MODELLING AND FABRICATION OF STORES-STACKER FOR PACKAGED MATERIAL HANDLING

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ABSTRACT
Handling of objects like boxes, packets, cylindrical shaped objects is very common phenomenon in most of the stores. As handling of multiple shaped objects is being done manually, it requires lot of man power and if the same is done with the help of forklifts which doesn't have holding or pulling arrangements, they require additional man power for performing operations like sling tying, hooking and pushing on to the fork. As a matter of fact, getting additional man power and using them for such tasks is not a cost-efficient process and delays the work flow, it is felt that there should be dedicated machine for performing these kinds of operations. Though technology has touched its heights during last five decades, there is no specific machine for handling multiple shaped objects in stores. As a part of my project work, It is planned to model, fabricate and test the stores-stacker which can handle boxes, cylindrical objects, packets using Far arm rotation, Near arm rotation, Blade elevating and 4-Wheel drive mechanisms.

KEY WORDS*: Stores-Stacker, Far Arm, Near Arm, Packaged Material, Column Tilting*

METHODOLOGY
Store-Stacker is mainly equipped with fallowing mechanisms to handle multiple shaped objects in stores;

1. **Far Arm** is useful to pull the objects on to the fork
2. **Near Arm** is useful to push the objects from fork and also to adjust the height of the upper jaw
3. **Lifting arrangement** is useful in lifting the fork and materials to different heights
4. **Column tilting** is useful for unloading materials in shelves or landings
5. **Pushing Arrangement:** This arrangement will be useful in unloading the objects without any additional manpower requirement
6. **Travel & Turning:** The machine is provided 4 wheels for travelling from one place to another, in this machine turning is achieved by forwarding one side wheels forward and another side wheels reverse using switches

LITERATURE SURVEY
Clark Material Handling Company. 2008. Archived from the original on 9 September 2013. Retrieved 15 December 2013
Manufacturing is a complicated operation. managing paintings in all the specific bays can be tough, in particular due to the fact the forklift or lifting truck as shown in figure (2.1) needs for every segment can be particular. whether or not it's within the dock yards where vans are being unloaded, within the warehouses, or shuttling goods among them, getting the right forklifts for each process could make the system a great deal easier alongside being extra green and productive.

Fig (2.1) fork lift

Accident while carrying circular pipes in manufacturing industries is shown in figure (2.2).

Fig (2.2) accident while carrying pipe

'Powered industrial trucks' is a communal word stating to fork lifts as shown in figure (2.1), container handling trucks, reach-trucks, turret trucks and the like. Since their introduction forklifts have been an integral ingredient for materials handling across a multitude of industries.

"Forklift- The Backbone of The Industry". MHEDA Journal Online. Archived from the original on 18 December 2007. Retrieved 25 January 2008.

One of the most common pieces of equipment hired for a wide range of tasks is a forklift truck. They range from large-scale businesses with several sites to the utilisation of warehouses. They make big equipment lifting much quicker and simpler than manual lifting.

There is a wide variety of forklifts available that will perfectly match your unique needs and specifications. difficult The majority of brand-new production worksites and regions where you'll be walking on loose gravel or dust employ terrain forklift vehicles. Forklift trucks can be run by diesel, gasoline, electricity, or propane.

Although many of the forklifts are made for outdoor usage, they are frequently employed inside warehouses. The vast majority of rugged forklift trucks run on propane.

INTRODUCTION

A crucial component of commercial endeavours, whether public and private, is the store function.

In other words, "store" is a standard term for items that are held in storage and stock stocks, all of which are necessary for manufacturing.

• Raw material component components, in-progress packaging, and related materials will all be present in the production activity.

• Finished inventory, component components, and partially finished work will all be present in a distribution operation.

• A maintenance and engineering operation will have clearing and servicing materials, equipment, tools, and spare components.

