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Review on Hydraulic Scissor Lift

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Abstract - Lift may be a very simple device used to raise elements or objects or load from ground level to a specific height to perform a particular work with maximum load capacity and minimum efforts of a worker. To achieve this we required the higher strength material, hydraulic components such as hydraulic cylinder, wheels, etc. all the researchers attempt to optimize these parameters according to the concerned requirement. In this review paper, it had been tried to think about different research papers containing the research and analysis made on scissor lift evaluated the design and analysis of hydraulic Scissor Lift. It gives a brief description of its types, working, system requirements and design methodologies. This review paper also focused on the analysis of some research papers containing the entire study of components (hydraulic or pneumatic cylinder, spacing shaft, and platform and scissor arm), selection of material, and analyzes the dimension of components. After the analysis of the research papers, the longer-term scope of the research was also suggested.

Keywords- Hydraulic jack, Scissor lift, Design, Safety.

1. INTRODUCTION

A scissor lift is a sort of platform which will move only vertically. With Today's development of science and technology, more and more new technologies were applied to material handling. The main aim of the scissor lift was material handling and providing comfort to the operator while performing the operation. The scissor lift was convenient to operate or use and it will be used frequently in industries and other common places. A scissor lift table is used to hold, stack, raise or lower, convey or transfer materials or loads between two or more height. The mechanism used in a scissor lift to achieve this function was nothing but the utilization of linked, folding arms during a criss-cross 'X' pattern, referred to as a pantograph. A scissor lift provides the most economically dependable and versatile methods of lifting heavy loads in the industry; it had few moving parts which can only require lubrication. A scissor lift used to extend or retract a platform by pneumatic, hydraulic, or mechanically. There are some applications of hydraulic jack are pallet handling, vehicle loading, and work positioning, automatic production lines, distribution lines, and so on. Scissor lifts (Aerial work platforms in general) are generally used for temporary access purposes like maintenance and for construction work for emergency access, which distinguishes them from permanent access equipment like elevators. They're designed to lift limited weights. The extension and retraction action of the scissor arms are mostly done by hydraulic, pneumatic, or mechanically.

A Scissors lift is the most economical device to raise the load. It is also a dependable and versatile method of lifting heavy loads. Scissors lifts have less moving parts; they are well lubricated and provide many years without giving trouble. These lift tables raise the loads smoothly to any required height and may be easily configured to satisfy the required speed, capacity, and footprint requirement of any hydraulic lifting application. And it is so popular and efficient of all styles of scissors lift used in material handling applications.

2. COMPONENTS OF SCISSOR LIFT

Hydraulic scissor lift tables contain five major components:

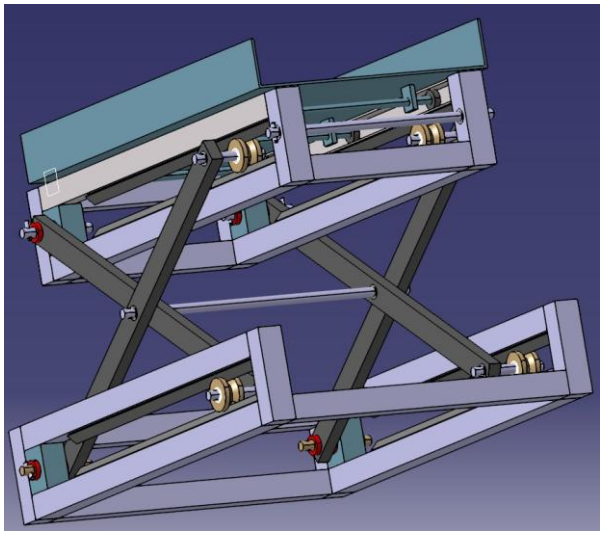

Fig.1: Components Of Scissor Lift

- **Platform**: This is the top of the lift table where lifted heavy work pieces. It can be available in a variety of sizes. This component is subjected to the weight of the work piece and his equipment, hence strength is required.
- **Base platform**: This is the bottom of the structure that rests on the ground. It contains the track the scissor legs travel in his component is subjected to the load of the top platform and the scissors arms. It is also liable for

the stability of the whole assembly, therefore strength. Hardness and stiffness are needed mechanical properties for the scissor lift.

- **Scissor legs**: These are the vertical members that allow the platform to vary elevation. This component is subjected to buckling load and also bending load causes breaking or cause bending of the components. Hence based on strength, stiffness, plasticity, and hardness requirement the recommended material is stainless steel or mild steel. The longer the scissors legs are, the harder it is to control bending under heavy load. Increased leg strength via increased leg material height also improves resistance to deflection.
- **Hydraulic cylinder:** Industrial scissors lifts are mostly operated by one, two, or three single-acting hydraulic cylinders. These allow the scissor lift table to lift and lower the load to the required height. This component is called a strut with both ends pinned. So they are subjected to direct compressive force which would cause bending stress which can cause buckling of the component. It is subjected to internal compressive pressure which generates circumferential stresses and longitudinal stresses all around the wall thickness. Hence necessary material property must be include strength, ductility, toughness, and hardness
- **Motor or Power Source:** Generally hydraulic scissor lifts are powered by an electric motor or air motor.

