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Fabrication of Hydraulic Scissor Lift

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ABSTRACT

This report focused on force acting on the hydraulic scissor lift when it is extended and contracted. Generally, a hydraulic scissor lift is used for lifting. Material selection plays a key role in designing a machine and also influence on several factor such as durability, reliability, strength, resistance which finally leads to increase the life of scissor lift. The following project describes the fabrication of a hydraulic scissor lift. Conventionally a scissor lift is used for lifting the body to appreciable height, and many other applications also such lifts can be used for various purposes like maintenance and many material handling operations. It can be of mechanical, pneumatic or hydraulic type. The design described in the report is developed by keeping in mind that the lift can be operated by mechanical means by using pantograph shaped scissor, so that the overall cost of the scissor lift is reduced. The upward motion is achieved by the application of hydraulic cylinder which is placed vertically. In our case upward motion of the lift was to be designed in a portable manner and also which works without consuming any electric power so we decided to use a hydraulic cylinder.

Keywords : Hydraulic Cylinder, Scissor Arms, Lifting The Body

I. INTRODUCTION

The project is aimed at fabrication and constructing a hydraulically powered scissor lift to lift the body at a certain height. The lift is expected to work with minimal technical challenges and greater comfort due to its wide range of application. The device can easily be handled and can be operated by a single person. A hydraulic scissor lift is a mechanical device used for various applications for lifting of the loads to a height or level. A scissor lift provides most economic dependable & versatile methods of lifting loads; it has few moving parts which may only require lubrication. The lift raises load smoothly to any desired height. The scissor lift can be used in combination with any of applications such as pneumatic, hydraulic, mechanical, etc. Scissor lift design is used because of its economically friendly as compared to other heavy lifting devices available in the market. The frame is very sturdy & strong enough with increase in structural integrity. Industrial scissor lifts are used for a wide variety of applications in many industries which include manufacturing, warehousing, schools, grocery distribution, military, hospitals and printing. This factor depends on the position of the points chosen to connect an actuator and the number of cross bar stages. The amount of force required from the actuator is also amplified, and can result in very

large forces required to begin lifting even a moderate amount of weight if the actuator is not in an optimal position. Most are powered either pneumatically or hydraulically. This then allows workers to work on a required height, example changing bulb of a street light. Other uses include use by fire brigade and emergency services to access people trapped inside building. However generally they are designed to lift fairly light loads and so cannot be used to elevate vehicles, generators or pieces of architecture for which a crane would more likely be used. In some cases however elevated work platforms can be designed to allow for heavier loads.

Fig1: Simple

Hydraulic scissor lift

Types of Scissor lift

The scissor lifts can be classified as follows:

- Hydraulic lifts
- Pneumatic lifts
- Mechanical lifts

Hydraulic Lifting

The hydraulic lift makes use of fluid pressure to produce smooth movement during lifting. It has some benefits when compared to other lifting device; firstly, its dependency on power supply is eliminated. Secondly, it allows smooth movement without jerking due to steady increase in fluid pressure, majority of lift platform in market make use of hydraulic. Above all it has a high capacity in terms of lifting.It is not economical to the common technician or artesian. Since it make use of oil, it require a temperature range for it proper storage. It is very difficult to move from place to place due to its complex design. Studies have shown that hydraulic lift that operates on two cylinders at most time experience delay in one of the cylinder to actuate due to poor cross feeding between cylinders. Sometime debris from improperly preserved oil block oil tubes and at times disrupts proper functioning of the system.There is frequent problem of seal leakage. Aging problem of oil leads to failure in valves and shorter life of pumps. There is problem of accumulation of debris in oil tank.When you are designing an application that involves hydraulic cylinders, it's important to consider operating conditions. Cylinders must match a specific application in terms of the amount of pressure, the force exerted, and space requirements imposed by the machinery's design. But knowing the operating requirements is only half of the challenge. Cylinders must be able to withstand extreme high or low temperatures for some designs.Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The barrel is closed on one end by the cylinder bottom also called the cap and the other end by the cylinder head also called the gland where the piston rod comes out of the cylinder.

Cylinder Barrel

The main function of the cylinder body is to hold cylinder pressure. The cylinder barrel is mostly made from honed tubes. The surface finish of the cylinder barrel is typically 4 to 16 microinch. Honing process and Roller burnishing process are the two main types of processes for manufacturing cylinder tube. The piston reciprocates in the cylinder. The cylinder barrel has features of smooth inside surface high precision tolerance, durable in use.

