THINK INDIA Journal

ISSN:0971-1260
Vol-22-Issue-16-August-2019

To Fabricate The Portable Material Handling Machine For Industries

Jagdeep Singh, Munish Mehta, U.C. Jha

Department of Mechanical Engineering, Lovely professional university, Phagwara, Punjab (India)-144411

ABSTRACT

Material handling, it means handling the material like moving from one place to another place and lifting to higher grounds, loading and unloading, it is one of the important tasks in everyone's day to day life whether it is in a small scale, We need to lift objects and weights every day even in houses like carrying gas cylinders from outer gate to kitchen and moving some kind of heavy weights.In some ware houses and industries workers are employed specially to perform the task of material handling, to lift and move objects from one place to another. Workers who perform this kind of task for their entire shift they tend to experience fatigue in their muscles and at the end of the shift they feel tired after working years on this kind of jobs the workers are mostly likely to get affected by musculoskeletal disorder. This project aims at developing a mechanism that facilitates the transport of heavy loads. They need such a framework that stems from the daily needs of our society; Nevertheless, these devices usually fail when the load is lifted to a certain height and removed. With this idea in mind, this project aims to develop a powered hand trolley that can carry heavy objects up to a certain height with less effort compared to carrying them manually.

Keywords: Trolley, Safe lifting, Portable, Material, Industrial.

1. INTRODUCTION

1.1 Material Handling:

America's material handling industry is defined as "the transfer, processing, safety and control of products, including their use and disposal, throughout the manufacturing and distribution cycle." Material handling must be performed safely, efficiently, at low cost, in a timely, accurate manner (the right materials in the right quantities at the right locations) and without having to do so which causes any kind of material damage. The primary objective of a material handling system is to reduce the unit cost of production.

There are several types of manual aids of material handling equipment; the most used equipment is the trolleys and forklifts, in almost every industry have the trolleys for moving and carrying of the material and fork lift for stacking them and placing them at higher places like stack racks.

1.2 Trolley

A trolley is a small device for moving large loads from one location to another. Hand trolleys are widely used to convey finished product or raw materials in most industries. Many industries use the movement of physical products as a very common tool. The hand trolley is often used by people who organize and store items in retail stores, often referred to as a hand trolley or a dolly. Using trolleys properly can protect people against back injury and other health problems that may result from heavy loads being lifted or attempted to move. There are different types of these trolleys, and the model used is always selected based on what type of material it is going to move. Hand trolleys are made of various kinds of hard materials, including metal,

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aluminum and plastic with high impact. Some hand trolleys are available in standard sizes and are used for general loads, but some are specifically designed for very small or large items.

Hand trolley are grouped into two divisions

1. Two-wheel hand trolley Fig 1
2. Multiple wheel hand trolley Fig 2

Fig 1 Folding trolley [1]

Fig 2 Garden Trolley [2]

As good as the product may be, there will still be some kind of limitations along with the advantages that it has for us. For trolleys the trolleys can't lift the weight to a higher place or load the weight into the truck, it just simply can move from one place to another. It still even is the case with the trolleys, and even though there are some with zigzag ladder arrangement the usage was difficult and very rare. For forklift, the main and major disadvantage comes with the fork lift is the cost of owning the forklift itself, and also the maintenance charges. Along with the charges here comes another problem that is storing it because, the forklift is not something that can be stored in a congested space it requires certain considerable amount of space to store it without damaging.

The aim of this project is to reduce the limitations described above, and to provide a better solution for these common problems. This is a material handling machine for moving, safe lifting and loading small or bulky loads weighing up to 80 kg (176 lbs.). It provides a easy and efficient way to lift the material with the help of a hook and actuator attachment, it can be operated by one person. The machine uses a linear actuator which supports the lifting arm to raise the load to certain height easily, and it is powered by a battery. Hence no need for the continuous power source.

