

Design of Enclosure for Charging Point of Electric Vehicle.

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Abstract: In recent years, due to increase in environmental pollution, increased fuel costs & energy crisis, automobile industry is shifting away from production of internal Combustion engine vehicles to electric vehicles. The major problems associated with these vehicles are availability of charging stations & safety of charging points from environmental contaminations. Therefore, an enclosure should be designed for charging point for these vehicles which can protect it from environmental contaminations such as dust, dirt & moisture and which should be also provided with locking & unlocking system so that if one person using it, other person can't open it which also prevents its safety. The present study is focused on design of enclosure for charging point for electric vehicle which can be used to prevent it from environmental contaminations and which can be provided with locking and unlocking system which prevents damage to it by other person and ensures safe charging of electric vehicle. The operating temperature range, ingress protection Rating, enclosure material, mounting method & dimensions of enclosure are considered as input parameters for designing it. The design of various parts of enclosure & their assembly is carried out using CATIA design software.

Keywords: Electric Vehicles, Charging point, Enclosure, etc.

1. Introduction

In recent years, it is observed that most of the automobile industries are shifting away from production of internal combustion engine vehicles to Electric Vehicles (EV) due to increase in environmental pollution, increased fuel costs and energy crisis. An EV uses one or more electric motors for propulsion. These vehicles use batteries which are used to store electrical energy that provides power to electric motors. The batteries are charged by plugging the vehicle into an electric power supply source (charging point). With increase in use of these vehicles, the requirement of charging point is also increased. Power load of EV charging point is more than traditional power load. The major problem associated with these vehicles are availability of charging stations and safety of charging point from environmental contaminations. Therefore, safety design of EV charging equipment is very important for its effective working (Hung Luat et al. ^[1]).

Researchers have developed smart battery charging system for electric vehicles whose charging process is controlled by an appropriate control logarithm whose aim is to increase life span of

batteries (Monteiro et al. ^[2]). A study is carried out on design of intelligent vehicle to grid (iV2g) charging platform for electric vehicle and which includes mobile control system by using which car drivers can control charging and discharging process from remote locations (Ferreira et al. ^[3]). Most of the research is done on design of charging system but for prevention of charging point from environmental contaminations and to ensure its safety an enclosure should be designed which can protect charging point from environmental contaminations and which can be also provided with lock and unlock system so that while one person using it other person can't open it which prevents safety of charging point from other person and ensures smooth charging of EV. So main purpose of the work in this paper is to design an enclosure for charging point for electric vehicle for preventing it from environmental contaminations as well as for ensuring safety of it. Thus, in this paper design and simulation of enclosure carried out by using CATIA design software is described.

2. Literature Survey

It is observed that different researches have worked on smart and efficient charging system for EV and design of charger based on various electric parameters.

Akmalat el. ^[4] designed a solar power charger for electric vehicle. The charger used the green energy that is solar energy for charging of EV. The main objective behind the research was to install solar powered charging station in environment and shifting towards green energy use and to reduce pollution. Monteiroat el. ^[5] presented an innovative off-board EV charging station operated as smart home enabler. The main motivation and advantages of offboard EV-HCS was (a) It was faster than classical on-board charger (b) Flexible operating power value aiming an optimized power management in home. (c) Bidirectional operation with an EV. The method used to describe these advantages is validated using computer simulation. Ferreiraat el. ^[6] designed a system for handling and managing EV charging process. The interaction of mobile applications would facilitate the connectivity user's interaction. It used vehicle to grid technology for connection of EV. Kanstadatel. ^[7] used the concept of fractional power conversion for on-board charger of EV. After comparing efficiency analysis of various power devices including Si, GAN, sic it is concluded that the Sic device was more suitable for highly efficient charger. A prototype was tested on a 300 V EV battery, which achieved converter efficiency of 97.6%.

Zhang atel. ^[8] worked on contactless charging system for roadway powered electric vehicles. In this paper, the simulated and experimented results are both provided to illustrate the effectiveness of the proposed the encrypted contactless charging point for multiple roadway powered EV. Dwarakanathat el. ^[9] worked on solar powered electric vehicle charging station. The main aim behind research paper was to reduce CO₂ emission and protect the environment from pollution and to save the overall energy cost of charging. Kubendranat el. ^[10] discussed about charging station of electric vehicle including PV (photovoltaic panel / solar panel) and wireless

battery charger. It has used QDQ (quad d quadrature)-QDQ coil design which increases the efficiency of power transfer at reasonable misalignment.

