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Fabrication of Electric – Cargo Vehicle

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ABSTRACT: The project, Fabrication of E-Cargo Vehicle aims to reduce the pollution. The pollution caused by commercial IC engines has resulted in air pollution which affects the ozone layer and will be a threat in the future. Sound pollution is also a disadvantage of an IC engine which has its own effects on us. Taking all these warnings into consideration we have come up with this vehicle. The project revolves around fabrication of a cargo-based vehicle designed to perform as an electric vehicle-based system. In recent years, the automotive industry has been looking forward to manufacture Electric Vehicles (EV) which are completely pollution free. This project mainly concentrates on conversion of an IC Engine Vehicle to a completely Electric Vehicle (Cargo/Commercial Goods vehicle). This work is aimed at developing of a lightweight multi-utility electric vehicle. The proposed vehicle is capable of doing versatile operations in small scale industries, workshops, institutes, and many more by carrying medium-heavy loads in the premises or the campus, also this vehicle can also be used as a personal mobility vehicle for short distance transportation purpose with ease.

KEYWORDS: Electric Hub Motor, Lead acid battery, 48V Controller, Electric Vehicle, Transportation

I. INTRODUCTION

An electric car is powered by an electric motor instead of a gasoline engine. The electric car (also known as electric vehicle or EV) uses energy stored in its rechargeable batteries, which are recharged by common household electricity. Now-a-days peoples are spoiling the environment. An EV is a shortened acronym for an electric vehicle. EVs are vehicles that are either partially or fully powered on electric power. Electric vehicles have low running costs as they have less moving parts for maintaining and also very environmentally friendly as they use little or no fossil fuels (petrol or diesel). All-electric vehicles (EVs), also referred to as battery electric vehicles, have an electric motor instead of an internal combustion engine.

Electric vehicles (also known as electric cars or plug in electric vehicles) are connected, fun, and practical. They reduce pollution and are even very cheap to use and maintain when compared to conventional I.C Engine Vehicles. Using electricity as fuel has a few merits which are not available in conventional I.C Engine Vehicles. We know that electric motors react quickly and instantaneously, Electric Vehicles have instant high torque and are quite responsive. In large storage facilities transportation of materials are done by conventional IC- Engine Vehicles. This results in population; wastage of fuel and the vehicle are large and are not compactable to all spaces. The pollution caused by commercial IC engines has resulted in air pollution which affects the ozone layer and will be a threat in the future. Sound pollution is also a disadvantage of an IC engine which has its own effects on us.

II. LITERATURE SURVEY

The automotive industry has become one of the most important world-wide industries, not only at economic level, but also in terms of research and development. Increasingly, there are more technological elements that are being introduced on the vehicles towards the improvement of both passengers and pedestrians' safety. In addition, there is a greater number of vehicles on the roads, which allows for us to move quickly and comfortably. However, this has led to a dramatic increase in air pollution levels in urban environments (i.e., pollutants, such as PM, nitrogen oxides (NO_x), CO, sulfur dioxide (SO₂), etc.).

In addition, and according to a report by the European Union, the transport sector is responsible for nearly 28% of the total carbon dioxide (CO₂) emissions, while the road transport is accountable for over 70% of the transport sector emissions [1]. Therefore, the authorities of most developed countries are encouraging the use of Electric Vehicles (EVs) to avoid the concentration of air pollutants, CO₂, as well as other greenhouse gases. More

specifically, they promote sustainable and efficient mobility through different initiatives, mainly through tax incentives, purchase aids, or other special measures, such as free public parking or the free use of motorways. EVs offer the following advantages over traditional vehicles:

