

Design and Fabrication of Hand Operated Lift

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Abstract— Nowadays there is a requirement to paint the roof and plaster the wall, therefore to meet the requirement of the problems, and reduce the risk of life there is need to make a lifting mechanism, which can reduce the probability of accident in common day life. The present work meets the criteria to solve these problems by providing manual operation of handle to obtain elevated heights of required specification under application of minimal effort. This lift is manually operable with help of hand which is further moved by rack and pinion mechanism to convert the rotatory motion into linear motion to reach the elevated height. The present work has tremendous application in painting industry as well as in shop floor. Today lifestyle of man is not able to dedicate specific time for his health, importance is least given to exercise and body fitness due to time shortage and stressful life. To cope with time deficit, we can utilize the time spent on rotating the handle, which has health benefit.

Key words: Hand operated lift, Rack and Pinion mechanism, links, Chain drives, Worm drives, Journal Bearings

I. INTRODUCTION

This work deals with lifting mechanism which could solve daily life problems in efficient and effective manner. Lift is a device used for achieving the required height based upon user's specification. The present work is portable in nature which can be carried to places as required. It is robust in design and cost effective in nature. Moreover there is no requirement of external power source for the said mechanism. Some mechanical equipments such as chain drive, handle, worm drives, rack and pinion, hinge joints and links are used to create the shape of present work.

II. LITERATURE REVIEW

A. 2015- 'Divyesh Prafulla Ubale':

'Design, Analysis and Development of Multiutility home equipment using Scissor Lift Mechanism'- In this paper authors have explained about the conventional method of using rope, ladder lift getting person to a height encounter a lot of limitation (time and energy consumption, comfort ability, amount of load that can be carried etc.) also there may be a risk of falling down in case of ladders. Hence hydraulic scissor lift is designed to overcome all these difficulties. The main aim of this paper is design and analysis and to construct a multi utility home equipment for senior citizens so that they can carry their daily activities efficiently. Also the equipment should be compact and cost effective. Lifting height achieved by scissor mechanism is of 1 m from bottom level. Buckling and bending failure analysis of scissor is also done in this paper. [1]

B. 2014- 'Vitus M. Tabie':

Weight Optimization of A Lift-Tipping Mechanism for Small Solid Waste Collection Truck'- In this paper authors have

explained about optimization of a lift-tipping mechanism for a small solid waste collection truck. Finite element analysis was performed on a linkage mechanism that operates the tipping mechanism. The exercise involved validating the design changes made in the stress analysis environment.[2]

C. 2008- 'Jovan Vladic':

'Dynamic Analysis of the Load Lifting Mechanisms'- In this paper have explained about problems of dynamic behaviour of load lifting mechanism (such as elevators). In the case of considerable lifting heights, high velocity devices are applied.[3]

D. 2013- 'C.Veeranjaneyulu':

'Design And Structural Analysis of Differential gear Box At Different Loads'- In this paper, authors have explained about mechanical design and analysis on assembly of gears in gear box when they transmit power at different speeds. . Stress displacement is analyzed by considering weight reduction in the gear box at higher speed. . Analysis is also conducted by varying the materials for gears, Cast Iron, Cast Steels.[4]

E. 2013- 'Dr. Ramachandra C G':

'Design And Fabrication of Automotive Hydraulic Jack System For Vehicles'- have explained about an inbuilt jacks have been designed and fabricated which is assembled on the vehicle. With the help of the existing brake pad and fluid arrangement of the braking system we incorporate the jack into chassis of the vehicle with a set of unions, ball valves, master cylinder, five-way directional control valve, separated by a piping arrangements lifts the incorporated jack to action desired without raising any sweat of the driver.[5]

F. 2013- 'Jaydeep M. Bhatt':

'Design And Analysis of An Aerial Scissor Lift'- have explained about 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. The design described in the paper is developed keeping in mind that the lift can be operated by mechanical means so that the overall cost of the scissor lift is reduced. Also such design can make the lift more compact and much suitable for medium scale work.[6]

G. 2014- 'K.Sainath':

'Design of Mechanical Hydraulic Jack'-In this paper authors have explained about a jack which is a device that uses force to lift heavy loads. The primary mechanism with which force is applied varies, depending on the specific type of jack.[9]

III. WORKING PRINCIPLE

The present work is being done to reduce human effort for lifting themselves without others help. Here we have developed an idea of industrial vehicle which can be moved inside the industries and also the vehicle can be lifted by the help of handle provided with it. The components used in this project is that chain and sprocket, rack and pinion, worm gear arrangement and bearings. These components were mounted over the base frame which is provided with wheel for locomotion of the vehicle.[7] This hand operated lifting vehicle can be moved towards the required area and can be lifted to a required height within the limit by rotating the worm gear. When the worm gear is rotated through the handle, the sprocket in the same shaft will be rotated and it will tend to rotate the pinion gear through chain drive. Hence the rack will be moved up and down with respect to the pinion gear rotation. This hand operated lift vehicle can be used in various industries. [8]

