



(11) **EP 2 363 866 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.09.2011 Bulletin 2011/36

(51) Int Cl.:
H01F 27/02 ^(2006.01) **H01F 27/10** ^(2006.01)
H01F 27/26 ^(2006.01)

(21) Application number: **10155025.9**

(22) Date of filing: **01.03.2010**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL
PT RO SE SI SK SM TR**
Designated Extension States:
AL BA ME RS

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(54) **Coil arrangement**

(57) The invention relates to a coil arrangement for an electronic device, comprising a core, a coil (7) arranged around said core, and a cooling element (1) comprising an inlet (2) for receiving a cooling fluid and an outlet (3) for forwarding the cooling fluid from said cooling element (1). In order to obtain an efficient coil arrangement with an adequate cooling said core comprises at least two core elements (6) arranged at a distance from each other. The cooling element (1) is arranged between said at least two core elements (6).

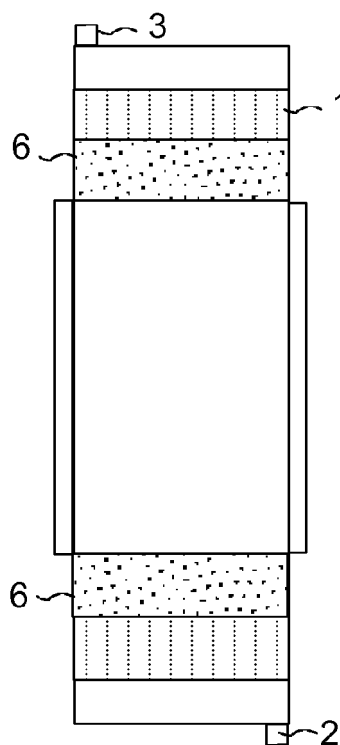


FIG. 4

Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to a coil arrangement of an electronic device and in particular to a solution for cooling such a coil arrangement.

DESCRIPTION OF PRIOR ART

[0002] A heat load generated in a coil of an electric device can be significant. In order to avoid that the temperature of the coil rises too high there are prior art solutions where a cooling element is arranged in connection with the coil. This cooling element comprises an inlet for receiving a cooling fluid and an outlet for forwarding the cooling fluid from said cooling element. Heat generated by the coil is therefore passed to the cooling fluid.

[0003] The above described prior art solutions are, however, complicated and in addition they fail to provide a sufficient cooling for all implementations.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is to provide a novel and efficient coil arrangement with an adequate cooling. This object is achieved with the coil arrangement of independent claim 1.

[0005] To utilize a cooling element between two core elements makes it possible to obtain a simple and efficient solution for cooling the core of a coil arrangement. In this way, the temperature of the coil arrangement can be controlled efficiently.

BRIEF DESCRIPTION OF DRAWINGS

[0006] In the following, the present invention will be described in closer detail by way of example and with reference to the attached drawings, in which

[0007] Figures 1 to 3 illustrate a cooling element for an embodiment of a coil arrangement,

[0008] Figures 4 to 5 illustrate a first embodiment of a coil arrangement, and

[0009] Figures 6 and 7 illustrate a second embodiment of a coil arrangement.

DESCRIPTION OF AT LEAST ONE EMBODIMENT

[0010] Figures 1 to 3 illustrate a cooling element 1 for an embodiment of a coil arrangement. Figures 1 and 2 illustrate a front and side view of the cooling element 1, and Figure 3 is a cross section of the cooling element along line III - III in Figure 1.

[0011] In the illustrated embodiments, the cooling element 1 comprises an inlet 2, an outlet 3 and a plurality of conduits 4 providing parallel fluid paths for passing

fluid from said inlet 2 to said outlet 3. The term "parallel fluid paths" does not require that all conduits are exactly parallel with each other, though this is probably the case in many implementations, but instead it is sufficient that the conduits 4 provide alternative fluid paths for passing fluid from the inlet to the outlet. However, it should be observed that it is not necessary in all implementations to utilize a cooling element with parallel fluid paths. Instead in some implementations, it may be advantageous to utilize a cooling element with only one single fluid path between the inlet and the outlet.

[0012] In the illustrated embodiment, the conduits 4 are connected to each other with pipe sections 5 at the opposite ends of the cooling element 1 for providing a fluid path between the conduits 4 to the inlet 2 and outlet 3, respectively. The cooling element 1 may be manufactured from aluminum, for instance, and it can be relatively thin, which has the advantage that the width of the coil arrangement can be kept small.

