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REVIEW ON DESIGN OF BATTERY OPERATED TUGGER

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ABSTRACT

Material handling is a necessary and essential , but it is a wasteful and expensive activity in manufacturing and distributing. Insufficient material handling accounts for additional costs in two main ways: idle time and cost of labor. In earlier days, industries were facing actual problem of supply of the goods from one place to another. For reduction in the time and increasing the production of industries, some corrective and effective measures had been adopted. The measures should be in such a way that it should reduce the labour work & reduce repair and maintenance cost of the station. As a measure of cost reduction now a days material handling equipments like forklift, stackers, tugger are used .Material handling has improved immensely since it started as fully manual operations, where men were employed to lift, stack. Employees transporting materials using powered equipment and now a fully automated techniques are developing. This paper looks at material handling solutions mainly Battery operated tugger. Each of these is described in their applications to either manufacturing or distributing. This paper shows that companies perform various types of checking, analysis, including simulation, before investing in any type of material handling system.

Keywords: Automated vehicle, material handling equipment, Tugger

I. INTRODUCTION

The industries always try to acheive a high production rate with a better quality in a minimum possible time to improve the status of inustries and provide the service to customers.In earlier days manual powered euipments were used for material handling which took a lots of time and affecting the production rate.Therfore many revolutions takes place in which manual force minimised and automated techinques are introduced.This papers mainly focus on one such kind of material handling euipment known as battery operated tugger which is used for carrying a huge load from one place to another.An electric tug is a battery-powered and pedestrian-operated machine used to move heavy loads on wheels. Suppliers and customers regularly use many different type of material handling equipments which include towing tractors, battery-powered tugs, electric hand trucks, electric tuggers and pedestrian operated tugs. The tugs move loads across a single level. They do not lift the load clear of the ground which is why the load must be on wheels. If the load itself does not have wheels, then it is placed on a wheeled platform by making it as a unit load often referred to as a trolley, bogie or skate. The tug connects to this wheeled platform just as a fork lift truck links to a pallet in order to move a load sat on it. This paper tells us information about electric tugger. [1,2]

II. LITERATURE REVIEW

2.1 Arun et al. (2015)

In this paper they have studied that, Hybrid bike system the power is delivered both via an internal combustion engine and electric motor. They studied about the batteries braking systems and controllers in electric vehicle and from this they have conclude that the electrical power is used to achieve either better fuel economy than a conventional vehicle, better performance and it cause less pollution. Driving mode selectivity improves this system more economical, stable and more efficient.

2.2 Marc and Don (1995)

In this investigation, they have studied about the pushing and pulling task which have become increasingly common as the result of the introduction of a variety of carts and other materials-handling assistance devices. In order to examine the peak performance of workers in these tasks, and the biomechanical stresses and fatigueness that can result from them, the exertions involved in cart pushing and the amount of forces for pushing were studied. And Calculated static compression forces at the L5/Sl spinal disc were consistently above the MOSH Action Limit of 3400 N for strong subjects when the cart load reached 225 kg. Finally conclude that static testing or acceptability scaling in low-inertia situations may be appropriate for predicting peak forces in jobs where loads are moved slowly. For faster movements, however, new dynamic standards will be required.

2.3 Rui Santos et al. (2007)

This paper focuses on strategies and construction problems for the power converter, its protection and control of the power train. In this they have studied about sliding mode control, electric vehicle and DC-DC converter. The main objective of this paper is to evaluate and find solutions for the power converter and control. Other subjects where addressed in this project: like protection circuits, mechanics, etc. but they aren‟t focused here. The result of this project is used in mini-electric vehicle.

2.4 Nuraida et al. (2014)

Vehicles in use around the world have produce serious problem to the environment by using petroleum so it has increase the necessity of alternative method. This paper focuses on development on electrical vehicles and its construction. This vehicle used electrical energy stored in batteries. For controlling purposes controllers are used.

2.5 Lee et al. (1991)

In this paper study has been conducted to estimate lower back loadings in cart pushing and pulling experiment has been conducted with six different people with different weight for different pushing and pulling forces. It was found that pushing a cart result in lesser lower back loading than pulling. Body weight of person affects the lower back loading more in pulling than in pushing.

2.6 Christopher et.al. (2017)

This paper test the possibilities for the consideration of ergonomics in the system design of tugger train system. in this experiment three basic concepts of tugger train used in germen automotive are define. With the help of software based model of tugger train which consider whole life of tugger and ergonomic advantages are analyze.

III. DESIGN REVIEW

3.1 Motor

Almost every mechanical movement that we see around us is accomplished by an electric motor. Electric motors are used to power hundreds of devices we use in everyday life. Motors come in various sizes. Huge motors that can take loads of 1000‟s of Horsepower are typically used in the industry. Here used Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors) are synchronous motors that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor. About the AC (alternating current), it does not imply a sinusoidal waveform, but it implies a bi-directional current with no restriction on waveform system. Additional sensors and electronics control the inverter output amplitude and waveform (and therefore percent of DC bus usage/efficiency) and frequency (i.e. rotor speed). [3]

3.1.1 Different resistance consideration

a) Grade resistance

Grade resistance is amount of force necessary to move a vehicle up a slope or grade.

