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(54) HIGH VOLTAGE ASSEMBLY AND METHOD TO OPERATE THE VOLTAGE ASSEMBLY

(57) A high voltage assembly (2) is provided, in particular, a high voltage transformer or a high voltage reactor, comprising a first compartment (12) containing an active component (4) and a second compartment (14). The first compartment (12) is connected to the second compartment (14) via a return fluid connection (40), wherein the return fluid connection (40) comprises a pumping means (42) adapted to deliver insulation fluid from the second compartment (14) to the first compartment (12).

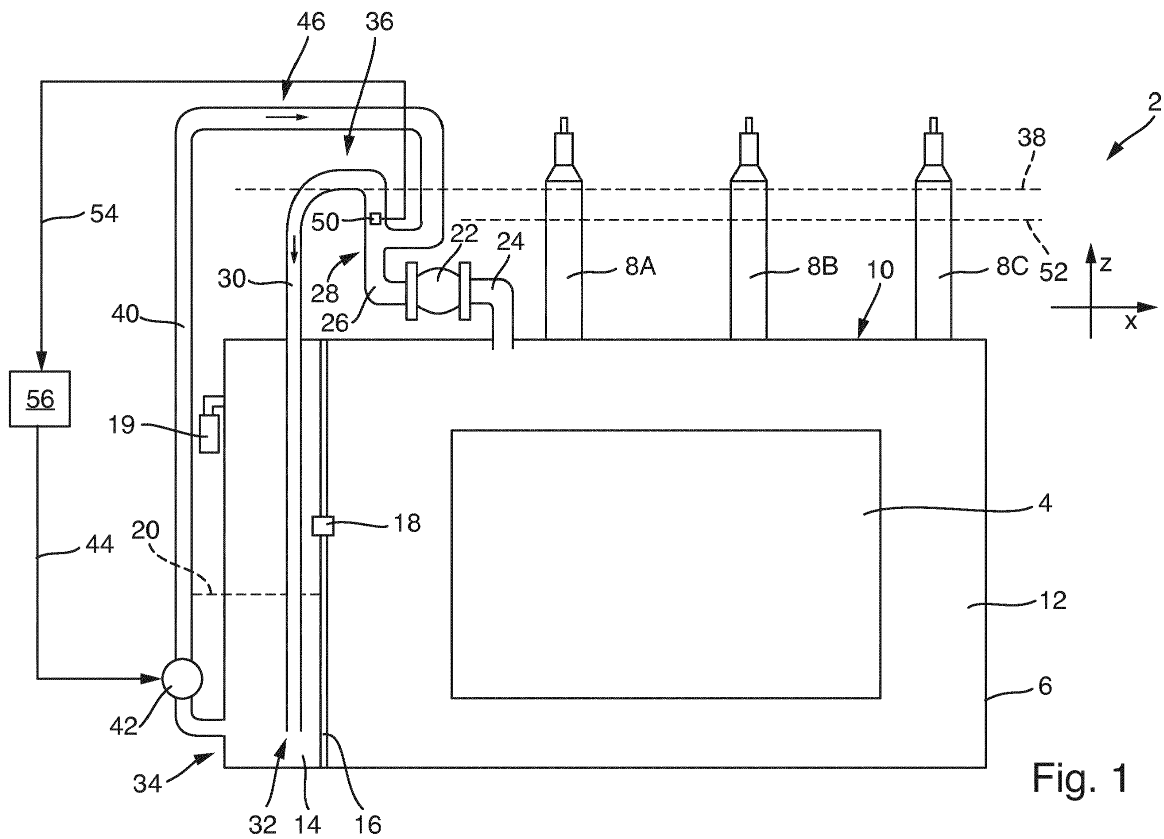

Fig. 1

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Description

Specification

Field of the invention

[0001] The present invention relates to a high voltage assembly according to the preamble of claim 1 and to a method to operate the high voltage assembly according to the preamble of claim 11.

