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Design and Development of Pneumatic Scissor Lift

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Abstract - *The Scissor lifts are a type of mechanism that allows for vertical displacement of some load, thorough the use of linked and folding supports in a crisscross "X" pattern, referred to as a pantograph or simply a Scissor Mechanism. Scissor lifts are widely used in industrial applications and also a staple design element in competitive robotics. Each arm of the crosses is called a 'scissor arm' or 'scissor member' The upward motion is produced by the application of force by some actuators usually Hydraulic, Pneumatic or mechanical*

***Key Words*: Low-cost application[1], Scissor Lift[2], Pneumatics[3], Actuator[4], Mechanical Advantage[5]**

1.INTRODUCTION

Lift is a very simple device or mechanism used for raising any elements or objects or load from ground level to a specific height to perform a particular task or work with maximum possible load carrying capacity and minimum efforts of a workman. To get this, we required material with higher strength, hydraulic components such as wheels, hydraulics cylinders, etc. all the researchers attempt to optimize all these parameters according to the all requirements. In this project and research, we tried to think about lots of different research papers containing the research & analysis made on scissor lift mechanism evaluated the design and analysis of these Scissor Lift.

1.1 PROBLEM STATEMENT

Many industries require periodic maintenance of some machines, overhead cranes, light system, electrical maintenance, etc. So, all of this component is not within human reach from maintenance point of view. So, use of ladder, ropes are brought in consideration for maintenance work. So, to overcome this situation we are constructing Pneumatic lifting machine.

We are selected to construct Pneumatic Lifting Machine rather than Hydraulic because, in some cases we can't afford the hydraulics system because we want to use it for smaller scale work. So, it's a waste of money to use hydraulic machine for maximum 150 to 200 kg load, Pneumatics are ideally suitable for that.

1.2 COMPONENTS INVOLVED

1. **Pneumatic cylinder**
2. **Flow control valve (5/2 DCV)**
3. **Pneumatic connector**
4. **Pneumatic pipes and hoses**
5. **Structure frame**
6. **Roller wheels**

2. LITERATURE REVIEW

Prushotam & Apsad Ali, done the work on, Design and Analysis of Hydraulic Scissor Lift by Using ANSYS, this paper mainly tells about force following up on the pressure driven scissor lift when it is contracted and expanded. In most of the cases hydraulic lift is used to lift heavy objects like vehicle in automobile industry. In planning a machine Material choice is a key job and further more changes on a few factors, for instance, unsteady quality, quality obstruction which at long last increases the life of scissor lift. The plan is performed by considering pressure driven hydraulic scissor lift as a convenient, conservative and much appropriate for medium and high level of load carrying mechanisms.

Plan of water powered framework scissor lift is finished utilizing CATIA V5 R20 with appropriate demonstrating and imported to ANSYS V17.0 for examination and stimulation. As result, the static observation of the pneumatic scissor lift incorporates add up to imbalanced force, load, Equivalent pressure, weight was performed in ANSYS and every fusion add up to defacement load, Equivalent pressure, force, weight was performed in ANSYS and every single reliable parameter were anatomized with the end goal to check the similarity of the outlines . The computational estimations of three different materials, for example, auxiliary steel, carbon fibre and Aluminium Alloy are looked at for best outcomes. From all the experimental analyses performed, it can be clearly seen that Carbon Fibre material has extremely low weight than other conventional materials being use for manufacturing of machines like scissor lifts . The design and manufacturing of a remote work platform lifted by a hydraulic cylinder was carried out to meet the need of design standards.

Gaffar Momin, Karan Dalvi, Rohan Hatti, Rohit Devare, Faisal Bargi, , completed the work on, Design - Manufacturing and

Inspection of Hydraulic Scissor Lift, where the subsequent paper describes the design, construction as well as analysis of a hydraulic scissor lift. Conventionally a scissor lift is used for lifting gain access to go to the underside of the vehicle, to lift up the body to maximum height, and many other applications Also such as lifts can be used for various purposes like maintenance , cleaning and many material handling work operations . It can be built of mechanical, pneumatic or hydraulic type. The detailed overall design explained in this paper is developed keeping in mind that the lift can be operated by mechanical means by using pantograph so that the overall cost of the scissor lift is reduce as much as possible . In our case our lift was required to be designed in such a way that a portable and also work without consuming any electric power supply so we decided to use a hydraulic hand pump to pressurized the cylinder Also such design can make the lift more compact and much suitable for medium and high scale operations . In last, the analysis of the scissor lift was completed in ANSYS designing software & all responsible parameters were demonstrated in order to check the compatibility and requirement of the design values. The design, development & manufacturing of a remote work platform lifted up by a hydraulic cylinder was carried out in proper way by meeting the required design standards norms. The remote work platform is operated by hydraulic cylinder which is operated by a hand pump ergonomics Of a workman working in the workshops or compony is a responsibility of an organizations . operators comfort is also an important thing. Hence, by making this hydraulic lift we improved the comfort level of the operator working on the cold forging machine in his work place.

