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A Review on Electric Vehicles and Their Components

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Abstract - *This is a review paper on various types of electric vehicles and their components. It is clear that electric vehicles are the future of the automobile industry because their uses of them are environment friendly; they do not emit harmful gasses and save fossil fuel. In this paper, we studied various research papers which clarify the concept of electric vehicles. This paper clears about the motor selection, battery selection, safety measures, sensor development, and battery management for electric vehicles.*

Key Words: Electric vehicles, Components of electric vehicles, Hybrid electric vehicles, Sensor development, Battery management system, Manufacturing of electric vehicles, Electric motors.

1. INTRODUCTION

Electric vehicles are the future of the automobile industry either for personal use or for transportation use. Various researches are going on electric vehicles to develop and enhance their efficiency of electric vehicles. Development and experiments on the different parts of an electric vehicle are going on to increase its overall efficiency of it. The components used in electric vehicles like electric motors, battery packs, converters, chargers, controllers, thermal systems, battery management systems, transmission systems, etc. We know electric vehicles do not emit any harmful gasses therefore it keeps the environment green and clean. In markets, the demand for electric vehicles is rising day by day to meet the requirement of a market company that is manufacturing electric vehicles in huge amounts. The demand of customers to companies is low cost, low maintenance, high speed, and long-range; this can be achieved by increasing the efficiency of each component and using the most suitable type of part for Electric vehicles. The choice of battery for the electric vehicle plays an important role. The proper selection of batteries, their periodic maintenance, and proper battery management system can improve efficiency. The selection of electric motors and types of motors that are suitable for use increases the efficiency of electric vehicles.

2. LITERATURE REVIEW

Bo-chiuan Chen etal. [1] A hybrid electric motorcycle (HEM) with a direct driven wheel motor is proposed in this paper. Sometimes in hilly areas, the motor of an electric vehicle cannot provide sufficient power to climb in that area, Therefore people in this type of area avoid the use of electric vehicles. To overcome this problem hybrid electric motorcycles are proposed. It is equipped with two sources of force, the first an internal combustion (IC) engine and the second is an electric motor.

A hybrid electric motorcycle is a parallel configuration when required both the wheels can provide a tractive force to an electric vehicle. The front wheel is driven by a direct driven wheel motor which is powered by a battery source. The rear wheel is driven by an internal combustion engine which is a 100 cc four-stroke engine. A 1300-watt permanent magnet DC motor is used with a four lead-acid battery to provide power to electric vehicles. The fuel consumption is improved by about 11.6 % as compared to the traditional motorcycle but the proposed design is heavier than the traditional one.

Hiroshi Shimizu etal. [2] In this paper, the concept of an energy-saving electric vehicle (ESEV) is used. Energy-saving electric vehicles are developed by using simulation, A brushless motor, and the direct drive motor is used in this vehicle. The battery used in this is a conventional lead acid battery and the range of the battery is improved by applying various techniques. The tires used in ESEV are the low rolling drag type, by using this the range improvement rate is as small as 30%. The weight of the vehicle is less. A low air drag body and regenerative braking system are used in this vehicle. Pulse width modulation is used to control the speed of the motor and power MOSFET is used as a switching device.

The acceleration time of ESEV for 0-30 km/hr is 6.5 seconds and has a maximum velocity of 55 km/hr. At 30 km/hr constant speed it gives a range of 56 km and in the city range is 34 km. In this paper, it is shown that by introducing new concepts performance of EVs is increased.

Johann Willberg et al. [3] In this paper identification of a suitable electric motor type for wheel hub application is done. The experimental study of different types of electric motors which are used in a wheel hub applications. The comparison of energy consumption of an induction motor (IM), the synchronous motor with surface mount magnets (SPM), and the synchronous motor with an interior mounted magnets (IPM) at different driving cycles is done. Each motor has a different characteristic like torque density, efficiency at potential load and full load, torque ripple, noise impact, overload capacity, maximum velocity, robustness, reliability, and cost.

This paper does not focus on each difference of motors, it focuses on the efficiency aspects of each suitable

for wheel hub application. An efficiency map of each type of motor is produced and discussed briefly. He concluded that synchronous motors are more favorable for wheel hub motors and induction motors are designed for high torque. The cost reduction of the magnetic material and low assembly cost makes synchronous machine competitive in hybrid topologies.

Nasser Hashemnia etal. [4] In this paper, different types of electric motors are studied, tested, and compared for an electric vehicle. We studied about five types of electric motors- DC motor, Induction motor, Permanent magnet synchronous motor, Switched reluctance motor, and Brushless DC motor. DC motors are used in the old days but due to their maintenance problems, they are not frequently used nowadays. DC motors are still used in low-power applications. Induction motors are already used in many vehicles because of their reliability and robustness and fewer maintenance problems. Permanent magnet synchronous motors have high power density and higher efficiency.

