Use of Disc Brake in E-Car: A Review

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Abstract

There are many problems that the conventional petroleum vehicle poses such as dependency on foreign oil, degradation of air quality and carbon emissions that perpetuate climate change. India imports large amount of oil for automotive use. Nearly 80% of India’s crude oil requirement is imported. So, there is the need for alternative fuelled vehicles to reduce the problems of exhaust emissions from internal combustion engines and to reduce the dependency on imported foreign crude oil. An electric car is an alternative-design automobile that uses an electric motor to power the car, with the electricity being provided by a battery. It produces zero emission and it has noiseless operation. The overall impact of the electric car ultimately benefits the people. Compared to gasoline powered vehicles, electric vehicles are considered to be ninety-seven percent cleaner, producing no tailpipe emissions that can place particulate matter into the air. According to the survey of today’s scenario, there is a big need of small, light weight and more efficient electric car with better safety to overcome from traffic problem, and to increase the overall efficiency. I think it is time to consider it necessary to produce varied types of electric cars. The reason is simple, we need to find substitute for oil and gasoline powered cars and we need to lower the pollution from vehicles. I think the best solution is electric vehicle and I am positive that is a big part of our future. This review paper includes the basic details of electric car and the basics of a brake system of the vehicle as a safety features well as survey of some well-known company’s electric vehicle.

Keywords: Alternative fuels, Brakes, Disc brake, Electric car, Efficiency of E-car, Light weight material, Pollution

I. INTRODUCTION

Internal combustion engines are the engines, in which, combustion of fuel with oxygen of the air occurs within the cylinder of the engine. The combustion process occurs inside the engine. They are classified as SI and CI engines.

SI engine works on Otto cycle and petrol used as a fuel. Air-fuel ratio of this engine is 10:1 to 20:1 and the fuel supply is done by carburettor. It has Low thermal efficiency, less noise and vibration. CI engines works on diesel cycle and diesel used as a fuel. Air-fuel ratio of this engine is 18:1 to 100:1 and the fuel supply is done by injection. It has High thermal efficiency, more noise and vibration.

Internal Combustion engines can also run on different kinds of fuel like Liquid, Gaseous and Solid fuels. The properties and the character of the fuel exercise profound influence on the design, output, efficiency, fuel consumption and the reliability and durability of the engine. Natural gas (CNG), Liquefied petroleum gas (LPG), Alcohol, Hydrogen, Biogas used in IC engines as alternative fuels. All IC engines which used these types of different fuels produce emission.

A. E-Car:

E-car is a one type of Battery Electric Vehicle. It is “pure” electric vehicle in that all of their power is derived from mains electricity, supplied to an on-board battery which then drives an electric motor (or possibly more than one) within the vehicle. These vehicles produce zero emissions. An electric car is an alternative fuel automobile that uses electric motors and motor controllers for propulsion, in place of more common propulsion methods such as the internal combustion engine (ICE). An electric car is an automobile that is propelled by one electric motor or more, using electrical energy stored in the batteries or another storage device. Electric motors give electric cars instant torque, creating strong and smooth acceleration.
Advantages of E-car:
Fuel can be harnessed from any source of electricity, which is available in most homes and businesses. It reduces hydrocarbon and carbon monoxide, responsible for many environmental problems, by 98%. Also reduces pollution. It does not produce emissions and that is important in urban cities, where cleaner air is much needed. It is energy efficient and environmental friendly.

Brake of Vehicle:
Brakes are one of the most important control components of the vehicle. They contribute very much in the running and control of the vehicle. The braking system provides added friction to overcome motion and to slow up or to stop the vehicle. They are required to stop the vehicle within the smallest possible distance and this is done by converting the kinetic energy of the vehicle into the heat energy which is dissipated into the atmosphere. (17)
Functions of brake system is to stop the moving vehicle in the shortest possible time and distance and to help in controlling the speed of the vehicle and to reduce the speed at turning and other crowded places. (17)

Requirements of a Good Braking System:
The brake should stop the vehicle within a reasonable distance. The braking system should be very reliable to promote highest degree of safety on the road. The braking system should not be affected by water, heat, road grit or dust etc. Pedal effort applied by the driver should not be more. Brake should work equally well in all weathers. The wear and tear of the Material of the brake lining should be minimum for its longer life. All the components and levers of the braking system should be strong enough to take the mechanical stresses and strains during brake actuation. (17)

