

Staircase Climbing Trolley

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Abstract: This topic deals with the designing and manufacturing of a hand trolley, which can climb stair with less effort compared to carry it manually. 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 non-technical 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.

Keywords: Staircase Climbing Trolley and Manual Operator

I. INTRODUCTION

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. Most of the buildings of the country are structurally congested and unavailing of elevator facility so it is difficult and laborious to lift up heavy loads. The stair climbing hand truck can play an important role in those areas to lift loads over a short height, like libraries, hospital, and in construction area. The vehicle, which can move upper level through stairs, or run in very rough and rocky surfaces, is called stair climbing hand truck or say stair climbing vehicle. In the year of 2000, a group of researchers introduced a rover type of vehicle to run over stepped path. Using a rhombus configuration, the rover had one wheel mounted on a fork in the front, one wheel in the rear and two bogies on each side. Researchers around the world are thinking seriously to redesign such vehicle, which will be economical and affordable. Chang Hsueh-Er developed a five-wheeler trolley, which was driven by manual power. Anastasias et al. and D. Helmick et al. designed a robotic carrier with belt driven. No wheel was introduced in his robotic carrier.

II. LITERATURE SURVEY

Pratik H. Rathod et al. [1], designed and fabricated a hand truck which climb stair with less effort which is useful for library, hospital, regular goods carrier etc. the main modification in this truck were made at wheels using plat surface roller plat attached instead of traditional wheel frame. The mechanism based on retched arrangement mechanism. The maximum bending moment was calculated. The inclination of 44 degrees plays a major role which covers more than 90% of all stairways within this limit. There is an optional maximum inclination warning alarm that alerts the operator of an inclination of more than 44 degrees. When truck operated with exceeding the limit there should be taken the necessary safety precautions.

Raj Kishor Kumar et al. [2], investigated on stair climbing functionality is embedded in the design through its structure and mechanism. The product mainly consists of modules viz. seat, links and frame. Anthropometric measures are considered in the dimensioning of seat. Focus is laid on different parameters such

as form, functionality technology and architecture if the product. The design is validated by developing digital mockups of individual parts are simulations of the product generated in virtual environment of PRO-E Creo software. The physical and focused prototype indicating the structure and functionality is developed using thermocol material. Here wheel carries are made in RP (Fused Deposition Modelling) using ABS (Acrylo Butadiene Styrene). Wheel chair is embedded with some additional features like integrated commode facility, after gathering customer requirements.

P. Jey Praveen Raj et. al. [3], 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.

Roshan Alaspure et al. [4], designed and fabricated a stair climbing wheel mechanism which can be considered as alternate for lifting goods in such a way that it can climb a stepped path with its modified wheel structure using manual metal arc welding (MMAW) or stick welding. An electric current is used to strike an arc between the base material and consumable electrode rod or stick. The electrode rod us made of a material that is compatible with the base material being welded and is covered with a flux that gives off vapors that serve as a shielding gas and provide a layer of slag, both of which protect the weld area from atmospheric contamination.

P P Gondole et al. [5], fabricated a stair climbing hand trolley with proper dimensions of Height 4 feet, Lower frame 38 38 cm, Length of each arm trigonal wheel axial geometry 15 cm, Diameter of shaft 15 mm. The major components used to fabrication process are square bar cast iron pipe, Round bar shaft of SAE 1030, rubber rest, caster wheels (industrial rubber), iron plate, long gudgeon pin. Mathematical calculations are made to this work to exhibits expected results and carried load across the stair very easily thus climbing across stairs transportation of goods very easily.

III. OBJECTIVES AND METHODOLOGY

3.1 Objectives

Following are the objectives of staircase climbing trolley.

- The project aims at making headway for developing a mechanism for transportation of considerable loads over stairs.
- Lifting material with heavy weight to upper level from the ground with painless work. Especially where are no lifting for moving objects from lover level too upper level and vice versa.
- To provide Tri-Star wheel arrangement is better than normal wheel structure at climbing the stairs.
- Weight reducing and minimum effort require carrying the load.
- Keep safety, weight and size in perspective.

3.2 Methodology

The mild steel frame with square cross section are welded to form as a trolley using wheel additional setup three in number forming an equilateral shape on both ends of the trolley. The fabrication is made using design and modelling sketched in SOLIDWORKS software. Analysis is done on the trolley to find Von-mises stresses and deformation to find out the failure criteria on entire trolley setup. The number of nodes and elements formed by meshing component gives the fine analysis requirement. The mechanical design of the stair climbing cart has been developed & modified considering available materials. Low-cost available materials help to reduce the cost of a product easily. Also, the availability of the technology of processing the materials is very important during the design of the product. Continuous material supply at the lowest cost has a great impact on product quality & cost [23-26]. The design of the cart with main parts has been illustrated in figure 1 where part no. 2 the load-carrying base is the main part of this cart. The object will be placed on it. The no. 6 part of which name is load support is added to prevent the load from slipping backward. In case of carrying heavy loads, ropes can be used to tie the loads with the load support & the frame under the handle. The dimensions of the stair climbing cart are bellowed. The mainframe of the cart is designed to make with structural members which will be joined by welding after the cutting according to the required size and edge preparation. The members are

available at a cheaper price and the use of structural members will reduce the manufacturing process step and operator. Also, the structural members with a welded joint will reduce the utilization of extra machines as well as operator cost.