The design enables a single person to operate the machine, Lifting and loading directly into vehicles (trucks, vans and cars) or placing equipment and small loads on the top of the bench. It eliminates uncomfortable and dangerous back injuries and other injuries caused by lifting heavy objects. It is lightweight and easy to manoeuvreas compared to several other powered material handling machines. After use it can be stored in small place or place it against the wall, which saves space.

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2. Literature Survey

Even though with the day to day increasing and development of technologies there are several million people die around the world every day, after researching we found there are several lives has lost every day in the industry and lots of many people are suffering many dreadful diseases and disorders, from the material handling techniques they are following and the equipment they are using.

An ergonomic intervention and design of trolley for manual material handling improved the posture which in turn improves the working conditions leading to reduce the discomfort and fatigue of workers. It also increases the productivity and efficiency. In many of today's industrialized nations, the most common form of occupational ill-health is musculoskeletal disorders related to manual material handling tasks. The trolley discussed in this paper is available for electronic manufacturing company.[4].

Shubham S. ShiwarkarsaidThere are several cases of workers falling while climbing the stairs while carrying, So,they designed astaircase climbing trolley with improved ergonomics design to reduce the fatal injuries and disorders caused due to lifting the heavy objects, the trolley has a very close contact to ground as a shape of stack trolley on one side and has a tri wheel based design at the place of normal wheel, which gives it the ability to climb the stair case while carrying the load, and the handle are also a certain height from the ground to avoid awkward position of position of pushing the trolley and carrying the weights along the stairs.[5]

Christopher Schlick and Jennifer Butzlerstatedit are crucial and it should be remembered that ergonomic measures must be introduced on a priority basis to preserve employees ' ability to work and reduce the occurrence of injuries and accidents in various construction jobs. In India, because of extreme manual material handling (MMH) practices at the workplace, employees face a lot of health problems, and the factory act, 1948, does not suggest a healthy load limit for the Indian population. [6].

Sabde Abhijit ManoharraoThe construction has more number casualties while handling the material So,in this he designed a hydraulic scissor lift to rise the material using a hydraulics, lift is in the scissors or zigzag shape. which reduce the workers moving or walking along the site carrying heavy weights on their heads, it will reduce rate of the injuries caused at construction sites and will resulting in the saving lives from certain fatal injuries.[7] Rupesh NairAs transporting the goods is a major problem, they designed a cycle which has detachable trolley on its back, which helps in carrying a medium load for shorter distances which can eliminate the pollution that can cause by using a car or truck and reduce the fatigue caused by carrying the weight by hands.[8]

Strindberg and Peterson conducted a laboratory experiment to evaluate load perceptions during trolley use, measuring the responses of their subjects using the magnitude estimation psychophysical technique. Their experiments involved moving tall four-wheeled cage-type trolleys filled with weights between 100 and 800 kg, the test results showed that the force exertion was seen as equivalent to the physical force involved in pushing the trolley for pushing forces up to a critical value of 130 N. Furthermore, after 130 N, the pushing forces have increased significantly, this means that if the weight is above 130 N, the pushing trolley will be a heavy work. [9]

According to the Kathleen Mack, Christine M.Hasle Grave it stated different problems caused in the material handling system and equipment like steerability, stability, force required to move and lift the goods. By taking them into consideration we design this project to overcome these major problems [10].

Michael Kay, noted out the different ways of handling various materials. It involves “short-distance movement that usually takes place within the confines of a building such as a plant or a warehouse and

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between a building and a transportation agency". Although it does not provide a product with form utility, the time and place utility provided by it can add real value to a product.[12]

Kulkarni S.R has clearly pointed that as per the survey more number of accidents happen due to more number of trolleys connected to a single tractor along with more load and it becomes difficult for the driver to control the tractor and its attachment trolleys. In this paper, they have designed a collapsible trolley that can be adjusted in size. So, to eliminate all the trolley related problems and reduce the cost, they have designed a simple trolley so that the work of two trolleys can be done in a single trolley. With this kind of design, it becomes easy for the drivers to drive the tractor and the trolley to the long distance safely. [13]

The primary objective of our project is to help people by creating a solution for problem that has been with in every country and causing several lives every year, to create a solution first you have to decide the problem in the first place, for deciding the problem you have to research and study about the problems that are in the industry and find the cause of that specific problem.