- Zero emissions: this type of vehicles neither emit tailpipe pollutants, CO₂, nor nitrogen dioxide (NO₂). Also, the manufacture processes tend to be more respectful with the environment, although battery manufacturing adversely affects carbon footprint.
- Simplicity: the number of Electric Vehicle (EV) engine elements is smaller, which leads to a much cheaper maintenance. The engines are simpler and more compact, they do not need a cooling circuit, and neither is necessary for incorporating gearshift, clutch, or elements that reduce the engine noise
- Reliability: having less, and more simple, components make this type of vehicles have fewer breakdowns. In addition, EVs do not suffer of the inherent wear and tear produced by engine explosions, vibrations, or fuel corrosion.
- Cost: the maintenance cost of the vehicle and the cost of the electricity required is much lower in comparison to maintenance and fuel costs of traditional combustion vehicles. The energy cost per kilometre is significantly lower in EVs than in traditional vehicles, as shown in Figure 1.
- Comfort: traveling in EVs is more comfortable, due to the absence of vibrations or engine noise [2].
- Efficiency: EVs are more efficient than traditional vehicles. However, the overall well to wheel (WTW) efficiency will also depend on the power plant efficiency. For instance, total WTW efficiency of gasoline vehicles range from 11% to 27%, whereas diesel vehicles range from 25% to 37% [3]. By contrast, EVs fed by a natural gas power plant show a WTW efficiency that ranges from 13% to 31%, whereas EVs fed by renewable energy show an overall efficiency up to 70%.
- Accessibility: this type of vehicle allows for access to urban areas that are not allowed to other combustion vehicles (e.g., low emissions zones). EVs do not suffer from the same traffic restrictions in large cities, especially at high peaks of contamination level. Interestingly, there was a recent OECD study that suggests that, at least in terms of Particulate Matter (PM) emissions, EVs will unfortunately not improve the air quality situation [4].

Comparison of savings in cost per kilometre offered by vehicles powered by Gasoline, Ethanol (E85), Hybrid, Diesel oil, Biodiesel, Liquefied Petroleum Gas (LPG), Natural Gas Vehicle (NGV), and Electricity [5].

On the other hand, EVs do, however, face significant battery-related challenges:

- Driving range: range is typically limited from 200 to 350 km with a full charge, although this issue is being continually improved. For example, the Nissan Leaf has a maximum driving range of 364 km [6], and the Tesla Model S can reach more than 500 km [7].
- Charging time: full charging the battery pack can take 4 to 8 h. Even a “fast charge” to 80% capacity can take 30 min. For example, Tesla superchargers can charge the Model S up to 50% in only 20 min, or 80% in half an hour [7].
- Battery cost: large battery packs are expensive.

Methodology: The main objective is to reduce pollution. The electrical cargo vehicle is used to carry the small amount of loads to be done easily. This vehicle is aims to reduce cost for material transportation as well and load carrying is done in ease. The controller is used to control the full operation of the Hub Motor according to accelerator inputs hence making it as usable and power saving as a commercial IC Engine Vehicles.

Parts of Electric Cargo Vehicle:

1.Chassis: Chassis is the basic framework of the automobile. It **supports all the parts of the automobile**. It has to withstand centrifugal force while cornering and bending stresses due to rise and fall of front and rear axles. Chassis, also known as 'Frame', is **the foundation structure of any car that supports it from underneath**. The purpose of the chassis is to bear the weight of the car in its idle and dynamic states.

2.Hub Motor: The **wheel hub motor** (also called **wheel motor, wheel hub drive, hub motor** or **in-wheel motor**) is an electric motor that is incorporated into the hub of a wheel and drives it directly. The hub motor (also called wheel motor, wheel hub drive, wheel hub motor, or in-wheel motor) is characterized by the integration of power, transmission and braking devices into the wheel hub, thus greatly simplifying the mechanical part of electric vehicles. Hub motor is not a new thing, as early as 1900, already manufactured the front wheel equipped with hub motor

electric vehicles, in the 1970s, hub motor technology in the field of mining transport vehicles and other applications. There are two types of hub motors sold online by ATO: gear hub motors and gearless hub motors.



