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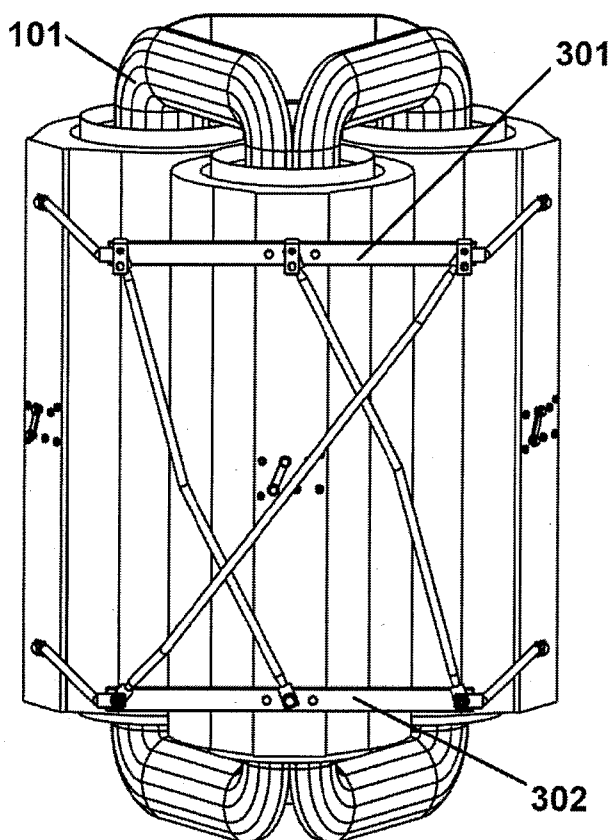
Park Apt., Baekseok-dong, Seobuk-gu, Cheonan-si, Chungcheongnam-do 331-793 (KR). **AHN, Sung-Ick** [KR/KR]; 105-701, Iaan Apt., Dujeong-dong, Seobuk-gu, Cheonan-si, Chungcheongnam-do 331-753 (KR). **LEE, Chang-Hyeon** [KR/KR]; 1933, Young-Jin Officetel (601), Dujeong-dong, Seobuk-gu, Cheonan-si, Chungcheongnam-do 331-964 (KR).

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(54) Title: A TRANSFORMER HIGH VOLTAGE COIL ASSEMBLY



(57) Abstract: The present invention provides a high voltage coil assembly of a triangular transformer and a triangular core transformer thereof. The high voltage coil assembly comprises three high voltage coils (102) and each high voltage coil (103) comprising a first terminal and a second terminal. The high voltage coil assembly further comprising a first supporting insulation bar (301) and a second supporting insulation bar (302); the first terminals of each of the high voltage coils are connected to the first supporting insulation bar (301) by a conductor and the second terminals of each of the high voltage coils are connected to the second supporting insulation bar (302) by a conductor.



RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Description

Title of Invention: A TRANSFORMER HIGH VOLTAGE COIL ASSEMBLY

Technical Field

- [1] The present invention relates generally to the field of transformer technology, and in particular, relates to a high voltage coil assembly with supporting bar and also to a transformer, especially a triangular transformer using such a high voltage coil.

Background Art

- [2] Triangular core transformers have many benefits such as lower losses, reduced noise level, lower weight, smaller inrush current, smaller foot print, more manageable external magnetic radiation field and lower third harmonics in a three-phase distribution system.
- [3] See FIG. 1, triangular cores for three-phase distribution transformers 100 typically consist of three core frames 101, which are essentially a group of one or more loops of magnetic steel or a similar, low magnetic reluctance material. The core frames are fit together such that when viewed from above, the core takes the form of a triangle. Each phase of the transformer fits on a single core leg, through which two of the loops pass through. The triangular cores are located in a low voltage coil 102. The low voltage coil 102 is located in a high voltage coil 103 with an air gap between them. The air gap is for electrical strength.
- [4] See FIG. 2a and FIG. 2b, each of the high voltage coil 103 has two terminals. To connect the three high voltage coils 103 together, the second terminal of the first high voltage coil is connected to the first terminal of the second high voltage coil. And the second terminal of the second high voltage coil is connected to the first terminal of the third high voltage coil.
- [5] The existing device 121 to connect the three high voltage coils 103 together is quite complex, unordered and conductor material consuming.
- [6] Thus it is needed to improve the existing high voltage coil. To provide a new structure which is simpler, saves the conductor material and increase the heat dissipation efficiency.
- [7] **Summary of The Invention**
- [8] One of the objectives of the embodiments of the present invention is to provide a transformer high voltage coil assembly, which at least is simpler, saves the cost and increases the heat dissipation efficiency.
- [9] In one aspect of the present invention, there is provided a high voltage coil assembly of a triangular transformer. It comprises three high voltage coils and each high voltage

coil comprises a first terminal and a second terminal. The high voltage coil assembly further comprises a first supporting insulation bar and a second supporting insulation bar. The first terminals of each of the high voltage coils are connected to the first supporting insulation bar by a conductor and the second terminals of each of the high voltage coils are connected to the second supporting insulation bar by a conductor.

