DESIGN AND FABRICATION OF A SCALED DOWN SELF LOAD PNEUMATIC MODERN TRAILER

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Abstract: - This research work has mainly concentrated on the difficulty of the movement of 3 axes on a modern trailer and hence a suitable arrangement has been designed such that the materials can be unloaded from the trailer in three axes without application of any impact force. Our survey is in the regard of several automobile industries that revealed some facts which are most likely difficult methods that were adopted in weighing load especially in difficulties of unloading the materials from the trailer. It is difficult to unload the materials in small, compact streets and roads; therefore, in our project these issues are rectified to unload the trailer in all three sides with ease. The control valve of the trailer is activated manually and hence the compressed air passes to the pneumatic cylinder through the valve. The ram of the pneumatic cylinder acts as a lifting arm of the trailer cabin. This project also focuses on application of self-load weighing such that the material loading and unloading weight display is viewed to cross check while unloading. The automobile engine drive is coupled to the compressor engine, so that it stores the compressed air when the vehicle is running. This compressed air is used to activate the pneumatic cylinder when the valve is activated. Also, rotation of the trailer is done with the help of gear drive system operated by the motor. The whole mechanism is controlled by the operator or driver which is near the driving seat that helps them to operate safely and easily.

Keywords: 3 axes, compressed air, pneumatic cylinder, self-load weighing, gear drive system.

1. Introduction

Transport firms want to transfer goods quickly without being burdened by bureaucracy, paperwork and regular stoppages for authorities to test enforcement. In general, transport companies are also involved in fair competition, which involves applying and prosecuting regulatory standards fairly for all players in the industry Public authorities need to understand how to enhance the overall goals they want to accomplish, e.g. reduced maintenance costs for road infrastructure, reduced impact on the environment from road transport, increased road safety, more effective use of road transport [1]. Automation can be accomplished by computers, hydraulics, pneumatics, robots, electronics, etc. Public authorities need to understand how to enhance the overall goals they want to accomplish, e.g. reduced maintenance costs for road infrastructure, reduced impact on the environment from road transport, and increased road safety, more effective use of road transport. Automation can be accomplished by computers, hydraulics, pneumatics, robots, electronics [2] etc.

Figure 1. Pit mounted weighbridge
One aspect was surprising, that it was very difficult to unload material on complicated locations such as angular sides and directional sides (left and right) of dumper. Dumper truck remained suitable in situations such as these. It ate extra. Trailers are still the most common cause of construction site and factory accidents. A typical dump truck is fitted with an open box that is pneumatically controlled dead hinged at the rear [3]. The front of which can be raised to allow the contents to be deposited on the ground at the side of delivery behind the truck. Nowadays it is possible to rotate dumpers with swivel skips to sideways (3 directional trailer) which become common, particularly for working in narrow sites such as road works but even this technology is inadequate to fulfill our full unloading requirement. This technology is concerned only with solving the unloading problem on truck directional sides.

2. Literature review
Picking the "right" or "ideal" plan building has consistently been a significant worry of the creators. Decrease of frame weight is the most basic assignment of numerous sorts of boats in basic plan. Be that as it may, the estimation strategies accessible for this job truly limit the capacity of originators to make ideal plans of boat structures [4]. A cylindrical ram housing is pivotably connected to the chassis to be lifted in a self-stored chassis leveling hydraulic hammer. A cylindrical hydraulically actuated ram is carried telescopically inside the cylindrical ram frame. Within the ram is housed an electric motor. The engine drives a hydraulic pump which is also in the ram [5].

The pump output passes through a control valve to pipe the hydraulic fluid selectively between a ram extension chamber and a ram retracting chamber to selectively expand or retract the telescoping screw [6]. A three-point tractor hitch allowing an operator to connect or remove an implement without leaving the seat of the tractor. The upper hitch arm contains a linear actuator with hand grip and a manually controlled switch controlling upper arm extension and contraction. A latching device and a hand-controlled latch release are placed on the upper arm to allow connection and release of the upper arm to the upper connecting pin of a hitch mast of the implement [7].

