JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

SCISSOR LIFT MECHANISM

Tanmay Hire[1], Prem Barde[2], Madhuri Bhad[3], Sagar Dalvi[4], Dr. P. S . Kachare[5]

[1,2,3,4]*Student, of Mechanical Engineering, JSPM's Bhivarabai Sawant Institute Of Technology And Research Wagholi, Maharashtra, India*

[5]*Professor, Dept. of Mechanical Engineering, JSPM's Bhivarabai Sawant Institute Of Technology And Research Wagholi, Maharashtra, India*

Abstract : *Lift is a simple mechanical device used to raise element or object from ground level to a certain height to perform a specific work with maximum load and minimum efforts. This project describes the design as well as analysis of scissor lift which will be operated on DC motors. Also, such design can make the lift more compact and much suitable for medium scale work. But in this case along with lifting material we are also going to make an effort to move the material at a same height in different direction. The upper base or panel will be moved with the help of lead screw which is operated by DC motor. Finally, the analysis will be carried out in order to check the compatibility of the design values.*

I. INTRODUCTION

1.1 Scissor Lift:

A scissor lift or mechanism is a device used to extend or position a platform by mechanical means. The term "scissor" comes from the mechanic which has folding supports in criss-cross "X" pattern. The extension or displacement motion is achieved by the application of force to one or more supports, resulting in an elongation of the cross pattern. The force applied to extend the scissors mechanism may by hydraulic, pneumatic or mechanical (via a lead screw or rack and pinion system). The need for the use of lift is very paramount and it runs across labs, workshops, factories to lift load, machine etc. expanded and less-efficient, the engineers may run into one or more problems when in various use.

The name scissors lift originated from the ability of the device to open (expand) and close (contract) just like a scissors. Considering the need for this kind of mechanism, estimating as well the cost of expanding energy more that result gotten as well the maintenance etc. it is better to adopt this design concept to the production of the machine. The maximum lift of table is 1380mm and minimum lift of table 800mm. It ishas mechanism which is completely mechanical which has lead screw and motor unit for to opening and closing of lift.

1.2 Lead Screw:

A lead screw (or lead screw), also known as a power screw or translation screw, is a screw used as a linkage in a machine, to translate turning motion into linear motion. Because of the large area of sliding contact between their male and female members, screw threads have larger frictional energy losses compared to other linkages. They arenot typically used to carry high power, but more for intermittent use in low power actuator and positioner mechanisms. Common applications are linear actuators, machineslides (such as in machine tools), vises, presses, and jacks.

Leadscrews are manufactured in the same way as other thread forms (they may be rolled,cut, or ground). A lead screw is sometimes used with a split nut also called half nut which allows the nut to be disengaged from the threads and moved axially, independently of the screw's rotation, when needed (such as in single-point threading ona manual lathe).

II. LITERATURE SURVEY

Balkeshwar Singh, Anil Kumar Mishra have worked on "Analysis and Fabrication of Remote Control Lifting Jack" This research paper analyzes the modification of the existing motor screw jack by incorporating an electric motor in the screw in order to make load lifting easier. In this modified design, the power screw is rotated by connecting motor through universal coupling, plugged to the automobile 12 V battery source to generate power for the prime mover (motor), which transmits its rotating speed to the power screw to be rotated with required speed reduction and increased torque to drive the power screw.

Dr. Ramachandra C G, Krishna Pavana, ShivrajShet and Venugopal Reddy, Virupaxappa B have worked on "Design and fabrication of automotive hydraulic jack system for vehicles",Whenever any vehicles undergo a tyre failure, it becomes a very cumbersome task

for the person to lift the vehicle from the ground level and lot of manual effort is required even though a jack is used. "Necessity is the mother of all inventions". This quote is a befitting to our project as we believe that man in today's world wants comforts and problem faced by people driving vehicles is more when the vehicle's tyre fails.