It is observed that many researchers have worked on smart efficient green energy charging system and design of charger based on electric parameters. It is observed that no researcher has worked on design of enclosure for a charging point considering mechanical aspects and safety of charging point. The present study is focused on design of enclosure for charging point for electric vehicle which can be used to prevent charging point of EV from environmental contaminations and which is also provided with locking and unlocking system which prevents safety of charging point from other person and ensures safe charging of EV.

3. Enclosure Design

The main aim of this research work is to design an enclosure for charging point for electric vehicle for preventing it from environmental contaminations as well as for ensuring safety of it. The design of this enclosure carried out in CATIA software.

Fig.1 shows the proposed theoretical design of enclosure. In theoretical design of enclosure, dimensions and cross section of enclosure are shown. The dimensions of enclosure are provided in such a way that it makes the enclosure compact in size. LED indicators are provided on enclosure to show that whether the charger is connected properly or not. This system helps the user to understand the charging status.

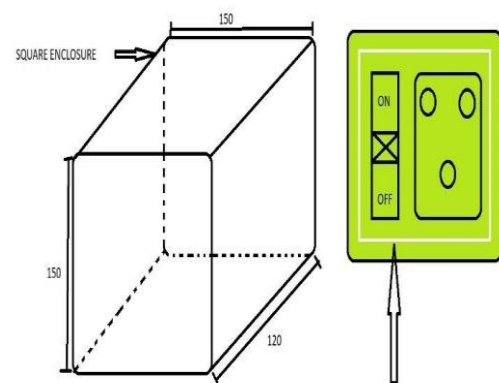


Fig.1 Proposed design of enclosure.

Fig.2. Shows the design of various parts of enclosure. The main parts of enclosure are Main box frame, Middle plate with gasket and Cover plate. Fig. 2(a) shows the design of main box frame of enclosure. The function of this frame is to provide support to other parts of enclosure and to provide base for charging port. Fig. 2(b) shows the design of middle plate with gasket. The middle plate is mounted between main box frame and cover plate and it is provided with gasket. The main function of gasket is to prevent dust, dirt and water particles from entering into the enclosure. The middle plate and cover plate are provided with slots for mounting joint pin. Fig. 2(c) shows the design of cover plate. The main purpose of cover plate is to protect the enclosure from environmental contaminations. Cover plate is connected with middle plate using joint pin which acts as hinged joint which can be used for opening and closing of cover plate of enclosure. Air ventilation grid is provided in the enclosure for maintaining proper ventilation of air in the enclosure to avoid overheating of charging system.

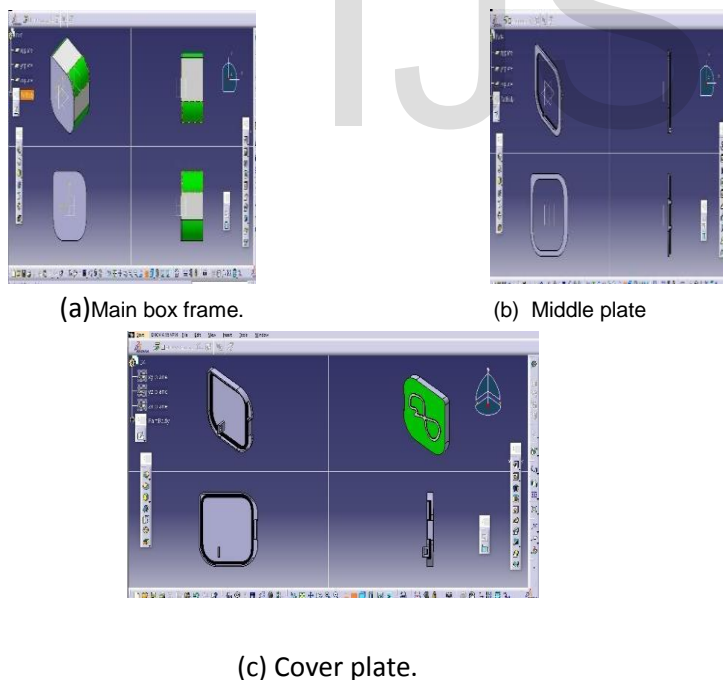


Fig.2 Design of various parts of enclosure.