Types of Brake:
1) Drum Brake:
A drum brake is a brake that uses friction caused by a set of shoes or pads that press outward against a rotating cylinder-shaped part called a brake drum. Drum brake is a brake in which shoes press on the inner surface of the drum.
2) Disc Brake:
A disc brake is a type of brake that use callipers to squeeze pairs of pads against a disc in order to create friction that retards the rotation of a shaft, such as a vehicle axle, either to reduce its rotational speed or to hold it stationary.
3) Components of Disc Brake:
1) Disc
2) Calliper
3) Brake pads
4) Master cylinder
5) Brake fluid reservoir
6) Brake line
7) Brake fluid

II. LITERATURE SURVEY

Puridur Bjorg Guðnadóttir [1]: This paper contains basic concept of electric car, how the technology has evolved and what the prospects are. According to the author, the best solution is electric car, as substitute for oil and gasoline powered cars and to lower the pollution from vehicles. An electric car is an alternative-design automobile that uses an electric motor to power the car, with the electricity being provided by a battery. The main advantage to electric vehicles is that the motor and battery configuration
allows the vehicle to run more fuel-efficiently. Electric vehicles can perform quite well in the cold. Compared to gasoline powered vehicles, electric vehicles are considered to be 97 percent cleaner, producing absolutely no tailpipe emissions that can place particulate matter into the air. Electric cars are completely silent because there is no internal combustion engine. Author concludes that Electric car need to become commercially available so people can choose between electric or other options. According to the survey of him, there is a demand for EV but the supply is very poor. He also concludes that electric vehicles have much to offer and it is going to be a big part of our future.

Rony Argueta [2]: Due to the problems caused by the gasoline engine on the environment and people, the automotive industry has turned to the electrical powered vehicle. This report explains how an electric vehicle works and compares the electric vehicle to the internal combustion engine and hybrid vehicle. In addition, a brief future view of the technology is given. Compared to gasoline powered vehicles, electric vehicles are considered to be ninety-seven percent cleaner, producing no tailpipe emissions that can place particulate matter into the air. As seen in this report, the electric vehicle has many advantages and benefits over the internal combustion engine and hybrid vehicle, however, it also has disadvantages. It is heavier, limited to the distance it can travel before recharge, and costs more. The future of the EV relies on its battery. If researchers can produce or find the “super battery”, the EV’s future is promising.

Anu G Kumar et.al. [3]: In wake of the very recent initiative by the Indian government under the Faster Adoption and Manufacturing of Hybrid and Electric Vehicle (FAME) scheme 2015, to provide subsidies for electric vehicle purchase, the cost difference between electric vehicle and conventional diesel vehicle is bridged to an extent. This paper attempts to provide strategies to increase the cost advantage of Electric vehicles by reducing its payback period by exploring possibility of vehicle to home (V2H) scheme and thus to increase the willingness to pay (WTP) of the customer. The biggest beneficiary of this scheme will be the Indian power grid. Electric vehicle can be used as a storage methodology. The hypothesis presented by the author is specific for a State, nevertheless these findings are heterogeneous enough across the country and this can significantly increase social benefits for the whole nation. As the future scope, green House Emissions can be also reduced if this system is integrated with renewable energy sources such as solar or wind. At last, author conclude that In the near future, as the battery technology becomes cheaper, fossil fuels becomes costlier, electric vehicle technology becomes cost effective, government subsidies for PHEVS, Tax Benefits for V2H, charging stations becomes widespread, and GHG emission law more stringent, it is a natural expectation that the vehicle to home (V2H) methodology will becomes popular and economically viable.

