(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 043 362 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.07.2016 Bulletin 2016/28

(51) Int Cl.:
H01F 30/12 *(2006.01)*

(21) Application number: **15150285.3**

(22) Date of filing: **07.01.2015**

(84) Designated Contracting States:
AL 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 RS SE SI SK SM TR
Designated Extension States:
BA ME

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

(72) Inventors:
- **Buschmann, Irma**
  59929 Brilon (DE)
- **Carlen, Martin**
  5443 Niederrohrdorf (CH)
- **Cornelius, Frank**
  59929 Brilon (DE)
- **Tepper, Jens**
  59929 Brilon (DE)

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

(54) Voltage-regulation-transformer

(57) The invention is related to a voltage-regulation-transformer (10), comprising a transformer core (40) and a first group (12, 72) of three hollow cylindrical coils (14, 16, 18), wherein the transformer core (40) comprises three parallel limbs (54, 56, 58) extending along three parallel limb axis (34, 36, 38), wherein the transformer core (40) comprises a first (42) and a second (46) parallel yoke section connecting the respective first and the respective second ends of the limbs (54, 56, 58) and wherein each coil (14, 16, 18) of the first group (12, 72) is arranged around a respective limb (54, 56, 58). The transformer core (40) comprises three further limbs (60, 62, 64) that's respective first ends are connected with the second yoke section (46) and that's respective second ends are connected with a third yoke section (50), which is arranged in parallel to the first (42) and second (46) yoke section and a second group (20, 78) of three hollow cylindrical coils (22, 24, 26) is foreseen, wherein each coil of the second group is arranged around one of the respective further limbs (60, 62, 64).

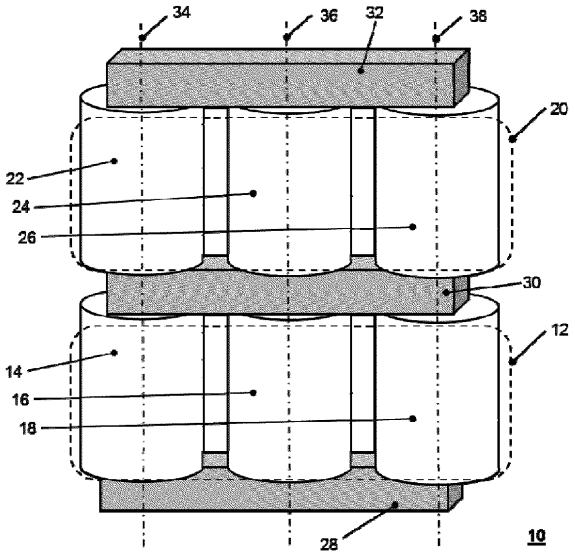

Fig. 1

EP 3 043 362 A1

Description

[0001] The invention is related to a voltage-regulation-transformer, comprising a transformer core and a first group of three hollow cylindrical coils, wherein the transformer core comprises three parallel limbs extending along three parallel limb axis, wherein the transformer core comprises a first and a second parallel yoke section connecting the respective first and the respective second ends of the limbs and wherein each coil of the first group is arranged around a respective limb.

[0002] It is known that in an electric distribution network the voltage level has to be kept within a certain tolerance band around the respective rated voltage. Dependent on the network topology and the flow of active respectively reactive power the admitted tolerance band of voltage is subject to be left.

[0003] In order to keep the voltage level in distribution networks within a desired range around the nominal voltage of the respective part of the distribution network - for example a nominal voltage level of 10kV - it is known to provide tap changers for the distribution transformers of the distribution network.

[0004] Tap changers have the ability to adapt the voltage ratio of a transformer, for example with a rated voltage of 36kV on the primary side and 6kV on the secondary side and with a rated power of 1 MVA, within a certain range, so that the voltage on the output side of the transformer is within a desired range around the nominal voltage.