2.1. Objective of the study:

a) Handling

The objective is to find the problem in the Industrial Engineering sector. The first thing that comes into the mind after saying the industry is the manufacturing and warehouses or storage units, every industry has any one of these may be all three of these. After researching and studying several papers and study about the problems faced by the industries, the most common problems from the engineering aspect is the material handling. As we mentioned before in the literature review there are several lives lost in these sectors every day due to mis handling the equipment or unskilled for using those machines. So, we decided to do something to reduce the lives lost count in the world due to these simple reasons.

b) Cost of the Product

The other thing that we learn from studying is the designing wont simply cut the problem, the machine has to be effective and inexpensive, only then the lost lives will be reduced, because every company can't afford the expensive product. So, the other thing that we have to keep in our mind is the cost of our product.

c) Storage Place

There is one more parameter that we have to consider while designing a solution that is storing place for the machine, because it can be a issue, we have to design a product which can be used in small warehouse as well as in the houses for in case, apart from the large warehouses, when it comes to storage place for the machine every warehouse won't have enough space that they can spare for storing large machines, if the machine occupies large space while storing, then it will become a obstacle rather than being helpful.

The above mentioned are the three parameters, that we choose are to be the requirements that has to be fulfilled by us while producing a solution for the problem.

2.2 Objective of the research work

i The goal of the project to design and fabricatea material handling machine that can be used to move the materials from one place to another, load and unload the mini trucks or small vehicles, and lift the materials to a certain height for storing etc. safely and effectively.

ii We decided to avoid make the product, free from the requirement of continuous power source which can be a problem for to maintain a long-connected source while moving the machine in the large warehouse.

iii We decided to create a design which can be afforded by small industry purposes and even for personal purposes for homes and small storage units.

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iv We wanted the product to be able to transport easily from one warehouse to another without any extra effort. In-short we have to make the product portable.

4. Designing and fabrication

4.1 Working Principle

The machine is working on the principle of the momentum force, which is the law that is used on lifting the dumping trucks as we called them tippers, the reason for attaching the lift at the front of the carrier body, length will help in reducing the load or effort required to lift the load.

The formula:

M= F.R

M- Momentum, F- Force or load, R= Distance at which the load is acting

4.2 Design of material handling machine

Considering the mechanical aspect of the project we have designed the project to giving the idea before developing the physical model and to know each step before developing it. We have checked the constraint and created a virtual model to preview.

Software used: Creo 4.0 M030.

We have used various features of the Creo program to create a full proof model that can sustain the design.

The steps included

1. Part Modelling
2. Assembly

4.3 Part Modelling

We created every part of our model and assembled in the software to create a virtual product of our project.

