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- **Kmita, Grzegorz**
32-085 Giebultow (PL)
- **Kozupa, Michal**
30-348 Krakow (PL)
- **Platek, Robert**
30-719 Krakow (PL)
- **Weber, Benjamin**
59955 Winterberg (DE)

(71) Applicant: **ABB Technology AG**
8050 Zürich (CH)

(72) Inventors:
• **Cornelius, Frank**
59939 Olsberg (DE)

(74) Representative: **Kock, Ina**
ABB AG
GF-IP
Wallstadter Straße 59
68526 Ladenburg (DE)

(54) **Dry transformer**

(57) The invention is related to a dry transformer (10), comprising at least one hollow-cylindrical resin casted coil (12, 14) and a transformer core (16, 46) extending at least in part there through, wherein support elements (18, 26) are foreseen to carry the weight of the resin casted coil (12, 14) to the transformer core (16) respectively

to mounting elements (20) connected therewith. The support elements (18, 26) comprise damping material at least in a section so that transmission of vibrations of the transformer core (16, 46) to the resin casted coil (12, 14) is damped.

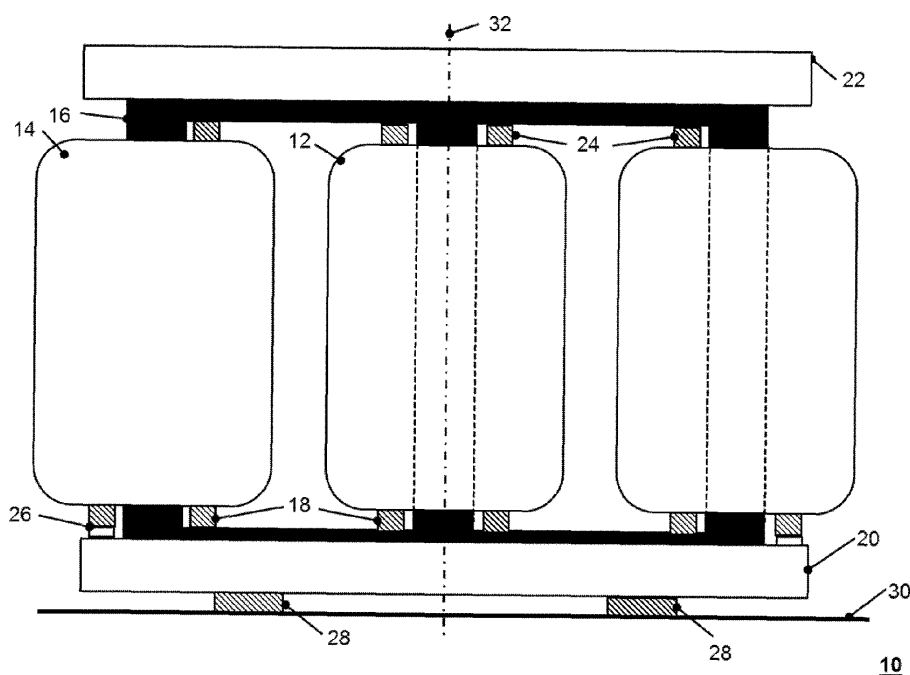


Fig. 1

Description

[0001] The invention is related to a dry transformer, comprising at least one hollow-cylindrical resin casted coil and a transformer core extending at least in part there through, wherein support elements are foreseen to carry the weight of the resin casted transformer coil to the transformer core respectively to mounting elements connected therewith

[0002] It is known that transformers are used in electrical distribution networks to adapt the voltage level inbetween network parts of different rated voltages, for example 30kV or 60kV on the high voltage side and 6kV or 10kV on the low voltage side. Those transformers have typically a rated power in the range of 0,5MVA to 10MVA and are of the type of a dry transformer. The windings of such dry transformers are typically resin casted so that each coil is comparable to a solid hollow cylinder wherein vibration inbetween adjacent loops of the winding are excluded. Transformers are operated with an alternating current voltage of a certain frequency, for example 50Hz or 60Hz, thus during operation a transformer noise of mainly twice the frequency is arising as known by the man skilled in the art. Main source of noise is the transformer core itself. Comparable to a transformer also reactors produce noise during operation. A reactor comprises as well a reactor core as a reactor coil. Thus the wording "transformer" as understood within the frame of the invention covers as well a transformer as such but also reactors.

