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(54) **CURRENT TRANSFORMER HAVING SECONDARY TRANSFORMATION COMPONENTS INTO ITS BASE**

(57) The invention relates to an electrical current transformer for measuring the intensity of an electrical main current of a power line, comprising:

- a head (4) comprising a main toroidal core (8) with a winding, this main toroidal core (8) being intended to be traversed by the main electrical current to form a first stage (7) of current transformation ;
- a hollow electrically insulating column (3) having an extremity carrying the head (4) ;
- a base (2) carrying the hollow electrically insulating column (3) ;
- electrical conductors (13) extending in the hollow insulated column (3) from the winding of the main core (8) to the base (2) ;
- one secondary stage (19) of current transformation in the base (2) connected to the electrical conductors (13) to convert the main current of the power line firstly in the head (4) of the transformer (1) and secondly in the base (2) of the transformer.

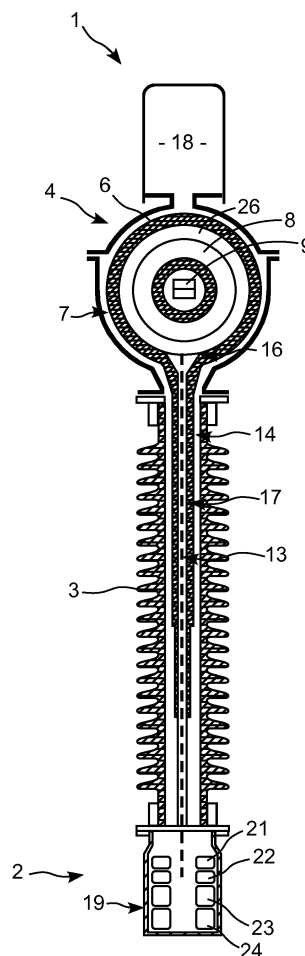


FIG. 2

Description

TECHNICAL FILED

[0001] The invention relates to a current transformer also called instrument transformer, which is used for measuring an alternating electric main current of an electrical power line transferring current at high intensity and under high voltage, such as for example a power line conveying the electric current from a power plant to a town.

STATE OF PRIOR ART

[0002] When wanting to measure electric currents having an intensity of several hundreds of amperes, it is not possible to install a current sensor directly to the electrical power line, since common current sensors are not able to sustain such high levels of intensity.

[0003] For this reason, a current transformer is used to convert linearly at fixed rate the main current carried by the electrical power line into an output current having a lower intensity. The conversion rate can be for example 400/1, converting a main current of 400 amperes to an output current of 1 ampere, which means that if the effective main current in the electrical power line is of for example 200 amperes, the current output by the transformer will be 0.5 ampere.

[0004] A current sensor connected to the output of the transformer can be used to determine the intensity of the current provided by the transformer, and to deduce the intensity of the main current of the electrical power line.

[0005] Practically, such a current transformer comprises a head which is traversed by the main current of the electrical power line, and a hollow insulating column which carries this head, this hollow insulating column being carried by a base. The head comprises a toroidal magnetic core which surrounds the path of the main current of the electrical power line, and a winding is rolled onto this magnetic core. This winding is connected to an electrical conductor which extends in the hollow insulating column, from the head where it is connected to the winding of the toroidal core, to the base. The current sensor is connected to corresponding output connectors, at the base of the transformer.

[0006] The alternating main current traversing the head of the transformer generates an alternating magnetic field in its vicinity. This alternating magnetic field which is carried by the magnetic toroidal core which links with the winding applied on it generates in the winding, the output current of the transformer.

[0007] Due to the different kinds of electrical power lines which exist, and the corresponding nominal intensities, and also due to different kinds of current sensors which are commonly used at site, the conversion rate has to be adapted for almost every case and every particular situation when designing such a current transformer.

[0008] These adaptations result in changing the number of coils of the winding and into changing the size and sectional area of the toroidal magnetic core as well. In other cases, it can be necessary to output two currents at different ratios, resulting into a design where the head comprises two toroidal cores with two corresponding windings, or more.