Fig. 1. Hub Motor

3.Battery: Lead acid batteries are the most commonly used type of battery in photovoltaic systems. Although lead acid batteries have a low energy density, only moderate efficiency and high maintenance requirements, they also have a long lifetime and low costs compared to other battery types. One of the singular advantages of lead acid batteries is that they are the most commonly used form of battery for most rechargeable battery applications (for example, in starting car engines), and therefore have a well-established established, mature technology base. A lead acid battery consists of a negative electrode made of spongy or porous lead. The lead is porous to facilitate the formation and dissolution of lead. The positive electrode consists of lead oxide. Both electrodes are immersed in a electrolytic solution of sulfuric acid and water. In case the electrodes come into contact with each other through physical movement of the battery or through changes in thickness of the electrodes, an electrically insulating, but chemically permeable membrane separates the two electrodes. This membrane also prevents electrical shorting through the electrolyte.



Fig. 2. Battery

4.Controller: Motor controller is a device that improves the performance of an electric motor in a prearranged manner. Motor controllers can include an automatic or manual means for starting/stopping the motor, choosing forward/reverse rotation, selecting and controlling the speed, modifying or limiting the torque, and shielding against faults and overloads. The major constituents of electric vehicle systems are the motor power supply, controller, drive train and a charger. An EVM controller or electric vehicle motor controller is a machine that is employed to regulate the torque generated by the motors of electric vehicles by means of modifying the energy flow from the power sources to the motor. Motor controllers may use electromechanical switching, or may use power electronics devices to regulate the speed and direction of a motor. An electric motor controller can be classified by the type of motor it is to drive, such as permanent magnet, servo, series, separately excited, and alternating current. A motor controller is connected to a power source, such as a battery pack or power supply, and control circuitry in the form of analogue or digital input signals.



Fig. 3. Controller

5. Steering System: The steering of an electric car is very sensitive. Rack-and-pinion steering is quickly becoming the most common type of steering on cars, small trucks and SUVs. It is actually a pretty simple mechanism. A rack-and-pinion gear set is enclosed in a metal tube, with each end of the rack protruding from the tube. A rod called a tie rod, connects to each end of the rack. When you turn the steering wheel, the rod which is in constant with steering is inserted into the roller ball bearing which is fixed on chassis the tie rods at each end of the wheel bearing are connects with the rods, this rod will turn the front wheels.

6. Tyres: A **tire** or **tyre** is a ring-shaped component that surrounds a wheel's rim to transfer a vehicle's load from the axle through the wheel to the ground and to provide traction on the surface over which the wheel travels. Most tires, such as those for automobiles and bicycles, are pneumatically inflated structures, which also provide a flexible cushion that absorbs shock as the tire rolls over rough features on the surface. Tires provide a footprint, called a contact patch, that is designed to match the weight of the vehicle with the bearing strength of the surface that it rolls over by providing a bearing pressure that will not deform the surface excessively. For electric car, wheels and tyres are much smaller than those used on a normal car. The tyres will have increased grip and a hard one and also it can withstand the high temperature. In this car, we use tyres having 15" dia for the front and for rear. This is used for an aerodynamic shape. The tyres must have pressure of at least 18psi.

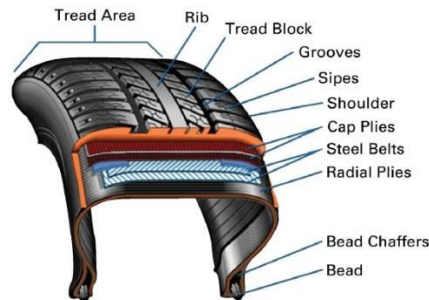


Fig. 4. Parts of tyre

7. Brakes: A brake is a mechanical device that inhibits motion by absorbing energy from moving system. It is used for slowing or stopping a moving vehicle, wheel, axle, or to prevent its motion often accomplished by means of friction. Drum brakes have been around for almost as long as the automobile itself and are still fitted today in a modified and more sophisticated form in modern cars. The term drum brake describes the design principle: namely, an enclosed cylindrical structure.