[10] In one of the embodiments of the present invention, the first support insulation bar and the second support insulation bar are parallel to each other.

[11] In one of the embodiments of the present invention, the first support insulation bar and the second support insulation bar are horizontal or vertical.

[12] In one of the embodiments of the present invention, the first terminals and second terminals of each of the high voltage coils are delta connected or Y connected.

[13] In another preferred embodiment of the present invention, each ends of the high voltage coil are fixed by 3 coil blocks.

[14] In another aspect of the present invention, there is provided a triangular core transformer. It comprises a triangular core, a low voltage coil assembly and a high voltage coil assembly. The high voltage coil assembly comprises three high voltage coils, a first support insulation bar and a second support insulation bar. Each of the high voltage coils comprises a first terminal and a second terminal. The first terminals of each of the high voltage coils are connected to the first support bar by a conductor and the second terminals of each of the high voltage coils are connected to the second support bar by a conductor.

[15] In one of the preferred embodiments of the present invention, the low voltage coil assembly and the high voltage coil assembly are fixed by 3 coil blocks.

[16] In one of the preferred embodiments of the present invention, the first terminals and second terminals of each of the high voltage coils are delta connected or Y connected.

[17] In one of the preferred embodiments of the present invention, low voltage coil assembly comprises three low voltage coils. Each of the low voltage coils comprises at least two lead bars and the at least two lead bars are located separately in a way that the projection towards the radial direction of each of the at least two lead bars on the internal surface of the low voltage coil are non-overlapped.

[18] In one of the preferred embodiments of the present invention, the high voltage coils are made by foil disc winding.

[19] In one of the preferred embodiments of the present invention, the high voltage foil is made by horizontally casting a high voltage coil disc winding.

Brief Description of Drawings

[20] Having thus described the example embodiments of the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily

drawn to scale, and wherein:

- [21] FIG. 1 is a perspective view of a triangular core transformer;
- [22] FIG. 2a and FIG. 2b are perspective views of a prior triangular core transformer with prior high voltage coil assembly;
- [23] FIGs. 3a-3d show a triangular core transformer with a high voltage coil assembly according to a preferred embodiment of the present invention; wherein FIG. 3a is a perspective view, FIG. 3b is a front view, FIG. 3c is a top view; FIG. 3d shows the Y connection;
- [24] FIG. 4 shows a triangular core transformer with a high voltage coil assembly according to another preferred embodiment of the present invention, wherein the supporting insulation bars are vertically arranged;
- [25] FIG. 5a is perspective views of a triangular core transformer with a prior high voltage coil assembly which comprising four coil blocks; FIG. 5b is a perspective views of a triangular core transformer with a high voltage coil assembly according to the present invention and only three coil blocks;
- [26] FIG. 6a is a sectional view of a triangular core transformer with prior low voltage coil lead bars; FIG. 6b a sectional view of a triangular core transformer with two low voltage coil lead bars according to a preferred embodiment of the present invention.

[27] **Detailed Description**

- [28] The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the inventions are shown. Indeed, these inventions may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.
- [29] The present invention will be described in more details by a triangular transformer, but the design and the improvement according to the present invention is applicable to all types of transformers.
- [30] As described above, shown in FIG. 2a and FIG. 2b, each of the high voltage coils 103 has two terminals. To connect the three high voltage coils 103 together, the second terminal of the first high voltage coil is connected to the first terminal of the second high voltage coil. And the second terminal of the second high voltage coil is connected to the first terminal of the third high voltage coil.
- [31] According to one preferred embodiment of the present invention, there is provided a triangular core transformer. As shown in FIG. 3a-3d, the triangular core transformer comprises a triangular core 101, a low voltage coil assembly and a high voltage coil assembly. The high voltage coil assembly comprises three high voltage coils 103, a first support insulation bar 301 and a second support insulation bar 302. Each of the

high voltage coils 103 comprises a first terminal and a second terminal. The first terminals of each of the high voltage coils are connected to the first support bar 301 by a conductor and the second terminals of each of the high voltage coils are connected to the second support bar 302 by a conductor.