[0003] Such a noise is - dependent on the environment where the transformer is operated - highly undesirable. For noise reduction of a transformer it is state of the art to encapsulate it so that the generated noise is damped by the encapsulation. Such an encapsulation requires disadvantageously on the one hand additional material and space and on the other hand more cooling effort, since the losses of the transformer have to be dissipated through the encapsulation.

It is also known to damp the transformer as such by use of for example rubber wheels, where the transformer core is arranged on and can become moved with. In this case vibration transmission from the transformer core to the floor where the transformer is standing on is reduced, but the whole transformer is still acting as a source of noise.

[0004] Based on this state of the art it is objective of the invention, to provide a transformer with a reduced noise emission.

[0005] The problem is solved by a dry transformer of the aforementioned kind. This is characterized in that the support elements comprise damping material at least in a section so that transmission of vibrations of the transformer core to the resin casted coil is damped.

[0006] The basic idea of the invention is based on the fact, that mainly the transformer core itself and not the transformer coils are the source of vibration. By replacing the typically already existing stiff support elements with support elements comprising damping material a damping is easily realized. Suitable damping material is for example a rubber material. By damping the transformer coils relative to the transformer core vibration transmission from the transformer core to the transformer coils is significantly reduced. Thus according to the invention vibration of the coils is advantageously reduced and emission of noise is also reduced therewith. Compared with an encapsulation of a transformer existing noise is not damped, moreover the size of the vibrating surface is reduced so that less noise is produced.

[0007] Of course the same effect is gained if the weight of the transformer coils is not carried directly by the transformer core itself, it is also possible that the weight of the transformer coils is carried - also in part - by some mounting elements, for example a lower press bar of the transformer. Inbetween the mounting elements and the transformer coils the support elements with damping material are foreseen. In the end a mechanical decoupling from the vibrating transformer core to the transformer coils has to be gained.

[0008] Base condition for the invention is the use of a resin casted coil. This means that the transformer coil has to have a solid, stable form of preferably a hollow cylinder which is not a swinging system itself. The resin of the transformer coil might be enforced with fiber for example and is fixing each winding loop of the transformer coil to each other. So it is ensured that - if the coil is mechanically damped on its lower side - in principal the whole coil is damped.

[0009] According to a further embodiment of the invention at least one resin casted coil is arranged in upright position wherein the support elements are foreseen at the lower side of the resin casted coil. The upright position of a transformer coil is the most typical working position. Thus, if support elements are foreseen at the lower end of the transformer coil, the whole weight of the transformer coil is carried by the support elements with damping material and a mechanical decoupling inbetween transformer core and transformer coil is gained.

[0010] According to a further embodiment of the invention fixing elements are foreseen, which are fixing the resin casted coil relative to the transformer core by applying a pressure force and which comprise damping material at least in a section. Thus on one side a better fixation of the transformer coil is gained but on the other side transformer core and transformer coil are still mechanically decoupled by use of the damping material.

[0011] According to a further embodiment of the invention the fixing elements are foreseen at the upper side of the resin casted coil. Thus a kind of clamping effect is realized for fixing the coil in a desired position.

[0012] According to another embodiment fixing elements are foreseen in radial direction inbetween the inner of the hollow-cylindrical resin casted coil and the part of the transformer core extending there through, typically a respective limb. Thus it is also possible to tilt the transformer, for example for purpose of transportation. In case of a horizontal arrangement of the transformer coil during operation those radial fixing elements would have the function of support elements carrying the weight of the transformer coil to the transformer core.

[0013] According to another embodiment of the invention the transformer core and/or its mounting elements are arranged on damping elements wearing the whole weight of the transformer. In this case the vibrating transformer core is arranged completely damped. On one side the production of noise is reduced by mechanical decoupling the transformer core from the transformer coils and on the other side the transformer core is also decoupled from the ground area where it is arranged, so that the ground area does not vibrate and emits noise therewith.

[0014] According to a further embodiment of the invention the transformer core and/or its mounting elements are arranged on wheels with damping characteristic wearing the whole weight of the transformer. Wheels are used to make the transformer moveable from one location to another. Making the wheels of rubber material brings additional damping into the vibrating system and reduces noise emission in an advantageous way.