M.M.Noor, K.Kadirgama, M.M.Rahman, M.S.M.Sani, M.R.M.Rejabhave worked on "Development of Auto Car Jack Using Internal Car Power", Car jacks usually use mechanical advantage to allow a human to lift a vehicle by manual force. More powerful jacks are using hydraulic power to provide more lift over greater distances. This paper presents the development of the car jack for emergency use with using internal cigarette lighter power (12volts). The automatic easy car-jack utilizes this power source to save individuals having to exert any energy. To increase the lifting power in order to ensure the power is adequate, gear ratio was used. The car jacker was developed utilizing the Solidworks and its analyses to check the safety factor and force acting. The fabrication work has been done with milling and grinding machine. The car jacker will be tested and it predicted to have enough power to lift and holding the car as normal car jacker.

Jaydeep m. bhatt, milan j. pandya have worked on "Design and analysis of an aerial scissor lift",The following paper describes the design as well as analysis of a simple aerial scissor lift. Conventionally a scissor lift or jack is used for lifting a vehicle to change a tire, to gain access to go to the underside of the vehicle, to lift 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.

Rahul J.Kolekar, S.S.Gawadehas worked on "Design and development of lift for an automatic car parking system", Metropolitan cities strongly need advanced parking systems, providing drivers with parking information. Existing parking systems usually ignore the parking price factor and do not automatically provide optimal car parks matching drivers' demand. Currently, the parking price has no negotiable space; consumers lose their bargaining position to obtain better and cheaper parking. This dissertation study gives an automatic car parking system, and considering negotiable parking prices, selects the optimal car park for the driver. The autonomous coordination activities challenge traditional approaches and call for new paradigms and supporting middleware. The coordination network is proposed to bring true benefit to drivers and car park operators. This automatic car parking system has capabilities including planning, mobility, execution monitoring and coordination.

Gaffar G Momin, Rohan Hatti, Karan Dalvi, Faisal Bargi, Rohit Devarehas worked on "Design, Manufacturing & Analysis of Hydraulic Scissor Lift", The following paper describes the design as well as analysis of a hydraulic scissor lift. Conventionally a scissor lift or jack is used for lifting a vehicle to change a tire, to gain access to go to theunderside of the vehicle, to lift the body to appreciable height, and many other applications Also such lifts can be used for various purposes like maintenance and manymaterial handling operations. It can be of mechanical, pneumatic or hydraulic type. The design described in the paperis developed keeping in mind that the lift can be operated by mechanical means by usingpantograph so that the overall cost of the scissor lift is reduced. In our case our lift wasneeded to be designed a portable and also work without consuming any electric power so we decided to to use a hydraulic hand pump to power the cylinder Also such design can make the lift more compact and much suitable for medium scale work. Finally, theanalysis of the scissor lift was done in ansys and all responsible parameters were analyzed in order to check the compatibility of the design values.

P.S. Rana, P.H. Belge, N.A. Nagrare, C.A. Padwad, P.R. Daga, K.B. Deshbhratar
N.K. Mandavgadehas worked on "Integrated Automated Jacks for 4-wheelers",An Automobile hydraulic jack can be easily operated by a single push button provided on the dash board. The jack will be installed on both the sides of chassis according to the weight distributions of the car. Similarly, it will be installed on the other side of the car.The system operates on hydraulic drive which consists of three main parts: hydraulic pump, driven by an electric motor, hydraulic cylinder to lift the vehicle. The hydraulic jacks actuate separately for either side of car as per the breakdown condition. The car gets lifted and load gets distributed on three point i.e., plunger or ram of hydraulic cylinder and two tires opposite to side which is lifted. This jack will be very useful for all the senior citizens and especially for females (ladies) who find it extremelydifficult to operate the jack manually in any breakdown condition. The motive behind using hydraulic system instead of a pneumatic system is the more power produced by the system and simple in design as compared to a pneumatic design. As the hydraulic oil is incompressible so the lifting capacity is more in comparison with the pneumatic system which operates on air which is compressible.