Cylinder base or cap

The main function of the cap is to enclose the pressure chamber at one end. The cap is connected to the body by means of welding, threading, bolts, or tie rod. Caps also perform as cylinder mounting components. Cap size is determined based on the bending stress. A static seal is used in between cap and barrel.

Cylinder head

The main function of the head is to enclose the pressure chamber from the other end. The head contains an integrated rod sealing arrangement or the option to accept a seal gland. The head is connected to the body by means of threading, bolts, or tie rod. A static seal is used in between head and barrel.

Piston

The main function of the piston is to separate the pressure zones inside the barrel. The piston is machined with grooves to fit metal seals and bearing elements. These seals can be single acting or double acting. The difference in pressure between the two sides of the piston causes the cylinder to extend and retract. The piston is attached with the piston rod by means of threads, bolts, or nuts to transfer the linear motion.

Piston rod

The piston rod is typically a hard chrome-plated piece of cold-rolled steel which attaches to the piston and extends from the cylinder through the rod-end head. In double rod-end cylinders, the actuator has a rod extending from both sides of the piston and out both ends of the barrel. The piston rod connects the hydraulic actuator to the machine component doing the work. This connection can be in the form of a machine thread or a mounting attachment. The piston rod is highly ground and polished so as to provide a reliable seal and prevent leakage.

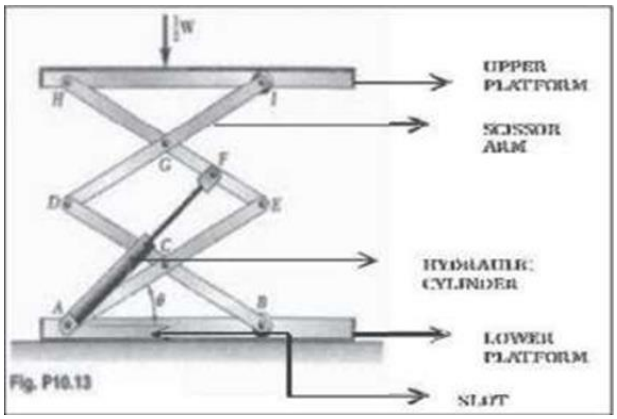

Fig 2 : Mechanism of Hydraulic lift.

II. Applications

After all these efforts, our experiment reached the final stage of trials, we tried to be lifted using one foot each time which is the safest way in order to avoid instabilities. However, we also tried to make a siltation in order to open both shoes simultaneously. Although, this is a more dangerous way to lift up, it is the most impressive way to do so. Then, we tried to make some steps which is very hard to be achieved as the weight of the shoes is heavy enough. We also used them in multiple tasks with a great success such as to change the lamp, to polish some high points, to clean a tall car and to cut fruits from a tree.A hydraulic lift typically uses hydraulic cylinders to either raise or lower platforms for work. Hydraulic lifts are cheaper to install than others.

III. Literature survey

Man's quest for improvement has never been satisfied. The drive towards better and greater scientific and technological outcome has made the world dynamic. Before now, several scientist and engineers have done a lot of work as regards the scissors lift in general.

Mechanical Scissor Lift

The mechanical scissors lift is used for lifting materials especially on construction sites. This is one of the most recent advancement on scissors lift. There, the lift utilizes a belt drive system connected to a load screw which constructs the "X" pattern on tightening and expands it on loosening. The lead screw actually does the work, since the applied force from the wheel is converted to linear motion of the lift by help of the lead screw. This can be used to lift the working and equipment to a height.A general knowledge however, regarding screws will reveal the loss due to friction in the screw threats. Therefore, the efficiency of this device is low due to losses in friction. Also, the power needed to drive the machine is manual, and much energy is expanded to achieve a desired result. Its suitability however, cannot be overemphasized as it can be used in almost every part of the country whether there is availability of electricity or not.truction of a hydraulic sciss The scissor lift has a unique mechanism which uses worm and worm wheel. This mechanism provides a self-locking system which makes the scissor lift completely safe for use. Unlike the hydraulic systems, thisThe scissor lift has a unique mechanism has to be driven to bring the platform back down. This gives us the opportunity to use this lift as a machine part for accurate elevation. We have calibrated the lift with respect to each rotation of the angle.