- [32] In the preferred embodiments of the present invention, the first terminals and second terminals of each of the high voltage coils are delta connected or Y connected. FIG. 3a shows the high voltage coils are in delta connection and FIG. 3d shows the high voltage coils are in Y connection.
- [33] In one preferred embodiment of the present invention, as shown in and FIG. 5b, the low voltage coil assembly and the high voltage coil assembly are fixed by three coil blocks 108. In the prior design as shown in FIG. 5a, there are four coil blocks 107, 107' to fix the high voltage coils 103. The internal coil blocks 107' which are located in the inner part of the triangular core block the airflow and thus reduce the heat dissipation quite a lot. Comparing with prior design of using four coil blocks, this invention saves cost by reducing one coil block. Furthermore, by removing the internal coil blocks 107', the heat dissipation efficiency is highly increased.
- [34] Also as shown in FIG. 1, the low voltage coil 102 needs two lead bars 111, 112 for further connection to its both terminals. Traditionally, the both lead bars 111, 112 are located together as show in FIG. 6a. That means both lead bars are located at the same place on the perpendicular direction of the low voltage core axis 119. As the transformer cores are located in the low voltage coil, low voltage mold cannot collapse for low voltage lead bar 112. Therefore, low voltage coil outer diameter should be increased by low voltage lead bars 111, 112. The low voltage coil thickness 120 is calculated by the thickest part. See FIG. 6a, that is the two-lead bar part. It increases additional High-Low air clearance.
- [35] The traditional design of low voltage lead bars 111, 112 makes the low voltage coil very large and consequently, the High-Low air clearance large. This further makes the high voltage coil large and the triangular core large.
- [36] According to a preferred embodiment of the present invention, the transformer low voltage coil comprises a low voltage coil 102 and at least two lead bars 211, 212, wherein said at least two lead bars 211, 212 are located separately in a way that the projection towards the radial direction 118 of each of the at least two lead bars 211, 212 on the internal surface of the low voltage coil 102 are non-overlapped. Here the radial direction 118 means a direction perpendicular to and towards the axial 119 of the low voltage coil 102. See FIG. 6b.
- [37] By separating two lead bars 211, 212 in perpendicular direction 118 to the axial 119, the prior thickest part 120, as shown in FIG. 6a, can be reduced to the thickest part 220 according to the present invention. By this, the thickest part of the low voltage coil can

reduce from a thickness of a lead bar 211 or 212. See FIG. 6b. Consequently, the high voltage coil can reduce a semi-diameter of the thickness of a lead bar 211 or 212, and each frame of the delta core 101 can reduce a length of twice thickness of a lead bar 211 or 212.

[38] In one preferred embodiment of the present invention, the high voltage coils are made by foil disc winding. This has been described in the patentee's previous application. Please refer to patent application PCT/US 12/36207.

[39] In one preferred embodiment of the present invention, the high voltage foil is made by horizontally casting a high voltage coil disc winding. This has also been described in the patentee's previous application. Please refer to patent application PCT/US 12/36207.

[40] Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Moreover, although the foregoing descriptions and the associated drawings describe example embodiments in the context of certain example combinations of elements and/or functions, it should be appreciated that different combinations of elements and/or functions may be provided by alternative embodiments without departing from the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

[41]

