Design and manufacturing of six wheel Staircase trolley

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Abstract

This article deals with the designing and manufacturing of a trolley, which can climb stair or move along very rough surface. The technical issues in designing of this trolley are the stability and speed of the trolley while climbing stairs. However, the steepness of the stairs is also the important concern of this study. The uses of this special trolley are in the frequent lift of goods such as books for library, medicines for hospital, regular mails for any 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. 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.

Keywords: Stair climbing trolley, wheel frame, sun wheel.

Introduction:

Lifting recurring loads like books, food grains etc. to store upper level, or even patients to move upper level is not easy job, especially where there is no lifting facilities (elevator). Moreover, in most of the buildings in the world do not elevators or escalators. In this case human labors are considered to be the only solution. Labor is becoming costly in the developed countries, where growth rate is getting negative. This problem can be solved if a trolley can lift loads while traveling through strains. The trolley which having 6 wheel for stair climbing with less human effort. In this it is having suspension to the wheel for easy load lifting. [1]

Construction:

Principle:

The project introduces a new horizon 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 trolley can play an important role in those areas to lift loads over a short height, like libraries, hospital, and in construction area.[2] The main function of this trolley is to carry load not only on table platform but also on stair case. By using this trolley the labour can easily carry the load on the table platform and when stairs are come then he can easily move this trolley on the stairs because of its wheel arrangement with suspension. [4]
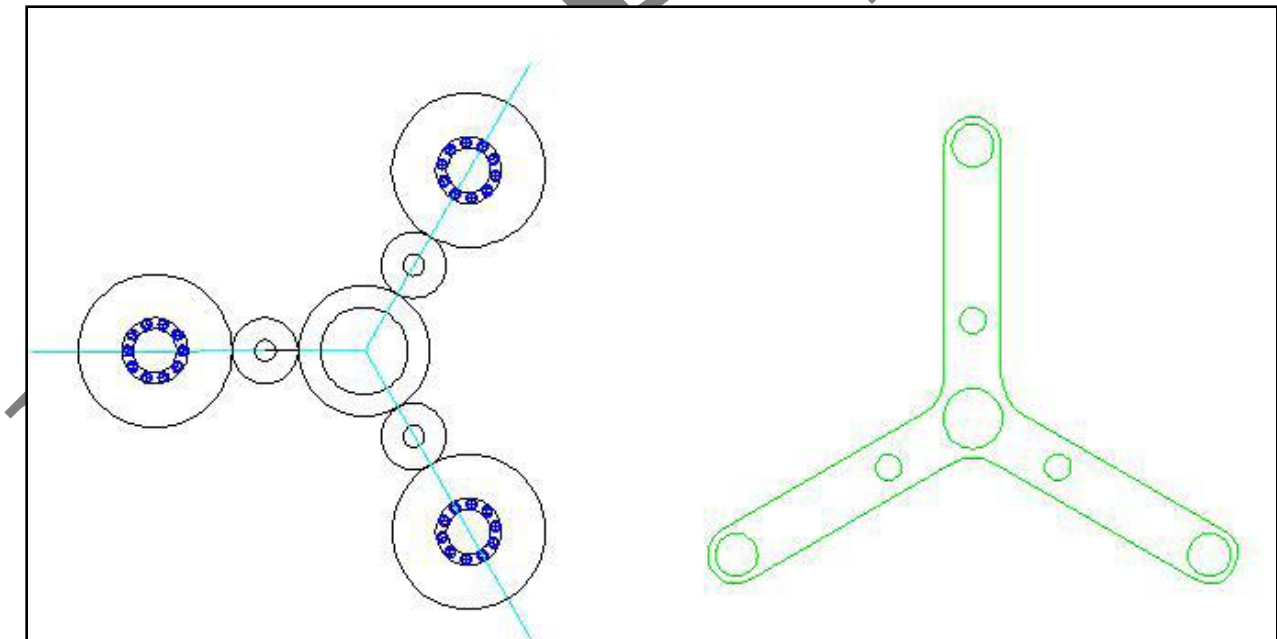

Fig. 1: Wheel Alignment of Trolley.

The figure (Fig. 1) shows wheel arrangement of trolley. It consists of frame to keep a load on it. Main shaft for load

carrying at the both side of the shaft two press fit bearing are placed on the bearing two disc are fitted in between two

disc/plates the wheel assembly is created in which three square rod are fixed in this rod again we can insert the another square or which is less in size as compare to the another rod this small rod can attached to the C clamp. This C clamp can be hold the wheels 6wheels mounted on the circular plate of metal .On the wheel there are a groove for mounting a leather thread for suspension and minimize the vibration and jerk. It is having the adjustment for increasing or decreasing length of wheel with respective to stairs .Six wheel are placed in whole trolley 3wheel at one side an 3wheel at another side. In each wheel there is 120degree angle is maintained. Leather threads are used for reducing noise.

The main shaft of diameter 16mm which is of length   having high strength to carry the load

Working:

The main function of this trolley is to carry the load not only on the flat surface but also on the stair case. in the this the load(goods) are simply placed in the trolly or box type construction. By using handle we can push the trolly forward direction when the trolley is move on the flat surface that time only one side 2 wheels and another side 2 are rotate easily. due to the wheel load can be easily move or carry from one place to another place. When we want to go by the stairs that time we can pull the trolley backward direction and towards the stairs. One we can pull the trolley one wheel are restricted by the stairs that time again we can apply few amount of effort the second

wheel is come on the upward stairs. in this when the restriction is created that time the all wheel assembly apart which is connected to the main shaft with the help of the bearing the main disc and all wheel assembly rotate as like a one wheel. And three wheels can be move one by one the wheel can be move on the stairs. And when we are going to top side to bottom side that time only two wheels can be move.

