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Design and Analysis of External Cooling Mechanism for Controller in E-Vehicle

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ABSTRACT

Hybrid electric vehicles have lower emissions and a wider range thanLand engines, both conventional and hybrid. Due to operating cycles and atmospheric conditions, effective cooling of electric circuits remains a problem regardless of propulsion strategy.Since the controller is an extremely sensitive component with a lot of semiconductors, we cannot use external air pressure or oil to cool it., allowing the circuits and other vehicle components to work within the temperature ranges specified an integrated thermal device is designed to efficiently transfer heat from the circuit housing to the base frame for transport to an external heat exchanger.A radial pair of fins, depending on the design, can serve as an effective thermal link between the circuit and the heat connector or thermal bus.A variety of driving cycles have been used to test cooling efficiency.

KEYWORDS

Hybrid Electric Vehicle,Heat Exchanger.

Introduction

The market for noble energy vehicles is the, such as diesel and hybrid electric cars, has exploded in recent years. Researchers and engineers have focused their attention on power batteries, which are one of the most critical components in electric vehicles (EVs) and hybrid electric vehicles (HEVs). A vehicle's entire battery pack typically consists of several single cells linked serially or in parallel. During the charge and discharge process, a large number of battery cells can produce a lot of heat and cause temperatures to rise.The operating temperature has a significant impact on the voltage, energy, efficiency, and life cycle of a cell. If the heat cannot be dissipated efficiently, more thermal runaway and safety issues will occur.Furthermore, the temperature difference between each cell will trigger a variable capacity descending rate, reducing the battery pack's life cycle. Heat degrades charging efficiency and battery life the most at temperatures above 50 degrees Celsius. As a result, more attention must be paid to battery thermal management system (BTMS) study, which is critical for battery efficiency, life, and protection. The optimal operating temperatures for Ni-MH and Li-ion batteries, according to Pesaran et al., are 25 to 40 degrees Celsius, with temperature variations between cells inside a battery pack of less than 5 degrees Celsius.

Literature Review

1.Jiling Li Zhen Zhu

Battery Thermal Management Systems of Electric VehicleComparedwith internalcombustion engine automobile, the battery capacityand motor conversion efficiency for electric vehicles (EV) are limited, which means itrequireslowerenergyconsumption.Tothisaim,EVneedsmorecomplexthermalmanagement system and higher thermal management requirements. This paper proposesan active and passive liquid cooling-based system cooling scheme. Coolant circulation'scomponentsmodelandrefrigerantcirculation'scomponentsmodelarebuilt.Theperformance parameters forthecomponentsare obtained by fittingtheexperimentaldata. To demonstrate the performance of the proposed method, simulation experimentsare conducted. The results show that it is feasible and robust to cool and heat the batteryusing passive coolingcircuits in lowandmedium temperature environments. Duringcritical conditions where the ambient temperature changes from 28° C to 32° C, theactive and passiveliquidcooling-basedschemecannotonlyguaranteethebatteryoperatingtemperature, but also save energyComparedwith internal combustion engine automobile, the battery capacityand motor conversion efficiency for electric vehicles (EV) are limited, which means itrequireslowerenergyconsumption.Tothisaim,EVneedsmorecomplexthermalmanagement system and higher thermalmanagement requirements. This paper proposesan active and passive liquid cooling-based system cooling scheme.Coolant circulation'scomponentsmodelandrefrigerantcirculation'scomponentsmodelarebuilt. Theperformance parameters forthecomponentsare obtained by fittingtheexperimentaldata. To demonstrate theperformance of the proposed method, simulation experimentsare conducted. The results show that it is feasible and robust to cool and heat the batteryusing passive coolingcircuits in lowandmedium temperature environments. Duringcritical conditions where the ambient temperature changes from 28° C to 32° C, theactiveandpassiveliquidcooling-basedschemecannotonlyguaranteethebatteryoperating temperature, but also save energy Comparedwith internal combustion engine automobile, the battery capacityand motor conversion efficiency for electric vehicles (EV) are limited, which means itrequireslowerenergyconsumption.Tothisaim,EVneedsmorecomplexthermalmanagement system and higher thermal management requirements. This paper proposesan active and passive liquid cooling-based system cooling scheme. Coolant circulation'scomponentsmodelandrefrigerantcirculation'scomponentsmodelarebuilt.Theperformance parameters forthecomponentsareobtained by fittingtheexperimentaldata. To demonstrate the performance of the proposed method, simulation experimentsare conducted. The results show that it is feasible and robust to cool and heat the batteryusing passive coolingcircuits in lowandmedium temperature environments. Duringcritical conditions where the ambienttemperature changes from 28° C to 32° C, theactiveandpassiveliquidcooling-basedschemecannotonlyguaranteethebatteryoperating temperature, but also save energy.

