УДК 629.3

ESPECIALLY SECURITY SYSTEMS ELECTRIC AND HYBRID CARS

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Annotation. *This article deals with especially security systems of electric cars and hybrid cars. In the design of vehicles with high-traction batteries should provide additional measures of active and passive safety. The ways and means of improving the safety of electric drive.*

Keywords: *electric car, hybrid car, security systems, active safety, passive safety, high voltage batteries.*

ОСОБЛИВОСТІ СИСТЕМ БЕЗПЕКИ ЕЛЕКТРОМОБІЛІВ ТА ГІБРИДНИХ АВТОМОБІЛІВ

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Анотація. *Розглянуто особливості систем безпеки електромобілів та гібридних автомобілів. При проектуванні автомобілів з високовольтними тяговими акумуляторними батареями треба передбачити додаткові заходи активної та пасивної безпеки. Визначено напрями та засоби підвищення рівня безпеки автомобілів з електроприводом.*

Ключові слова: *електромобіль, гібридний автомобіль, системи безпеки, активна безпека, пасивна безпека, високовольтні акумуляторні батареї.*

ОСОБЕННОСТИ СИСТЕМ БЕЗОПАСНОСТИ ЭЛЕКТРОМОБИЛЕЙ И ГИБРИДНЫХ АВТОМОБИЛЕЙ

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Аннотация. *Рассмотрены особенности систем безопасности электромобилей и гибридных автомобилей. При проектировании автомобилей с высоковольтными тяговыми аккумуляторными батареями следует предусмотреть дополнительные меры активной и пассивной безопасности. Определены направления и средства повышения уровня безопасности автомобилей с электроприводом.*

Ключевые слова: *электромобиль, гибридный автомобиль, системы безопасности, активная безопасность, пассивная безопасность, высоковольтные аккумуляторные батареи.*

Entry

The basic requirement facing designers of modem vehicles, is a high level of security. The process of improving the efficiency of active and passive safety of electric and hybrid cars is different. These features are associated with the use of high-voltage batteries, which used to power the electric traction drive.

Analysis of research and publications

At present, the world fleet includes more 600 million units of cars. In modern terms motorization is developing rapidly, changing the principle of cars building. Environmentally friendly cars, electric cars and hybrid cars with new qualities are developed and require additional conditions of safe movement they. Improving the efficiency of active and passive safety is electric

and hybrid vehicles is an important issue of road transport [1-3].

The problem of road transport security includes four main aspects - road safety, safety of the vehicle (active and passive), participants and cargo transportation. [4] The fact that the leading automobile companies have developed electric cars (electric and hybrid cars), requires special treatment for active and passive safety systems of environmentally friendly vehicles.

Purpose and problem statement

The aim - to improve the efficiency of active and passive safety of electric and hybrid vehicles, the preservation of life and health of the occupants of the vehicle and other road users.

The object of study - the process of safety of electric cars and hybrid cars due to the development of additional measures concerning the implementation of active and passive safety.

The primary goal of the research is to analyze and study the characteristics of active and passive safety of electric and hybrid vehicles for its implementation in developed hybrid car ZAZ Lanos Hybrid.

Key aspects of the safety of vehicles with electric drive

Vehicles developers pay much attention to active and passive safety systems. But the security of vehicles with electric security system is different from conventional cars with internal combustion engine (ICE). This is due to the fact that electric cars and hybrid cars incorporate a high-voltage battery pack that can be an additional source of danger to the occupants. Therefore, to improve the electrical safety and fire at the vehicle additional measures should be provided. Such events are caused, for example, that if at the time of the accident did not disable high-range electric vehicle or hybrid vehicle, the high voltage can lock the metal body of the car and hit the current occupants that there are. High voltage can also be dangerous for people who are trying to help

For example, the power circuitry of the electric hybrid car Lexus GS450h has a high- voltage battery with the voltage of 288 V, voltage converter that inverts the DC to particularly dangerous variables to 650 V (Fig.1.).

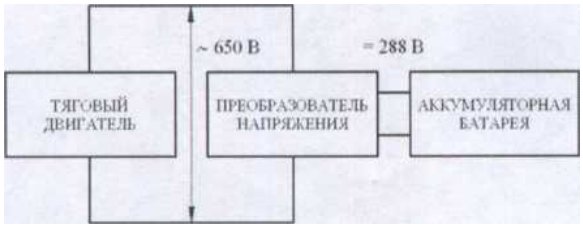

Fig. 1. The electric power car Lexus GS450h scheme

In today's electric cars and hybrid cars are used traction batteries are usually lithium, which have increased fire hazard and explosiveness in the event of depressurization. This is the type of batteries are also used in mobile phones, which at high currents can overheat and power in some cases explode. If you violate sealing the case of high lithium storage battery hybrid vehicle or electric vehicle, it can also catch fire and explode. Thus, for electric and hybrid vehicles should provide additional measures of active and passive safety.