IV. Methodology

Deflection in scissors lifts can be defined as the change in elevation of all parts to the original size of entire assemblies from the floor to the top of platform deck, whenever loads are applied to or removed from the lift. Each component within the scissors lift has the potential to store or release.Energy when loaded and unloaded. Deflection takes place in all parts of scissor lift i.e. Scissors Legs, Platform Structure, Base Frame, Pinned Joints. To reduce stresses and deflection in scissor lift the load should transfer equally between the two scissors arm pair. Base frames should be attached to the surface on which they are mounted.

V. WORKING PRINCIPLE

Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The piston pushes the oil in the other chamber back to the reservoir. It mainly works on pascals law which is defined below.

Pascals law

The principle states that external static pressure exerted on a fluid is distributed evenly throughout the fluid. Differences in static pressure within a fluid thus arise only from sources within the fluid such as the fluid's own weight, as in the case of atmospheric pressure.

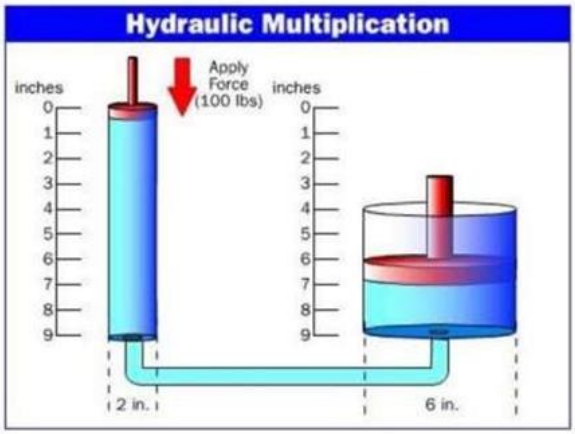

Fig 3. Pascals law

A Scissors lifts provide the most economical, dependable, and versatile method of lifting. Scissors lifts have few moving parts, are well lubricated, and provide many years of trouble free operation. These lift raises smoothly to any desired height, and can be easily configured to meet the specific speed, capacity, and foot print requirement of any hydraulic lifting application. And is by far the most popular and

efficient of all styles of scissors tables used in material handling applications

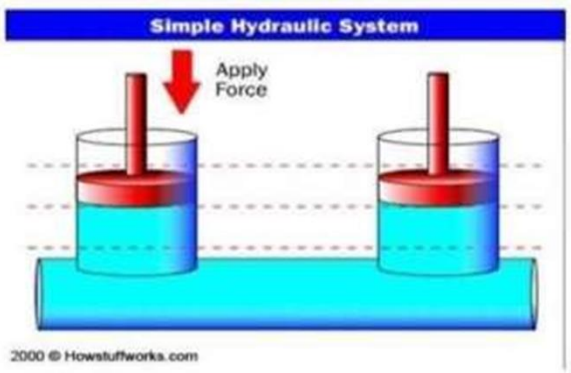

Fig 4. Hydraulic Multiplication

The force is multiplied by nine on the right-hand piston. Click the red arrow to see the animation. To determine the multiplication factor, start by looking at the size of the pistons. Assume that the piston on the left is 2 inches in diameter 1inch radius, while the piston on the right is 6 inches in diameter 3-inch radius. The area of the two pistons is Pi * r . The area of the left piston is therefore 3.14, while the area of the piston on the right is 28.26.The piston on the right is 9 times larger than the piston on the left. What that means is that any force applied to the left-hand piston will appear 9 times greater on the right-hand piston. So if you apply a 100-pound downward force to the left piston, a 900-pound upward force will appear on the right. The only catch is that you will have to depress the left piston 9 inches to raise the right piston 1inch. The brakes of a car are a good example of a basic piston-driven hydraulic system. When you depress the brake pedal in your car, it is pushing on the piston in the brake's master cylinder. Four slave pistons, one at each wheel, actuate to press the brake pads against the brake rotor to stop the car. (Actually, in almost all cars on the road today two master cylinders are driving two slave each cylinders. The hydraulic type, but this time, the load screw is replaced by a hydraulic ram powered by a pump and on electric motor and generator. One outstanding feature about this design however. Is its independent operation and increased efficiency. Fluid power is one of the greater form of power where small input results in a very large output. This scissors lift can be handled by one person to a place of use, and power the generator. The lift does not lifting immediately, the operators climbs on the platform and switches open the hydraulic circuit thereby leading to an upward extension. When the required height is reached the circuit is closed, and lifting stops the control panel or station is located on the top frame.