Switched reluctance motors are receiving much attraction because they have rigid construction, fault tolerance properties, simple control, and excellent torque speed characteristics. Brushless DC motors have various properties like deletion of brushes, compactness, high efficiency, and high energy density. An induction motor is best for an electric vehicle because of its robustness, less costly, mature technology, and less maintenance.

Clifford L. Hyden etal. [5] He mentioned in this paper that with proper battery maintenance service they can increase the life cycle of a battery, he told about 9 different types of battery maintenance activity. He said about the lead-acid battery that the batteries are powerful enough to provide sufficient power to modern electric vehicles. Maintaining proper electrolyte levels in a battery can increase the life cycle of the lead acid battery. The evacuation of hydrogen gas is essential for the safe operation of electric vehicles. He mentioned that lead-acid batteries can be used more efficiently and more productively by improving the battery management system. The proper cleaning of the terminals of the batteries is required. It was found by various maintenance activities of the lead-acid battery its performance can be increased by 30%.

Eric Jelinski etal. [6] In this paper they conducted a test on a Nissan truck; they have converted it into an electric truck. They tested that electric truck in a cold climate condition. The internal combustion (IC) engine of a truck is removed and fitted with the electric traction motor, battery pack, etc to power up the truck with electricity. The thermal management system and regenerative braking system are also used in this truck. After testing this truck in a cold climate condition they conclude that it is suitable for the various climate conditions. There are many problems with the conventional IC engine like cold starting and engine warm-up in cold conditions but in electric vehicles, this type of problem does not occur. An electric vehicle has zero-emission that does not emit harmful gases.

Mark Harrison etal. [7] To avoid accidents and casualties a safety system has been developed in this paper. Vehicle stability control systems (VSC) are multifunctional system which has included an acceleration sensor to detect force applied to the vehicle. In this paper, a small-sized acceleration sensor for the vehicle stability control system has been developed. He developed super-sensitive and highly accurate acceleration sensors for the VSC system; firstly he used an inertial sensor which is a combination of the yaw rate sensor and pitch sensor. The inertial sensor is very sensitive and accurate; it is used to detect vehicle side slip and vehicle drift. He developed an acceleration sensor by using the electrical and mechanical sensors stacked together on ceramic. This newly developed sensor transforms information in terms of voltage. The super small packaging size is archived by adopting a stack structure.

David Hobbs etal. [8] In this paper, we know about the detailed safety, dismantling, storage, and shipping information and how this can be improved in the future to enhance safety. In this paper, we get knowledge about the type of cables assigned for different voltage levels and about the hybrid electric components. The handling and maintenance procedure of battery packs and precautions which should be taken with battery installation and dismantling are discussed. Precautions to be used for inverters and converters used on hybrid electric vehicles are discussed. A person who deals with electric vehicle parts should be properly trained in safety procedures should be followed in case of any condition it may deal with it properly. Some procedures should be followed during the power down of electric vehicles. During the shipping process of batteries if proper instructions are not followed then it can become a major problem. Always check the ding, dents, punctures, and swelling signs on the lithium-ion battery to avoid blasts and explosions of batteries.

Cheng Zhang etal. [9] In this paper life cycle assessment of e-bikes in Shanghai is done, they research electric-powered bikes and internal combustion engine bikes. After research and evaluation, it was found that e-bikes are worse than engine-powered bikes. The e-bike creates scraps and uses more plastic and other elements than engine-powered bikes. Internal combustion engine bikes spend more energy in a life cycle than e-bikes. The life cycle of e-bikes consumes less energy therefore he said the government should boost battery-powered bike production.

Bruce R. Laumeister etal. [10] In this paper, the experimental vehicle of General Electric Co. is covered in detail. The model of the vehicle, construction, material, cost, power system, and performance are discussed briefly.

They studied propulsion battery energy density, cost, drain rate, Life cycle, and the recharge-discharge cycle of a battery. He discussed briefly GE's vehicle components and regenerative braking. The compound wound motor is used for regenerative braking and various tests are performed on it.

3. CONCLUSION

Electric vehicles are the future of transportation either for personal use or commercial use. By increasing the efficiency of each part, the overall efficiency of electric vehicles can be improved. The production cost of electric vehicles is slightly high as compared with the internal combustion engine but the government is giving subsidies to consumers to encourage them. The market for the electric vehicle industry is rising day by day and it will see a surge in the coming years. The efficiency of the battery can be increased by proper maintenance procedures and a battery management system. The proper selection of an electric motor for an electric vehicle plays an important role. The properly trained personnel should deal with the transportation, storing, and assembling of parts of an electric vehicle. By using fast charging technology the performance of the electric vehicle can be increased. The working of electric vehicles does not affect climate conditions like internal combustion engines; it works perfectly in all climate conditions.

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