The many types of transportation vehicles and equipment used to convey goods and commodities during material handling are referred to as industrial trucks. Small hand-operated vehicles, pallet jacks, and several kinds of forklifts are a few examples of these transportation tools.

1. These vehicles have a range of qualities that make them appropriate for various tasks.
2. While some trucks can be loaded using a seperate piece of equipment, some vehicles have forks, like a forklifts, or a flat surface.
3. Requiring a person to mechanically move these or to ride alongside the vehicle, they can also be powered lifts or manual lifts that can be operated by walk or ride modes.

4. Items can be stacked using a stack truck, but not with a non-stack vehicle.

Forklift Drawbacks

In order to lift and marry materials inside the warehouse using forklift, we have to provide footings beneath the material. Even it footings are provided, there's no proper holding mechanism for these crates on to the forks firmly. If the traveling platform is uneven or forklift gets bump in small pet holes on the floor, it can drop the material which is being carried and damage them as shown in figure (1.1).

Fig (1.1) forklift dropping material crate

We can provide footings for square and rectangular shape materials and products but it is not possible to provide footing beneath circular pipe. Circular pipes as be on point contacts with forks as shown in figure (1.2). There's no proper holding mechanism for these circulars on to the forks firmly.

Fig (1.2) forklift carrying pipe

Usually, these types of pipes are tied on the forks directly with the help of additional manpower and time.

As a solution to above problems, I have modelled and fabricated a store stacker as shown in Fig (1.3) and it is capable of handling cylindrical, square and rectangular materials without footings. The machine doesn't require any additional man power and will perform activities in much lesser time. Mechanisms that are mounted on chassis for perfect handling of multiple shaped objects is shown in Fig (1.3)

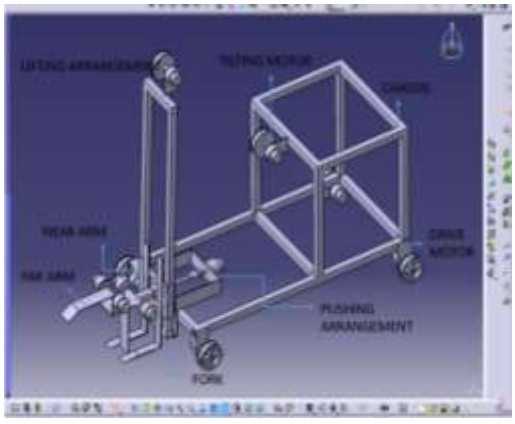


Fig (1.3) Stores Stacker

CALCULATIONS

Far Arm Calculation

Mass of the object to be pulled (m_f) = 1000gm = 1Kg
Radius of Far arm rotation (r_f) = 120mm = 0.12m

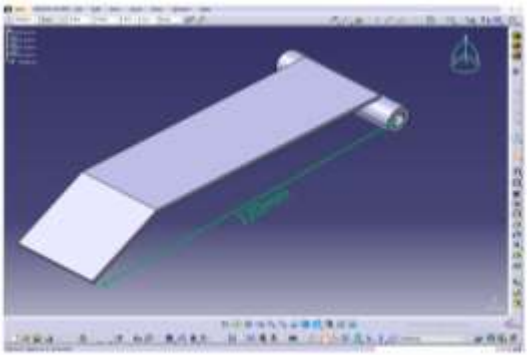


Fig (5.1) Far Arm Radius

Gravity (g) = 9.81 m/s2
Force of Far Arm (F_f) = m x g = 1 x 9.81 = 9.81 N
Torque of Far Arm (T_f) = F x r = 9.81 x 0.12 = 1.177 Nm
Speed of the Far Arm Motor (N_f) = 3.5rpm
Power required for Farm Motor (P_f) = 2 x 3.14 x N x T /60
= 2 X 3.14 x 3.5 x 1.177 / 60 = 0.43 Watts

12-watt motor are used which is higher than the required power hence the motor capacity is sufficient to perform the pulling operation