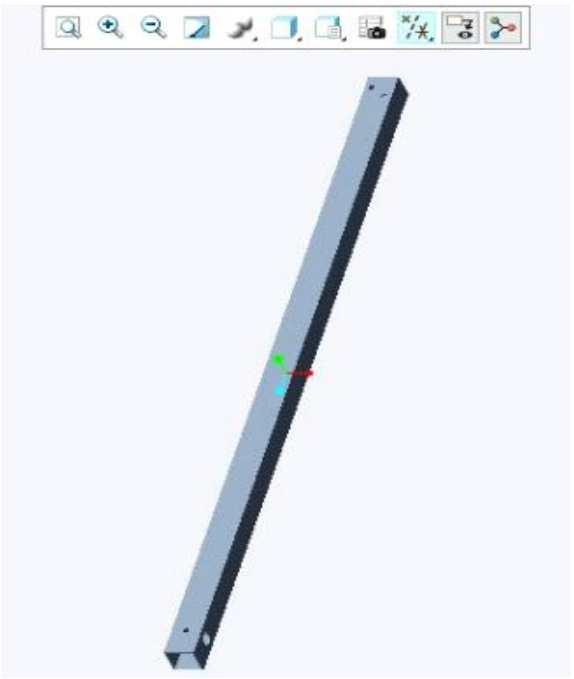

Fig 4.1 Creo model of base used in portable material handling machine

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The length of the base bar is 1.3 meters and it is of square shape, with 50 milli meter of width. It has a hole of one-inch diameter for the handle bar to pass through and 8.5mm diameter hole to fix the nut and bolt with the handle to restrain the moment.

Steps

1. Draw a square of side 50mm and inner square of 44mm.
2. Extrude up-to 1300mm
3. Draw a hole of 25mm and extrude through the other surface
4. Draw a hole of 8.5mm on the top of the bar and extrude.

Handle bar it is of 1inch outer diameter and 3mm of thickness, and has hole of diameter of 8.5 mm to fix the base on both the ends with 20mm distance from both the ends, and 225 mm from both the ends. To restrain the side movement of the arm.

Steps

1. Draw a circle of 25mm outer diameter and 22mm inner diameter.
2. Extrude up-to 500mm

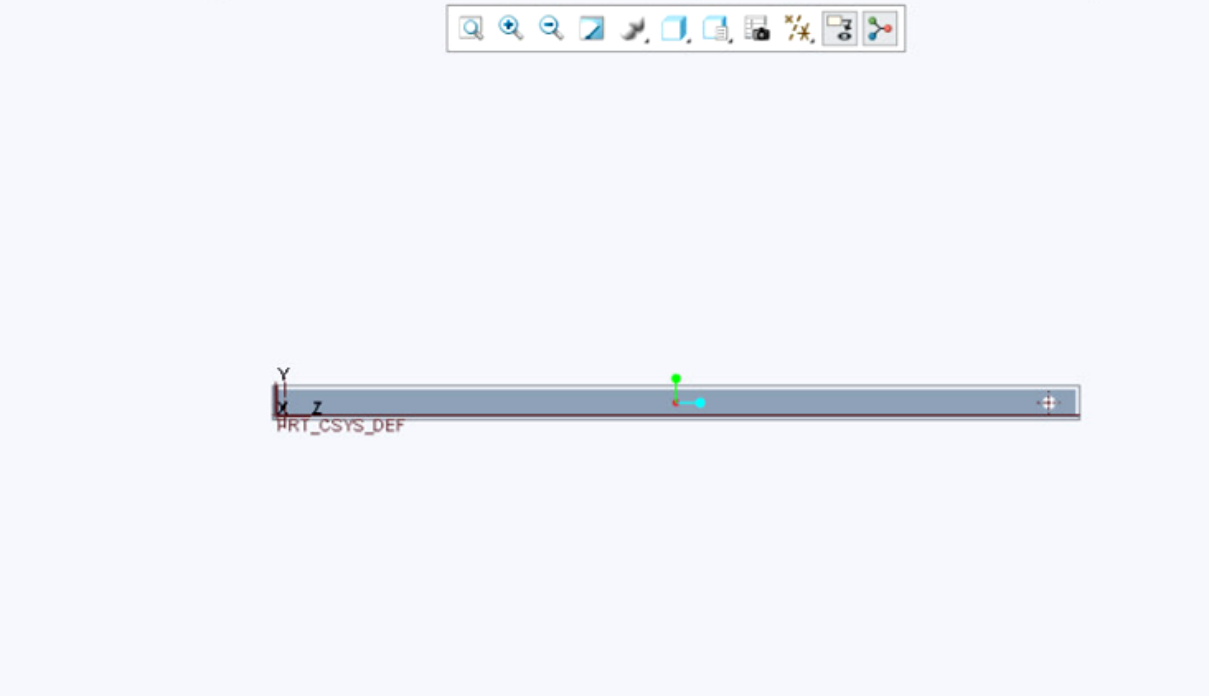

Fig 4.3 The Creo design of arm

The arm is 1.5meter long and square in shape with 50mm side and has a hole of 26mm diameter hole on the side for the free movement of the handle bar while the linear actuator is working.