III. DESIGN OF MACHINE

Weight of the motor will act vertically downward direction to the shaft Forces acting on the lead screw.

1. Weight of Above Structure Of Pannel.
2. Support reaction at both end of lead screw.

Hence

Total weight = Weight Of Structure

= 75 Kg

= 735.75 N

Now consider the Free Body diagram of the Lead Screw (shaft)
It is assumed that the whole assembly is at centre of the lead screwOn solving the FBD

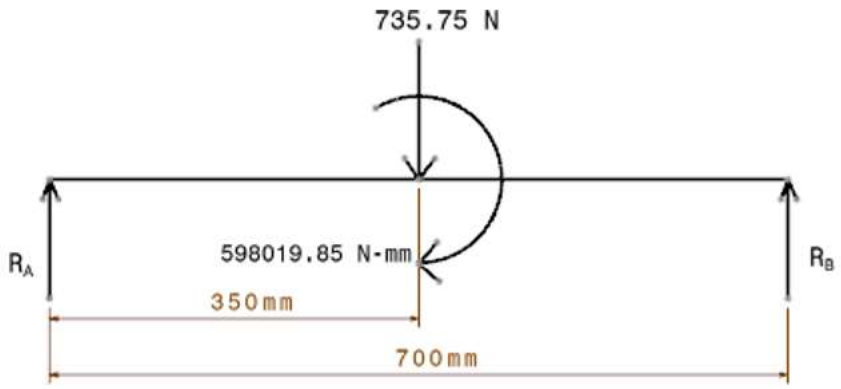

Fig. Free Body Diagram of Z Axis Lead Screw.

$$\sum F_Y = 0$$

$$R_A + R_B = 735.75 \text{ N}$$

$$\sum M_A = 0$$

$$735.75 \times 350 + 598019.85 - R_B \times 700 = 0$$

$$R_B = 1222.15 \text{ N} R_A = -486.4 \text{ N}$$

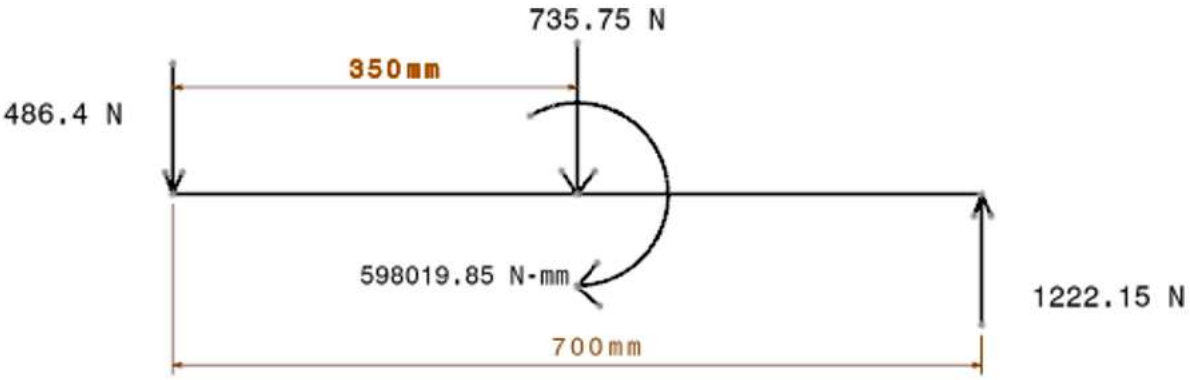

Fig. Free Body Diagram of Z Axis Lead Screw

Bending moment at A = 0 N mm

Bending moment at C = 427779.85 N mm Bending moment at B = 0 N mm

Mmax = 427779.85 N mm

Tmax = 598000 N mm

Material of the lead screw = mild steel

Syt = 370 MPa

Factor of Safety = 3.5

$$\tau_{Perm} = \frac{Sys}{\text{factor of safety}}$$

$$\tau_{Perm} = \frac{0.5 \times S_{yt}}{\text{factor of safety}}$$

$$\tau_{Perm} = \frac{0.5 \times 370}{3.5}$$

$$\tau_{Perm} = 52.8571 \text{ MPa}$$

Hence the lead screw diameter can be find by ASME code

$$\tau_{Max} = \frac{\quad}{\pi \times D^3} \times \sqrt{M^2_{Max} + T^2_{Max}}$$