[0005] It is also known that especially for long transmission lines, for example with a length of 10km or more, a continuous voltage drop or even a voltage rise along the transmission line might occur dependent on the actual load or generation conditions. In this case it might not be possible to provide a voltage level along the whole length of the transmission line which is within an admitted tolerance level around the nominal voltage for each location. So at one end of the transmission line the voltage level might be below the admitted tolerance band even on the other end the voltage level is at the upper edge of the admitted tolerance band.

[0006] In order to handle also those cases Line Voltage Regulation (LVR) devices with a feeder and booster transformer are known. The booster transformer is electrically in series with a transmission line that's voltage level is subject to be for example too low at its one end. The booster transformer is adding a controlled voltage to the voltage at the one end of the transmission line so that the output voltage of the booster transformer is within the acceptable tolerance band. The booster transformer is supplied by a feeder transformer by means of an intermediate circuit, wherein the feeder transformer itself is supplied by the transmission line, that's voltage level is not within the admitted tolerance band.

[0007] So on one hand the voltage level at the end of the transmission line will drop once again by the additional load of the feeder transformer, but on the other hand this effect will be more than compensated by the additional voltage of the booster transformer. Booster- and feeder- transformer are typically designed as two fully separated transformers with the same power rating.

[0008] Disadvantageously in this state of the art is that in conventional line voltage regulation systems a significant part of the footprint is used for the feeder and booster transformer so that those systems have a rather large size.

[0009] It is objective of the invention to provide a compact transformer solution for Line Voltage Regulation (LVR) devices with a reduced size. This problem is solved by a voltage-regulation-transformer of the aforementioned kind.

[0010] This is characterized in that the transformer core comprises three further limbs that's respective first ends are connected with the second yoke section and that's respective second ends are connected with a third yoke section, which is arranged in parallel to the first and second yoke section and in that a second group of three hollow cylindrical coils is foreseen, wherein each coil of the second group is arranged around one of the respective further limbs.

[0011] The basic idea of the invention is to arrange the two groups of coils of the two transformers for a line voltage regulation device - the booster and the feeder transformer - on the same transformer core with a common used center yoke, in this case the second yoke area. The first group of coils corresponds to the coils of a feeder transformer and the second group of coils corresponds to the coils of a booster transformer.

[0012] Due to the coupling of both transformers respectively groups of coils by means of the intermediate circuit, the current flow through the respective involved windings of first and second group of coils is equal. Hence also the magnetic flux within the yokes of the transformer core caused by the current flow through the first and the second groups of windings is in principal equal at least concerning the absolute value of the respective magnetic flux vectors.

[0013] In case that the groups of coils are arranged in that way, that the magnetic flux caused by the first and second group of coils is opposed each to each other, the magnetic flux in the second yoke area respectively in the common used center yoke is reduced, in the ideal case to zero.

[0014] Thus it becomes possible to reduce the cross section of the center yoke without exceeding an acceptable level of magnetic flux density there through compared to the sum of the respective yoke cross sections of separate feeder and booster transformers. The size of the transformer and the required amount of core material is reduced therewith in an advantageous way.

[0015] A further effect of the reduced magnetic flux in the common center yoke are reduced no-load losses. Additionally a reduction of the sound- respectively vibration level of the voltage-regulation-transformer according to the invention is gained. Also the effort for cabling be-

tween the different groups of coils is reduced when arranging them on the same transformer core.

[0016] According to another embodiment of the invention the cross section of the yoke(s) in the second yoke section is (a) equal or (b) less compared with the cross section of the yoke(s) in the first or third yoke section. Variant (a) implies a reduction of the cross section of the center yoke by 50% compared to the sum of respective yoke cross sections of a single feeder and a single booster transformer wherein additional advantages concerning reduced losses and sound emission are gained. Variant (b) implies a further reduction of the cross section of the center yoke wherein the effect of the additional advantages might be reduced therewith.

[0017] According to another embodiment of the invention the further limbs extend along the three parallel limb axes where also the first three limbs are extending along. Thus the geometry of the core sections for first and second group of coils is equal. Additionally the footprint required for the voltage-regulation-transformer is reduced in an advantageous way since both transformer core sections are stacked on top of each other.

