * 40²)/4}
 = 739.6N
 Design stress(σ_y) = σ_y /FOS
 =353.16/2
 =176.5N/mm²
 Minimum diameter of the rod required for the load
 =2.3mm
 We assume the diameter of rod =15mm



Fig. 1. Pneumatic Cylinder

2.1.1. Design of cylinder thickness

Material used = Cast Iron
 Internal diameter of cylinder =40mm
 Ultimate tensile stress =250N/mm²
 Working stress = ultimate tensile stress/ FOS
 FOS assuming =4
 Working stress (f_t) =250/4
 = 62.5N/mm²

2.1.2. Design of piston rod

Force of piston rod (f) =pressure *area
 =p * ($\pi d^2/4$)
 =0.5886 * ($\pi / 4$) * (40)²
 =739.6N
 Also force on the piston rod (F) = ($\pi / 4$) * (dp)² * f_t
 = ($\pi / 4$) * (dp)² * 62.5
 739.6 = ($\pi / 4$) * (dp)² * 62.5
 dp² = 739.6 * (4 / π) * (1/62.5)
 dp² = 15
 dp = 3.8 mm



Fig. 2. Design of Piston Rod

2.1.3. Length of piston rod

Approach stroke =160mm
 Length of threads=2*20
 =40mm
 Extra length due to front cover=12mm
 Extra length of accommodate head =20mm
 Total length of piston rod =160+40+12+20
 =232mm

2.2. Connectors

Maximum working pressure =10*10⁵N/m²
 Temperature=0-100c
 Fluid media=air
 Material=brass



Fig. 3. Connectors

2.3. Hosepipe

Maximum pressure = $10 \times 10^5 \text{ N/m}^2$
 Outer diameter = 6mm
 Inner diameter = 3.5mm



Fig 4. Hosepipe

2.5. Flow control valve

Port size = $0.635 \times 10^{-2} \text{ m}$
 Pressure = $0.8 \times 10^5 \text{ N/m}^2$
 Media = Air
 Quantity = 1



Fig 6. Flow Control Valve

2.4. Design of Ball-Bearing

Outer diameter of bearing(D) = 45mm
 Thickness of bearing(B) = 12mm
 Inner diameter of bearing (d) = 17mm
 Mean diameter(dm) = $(D+d)/2$
 = $(45+17)/2$
 = 31mm



Fig 5. Ball Bearing

2.6. Wahl's Stress Factor

$$K_s = \frac{4C-1}{4C-4} + \frac{0.65}{C}$$

$$= \frac{4 \times 2.3 - 1}{4 \times 2.3 - 4} + \frac{0.65}{2.3}$$

$$= 1.85$$

2.7. Air Compressor

The maximum capacity of compressor is 10×10^5 to $12 \times 10^5 \text{ N/m}^2$
 This is two stage or two cylinder reciprocating compressors.
 Pressure gauge:
 This is use for measuring the outlet pressure of the air from compressor ,the gauge is use is Bourdon type pressure gauge the maximum capacity of gauge is 10×10^5 to $12 \times 10^5 \text{ N/m}^2$



Fig 7. Air Compressor

2.8. Trolley Body

Trolleys are most popular and cheaper mode of goods transport in rural as well as urban area. Trolleys are more widely used for transporting agriculture product and goods, building construction material and industrial equipment. The main requirements of trolley manufacturing are high performance, easy to maintain, longer working life and robust construction. In this work, the tractor trolleys are used for the agriculture work and some cases used for transporting building construction material.

2.9. Wheel Arrangement

A three-wheeler is a vehicle with three wheels. some of are human powered vehicles and animal powered vehicles. Many three-wheelers which subsist in the form of motorcycle-based machines are frequently known as trikes and often have the front single wheel and mechanics similar to that of a motorcycle and the rear axle similar to which a car.

3. WORKING

Since pneumatic circuit plays a important role in this device, it is very necessary to explain the working of this circuit. Initially starting with air compressor, its function is to compress air from a low inlet pressure (usually atmospheric) to a higher pressure level. This is an cause by reducing the volume of the air. Air compressors are usually positive displacement units and are either of the reciprocating piston type, rotary screw or rotary vane types. The air compressor used here is a ideally small sized, two stage compressor unit. It also consists of a compressed air tank, electric rotor and pulley drive, pressure controls and instruments for quick hook up and use. The compressor is driver by a 1 HP motor and designed to operate in 10 – 100 PSI range. If the pressure is more than the designed pressure of the receiver a release value provided releases the excesses air and thus stays a head of any hazards to take place.

4. CONCLUSIONS

The “THREE AXIS MODERN PNEUMATIC TROLLEY” is working with satisfactory condition we are able to understand the difficulties in maintaining the tolerances and also quality. The three axis pneumatic machine is one of the lifting system in which we can unload the material in the direction up to angle of 180degrees with the help of rotating trolleys the rotation of trolley is provided with the help of electric motor and gear arrangement and unloading of material to e done with the help of pneumatic cylinder.

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