Background

[0002] Known high voltage assemblies, like oil immersed power transformers, or oil immersed reactors, comprise a conservator mounted above and/or besides a ceiling of the respective high voltage assembly. The conservator is intended to receive an expanding oil volume in the event that the temperature of the oil in a compartment containing an active component rises. When the oil temperature drops, the oil flows back into the compartment by means of the gravitational force of the oil itself.

[0003] AT 69108 B describes a known conservator for an oil immersed high voltage transformer , which is arranged at a distance, but laterally to, the compartment comprising the active component.

Summary

[0004] It is an object of the present invention to provide an improved high voltage assembly.

[0005] In a first aspect, the invention resides in a high voltage assembly, in particular, a high voltage transformer or a high voltage reactor, comprising a first compartment containing an active component and a second compartment. The first compartment is connected to the second compartment via a return fluid connection, wherein the return fluid connection comprises a pumping means adapted to deliver insulation fluid from the second compartment to the first compartment.

[0006] The return fluid connection allows the second compartment, which forms a conservator, to be placed below a nominal or maximum insulation fluid level for the first compartment. Consequently, the location of the second compartment can be selected to reduce overall costs for the high voltage assembly.

[0007] In one advantageous embodiment, the second compartment is arranged adjacent to the first compartment. Therefore, in comparison with a traditional conservator arrangement, more space above the ceiling of the first compartment will be available.

[0008] Another advantageous embodiment is characterised in that the second compartment forms an integral part of a metal enclosure of the high voltage assembly, wherein the metal enclosure comprises the first compartment. By forming an integral part of the metal enclosure, the second compartment results in reduced costs, as circumstantial assembly in the manufacturing stage and in the commissioning stage of the high voltage assembly are avoided. In particular, transporting of an insulation fluid in separate tanks can be avoided and heavy equipment such as a crane for reassembling, and for respective oil treatment, are not needed. Furthermore, the adaption of a support structure for the high voltage assembly, due to an overhanging conservator, is no longer necessary. Therefore, manufacturing and transportation costs before commissioning on site can be reduced.

[0009] In addition the dimensions of the installed high voltage assembly on site are reduced and the support structure required will be smaller. Consequently, the whole substation comprising the proposed high voltage assembly will benefit.

[0010] The more compact design of the high voltage assembly allows a more flexible design of the ceiling of the high voltage assembly. For example, there is more space available to place the high voltage bushings at a greater distance from each other.

[0011] In an advantageous embodiment, the first compartment and the second compartment are separated by a conjoint wall. This also reduces costs due to reduced steel consumption.

[0012] A further advantageous embodiment is characterised in that the first compartment and the second compartment are connected via a pressure relief valve. In the event of an overpressure in the first compartment, the pressure relief valve transports the oil directly into the second compartment. Consequently, there will be no oil leakage into the environment should an overpressure event occur.

[0013] In yet another advantageous embodiment, the overflow fluid connection comprises an overflow section arranged above a ceiling of the first compartment. This overflow section defines the maximum insulation fluid level of the first compartment and therefore serves to conduct insulation fluid from the first compartment to the second compartment.

[0014] A further embodiment is characterised in that the return fluid connection comprises a return section arranged above the overflow section. Advantageously, the return fluid connection will not be exposed to rising insulation fluid from the first compartment.

[0015] In one further embodiment, a Buchholz relay is connected to the first compartment, and the Buchholz relay is connected to the overflow fluid connection and/or the return fluid connection. Therefore, failures inside the first compartment can be detected via the Buchholz relay. For the Buchholz relay, the second compartment acts like a traditional conservator.

[0016] In another embodiment, the second compartment comprises a breather. The breather allows a variable insulation fluid level inside the second compartment.

[0017] Another embodiment is characterised in that a level sensor is arranged and adapted to determine a fluid level of the first compartment, and that the pumping means is adapted to pump insulation fluid from the second compartment to the first compartment in dependence on the fluid level. Therefore, the fluid level of the first compartment is controlled by means of the level sensor and the pumping means, to guarantee a fluid level sufficient for maintaining operability of the high voltage assembly.