[0018] According to another embodiment of the voltage-regulation-transformer the three parallel limb axes are arranged within the same plane. So a space-saving flat design of the voltage-regulation-transformer is gained. Of course also other designs such as triangular are possible.

[0019] According to another embodiment of the invention each coil of a group of three hollow cylindrical coils comprises a primary and a secondary single-phase winding which are electrically connected in respective vector-groups to a three-phase primary and secondary winding. A vector group might be triangular (D) or star-like (Y) for example. In a preferred embodiment of the invention all single-phase windings have terminals for their electrical connection and are not brought together directly in the voltage-regulation-transformer (Group IIIiii0). Moreover they are indirectly brought together by the neutral point treatment of the respective network they are connected with.

[0020] According to another embodiment of the invention the vector-groups of the first and second group of coils are identical.

[0021] Thus a preferred combination is:

Group 1: IIIiii0 Group 2: IIIiii0

[0022] This embodiment enables in an easy way to arrange the coils in that way, that the flux through the common center yoke caused by the first group of coils is opposed to the flux caused by the second group of coils if the voltage-regulation-transformer is used as feeder-booster- transformer combination. In order to gain an opposed magnetic flux direction respective couples of coils of first and second group for the same electric phase should be arranged along the same limb axis.

[0023] According to another embodiment of the invention the first and the second group of coils are rated for at least approximately the same power. This is also of advantage for the use as feeder- booster- transformer combination, since in this case both groups of coils are loaded with the same power due to the coupling in an intermediate circuit.

[0024] According to another variant of the invention the secondary winding of the first group of coils is electrically connected with the primary winding of the second group of coils in an intermediate circuit and the secondary winding of the second group of coils is foreseen to be connected in series with an electrical component to be supplied. This is a suitable kind of connection of the first and second group of coils to a feeder-booster- transformer combination as it is required for a Line Voltage Regulation (LVR) device.

[0025] According to a further embodiment of the invention the secondary winding of the first group of coils is provided with taps, so that the current flow through the intermediate circuit is influenceable by selecting a respective tap. In order to regulate the voltage added by the secondary winding of the second group of coils the current flow through the intermediate circuit has to be influenced. If for example the secondary winding of the first group of coils is foreseen over its whole electrical length in equidistant sections with taps - for example 10 in total - the current through the intermediate circuit can be influenced from zero (lowest tap) to maximum (highest tap).

[0026] According to another embodiment of the invention first and second groups of coils are electrically connected in that way, that the magnetic flux through the yokes of the second yoke section caused by the first group of coils is opposed to the magnetic flux through the yokes of the second yoke section caused by the second group of coils if used as feeder- and booster transformer combination. Thus the cross section of the common used center yoke in the second yoke section can be reduced in an advantageous way.

[0027] The problem of the invention is also solved by a voltage-regulation-transformer, comprising a transformer core and a first hollow cylindrical coil,

- wherein the transformer core comprises two parallel limbs extending along two parallel limb axis,
- wherein the transformer core comprises a first and a second parallel yoke section connecting the respective first and the respective second ends of the limbs,
- wherein the first hollow cylindrical coil is arranged around a respective limb,
- the transformer core comprises two further limbs that's respective first ends are connected with the second yoke section and that's respective second ends are connected with a third yoke section, which is arranged in parallel to the first and second yoke section,

- a second hollow cylindrical coil is foreseen which is arranged around one of the respective further limbs,
- each coil comprises a primary and a secondary single-phase winding,
- the secondary winding of the first coil is electrically connected with the primary winding of the second coil in an intermediate circuit,
- the secondary winding of the second coil is foreseen to be connected in series with an electrical component to be supplied and
- the cross section of the yoke(s) in the second yoke section is equal or less compared with the cross section of the yoke(s) in the first or third yoke section.

[0028] The advantages of this single phase arrangement correspond to the advantages of the respective embodiments of the three-phase arrangement as disclosed above.