3. Objectives
- To reduce the effort of man power and ensure sufficient accuracy level.
- To operate the trailers, lift at 360 degrees rotation so that the loading and unloading is done with ease at any direction and weight the load at shortest time.
- To incorporate load sensor for intimating the load or weight carried on to the trailer and to improve the loading and unloading system in a trailer lift of the truck or any load carrying trolleys.
- To ensure the availability of equipment at Low cost and to ensure less space is used to weigh large load.

4. Methodology
1) The first step was the selection of the project. After weighing in various factors, such as feasibility, cost, usefulness and the challenges involved, we decided on this project. This was done after extensive discussions with our guide.
2) After the selection of the project, we selected the various general elements necessary for the project. This involved the purchase of a welder and the receipt of a quotation on the steel pipes used.
3) Next, we designed an engine chassis and its accessories, receiver and transmitter unit. We based this on a guided planning structure and made the necessary changes.
4) The electrical components were selected to best suit the needs of the project. The circuit diagram was used as the basis for the selection of components.
5) The next step involved two almost simultaneous steps –the production of the model according to the design and the assembly of the electrical circuits, the calibration of the sensors and the microcontroller.
6) After the production of the model and the completion of the electrical circuits, the
7) We test the integrated unit for accuracy and robustness.
8) If any changes or additions are required, we shall implement them and re-test them until satisfactory results are achieved.

Figure 2. Flow Chart

5. Design calculations

5.1 Pneumatic Cylinder

**Piston rod design:**
- Stacking because of gaseous tension, Piston distance across, (d) = 45 MM
- Acting Weight (p) = 8 KGF/CM²
- Materials used for the bar = C 45
- Yield pressure (σy) = 38 KGF/MM²
- Expecting FOS = 2
- Force following up on your bar (P) = Weight * area
  \[ P = \frac{\pi d^2}{4} \]
  \[ p = 8 \times \frac{\pi \times 4.5^2}{4} \]
  \[ p = 127.23 \text{ KGF} \]
- Stress design (σy) = \[ \frac{\sigma_y}{FOS} \]
= $38 / 2 = 19$ KGF/MM²

\[ \sqrt{\frac{4 \times 127.23}{\pi \times 19}} \]

= $\sqrt{8.52} = 2.91$ MM

∴ Least measurement of the bar required for stacking = 2.91 MM

We’re accepting the distance across of the bar = 15 MM

Structure of the thickness of the chamber:
Material utilized = Cast iron
Accepting within measurement of the chamber = 45 MM
Extreme pressure on the tension = 255 N/MM² = 2550 GF/MM²
Working Stress = Extreme pressure on the tension/ FOS
Assuming, FOS = 4
Working stress (ft) = \[ \frac{2500}{4} = 625 \text{ KGF/CM}^2 \]

According to ‘LAMES EQUATION’
Minimum cylinder thickness (t)
Where,
\( R_i \) = Internal radius of the cylinder in CM.
\( F_t \) = Working stress (KGF/CM²)
\( p \) = Pressure to working KGF/CM²

∴ Substituting the values
\[ t = \frac{2.0 \times \sqrt{\frac{625+8}{625}-8}}{0.322 \text{ CM}} = 3.2 \text{ MM} \]

The thickness of the cylinder is assumed = 3.5 MM
The inside diameter of the barrel = 45 MM
External diameter of the barrel = 45 + 2
= 45 + (2 * 3.5) = 52 MM

Design of Piston rod:
Cylinder Rod Diameter:
\[ \text{Cylinder Rod Force (P)} = \frac{\pi}{4} (d_p)^2 \times f_i \]
\[ P = 127.23 \text{ KGF} \]
\[ \therefore d_p^2 = \frac{75.39 \times (4/\pi) \times 1/625}{0.509} \]
\[ d_p = 0.509 \text{ CM} \]

By standardization, \( d_p = 20 \text{ MM} \)

Piston rod length:
Approach stroke = 180 MM
Length of strings = 2 x 15 = 30 MM
Additional length due to front cover = 14 MM
Extra length of the head of accommodation = 25 MM
Total length of piston rod = 180 + 30 + 14 + 25 = 249 MM

