



Two Wheel Aisle Forklift

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Abstract:

Forklifts are designed to handle and transport both raw materials and goods carefully and efficiently. From time to time these machines must be transported from one work site to another. A normal sit-down forklift with the ability to lift 5,000 pounds will itself weigh as much as 9,000 pounds. The average automobile weighs approximately 4,000 pounds. Weighing in at more than two times the weight of the average family automobile. This paper presents research related to the choice of the criteria that can be used to fill the gap between the forklift's minimum capacity and works maximum capacity to lift the objects from a place to another place in warehouse operation. The analysis had been done with the aim of exploring the requirements of warehouses and construction sites. With some changes to forklift we designed a two wheeler forklift, This research paper gives an exact idea about how should be a two wheel forklift is useful, safer and efficient in narrow passages working sites and how to design and contrast the two wheel aisle forklift for such working places.

Keywords: Forklift, Stability Triangle, load centre, Tructractor, roller chain, hydraulic piston, human safety, logistics, electric motor.

I. INTRODUCTION

In general the forklift can be defined as a tool capable of lifting load of tons. A forklift is a vehicle similar to a small truck that has two metal forks on the front or side used to lift the load. The forklift operator drives the forklift front until the forks push under the cargo, and can lift the cargo to the required height in the air by using the forks. The forks are usually made out of steel and can lift up to a few tons. Forklifts are either powered by petrol or electricity. Electric forklifts relay on batteries to operate. Petrol forklifts are heavy duty and faster than electric forklifts, but they are difficult to maintain and operate so fuel cost is higher. Electric forklifts are best for warehouse use because they do not produce noxious fumes and noise like gas powered machines do. Some forklifts are meant to be used outdoors too. The majority of rough terrain forklifts operate on petrol, and some use diesel or natural gas. Rough terrain forklifts have the highest lifting and loading capacity and heavy-duty tires, making it possible to drive them on all terrain. Forklifts plays revolutionary role in warehouse work of carry loads. They made it possible for single person to move thousands of kilograms at once. Well-maintained and safely operated forklifts make lifting and transporting cargo infinitely easier.

Types of Forklifts

Forklifts come in different shapes and sizes; they also come in many varieties and full fill multiple purposes. While some may know forklifts primarily as a material handling appliance, there are in fact many different categories of forklifts. For example a pallet jack is different as a three-wheel counterbalance lift truck yet they are both classed as a forklift. Whether you are trying to learn more about these wonderful machines or perhaps hoping to diversify your fleet, here are the seven different varieties of forklifts,

1. Counterbalance they are the most common trucks used in virtually all material handling capacities. And the counterbalance forklifts are a direct appliance that features dual forks for weighty loads and huge items.
2. Three Wheel Counterbalance Three Wheel Counterbalance forklifts feature three wheels as opposed to four in their counterbalance forerunners. Three wheel counterbalance forklifts are ideal for narrow aisles as they have improved maneuverability for constricted spaces.
3. Reach Trucks This are known for what they are named after, their extended lift height. Reach trucks are finest in any warehousing situation with high storage pallet racking. Reach trucks come in different forms, including the Stand-Up truck and Double Deep truck. The most common type Stand-Up trucks are often used where there's only one load per bay. Double Deep trucks are similar, but longer forks, making them perfect for areas where multiple pallet loads are stored in each bay as they will reach right to the back of the bay.
4. Pump Trucks this are considered a bit of a throwback. Pump trucks are initially used as a pallet jack but they do not use any electric power to lift any materials. Instead of it pump trucks rely on good old-fashioned manual labor as the operator pumps the jack to lift the skids with their own force.
5. Powered Pallet Trucks conversely, it's the most modernized innovation of a pump truck. The powered pallet truck are utilizes for heavy lifting. Reflecting functionality of a pump truck, powered pallet trucks are ideal for small packages that need to be stored or transported.
6. Side lines This are designed to operate in narrow aisles as well as Side-lines having forks which are mounted to the side of the truck and are designed to lift the loads that would Heavy to the typical forklift. As many other types of forklift, these to come in various forms. First is the Bounded Cab that is often used outdoors and the Stand-Up which is geared to handle indoor assignments.

7. Teletrucks this also identified as Short for telescopic handler forklift, these devices are another option for users that are tasked with high rise lifting or simplification of mezzanine storage. These forklifts are able to reach heights and angles that standard lift trucks cannot reach.

