DESIGN OF STAIR CLIMBING TROLLEY WITH ANTI-SLIPAGE MECHANISM

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Abstract : Earlier men used to carry their luggage on their head and in hands. But later on the invention of wheels and cark changes everything. But later on men invented bridges and stairs. The problem again remain same because wheels can't move on the stairs. Later on man invented some mechanism to climb on the stairs. But in that there are certain problems such that sometimes the surface was not exactly flat and the shaft would rotate. And sometimes while pulling on the stairs trolley would slip. In order to remove that problem we think and apply mechanism in that trolley. We apply the mechanism use in cycles so that it will not slip back on the stairs and a breaking system which will hold the wheel and shaft in its position when it is moving on the flat surface to avoid the problem of slippage.

***IndexTerms* – Stair climbing mechanism, Trolley, Anti-lock mechanism.**

I. INTRODUCTION

Staircase trolley is a crucial element in climbing the steps which helps to get maximum results with less effort between surface and wheels. Due to application of load in the downward direction[1-2].This need to apply more force for a regular trolley to climb the staircase. While designing, the two most important parameters to be considered are firstly, the shaft must rotate in one direction and secondly the tri-wheel motion should be rotated restricting the motion of individual wheels.The different conditions like flat and staircase are the two different surface where the trolley can move without any difficulties.

Firstly let's consider the trolley moving on flat surface, Which is having set of three wheels on both sides connected with shaft. While moving on the flat surface the trolley will move on the two wheels on the both sides(total four wheels on the surface). On the other hand the motion of the third wheel is restricted on the both the sides for a smooth motion of the trolley. So, in this in interval we need to achieve the motion by constricting the motion of third wheel which will be done naturally when load applied, the wheels automatically stop rotating on its axis [1-3].

Secondly, while climbing on staircase we are stopping the motion of the individual wheel by applying break. Moreover the wheels must rotate on the central axis, which is on the shaft. So that when the two wheels on the flat surface will stay constant and the third wheel will give the support to climb for the first wheel in the same manner moving to the second step the wheel in the air will incline to the stair and give support to the rest two wheels, in the mean while the central shaft will rotate so that the wheels will climb the stairs. This helps the user to climb stair with luggage makes easier [2-3].

Here, We are restricting the motion of two things which are central shaft moving in backward direction by using bearing in the shaft so there will be no gravitational force acting on the trolley while moving on the staircase. Second is the motion of individual wheels over its own axis, this will help in gripping of motion of the trolley. The whole process of the synthesis is categorized into two parts. In the first phase, motion of on the flat surface is carried out. In the second phase, motion on the staircase can be achieved by followed modification in design. Even though main researchers investigated on fabrication and design of stair climbing trolley less effort where implemented to perform analysis on cabin structure and wheel alignment. In this paper the efforts are insisted to carry analysis on entire trolley structure is including wheels and fabricated with optimal measurements with suitable materials. It requires much effort, time to lift a heavy weight component and to transport them to different locations [4-6].This type of problems raises in industrial sector, factory, manufacturing units and production sector where heavy mechanical components are to be transported from one place to another place and also from one floor to another floor using simple mechanism in involved in such operation it becomes very much difficult to move heavy components to different locations.

II. TRI-STAR WHEEL

A Tri-Star wheel capability as an ordinary wheel on the flat ground, but has the potential to climb robotically whilst an impediment to rolling is encountered. This wheel configuration contains three tires, every established to a separate shaft. These shafts are positioned at the vertices of an equilateral triangle. While geared on this quasi-planetary style, these triangular sets of wheels can negotiate many kinds after rain. They can also permit a vehicle to climb over small obstructions inclusive of rocks, holes, and stairs.

III. Material Selection

3.1 Trolley body:

Mild steel is the most well-known type due to the fact its price is tremendously low even as it affords material properties that are best for plenty applications, greater so than iron. Low-carbon metallic includes approximately 0.0503 percentage carbon making it malleable and ductile. Mild steel has a relatively quite low tensile strength, but it is cheap and malleable; surface hardness can be increased through carburizing.