[0009] Since the head of the transformer requires a high level of electrical insulation between its outer metal casing and the magnetic cores, such adaptations result in significant design costs which are required to design such a transformer.

PRESENTATION OF THE INVENTION

[0010] The invention relates to an electrical current transformer for measuring the intensity of a main electrical current circulating in an electrical power line, this transformer comprising:

- a head comprising a main toroidal core with a corresponding winding, this main toroidal core being intended to be traversed by the main electrical current to form a first stage of current transformation delivering a transformed current in its winding ;
- a hollow electrically insulating column having an extremity carrying the head ;
- a base carrying the hollow electrically insulating column ;
- at least one pair of electrical conductors extending in the hollow insulated column from the winding of the main core to the base ;
- one secondary stage of current transformation in the base to convert the current provided by the winding of the main toroidal core into an output current of the transformer.

[0011] With this arrangement, adapting a given transformer to a particular conversion rate corresponding to a given specification only requires to adapt the secondary stage which is in the base of the transformer. Such a modification, in the base of the transformer, is far much easier and less costly than a modification of the components of the head of the transformer.

[0012] The invention also relates to such a transformer, wherein the secondary current transformation stage comprises a secondary toroidal core with a corresponding winding, this secondary toroidal core being traversed by the current provided by the winding of the main toroidal core, the output current of the transformer being provided by the winding of the secondary toroidal core.

[0013] The invention also relates to such a transformer, comprising in its base a plurality of secondary toroidal cores with a corresponding winding for each toroidal core to provide different output currents for the transformer.

[0014] The invention also relates to such a transformer, comprising two main cores with corresponding windings in its head, and at least two pairs of electrical conductors

extending in the hollow insulating column from the windings of the main cores to the base, in order to result in two output current of the transformer corresponding to two different transformation rates.

[0015] The invention also relates to such a transformer, comprising a central conductor extending in the middle of the main toroidal core intended to be connected to the electrical power line, in order to be traversed by the current of the electrical power line.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Figure 1 is a lateral view in section of the current converter according to the invention;

Figure 2 is a front view in section of the current converter according to the invention.

DETAILED PRESENTATION OF PARTICULAR EMBODIMENTS

[0017] The basic idea of the invention is a current transformer having a first stage of current transformation in its head and a second stage of current transformation in its base, this second stage being designed and adapted to provide the appropriate conversion rate for the whole transformer according to a given specification.

[0018] Thanks to the invention, when wanting to design a current transformer having a different conversion rate, it is only necessary to adapt the second transformation stage which is easier to modify since it is located in the base, i.e. where it is not necessary to have important electrical insulation, when compared to the electrical insulation which is required in the head.

[0019] Practically, the first stage of current transformation in the head can be designed with a standard conversion rate such as 400/5, and the second stage of transformation located in the base of the transformer can be designed for a transformation rate corresponding to the specification of the customer.

[0020] As seen in figure 1, the current transformer according to the invention which is marked as 1, comprises a base 2 which carries an insulating hollow column 3 at the extremity of which is secured the head 4 of this current transformer.

[0021] The head 4 which has a generally circular shape comprises a metallic housing 6 which encloses the first stage 7 of current transformation. This first stage comprises a main toroidal magnetic core 8 with a corresponding main winding, which is not shown on the drawings, but which comprise coils surrounding the section of the main magnetic core.

[0022] Additionally, a central electrical conductor 9 extends through the center of the main toroidal magnetic core 8 along a direction which corresponds to the axis of revolution of the main toroidal core 8. The extremities of this central conductor 9 passes through two opposite

walls of the housing 6 of the head, and comprise connecting ends 11, 12 located out of this metallic housing 6.

[0023] The electrical power line is to be secured to these connecting ends 11, 12, to ensure that the main current to be measured flows through the central conductor 9, i.e. through the central region of the main magnetic core 8. Under normal operation, the main alternating current flowing through the central conductor 9 generates an alternating magnetic field in the main toroidal core 8, resulting in an electric current circulating in the main winding.

[0024] The main core 8 and its winding are designed to provide a first transformation rate having a standard value, such as for example 400/5. It means that if the intensity of the main current in the power line is 200 amperes, the intensity of the resulting current in the main winding is of 2.5 amperes.