Steps

1. Draw a square of side 50mm and inner square of 44 mm.
2. Extrude up-to 1500mm
3. Draw a hole of 26mm and extrude through the other surface

4.4 Assembly

Assemble means joining the parts together, Assembly comprises of several parts that will be joining with one to another and form a product of virtual working model. We use constraints while doing the assembly to

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attach the parts and by doing so we only give the specific motions to the part and some movements will be restricted. The following are the Extended Views of our final completed product. after the assembly

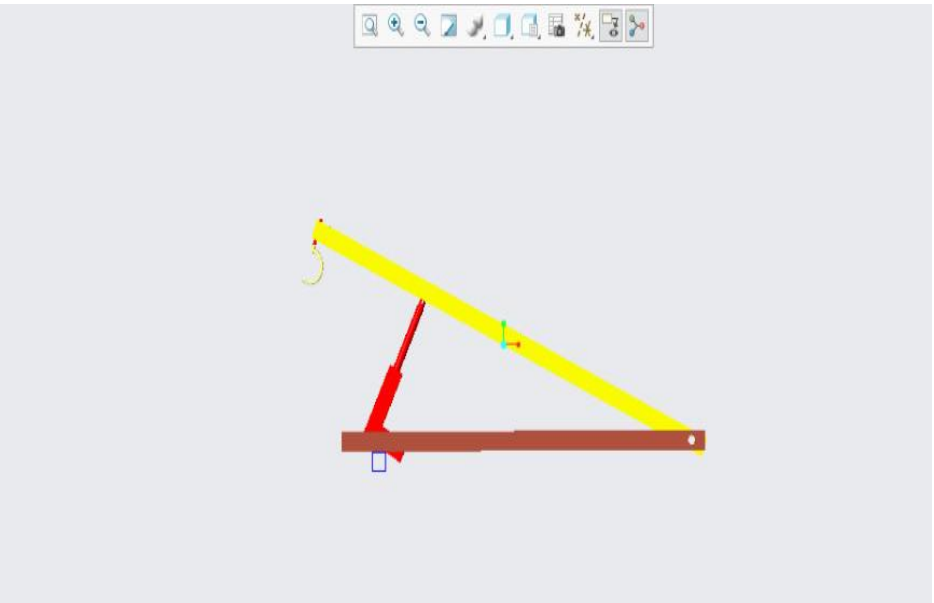

Fig. Side view for the portable material handling machine

4.5. Fabrication of portable material handling machine

4.5.1. Working Principle:

The principle that the machine is simple momentum force which depends on the area of the force that should be acting will be depend on the amount of the load it has to lift.

4.5.2. Working Mechanism:

The working of our device is simple as stated in the design and principle, the momentum force which will be bear by the actuator which is used to lift the weight above the ground.

We attached a linear actuator to the arm and the actuator is connected to the power supply of battery, and controlled by a dpdt switch, which is used to control the movement of the linear actuator in both the directions, a hook is fixed at the end of the arm, the actuator is attached at a distance of 400mm from the hook arrangement, when the dpdt switch is turned on to positive side the linear actuator will start rising from the actuator the lead screw will extend from the casing and lift the arm to the certain height along with the weight attached to the hook, and hen the dpdt switch is turned negative the linear actuator starts descending from the point. The brakes are applied while both ascending and descending of the actuator to prevent the rolling of the vehicle and causing the accident.

4.5.3. Material and Components

4.5.3.1 Material

The material we choose for fabricating our device is stainless steel Grade 304 hollow square bars of 50*50 mm^2 in dimensions, it is the standard "18/8". Class 304L, the low carbon version of 304, does not require post-welded annealing and is therefore widely used in broad gage components (over 6 mm). Class 304H is added with its higher carbon content at high temperatures. The austenitic structure also gives these levels excellent durability, right down to cryogenic temperatures.