Our main motive behind developing this lifter was providing comfort to the operator and material handling. This was considered as a radical improvement in the productivity by the company or industry. We can design scissor lift for high load also if a proper High capacity hydraulic cylinder is considered. The pneumtic scissor lift mechanism is very simple in operation and does not require regular maintenance. It can lift very heavy and high loads. The main constraint of this device is it has high initial value, but has a very less operating cost. To obtain high strength the shearing tool should be heat treated.

Ankita Chimote, Prof. Vinod Bhaiswar, Ass.Prof. Vishal Kshirsagar, done the work on, Review on Industrial Scissor Lift, this paper evaluated the design and analysis of industrial Scissor Lift. It gives the brief overview and description of its all types, system requirements , working & design methodologies. This paper examine the need of designing jack to overcome system requirement by selecting appropriate drive system as per the application. This paper gives the design methodologies of pneumatic scissor lift. Also, industrial requirements and the application of pneumatic scissor lift are elaborated. Various 3D software is used for modelling. ANSYS software is used to carry the analysis of this mechanism. Amalgamation of different material and their results are given which leads to proper material selection to meet the standard system requirements.

3. CONSTRUCTION

3.1. Scissor arms:

Leg deflection due to bending is caused due to stress. As the length increases of scissor leg it is more difficult to balance it and stress concentration point also changes. To improve resistance to deflection leg strength is increased via increasing strength of leg material and also using high strength material, but can create a potentially undesirable increased collapsed height of the lift.

3.2. Platform Structure:

If center of gravity of loads moves from the center (distributed evenly) to any edge (eccentrically loaded) of the platform then platform bending may occur. Through lifting of scissor lift, the rollers roll backs towards the platform hinges and create an overhung and unsupported part to the base platform assembly. High central loads applied to this unsupported ends of the platform can cause bending of the base platform.

3.3. Base Frame:

Basically the base frame is mounted to the floor and should not experience any type of deflection. Because its fixed to its position for stability of whole mechanism. In such cases where the scissors lift is mounted to an portable frame, the base frame must be rigidly supported from below to support the point loading created by the two scissor leg roller and the two scissors leg hinges.

3.4. Pinned Joints:

Scissor lifts are attachedor joined at all end points, and each pin runs through clearance between Outer Diameter of the pin and the Inner Diameter of its clearance bushing or hole. The more scissors pairs or scissor mechanism that are assembled on top of each other, there are more pinned connections to accumulate movement or deflection, when compressing all these designed clearances.

3.5. Pneumatic Cylinder

Our project is on Pneumatic control system. The Pneumatic piston cylinder is an actuator which converts pressure of compressed air to displacement. When their is pressure difference between both the ends of piston cylinder to neutralize these the displacement of piston rod occurs. The speed of these motion is directly proportional to the pressure difference between both end. There is a two port in double acting cylinder through which the supply of air is

reversed in direction to cause displacement in both direction. Cylinders of those lift are nearly flat within each of the scissors legs once the lift is absolutely lowered at bottom and should produce initial horizontal forces up to five to ten folds of the amount of the load on the bottom base platform of scissors lift because of the mechanical disadvantage of their machine geometries. In result of that, there are lots of stresses and ensuing deflection placed on the scissors inner leg member or members that are designed to impede these cylinder forces. As already mentioned higher than any alteration in column length of the elevating actuator , results vertical lift movement is multiply by 5 of that amount of change

3.6. Pneumatic Circuit:

All trapped air should be for the pneumatic circuit through approved â€oebleedigâ€ procedures â€“ air is extremely compressible and is rarely the culprit once a scissors lift over compresses below load and otherwise bounces throughout operations.

Air as a fluid can compress slightly lower pressure. And because of there's assosiate nearly ten bar of operating maximum of lift travel to cylinder stroke for many scissors lift designs , there is a ensuing ratio of scissors lift compression to cylinder compression. All high pressures, changeable hosing is probably going to degree of hose bulge once the system pressure is exaggerated. System pressure fells significantly owing to this exaggerated hose volume, and therefore the scissors table wedging under load upto the most system pressure is re-established. And as with compressibility, the resulting lift movement is five folds the modification in oil column height within the hose.

