International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

Designing and Manufacturing of Stair Climbing Trolley

Ganesh Salunke [1], Suraj Pol[2], Yatin Bhamare[3], Amol Bhakte [4], Yogesh Ingulkar[5]

[1,2,3,4]Department of Mechanical Engineering, DPCOE, Pune, Maharashtra, [5]Internal Guide, Department of Mechanical Engineering, DPCOE, Pune Maharashtra.

Abstract- *This topic deals with the designing and manufacturing of a hand truck, which can climb stair with less effort compare to carry it manually and measure the weight of load applied over it and made it ergonomically good. The technical issues in designing of this vehicle are the stability and speed of the vehicle while climbing stairs. However, the steepness of the stairs is also the important concern of this study. The uses of this special vehicle are in the frequent lift of goods such as books for library, medicines for hospital, regular goods of any technical or nontechnical institutes, or transportation any toxic material for industries and give freedom to the retarded person or paralyzed patients to move anywhere over flat surface as well as stairs. The vehicle has four wheels arrangement to support its weight when it moves over the flat surface. Each set wheel frame consists of three wheels attached with nut and bolt. Using of this vehicle, the labor cost can be reduced as well as huge amount of loads can be transferred uniformly with less power consumption. Moreover, considering some drawbacks due to lack of implementation of all techniques during manufacturing phase the test and trial run showed considerably significant and encouraging results that might help the future researchers to incorporate a gear box and steering mechanism to make the vehicle more versatile.*

Key Words: Stair climbing vehicle, wheel frame, nuts and bolts, bearings, and axel. Weight sensor.

1. INTRODUCTION

A typical hand trolley consists of two small wheels located beneath a load-bearing platform; the hand trolley usually has two handles on its support frame. These handles are used to push, pull and maneuver the device. The handles may extend from the top rear of the frame, or one handle may curve from the back. An empty hand trolley usually stands upright in an L-shape, and products are usually stacked on top of the platform. When the goods are in place, it is tilted backward so that the load is balanced between the platform and the support frame. Especially if heavy or fragile materials are moved, the person operating the trolley should return it to an upright position carefully, to insure nothing falls off the platform. The front of the frame may be squared off for boxes or curved for drums and barrels. Sometimes, a hand truck also has straps for securing loose freight during transport. Professional material handlers prefer to use a hand truck when moving stackable items such as boxes, crates or packages. Heavier items are usually stacked on the bottom of the hand truck, with lighter objects saved for the top. Hand truck users must be careful not to stack it so high that their vision is blocked or the load becomes unstable. Generally, it is safe to load a hand truck to the level of its handles or the top of the frame. The load is then shifted onto the wheels with a backwards lifting motion. The user can maneuver the cargo by steering it left, right or forward.

Fig -1: Schematic Representation of Vortex Tube

2. LITERATURE REVIEW

In 2018, Sohan Kumawat [1]. This project aims at developing a mechanism for easy transportation of heavy loads over stairs. The need for such a system arises from day-to-day requirements in our society. Devices such as hand trolleys are used to relieve the stress of lifting while on flat ground; however, these devices usually fail when it comes to carrying the load over short fleet of stairs. In the light of this, the project attempts to design a stair climbing hand cart which can carry heavy objects up the stairs with less effort compared to carrying them manually. It also endeavors to study the commercial viability and importance of such a product. Several designs were conceived that would allow a non-industrial hand trolley to travel over stairs, curbs, or uneven terrain while reducing the strain on the user. In our project, the trolley is equipped with Tri-Star wheels which enable us to carry load up and down the stairs. It also eases the movement of trolley in irregular surfaces like holes, bumps, etc.

In 2018 B. Ravindar [2] Trolley is generally use for the carrying heavy weights with the help of less human effort. The manufacturing of the trolley deals with proper design, accurate fabrication and prescribed analysis using finite element software gives better motion which resist to high load by applying less effort this paper deals with manufacturing of such stair climbing trolley with simple mechanism(i.e. ratchet mechanism) initially the model is sketched using solid works and imported into ANSYS software for structural analysis used to find von-mises stresses under load which deals to fabricate trolley with better performance under heavy duty with less effort.