I. Chemical composition

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S. No	chemical	Minimum%	Maximum%
1.	Carbon	0	0.08
2.	Silicon	0	0.75
3.	Manganese	0	2.00
4.	Chromium	18	20.0
5.	Phosphorous	0	0.045
6.	Sulphur	0	0.030
7.	Nickel	8	10.5

4.5.4. Actuator

Actuator is a device which converts signals or energy that is entering into motion as per our requirement either rotary or linear.

i **Linear actuator**

As the name itself implies the motion that produced will be linear from the energy.it is used to move the objects in the linear path, it is used for movement of doors or shutters and objects up and down there are several uses for this type in the industry. It has certain limit of length that it can travel before stopping, it has self-locking screw which prevents it from descending after application of the load on the top.

ii **Rotary Actuators**

It means the motion that will be generated from the energy entering will in the rotation form, it has no limit to apply, it will rotate continuously as long as it is needed without any interruption

There are three types of actuators based upon the power supply:

- Hydraulic

In this the power supply will be in the basis of the liquid which uses pumps and valves to operate.

- Pneumatic

In this type it uses the vacuum and compressors for the supply of the power.

- Electric:

In this type the power source will be either battery or current supply

Specifications:

We use an electric Linear Actuator with **300mm** Stroke Length, which runs on DC **24V,** which has a load carrying capacity of **2000N,** with speed of 3mm/s and a duty cycle of 10% of fig 4[13]. These are the electric linear actuator's two most important pieces. This actuator consists of fewer working parts compared to the other linear actuators. Therefore, very little maintenance is required. The following parts make up the entire electrical linear actuator model Fig 7.

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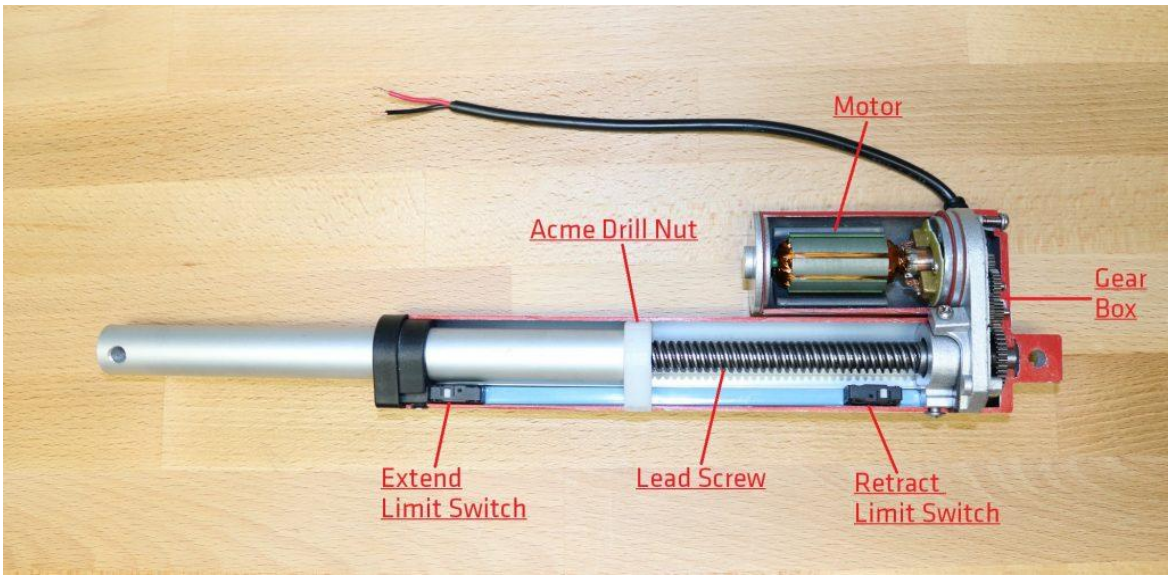