[0013] Figures 4 to 5 illustrate a first embodiment of a coil arrangement. In Figures 4 and 5 it is assumed, by way of example, that the cooling element of Figures 1 to 3 is utilized. The illustrated coil arrangement may be a choke for an electronic apparatus, such as a frequency converter, for instance.

[0014] In Figures 4 and 5 two core elements 6 are arranged on opposite sides of the cooling element 1. The core elements may be of a ferromagnetic or ferrite material, for instance. Each core element may be a single element or consist of a plurality of thinner elements (such as plates) arranged on top of each other.

[0015] Outmost in Figures 4 and 5 there is a coil 7. This coil 7 is arranged to surround the cooling element 1 and the core elements 6. The coil may consist of an electric conductor, such as a wire, wound in several turns around the cooling element 1 and the core elements 6. Alternatively, the coil 7 may consist of a band or a plate.

[0016] In Figures 4 and 5 it can be seen that the cooling element 1 extends past the coil 7 and the core elements 6 at both ends (below and above). In this way, the inlet 2 and outlet 3 of the cooling element 1 are easily accessible in order to carry out the necessary pipe attachments for passing the cooling fluid to and from an external device where the cooling fluid is cooled before reintroduction into the cooling element 1.

[0017] Figures 6 and 7 illustrate a second embodiment of a coil arrangement. Figure 6 is an end view and Figure 7 a side view of the coil arrangement. The embodiment of Figures 6 and 7 is very similar to the one described in connection with Figures 4 and 5, and therefore this embodiment will mainly be described by pointing out the differences between these embodiments.

[0018] In the embodiment of Figures 6 and 7, three pairs of cooling elements 1 are utilized. Each pair of cooling elements comprises a core element 6 arranged between the two cooling elements 1, and a second and a third core element 6 is arranged against the respective outer surfaces of the cooling elements 1. Finally, for each

pair of cooling elements 1 and the three respective core elements 6 a coil 7 is arranged to surround the two cooling elements 1 and the three core elements 6.

[0019] The embodiment of Figures 6 and 7 additionally comprises three core elements 8 which extend between all three pairs of cooling elements 1.

[0020] It is to be understood that the above description and the accompanying figures are only intended to illustrate the present invention. It will be obvious to a person skilled in the art that the invention can be varied and modified without departing from the scope of the invention.

Claims

1. A coil arrangement for an electronic device, comprising:

a core,
a coil (7) arranged around said core, and
a cooling element (1) comprising an inlet (2) for receiving a cooling fluid and an outlet (3) for forwarding the cooling fluid from said cooling element(1),**characterized in**
that said core comprises at least two core elements (6) arranged at a distance from each other, and
said cooling element (1) is arranged between said at least two core elements (6).

2. A coil arrangement according to claim 1, **characterized in that** said coil arrangement is a coil arrangement for a choke or a transformer.

3. A coil arrangement according to claim 1 or 2, **characterized in that** said core is of a ferromagnetic or ferrite material.

4. A coil arrangement according to one of claims 1 to 3, **characterized in that** said coil arrangement comprises:

at least two cooling elements (1),
at least two core elements (6) arranged on opposite sides of each respective cooling element (1),
at least one coil (7) arranged around each respective two core elements (6) and said respective cooling element (1), and
at least two core elements (8) on each side of said cooling elements (1), which core elements (8) extend between said at least two cooling elements (1).

5. A coil arrangement according to one of claims 1 to 3, **characterized in that** said coil arrangement comprises at least two

cooling elements (1),

that said cooling elements (1) are arranged against each other with a core element (6) between them, **that** a second and a third core element (6) is arranged against a respective outer surface of said cooling elements (1), and
a coil (7) is arranged around said cooling elements (1) and core elements (6).

6. A coil arrangement according to one of claims 1 to 5, **characterized in that** said coil arrangement is a coil arrangement of a choke in a frequency converter.

7. A coil arrangement according to one of claims 1 to 6, **characterized in that** at least one of said cooling elements (1) comprises a plurality of conduits (4) providing parallel fluid paths for passing said fluid from said inlet (2) to said outlet (3).

