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Design and Fabrication of Easy Handling Trolley

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Abstract - *This project aims at developing a mechanism for straightforward transportation of masses over stairs. The requirement for such a system arises from regular necessities in our society. Devices like hand trolleys (single or double wheel trolley) square measure used to relieve the stress of lifting whereas on flat ground. However, these devices sometimes fail once it involves carrying the load over the steps. Keeping this concept in mind, the project tries to design a stair rising hand cart which may carry objects (up to 150kg) up the steps with less effort compared to carrying them manually by hand. It's conjointly a sincere plan to study the utility and importance of such a product. Many styles were envisioned that might enable a non industrial hand trolley to travel over stairs, curbs or uneven terrain whereas reducing the strain on the user.*

Key Words: **Trolley, Wheels, Tri-star Wheel Frame, Axle, Relaxation Chair, Ball Bearing**

1. INTRODUCTION

A trolley is small transport device used to move significant load from one place to another. In most of the industries hand trolleys normally used to transport finished product or raw materials. Differing kinds of trolley exist and also the type used is commonly chosen supported what kind of material it'll move.

For example: wheeled trolley, folding trolley, gardening trolley, sack trolley, kitchen trolley, etc. as shown figure

Fig 1.1: Folding Trolley

Fig 1.2: Kitchen Trolley

Fig 1.3: Garden Trolley

Fig 1.4: Sack Trolley

But these trolleys cannot use to move on stairs, rough surfaces etc. So, in such place there are going to be a requirement of ascent trolley that reduce human efforts. In our project the trolley is provided with tri-star wheels that alter us to hold load up & down the steps. It additionally eases the movement of trolley in irregular surface like holes, bumps, etc. This trolley is that the hybrid of hand trolley & stairs rising trolley which may be utilized in each functions i.e. carrying load on plane surface moreover as from rough surfaces.

2. LITERATURE REVIEW

2.1 ADVANCED MATERIAL HANDLING TROLLEY USING TRI-WHEEL MECHANISM [1]

They introduced about in developing a mechanism for easy transportation of heavy loads over uneven terrain. 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 height. 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 this they concluded some limitations regarding the strength and built of the structure, it can be considered to be a small step forward, as far as Stair Climbing Vehicles are concerned. During the test run of this project, it was realized that it wouldn't be a bad idea to consider this design for carrying heavy loads up the stairs.

2.2 DESIGN AND MANUFACTURING OF A STAIR CIMBING VEHICLE

This article deals with the designing and manufacturing of a vehicle, which can climb stair or move along very rough surface. The technical issues in designing of this vehicle are the stability and speed of the vehicle while climbing stairs. In the initial design, each wheel contained frame, a sun wheel and three planetary wheels. The planetary wheel was connected with the sun wheel through an idler. The purpose of using the idler was to rotate the planetary wheels in the same direction of sun wheel. Each planetary wheel was aligned in a straight line with idler and sun wheel. Planetary wheels were 120° apart from each other.

2.3 DESIGN AND MANUFACTURING OF SIX WHEEL STAIRCASE TROLLEY [3]

In this they introduce 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. The main function of this trolley is to carry load not only on table platform but also on stair case. It can move on flat surface uniformly at 20 rpm without any fluctuation.

2.4 DESIGN AND FABRICATION OF A STAIR CLIMBING HAND TRUCK [4]

In this article 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. 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. 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. If the inclination is more than 44° it would fail to climb the stair.

In this they concluded that 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.

2.5 DESIGN AND FABRICATION OF STAIR CLIMBING HAND TRUCK [5]

This topic deals with the designing and manufacturing of a hand truck, which can climb stair with less effort compare to carry it manually. The technical issues in designing of this vehicle are the stability and speed of the vehicle while climbing stairs. Using of this vehicle, the labour cost can be reduced as well as huge amount of loads can be transferred uniformly with less power consumption.

3. AIM AND OBJECTIVE

3.1 AIM:

To modify two wheel trolley into tri-wheel for easy mode of transportation with addition of relaxation chair.