[0018] According to another aspect of the invention, there is provided a method to operate a high voltage assembly, in particular, a high voltage transformer or a high voltage reactor, the high voltage assembly comprising a first compartment containing an active component and a second compartment. The first compartment is connected to the second compartment via a return fluid connection. A pumping means of the return fluid connection delivers insulation fluid from the second compartment to the first compartment.

Brief description of the figures

[0019]

Figure 1 shows a schematic sectional view of a high voltage assembly; and

Figure 2 shows a schematic flow diagram of a method according to an embodiment of the present invention.

Description of the Embodiments

[0020] Figure 1 shows a schematic sectional view of a high voltage assembly 2. The high voltage assembly 2 may be a high voltage transformer, or a high voltage reactor, such as a series reactor, a shunt reactor or a smoothing reactor. The high voltage assembly 2 comprises an active component 4, for example a transformer core and transformer windings. The high voltage assembly 2 comprises a metal enclosure 6 which, in an operational state, is filled with an insulation fluid like oil. In the operational state, the metal enclosure 6 is connected to ground potential. High voltage bushings 8A, 8B and 8C are arranged on a ceiling 10 of the metal enclosure 6 and extend therefrom. The metal enclosure 6 has an essentially cuboid-like outer shape. The ceiling 10 of the metal enclosure 6 is arranged in a horizontally upward z-direction.

[0021] The metal enclosure 6 comprises a first compartment 12 and second compartment 14, both having an essentially cuboid like form. The first compartment 12 and the second compartment 14 are separated by a conjoint wall 16. The conjoint wall 16 comprises a pressure relief valve 18. The pressure relief valve 18 remains in a closed state until a pressure in the first compartment 12 exceeds a threshold. When the pressure in the first compartment exceeds the threshold, the pressure relief valve 18 switches to an open state and allows a transport of insulation fluid from the first compartment 12 to the second compartment 14. The second compartment 14 can be also referred to as a conservator. The second compartment 14 has a maximum oil-expansion volume which depends on the oil volume in the first compartment 12. It should be understood that a plurality of second compartments 14 can surround the first compartment 12.

[0022] The second compartment 14 comprises a breather 19 which connects the second compartment 14 to the ambient environment and allows a flexible insulation fluid level 20 inside the second compartment 14. The breather 19 is adapted to reduce moisture of natural air of the ambient environment flowing into the second compartment 14. The outer walls of the second compartment 14 and all walls of the metal enclosure, are preferably made of steel and are essentially not flexible.

[0023] A Buchholz relay 22 is connected via a fluid connection 24 to the first compartment 12. The Buchholz relay 22 is arranged above the ceiling 10 of the metal enclosure 6. A further fluid connection 26 connects the Buchholz relay 22 to a branch 28. The branch 28 is arranged above the Buchholz relay 22 and is connected to the second compartment 14 via an overflow fluid connection 30. The overflow fluid connection 30 ends in an opening 32, the opening 32 being arranged in a lower portion 34 of the second compartment 14. The overflow fluid connection 30 comprises an overflow section 36, wherein the overflow section 36 is arranged at the horizontally most upward position of the overflow fluid connection 30. The overflow section 36 defines a maximum insulation fluid level 38 for the first compartment 12. When the insulation fluid in the first compartment 12 expands due to a rising temperature, the fluid level of the first compartment 12 also rises. When the insulation fluid reaches the maximum insulation fluid level 38, the insulation fluid overflows into the second compartment 14 by means of the overflow fluid connection 30.

[0024] The branch 28 is connected to the second compartment 14 by means of a return fluid connection 40. The return fluid connection 40 comprises a pumping means 42 which is activated by an activation signal 44. Furthermore, the return fluid connection 40 comprises a return fluid section 46 which is arranged above the overflow section 36.

[0025] Throughout this description the wording that a first feature is arranged above a second feature comprises that the first feature is located on a side of the second feature being opposed to the base or support structure of the high voltage assembly 2. More specific, a horizontal plane that is essentially parallel to an upper surface level of the base or support structure of the high voltage assembly 2 lies between the first feature and the second feature and the second feature is arranged between the first feature and the base or support structure of the high voltage assembly.