Principle of Operation of A Hydraulic Lift (Extension And Contraction)

A scissors lift is a type of platform that can usually only move vertically. The mechanism to achieve this is the use of linked, folding supports in a criss- cross X pattern, known as a scissors mechanism. The upward motion is achieved by the application of pressure to the outer side of the lowest set of supports, elongating the crossing pattern and propelling the work platform vertically. The platform may also have extending “bridge” to allow closer access to the work area, because of the inherent limits of vertical only movement. The contraction of the scissor action can be hydraulic, pneumatic or mechanical but in this case, it is hydraulic. Depending on the power system employed on the lift, it may require no power to enter desert mode, but rather a simple release of hydraulic or pneumatic pressure.

Cylinder Selection

The hydraulic cylinder or the hydraulic actuator is a mechanical a actuator that is used to give unidirectional stroke. It has many applications in engineering.

Single Acting Cylinders

Single acting cylinders use hydraulic oil for a power stroke in one direction only. The return stroke is affected by a mechanical in one direction only. The return stroke is affected by a mechanical spring

located inside the cylinder. For single acting cylinders with no spring, some external actin force on the piston rod causes its return.

Double acting cylinder

Double acting cylinder uses compressed air or hydraulic fluid to pour both the forward and return strokes. This makes them ideal for bushing and pulling and pulling within the same application they are suitable for full stroke working only at slow speed which results in gentle contact at the ends of stroke.

Operation

Hydraulic lifts owe their mechanical capability to the pantograph. A pantograph is a series of linked parallelograms with hinged

Fig: 6. a.Initialstage b. Final stage

Scissor Lifting intersections that allow the operator to elongate the mechanism while maintaining the integrity of the geometric figure. The structural components of the pantograph serve as opposing line segments within adjacent parallelograms; geometric changes are therefore uniform across the mechanism. True vertical lift is accomplished by using components of equal length.As L the length of the base increases, the pantograph contracts, and X° deceases while Y° increases. As L decreases, the pantograph extends, and X° increases in contrast.When two pantographs are arranged so as to actuate from a single drive they extend correspondingly and loads can be balanced between them. A calculator exists for computing the linear input force required according to where the drive supplies power to the scissor mechanism, be it upon the base or a center pin as depicted below.

Hydraulic lifts require linear motion to supply elevation and this force is provided by a pneumatic or hydraulic actuator, or a mechanical input such as a lead screw or rack and pinion drive. Hydraulic lifts under fluid power are preferred because a purge valve allows the lift to be lowered during a malfunction. Lifts with independent locomotion can integrate lifting and propulsion into a single power source, be it petrol or electric.

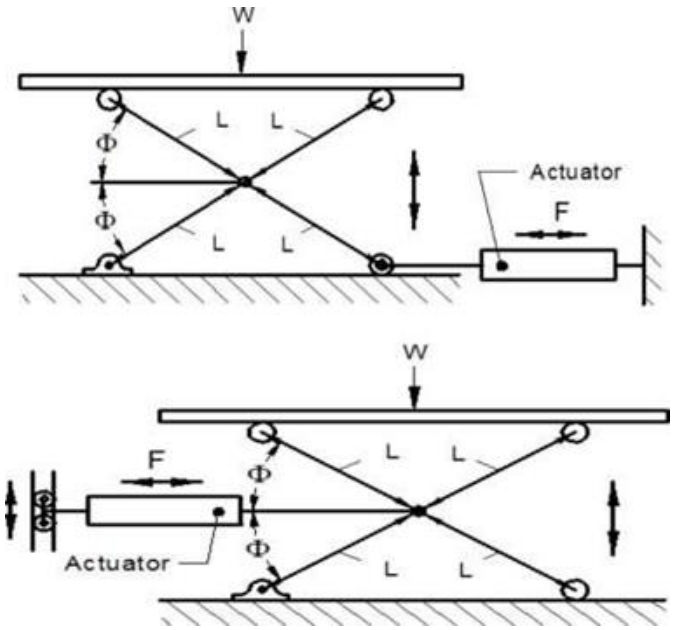

Fig: 7 Drive at base and centre pin is an example of the use of a linear actuator in a 2-stage scissor lift.

The Actuator

This paper will discuss the force applied on the scissor lift in terms of a linear actuator, in which one end translates (extends out) and does work on the lift.

Usually, the translating end will be attached to some point on the lift, and the static end will be attached to some fixed support. Hence, when the actuator extends,

it will cause the lift to extend. It should be noted that this does not imply loss of generality, as the derivation holds true even if the force is applied by any means other than a linear actuator.