IV. MODELLING

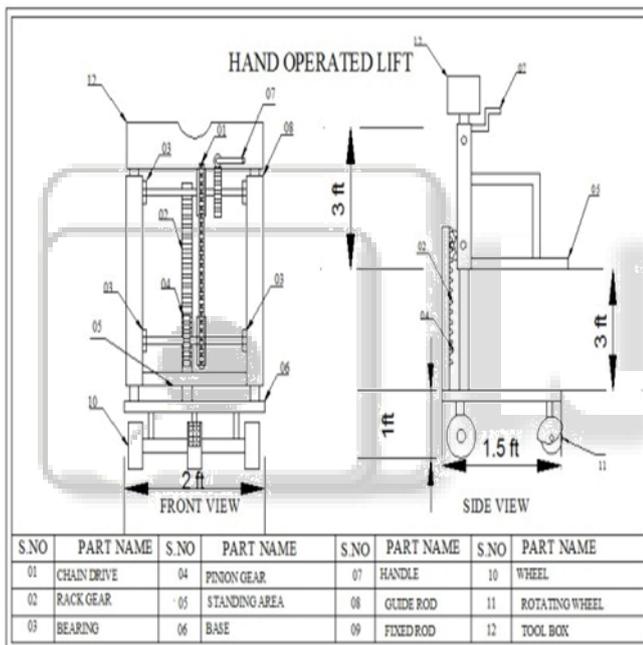


Fig. 1: 2D modelling of Hand operated lift



Fig. 2: 3D modelling of Hand operated lift

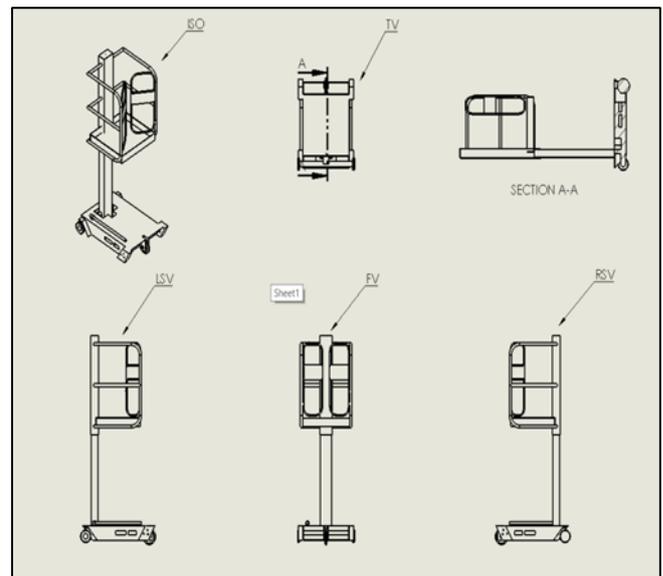


Fig. 3: Different views of Hand operated lift

V. DESCRIPTION OF EQUIPMENTS

Chain Drive- Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles. The power is conveyed by a roller chain, known as the drive chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting power mechanical force.[10] This is used in lift to transmit power from worm wheel to the rack and pinion arrangement.[11]



Fig. 4: Chain Drive being used in present work

Rack and Pinion- A rack and pinion is a pair of gears which convert rotational motion into linear motion.[13] The circular pinion engages teeth on a flat bar - the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel. The pinion is in mesh with a rack. The circular motion of the pinion is transferred into the linear rack movement. Here the shaft is fitted in the pinion which is attached with the chain drive. The rotation is provided to the rack and pinion with the rotation of handle. So that arrangement will smoothly lift up to required height.



Fig. 5: Rack and pinion being used in present work.

Worm Gear-A worm gear is type of mechanical gear. Worm gears are used when large gear reductions are needed. It is common for worm gears to have reductions of 20:1, and even up to 300:1 or greater. Many worm gears have an interesting property that no other gear set has the worm can easily turn the gear, but the gear cannot turn the worm. This is because the angle on the worm is so shallow that when the gear tries to spin it, the friction between the gear and the worm holds the worm in place. A gear consisting of a spirally threaded shaft and a wheel with marginal teeth that meshes into it. The toothed wheel of this gear is called a worm wheel. Compact structure saves mounting space.[15]



Fig. 6: Worm gear

Bearing- A bearing is a device to permit constrained relative motion between two parts. Bearings may be classified broadly according to the motions they allow and according to their principle of operation. Low friction bearings are often important for efficiency, to reduce wear and to facilitate high speeds. Essentially, a bearing can reduce friction by virtue of its shape, by its material, or by introducing and containing a fluid between surfaces.[12]



Fig. 7: Ball Bearing

Rotating handle- Rotating handle is the component on which the lifting effort acts so that required height can be achieved. Rotating handle is attached to worm gear whose rotation gives the rotatory movement to pinion for vertical movement. Thus it helps a person standing on the lift to go both up and down based upon the need of the problem.[14]



Fig. 8: Rotating Handle.