Security of electric and hybrid vehicles are complicated:
- The use of high-voltage batteries that can short circuit in the event of an accident or hit the driver or passengers or cause a fire, requiring additional security measures for the timely disconnect all high voltage circuits. This is due to the fact that the high voltage from batteries or from a voltage converter may harm the life and health of people and become a source of arson car;
- As a high-voltage batteries use Lithium batteries are generally type, with damage and disruption have increased sealing fire hazard and explosiveness. Therefore, to prevent damage to the batteries should provide security measures for their integrity at the time of the accident;
- During the passage through the high-volt rechargeable battery of high current charge or discharge the battery temperature rises. Therefore, it is necessary to provide for measures to maintain the temperature of the battery within acceptable limits;
- The batteries of electric cars and hybrid cars have a large mass, so it is necessary to provide additional active safety measures, for example, you need to implement an improved system of exchange rate stability. This aspect can be improved through the use of you-wheel motor management system that can speed up and slow down each wheel separately.

The development of security systems for hybrid ZAZ Lanos Hybrid

The department of automotive electronics at HNADU developed an experimental vehicle with a hybrid series-parallel type on the basis of serial car ZAZ Lanos Pick-up (model TF55YO-02), which is provided by PJSC "ZAZ" for scientific research and further implementing hybrid power installation in production.

As a power source for electric traction motor 20 lithium-iron-phosphate batteries (type Thunder Sky LFP 90 Ah),is used. They are specifically designed for use in hybrid cars, electric cars, electric buses and other vehicles to power the electric motors traction. Total operating voltage of the batteries does not exceed 85 V, therefore it requires no additional protection conditions.

To increase operational safety of storage elements Thunder Sky LFP 90 Ah, they are collected in metal durable bags: two blocks of 8 elements in each and 1 block of 4 elements (a total of 20 batteries). This is due to the fact that lithium-iron-phosphate batteries Thunder Sky LFP 90 Ah are crimped tightly, since the flowing of high currents during charging/discharging is heated, so that can change its volume. During the preparation for the collection of batteries in the battery it is advisable to the battery to prevent accidental short circuit elements. Power Traction batteries based on elements Thunder Sky LFP 90 Ah and the electronic balancing system is placed in the car seat for driver and passenger.

Each element of Thunder Sky LFP 90 Ah is completed by management system BMS (Battery Management System), which supports the permissible level of charging/discharging. BMS control system is an electronic device that measures:
- Voltage of the element;
- Temperature, average temperature, coolant temperature at the inlet and outlet, temperature element;
- The current state of charging (SOC) or the discharge depth (DOD), to indicate the actual level of the battery at this time;
- The number of charging /discharging cycles;
- The general condition (SOH), which characterizes the degree of degradation of the element and is measured in% (during the production of SOH battery it is 100% and will decrease during the time and under the conditions of usage);
- Assessment of the failure probability of the battery.

Tab. Key performance characteristics of the battery Thunder Sky LFP 90 Ah

Type	Lithium-iron-phosphate
Capacity C, Ah 90	90
The current charge, A	0,5-C
Max. discharge current, A	3C
Operating Voltage, V	2,5...4,25
The number of charge-discharge cycles	3000...5000
Operating temperature range, °C	-45...+ 85
Weight, kg	3,2

BMS battery management system computes the following values:
- The maximum charge current (CCL);
- The maximum discharge current (DCL);
- Energy supplied to the load from the last charge;
- The total energy that comes from the first use;
- The total time from the first use.

The main objective of the control system BMS is:
- The acceptable control level of charging / discharging;
- The voltage control on batteries and currents shunting at reaching limits;
- Element Temperature control.

BMS control system in the developed hybrid vehicle ZAZ Lanos Hybrid is integrated into other control systems, the batteries charge system, a control system of hybrid power plant and etc.

Findings

It was determined that in order to improve the safety of electric cars it is necessary to introduce additional measures and systems for the safe use of high-traction batteries, high voltage circuits etc.

To power the electric drive, working as a part of a hybrid power plant ZAZ Lanos Hybrid 20 lithium-iron-phosphate batteries at Thunder Sky LFP 90 Ah type are applied. For their safe usage implemented the following measures and security systems, cordless items collected in strong metal crates, each item comes with a control

system BMS, which supports the permissible level of charging / discharging, etc.

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Article received on November 6, 2014