These provide power to the hydraulic pump which actuates the lift table to move upward or downward.

3. PRINCIPLE OF WORKING

Hydraulic scissor lift works on the principle of Pascal Law. The principle of transmission of fluid-pressure or Pascal Law is the principle in fluid mechanics that explain that the pressure applied anywhere in a confined incompressible fluid is transmitted equally in all directions throughout the fluid such that the pressure variations (initial differences) remain the constant. The common logic behind every hydraulic mechanism is very simple that is Force that's applied at one point is transmitted to another point using an incompressible fluid. The force is almost always multiplied in a process. A common hydraulic mechanism consists of two pistons and an oil-filled pipe connecting to them. Due to the shape of the original device, a pantograph is also referred to as a sort of structure that will retract or extend like an according, forming a characteristic rhomboidal pattern. The rhomboidal pattern will be found in the extension of arms for wall-mounted mirrors, temporary fences, scissor lifts, and other scissor mechanisms like the pantograph is utilized in electric locomotives and trains.

The hydraulic type scissor lift replaced the lead screw by a hydraulic ram or hydraulic cylinder powered by a pump or an electric motor and generator. One outstanding feature of this design however is that its independent operation and increased efficiency. Fluid power is one among the greater form of power where small input causes results in a very large amount of output. This scissors lift often handled by one person to an area of use, and power the generator. The hydraulic lift does not lift the load immediately; firstly the operator's climbs on the platform and opens the hydraulic circuit by switches thereby leading to an upward extension of the lift. When the specified height is reached the circuit is closed, and lifting stops the control panel or station is located on the top frame of the lift. When work gets completed, then the scissors lift is folded by using a hydraulic circuit and handled back to the point of collection.

4. LITERATURE REVIEW

Gaffar G Momin, et al found that design as well as analysis of a hydraulic scissor lift. Conventionally a scissor lift or jack is employed for lifting a vehicle to change a tire, to gain access to travel to the underside of the vehicle, to lift the body of the vehicle to appropriate height, and lots of other applications also such lifts can be used for various purposes like maintenance and many material handling operations. The lift can be of mechanical, pneumatic, or hydraulic type. The design of the lift described within the paper is developed in such a way that the lift is operated by mechanically means by using a pantograph such that the overall cost of the scissor lift is reduced to some extent. In our case, we required the lift is portable and also works without consuming any electric power source so they decided to use a hydraulic hand pump to power the hydraulic cylinder Also a such design can make the lift more compact and much suitable for medium scale work. Finally, the analysis of the scissor lift was done in ANSYS and also all responsible parameters were analyzed to check the design of the lift [1].

M. Kiran Kumar, et al concluded that force is also acting on the hydraulic scissor lift when it is extended and contracted. Generally, a hydraulic scissor lift is used for lifting and also holding heavyweight components. Material selection plays a very important role in designing a machine and also influence on several factors such as durability, reliability, strength, resistance which finally helps to increase the life of scissor lift. The hydraulic lift design such a way that it must be portable, compact, and more suitable for the medium type of load handling application. Drafting and drawing of the hydraulic system of a scissor lift are done using solid works software with suitable modeling and imported to Ansys workbench software for meshing and analysis of lift. Hence, the analysis of this scissor lift includes Total deformation load, and Equivalent stresses were done in Ansys software and all other responsible parameters of the lift were analyzed to check the compatibility of the design value. The computational values of two different materials such as aluminum and mild steel are also compared for the best results [2].

Uttam Panwar, et al stated that operating mechanism and study of hydraulic lift. This research paper solves material handling and provides comfort to the operator. This paper shows the study and also the design of hydraulic scissor lift components. It can lift up 300kg of load with a raise of 3.5ft. The main aim of this research paper is to study the hydraulic scissor lift also design and fabrication of hydraulic scissor lift. In this case, lift has to be movable and portable so rollers or wheels are provided for motion at the bottom side of the lift and also we can't use electric power in this lift so they use a hydraulic pump. Hydraulic generate more and accurate pressure. By use of this mechanism and design hydraulic lift became more efficient and can operate in industries. The purpose of this research is to use all components effectively gives good results [3].

Deepak Rote, et al revealed that design as well as analysis of a mechanical scissor lifts which works on the principle of screw jack. The scissor lift may be of mechanical or pneumatic or hydraulic type. This type is separated according to the lifting mechanism utilized in the construction of the lift. The lift is selected such that calculation regarding lift allowable maximum deflection must not be exceeded limit. To determine, solid modeling and computer simulations were involved using CAE software. Several linear static FEA analyses have been done to get the correct results. Also, these results can be cross-check by using manual calculations simultaneously. The result shows that the designed component of scissor lifts remains within the acceptable range. However, some manufacturers find the allowable maximum deflection is just too excessive to improve the factor of safety. Perhaps, advice on critical areas to the application must be given and other safety precautions must be taken to avoid the failure during operating conditions. With such a design of a scissor lift, the complexities in the design can be reduced so that the manufacturing time of a scissor lift can be reduced. Mechanical scissor lift operates at a very simple principle of screw jack. This consumes less amount of energy as compared to other types of scissor lifts. Also, it makes the lift portable. A height of 5 feet can be easily achieved. Also, the results on ANSYS show that this design is safe for high loads. That means this lift is capable of lifting the weight up 1000 kg with a minimum amount of effort. Such a type of lift mostly used in automobile industries and also for production industries. Also, further modifications can be implemented for optimizing the design and further analysis can also be carried out for better optimization related to scissor lifts [4].

