EMERGENCY METAL-HYDRIDE ELECTRIC POWER SOURCE

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Introduction

Until the present time no alternatives have been to the acid storage batteries and Diesel-generators as devices ensuring supply of electricity in the case of network failure or turn-down. The technology of fuel cells penetrates this energy segment.

The present report describes the design of an emergency hydrogen power source that allows the continuous use of a lamp 20 W in power for 50 h. This source represents the class of devices that combines both a container for hydrogen storage and its consumer (Fig.1).

Fig.1. External view of the device.

Results and discussion

The use of a metal-hydride accumulator built into the device allows the generation of electrical energy at its output. Hydrogen is converted into this energy though a fuel cell. This cell is a basis of the proposed device.

Contrary to the diesel generators, batteries of fuel cells have no movable parts. Consequently, they operate noiselessly, without vibrations and are characterized by a long term of exploitation. However not every design from the six known ones is suitable for these purposes. For example, the starting-up of high-temperature cell requires several hours and an additional power source. Other designs have their own disadvantages.

In the range of emergency power sources with the lowest power up to 3 kW, the cells with a polymer-electrolytic membrane (PEM) are the most suitable. PEM electrolyte consists of the thinnest polymeric film. In the cell of this type the reaction proceeds at ~ 80^{o}C. Positive properties of PEM are low thermal requirements for the material, high power density and ability to the fast and cold start-up. The cells are capable of supporting a full load already in 10…20 s.

PEM drawbacks are that high requirements are necessary for the fuel gas quality and preparation. In addition, high power density of PEM fuel cells defines the fuel gas feed under high pressure.

In the proposed emergency power source (Fig.2), compounds of the AB_5 type based on a lanthanide alloy were chosen as a hydrogen-sorption material for the metal-hydride accumulator. These compounds exhibit sufficiently high hydrogen capacity, low sensitivity to impurities of poisonous gases and moisture, provide a possibility to control the required equilibrium pressure at room temperature.

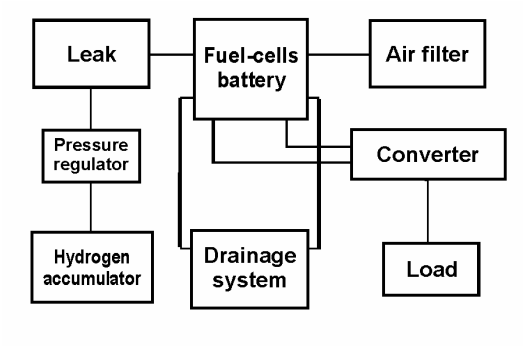

Fig. 2. Block-diagram of the emergency hydrogen electric power source.

Technical hydrogen supplied in standard cylinders, to which no special safety requirements are needed, can be used to fill a metal-hydride accumulator. Hydrogen is purified by hydrogenation to high purity in filling an accumulator. Oxygen is supplied from ambient air.

The required hydrogen pressure is provided by a low-pressure reducer, and the required outlay – by a needle leak.

A battery of fuel cells is connected up to the built-in converter that stabilizes the output voltage depending on the load.

Such electric power source equipped with a metal-hydride accumulator of hydrogen and a battery of fuel cells with a polymer-electrolytic membrane does not practically require any service. In its exploitation, a filter for air cleaning needs to be changed only once a year. Any user can do this operation.

Until now electric power sources with metal-hydride accumulators on fuel cells have been used in cosmonautics, defense industry to supply the remote independent units with little amounts of energy, and in the field of information technologies. However nothing can hinder their applications in other fields of industry and in private life in spite of their relative expensiveness.

The main technical characteristics of the device proposed can be considered the following:

-voltage – 12 V;
-power – 20 W;
-capacity of hydrogen accumulator – 800 l;
-period of continuous operation – 50 h.

Conclusions

The proposed emergency hydrogen electric power source can be used in different fields of human's activities. It can be used in the regions remote from the centralized power supply, deeply underground and underwater.

Acknowledgment

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