3.2OBJECTIVES:

- Lifting heavy objects especially where there are no lifting facilities.
- New option for transportation of loads over stairs which reduces man power.
- Easy to lift load over suitable height.
- Relaxation chair for a person in idle condition.

4. MATERIAL USED AND MODIFICATION

4.1 WHEELS

A wheel is a circular part that's meant to rotate on a shaft bearing. The wheel is one amongst the key parts of the wheel and shaft that is one of the easy machines. Wheels, in conjunction with axles, permit heavy objects to be moved simply facilitating movement or transportation whereas supporting a load, or performing labour in machines. Wheels are also used for different purposes, like a ship's wheel, hand wheel, wheel and flywheel.

Material: Polyurethane (PUR and PU)

It may be a compound composed of organic units joined by carbamate (urethane) links. Whereas most polyurethanes area unit thermoset polymers that don't soften once heated, thermoplastic polyurethanes also are on the market.

Fig.4.1.1: Assembly of tri-star wheel

Polyurethanes possess high tear resistance together with high tensile properties. Polyurethane's material properties can stay stable (with token swelling) in water / oil / grease. Polyether compounds can last a few years in subsea applications.

4.2 TRISTAR WHEEL FRAME

A Tri-Star wheel functions as a standard wheel on flat ground, however has the ability to climb automatically once an impediment to rolling is encountered. This wheel design consists of three tyres, each mounted to a separate shaft. These shafts are placed at the vertices of a trilateral. They will conjointly allow a vehicle to climb over little obstructions like rocks, holes, and stairs.

The third wheel idles at the top till the lower front wheel hits an obstruction. The obstruction prevents the lower front wheel from moving forward however doesn't have an effect on the motion of the live axle. This causes the top wheel to roll forward into position because the new front wheel as shown in fig4.2.1

Material: GI METAL SHEET

Fig.4.2.1: Tri-star wheel frame

4.3 AXLE

An axle is a central shaft for a rotating wheel or gear. On wheeled vehicles, the axle is also fastened to the wheels, rotating with them, or fixed to the vehicle, with the wheels rotating around the axle. in the several cases, bearings or bushings are provided at the mounting points wherever the axle is supported.

Material: MS METAL

4.4 TROLLEY FRAME & HANDLE

Frame is main assembly of trolley mounted on axle .Aim to kept material that must be moved. A frame is usually a structural system that supports different parts of a physical construction and/or steel frame that limits the construction's extent. Framing, in construction, is the fitting together of items to give a structure support and shape. Framing materials are usually wood, built wood, or steel.

Handle is to hold by mover and easy movement of trolley from one place to different to hold heavy load.

Material

Frame: Tin

Handle: GI Pipe

4.5 RELAXATION CHAIR

A chair is a piece of article of furniture with a raised surface supported by legs, normally accustomed seat one person. Chairs are supported most frequently by four legs and have a back; but, a chair will have three legs or will have a different shape.

Chairs are fabricated from a large variety of materials, ranging from wood to metal to artificial material (e.g. plastic), and they is also cushioned in numerous colours and materials, either simply on the seat (as with some eating space chairs) or on the entire chair.

It is shown in fig.4.5.1 and complete assembled trolley as shown in fig 4.5.2

Material

Frame: MS PIPE

Seat: Canning

Fig.4.5.1: Assembly of chair on trolley

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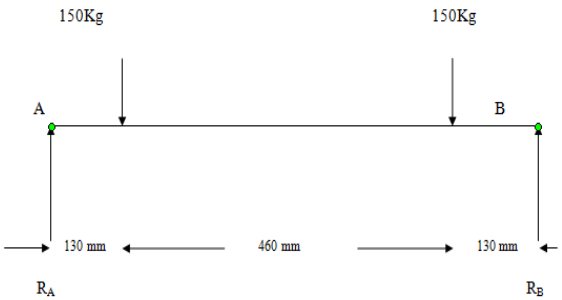
Fig.4.5.2: Final Assembly of easy handling trolley

4.6 BALL BEARING

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. Select a ball bearing with minimum diameter of 12mm, minimum load carrying capacity of 150 kg radially and speed greater than 100rpm.