Material used:

Name of material
Quantity

Fiber wheels	06
Main shaft	01
Bearing 6201	06
Bearing 6202	04
Short shaft of 12mm diameter	06
Leather thread	02
Square metal rod	02

Results and Analysis

It was found that the vehicle was moving well over the stair. It can move on flat surface uniformly at 20 rpm without any fluctuation. Separate motor worked properly for moving over the steps and there was no variation of speed over steps. It was observed that there was very low noise and vibration over flat surface or stair. It was observed that the vehicle was disturbed when it faced the stair of different step sizes. This was because of the shape and size of the wheel frame. Therefore for a range of stairs size can be considered for this vehicle. Although, different sizes step are not usually

available in building design. It showed good performance when the step size was uniform. Here in this project separate motor was used to move over the stair, which made its circuit design a little bit complicated and increased the weight of the vehicle.
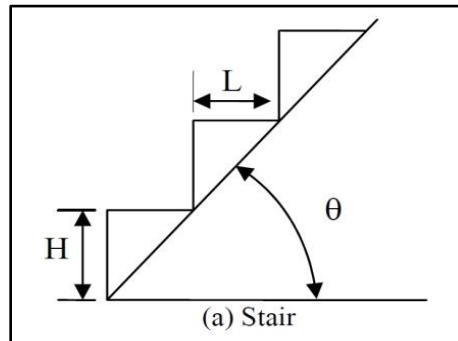

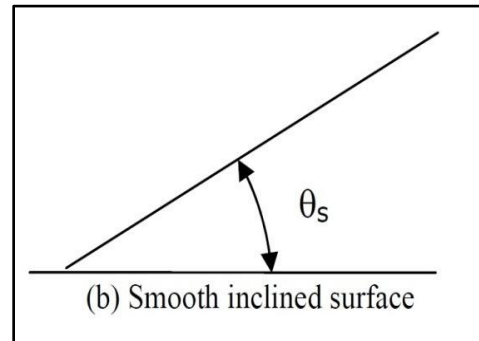Fig. 2: Structure of a stair case

Fig. 3: Maximum climbing angle

From the test run of the vehicle it was seen that the maximum height the vehicle could climb the stair whose inclined angle was 44° maximum. Figure 2 Shows Structure of a stair case. If the inclination is more than 44° it would fail to climb the stair. In building construction, very few stairs are generally available having inclination more than that i.e.44°. The smooth ramp angle (θs) was not listed for the vehicle. But it can be easily predicted that stair inclined angle (θ) is less than that of ramp (θs). (a) Stair (b) Smooth inclined surface Figure 3: Maximum climbing angle, (θ, θs) The velocity of the vehicle during climbing the stair was higher than that on the flat surface as the wheel frame (higher radius) was used to climb stair. The velocity of the vehicle on the stair was 55 in/hr. However; the speed of the vehicle running on a ramp was not measured. This speed should not be higher or equal to the speed on the horizontal surface.

From the above discussion, it could be summarized that considering some of the limitations, the vehicle was an effective alternative to transport loads using stairs. Some limitations could not be avoided because of the lacking in technological availability. This pioneer project, with a little further improvement, was hoped to be succeed to meet up the demand of carrying loads over the stair.

Conclusions:

Though this project had some limitation as a first step of making any Stair Climbing Vehicle, it was a pioneer project. During the test run of this project, it was 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 cost.

References:

1.   Stewart, R., Lauria, M., Mäusli, P., Winnendael, M., 1998, "Design and Implementation of an Innovative Micro-Rover," Proceedings of Robotics 98, the 3rd Conference and Exposition on Robotics in Challenging Environments, April 26-30, Albuquerque, New Mexico.

2.   Hsueh-Er, C., "Stair-climbing vehicle, 2008, "Patent No. US2008164665(A1)", Jan 24.

3.   Mourikis, A.I., Trawny, N., Roumeliotis, S.I., Helmick, D.M., and Matthies, L., 2007, "Autonomous Stair Climbing for Tracked Vehicles," International Journal of Computer Vision & International Journal of Robotics Research - Joint Special Issue on Vision and Robotics, 26(7), 737-758.

4.   Helmick, D., Roumeliotis, S., McHenry, M., Matthies, L., 2002, "Multi-sensor, high speed autonomous stair climbing", IEEE/RSJ Conference on Intelligent Robots and Systems (IROS), September.

5. Schilling, K., Jungius, C., 1996. "Mobile Robots for Planetary Exploration," Control Engineering Practice, Vol. 4, No. 4.

6. Burdick, J.W., Radford, J., and Chirikjian, G.S., 1993, "A 'Sidewinding' Locomotion Gait for Hyper Redundant Robots," Proc. IEEE International Conference on Robotics and Automation.

7. Desai, R.S., Wilcox, B., Bedard, R., 1992, "JPL Robotic Vehicle Overview," in AUVS.

8. McTamaney, L.S., Douglas, B.D., Harmon, S.Y., 1989, "Mars Rover concept development," Proc. SPIE Conf. 1007, Mobile Robots III.

9. Spiessbach, A., Clark, B., Larimer, S., Tobey, B., Lindauer, B., Koenig, R., Lisec, T., 1987, "Issues and Options for a Mars Rover", Proc. SPIE Conf. 852, Mobile Robots II.

10. Wilcox, B., Matthies, L., Gennery, D., Cooper, B., Nguyen, T., 1992, "Robotic Vehicles for Planetary

Exploration", Proc. of the 1992 IEEE International Conf. on Robotics and Automation.

11. Wright, D.D., Watson R.E., 1987, "Comparison of Mobility System Concepts for a Mars Rover", Proc. SPIE Conf. 852, Mobile Robots II