3.7. 5/2 Valve DCV:

In our machine, we used two 5/2 valve to direct the flow of compressed air on the either side of piston for the reciprocating motion of same. The directional control valve must direst the flow from the compressor either to port A or port B. The fluid exhausted by the cylinder must be directed from the other port to back to tank. The above given valve has 2 positions and 5 ports so that's why it is called as 5/2 directional control valve. Valves are required to control the flow rate, pressure and direction of the fluid. These pneumatic systems are comparatively low pressure systems. Pneumatic valves are made from cheaper materials like aluminium and polymers and are cheaper to manufacture. The DCV must give the flow from the compressor to port A or B. The valve we used and shown has five ports and two positions so it is designated as a 5/2 DCV. It is noted that the third position in a 5/2 valve is center position. The air control mechanism within the 5/2 DCV is moved towards the center position inside the DCV by one internal spring valve actuator from two of them. The spring is located inside the valve at every end of the internal spool.

4. WORKING

A frame is supporting all pneumatics & scissor mechanism of a machine as shown in fig.4.1 Here we used a compressor for a generation of compressed air. A compressed air is supply to the double acting cylinder by means of pneumatic hose pipe & 5/2 Direction control valve. The scissor mechanism is provided at end of the pneumatic cylinder rod. When compressed air is supply by the DCV to double acting cylinder due to pressure & force created by compressed air causes rising action of the load. Here the advancement of the scissor mechanism is carried out in the upward and the downward direction using the pneumatic double acting piston and cylinder unit arrangement with the hand lever operated DCV(Direction control valve) . In this machine the high pressure compressed air is used as the working fluid for the transfer of power, force and the motion to the system. We developed a model of the pneumatic scissor lift . In this mechanism we used piston cylinder with smaller stroke. But if we want to develop a pneumatic scissor lift that is to be used in the factory floor, we can use the piston cylinders with higher stroke and Bore diameter to get the extra movements and force of the pneumatic scissor lift . Also, for high load lifting capacity.

Fig -1: **Pneumatic Scissor Life**

5. DESIGN

5.1. Design of Base Frame:

The base frame in a scissor lift only provides proper balance and stability to the structure. Considering the size constraints, the dimensions of the base frame were taken as follows. Also, it had been considered that not much of the stresses are developed in the base frame.

Fig -5.1: **Base Frame**

5.2. Design of Pin:

Pin is the most important factor in scissor lifting mechanism. It connects the top and bottom frame because of that we have to use pin with some extra higher strength in it . In scissor lifter, pin underwent the shear stress. Shear stress is a force per unit cross sectional area.

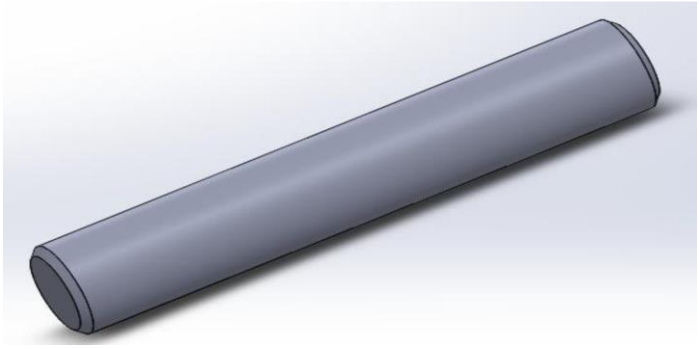

Fig -5.2: Pin

Pin goes under shear stress,

$$\tau_{all} = \frac{0.5 \times yield\ stress}{FOS} = \frac{0.5 \times 250}{4}$$

$$\tau_{all} = 31.25 N/mm^2$$

$$\tau_{all} = \frac{P}{2A}$$

$$31.25 = \frac{500}{2 \times \frac{\pi}{4} \times d^2}$$

$$d = 3.19mm$$

Therefore, we selected 5mm diametric pin.

here,

τ_{all} = allowable shear stress in pin (N/mm^2)

P = Total force applied on pin (N)

A = Cross sectional area which is in shear - mm^2

5.3. Pneumatic Cylinder:

The pneumatic cylinder is mounted in inclined position.