In 2018 Senthil Kumar [3] This project aims at making headway for developing a mechanism for transportation of considerable loads over stairs. The requirement for such a trolley emerges from everyday prerequisites in our general public. Hand trolleys are used to lessen the stress of lifting while moving it on flat ground; however, these

hand trolleys usually fail when it comes to shifting the load over stairs. This project endeavors to design a stair climbing trolley which helps anyone to carry heavy objects up the stairs with fewer struggles compared to carrying them physically. Several designs were formulated that would allow a non-industrial hand trolley to travel over stairs which reduce the struggle on the user. In this project, the trolley is equipped with Tri-Star wheels which entitle us to convey load up and down the stairs.

In 2016, P. Jey Praveen Raj [4] This project aims at developing a mechanism for easy transportation of heavy loads over stairs. The need for such arises from day to day requirements in our society. Devices such as hand trolleys are used to relieve the stresses of lifting while on flat ground. However these devices usually fail when it comes to carrying the load over short fleet of stairs .Our project attempts to design a stair climbing trolley which can carry heavy objects up the stairs with less effort compared to carrying them manually .The main objective of the project is to find an efficient and user friendly method of carrying various objects through stairs using minimum effort from the user and to also provide a smooth movement while climbing the stair. Under this project we have manufactured a stair climber with tri lobed wheel frames at both sides of the climber and three wheels on each side are used in the tri lobed frame. The wheel assembly is rotated by a gear- motor mechanism where a DC gear motor is used to provide the necessary power for rotation and a pinion- gear mesh is used for reducing the rotating speed of the wheel. The motor is connected to a lead acid battery of similar ratings and they are in turn connected to DPDT switch.

In 2016 Prajan Pradip Gondole [5] A hand truck with the ability to climb stairs would decrease the possibility of injury from having to lift a wheeled cart or its contents over an obstruction. If successful, this device should provide increased safety both in the home and in the workplace. Also, it is hoped that a simple stair-climbing device such as this one might increase public acceptance of other, more complex stair-climbing devices such as wheelchairs.

3. PROBLEM DEFINATION

Lifting heavy objects to upper stories or lifting patients to upper levels from the ground are not painless jobs, especially where there are no lifting facilities (elevator, conveyer, etc.). Also, while handling trolley for peoples with different height is difficult and there may be contradiction in views of customer and owner or driver of trolley about fair of transporting goods so we can demand fair by weighting the goods. Moreover, most of the buildings are structurally congested and do not have elevators or escalators. This project can introduce a new option for the transportation of loads over the stairs. The stair climbing hand trolley can play an important role in those areas to lift loads over a short height. Lifting objects, loads such as books, food grains etc. to store above the ground level, or even patients to move upper level from ground is not easy job, especially where there is no lifting facilities (elevator, conveyer, etc.) Moreover, in most of the buildings in the world does not have elevators or escalators. In this case human labors are considered to be the only solution. Labor is becoming costly as well as time consuming in the developed countries, where growth rate is getting negative. This problem can be solved if a vehicle can lift loads while traveling through stairs. The project introduces a new option for the transportation of the loads over the stair.

The design and manufacturing of a stair climbing hand truck has been presented. The vehicle is designed in such a way that it can climb a stepped path (like stairs) with its modified wheel structure. Not only on the stairs, has it also moved with load over flat or rocky surface. This is the individuality of this vehicle. Wheeled rollers are the optimal solutions for well structured environment like roads or habitations. But off-the road, their efficiency is very dependent on the typical size of encountered obstacles that have to be overcome in a standard motion mode. This is the case for, which can typically overcome obstacles of their wheel size, if friction is high enough. Adding real climbing abilities to a wheeled rover requires the use of a special strategy and often implies dedicated actuators like or complex control procedure like. During the designing process the main focus was given to design its wheel, and design of size of frame especially for the stair. Normal circular wheel is attached here with nuts and bolts to the frame which guides the set of three wheels are getting power from the manual pulling effort. The planetary wheels are apart by 120º, the modification of the wheel frame was the main task in the project.

4. WORKING OF STAIR CLIMBING TROLLEY

Purpose of this trolley is to reduce human effort while carrying load over stairs. It has two sets of three wheels each on both sides of trolley. When first wheel come across a vertical side of step its motion will resisted and whole set of Tri-Star wheel will tilt and another wheel will fall on next step of stair and this process will repeated and with less effort load will be transported over stairs.