Near Arm Calculation

Mass of the object to be pushed (m_f) = 1000gm = 1Kg
Mass of the Far Arm & Motor (m_n) = 350 gm = 0.35kg
Total mass (m_t) = 1.35Kg
Radius of rotation for Far and Near Arm together (r_n) = 0.2m

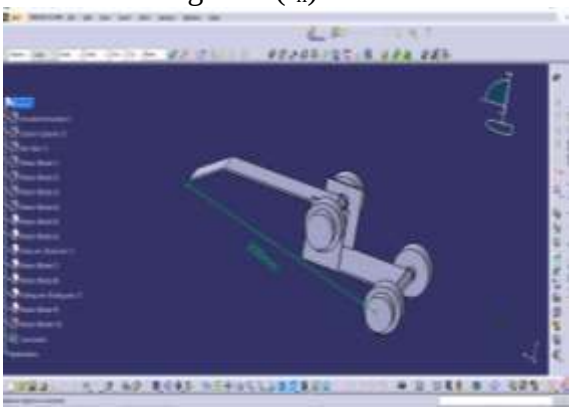


Fig (5.2) Far and Near Arm Radius

Gravity (g) = 9.81 m/s2
Force of Near Arm (F_n) = m x g = 1.35 x 9.81 = 13.24 N
Torque of Near Arm (T_n) = F x r = 13.24 x 0.2 = 2.64 Nm
Speed of the Near Arm Motor (N_n) = 3.5rpm
Power required for Near Arm Motor (P_n) = 2 x 3.14 x N x T /60 = 2 X 3.14 x 3.5 x 2.64 / 60
= 0.9672 Watts

12-watt motors are used which is higher than the required power hence the motor capacity is sufficient to perform the work and above load is being shared by 2 motors

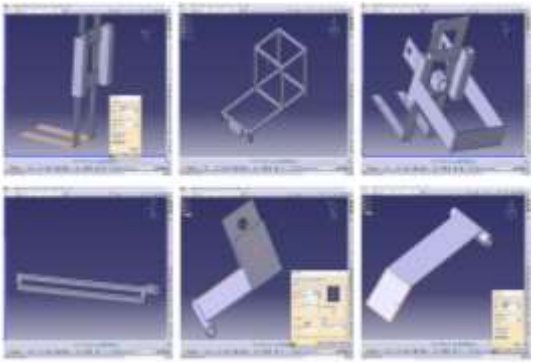
Lifting Power Calculation

Mass of the Object + Fork arrangement + Far and Near Arm (m_l) = 3500gm = 3.5Kg
Radius of lifting Pulley (r_l) = 0.015m
Gravity (g) = 9.81 m/s2

Force of Lifting Motor (F_l) = m x g = 3.5 x 9.81 = 34.33 N
Torque of Lifting Motor (T_l) = F x r_l = 34.33 x 0.015 = 0.515 Nm
Speed of the Lifting Motor (N_l) = 10 rpm
Power of the lifting motor (P_l) = 2 x 3.14 x N x T /60
= 2 X 3.14 x 10 x 0.515 / 60 = 0.1886 Watts
12-watt motor is used which is higher than the required power hence the motor capacity is sufficient to perform the work

RESULTS AND DISCUSSIONS

Modelling of store stacker is performed using CATIA V5 R21 Software and it is given with mechanisms including Far arm rotation to pull objects on to the fork, Near arm rotation to lock the objects, Lifting, pushing, column tilting and four-wheel drive as shown in Fig 6.1



6.1 Parts Modelling

Assembly of above parts is performed using Catia V5 R21 Software as shown in Fig 6.2