[0029] Further advantageous embodiments of the invention are mentioned in the dependent claims.

[0030] 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 voltage-regulation-transformer,
Figure 2 shows an exemplary transformer core and
Figure 3 shows a voltage-regulation-transformer with intermediate circuit.

[0031] Figure 1 shows an exemplary voltage-regulation-transformer 10 in a three-dimensional view. A first group 12 of hollow cylindrical coils 14, 16, 18 is arranged on three parallel limbs of a transformer core, which are extending along three parallel limb axes 34, 36, 38. Each of the coils 14, 16, 18 comprises a single-phase primary and secondary winding. The primary windings are electrically arranged in a star (Y) connection and the secondary windings are also arranged in a star (Y) connection which can't be seen in this drawing. On both axial ends of the limbs respectively coils 14, 16, 18 a first yoke 28 respectively a second yoke 30 is foreseen.

[0032] Also extending along the three limb axis 34, 36, 38 and above the second yoke 30 further limbs of the transformer core are foreseen. On those further limbs a second group 20 of hollow cylindrical coils 22, 24, 26 is arranged. The further limbs are connected at their upper end with a third yoke 32 which is in parallel to the first 28 and second 30 yoke. The cross section of all three yokes 28, 30, 32 is equal. Each of the coils 22, 24, 26 comprises a single-phase primary and a single-phase secondary winding.

[0033] Figure 2 shows an exemplary transformer core 40 from a side view. The transformer core 40 comprises three couples of limbs (54, 60; 56, 62; 58, 64) which are extending one above each other along three respective limb axes. At the respective axial ends of the limbs 54, 60; 56, 62; 58, 64 respective yoke sections 42, 46, 50 are indicated which are extending perpendicular to the axial extension of the limbs 54, 60; 56, 62; 58, 64. Each yoke section 42, 46, 50 is represented by a respective yoke 44, 48, 52 but can of course comprise more than one yoke, for example in case of a triangular transformer core. The transformer core consists in this example mainly of insulated stacked metal sheets. All yokes 44, 48, 52 and limbs 54, 60; 56, 62; 58, 64 have the same cross section in this example.

[0034] Figure 3 shows a voltage-regulation-transformer with intermediate circuit in an electrical sketch 70. The sketch is drawn in a single phase view, but it has to be remarked, that all components are three-phase. The sketch shows the principal circuit of a Line Voltage Regulation (LVR) device. At its input side an input voltage 86, for example at the end of a transmission line that's voltage has to be controlled, is provided. At the output side of the LVR device a controlled voltage 88 is provided which differs from the input voltage 86 by a booster voltage 90.

[0035] The booster voltage 90 is added by means of a secondary winding 82 of a second group of coils 78, which is used as a booster transformer. An intermediate circuit 84 is foreseen to drive a current through the primary winding 80 of the second group of coils 78 respectively the booster transformer. The current within the intermediate circuit 84 is driven by the primary 74 and secondary 76 winding of a first group of coils 72, which is used as a feeder transformer. The primary winding 74 is connected with the input of the LVR device. Dependent on the current through the intermediate circuit 84, which is for example controllable by a selection of respective taps of the secondary winding 76 of the feeder transformer, a voltage 90 is added to the input voltage 86 and provided as voltage 88 at the output of the LVR device. An LVR device might be foreseen to add +/- 10% of the rated voltage of a transmission line.