It has adjustable handle. Whenever height or position of handle is not suitable for a person carrying, he may feel back pain or stress will act on his back. To reduce this problem person can adjust the handle of trolley as per his need just by unbolting nut-bolt and entering bolt in suitable hole of handle.

It has weight calculating electronic machine which will display weight of load applied over it.

It has provision to adjust distance between three wheels of Tri-Star wheel from one another so that whenever size of step will change, we can change distance between wheels so that it will not create problem while climbing stairs.

5. METHODOLOGY

A Trolley & frame design methodology has been outlined. Steps of the design process include:

- Design calculation
- Modelling of Trolley & frame
- Details and assembly drawing of Trolley & frame
- Selection of material
- Laser Cutting of MS Plate
- Selection of standard parts from manufacturers catalogue
- Manufacturing of Trolley.

6. FINAL CAD MODEL OF TRISTAR WHEEL

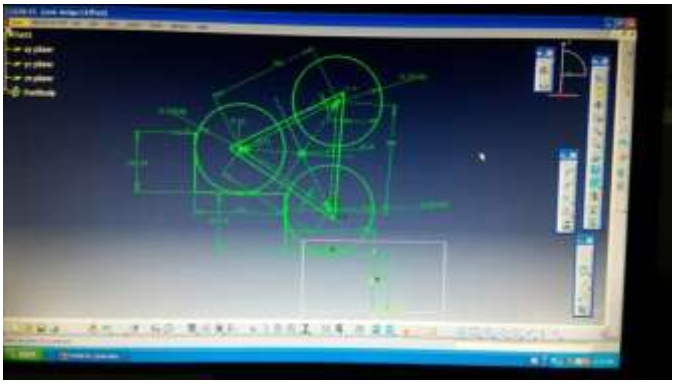

Fig. Model of tristar wheel

8. EXPECTED OUTCOMES

- Easy Vertical Transportation.
- Ergonomically suitable for the peoples with different height.
- Can measure the weight applied over it.
- Efficient Goods/Material Transport in Buildings.
- Less maintenance and cost.
- Can easily move on stairs as well as flat surfaces.

9. CONCLUSION

Though this project has some limitation as a first step of making any Stair Climbing hand truck, it is a pioneer project. During the test run of this project, it is realized that it would capable of carrying heavy load without suffering any deformation or local fractures if it would go into real world production at an ideal scale. Though the initial cost of the project seemed to be higher but more accurate manufacturing would shorten this. Our project can carry load easily irrespective of structure irregularities and even though this project cost very high if we manufacture it on large scale, we can reduce its cost.

10. ACKNOWLEDGEMENT

The authors would like to thanks Prof.Yogesh Ingulkar, for whom we have greatest amount of respect admiration. He has not only afforded us the opportunity to work on this topic but also provided valuable guidance and support throughout our time as student in mechanical engineering department of Dhole Patil College of Engineering (Pune).

We are sincerely thankful to Prof. Yogesh Ingulkar HOD of mechanical department, for there kind guidance and support throughout this work.

We express our deep gratitude to all staff members of mechanical department for proving valuable support and help during our project work.

11. REFERENCES

1. Sohan Kumawat, MilindSonawane, Shubham Khadangle, Omkar Chavan, B. J. Vispute "AUTOMATIC STAIR CLIMBING TROLLEY" IJSRD Vol.6, Issue 02, 2018
2. B. Ravindar, M. Kiran Kumar, K. Rajashekar, G. Rajkumar

   "DESIGN AND FABRICATION OF STAIR CLIMBING TROLLEY" JETIR Vol. 05, Issue: 09

3. Senthil Kumar, Anoop C Abraham, Anandhagobi, Dinakar
   "DESIGN AND FABRICATION OF STAIR CLIMBING TROLLEY" IRJET Vol. 05 Issue: 03 | Mar-2018

4. P. Jey Praveen Raj, P.M. Mohamed Fuge, R. Paul Caleb, G. Natarajan
   "DESIGN AND FABRICATION OF STAIR CLIMBING TROLLEY" International Journal of Advancement in Engineering Technology, management & Applied Science Vol. 03, Issue 5 May, 2016

5. Prajan Pradip Gondole, Kamlesh Diliprao Thakre, Himanshu Anil Moon, Shubham yengalwar,
   Mr. S S Marathe
   STAIR CLIMBING HAND TROLLEY April 2016, Volume 3, Issue 4