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PULSATING AIR TO AIR HEAT EXCHANGER FOR ENCLOSURE COOLING

Mathieu Habert, Bruno Agostini
ABB Ltd. Switzerland,
Corporate Research,
Segelhofstrasse 1K, 5405 Daettwil, Switzerland
Phone: +41 (0)58 586 80 57
Telefax: +41 (0)58 586 40 06
mathieu.habert@ch.abb.com

Abstract

Outdoor cabinets containing power electronics components need to be cooled effectively and at the same time protected from outside air, which may contain moisture and various dirt that would reduce the reliability of the electronics. High power electronic devices need active cooling to transfer heat from the enclosure to the ambient. Sealing the cabinet from harsh industrial or outdoor environments helps to increase the lifetime and reliability of the components, but then thermal management solution needs to maintain high ingress protection of the enclosure by using an air to air heat exchanger to remove heat from inside the electronics cabinet. Air to air heat exchangers are widely used in the industry as they are cost-competitive, easy to install and maintain. On the other hand, they are inefficient and bulky. ABB has developed a cost-effective modular compact air to air heat exchanger for power electronics cabinets. These technologies uses numerous multiport extruded tubes with capillary sized channels disposed in parallel to achieve the desired compactness. A new concept, working as a pulsating heat pipe is investigated in the present study. The cooling unit is made of a stack of pulsating heat pipe heat exchangers to cope with the required heat loads. This new technology combines the respective advantages of compactness, design simplicity, modularity and freedom of the orientation. The performances of a single unit and stack of these pulsating air to air heat pipes using R134a were measured in a dedicated double loop air tunnel with controlled air flow conditions. Parameters like the fluid filling, orientation, temperature difference between hot and cold streams and number of pulsating heat pipes in the stack were varied. This novel technology was found to be 75% more compact than the standard air to air heat exchangers for the same performance and pressure drop and work in horizontal position with the same performances as vertically, at the optimal fluid filling.