3.2 Tri-Star wheel web:

Stainless Steel Grade is material with a higher chromium and lower carbon content. Lower carbon minimizes precipitation due to welding and its susceptibility to intergranular corrosion. Therefore, this combination can be utilized as a part of the as-welded condition, even in corrosive conditions. It regularly gets rid of the necessity of annealing weldments besides for applications specifying strain remedy.

3.3 Bearing:
The most common material used to produce bearing is Chrome Steel. A ball bearing is a sort of rolling-detail bearing that makes use of balls to hold the separation among the bearing races. The reason of a ball bearing is to lessen rotational friction and aid radial and axial loads.

IV. Overview:
We made stair climbing hand truck of:

- Height – 4 feet.
- Lower frame 38 X 38 cm.
- Length of each arm of trigonal geometry 15 cm.
- Diameter of shaft 15 mm.

V. Technical Data: Following part are used in the fabrication of project work named "stair climbing hand truck":

- Square bar cast iron pipe.
- Round bar shaft SAE 1030
- Rubber rest.
- Caster wheels (industrial rubber).
- Iron plate.
- Long gudgeon pin.

VI. Calculations:

As designing the staircase trolley, we are designing as a prototype and took the dimensions smaller.
We have various parts in this:
The cart- The length of the cart is 40 inch along with and the width of the cart is 20 inch. As there are various mountings they are made according to the requirements.

The second main part is in staircase trolley is the spinner like structure which is attached with the shaft. The dimensions for which we have designed may be different from the other stairs so the dimensions of this part may be arbitrary and make it according to the staircase.On the edges of this the wheels are attached and in the middle the shaft is attached to its wheels. The rotation of the