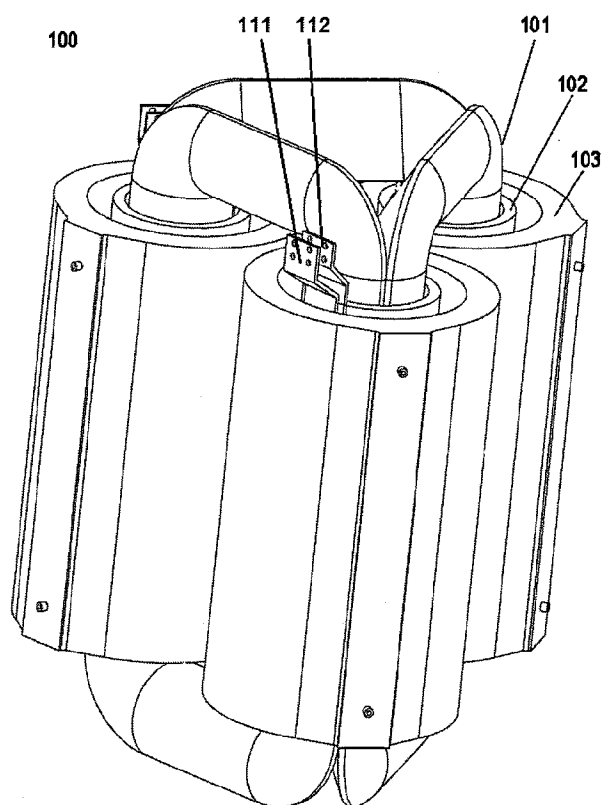
Claims

- [Claim 1] A high voltage coil assembly of a triangular transformer, comprising three high voltage coils (102) and each high voltage coil (103) comprising a first terminal and a second terminal, wherein, the high voltage coil assembly further comprising a first supporting insulation bar (301) and a second supporting insulation bar (302); the first terminals of each of the high voltage coils are connected to the first supporting insulation bar (301) by a conductor and the second terminals of each of the high voltage coils are connected to the second supporting insulation bar (302) by a conductor.
- [Claim 2] A high voltage coil assembly of a triangular transformer of claim 1, wherein said first support insulation bar (301) and the second support insulation bar (302) are parallel to each other.
- [Claim 3] A high voltage coil assembly of a triangular transformer of claim 1, wherein said first support insulation bar (301) and the second support insulation bar (302) are horizontal or vertical.
- [Claim 4] A high voltage coil assembly of a triangular transformer of claim 1, wherein the first terminals and second terminals of each of the high voltage coils (102) are delta connected or Y connected.
- [Claim 5] A high voltage coil assembly of a triangular transformer of any one of claims 1 to 4, wherein each ends of said high voltage coil (103) are fixed by 3 coil blocks (108).
- [Claim 6] A triangular core transformer, comprising a triangular core (101), a low voltage coil assembly and a high voltage coil assembly; the a low voltage coil assembly comprising three low voltage coils (102) and high voltage coil assembly comprising three high voltage coils (103); each high voltage coil (103) comprising a first supporting insulation bar (301) and a second supporting insulation bar (302); the first terminals of each of the high voltage coils (103) are connected to the first supporting insulation bar (301) by a conductor and the second terminals of each of the high voltage coils (103) are connected to the second supporting insulation bar (302) by a conductor.
- [Claim 7] A triangular core transformer according to claim 6, wherein each end of said low voltage coil and high voltage coil are fixed by 3 coil blocks (108).
- [Claim 8] A triangular core transformer according to claim 6, wherein the first terminals and second terminals of each of the high voltage coils are

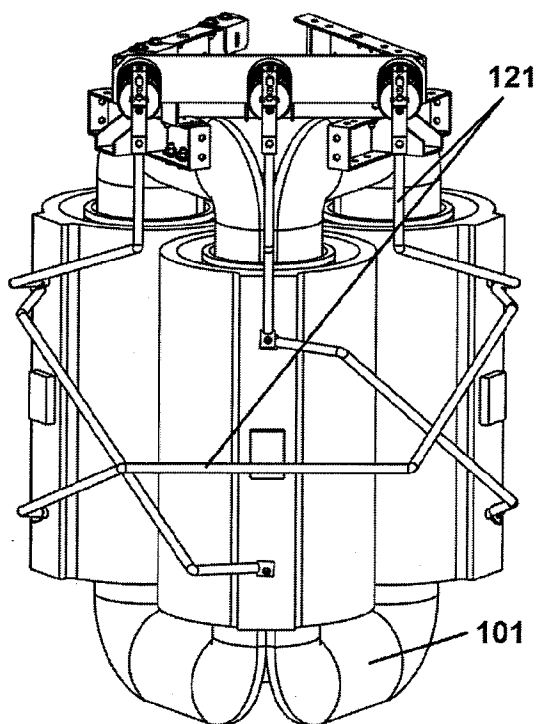
delta connected or Y connected.

- [Claim 9] A triangular core transformer according to any one of claims 6 to 8, wherein low voltage coil assembly comprises three low voltage coils (102); each of the low voltage coils (102) comprises at least two lead bars (211, 212) and the at least two lead bars (211, 212) are located separately in a way that the projection towards the radial direction of each of the at least two lead bars on the internal surface of the low voltage coil are non-overlapped.
- [Claim 10] A triangular core transformer according to claim 9, wherein the high voltage coil (103) is made of foil disc winding.
- [Claim 11] A triangular core transformer according to claim 9, wherein the high voltage coil (103) is made by horizontally casting a high voltage coil disc winding.