$$\tau_{Perm} = \tau_{Max} = \frac{\quad}{\pi \times D^3} \times \sqrt{M^2_{Max} + T^2_{Max}}$$

$$52.8571 = \frac{16}{\pi \times D^3} \times \sqrt{(427779.85)^2 + (598000)^2}$$

$$D = 41.37 \text{ mm}$$
$$D = 42 \text{ mm}$$

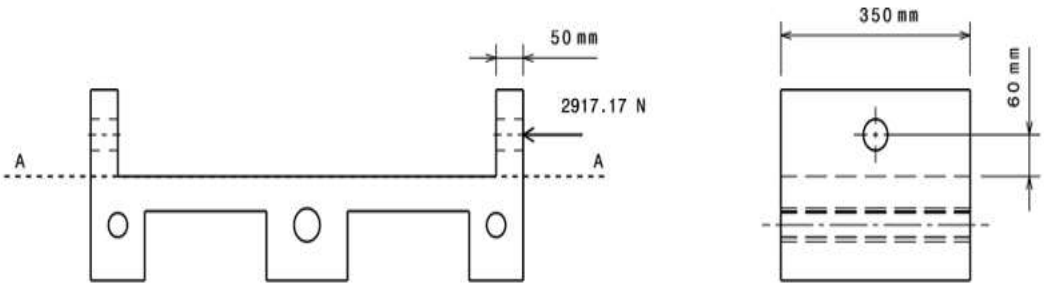

Fig. Thrust Force Acting On Middle Block While Drilling Operation.

3.1 Design of scissor link:

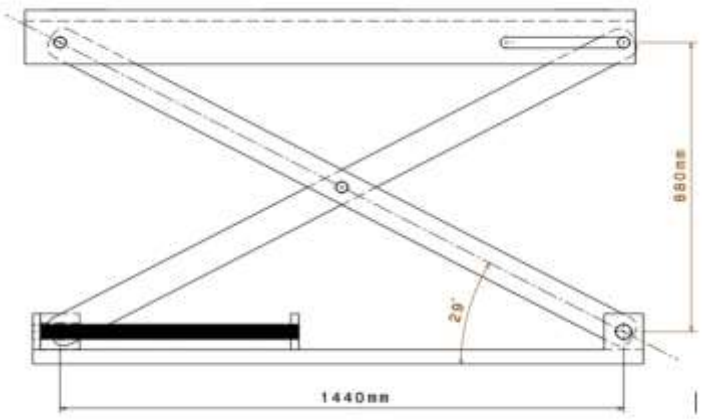

Fig. Scissor Lift

Length of scissor link can be determining by-
1st case At top position vertical height is 1380 mm and horizontal length between two link is 900 mm Length of link is L is given by Pythagoras theorem.

$$L = \sqrt{(1380)^2 + (900)^2} = 1647.54 \text{ mm} = 1648 \text{ mm}$$

2nd Case At bottom position vertical height is 800 mm and horizontal length between two link is1440 mm. Length of link is L is given by Pythagoras theorem.

$$L = \sqrt{(800)^2 + (1440)^2} = 1647.54 \text{ mm} = 1648 \text{ mm}$$

Forces acting on the links are
Total weight of the assembly including top plate (c section)
Total weight = weight of the motor + weight of motor holding block + weight of z axislead screw + weight of z axis holding lead screw block + weight of y axis lead screw + weight of y axis two guide shaft + weight of y axis lead screw and guide shaft holding L plate + weight of the top plate c section.