Doli Rani, et al describes scissor lift can be designed for high load also if a suitable high capacity hydraulic cylinder is used. The hydraulic scissor lifts simple in use and does not require routine maintenance. It can also lift heavier loads. For the present dimension, they get a lift of 5 ft., the scissor lift can lift a load of 1.5 – 2 tons. The main factor of this lift is its high initial cost but has a low operating cost. The shearing tool should be given to heat treatment to achieve high strength. Savings resulting from the utilization of this device will make it pay for itself within a short period and it can be an excellent companion in any engineering industry dealing with rusted and unused metals. This device affords much more scope for modifications for future improvements and operational efficiency, which should make it commercially available and attractive. Hence, it's having number of application in industries, hydraulic pressure system, for lifting of a vehicle in garages, maintenance of huge machines, and for staking purpose. So, it is recommended [5].

N. Pandit, et al studied the design, analysis, and safety requirements of the scissor lift. It is a versatile material handling equipment that can use hydraulic, pneumatic, or mechanical energy as input for its working. For designing, forces can be calculated by considering the equilibrium of the system at both the positions, closed and open. The various attachments can be added to the equipment which ensures the safety of the worker operating it and gives the guidelines for handling the unit [6].

Wubshet Yimer, et al made a conclusion in this paper that the design and fabrication of a portable work platform of the lift which is elevated by one hydraulic cylinder were carried out effectively and meeting the necessary design criteria. The double type of scissors lift is elevated by one hydraulic cylinder and it is operated by the foot pedal. This scissor lift is design for average load purposes, because the higher the load more the effort required for raising the load from ground level. The hydraulic scissor lift is easy to use and does not require continuous repairs and maintenance. It can also lift heavier loads. For the given dimensions of the scissor lift can raise a load up to 280 kg up to the height of 1000mm. Hence, its extensive application in industries, hydraulic pressure system, for the lifting of a vehicle in garages, maintenance of huge machines, and for staking purpose [7].

Sandeep G. Thorat, et al found that Hydraulic scissor lift is designed for high load resistance. Scissor lift is easy to use and daily maintenance is not required. Mild steel is selected for the manufacturing of scissor lift because it has greater durability, strength, easy and cheap availability. For the given dimensions of the scissor lift, it can lift a load in the range between 3000 to 4000 kg up to the height of 7ft. The lift provides plenty of scope for modification for further improvements and operational efficiency [8].

Georgy Olenin, et al studied that the design and analysis of scissor lifting platform for both for the highest and lowest position. Also, the working principle of scissor lift and types are discussed in this paper. Along with design the faults occurring during the operation of the scissor lift and their methods of elimination are provided to improve productivity. Design calculations are carried out by using concept of free body diagram and slandered formulae. In this paper numbers of cases are given for cylinder mountings which depended on the angle of inclination of the cylinder

and also the transferred force by the cylinder on arms. The analysis is carried out with the help of shear force diagram also bending moment diagram [9].

5. FUTURE SCOPE

1. The upper base can be made with a sliding mechanism so it is easy for heavy jobs can easily slide over the base.
2. The design can be made more compact and material made lighter and low frictional contact.
3. By providing the roller at the base support scissor lift is portable.
4. By providing the foot pedal to the lift so we can avoid the hydraulic motor so it does not require the electric connection and the lift become more portable and move to any corner in the industry.
5. By using the mild steel and aluminum alloy it makes a more durable.
6. We can increase contact force between the shaft and pinion to prevent slipping and allow lifting of larger weights.
7. The number of plates in the scissors can be increased to improve the height to the number of rotations ratio.

6. CONCLUSION

1. The portable work platform is operated by a hydraulic cylinder which is also operated by a hand pump by of a person or an operator working in the company premises is the responsibility of an organization so it is an important thing to give some amount of comfort to the operator. Hence by making this hydraulic lifter we improved the comfort level of the operated working on the machine.
2. The natural frequency of lift should not be equal to the external excitation frequency hence no vibration in the lift.
3. A portable work platform hydraulic scissor lift is designed for high load resistance.
4. The hydraulic scissor lift is simple in use and does not require routine maintenance.
5. The scissor lift reduces the complexities in a design and fabrication time was reduced.
6. But the limitation of this lift is the initial cost. The design and fabrication of a portable work platform raised by a hydraulic cylinder were carried out meeting the required design standards.
7. The portable work platform of a scissor lift is operated by a hydraulic cylinder which is operated by a motor.
8. The scissor lift can be design for high load also if a suitable high capacity hydraulic cylinder is used.
9. It can also lift heavier loads. The main objective of this device is its high initial cost but has a low operating cost.

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