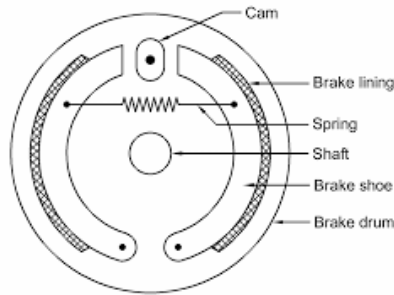


Fig. 5. Drum Brake

8.Shock Absorbers: will go. In most dashpots, energy is converted to heat inside the viscous fluid. Shock absorber are the important part of the vehicle's suspension, which is fabricated o reduce shock impulse. Shock absorber minimizes the effect of travelling on a rough ground. Modern vehicles are designed with strong shock absorbers to tolerate any type of bouncy conditions. If supposedly shock absorber is not used then to control excessive suspension movement, stifler springs will be used. The shock absorbers duty is to absorb or dissipate energy. One design consideration. When designing or choosing a shock absorber is where that energy.



Fig. 6. Shock absorbers

In a vehicle, it reduces the effort of travelling over rough road ground, leading to augmented ride quality and increase in comfort due to substantially reduced amplitude of disturbances, without shock absorber, the vehicle would have a bouncing ride, as energy is red in the spring and then released to the vehicle, possibly exceeding the allowed the range of suspension movement. Shock absorber are attached at the end of the piston rod and works against hydraulic fluid in the pressure tube. The oscillating movements of suspension force the hydraulic fluid through the minute holes inside the piston, However, only small amount of fluid is forced inside the piston. The insertion of fluids reduces the Speed of the piston which turn slows down the piston, resulting in slowing down of spring and suspension movement.

Principle of Electric Cargo Vehicle: Power is converted from the DC battery to AC for the electric motor. The accelerator pedal sends a signal to the controller which adjusts the vehicle's speed by changing the frequency of the AC power from the inverter to the motor. The motor connects and turns the wheels through a cog. An electric vehicle works on a basic principle of science: conversion of energy. Electrical energy is converted into mechanical energy. There is a motor used in the electrical system to carry on this duty of conversion. Motors can be of various types. The motor is to an electric vehicle what engine is to the IC vehicle. Let's have a look at different types of motors used in EVs.

Working of Electric cargo vehicle:



Fig. 7. Electric Cargo Vehicle

In E-Cargo vehicle fitting the hub motors to rear wheels and to connect the controller and battery the battery is placed under the driver's seat along with the charging port. The controller is fixed to the vertical bars of the chassis. The controller sends power from the battery to the Hub motor whenever the driver pushes the accelerator pedal the vehicle is move the forward direction and the controller is to be control the vehicle. This is a Manual type transmission system. The electric motor gets energy from a controller, which regulates the amount of power—based on the driver's use of an accelerator pedal. The electric car (also known as electric vehicle or EV) uses energy stored in its rechargeable batteries, which are recharged by common household electricity. Thus, an electric vehicle will have three basic components:

- Energy Storage Unit
- Controller
- Propulsion system

The energy storage unit will have a way to store power. A chemical battery is the most common energy storage technology currently, although it can be different - for example - A fuel cell (which gets its electricity from hydrogen rather than a battery pack), can be used instead of a chemical battery as the energy storage unit.

The controller acts as a pipeline or gateway to the electric motor. The controller will do other things too - it moderates the power, will also act as a converter - converts power from DC to AC, or it might also increase or decrease the amperage etc. The controller is the brains of the system. The electric motor, which is the propulsion system, converts the electric power and converts this into physical energy for movement. The whole system is a much simpler, more efficient device than the combustion engine found in most cars, enabling you to get the most mileage for your charge. Historically, EVs have not been widely adopted because of limited driving range before needing to be recharged, long recharging times, and a lack of commitment by automakers to produce and market electric cars that have all the creature comforts of petrol-powered cars. That's changing. As battery technology improves—simultaneously increasing energy storage and reducing cost—major automakers are expected to begin introducing a new generation of electric cars.