[0015] Further advantageous embodiments of the invention are mentioned in the dependent claims.

[0016] The invention will now be further explained by means of an exemplary embodiment and with reference to the accompanying drawings, in which:

Figure 1 shows an exemplary dry transformer with support elements comprising damping material,

Figure 2 shows a sectional view of transformer core extending through resin casted coil,

Figure 3 shows a dry transformer on wheels.

[0017] Figure 1 shows an exemplary dry transformer 10 with support elements 18, 26 comprising damping material such as a rubber material. The dry transformer comprises a transformer core 16 with three limbs and two yokes. Around each limb a hollow-cylindrical resin casted coil 12, 14 is arranged, which comprises in this example as well a primary as a secondary winding. The resin casted coils 12, 14 are in the upright position as indicated with the dotted line 32. At the lower and upper yoke of the transformer core 16 respective pressbars 20, 22 are foreseen to give the transformer core 16 an improved stability. Due to the stiff connection the pressbars 20, 22 are subject to the same vibrations than the transformer core 16 itself.

[0018] The resin casted coils 12, 14 are supported by the support elements 18, 26, which carry the whole weight of the resin casted coils 12, 14 and which comprise a damping material like rubber to mechanically decouple transformer core 16 and resin casted coils 12, 14. The support elements with reference number 18 carry the respective share of the weight of the transformer coils 12, 14 to the transformer core 16, whereas the support elements with reference number 26 are slightly prolonged and carry the respective share of weight to the respective lower pressbar 20. On the upper side of the resin casted coils 12, 14 fixing elements 24 are foreseen, which comprise damping material and which apply a pressure force on the resin casted coils 12, 14, which are fixed therewith.

[0019] The whole transformer is arranged on damping elements 28 respectively damping mats, which are foreseen inbetween lower pressbar 20 and floor 30 in this case. Thus the vibrating transformer core is mechanically decoupled from the transformer coils 12, 14 and the floor 30 so that a noise reduction is gained.

[0020] Figure 2 shows a sectional view of transformer core extending through resin casted coil in a sketch 40. A primary 42 and secondary 44 winding section of an exemplary resin casted coil is arranged around a limb 46 of a transformer core. Inbetween primary and secondary winding a cooling channel with not shown spacer elements is foreseen. Fixing elements 48 with damping material such as rubber are foreseen for the radial fixation of the coil. It is as well possible to handle primary 42 and secondary 44 winding as individual coils with separate support elements as to handle them together as one resin casted part.

[0021] Figure 3 shows an exemplary dry transformer in a sketch 50. The transformer is similar to the transformer shown in figure 1, but in this the transformer is arranged on rubber wheels 54, which are wearing the whole weight of the transformer. Additionally optional damping elements 52 are foreseen for each wheel, which also are wearing the whole weight of the transformer. Thus vibrations of the transformer are damped in an advantageous way and noise emission is reduced therewith.

List of reference signs

10	exemplary dry transformer with support elements comprising damping material
12	first hollow-cylindrical resin casted coil
14	second hollow-cylindrical resin casted coil
16	transformer core
18	support element comprising damping material at lower side of coil
20	first mounting element (lower pressbar)
22	second mounting element (upper pressbar)
24	fixing element comprising damping material at lower upper side of coil
26	further support element comprising damping material at lower side of coil

(continued)

	28	damping element
	30	floor
5	32	orientation of resin casted coils
	40	sectional view of transformer core extending through resin casted coil
	42	first winding of resin casted coil
	44	second winding of resin casted coil
10	46	limb of transformer core
	48	fixing element between resin casted coil and limb of transformer core
	50	dry transformer on wheels
	52	damping element
15	54	rubber wheels

