

Technology Offer

Efficient cooling of commercially available electrical wiring by the use of metals with low melting temperatures

Ref.-No.: 1801-4852-WT

Resistance induced heating of electrical wiring during operation is one of the limiting factors to design high-power electromagnetic coils. The commonly used approach to eliminate the heating of electrical wires is to introduce a hollow conductive copper wire into electrical wiring and to cool this wire with water. Unfortunately, this approach is not applicable for high power density electromagnetic coil as well as for coils with small dimensions. Another approach to enhance the cooling properties is the fabrication of electromagnetic coils with flattened geometries, but this design is not feasible for many applications. Therefore, the efficient cooling technology for electrical wires and cables is highly demanded.

Technology

We offer a new approach to produce electrical wiring for electromagnetic coils that can be efficiently cooled.

We use commercial available insulated wires and embed these wires into conductive low melt temperature metals (LMTM) such as tin containing alloys. We use vacuum casting technique for the wire embedding to achieve full thermal contact between the cooling channel and the wires. Due to excellent heat conduction properties of the LMTM, the operation induced heat is immediately transferred to the cooling channel although it is spatially separated from the wire. Electrical wiring produced according to our technology can be used for the fabrication of high power electromagnetic coils with different dimensions and designs. The location of the cooling channel can be spatially adjusted. Even more, multiple cooling channels can be implemented into the wiring to achieve higher cooling rates. The sketch and the photograph of the electromagnetic coil prepared as described above are shown in the Fig. 1.

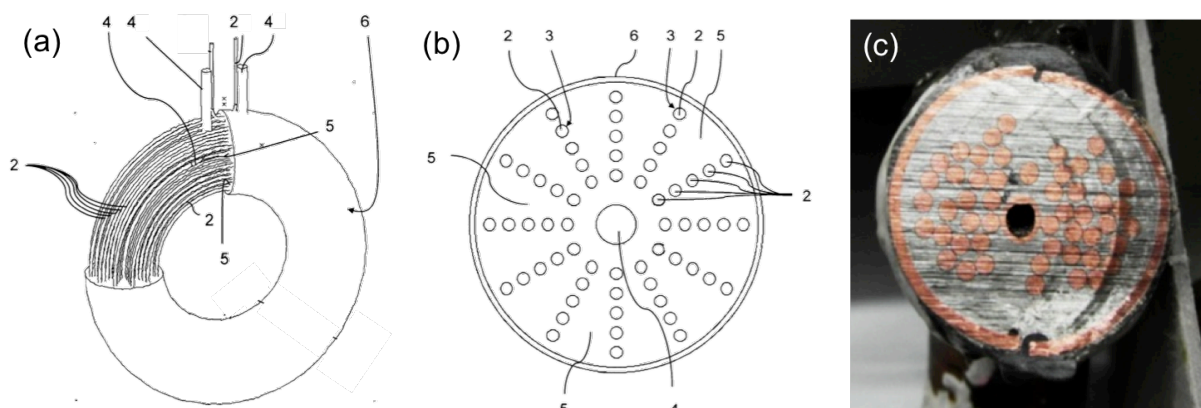


Fig. 1: Sketch (a) side view and (b) cross section of the electromagnetic coil prepared as described above. Single electrical wires 2, insulating layer 3, cooling channel 4, LMTM matrix 5 and external coil enclosures 6 are displayed. Photograph of the cross section (c).



Our results show that the original wire insulation made of polyimide or polyester is sufficient to avoid short-circuit and the electromagnetic coils fabricated according to this method can be used in high power electromagnetic coils.

Advantages

- Fast and low-cost manufacturing by means of vacuum casting
- Usage of commercial available polyimide or polyester insulated wires/cables
- Fully cooled high electrical power density electrical wires
- Adjustable cooling power and design
- Applicability in coils with high magnetic field as well as with pulsed operation

Patent Information

DE patent application (DE102014017857B3) granted in February 2016.
PCT patent application filed in November 2015.

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