Using empherical relation of grade resistance, GR = 0.0981 * GVW * % Grade

Where, GR = Grade resistance ,GVW = Gross vehicle weight

b) Aero dynamic resistance

Aero dynamic resistance is taken into account for high and medium velocity application. As the working velocity of tugger is 1.27 m/s^2 i.e it is to small so aerodynamic resistance is neglected.

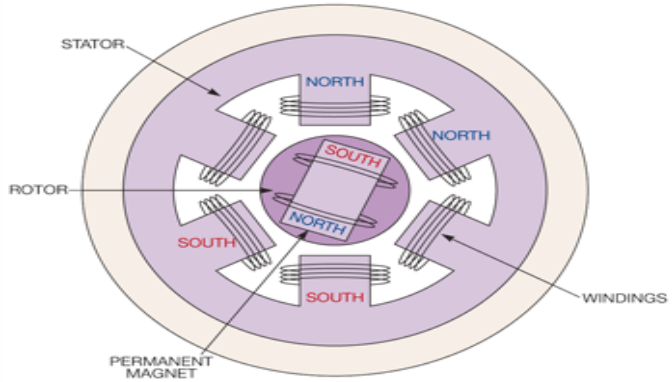

Figure 1 BLDC motors have a rotor with a permanent magnet containing north and south poles. The stator comprises multiple electromagnets.

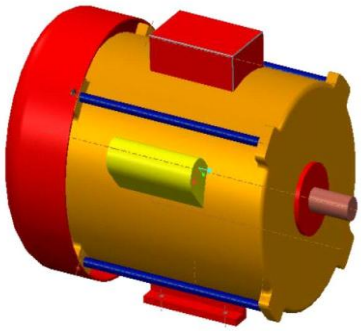

Fig 1. CAD model of motor

3.2 Battery

In this Lead-Acid Battery is used. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, it has the ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. This feature, along with their low cost, makes it attractive for use in motor vehicles to provide the high current required by automobile starter motors. As they are cheap compared to new technologies, lead-acid batteries are widely used even when current is not important and on the other hand other designs could provide higher energy densities. Large-format lead-acid designs are widely used for storage in backup power supplies in cell phone towers, high-availability settings like hospitals, and stand-alone power systems. [4]

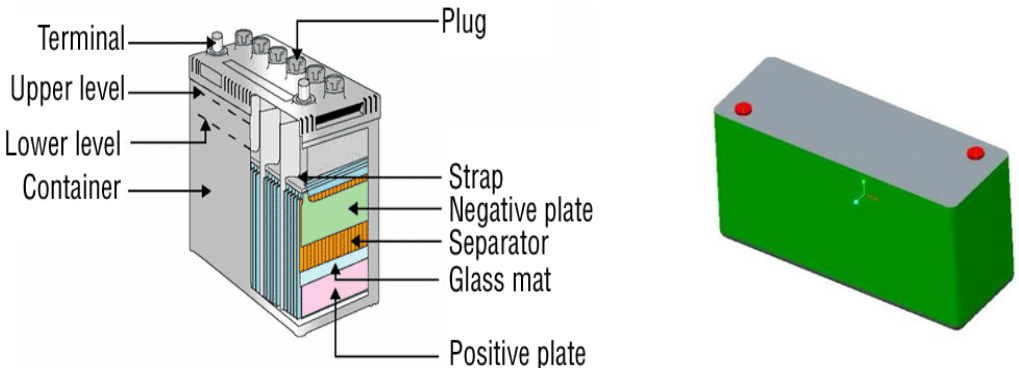

Fig 2. Battery

3.2.1 Battery Calculation

It is essential to calculate watt hours for

a) Total run with load, b) Extra power for upgrade, c) Return run unloaded

Extra power required for grade equals = tons x length of grade x % of grade x Constant

Ampere Hour = $\frac{watt\ hrs}{v}$

3.3 Brakes

Brake is mechanical device that inhibits motion of vehicle or other moving mechanism by the absorption or transfer of energy of momentum by means of friction.In this, electromagnetic brake is used to stop the vehicle motion. Electromagnetic brakes (also called electro-mechanical brakes or EM brakes) slow or stop motion using electromagnetic force to apply mechanical resistance (friction). Especially in trains and trams, the variety of applications and brake designs has increased drastically, but the basic operation remains the same. A typical electromagnetic brake has three elements in its construction – a magnetic field comprising of a coil and a shell, an armature and the hub. When the brakes are applied, the armature is attracted towards the magnetic field develop by the coil. Simultaneously, a torque working in the opposite direction is transferred into the field to counteract the effect of the magnetic field. As the strength of the field decreases, the vehicle begins to slow down and finally stops. The disengagement process begins as soon as the vehicle stops. [5]

a) Braking torque(T), T=F*0.5*d/R

b) Clamp force(C), C=T/coeff. of friction*r

where, F= braking force, d= wheel diameter, R= ratio of wheel diameter to disc diameter, r = effective disc radius

Fig 3. Electromagnatic brake

IV. CONCLUSION

It is always seen in industries that how there will be maximum work done with less labour force. In this paper work, study of battery powered tugger is done and also main components of the tugger are studied. Tugger is a compact, light weight, battery powered, eco-friendly material handling equipment and how it is useful in increasing production rate.

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