Fig 7 Linear actuator parts view [14]

- **Motor:** This is one of linear actuators ' most important components, which actually makes the movement. A 24-volt DC motor is used which interacts to transmit the motion with other parts of the actuator.
- **Limit Switch**
- **DC Brushes**
- **Lead Screw**
- **Gears**
- **Cylinder**

Types of brakes

- Mechanical brakes
- Hydraulic brakes
- Electromagnetic brakes
- Vacuum brakes

4.5.5. Working of portable handling machine

This arrangement transfers the hand lever movement to a sliding equalizer through a single primary cable. End of this cable is connected to the brake lever of one side wheel. The hand brake lever can be adjusted by a nut screwed on threaded end of the primary cable. When the brake lever is pressed the primary cable pulls the lever attached to wheel and compress the spring attached to it, which gets in contact with the wheel and stops the motion. When the brake lever is released the compressed spring get back to it original position by making the lever attached to wheel to straight position which again allows the wheel to move.

4.5.5.1. Wheels

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The wheel we used are the double wheel Pu Braked wheel, these are special types of wheels which has brake lever attached to it while the manufacturing of the wheel itself. To sustain a heavy weight two wheels are paired together and used as one. Specifications:

- Size (or) Width -50mm
- Height – 70mm
- Material – virgin polyurethane
- Load Capacity- 500kg

It is used because of its heavy-duty weight carrying capacity and capable to move on rough terrain.

Fig. Tyres for portable material handling machine

4.5.5.2. Lifting Hook

Hook is used for lifting weights in our machine by which we can lift up 100kgs, we used the simple S-shaped hook fig 10 for the lifting purpose.

Fig 10 S Shaped hook for portable material handling machine [17]

4.5.5.3. DPDT Switch

It is a special kind of switch which allows us to reverse the polarity of the power supply, which in our case helps to ascend and descend the actuator without reversing the polarity. It has 6 terminals attached to it and with arranged in a specific manner we use this switch to control the actuator.

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Fig 11 DPDT Switch for portable material handling machine **[18]**

5. Results and discussions

The Project ended with the result of fabricating a material handling machine called as hand powered truck which runs on battery power, which can lift a weight up-to 80kg to 1meter height with the help of the linear actuator.

The positive outcomes from this research work are:

1. Easy and safe to use for anyone above 15 years, no need of the training.
2. No licence required to maintain it.
3. Less risk of injuries and musculoskeletal disorders.
4. Easy loading and unloading of the loads.
5. The required storage space is less can be stored easily even in the home.
6. Cost of production is less.

Table Cost Estimation

S. No	Components	Price (Rupees)
1.	Material (304 steel)	3000
2.	Linear actuator	7000
3.	Battery	2000
4.	Brakes	500
5.	Cables & wheels	2000
6.	Misc. charges	3000
	Total	**17500**

6. Conclusions

As entering as the raw material into the industry the material has to undergo cutting trimming and heating and assembling and several other kinds of jobs before getting out the factory as a product, for this to be possible the material and half finished product has to move from one place to another and storing and

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shifting from one machine to another machine for jobs to be done on it, all this will be taken care by the material handling department.

As material handling is one the important task that has been carried in every industry, and several accidents of losing live on the jobs have been reported in the past years, and several advanced technologies also been developed for material handling which includes the automation of the material handling sector by using Automatic Guided Vehicles and robotic arms which made humans lose their jobs and companies who can't afford this kind of changes is still using the traditional way of handling things which result in accidents,

At the end of the project, after the study and research and effort we put in completing this project successfully and achieving the objectives we set at the start of the project and to reach the goal of saving lives of workers who are dying every year and to prevent several disorders from taking away the happiness of several families. We conclude by saying that our project **Powered Hand Truck** is success that our device can help workers in preventing their losing jobs from automation and lives from accidents and industries from investment, our machine is safe to use ,easy to handle and compact to store.

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