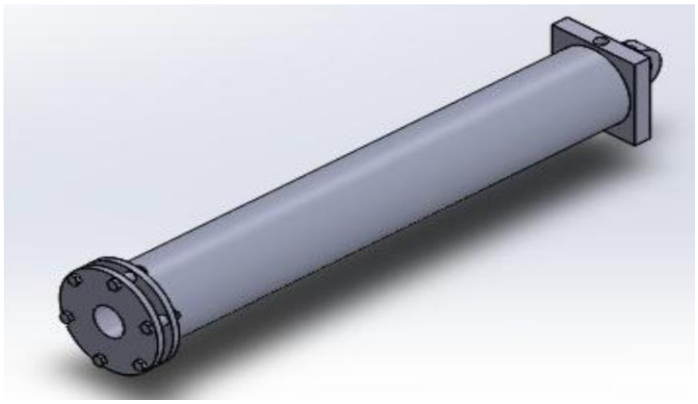

Fig -5.3: Pneumatic Cylinder

The total load acting on the cylinder consists of Mass to be put on lift = 100 kg = 981N = 1000N.

For cylinder design we use pressure equal to 6 bar

i.e. 0.6 N/mm^2

Therefore, $P = \frac{F}{A}$

$$0.6 = \frac{1000}{2 \times \frac{\pi}{4} D^2}$$

$$D = 46.065mm$$

Therefore, we selected 50 mm diametric cylinder.

6. CONCLUSIONS

The following conclusions are made from this whole project work:

1. During working it is found that the natural frequency of lift should not be equal to the external excitation frequency hence no vibration in the lift.

2. A portable work platform pneumatic scissor lift is designed for high load resistance.

3. The pneumatic scissor lift is simple in use and does not require routine maintenance.

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REFERENCES

[1] Prushotam & Apsad Ali, Design and Analysis of Hydraulic Scissor Lift by Using ANSYS, Shodh Sangam - A RKDF University Journal of Science and Engineering, Vol.-02, No.-01, Feb-2019, Page-12-20.

[2] Gaffar G Momin, Rohan Hatti, Karan Dalvi, Faisal Bargi, Rohit Devare, Design, Manufacturing and Analysis of Hydraulic Scissor Lift, International Journal of Engineering Research and General Science Volume-3, Issue-2, Part-2, March April, 2015, pp 733:740

[3] Chimote Ankita, Prof. Vinod Bhaiswar, Ass.Prof. Vishal Kshirsagar, Review on Industrial Scissor Lift, International Journal For Technological Research In Engineering Volume 6, Issue 8, April-2019,pp. 5395-5396.

[4] Anupam Chaturvedi, Prof. Jyoti Mishra, Prof. Parmar Vijay, An Improved Scissor Lift working on Lead Screw Mechanism Aerial Scissor Lift and its Accessories, International Journal of Advance Engineering and Research Development Volume-4, Issue-2, February -2017,pp. 89-95

[5] Suraj B, Dhanawade, Shubham S. Bhujbal, Rohan R. Dhane, Prof. Rahul R. Narkar , Prof. Sangram S. Bhosale, Design, Analysis and Development of Hydraulic Scissor Lift Material loading and unloading , International Journal of Advance Engineering and Research Development Volume-4, Issue -3, March : 2017,pp. 214-221

[6] Sabde Abhijit Manoharrao, Prof. Jamgekar R.S., Analysis & Optimization of Hydraulic Scissor Lift, International Journal of Engineering Development and Research, 2016 IJEDR | Volume 4, Issue 4,pp.329- 347.

[7] Kapatel Jainil ,Prit Patel, Rana Mitul, Prof. Mihir Rana, Prof. Jayesh Patel Proposed Work on Scissor Lift, IJSRD - International Journal for Scientific Research & Development| Vol. 5, Issue 06, 2017,pp. 414-416.

[8] M. Kiran Kumar, J. Chandrasheker, Mahipal Manda , Dr. Vijay Kumar, Design and Analysis of Hydraulic Scissor Lift, International Research Journal of Engineering and Technology, Volume: 03 Issue: 06 | June 2016 pp 1647 : 1653.

[9] Pentamalla Srinivasulu & Mr. K. Sainath, Design And Analysis Of Scissor Lifiting Mechanism, International Research Journal of Engineering and Technology (IRJET),Volume: 06 Issue: 06 | June 2019,pp. 446-452.

[10] Doli Rani, Nitin Agarwal & Vineet Tirth, Design and Fabrication of Hydraulic Scissor Lift, MIT International Journal of Mechanical Engineering, Vol. 5, No. 2, August 2015, pp. 81-87.

[11] Mahmut Can Şenel, Cengiz Görkem Dengiz, Kemal Yıldızl, Erdem Koc. Design and Analysis of Scissor Lifting System by Using Finite Elements Method Universal Journal of Materials Science 6 (2) 2018, pp.58-63.

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