[0025] The main winding is connected to the base of the transformer by means of a corresponding pair of electrical conductors, represented by the dash line marked as 13, and which extends from the main core 9 to the base 2 of the transformer along the axis of revolution of the hollow insulating column 3.

[0026] As seen in figures 1 and 2, the transformer comprises an inner insulator, marked as 14, which extends from a top portion 16 located in the head 4, to a main portion 17 extending in the hollow column 3. The top portion surrounds all the main toroidal core 8 in order to isolate this main toroidal core from the housing 6 which is subjected to high levels electrical tension. The main portion 17 of the inner insulator 14 surrounds the electrical conductors 13 from the region of the head of the transformer along almost all of the length of these conductors.

[0027] The inner insulator 14 is made of a significant thickness of wrapped paper and the like, and its main portion 17 corresponds to the capacitive insulator of an electrical bushing. The whole inner space of the insulator, i.e. the space delimited by the housing 6 of the head 4 and by the hollow column 3 to which this head 4 is secured, is filled with insulating oil. A diaphragm mechanism marked as 18 is secured and connected to the top the head 4 to keep the oil at constant pressure, despite significant temperature variations inducing corresponding variations of the volume of the oil.

[0028] As seen in the figures, the base 2 of the transformer comprises the second stage of current transformation, marked as 19, which comprises in the example of the drawings four secondary toroidal magnetic cores marked as 21, 22, 23 and 24, each of which having a corresponding winding, not visible on the drawings, and made of coils surrounding it.

[0029] Each of these secondary cores with its corresponding winding has a conversion rate of for example 5/1, whereas the head of the transformer has a conversion rate of 400/5. This results in a conversion rate of 400/1 for the whole transformer, meaning that the current available at its output is 400 times lower than the main current of the electrical power line.

[0030] The current transformed in the first stage 7, transferred by the electrical conductors 13 to the base 2, passes through the central region of the secondary toroidal cores 21-24. As a result, it induces another transformed current in the windings of these secondary cores, which corresponds to the output of the transformer.

[0031] Thanks to these four secondary magnetic cores 21-24, the transformer 1 comprises four output at its base 2 corresponding each to a conversion rate of 400/1, and allowing to connect four instrumentation devices in order to measure for example the intensity, the phase, and other electrical characteristics of the main current transferred present in the electrical power line.

[0032] As seen in the drawings, the head of the transformer can comprise an additional main core, marked as 26, with its corresponding winding which is independent from the winding of the other main core 8. This additional main core provides another transformed current, having a different transformation rate than the first toroidal core with its winding, this other transformed current being transferred to the base of the transformer by an additional electric conductors, through the length of the hollow column.

[0033] With this additional main toroidal core, the transformer can provide two currents corresponding to two different ratios on its output, the current of the winding of the additional main core 26 being converted at a second stage in the base, by means of one of the secondary toroidal cores.

[0034] The invention allows a high flexibility in adapting the conversion rate of a transformer to particular specifications, without having to redesign the head of the transformer with its inner main toroidal magnetic core and corresponding electrical insulator. It allows to have a standardized head which can be used with different bases in order to provide different conversion rates.

[0035] Since the secondary cores are located in the base of the transformer, it is not needed to provide a significant electrical insulation around these cores, since the base is not subjected to high electrical tension. Accordingly, modifying the design, the size and other characteristics of the secondary cores can be achieved more easily since the question of electrical insulation is not significant in the base of the transformer. Moreover, in case of any quality issues on any of these secondary cores, it cannot affect the main insulation. Finally, since the secondary cores are in the base, they can be assembled independently from the main cores and its corresponding insulator.

with a corresponding winding, this main toroidal core (8) being intended to be traversed by the main electrical current to form a first stage (7) of current transformation delivering a transformed current in its winding ;

- a hollow electrically insulating column (3) having an extremity carrying the head (4) ;

- a base (2) carrying the hollow electrically insulating column (3) ;

- at least one pair of electrical conductors (13) extending in the hollow insulated column (3) from the winding of the main core (8) to the base (2) ;

- one secondary stage (19) of current transformation in the base (2) to convert the current provided by the winding of the main toroidal core (8) into an output current of the transformer.