Electric vehicles (EVs) are rapidly evolving and gaining popularity as a result of their low emissions and high tank-to-wheels performance. However, certain factors, such as battery performance, cost, lifespan, and safety, are limiting the production of electric vehicles. As a result, battery management is required to achieve optimum efficiency while working under a variety of conditions.The battery thermal management system (BTMS) plays an important role. for controlling the thermal behavior of the battery. Air cooling, liquid cooling, direct refrigerant cooling, phase change material (PCM) cooling, and thermo-electric cooling, as well as heating, are among the BTMS technologies. Efficiency, weight, size, expense, reliability, protection, and energy consumption are all factors considered when designing these systems. Two primary battery thermal management systems are recommended by the analysis: a combined liquid system (CLS) and a variant system with PCM. The CLS and PCM device models were created and simulated using the MATLAB/Simulink programme. The simulation results estimate the battery temperature variance as well as the BTMS energy consumption. The effect of PCM on battery temperature variation was investigated using the PCM device model, and the correct PCM mass was calculated. According to the simulation results, BTMS is critical for controlling battery thermal activity. Combining the simulation process of battery thermal electric and CFD models may make future research more detailed and reliable.

2. Sourav Singh Katoch and M Eswaramoorthy: A Comprehensive Analysis of the Electric Vehicle Battery Thermal Management System

BTMS is crucial for monitoring battery thermal operation, according to the simulation results. Future research could be more comprehensive and accurate if the simulation model is combined with battery thermal electric and CFD models. EVs use lithium-ion batteries for energy storage, which have a number of drawbacks, including low efficiency at low and high temperatures, electrode life degradation at high temperatures, and safety issues related to thermal runaway in lithium-ion batteries, all of which have a direct effect on the vehicle's performance, durability, cost, and safety. Overheating caused by electron movements during chemical reactions during the charging and discharging phase in high temperatures will result in the batteries being fatally destroyed. As a result, an effective battery thermal management system (BTMS) is one of the most important technologies for the long-term success of electric vehicles.As a result, the different forms of battery thermal management systems, as well as advancement opportunities, are discussed in this review article.The conclusion is that there is a lot of need for further research in the BTMS for electric vehicles in the future.

3.Aihua Chu, Yinnan Yuan, JianxinZhu Xiao Lu and Chenquan Zhou:The Design and Investigation of a Cooling System for a High Power Ni-MH Battery Pack in Hybrid Electric Vehicles

The high discharge rate and large equal internal resistance, high-power cylindrical Ni-MH battery cells produce a lot of heat. This high heat load, combined with an imbalanced flow in parallel liquid cooling systems, can cause temperature variations in individual cells in the battery pack, reducing the battery pack's life cycle. A parallel-series combined liquid cooling system for a 288V Ni-MH battery pack was modelled in this paper, and several parameters influencing the system's flow balance through heat transfer and fluid dynamics were determined. The simulation results were then tested by a battery pack temperature experiment on a bench and in a car, which used Star CCM+ software to run a thermal-fluid simulation with various parameters. The findings show that the temperature and temperature variations in the cell can be held within a reasonable range. Under the constraints of battery power and structural constraints, we also discovered that spacing, the total cooling liquid flow rate, the main pipe to branch pipe cross-sectional area ratio, and the number of internal supporting walls in each branch differences pipe must all be high enough to keep the cell's maximum temperature and temperature rise to a minimum.

4.Qian Wang, Bin Jiang, Bo Li, Yuying Yan: A Critical Review of Thermal Management Models and Solutions of Lithium-ion Batteries for the Development of Pure Electric Vehicles

Power train electrification is being marketed as a possible option for reducing transportation's carbon intensity. Lithium-ion batteries have been found to be ideal for both hybrid electric vehicles (HEVs) and pure electric vehicles (EVs), and lithium battery temperature control is critical for long-term efficiency and durability. Unfortunately, due to a lack of understanding of battery thermal behavior, battery thermal management (BTM) has received little attention. Temperature has a drastic effect on cell efficiency, but it improves if a sufficient operating temperature window is maintained. The production of battery thermal models and thermal management techniques are discussed in this paper. Thermal runaway and reaction of lithium-ion batteries in cold temperatures will be investigated, and heat generation methods will be explored with the aim of performing accurate battery thermal analysis Furthermore, emerging BTM methods used by automotive manufacturers will be examined in order to recognize the major obstacles and important differences between study and practice. To reduce battery thermal impacts, current BTMs must be optimized, and new technologies must be explored. BTM should be in order to improve battery pack temperature uniformity, extend battery lifetime, and improve the protection of big packs.