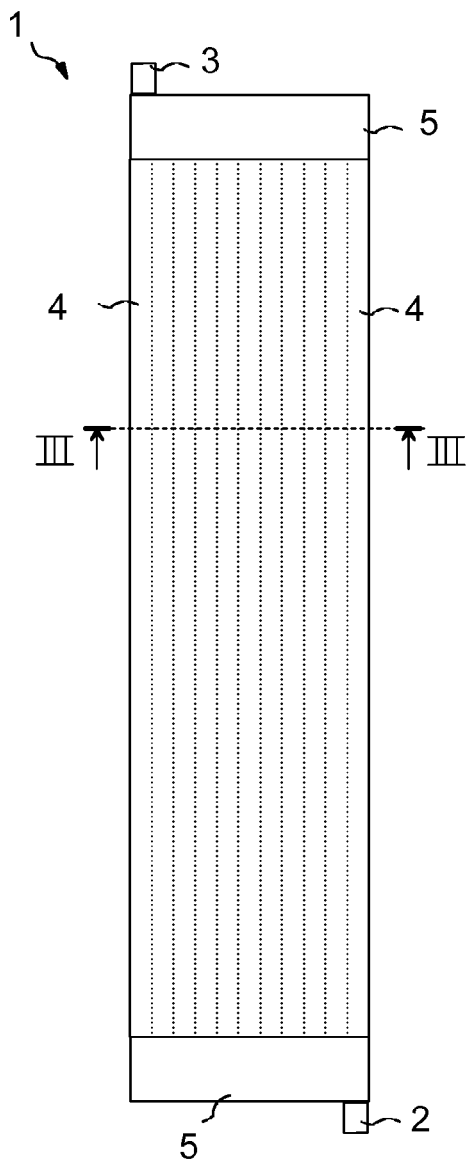


FIG. 1

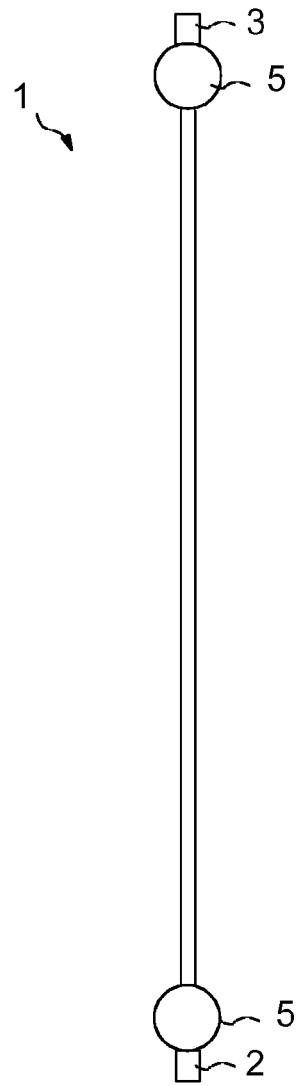


FIG. 2

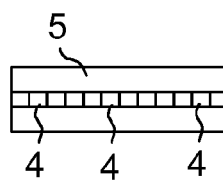


FIG. 3

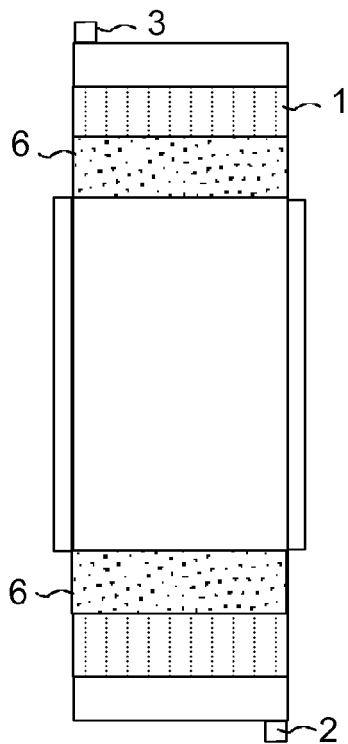


FIG. 4

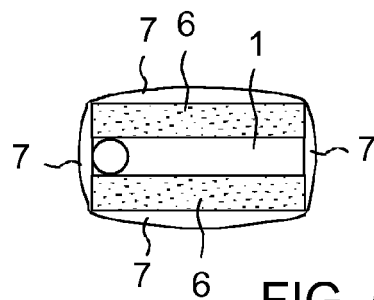


FIG. 5

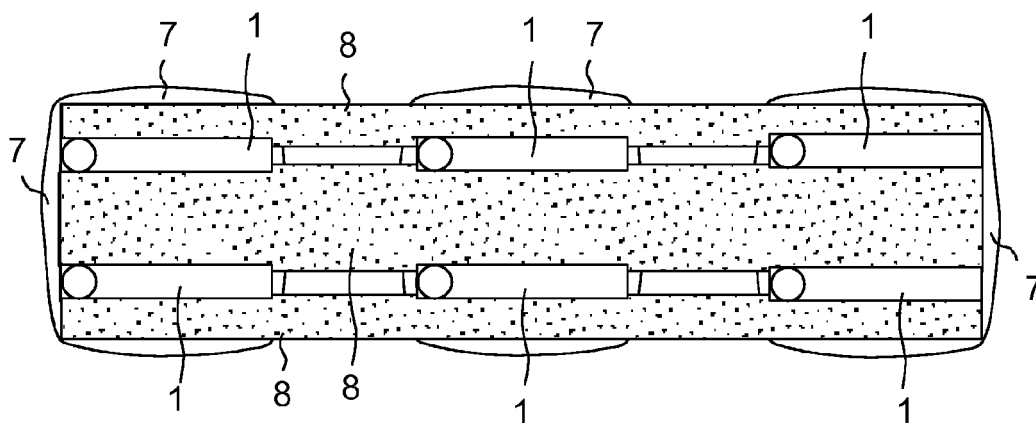


FIG. 6

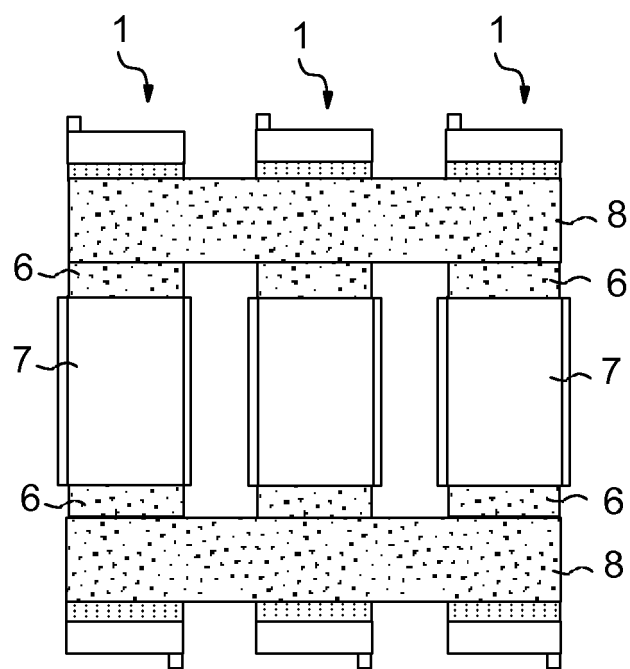


FIG. 7



EUROPEAN SEARCH REPORT

Application Number
EP 10 15 5025

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 513 420 A (ROWLAND HENRY A.) 23 January 1894 (1894-01-23) * page 1, line 51 - page 1, line 91; figures 1,2 *	1-7	INV. H01F27/02 H01F27/10 H01F27/26
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X	US 2004/257187 A1 (DRUMMOND GEOFFREY N [US] ET AL DRUMMOND GEOFFREY N [US] ET AL) 23 December 2004 (2004-12-23) * paragraph [0027] - paragraph [0031]; figure 2 *	1-3,6,7	
A	EP 0 982 832 A2 (SUMITOMO WIRING SYSTEMS [JP]; SUMITOMO ELECTRIC INDUSTRIES [JP]) 1 March 2000 (2000-03-01) * paragraphs [0056], [0057], [0059]; figure 2 *	1-7	TECHNICAL FIELDS SEARCHED (IPC) H01F
A	US 3 073 885 A (GUGLIELMO CAMILLI) 15 January 1963 (1963-01-15) * column 2, line 45 - column 2, line 57; figure 1 * * column 3, line 16 - column 3, line 32 *	1-7	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 16 July 2010	Examiner Bouhana, Emmanuel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 (03.02 (P04C01))

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 15 5025

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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16-07-2010

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