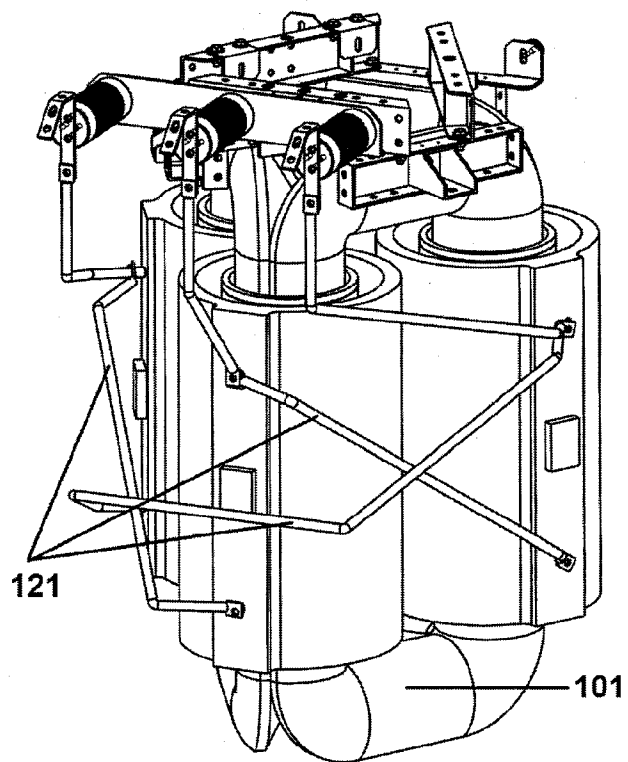
[Fig. 1]



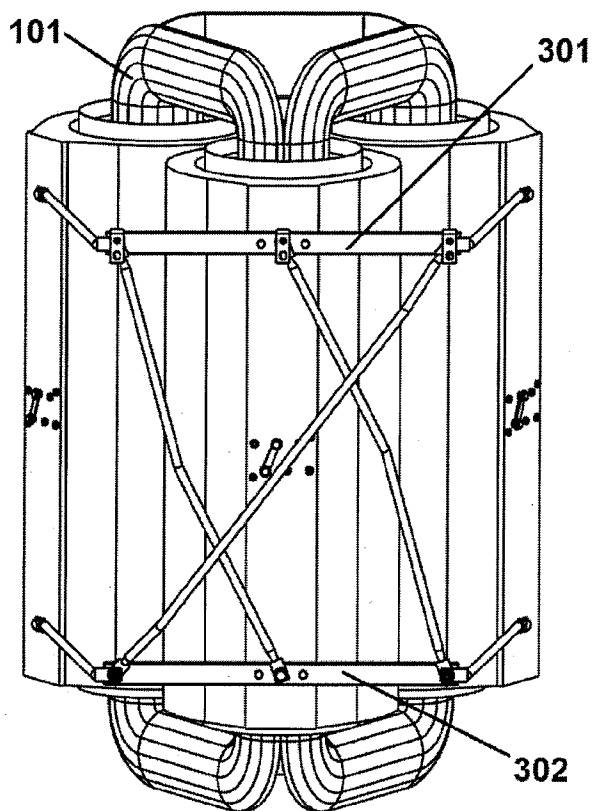
[Fig. 2a]



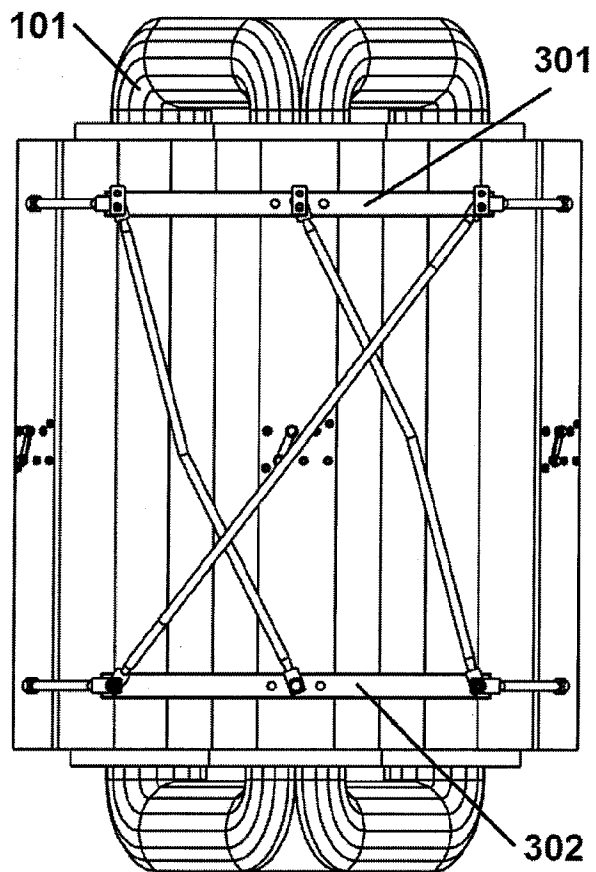
[Fig. 2b]