5. Y. LyuShaikh Hasibul Majid A.R.M. Siddique M. Biglarbegian:Electric Vehicle Battery Thermal Management System with Thermoelectric Cooling

An innovative battery thermal management system for new electric vehicles is the subject of an experimental investigation. The created battery thermal operations structure combines thermoelectric, forced air, and liquid cooling technologies. During operation, the liquid coolant comes into indirect contact with the battery and serves as a medium for removing the heat produced by the battery. The thermoelectric liquid casing's condenser side is used to remove heat with the aid of forced air Experiments on a virtual electric vehicle battery system are carried out in detail. The findings of the tests reveal a promising cooling effect with a manageable amount of power dissipation. Furthermore, when 40 V is supplied to the heater and 12 V to the TEC module, the battery surface temperature drops by around 43 ºC (from 55 oºC to 12 ºC) in the experimental test using TEC-based water cooling system for a single cell with copper holder.

Proposed Methodology

The base frame, which houses all of the components needed to create a prototype model of a heat conduction device, is made using square tubes and channels and a metal cutting and joining method known as welding. Inside the metallic box, an electrical circuit is rigidly fixed on the base frame. A prototype model TEG module is used to heat the circuit in order to perform cooling operation. TEG module's hot junction is placed by touching the electronic circuit's surface, and its cold junction is facing the atmosphere. Aluminum fins are fixed to the top of fins, and a cooling fan is mounted on the other side of the electronic control unit for performing cooling operations. The power for the TEG and cooling fan is supplied by a battery that is built into our system. As the TEG receives power from the battery, it appears to emit heat on its hot junction, which heats the surface of the electronic circuit in real-time operation. Because of its high thermal conductive property, the aluminum fin conducts this heat. With the aid of a

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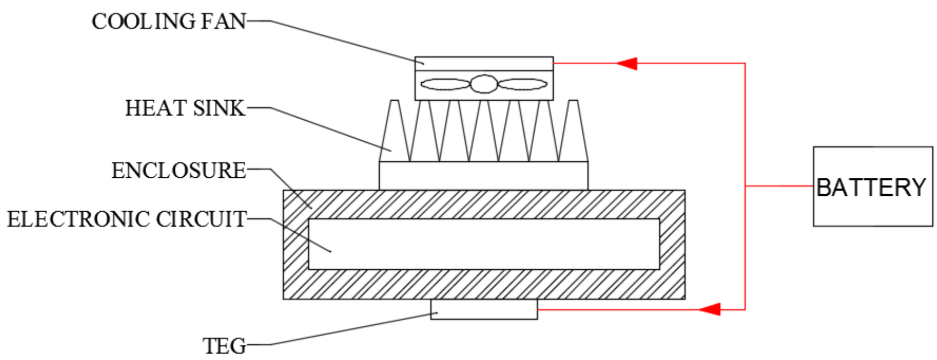
cooling fan powered by battery power, the conducted heat is dissipated to the atmosphere.