[0026] For example, the ceiling 10 of the first compartment 12 is arranged between the base or support structure of the high voltage assembly 2 and the overflow section 36. The return section 46, for example, is located on a side of the overflow section 36 being opposed to the foundation of the high voltage assembly 2.

[0027] A level sensor 50 is arranged inside part of the overflow fluid connection 30 that extends vertically from the branch 28. If the insulation fluid level of the first compartment 12 drops below a threshold level 52, a threshold signal 54 is generated and sent to a control unit 56. Therefore, the level sensor 50 is arranged and adapted to determine a fluid level of the first compartment 12. It should be understood that the level sensor 50 can alternatively be arranged in the return fluid connection 40, or at another respective position, at which the level sensor 50 can measure and determine, whether the fluid level drops below the threshold level 52.

[0028] It should also be understood that the high voltage assembly 2 may comprise a plurality of second compartments 14. Of course, the overflow fluid connection 30 and the return fluid connection 40 can be combined into a single fluid connection connecting the first compartment 12 and the second compartment 14 for exchanging insulation fluid.

[0029] According to a preferred embodiment, the pumping means 42 is arranged outside of the metal enclosure 6 for maintenance reasons. Accordingly the return fluid connection 40 runs at least in sections outside of the metal enclosure 6.

[0030] According to another preferred embodiment, the pumping means 42 comprises at least two pumping units, which are mechanically independent. This provides redundancy and contributes to a reduction of failure probability of the whole high voltage assembly.

[0031] Figure 2 shows a schematic flow diagram 60. The steps are executed by means of the control unit 56. In block 62, the operation is initiated. In block 64, a determination is made whether the fluid level is below the threshold level 52 by means of the control unit 56 in dependence of the threshold signal 54. If the insulation fluid level is above the threshold level 52, block 64 is executed once more. If the insulation fluid level is below or equals the threshold level 52, then block 66 is executed. In block 66, the pumping means 42 commences to pump insulation fluid contained in the second compartment 14 to the first compartment 12. After executing block 66, the process proceeds to block 68.

[0032] In block 68, it is determined by means of the level sensor 50 whether the insulation fluid level is above the threshold level 52. If the insulation fluid level is not above the threshold level 52, then block 68 is executed again. If the insulation fluid level is above the threshold level 52, the process proceeds to block 70. In a block 70, the pumping means 42 is stopped, which results in no fluid being carried to the first compartment 12. After executing block 70, the process proceeds to block 64.

[0033] According to an embodiment, block 70 comprises a timer, according to which the pumping means 42 is stopped after a certain time period. The time period starts on proceeding to block 60. Therefore, the pumping means 42 is stopped after the end of the time period which started at point in time when it is determined that the fluid level has risen above the threshold level 52.

Claims

1. A high voltage assembly (2), in particular, a high voltage transformer or a high voltage reactor, comprising:

   - a first compartment (12) containing an active component (4); and
   - a second compartment (14),

   wherein the high voltage assembly (2) is **characterized in that** thee first compartment (12) is connected to the second compartment (14) via a return fluid connection (40), and wherein the return fluid connection (40) comprises a pumping means (42) is adapted to deliver insulation fluid from the second compartment (14) to the first compartment (12).

2. The high voltage assembly (2) according to claim 1, wherein the second compartment (14) is arranged adjacent to the first compartment (12).

3. The high voltage assembly (2) according to claim 1 or 2, wherein the second compartment (14) forms an integral part of a metal enclosure (6) of the high voltage assembly (2), and wherein the metal enclosure comprises the first compartment (12).

4. The high voltage assembly (2) according to any of the preceding claims, wherein the first compartment (12) and the second compartment (14) are separated by a conjoint wall (16).

5. The high voltage assembly (2) according to any of the preceding claims, wherein the first compartment (12) and the second compartment (14) are connected via a pressure relief valve (18).

6. The high voltage assembly (2) according to any of the preceding claims, wherein an overflow fluid connection (30) is arranged above a ceiling (10) of the first compartment (12).