List of reference signs

[0036]

10 exemplary voltage-regulation-transformer
12 first group of hollow cylindrical coils
14 first coil of first group
16 second coil of first group
18 third coil of first group
20 second group of hollow cylindrical coils
22 first coil of second group
24 second coil of second group
26 third coil of second group
28 first yoke of first yoke section
30 first yoke of second yoke section
32 first yoke of third yoke section
34 first limb axis
36 second limb axis
38 third limb axis
40 exemplary transformer core

42 first yoke section
44 first yoke of first yoke section
46 second yoke section
48 first yoke of second yoke section
50 third yoke section
52 first yoke of third yoke section
54 first limb
56 second limb
58 third limb
60 first further limb
62 second further limb
64 third further limb
70 voltage-regulation-transformer with intermediate circuit
72 windings of first group of coils
74 primary winding of first group of coils
76 secondary winding of first group of coils
78 windings of second group of coils
80 primary winding of second group of coils
82 secondary winding of second group of coils
84 intermediate circuit
86 input voltage
88 output voltage
90 booster voltage

Claims

1. Voltage-regulation-transformer (10), comprising a transformer core (40) and a first group (12, 72) of three hollow cylindrical coils (14, 16, 18),

- wherein the transformer core (40) comprises three parallel limbs (54, 56, 58) extending along three parallel limb axis (34, 36, 38),
- wherein the transformer core (40) comprises a first (42) and a second (46) parallel yoke section connecting the respective first and the respective second ends of the limbs (54, 56, 58),
- wherein each coil (14, 16, 18) of the first group (12, 72) is arranged around a respective limb (54, 56, 58),

characterized in that

- the transformer core (40) comprises three further limbs (60, 62, 64) that's respective first ends are connected with the second yoke section (46) and that's respective second ends are connected with a third yoke section (50), which is arranged in parallel to the first (42) and second (46) yoke section,
- a second group (20, 78) of three hollow cylindrical coils (22, 24, 26) is foreseen, wherein each coil of the second group is arranged around one of the respective further limbs (60, 62, 64).

2. Voltage-regulation-transformer according to claim 1, **characterized in that** the cross section of the yoke(s) (30, 48) in the second yoke section (46) is equal or less compared with the cross section of the yoke(s) (28, 44, 32, 52) in the first (42) or third (50) yoke section.

3. Voltage-regulation-transformer according to claim 1 or 2, **characterized in that** the further limbs (60, 62, 64) extend along the three parallel limb axis (34, 36, 38).

4. Voltage-regulation-transformer according to any of the previous claims, **characterized in that** the three parallel limb axis (34, 36, 38) are arranged within the same plane.

5. Voltage-regulation-transformer according to any of the previous claims, **characterized in that** each coil (14, 16, 18, 22, 24, 26) of a group (12, 20, 72, 78) of three hollow cylindrical coils comprises a primary and a secondary single-phase winding which are electrically connected in respective vector-groups to a three-phase primary (74, 80) and secondary (76, 82) winding.

6. Voltage-regulation-transformer according to claim 5, **characterized in that** the vector-groups of the first (12, 72) and second (20, 78) group of coils are identical.

7. Voltage-regulation-transformer according to claim 5 to 6, **characterized in that** the first (12, 72) and second (20, 78) group of coils are rated for at least approximately the same power.

8. Voltage-regulation-transformer according to claim 5 to 7, **characterized in that**

- the secondary winding (76) of the first group (12, 72) of coils is electrically connected with the primary winding (80) of the second group (20, 78) of coils in an intermediate circuit (84),
- the secondary winding (82) of the second group (20, 78) of coils is foreseen to be connected in series with an electrical component to be supplied.

9. Voltage-regulation-transformer according to claim 8, **characterized in that** the secondary winding (76) of the first group (12, 72) of coils is provided with taps, so that the current flow through the intermediate circuit (84) is influenceable by selecting a respective tap.

10. Voltage-regulation-transformer according to claim 8 or 9, **characterized in that** the first (12, 72) and second (20, 78) groups of coils are electrically connected **in that** way, that the magnetic flux through the

yokes (30, 48) of the second yoke section (46) caused by the first group (12, 72) of coils is opposed to the magnetic flux through the yokes (30, 48) of the second yoke section (46) caused by the second group (20, 78) of coils.