Electric cars produce no tailpipe emissions, reduce our dependency on oil, and are cheaper to operate. Of course, the process of producing the electricity moves the emissions further upstream to the utility company's smokestack—but even dirty electricity used in electric cars usually reduces our collective carbon footprint. Another factor is convenience - Let's not forget two important points: charging up at home means never going to a petrol station—and electric cars require almost none of the maintenance, like oil changes and emissions checks, that internal combustion cars require. Electric motors develop their highest torque from zero rpms—meaning fast (and silent) zero-to-60 acceleration times.

Fabrication:

1.Chassis: First of all, a fixture for the base of the vehicle was made and the pipes were cut according to the fixture and welded together. Later on, a fixture of seat mounting side member was made and then the pipes were cut and welded accordingly. Finally, the base frame and seat mounting side members were welded together after which the

seat was mounted. Battery mounting was prepared on the base frame itself, below the seat for proper utilization of available space.

2.Wheel Mounting: Wheel Mounting Once the roll cage was ready both the wheels (front and rear) were mounted simultaneously to save time and distribute the work among the team member. After mounting the wheels, mounting of trolley wheels was carried out.



Fig. 8. Front Wheel Mounting



Fig. 9. Rear Wheel Mounting



Fig. 10. Trolley Mounting

3.Hub Motor Mounting: As the hub motor is used in the vehicle so motor mounting was itself done by mounting the Rear wheels in the vehicle. The hub motors were mounted at the Rear Axle of the vehicle.



Fig. 11. Hun Motor Mounting on Rear wheels

4.Battery and Seat Mounting:It is a load carrier vehicle so driver seat is fully comfortable and it is good to seat on it to ride a vehicle. Battery mounting is exactly bellow the seat mounting to utilize the space which is below the seat. It is a Four-Wheel vehicle for a single person drive so it is beneficial to utilize a space.



Fig. 12. Battery Mounting

5.Controller Mounting: Motor controller is a device that improves the performance of an electric motor in a pre-arranged manner. Motor controllers can include an automatic or manual means for starting/stopping the motor, choosing forward/reverse rotation, selecting and controlling the speed, modifying or limiting the torque, and shielding against faults and overloads. A controller is mounted on the sides of the vehicle in a small distance from the batteries and is connected to the throttle, battery, and hub motor.



Fig. 13. Controller Mounting

6.Steering and Brake Mounting: Steering is used as it provides riding comfort. Generally, these types of steering are used in four-wheelers and trucks etc. We used drum brake which is mounted in rear wheels of the vehicle. It is an integral part of the hub motor itself. The brakes are fitted in the rear wheels of the vehicle.



Fig. 14. Steering and Brake Mounting

7.Trolley: The trolley frame was constructed by cutting the L-section plates of suitable size and welding them together. Later on, various cross members were welded to the trolley frame which acts as the load carrying members of the trolley. Finally, a GI sheet was placed on trolley in order to facilitate proper placement of goods.



Fig. 15. Trolley

Advantages:

1. No heavy maintenance and easy to ride.
2. Pollution free.
3. Eco friendly to the environment
4. Comparatively cheap and can be easily afforded by a common people.
5. Easy maintenance.
6. The initial cost is low.

Disadvantages:

1. Less number of people can travel at a time.
2. Heavy load barring is not allowed because due to light weight.
3. Cannot travel long distances and even cannot run on hilly mountainous areas.
4. Due to battery the speed is comparatively slow.

III. CONCLUSION

To conclude, it is the hub motor propelled vehicle with multi usage like a load carrier and personal mobility vehicle, can be best utilized at many places like airport, college and university premises, small scale industries and many more with additive advantages of low cost, high efficiency, pollution free, low maintenance and compact in size. Electric cargo vehicles are definitely more environmentally friendly than internal-combustion vehicles, Batteries are being engineered to have a long life. When the electric cargo vehicles become more widespread, battery recycling will become economically possible.

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