7. The high voltage assembly (2) according to claim 6, wherein the return fluid connection (40) comprises a return section (46) arranged above the overflow section (36).

8. The high voltage assembly (2) according to any of the preceding claims, wherein a Buchholz relay (22) is connected to the first compartment (12), and wherein the Buchholz relay (22) is connected to the overflow fluid connection (30) and/or the return fluid connection (40).

9. The high voltage assembly (2) according to any of the preceding claims, wherein the second compartment (14) comprises a breather (18).

10. The high voltage assembly (2) according to any of the preceding claims, wherein a level sensor (50) is arranged and adapted to determine a fluid level of the first compartment (12), and wherein the pumping means (42) is adapted to pump insulation fluid from the second compartment (14) to the first compartment (12) in dependence on the determined fluid level.

11. A method to operate a high voltage assembly (2), in particular, a high voltage transformer or a high voltage reactor, the high voltage assembly (2) comprising:

- a first compartment (12) containing an active component; and
- a second compartment (14),

the method being **characterized in that**
the first compartment (12) is connected with the second compartment (14) via a return fluid connection (40), and wherein a pumping means (42) of the return fluid connection (40) delivers insulation fluid from the second compartment (14) to the first compartment (12).

12. The method according to claim 11, being adapted to operate a high voltage assembly (2) according to any of claims 1 to 10.

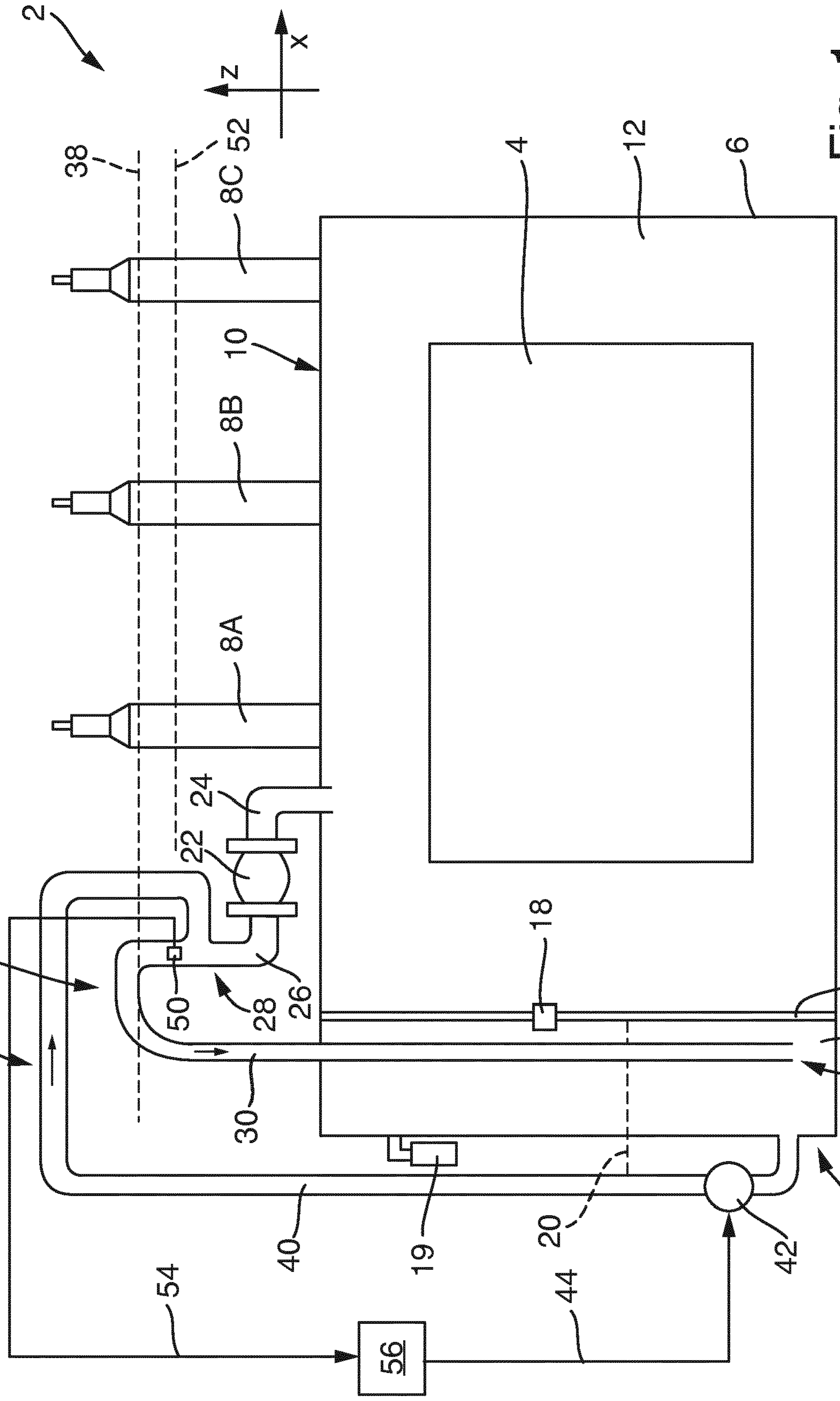
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Fig. 1

