Tri-Wheeler Stair Climber

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ABSTRACT

The project deals with the designing and manufacturing of a tri-wheeler stair climber, which can climb stairs with less effort as compared to manual work. The technical issues in designing of this vehicle are the stability and speed of the vehicle while climbing stair. The inclinations of the stairs is also the important parameter for this study. The application of this special trolley are often used to lift the goods such as books for library, medicines in hospital, regular goods of any technical or non technical institutes, or transportation of toxic materials 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 of wheel frame consists of three wheels attached with nuts and bolts. Using this vehicle, the labour 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 - *Trisection, Trolley, Stair Climber, Tri-Wheeler Mechanism, Heavy Load*

INTRODUCTION

In the modern world though there are many developments in the field of engineering. Still there are difficulties to carry heavy loads over stairs. The evolution of elevator reduces the effort of carrying heavy loads over stairs, it is not possible to use lift in all places like schools, colleges and constructional areas. This project aims at developing a mechanism for easy transportation of heavy loads over stairs. The need for such mechanism arises from our day to day requirements in the society. Devices such as hand trolleys are used to reduce the effort of carrying loads on flat grounds as well as on ramps. However there is difficulty in carrying of load over a flight 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 in the conventional manner. 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 also to provide a smooth movement while climbing the stair. Under this project we will design and manufacture a stair climber with tri wheeled frames at both sides of the climber and three wheels on each sides are used in the tri section frame. The vehicle is designed in such a way that it has three wheels are on each side. They are set in triangular pattern. The present project related to load carrying equipment of a type that is manually operated of moving upwardly and downwardly on flight of stairs. Load carrier is a wheeled mechanism device, is generally used to carry a loads. It is use to reduce human efforts.

PROJECT BACKGROUND

Carrying loads like books, food grains etc. to store upper level, or even patients to move upper level is very tiring task, in the absence of facilities (elevator). Most of the buildings in the world do not have the elevators or escalators facilities, therefore in such case humans are considered to be the solution. Labours are becoming costly in the developed countries. This problem can be easily resolved if a vehicle can lift loads while climbing up stairs.

The project introduces a new dimension for the transportation of the loads over stairs. Most of the buildings of countries are structurally small and do not have the elevator facility so it is difficult and tiresome to lift up heavy loads. The stair climbing vehicle can play a vital role in those areas to lift loads over short heights, like libraries, hospitals, and in construction areas. The vehicle, which can move upper level through stairs, or run in very rough and rocky surfaces, is called stair climbing vehicle.

PROBLEM STATEMENT

Create and design an easy to build mechanism that will help transport shopping dollies up stairs smoothly for the price conscious customers.

MATERIAL SELECTION

We have compared the different properties of different grade of material and we found AISI 1020 was best suited material for our project due to ease of machinability,availability.

AISI 1020

➢ It is a Carbon Steel with tensile strength of 420 MPa.

➢ It has high Machinability and ductility.

➢ It posses high turning facilities and great surface finish.

➢ It posses great hardnability by the process of induction hardening.