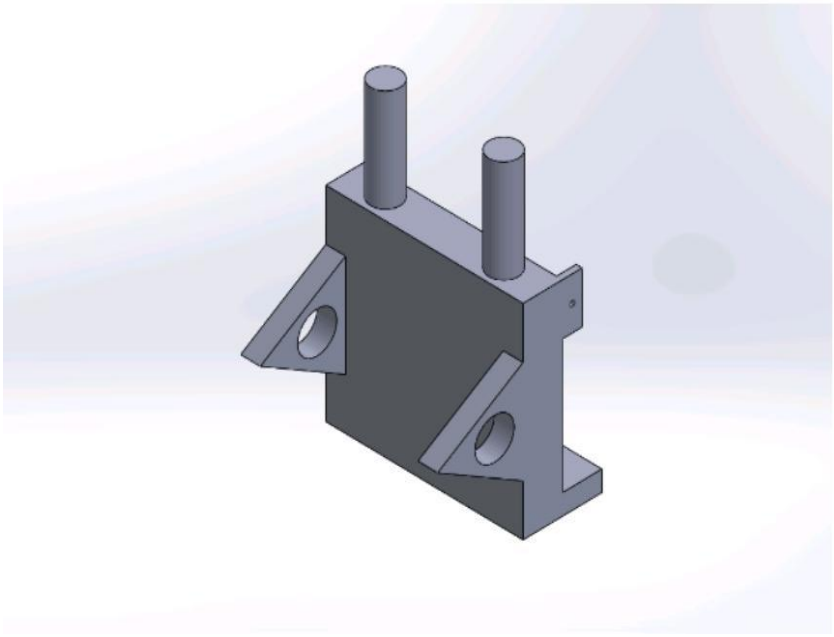

Figure 1. Hub for carrying spinner structure

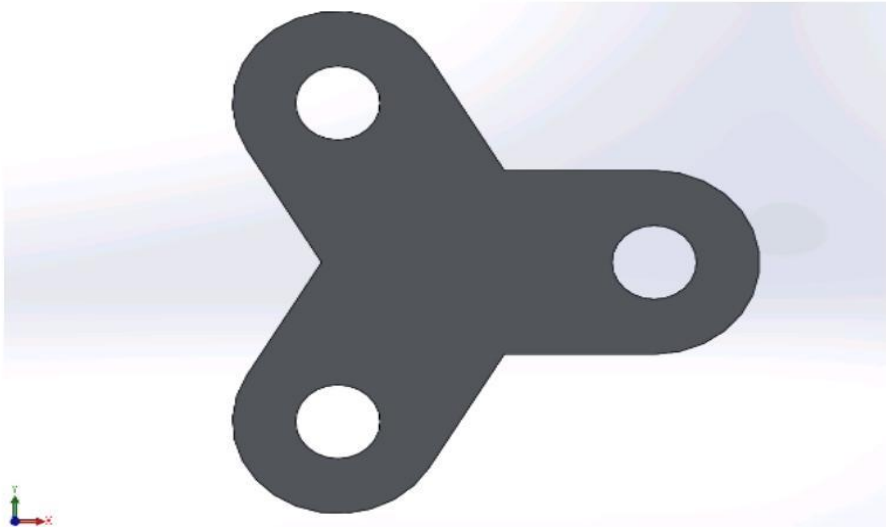

Figure 2. Spinner structure carrying wheels

shaft is only in that case when the trolley is on the stairs so we have to stop the rotation of the shaft when it is moving on the flat surface. So we just do one simple thing i.e. we just apply a shaft in the wheel which is not on the surface and attached that with the cart. For that purpose we just make holes in the wheels.

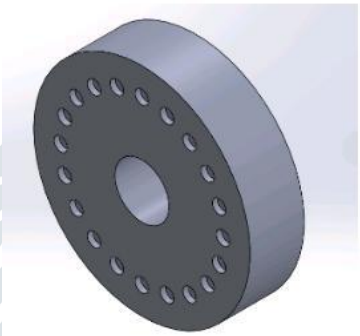

Figure 3. Locking device part 1 for providing anti slippage

To stop the reverse motion of the shaft we apply the mechanism which is used in the cycles. The shaft must not have back motion when it is on the stairs.

In this the process is that when we are pulling it the rollers in between will rotate but when it will go in other direction the rollers will go on the inclined surface and it will stuck.

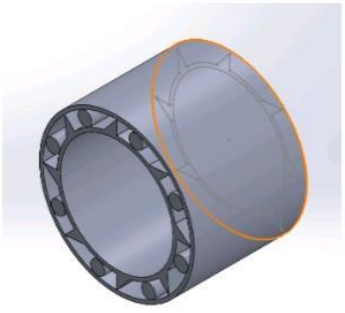

Figure 4. Locking device part 2 for providing anti slippage

VII. CONCLUSION

As this is the modern type of climber, we can get the better results by the less efforts. Here when we compare to other ones we have a tri-wheel set-up which is much effective and also this format of design gives the much more elegant way to look according to design as well as the adoptability in climbing the stairs. By this creation we can also transport the huge loads to the upper floors with minimal effort. 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. 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.

The above work on fabrication design and analysis of stair climbing trolley is based on modelling made by solid works with accurate values and imported into ANSYS workbench for structural analysis and proper mesh. After performing the analysis design brought into practical working model successfully. The wheel attachment as proper gap with each other and there is no slip,2sudden shock, wear and tear on other platform. The mechanism of transmission can carry heavy loads with less effort. The tri stair plate can weight itself to climb any height of stair with little tolerance using nut-bolt and adjustment mechanism with in less time more luggage can be moved to different locations with easy transportation. 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] Khurmi, R. S. 2014. Engineering Mechanics, S.Chand publication.
[2] Shivalkar, B.D. 2017 Design Data Book, Denett and Co.
[3] Mulik, S., Salunkhe, R., Shaikh, S., Waghmode, D., and Swipnil, G. 2016. Advance material handling trolley using tri-wheel mechanism, International Journal of Recent Research in Civil and Mechanical Engineering, ISSN 2393-8471, Vol. 2, Issue 2, pp: (160-165).
[4] Young, M. 1989. The Technical Writer's Handbook. Mill Valley, CA: University Science.
[5] Roshan, A., Chaitali, B., Snehal, C., Manish, M., and Prof. Joshi, Y. G. 2016. Fabrication of Stair Climbing Wheel Mechanism: Alternate for lifting goods, International Research Journal of Engineering and Technology, e-ISSN: 2395 - 0056, Volume: 03 Issue: 05, pp: (553-555).
[6] Raj, P. J. P., Fuge, P. M. M., Caleb, R. P., Natarajan, G. 2016. Design and Fabrication of Stair Climbing Trolley, International journal of Advancement in Engineering Technology, ISSN NO: 2349-3224, Volume: 3 Issue: 5, pp: (89-102).