Liquid-cooled High-power Brake Resistors for Fuel Cell and Hybrid Automotive 5 kW to 150 kW

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Abstract

Liquid Cooled High Power Braking Resistors - LCHP Series, 5 kW to 150 kW. This range of resistors has been aimed for as break resistors for fuel cell and hybrid vehicles but has the capability to be used in various industrial high-power applications whereever liquid cooling is available. The resistor and termination enclosure is made of in thermal plastic and is protected according to IP65 allowing the resistor to be mounted externally as well as internally. The LCHP series offers a very compact (sandwich) design and weight much less as conventional metal constructions. The enclosure is inherently an electrical insulator providing increased safety. The construction will also overcome the problem of capacitance, which is a problem in metal assemblies. Power handling capability is related to the coolant medium and the temperature as well as to the flow rate provided.

Keywords

liquid-cooled, high power braking resistor, fuel cell, hybrid automotive

1. NEW RESISTOR TECHNOLOGY

With the series LCHP Hipas GmbH, Germany, has developed a new technology of liquid cooled high-power resistor. This range of braking resistors has been designed for the Fuel Cell and Hybrid automotive vehicles where both, size and weight, is a major consideration. Due to the advanced construction and the use of new materials it has been possible to reduce the size dramatically and therefore the ability of mounting the resistor within the motor compartment. The weight reduction in comparison to the conventional metal construction can be up to 50% and in some cases even more. The LCHP range of resistors will, subject to the design of the controlling electronic and software, have the ability of provide a number of functions in the operation of the vehicle. The simplest function is to operate as the braking of the vehicle, by the electronic controller connecting the LCHP across the drive motor when it is in the generating mode for the purpose of slowing down the vehicle.

Adding to the electronic control software, the facility of controlling the braking of the vehicle in such a way, that when the vehicle is travelling down hill, a pre-set speed will be held by the LCHP braking resistor, by being interjected across the drive motor which by now is a generator, thereby holding the vehicle to the selected speed. The LCHP braking resistor, when power is directed to it by the electronic control unit, will convert the power into heat which is transferred to the liquid coolant. This raises the question, where this heat could be effectively used instead of just wasting it. In the simplest mode the generated heat, when required for the heating of the passenger compartment, will be directed to the heater, alternatively to the vehicle radiator. A more appropriate use of the LCHP braking function is, to use the coolant

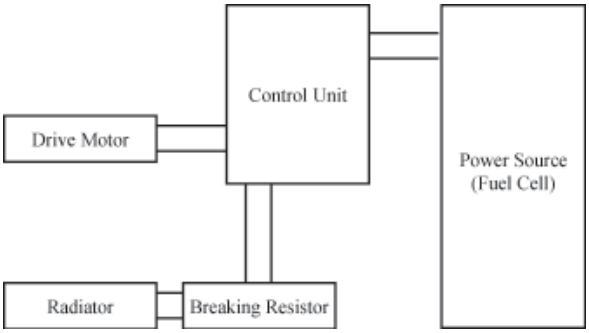

Fig. 1 Basic function diagram

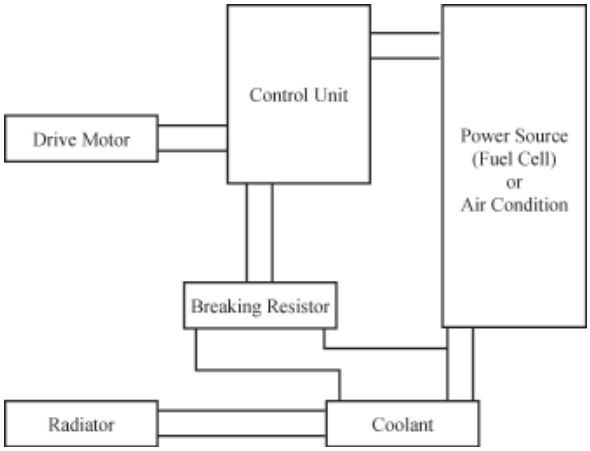

Fig. 2 Example with heat feed-back to FC stack or air-condition

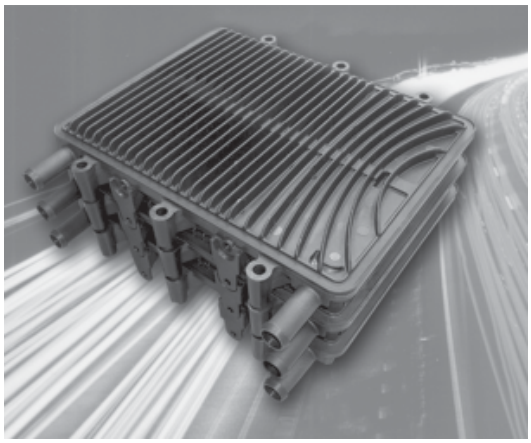

Fig. 3 Picture LCHP (treble unit)

and the generated heat for the purpose of retaining the Fuel Cell at the optimum temperature, so the temperature within the Fuel Cell is no longer sustained by the generating of electrical power.
Additionally the LCHP resistor can be used at the start-up, to assist the Fuel Cell obtaining the operating temperature by initially passing some or all of the generated power through the LCHP resistor and then using the coolant heat to rapidly increase the thermal status of the Fuel Cell. In Countries where the winter ambient temperature can be extremely low the LCHP resistor could be, through the electronic control unit, connected to the local power mains for the purpose of generating the minimum heating for the vehicle and the Fuel Cell to be kept at an appropriate temperature both for the vehicle occupants and the Fuel Cell.
The LCHP-series is initially available in 4 versions, with rated power of 35 kW, 75 kW, 100 kW and 150 kW. The enclosure, designed in thermal plastic, is protected to IP65 and the weight is only 6,0 kg - 13,5 kg. These constructions will overcome the problem of capacitance, which is a matter in metal assemblies.
The voltage range is up to 1200 V (Inverter / Chopper) and the test voltage > 2,5 kV, resistance > 5 MΩ. LCHP resistors can be used in an ambient temperature range from -40 ºC bis + 60 ºC. The maximum temperature of the cooling liquid is + 85 ºC and the pressure < 1,5 bar.

(Received April 9, 2008; accepted May 16, 2008)