w = 15 Kg + 60 Kg + 10 Kg + 240 Kg + 15 Kg + 10 × 2 Kg + 100 Kg + 350 kg

w = 810 Kg ≅ 850 Kg
W = 8338.5 N

3.2 Detailed Diagram of Each Part of Industrial Portable Drilling Machine:

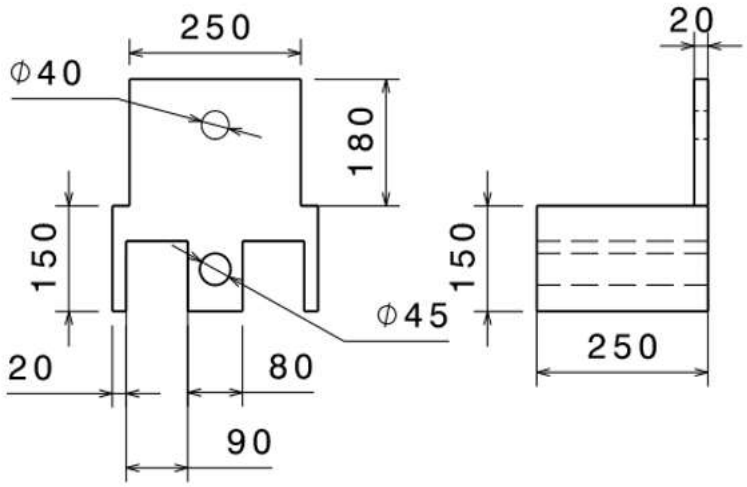

Fig. Detailed Diagram of Motor mounting block.