II. LITERATURE SURVEY

The forklifts are the necessary part of today's supply unit where it's transporting goods from one place to another in the storage, loading or unloading good to the truck the forklift utilized . The two-wheel hand operated forklift first appeared over one hundred years ago. These original units were wrought-iron axle and cast iron wheels which enabled loads to be lifted and transported without manual labor. In the era of early 19th century the evolution to combine horizontal and vertical motion resulted in the first hand operated forklift capable of lifting a few inches of the ground. And with this the development of the forklift are on FastTrack till today. In 1917 the company named Clark, started manufacturers of axles, and created a truck called the tructractor to move materials around their factory in the various units of the plants. As visitors to the factory saw the Tructractor at work they are also interested to use tructractor in their own plants so they placed orders to Clark to build tructractor for their companies. After few years the first hydraulic powered lift was added to some trucks to give them lifting power. In 1923, company named Yale is the first company to use forks that lifted loads off the ground and an elevated mast that could extend beyond the height of the truck. The Yale truck is considered to be the first forklift. After few developments helped the forklift to increase in production including the introduction of the standardized pallet in 1930s and World War II. Both of these developments increased production of forklifts and allowed distributors the means to efficiently move heavy loads in the factories. 'Load centres' represent the middle of a forklift truck load, from front to back. It is easily calculated by measuring the load to be carried, and dividing by two (providing the load is evenly distributed, and positioned to butt up to the forklift backrest). The load centre is the distance from the face of the forks to the load's centre of gravity. Many forklifts are rated using a 24-inch load centre, which means that the load's centre of gravity must be 24 inches or less from the face of the forks. Fig.1, the load centre and finds its balance point.

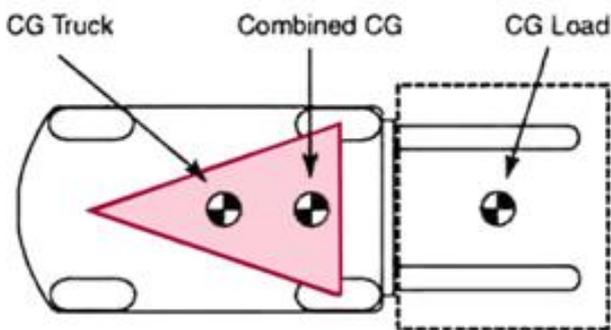


Figure.1. diagram showing centre of gravity of load, truck, and resultant CG

The combined centre of gravity of the truck and load system shifts forward outside the stability triangle, as the load's moment is greater than the vehicle's moment, and the forklift

tips forward, pivoting on the front axle or fulcrum. Fig.2, The forklift teeters and finds its balance point.