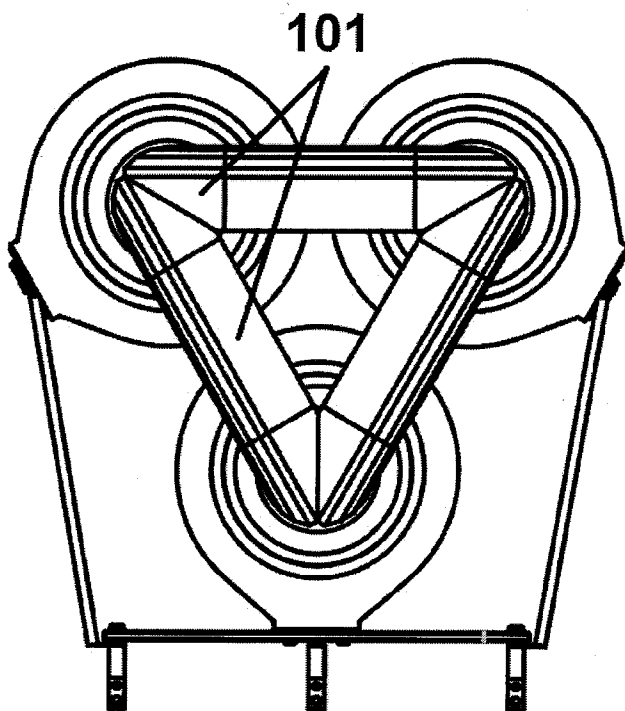
[Fig. 3a]



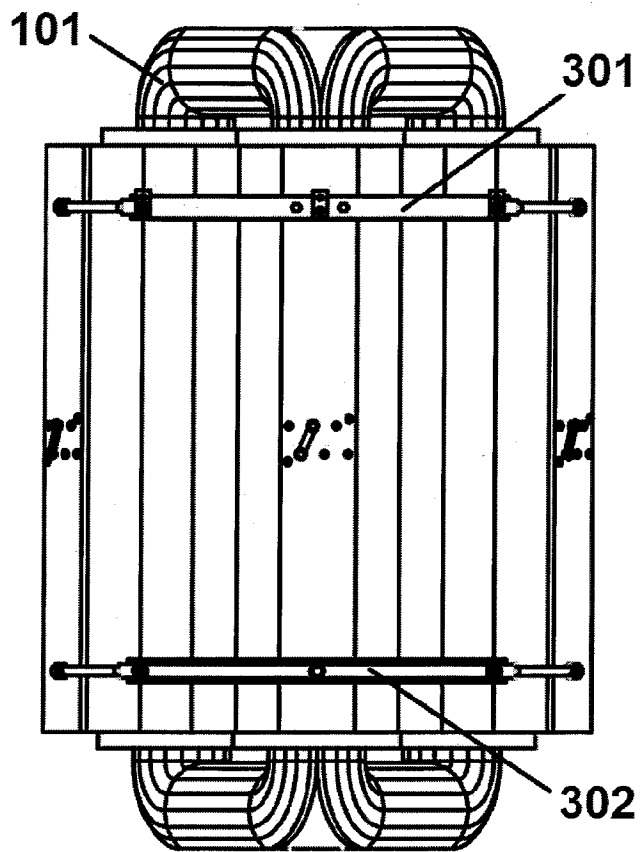
[Fig. 3b]



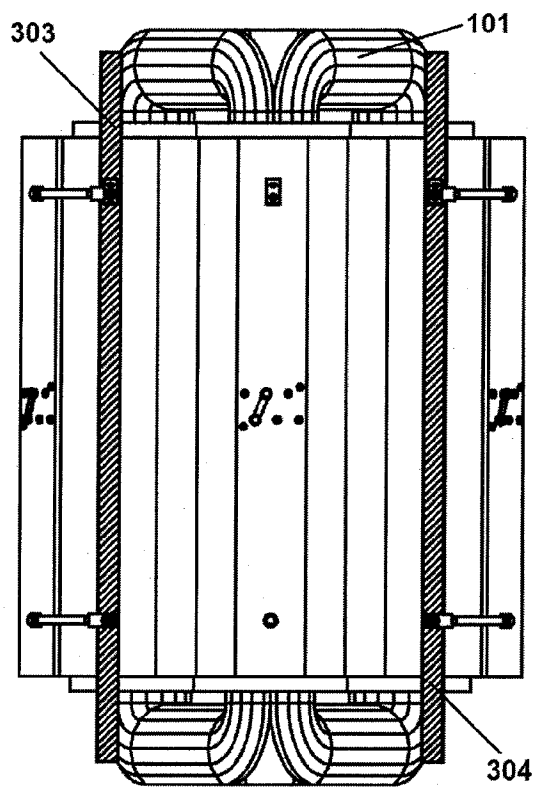
[Fig. 3c]