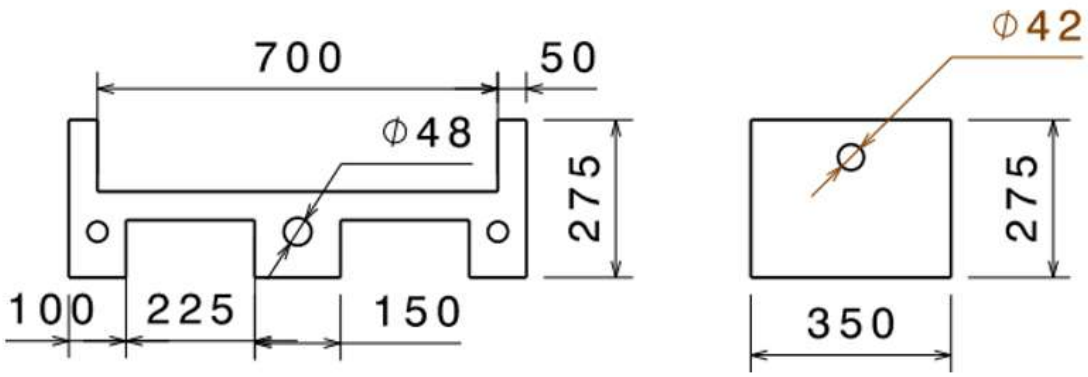

Fig. Detailed Diagram of Middle block

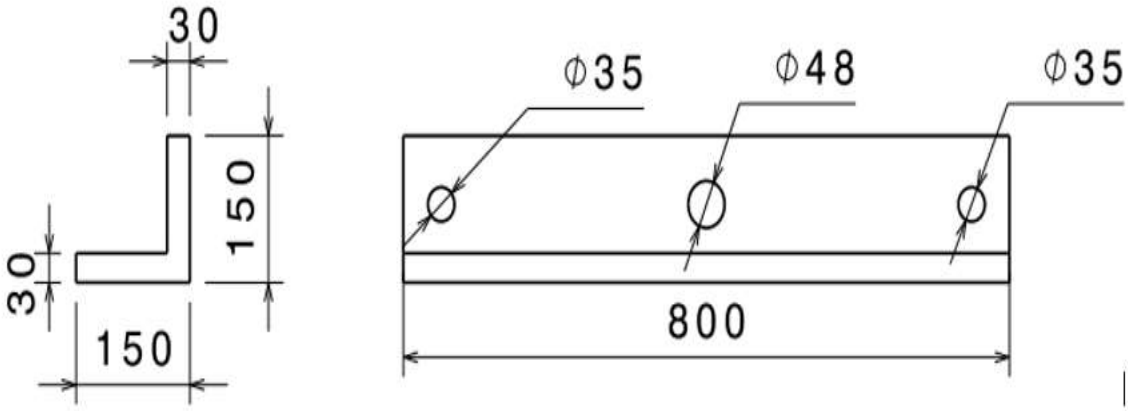

Fig. Detailed Diagram of L Plate Support For Guide Rod And Lead Screw.

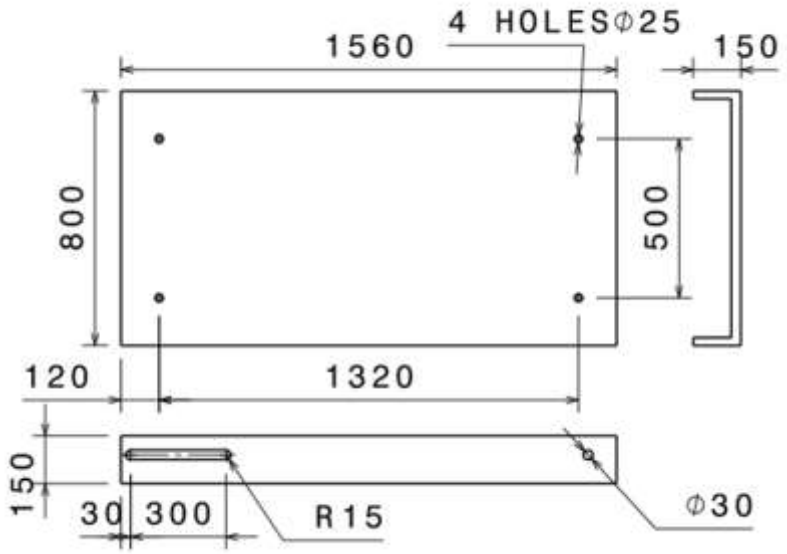

Fig. Detailed Diagram of Top Plate Of Scissor Lift.

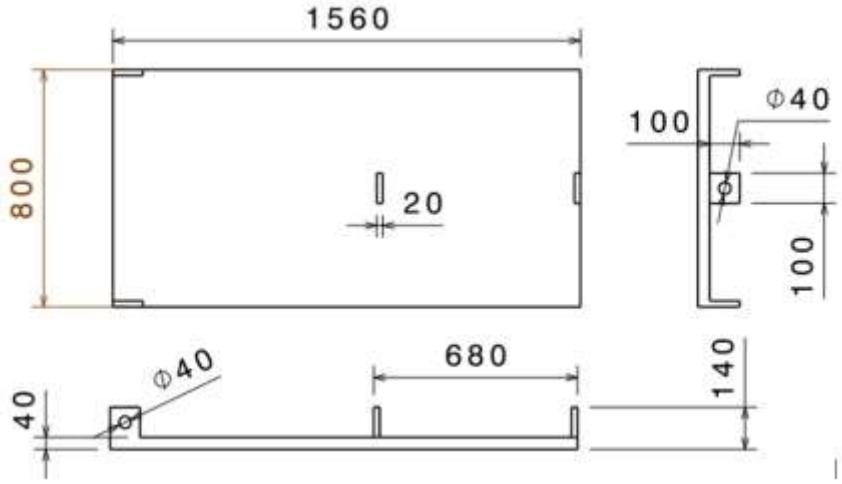

Fig. Detailed Diagram of Base Plate Of Scissor Lift.