DESIGN

The central idea behind our design is to create a triwheeler stair climbing mechanism for carrying loads along stairs which would incorporate a tri wheel design. We wanted to stick with the principles that we established and wanted our prototype to fulfil all those requirements. After through research about the various available model which incorporate the same triwheel mechanism we came to a conclusion that we will a completely new stair climbing device which would be efficient both in stair climbing as well as its stability on stairs.
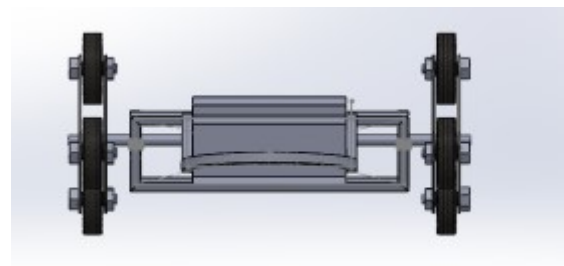
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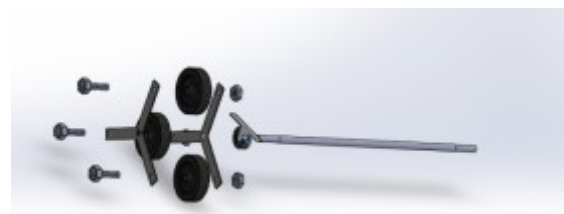
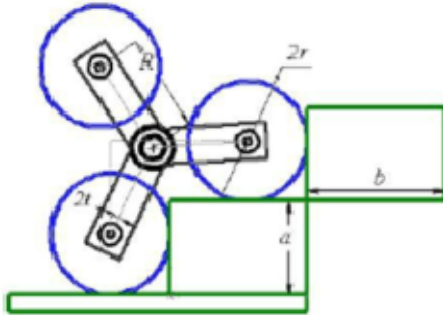
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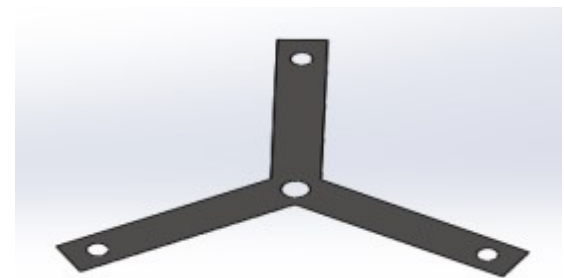
Tri section

Tri –Wheeler Mechanism

CALCULATION
Arm Length Calculation
Figure shows geometrical diagram of tri-wheeler on stairs.

$$R = \sqrt{\frac{a^2 + b^2}{3}}$$

$$R = \sqrt{\frac{16^2 + 32^2}{3}}$$

$$R = 20.65 \text{ cm}$$

Wheel Diameter Calculation
The basic idea behind selecting the wheel diameter was that it should not hinder the trisection and the was calculated by hit and trial method on the basis of trisection length such that it should climb the stairs. Diameter of wheel = 16cm

Length and Height of Trolley
The basic idea behind selecting length and height of the trolley was that the normal person (ranging from 4.5 feet to up) could easily hold the trolley for carrying the load.

Length of Trolley= 860mm
Height of Trolley = 1125mm

The final specification of the tri-wheeler stair climber are as follows:

   i.   Diameter of Axle = 23mm
  ii. Trisection length = 206.5mm
 iii. Trisection Width = 35mm

  iv. Diameter of wheel= 160mm
   v.   Length of Trolley= 860mm
  vi. Height of Trolley = 1125mm

CONCLUSIONS
Apart from a few limitations this project is a first step of making any Stair Climbing Trolley.

i. The stair climbing trolley was designed and manufactured in such way that it could lift inertial loads over stairs and also used for carrying loads on flat surface from one location to another with reduced human effort.
ii. During the trail of this project, it was found that it would be capable of carrying heavy load without suffering any deformation or local fractures, if it would go into real world production at an ideal scale.
iii. The initial cost of the project was a little bit higher but more accurate manufacturing would lessen it.
iv. By using different materials we can reduce its weight and cost simultaneously.
v. It can be made more efficient by using gear mechanism and electronics circuits.

SCOPE OF FUTURE WORK
i. The material of the stair climber components can be changed because using MS AISI 1020 as a material, weight of the stair climber would be increased. Inspite of using MS as material we could use composite materials to reduce weight.
ii. Electric motor could be used to carry load at all types of surface . A sensor and steering wheel can be implemented to move around the stairs.
iii. A suspension system could be incorporated to reduce shocks and vibrations.
iv. The height of the Tri-sectional member could be made adjustable, so that it could climb stairs of different sizes by using bolts and nuts or another adjusting mechanisms

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