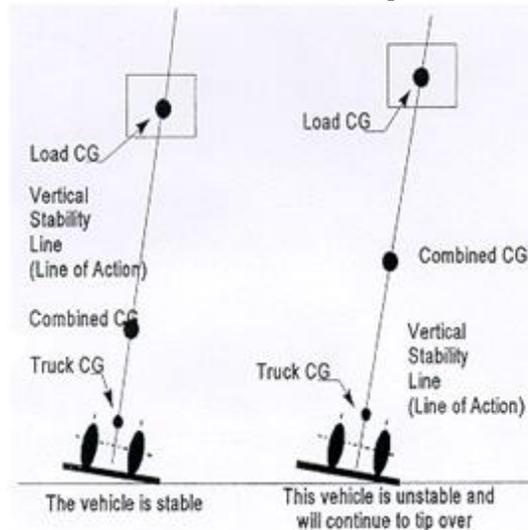


Figure.2. stable and unstable forklift condition

The regular forklift are broad in size and can't be utilized in narrow passages with load as there are having more chases of accident as it's quite difficult to rotate n control in narrow passages whereas the two wheeler forklifts can be utilized very easily in narrow passages as compared to regular forklift. Also, it's reduces the number of accident's happening in handling, operating and working in narrow space. The design features of forklifts is in many ways is at the heart of many forklift related accidents. The intersection between the shifting centre of gravity and the narrow track of the forklift, combined with the requirement to handle loads at height can have detrimental effects on the vehicle's stability. Much of the problem lies is in the success of the operator maintaining the forklifts centre of gravity within the triangle formed by the three suspension points. "If the centre of gravity goes out of this area by lifting a load that is too heavy, or by carrying a load too high and tilted forward, the forklift will tip over". (AMIC, 1999) As the topic suggests we need to design a forklift that having low lifting capacity (below 90kilograms) and we cannot utilize regular forklift's as they aren't convenient for this type of load as well as they consume very high energy to perform task as compared to suggested two wheel forklift for low weighted load therefore, we not only avoiding accidents in handling, operation, travelling with load, stability, working in narrow space, but also its efficient as it's consume less power for required load. Forklifts have two groups of controls, one for steering and one for lifting. The steering controls work much like those of a golf cart. Though, dissimilar a car or golf cart, forklifts use back wheel steering when you turn the steering wheel, the wheels on the rear axle turn back and forth. This design is intentional, rear-wheel steering allows the driver a larger degree of rotation and precision when control a load. The lifting controls consist of two levers, one for lifting the fork up and down as well as one for tilting the load back and forth. The lifting functionality works as discussed above--forward moves up and backward moves down. The tilting functionality, however, is slightly different. At the base of the masts are two sets of additional hydraulic cylinders that attach to the base of the vehicle. When the tilt- handle is moved

forward, fluid is pumped into the chamber. This rise in pressure pushes the piston head and causes the masts to lean away from the vehicle's body. When the tilt-handle is moved back, fluid is slowly released from this cylinder as fluid is pumped into the other pair of mast attached cylinders. When the pistons from the latter pair push forward, the masts are rocked back to the vehicle.

III. CURRENT FORKLIFT CHALLENGES

There are three main areas that this problems lies in Structure, while taking turn, disturbance in centre of gravity i.e. balanced. Factories ,Warehouses , godowns having number of goods weighting around 50-70 kilograms that are light in weight as compare to normal forklift lifting capacity and can't be moved by labors easily without any help . As the possibility of accidents exist anywhere from the unbalancing of centre of gravity to the crashes with any object in forklifts working route. Accordingly, structure that withstand in the turning velocity of forklift during its fully loaded. Despite, the wide range of applications are possible with forklifts mechanism. The vehicle must first perfect in structure according to its possible uses. Current forklift designs target to move loads above hundreds of kilograms however if they necessary lifting capacity is reduce , a reduction in a number of required a smaller structure and low power to drive forklift is possible, as the gap is bridged between the maximum possible lifting capacity of single labor and the forklift capacity. This would have direct advantages from the resulting reductions in the overall vehicle weight and dimension, a lower energy is required for the lifting loads of mass 40-70 kilograms and fewer systems that must work succession reliably thereby increasing overall vehicle safety. The focus on this project is to address this issue of reducing power consumption and increasing efficiency of forklift having lifting capacity 40-70 kilograms.

PROBLEM DESCRIPTION & SCOPE OF CURRENT WORK

A critical path issue in forklift development is for two wheeler forklift operability to be extended to lower lifting capacity and dimension specifically, two wheeler forklift lifting capacity should be increase to 70 kilograms while maintains performance at low lifting capacity within the same strength minimum variable geometry features and the use of high torque low voltage operating motor.