Enrico Ferrero, et.al. [4]: An experimental campaign is conducted close to a highway in Milan, Italy. Meteorological parameters and chemical concentrations are measured along with the traffic emissions. They have found that only a significant replacement (50%) of non-electric vehicles with electric ones yields a remarkable reduction of the pollutant concentrations. The first scenario (EV) considers replacing 25% of light vehicles with electric ones. The maximum effect of this change is a concentration decrease of 2.8% for NO2 and 8% for NO computed at two measurement stations. We also evaluate two additional scenarios. They first consider a replacement factor of both in the light field and in the heavy-duty field (EV2). Then, a third scenario (EV3) considers a replacement factor of 50% in the light car field only. In these cases, the pollution reduction is more significant. They find a relative difference of 6.7% and 17.6% for NO2 and NO respectively in the EV2 scenario. In the EV3 scenario, they find a relative difference of 5.5% for NO2 and 16% for NO. In the EV scenario, NO and NO2 concentrations are not significantly reduced. In EV2 and EV3 scenarios NO concentrations decrease more significantly than in the EV scenario, but the reduction of NO2 concentration is smaller. This demonstrates that only with a total replacement factor (regardless the kind of vehicles) of 50% can a significant (more than 10%) pollution reduction be obtained.

Yogesh Abhale, et.al. [5]: The Electric vehicles are upcoming interest in the market. The traditional braking topologies are nowadays used. These braking techniques have lot of wastage of energy during the braking in form of heat. Thus regenerative braking is the prime method to be focus as it is energy saving method. It increases efficiency of electric vehicle by saving of waste energy. In regenerative braking mode of electric vehicle the kinetic energy of wheels is converted into electricity and stored in batteries or capacitors. This method is improved by using flywheel, DC-DC converter, ultra capacitor as well as super capacitor. In this paper principle and various types of controllers have been studied to improve energy saving of electric vehicles. There are several advantages of regenerative braking taken over the traditional braking system. They are more control over braking, more efficient and effective in stop-and-go driving conditions. Prevents wear on mechanical brake systems and Better fuel economy. Authors conclude that Regenerative braking is one of the important systems in electric vehicle because it has the ability to save the waste energy up to 8-5%. The regenerative braking system has been improved by the advanced power electronic component such as ultra capacitor, DC-DC converter (Buck-Boost) and flywheel. In short, the regenerative braking is a tremendous concept that has been developed by Engineers. In the near future, regenerative braking techniques can be further developed by using different methods either by fuzzy controller or PID controller.

Tribhuwan singh, et.al. [6]: Using regenerative braking, braking improves the efficiency of an electric vehicle as it recovers energy that could go to waste if mechanical brakes were used. A novel regenerative braking system for neighbourhood electric vehicles was designed, prototyped and tested. The proposed system utilizes a seesaw system to capture energy whereas the conventional systems regenerate to the batteries. The user has direct control over the amount of current regenerated and hence the amount of negative torque applied for braking. The research has shown that the proposed regenerative braking system is significantly better in recovering energy and slowing the vehicle compared to a commercially available regenerative braking system. See Saw regenerative braking system is basically a modification in regenerative braking technique. They are doing two main things, first by the help of engaging & disengaging structure we are allowing ‘battery’ to get disengage from the system for some time because over charging a battery will ultimately lead it to lose its full charge capacity & the second thing is by disengaging...
III. Survey

This is the survey of brakes used in 10 well-known company’s electric vehicles.
From the above survey, it can be concluded that, according to today’s scenario, pollution is the major issue all over the country as well as the world and e-car is the best solution to reduce the pollution. The overall impact of the electric car ultimately benefits the people. Compared to gasoline powered vehicles, electric vehicles are considered to be ninety-seven percent cleaner, producing no tailpipe emissions that can place particulate matter into the air. Nowadays every design is related to high speed vehicles but I can say that there is a big need of small, lightweight and more efficient electric car with better safety to overcome from traffic problem, and to increase the overall efficiency. I am positive that it is a big part of our future. Government should give subsidies on purchasing more and more small electric vehicles as a substitute of conventional petroleum vehicles and the manufacturing of e-cars should in such a way that vehicle should be light in weight with better safety. One of the best safety features is brakes. Light weight of vehicle can give more efficiency and we can reduce the overall weight with using effective disc brakes and by reducing the weight of brake components by using alternative materials. Heat dissipation is easiest in the disc brake system. The design should be in such a way that location point of view, cost point of view and space point of view because these are the most common problems while designing the brakes of any vehicle.

IV. CONCLUSION

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