Layout



Advantages

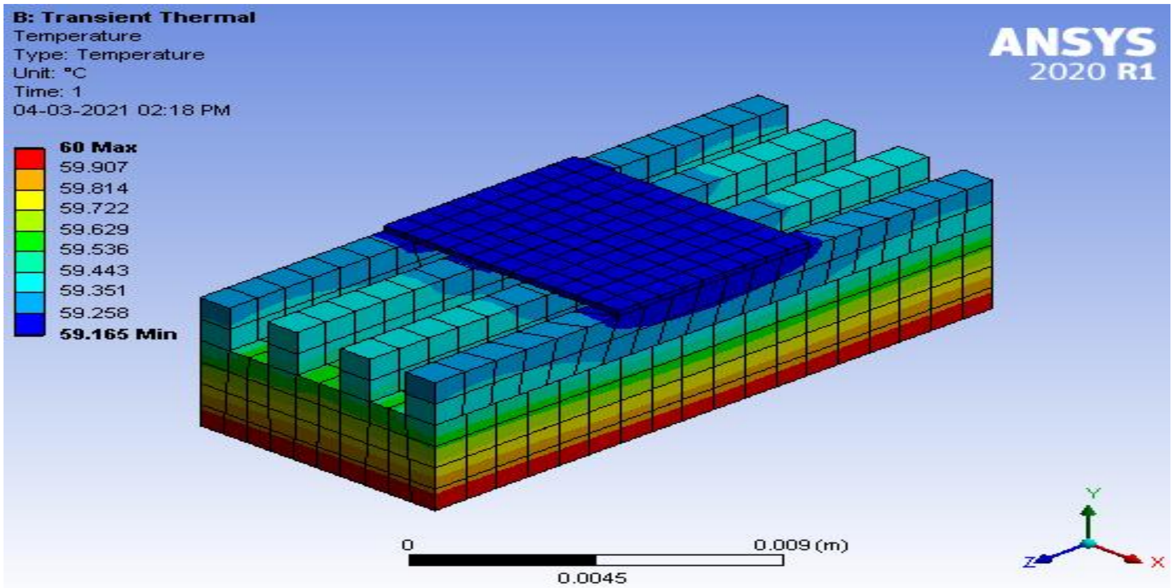
- Construction and installation is simple, components used are easily available in markets.
- Less maintenance is enough for its better performance.
- The life of components get increased.
- The performance of an electronic circuit has also been increased.
- Less costly cooling system when compared with existing systems.

Applications

While our system's primary use is for electric vehicles, it can also be used for other electronic components such as computer processors, industrial machinery, and so on.

Result and Performance Analysis

1. Temperature



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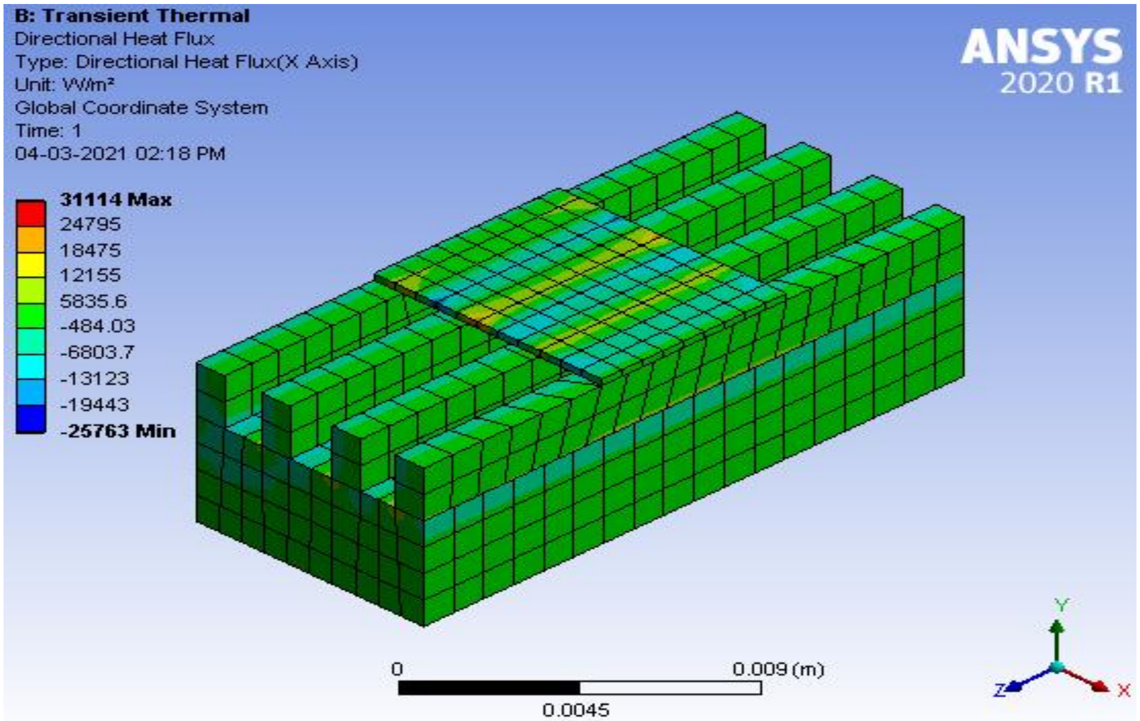
2. Directional Heat Flux



Conclusion

As far as sustainable transportation is concerned, the rapid adoption of electric vehicles would increase in the near future, necessitating the production of more powerful batteries. The thermal losses of batteries are one o
f the most difficult aspects of developing a better BTMS. The electric vehicle's range and work load would expand.

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