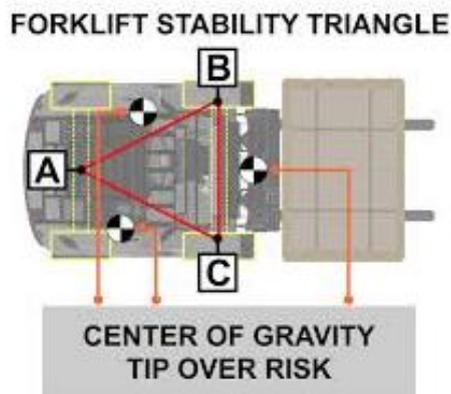


Figure.3. forklift stability triangle

Factories, warehouses need forklifts and cranes for storage and moving large goods. Also there are a number of goods weighing around 40 – 70 kilograms that are comparatively lighter but cannot be moved around easily by single labor. To full fill this need we have introduce a 2 wheel drive forklift to lift and transport such medium weight goods across factories & industrial warehouses. The 2 wheel drive is efficient and low power consumption vehicle that does not require much space to carry load. The mini forklift will run on 2 dc motors and can drive small weight with pickup across small distances easily. For this we use a mini 2 wheel vehicle body frame made with a platform with 2 motorized wheel mounts. It has a perpendicular handle ahead to hold take turns. Also we design a forklift type mechanism on the front handle of vehicle using 2 bent metal strips and lifting mechanism. The lift mechanism contains of large rotating belt mechanism. This mechanism is connected with a high power and high torque motor which used to lift loads on the forks. The further scope of development in the following aspects, Structure: in the four wheel forklift the structure is large due to its loading capacity must be high but in two wheel aisle forklift, the lifting capacity is below 90 kilograms. The large forklifts above capacity 150 kilograms can't be utilized for loading such low weighted goods. Due to energy wastage. So the two wheel aisles forklifts are the best in structure as well as efficiency and power saving. Turning angle: four wheel forklifts can take sharp turns up to 180 degree as they have balanced structure and safety measures but in two wheel aisles forklift the sharp turns like 90 degree, 180 degree can't be possible due to the rotational motion applied on the vehicle, operator and the load. Which can results accidents Centre of gravity: in the large forklifts the resultant centre of gravity due to vehicles centre of gravity and centre of gravity of load is near to centre of gravity of vehicle and hence the forklift is balanced and if the resultant centre of gravity is near to the centre of gravity of load the forklift is unbalanced. And hence the accidents occurs, but in two wheel the distance between centre of gravity of vehicle and balancing point is less therefore it can perform specific task only.

DESIGN OF MODEL OF TWO WHEEL AISLE FORKLIFT

We propose a structure of two wheel aisle forklift to overcome problems explained above. The proposed design of two wheel aisle forklift contains following main parts,

- Wheel Axle & Supporting Frame
- Handle Rods
- Vehicle Motor
- Chain & Sprockets
- Lifter Motor
- Lifter bearings
- Supporting Rods & Bearings
- Pulley & Belt
- Tires
- Shaft & Bearings
- Wires
- Mounts, Fixtures & Screws
- Supporting Frame
- Mast
- Emergency hand breaks
- Hydraulic actuator
- Wheel Hub

Forklifts are powered by electric battery or combustion engines. Some Forklifts allow the workers to sit while driving and operating the machine whereas others require the worker to stand. It is being widely used during the industry for moving materials and goods. Chassis are made from Mild Steel square rods and mild steel metal sheet having space to stand an operator on board which insure the chassis are strong enough to withstand the load. Also the chassis must have enough space and arrangement to mount motors, battery, oil sump, forklift arrangement, steering and operator on board. mast is mounted on front portion of the chassis and battery is mounted on rear portion of it, for making insure the resultant centre of gravity of empty vehicle is applicable on rare side of chassis. We can also add the protective frame to insure security of on board operator if needed, as in working in warehouses with narrow passage and high operation height where accident can take place due to various causes. The wheels mounted on below the chassis at the front portion. The wheel proposed are pneumatic pressure rubber tire as they have nice grip on any floor whether it having sloppy surface or rough surface. Also pneumatic tire can provide good speed to the forklift and which required less power to driven after overcoming the frictional resistance from surface. Also the emergency handbrake are mounted over the wheels with control on steering in on board operator's hand. The handbrake is required to insure the safety of operator and avoiding any accident which can cause financial loss, time loss, life loss, or can done damage to the load or cargo which need to shift. Mast is mounted on chassis. Having rectangular frame made of mild steel, square rods having good strength. It's also contain a high torque electric motor connected with teeth wheel connected with various teeth wheel to insure strength of the motor does not reduce while lifting load. The teeth wheel is connected with pinion and the rack arrangement is provided on fork support which insure that the fork moves both direction up and down as a required with its maximum lifting capacity. The hydraulic pistons are attached to the two main horizontal structures known as masts. Forks that are destined to carry the load are attached to the main body of the forklift by a set of roller chain pulleys whose fulcrum forms a gear at the peak of the mast. Hence, when the hydraulic pistons push the masts in ascending direction, the gears on the masts is forced against the roller chains. It happens because the one side of the chain is fixed to the permanent frame of the forklift, and the only way by which masts can move ascending is when gears rotate in clockwise direction and tug the forks above. The importance of this mechanism is that it let the forks go far away from the range of the cylinders. If it is not meant for roller chain pulleys then forklifts would need much larger cylinders to lift up the load to a comparable height.