11. Voltage-regulation-transformer (10), comprising a transformer core (40) and a first hollow cylindrical coil (14, 16, 18),

- wherein the transformer core (40) comprises two parallel limbs (54, 56, 58) extending along two parallel limb axis (34, 36, 38),
- wherein the transformer core (40) comprises a first (42) and a second (46) parallel yoke section connecting the respective first and the respective second ends of the limbs (54, 56, 58),
- wherein the first hollow cylindrical coil (14, 16, 18) is arranged around a respective limb (54, 56, 58),

characterized in that

- the transformer core (40) comprises two further limbs (60, 62, 64) that's respective first ends are connected with the second yoke section (46) and that's respective second ends are connected with a third yoke section (50), which is arranged in parallel to the first (42) and second (46) yoke section,
- a second hollow cylindrical coil (22, 24, 26) is foreseen which is arranged around one of the respective further limbs (60, 62, 64),
- each coil (14, 16, 18, 22, 24, 26) comprises a primary and a secondary single-phase winding,
- the secondary winding (76) of the first coil (14, 16, 18) is electrically connected with the primary winding (80) of the second coil (22, 24, 26) in an intermediate circuit (84),
- the secondary winding (82) of the second coil (22, 24, 26) is foreseen to be connected in series with an electrical component to be supplied,
- the cross section of the yoke(s) (30, 48) in the second yoke section (46) is equal or less compared with the cross section of the yoke(s) (28, 44, 32, 52) in the first (42) or third (50) yoke section.

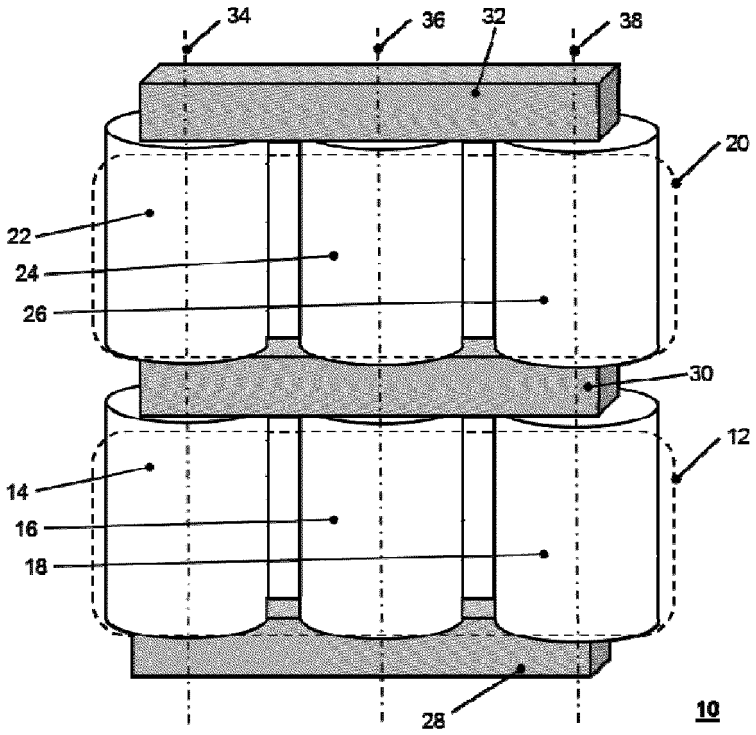
34
36
32
38
20
22
24
26
30
12
14
16
18
28
10