VI. DESIGN AND CALCULATIONS

A. Specification Of Worm Gear:

Number of teeth on worm wheel = 58
 Outer diameter of worm wheel = 120 mm
 Inner diameter of worm wheel = 15 mm
 Number of starts on worm = 6
 Handle rotation speed = $N = 18$ RPM (Approximately)
 Power of handle $p = 35$ watts (Approximately)
 Diameter of shaft = 15 mm
 Distance of handle from centre of worm wheel = 120 mm
 Mild steel shaft shear stress = $f_s = 210$ N / mm²
 Torque on worm wheel = 1078.2 N-m
 The effort required to lift the a person as calculated above is 154.67 N.
 Under such parameters the design calculations were done and obtained design is safe. [15]

B. Specification Of Rack And Pinion:

Length of Rack = 1380 mm
 No of teeth on the rack = 77
 Teeth Height of the Rack = 13 mm
 Thickness of the rack = 40 mm
 Diameter of gear = $\varnothing 120$ mm
 No of teeth = 24
 Thickness of the gear = 20 mm.
 Torque of the worm wheel will be transmitted to the chain drive and pinion gear.
 Therefore 24 tooth pinion gear needs 1078.2 N-m torque.
 Weight = torque / gravity
 = $1078.146 / 9.81 = 109.92$ kg per meter
 = 110 kg per meter (Approximately)
 Therefore our lift can lift up to 110 kg load per meter. [15]

VII. COST ESTIMATION

- 1) Material Cost = 10500/-
- 2) Labour cost = Lathe, drilling, welding, drilling, power hacksaw, gas cutting cost = 5500/-
- 3) Overhead charges=The overhead charges are arrived by "manufacturing cost".
 Manufacturing Cost =
 Material Cost + Labour Cost= 2100/-
 Overhead Charge = 20% of the manufacturing cost = 420/-
- 4) Total cost =Material Cost + Labor Cost + Overhead Charges
 Total cost incurred in the work = 18520/-[16]

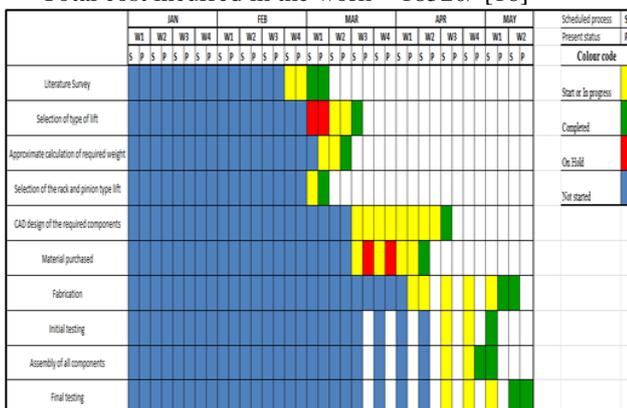


Fig. 9: Gantt chart Showing Progress of Present Work.

VIII. TESTING PHASE

After finishing process we started demonstration of lift. Thus we conducted several tests to ensure that everything we have done meets the standard criteria.



Fig. 10: Testing phase of Hand operated lift

IX. ADVANTAGES AND LIMITATIONS

A. ADVANTAGES:

- It is reliable.
- Low maintenance.
- Low power is enough.
- Can attain height upto 10 feet.
- Design is robust.
- Lift is portable, can be moved easily with less effort.
- There is no requirement of skilled labour.
- Cost efficient lifting system.
- Operating cost is less.
- Easy maintenance.
- Design is safe.
- Has a health benefit.

B. Limitations:

- Low torque is generated which has scope of improvement.
- Manual power is required.
- Lubrication is required at regular intervals.

X. APPLICATIONS

- It can be used in automobile service centres.
- It can be used by paint industries for easy paintings on the roof.
- It can be used by masons for doing plasters of wall at elevated heights.
- It can be used for cleaning Idols in temple at elevated heights.
- It can be for cleaning buses and cars effectively.
- It can be used by farmers for picking fruits from the trees.
- It can be used by electricity suppliers for fixing electricity circuits on electric poles.

XI. SCOPE OF FUTURE WORK

- The lifting is slow because it is operated by rotating the handle of lift which is attached with the worm wheel arrangement. In future to regulate lift fast motor arrangement used in the place of handle.
- Presently the lifting is around 10 feets. To increase the height of lifting as required we can increase the height of rack so that we can achieve a lift to a required height.
- While lifting on inclined plane, lift is moving. To stabilize this movement of lift we can use locking wheel so that while working with the lift, hassle free movement is achieved without any accident.
- To providing the better base support we can increase the square base support larger than the lifting standing base.
- To minimise the effort leg throttle can be used.

XII. CONCLUSION

This project is made with pre planning, that it provides flexibility in operation. This project is designed with the hope that it is very much economical and helpful to many industries. The present work helped us to know the periodic steps in completing the operations. Compared to other lifts present in the market our lift is economical and occupies less space, moreover it is portable in nature hence it can be moved from one place to another based upon user's requirement which is an added advantage to this lift. Thus this lift was designed with intent to provide the solution to daily life problems which can be painting the roof, doing the plaster on the backside of the walls etc., which this lift is able to give the solution. Hence, making it master key which open all the locks thus providing tremendous application. Thus the idea of providing lift at cheaper cost and maximum applications has been met.

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