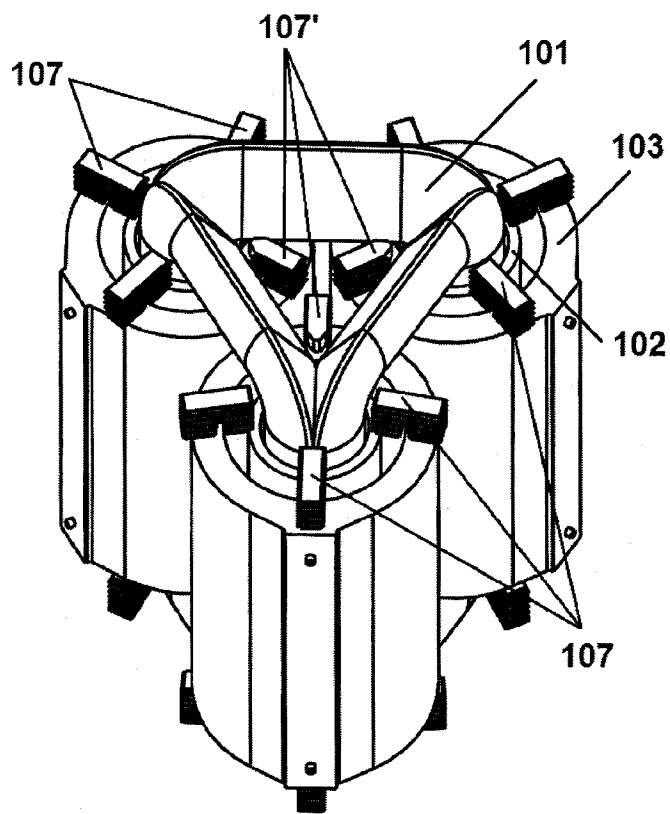
[Fig. 3d]



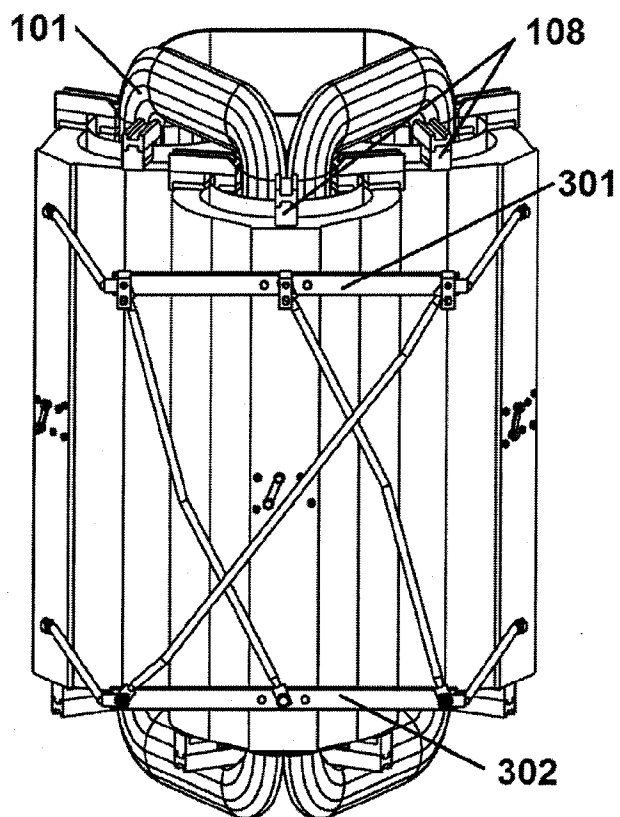
[Fig. 4]