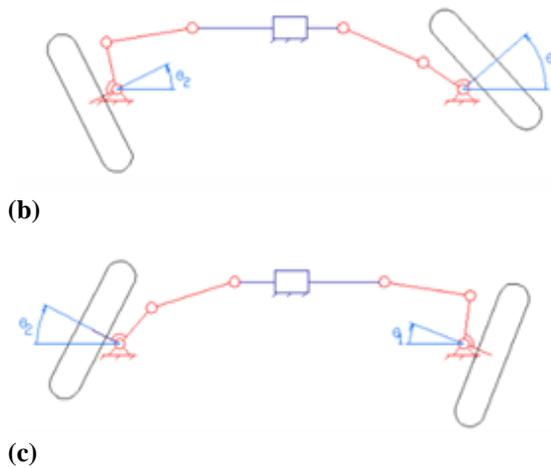
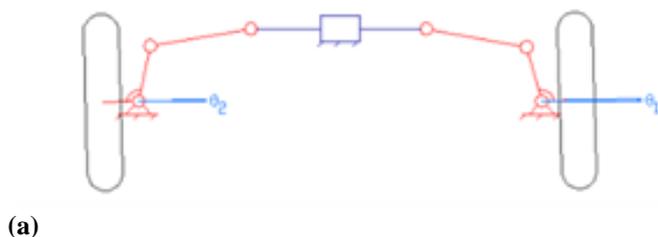


Figure.4. Rack and Pinion arrangement for driving of forklift showing various condition (a) moving forward or backward, (b) left turn (c) right turn

Steering is mounted over chassis to make comfortable to drive the forklift with all control in operators hand than include a hand break control mounted on steering. The steering provide good control over the forklift to avoid any loss and damages while working in narrow passages. It having a small turning angel so that operator can drive it comfortable even without much practice, the steering is connected to a gear and that gear are in contact with another gear so here we insure to avoid any shock to steering which can cause any accident while driving. Further another gear is connected to the driving shaft with rack and pinion arrangement over the driving shaft. Wheels are attached the high torque low RPM Geared electric motor which are used to drive the forklift. The motors are mounded horizontally bellow the chassis and wheels aligned to it with the help of bevel gear which helps to transform the rotation motion of the motor to the axis of wheel in 90 degree. Also the high torque motor which is used in fork lifting mechanism is also transferring the rotational motion to gear and further to chain with the use of bevel gear arrangement. The hydraulic actuator is mounted on the chassis supporting mast and controlling the angle of lifting fork to the ground. When the fork needed to load cargo over it the hydraulic actuator get compressed and provide small if to the cargo so it'll fit on the lifting fork easily, also it's helps in maintaining resultant centre of gravity close to centre of gravity of vehicles to helps it in maintaining balance. And when it needed to unload the lifting fork the hydraulic actuator get expanded with operators control over it and helps in unloading the cargo to its destination.

IV. ADVANTAGE

1. The loading and unloading process is easily done by this machine
2. This machine is faster as compared to existing machine
3. This machine is safe for worker during the material handling.
4. Easy to maintenance.
5. Cost effective.
6. Easily Attachable & Detachable
7. Industrial Goods Transport
8. Warehouse Internal Transport



APPLICATION

1. This machine can be used for transporting every material.
2. This machine can be used in warehouses as well as various cargo plants, airports, railway junctions etc.
3. This machine is used in manufacturing, automobile industry for transporting raw material, semi-finished material and also for finish product and packaged cargo.
4. This machine can use to Snow Plows, Dockyards, Recycling Operations, Construction Sites with little changes to it.

V. RESULT

In order to enhance the transportation system within the industries a manually operated vehicle is designed to move the finished product or industrial components. The advanced vehicle is forklift conveyer. This vehicle is completely eco-friendly as it is battery operated. In order to have smooth movement of the fork of the vehicle to move from top to bottom and vice versa, it is mounted with lead screw mechanism This consumption of forklift conveyer is less as compare to other transport vehicle within industries. As it is compact it requires less area. The components can be loaded and unloaded easily in a forklift conveyer. The working efficiency of the forklift is more as compare to other transport vehicle. On mass production it can be manufactured at low cost.

VI. CONCLUSION

The purpose of this paper was to focus on the solving problems at the warehouses using forklift to carry load of lighter weight and making it efficient n reduce the accident's happening in warehouses due to large forklifts. The two wheel aisle forklift is designed keeping the centre of idea to increase work efficiency, reducing power Consumption, smaller dimension and hence aisle for movement in narrow space of warehouses, high safety factor, time saving application, easy controlling from on board. At the closing of this report, it is evident that there are important areas which call for future research and analysis. The first of this is that completely autonomous working without any human assessment. This will enable more productivity and high reliability. Additionally, method of lifting forklift can be changed safety measures, power consumption can be reduced. For the next step in the design of this particular forklift, higher fidelity analysis method should be employed to ensure that lifting mechanism would to interesting and provide direction towards the application of this forklift.

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