Claims

1. Dry transformer (10), comprising at least one hollow-cylindrical resin casted coil (12, 14) and a transformer core (16, 46) extending at least in part there through, wherein support elements (18, 26) are foreseen to carry the weight of the resin casted coil (12, 14) to the transformer core (16) respectively to mounting elements (20) connected therewith,
characterized in that
the support elements (18, 26) comprise damping material at least in a section so that transmission of vibrations of the transformer core (16, 46) to the resin casted coil (12, 14) is damped.
2. Dry transformer according to claim 1, **characterized in that** the at least one resin casted coil (12, 14) is arranged in upright position wherein the support elements (18, 26) are foreseen at the lower side of the resin casted coil (12, 14).
3. Dry transformer according to claim 2, **characterized in that** fixing elements (24, 48) are foreseen, which are fixing the resin casted coil (12, 14) relative to the transformer core (16, 46) by applying a pressure force and which comprise damping material at least in a section.
4. Dry transformer according to claim 3, **characterized in that** the fixing elements (24) are foreseen at the upper side of the resin casted coil.
5. Dry transformer according to claim 3 or 4, **characterized in that** fixing elements (48) are foreseen in radial direction inbetween the inner of the hollow-cylindrical resin casted coil (12, 14) and the part of the transformer core (16, 46) extending there through.
6. Dry transformer according to any of the previous claims, **characterized in that** the transformer core (16, 46) and/or its mounting elements (20) are arranged on damping elements (28, 52) wearing the whole weight of the transformer.
7. Dry transformer according to any of the previous claims, **characterized in that** the transformer core (16, 46) and/or its mounting elements (20) are arranged on wheels with damping characteristic (54) wearing the whole weight of the transformer.