Standardization of piston rod length = 250 MM

1. BALL BEARING DESIGN
No. 5202 Bearing

Outer Bearing Diameter (D) = 40 MM
Thickness of bearings (B) = 15 MM
Internal mounting diameter (d) = 20 MM

\[ r_1 = \text{Corner radii of the pole and lodging} \]
\[ r_1 = 1 \quad \text{(From DDB)} \]
Maximum velocity = 14,500 RPM (From DDB)
Diameter of the mean \( d_m \) = \[ \frac{D + d}{2} \]
\[ d_m = 30 \text{ MM} \]

**FACTOR WAHL STRESS**

\[ K_s = \frac{4c - 0.65}{4c - 1} + \frac{0.65}{2.3} \]
\[ K_s = 1.85 \]

5.2 Specification

1. Double acting pneumatic cylinder

Technical Data

| Parameter                  | Specification |
|----------------------------|---------------|
| Stroke length              | Length of the cylinder stroke 180 mm = 0.18 m |
| Quantity                   | 1             |
| Seals                      | Nitride (Buna-N) Elastomer |
| End cones                  | Cast iron     |
| Piston                     | EN-8          |
| Media                      | Air           |
| Temperature                | 0-60 °C       |
| Pressure Range             | 8 N/m²        |

2. Solenoid Valve

Technical data

| Parameter      | Specification |
|----------------|---------------|
| Max pressure range | 0-12 x 10⁵ N/m² |
| Quantity       | 3             |

3. Flow control Valve

Technical Data

| Parameter      | Specification |
|----------------|---------------|
| Port size      | 0.653 x 10⁻² m |
| Pressure       | 0-6 x 10⁵ N/m² |
| Media          | Air           |
| Quantity       | 1             |

4. Connectors

Technical data

| Parameter        | Specification |
|------------------|---------------|
| Max working pressure | 12 x 10⁵ N/m² |
| Temperature      | 0-120 °C     |
| Fluid media      | Air          |
| Material         | Brass        |

5. Hoses

Technical data

| Parameter       | Specification |
|-----------------|---------------|
| Max pressure    | 12 x 10⁵ N/m² |
| Outer diameter  | 8 mm = 8 x 10⁻³ m |
Inner diameter : $4 \text{ mm} = 4 \times 10^{-3} \text{ m}$

6. Modeling

Figure 3. Frame Body

Figure 4. Spindle

Figure 5. Tray

Figure 6. Shaft

Figure 5. Middle Frame

Figure 6. Pneumatic Cylinder
7. Result and Discussions
A suitable arrangement has been designed such that the vehicles as LCD weighing display to show the exact materials loaded on the vehicle to cross check the loading materials. The trailer has multi direction axis can be easily rotated and tilted according to the comfort of the vehicle. There is the pneumatic system to tilt the trailer up to 30-40 degrees and rotation of the trailer with the help of gear drive system operated by motor. The whole mechanism is controlled by the operator or driver near the driving seat helps them to operate safely and easily.

8. Conclusion
This project work has given us an excellent opportunity and experience to use our manufacturing know-how. When doing this project research, we acquired a lot of practical information about preparation, ordering, assembly and machining. We believe the research of the project is a successful option for bridging the gaps between the institutions and business. We are happy to have effectively accomplished the research with the time restricted.

The "self-load weighing pneumatic modern trailer" is working as per required conditions. We are able to understand the difficulties in maintaining the tolerances and quality. We have used our ability
and skill to make maximum use of available facilities. Thus, we have developed a “self-load weighing pneumatic modern trailer” which helps to know how to achieve low cost automation. This system's operating method is very basic and therefore every unqualified individual should be able to control the device. The prototype can be modified and developed according to the applications through the use of additional processes.

9. Scope of Future work

1. Mounting of shaft to the trailer base.
2. Motor with the electrical components to be connected to the spur gear.
3. Pneumatic cylinder to be connected to the air compressor.
4. Switches and levers are to be connected.
5. Load sensor to be placed.
6. Chassis for the electrical component to be placed are to be welded.

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