Fig. 1

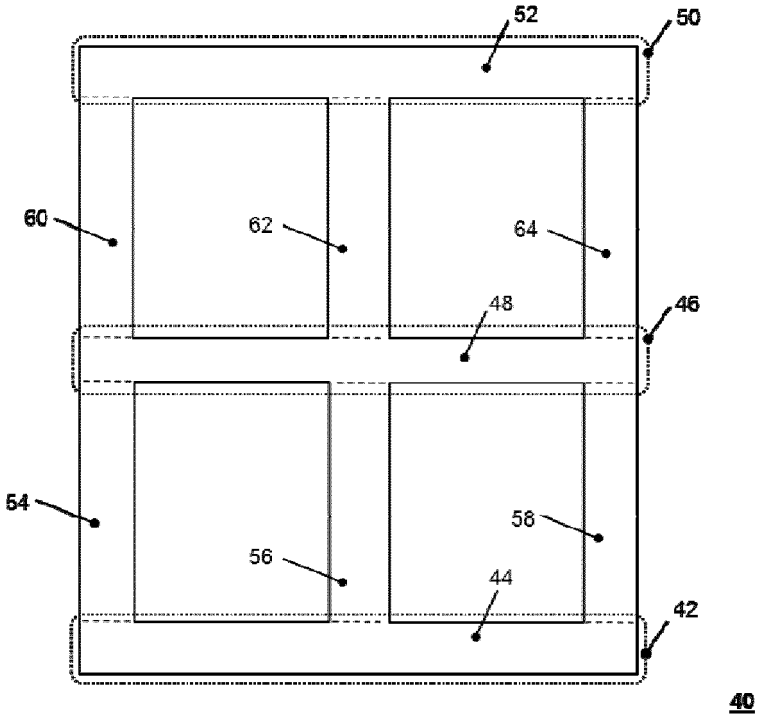
52
50
60
62
64
48
46
54
58
56
44
42
40

Fig. 2

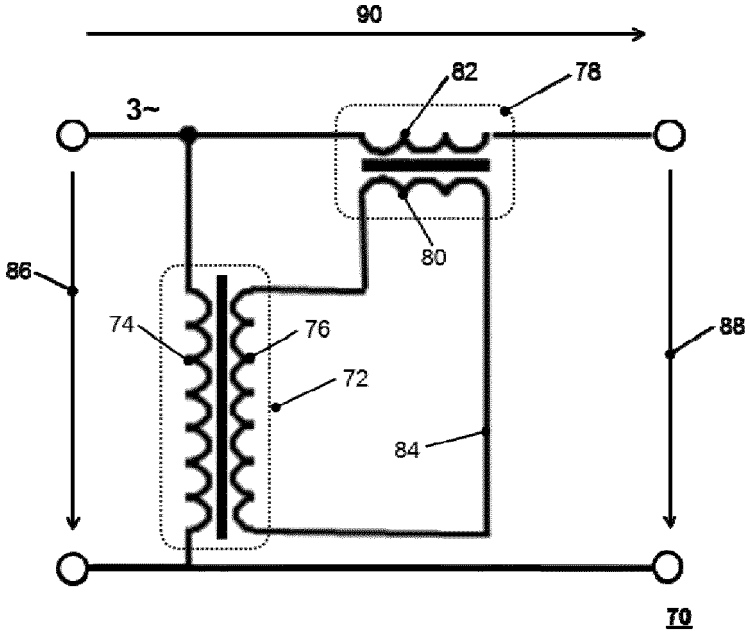

Fig. 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 15 0285

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	SU 1 148 507 A1 (INST ELEKTROSWARKI PATONA [SU]) 23 September 1992 (1992-09-23) * the whole document *	1-4	INV. H01F30/12
X	US 5 182 535 A (DHYANCHAND P JOHN [US]) 26 January 1993 (1993-01-26) * column 4, line 57 - line 67; figures 3,5,6,7 *	1-11	
X	US 2 127 232 A (NICHOLS LOUIS C) 16 August 1938 (1938-08-16) * column 6, line 71 - line 75; figure 3 *	1-11	
X	JP H01 179405 A (FUJI ELECTRIC CO LTD) 17 July 1989 (1989-07-17) * abstract; figure 1 *	1-11	
X	US 2 418 643 A (MARTIN HUGE HENRY) 8 April 1947 (1947-04-08) * figure 6 *	1-11	
X	FR 1 285 901 A (ERWIN PIERRE JUNG) 2 March 1962 (1962-03-02)	1	TECHNICAL FIELDS SEARCHED (IPC)
A	* abstract; figure 2 *	2-11	H01F
X	FR 2 126 900 A1 (SITELEC [FR]) 13 October 1972 (1972-10-13)	1	
A	* figure 1 *	2-11	
X	FR 2 506 064 A1 (WESTINGHOUSE ELECTRIC CORP [US]) 19 November 1982 (1982-11-19)	1	
A	* figure 2 *	2-11	
X	US 2003/088967 A1 (HOBSON BARRY REGINALD [AU] ET AL) 15 May 2003 (2003-05-15)	1	
A	* figure 3 * * paragraph [0058] *	2-11	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 July 2015	Rouzier, Brice