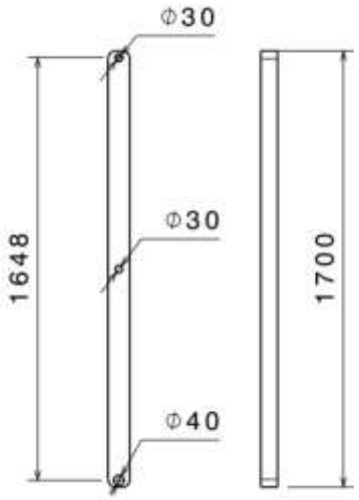

Fig. Detailed Diagram of Leg of Scissor Lift.

IV. CONCLUSION & FUTURE SCOPE

4.1 Conclusion:

With the help of current research, we briefed out the basic Design Procedure of the Mechanically Operated Scissor Lift working on the principle of Leadscrew. Moreover, we also explained the importance of some useful accessories such as Self Storing Maintenance Stand, Blocking Mechanism, Self Locking Pair, Loading by Saddle Plate,Stability Conditions as well as Controller Mechanism.Scissor lift are a type of mechanism that allows for vertical displacement of some load through the use of linked, folding supports, in a crisscross X patter, referred to as a pantograph (or, simply, a scissor mechanism). Scissor lifts are widely used in industrialapplications, and also from a staple design element in competitive robotics. Each arm ofthe crosses is called a 'scissor arm' or 'scissor member'. The upward motion is producedby the application of force, by some actuator (usually hydraulic, pneumatic, or mechanical) to the application to the outside of the one set of supports elongating the crossing pattern, and propelling the load vertically. However, the positioning of the actuator, in terms of the point of application of the forceon the pantograph, can affect the force required of the actuator for a given load. Prudentplacement of the actuator can greatly reduce the force required and the stress levels in the adjacent scissor arms. We all know climbing stairs to foot over bridge for changingrailway platform with heavy luggage is one of the major issue that every passenger andluggage carrier face during the beginning and end of the rail journey. Everyone wishesthe arrival and dispatch of a train from platform no 1 without requiring climbing stairs.So changing the platform with heavy luggage by climbing stairs to foot over bridge every time is very tried and painful experience for everyone. Portable work platform Mechanical scissor lift is designed for high load resistance.The Mechanical scissor lift is simple in use and does not required routine maintenance.Both the mild steel and aluminium alloy are good at their different aspet Mild steel hasgreater durability strength and it is also cheap and easily available. As these properties plays an important role in designing scissor lift. So in designing scissor lift mild steel has greater importance.

4.2 Future Scope:

In Today's industries have a conventional fixed Drilling Machines for Machining operation of pumps. To carryout operation on large pump such as series five pump whichis mentioned in above in problem statement. It is need of today and for better future in manufacturing process to develop a versatile drilling machine. Which has a unique mechanism and has mobility to vary shop and

without moving these large pump or components drilling operation could be carryout? Predecessors machine were good when it comes to operation on small scale but for high mass production it won't be convenient to use bulky conventional drilling machine. Industrial Portable Drilling Machine is designed according to industry needs andconsidering all the parameter while performing operations. Current machine is operatedwith help of servo motors controlled by electric switches. It can be upgraded in future for ease of operation.

- Mass optimization of machine using light weight material that has highstrength to weight ratio.
- Control panel can be upgraded by using PLC's system.
- Computerized Numerical version of this machine could be possible infuture.
- This machine not only used for large pump but operation on smallpump can be possible.