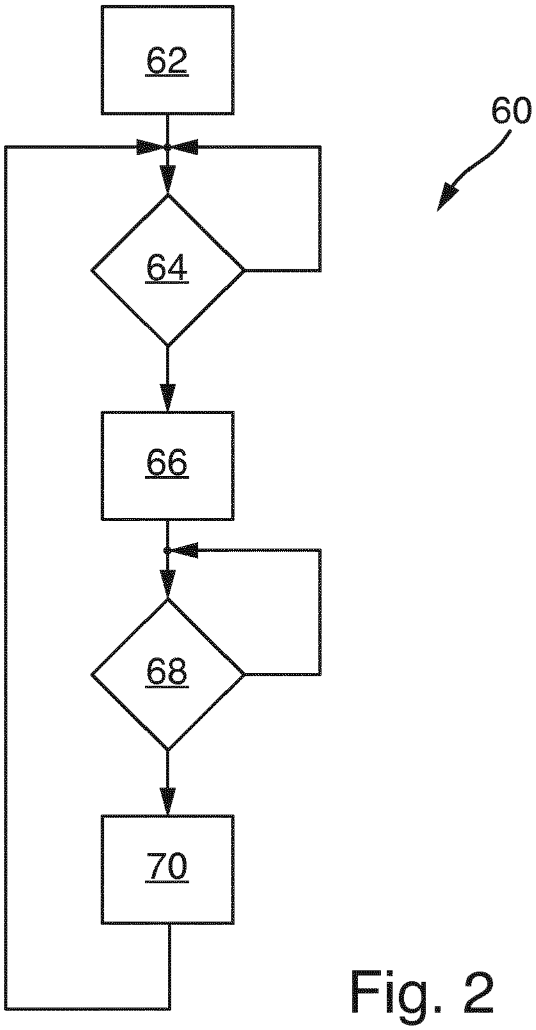

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 0634

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 A	US 2 340 898 A (RACE HUBERT H) 8 February 1944 (1944-02-08) * page 1, column 2, lines 25 - 45 * * page 2, column 1, lines 1 - 22, 41 - 49 * * claim 6 * * figures 1, 3 * -----	1,2,6,7, 10-12 3-5,8,9	INV. H01F27/14
X	US 6 052 060 A (BUTLER DAVID MCMAHAN [US] ET AL) 18 April 2000 (2000-04-18) * column 1, lines 5 - 9 * * column 2, lines 41 - 55 * * column 4, lines 11 - 22 * * figure 1 * -----	1,2,11, 12	

TECHNICAL FIELDS SEARCHED (IPC)

H01F
H02H
H05K

The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
Munich	24 January 2017	Van den Berg, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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24-01-2017

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US 2340898 A	08-02-1944	NONE	
US 6052060 A	18-04-2000	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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