The step-by-step procedure made for design and analysis of stair climbing trolley is manufactured by following procedure is represented below:

- Identify the specifications of parts assembled to form a trolley.
- Make sure about cost estimation for trolley components.
- Planning and designing for fabrication procedure to be performed.
- Sketch the trolley draft and model software and analysis of entire working model.

IV. WORKING PRINCIPLE

Goods transportation locally is highly dependent on manual trolleys. They are used in warehouses, construction sites, malls, residential relocations etc. These trolleys have a very huge limitation when it comes to stairs. They can only move on flat surfaces and moving them over a staircase is a very hectic task. So here we propose a smartly designed staircase climbing trolley. The trolley is smartly designed to carry goods up and down on staircases as well as on flat grounds and even rough terrains. The trolley makes use of a triple interlinked wheel arrangement that allows it to do so. The mechanism uses a trolley with a support wheel arrangement which will be used for support when at rest and will be suspended in air while the trolley is moved by lifting it. The interlinked wheel mechanism consists of 3 freely moving wheels. These wheels are connected to a connecting rod. There 3 such connecting shafts for each wheel with a main rod connecting through a free moving bearing mechanism to the three rods. This mechanism allows for efficient stair climbing functionality. This functionality allows for easy movement of goods across stair cases. This Fig. 7.1 shows the working of a Stair Case 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 angle 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.

V. FIGURES

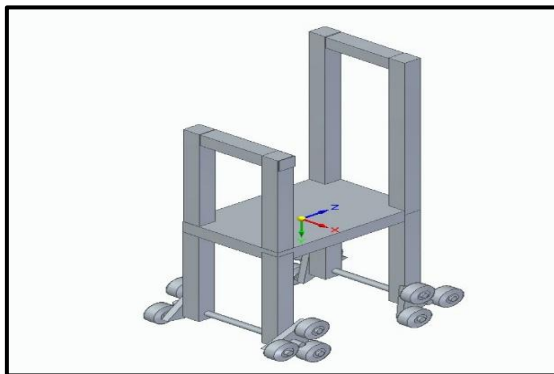


Fig. 1 View of Trolley

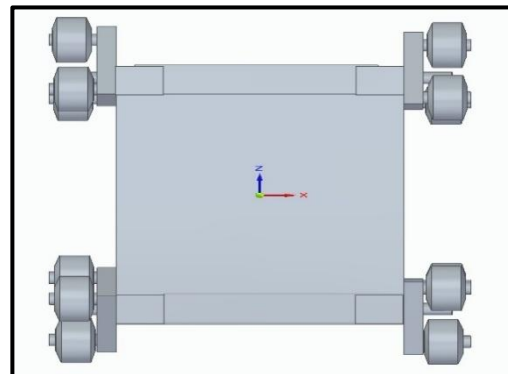


Fig. 2 Top View of Trolley

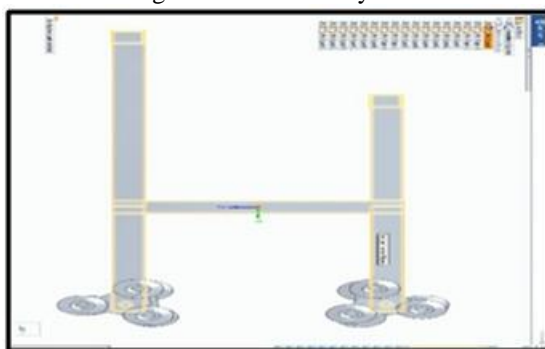


Fig.3 Side View of Trolley

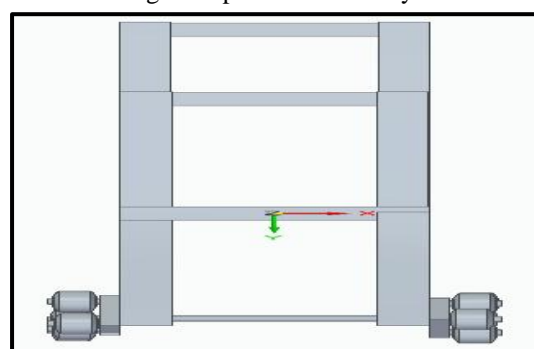


Fig. 4 Front View of Trolley

Fig. 5 Completed Project Model

VI. CONCLUSION AND FUTURE SCOPE OF WORK

6.1 Conclusion

The main aim of the project is stair climbing mechanism for load carrier with fewer efforts. Doing better work with lessor effort has been the main objective of human beings in any field. The main project as a platform we try to present mechanized stair climbing load carrier with reducing effort. Stair climbing mechanism in stair case load carrier which helps to carry the loads with help to carry the load with stair case. We completed the project to our best. The project work carried out exhibit expected result, and carry load across the stair very easily. Thus help in climbing across stairs the transportation of goods can be done very easily. This type of project work can be of very much useful for industrial use, dispatched with new household. This type of trolley will helpful to climb stairs with a particular height and width. According to the dimensions of stairs we can change dimensions of chair parts as well.

6.2 Future Scope of Work

The staircase climbing trolley can be a handy tool for carrying load very effectively and efficiently. The staircase climbing trolley designed by us might not be effective on all the stairs due to the tyre size that we used and height of the stairs. The size of tires can be increased and decreased to increase is efficiency in climbing stairs. In other words, better wheels can be selected analyzing the wheel contact is specific. Moreover we can also use internal breaking system to control the speed of vehicle during operation. Internal Breaking system can be used as effective breaking system. The same mechanism can be used for wheel chair providing high head motor along with more rigid structure is used. We can also make it automated by using motor if we increase our budget.

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