Fig.3 Shows the three-dimensional exploded view of enclosure parts and drafting of it with bill of material. Fig.3 (a) Shows the three-dimensional

exploded view of enclosure parts and fig.3(b) shows the drafting of enclosure parts with bill of materials.

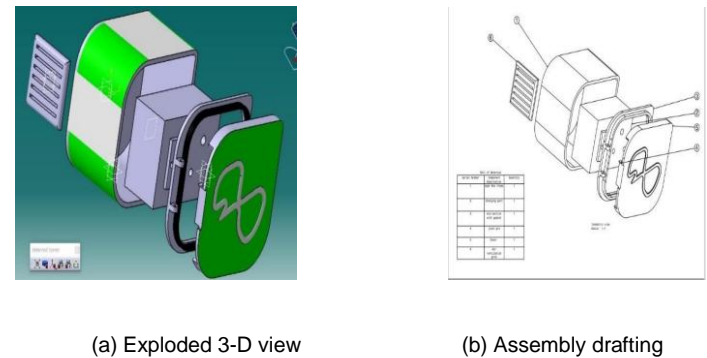


Fig. 3 Exploded view and drafting of enclosure parts with bill of materials.

The material that can be used for main box frame, middle plate and cover plate is 'Galvanized steel' because it is highly corrosion and abrasion resistant. It has higher quality surface finish. It can be easily converted into any shape and also it is less costly as compared to stainless steel. The material that can be used for gasket is 'Asbestos' because of their resistance to heat, strength and flexibility of their fibres. It is incombustible and is a poor conductor of heat. It is unaffected by temperatures up to approximately 450-degree Celsius. Also, it provides good protection against dust and moisture.

The proposed locking and unlocking system for enclosure are,

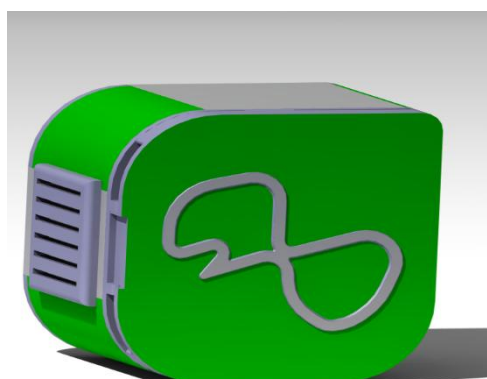
- i Solenoid valve operated security system.
- ii Magnetic type locking and unlocking system.
- iii Mechanical type locking and unlocking system.

According to need and availability of space any one of the above-mentioned systems can be used for locking and unlocking of enclosure.

4. Results and discussion

Fig.4 shows assembly of enclosure and its view with charging point when it is opened. Fig.4 (a) shows the assembly of enclosure when all the parts of enclosure are assembled and Fig.4(b) shows the view of

enclosure with charging point when enclosure is opened. It is observed that after assembly of enclosure, its size becomes compact. So that it requires less space for installation. The symbol on cover plate can be provided with LED system to ensure that the charger is properly connected or not and which also makes shape of enclosure more attractive.



(a) Assembly of enclosure



(b) Open view of enclosure

Fig. 4 Assembly of enclosure and its view with charging point.

5. Conclusion

In recent years, market need of electric vehicles is increased due to increasing pollution levels. With increase in use of electric vehicles, the requirement of charging points is also increased and safety of charging point becomes very important issue. Therefore, design of enclosure for providing safety of charging point is required. In this paper design of enclosure for charging point is required. In this paper design of enclosure for charging point for electric vehicle using CATIA software is presented. The

conclusions drawn from this research work are given below:) The enclosure is designed in such a way that it provides safe operation of charging point and prevents it from theft with the help of locking and unlocking system.

i.) The dimensions of enclosure are provided in such a way that it makes the design of enclosure compact in size. So that it requires less space for installation.

ii.) The enclosure is designed in such a way that it prevents charging point for electric vehicle from environmental contaminations such as dust, dirt and moisture.

6. References

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