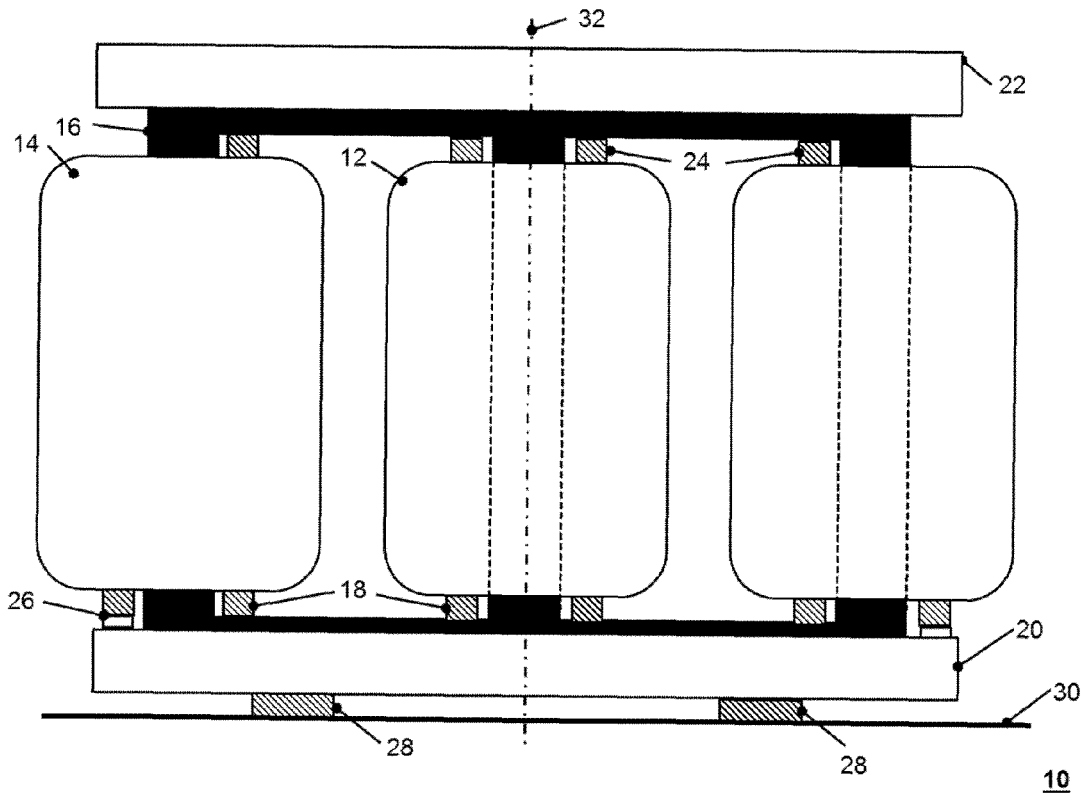


Fig. 1

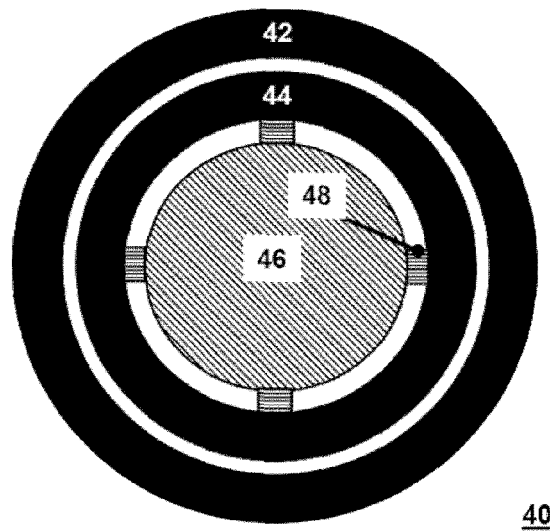
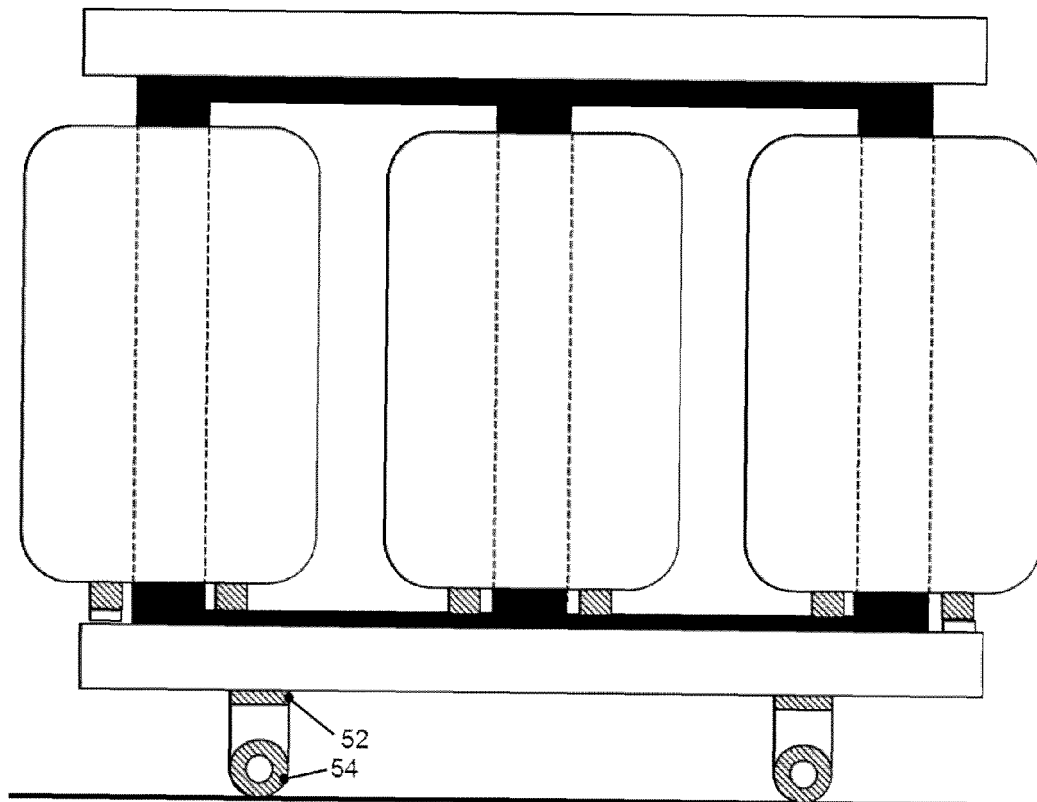


Fig. 2



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Fig. 3



EUROPEAN SEARCH REPORT

 Application Number
 EP 13 16 3557

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	GB 1 426 217 A (TRANSFORMATOREN UNION AG) 25 February 1976 (1976-02-25) * page 1, lines 9 - 35 * * page 1, lines 76 - 95 * * page 2, line 72 - page 3, line 7 * * page 3, lines 21 - 49 * * figure 1 * -----	1-7	INV. H01F27/32 H01F27/33
			TECHNICAL FIELDS SEARCHED (IPC)
			H01F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 July 2013	Examiner Van den Berg, G
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