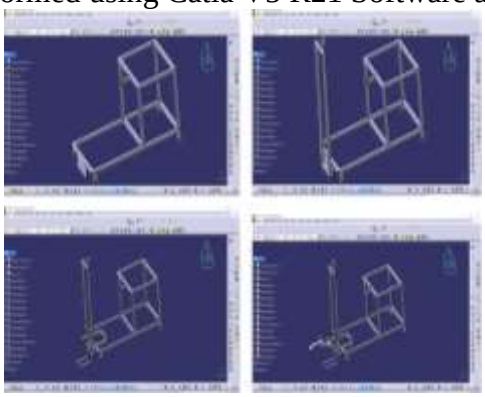


Fig (6.2) Assembly Drawings of Store Stacker

Fabrication of Components of store stacker is performed as per drawings and assembly is done as shown in Fig (6.3)

Fig (6.3) Fabrication of Store Stacker

The machine is tested the store stacker with square, rectangular and cylindrical objects weighing 500gm to 1000gm and the results are as below;

- Far arm is able to pull the objects on to the fork
- Near arm was helpful in pulling as well as holding the objects

- The machine was able to lifting objects to a height of 350mm and place them
- Tilting arrangement was helpful in unloading of the objects where there is an obstacle before placement position
- Turning is achieved by rotating opposite wheel motors in reverse directions and this has become possible due to four-wheel drive

➢ Theoretical Power required for far arm rotation is 0.43 Watts and Torque requirement is 1.177N-m. We have used 12Watts motor to power the mechanism hence it will easily pull objects on to fork

➢ Theoretical Power required for Near Arm rotation is 0.9672Watts and Torque requirement is 2.64N-m. We have used 2 numbers of 12Watts motor to power the mechanism hence it will easily perform holding operation

➢ Theoretical Power required for lifting motor is 0.1886 Watts and Torque requirement is 0.515N-m. 12Watts motor is used to power the mechanism hence it will easily pull objects on to fork Motors with higher torque and power are used for this application to avoid motor failures due to un expected load conditions during operation.

CONCLUSIONS

In this project various components of mechanisms are modelled and fabricated and assembly and wiring are performed.

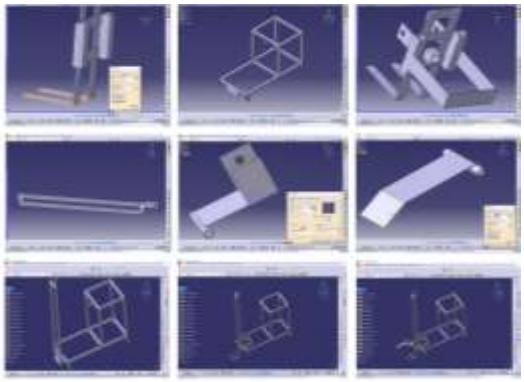


Fig. 7.1

During testing the machine is able to handle cylindrical, square and rectangular objects without footing with greater ease by using Far arm rotation to pull objects on to fork, near arm rotation to lock the objects, lifting, pushing, column tilting and four-wheel drive. Hence this machine will be very much suitable for handling the objects of different shapes in stores. This machine can be customised for handling different shaped objects with different weights as per customers requirement. As this machine doesn't require any assistance to load and un load the objects on to the fork, the owner of this kind of machine can save lot of money on manpower and also helps in saving lot of time. As near arm can hold the objects falling from fork, level of safety is also high.

While testing the machine it is observed fallowing;

Fig 7.2

- Far arm was able to pull the objects on to the fork

- Pushing plate arrangement was able to push the objects out of fork
- Lifting mechanism was able to lift 1000gm weight easily (By increasing motor capacity, lifting capacity can be increased)
- Wheel drive motors are helpful in travelling as well as turning
- Column tilting arrangement is helpful in placing objects on different levels in spite of obstacle

Usage of this machine for stacking materials / objects gives fallowing advantages:

- Can easily handle multiple shaped objects
- Requires less man power
- Requires less time to handle objects
- As this machine runs on electric energy. It will not pollute environment or warehouses
- Higher safety due to holding arrangement by near arm
- As we are not using any hydraulics in this machine, the machine requires less maintenance and stores will be clean and free from oil strains

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