REFERENCES

1. Beqir Hamidi, "Design and Calculation of the Scissores-type Elevating Platform," Open Journal of Safety Science and Technology, vol. 2, pp. 8-15, 2012.
2. Ren G. Dong, Christopher S. Pan, Jared J. Hartsell, Daniel E. Welcome, Tim Lutz, Anne Brumfield, James R. Harris, John Z. Wu, Bryan Wimer, Victor Mucino, Kenneth Means, "An Investigation on the Dynamic Stability of Scissor Lift.
3. M. McCann, "Death in Construction Related to Personnel Lifts, 1992-1999," Journal of Safety Research, Vol. 34, No. 5, 2003, pp. 507-514. doi:10.1016/j.jsr.2003.07.001
4. C. S. Pan, A. Hoskin, M. McCann, D. Castillo, M. Lin and K. Fern, "Aerial Lift Fall Injuries: A surveillance and Evaluation Approach for Targeting Prevention Activities," Journal of Safety Research, Vol. 38, No. 6, 2007, pp. 617-625. doi:10.1016/j.jsr.2007.08.002
5. C. Scheiner, Pantographice, seu ars delineandi res quaslibet per parallelorrammum lineare seu cavum, mechanis, mobile, Romae: Ex typographia Ludouici Grignani, sumptibus Hermanni Scheus, vol. 12, 1631, pp. 108.
6. Rolland, L. 2010. Kinematic Synthesis of a New Generation of Rapid Linear Actuator for High Velocity robotics, Advanced Strategies for Robot Manipulators, S. Ehsan Shafiei (Ed.), ISBN: 978-307-099-5.
7. Tao Liu1, Jian Sun, "Simulative Calculation and Optimal Design of Scissor Lifting Mechanism," 2009 Chinese Control and Decision Conference (CCDC 2009).
8. R. Sinha, V.-C. Liang, S. Member, C. J. J. Paredis, and P. K. Khosla, "Modeling and simulation methods for design of engineering systems,"Journal of Computing and Information Science in Engineering,vol. 1, pp. 84-91, 2001.
9. D. Karnopp, D. L. Margolis, and R. C. Rosenberg, System Dynamics: Modeling and Simulation of Mechatronic Systems, 4th ed. JohnWiley and Sons, Inc., Hoboken, New Jersey, 2005. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.
10. Dr. Ramachandra C G, Krishna Pavana, ShivrajShet And Venugopal Reddy Virupaxappa B, "Design And Fabrication Of Automotive Hydraulic Jack System For Vehicles", International Journal Of Advances In Engineering Research, (IJAER) 2013, Vol. No. 6, Issue No. VI, Dec
11. Helmi Rashida, MohdKhairolAnuarMohdAriffinb, Mohd Hafiz MohdNoha, Abdul Halim Abdullaha, Ahmad Hussein Abdul Hamida, Mohammad Azzeim Mat Jusoha, Akbar Othmanc, "Design Review Of Scissors Lifts Structure For Commercial Aircraft Ground Support Equipment Using Finite Element Analysis", International Symposium On Robotics And Intelligent Sensors, Procedia Engineering 41 (2012) 1696 – 1701
12. Jaydeep M. Bhatt, Ilan J. Pandya, "Design And Analysis Of An Aerial Scissor Lift", Journal Of Information, Knowledge And Research In Mechanical Engineering, ISSN (E): 2250-3021, ISSN (P): 2278-8719 Vol. 04, Issue 05 (May. 2014), ||V5|| PP 06-12
13. Ivan Sunit Rout, Dipti Ranjan Patra, SidharthaSankarPadhi, Jitendra Narayan Biswal, Tushar Kanti Panda, "Design and Fabrication of motorized automated Object lifting jack", Iosr Journal Of Engineering (Iosrjen) Volume 3, Issue 2, Part 2, March-April, 2015
14. Gaffar G Momin, Rohan Hatti, Karan Dalvi, Faisal Bargi, Rohit Devare, "Design Manufacturing & Analysis Of Hydraulic Scissor Lift", International Journal Of Engineering Research And General Science Volume 3, Issue 2, Part 2, March-April, 2015,
15. P.S. Rana, P.H. Belge, N.A. Nagrare, C.A. Padwad, P.R. Dagal, K.B. Deshbhratar,N.K. Mandavgad, "Integrated Automated Jacks For 4-Wheelers", Scholars Research Library, European Journal Of Applied Engineering And Scientific Research, 2012, 1 (4):167-172