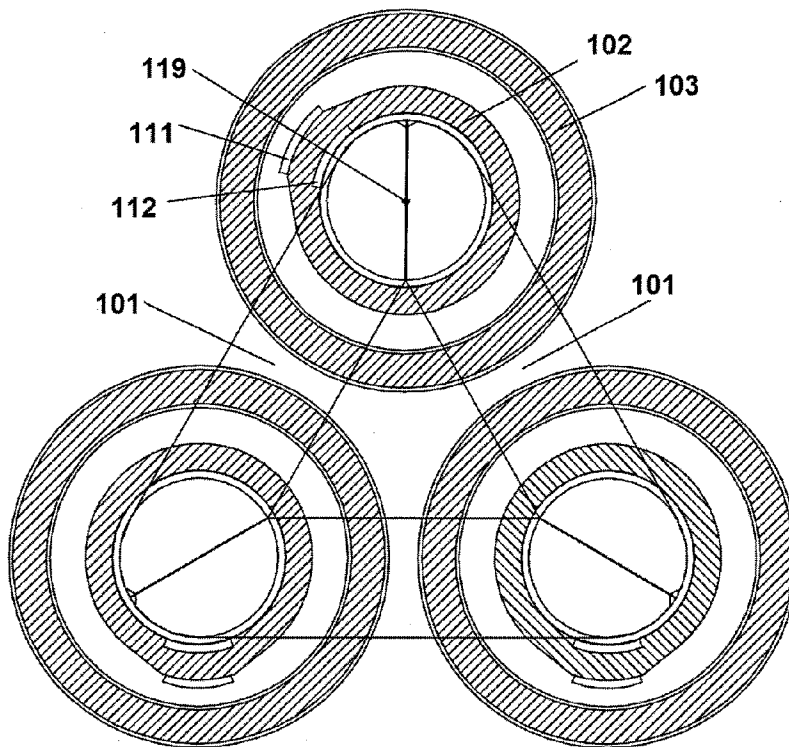
[Fig. 5a]



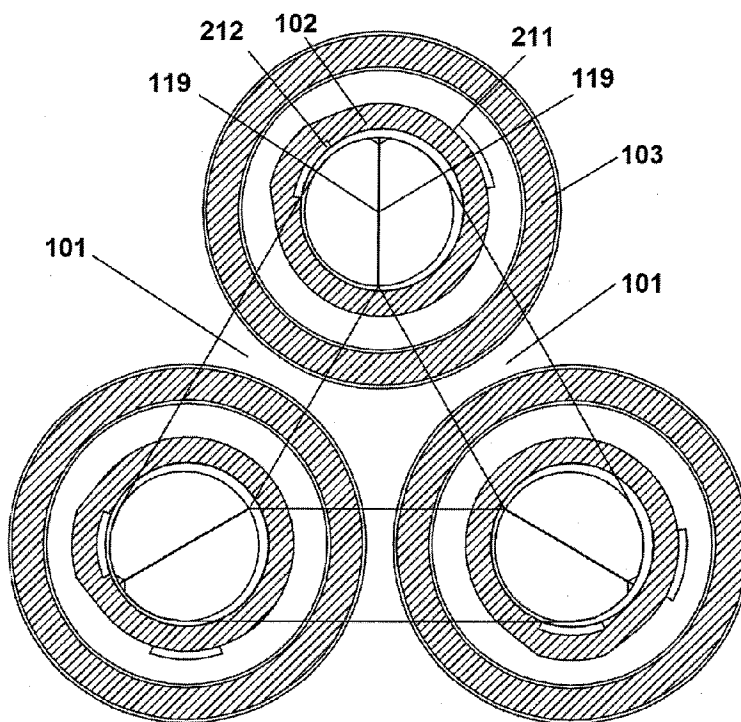
[Fig. 5b]



[Fig. 6a]



[Fig. 6b]



A. CLASSIFICATION OF SUBJECT MATTER**H01F 27/28(2006.01)i, H01F 27/24(2006.01)i, H01F 27/08(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01F 27/28; H01F 27/08; H02B 13/02; H01F 30/12; H01F 38/24; H01F 29/02; H01F 27/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords:high voltage coil, low voltage coil, triangular transformer, core, insulation bar, conductor, terminal, complex, simple

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011-0156851 A1 (HONNA) 30 June 2011 See paragraphs [0060]-[0085], and figures 1A-4C.	1-11
Y	JP 2007-142142 A (HITACHI INDUSTRIAL EQUIPMENT SYSTEMS CO., LTD.) 07 June 2007 See paragraphs [0009]-[0015], and figures 1-4.	1-11
A	US 2012-0126923 A1 (NAVARRO et al.) 24 May 2012 See abstract, paragraphs [0040]-[0063], and figures 1-5.	1-11
A	JP 2002-313653 A (TOSHIBA CORPORATION) 25 October 2002 See abstract, paragraphs [0010]-[0025], and figures 1-5.	1-11
A	JP 2009-064941 A (NICHICON CORPORATION) 26 March 2009 See abstract, paragraphs [0016]-[0030], and figures 1-3.	1-11



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search

16 September 2013 (16.09.2013)

Date of mailing of the international search report

17 September 2013 (17.09.2013)

Name and mailing address of the ISA/KR

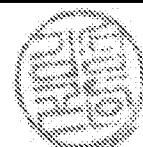
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2012/011016

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