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

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 15 0285

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 4 488 136 A (HANSEN IRVIN L [US] ET AL) 11 December 1984 (1984-12-11)	1	
A	* abstract; figure 6 *	2-11	
X	GB 907 338 A (SIEMENS REINGER WERKE AG) 3 October 1962 (1962-10-03)	1	
A	* the whole document *	2-11	
X	GB 423 618 A (SIEMENS AG) 5 February 1935 (1935-02-05)	1	
A	* figures 1,2 *	2-11	
A	WO 2013/132131 A1 (TORYTRANS S L [ES]) 12 September 2013 (2013-09-12) * abstract; figures 1,2,7 *	1-11	
X	WO 2012/103152 A2 (SHUDAREK TODD ALEXANDER [US]; WALCOTT WAYNE [US]; RUTHER WESLEY [US]) 2 August 2012 (2012-08-02)	1	
A	* abstract; figures 2a-3 *	2-11	
A	WO 2010/136033 A1 (VESTAS WIND SYSTEM AS [DK]; TRIPATHI ANSHUMAN [SG]; OPINA GIL LAMPONG) 2 December 2010 (2010-12-02) * figures 2,4,10 *	2-11	TECHNICAL FIELDS SEARCHED (IPC)
A	US 2006/250207 A1 (SHUDAREK TODD A [US]) 9 November 2006 (2006-11-09) * abstract; figures 8,9 *	1-11	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 July 2015	Rouzier, Brice

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 15 0285

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-07-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SU 1148507 A1	23-09-1992	NONE	
US 5182535 A	26-01-1993	NONE	
US 2127232 A	16-08-1938	NONE	
JP H01179405 A	17-07-1989	JP H0834158 B2	29-03-1996
		JP H01179405 A	17-07-1989
US 2418643 A	08-04-1947	NONE	
FR 1285901 A	02-03-1962	NONE	
FR 2126900 A1	13-10-1972	NONE	
FR 2506064 A1	19-11-1982	BE 893234 A1	18-11-1982
		BR 8202844 A	26-04-1983
		ES 8305965 A1	16-07-1983
		FR 2506064 A1	19-11-1982
		IN 161003 A1	12-09-1987
		JP S584912 A	12-01-1983
		JP H0243324 B2	28-09-1990
		NO 821547 A	19-11-1982
US 2003088967 A1	15-05-2003	NONE	
US 4488136 A	11-12-1984	NONE	
GB 907338 A	03-10-1962	BE 598462 A1	14-04-1961
		DE 1110299 B	06-07-1961
		FR 1287393 A	16-03-1962
		GB 907338 A	03-10-1962
GB 423618 A	05-02-1935	NONE	
WO 2013132131 A1	12-09-2013	EP 2824788 A1	14-01-2015
		ES 2425300 A1	14-10-2013
		US 2015054611 A1	26-02-2015
		WO 2013132131 A1	12-09-2013
WO 2012103152 A2	02-08-2012	AU 2012209150 B2	23-04-2015
		CA 2825476 A1	02-08-2012
		CO 6831977 A2	10-01-2014
		US 2012256719 A1	11-10-2012
		WO 2012103152 A2	02-08-2012

EPO FORM P0459

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

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 15 0285

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-07-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010136033 A1	02-12-2010	NONE	
US 2006250207 A1	09-11-2006	AU 2006201301 A1	23-11-2006
		CA 2541211 A1	03-11-2006
		CA 2756595 A1	03-11-2006
		US 2006250207 A1	09-11-2006

EPO FORM P0459

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