Ball bearing 6202 (as per standard diameter of solid shaft is 12 mm)

5. ANALYSIS



Now,

Load on axle (F) = 150 kg =150 * 9.81 =1470 N

R_A & R_B are the vertical reactions at A & B respectively.

To determine the support reactions taking moment about A

$\therefore \sum M_A = 0$

$(1470*130) + (1470*590) - (R_B*720) = 0$

$1058400 - (R_B*720) = 0$

$1412640 = R_B*720$

$\therefore R_B = 1512$ N

Now,

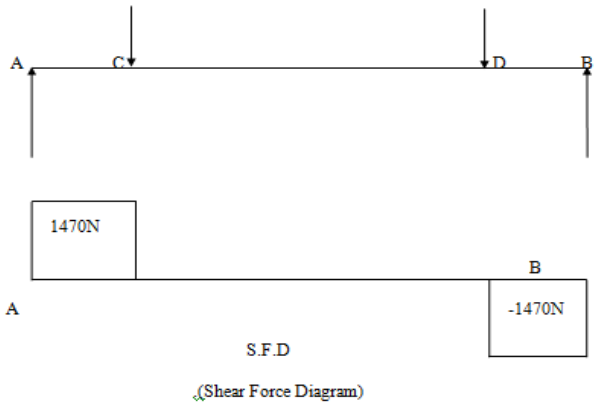
Sum of all vertical forces is zero

$R_A - 1470 - 1470 + R_B = 0$

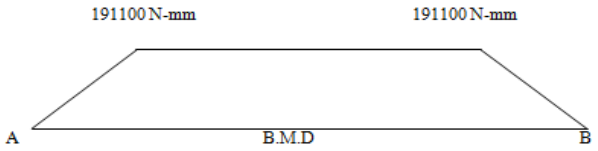
$R_A + R_B = 2940$ N

$R_A + 1470 = 2940$ N

$\therefore R_A = 1428$ N



(Shear Force Diagram)



(Bending Moment Diagram)

Shear Force Calculation

S.F. at A = 1470 N

S.F. at C = 1470 – 1470 = 0

S.F. at D = 1470 – 1470 – 1470 = - 1470 N

S.F. at B = 0

Bending Moment Calculation

$M_A = 0$

$M_C = 1470 * 130 = 191100$ N-mm

$M_D = (1470 * 590) - 1470 * 460 = 191100$ N-mm

$M_B = 0$

Considering maximum bending moment

$$M = \frac{\Pi}{32} * d^3 * \sigma_b$$

$$\sigma_b = \frac{\sigma yt}{F.O.S}$$

For SAE 1040, $\sigma_{yt} = 545$ N/mm^2 (From Design Data Book)

$\therefore \sigma_b = 545$ N/mm^2

$\therefore d = 15.91$ mm

d = 16 mm (Std. diameter from Data book)

5. CONCLUSION

Though this project had some limitation as a first step of making any Stair Climbing hand trolley, it was an experimental project. In all both rolling and climbing modes gives a new transportation mode over stairs and rough surfaces with maximum inclination angle 44 degree. The main aim of this project is easy handling, stairs climbing mechanism for load carrier with lesser efforts. With conclusion of all papers, we have an idea of materials, specification of bearings and wheels. With this we try include one another modification in our trolley i.e. "relaxation chair**".**

6. FUTURE SCOPE

- Internal breaking system may be used as effective breaking system.
- This trolley is operated by hand which may be operated by motor so as to reduce human effort.
- Both underground mines and open pit operations, there's currently a variety of equipment for extraction, handling and transportation of coal and ore.
- In significant construction projects, there's currently a choice of special ways and equipments of materials handling.
- It influences the civil engineers in project designing.

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