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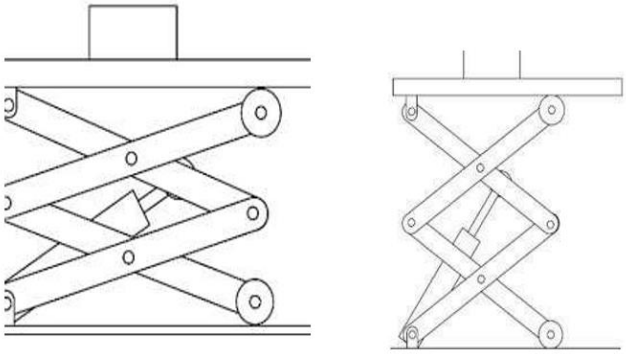

Fig 8. Stage Hydraulic Lift Powered by A Linear Actuator Before and After Extending

Construction Procedure

Base Platform

The material used for this purpose is mild steel angle bar. thickness 6mm, length of the platform is 37 cm, breadth is 22.5 cm. This is used because the base frame is responsible for the stability of the platform. The basic dimensions were marked out using on Engross rule and scriber and then cut with the use of hack saw after being welded firmly clamped to the vice. They are then joined together by welding to give the base frame.

Fig 9. Base Platform

Scissors Arms

These include the members that are arranged in a cross-cross 'X' pattern and whose construction is responsible for lifting the platform and extension and lowering of the platform. It is usually made up of rectangular cross-section, the length of arm is 32.5 cm breadth is 2.5 cm and has high resistance to bending. The material is stainless steel for corrosion and rust resistance to give high strength.

Fig 10. Scissor Arms

After marking out, they were cut to the required sizes holes of appropriate diameter were drilled at both ends and the middle of each member. Hollow pins of external diameter corresponding to the drilled holes we then fit into holes and welded in order to

strengthen the position then joined together to give the "X" pattern using bolts and nuts. The scissors arms were brazed to increase the strength and bending resistance.

Hydraulic Cylinder

In modeling hydraulic scissor lift ,cylinder are placed vertically to lift the body at a certain height, initially the height of the cylinder is 20 cm and further it is extended to 32 cm.

Fig 11. Hydraulic Cylinder

Pinned Joints

Scissors lifts are pinned at all hinge points, and each pin has a running clearance between the outer diameter 8mm and the inner diameter is 7mm of its clearance hole or bushing. The more scissors pairs, or pantographs, that are stacked on top of each other, the more pinned connections there are to accumulate movement, or deflection, when compressing these running clearances under load.

Fig 12 Pinned Joints

Coupler

In modeling scissor lift, couplers are fixed joints with support the hydraulic cylinder to lift the plate. The length of the coupler is 10 cm, the height is 4.5 cm, and the the thickness is 3 mm.

Fig 13. Coupler's

Brake

A brake is a mechanical device that inhibits motion by absorbing energy from a moving system. It is used for slowing or stopping a moving vehicle, wheel, axle, or to prevent its motion, most often accomplished by means of friction.Brake cables guide. The length of the cable is 75cm, Cables are used for braking on bikes with cable pull brakes. They consist of two parts: an inner cable of braided stainless steel wire and an outer cable housing, and work by transmitting force using a combination of tension on the inner cable and compression to the housing.

VI. CONCLUSION

The fabrication of a portable work platform elevated by a hydraulic cylinder was carried out meeting the required design standards. The portable work platform is operated by hydraulic cylinder which is operated by a handle. The scissor lift can be design for high load also if a suitable high capacity hydraulic cylinder is used. The hydraulic scissor lift is simple in

use and does not required routine maintenance. It can also lift heavier loads. The main constraint of this device is its low initial cost and has a low operating cost. The shearing tool should be heat treated to have high strength. Savings resulting from the use of this device will make it pay for itself with in short period of time and it can be a great companion in any engineering industry dealing with rusted and unused metals. The fabrication of a portable work platform elevated by a hydraulic cylinders was carried out successfully meeting the required design standards. The portable work platform is operated by hydraulic cylinder which is operated by the hand lever. The scissor lift can be designed for high load also if a suitable high capacity hydraulic cylinder is used. The hydraulic scissor lift is simple in use and does not required routine maintenance. It can also lift heavy weights. The main constraint of this device is its high initial cost, but has a low operating cost. The shearing tool should be heat treated to have high strength. Savings resulting from the use of this device will make it pay for itself with in short period of time and it can be a great companion in any engineering industry dealing with rusted and unused metals.

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