2. Electric current transformer according to claim 1, wherein the secondary current transformation stage (19) comprises a secondary toroidal core (21-24) with a corresponding winding, this secondary toroidal core (21-24) being traversed by the current provided by the winding of the main toroidal core (8), the output current of the transformer being provided by the winding of the secondary toroidal core (21-24).

3. Electric current transformer according to claim 1, comprising in its base a plurality of secondary toroidal cores (21-24) with a corresponding winding for each toroidal core (21-24) to provide different output currents for the transformer (1).

4. Electric current transformer according to claim 1 or 2, comprising two main cores (8) with corresponding windings in its head (4), and at least two pairs of electrical conductors (13) extending in the hollow insulating column (3) from the windings of the main cores (8) to the base (2), in order to result in two output current of the transformer corresponding to two different transformation rates.

5. Electric current transformer according to any of the preceding claims, comprising a central conductor (9) extending in the middle of the main toroidal core (8) intended to be connected to the electrical power line, in order to be traversed by the current of the electrical power line.

Claims

1. Electrical current transformer for measuring the intensity of a main electrical current circulating in an electrical power line, this transformer (1) comprising:

- a head (4) comprising a main toroidal core (8)

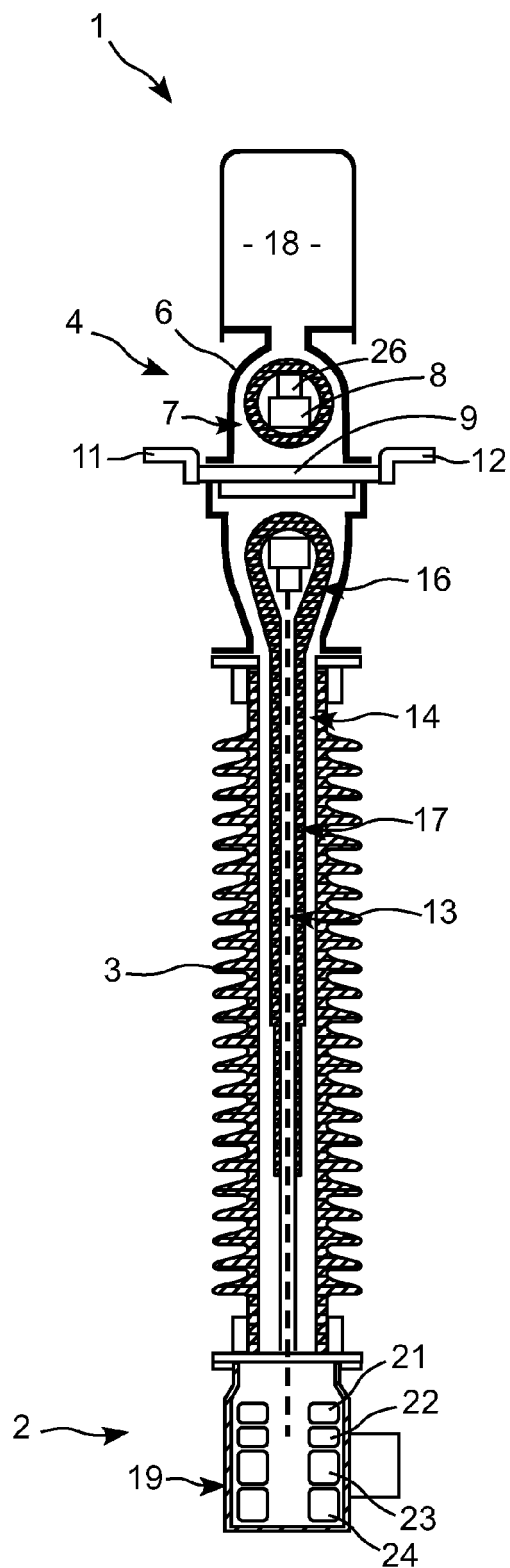


FIG. 1

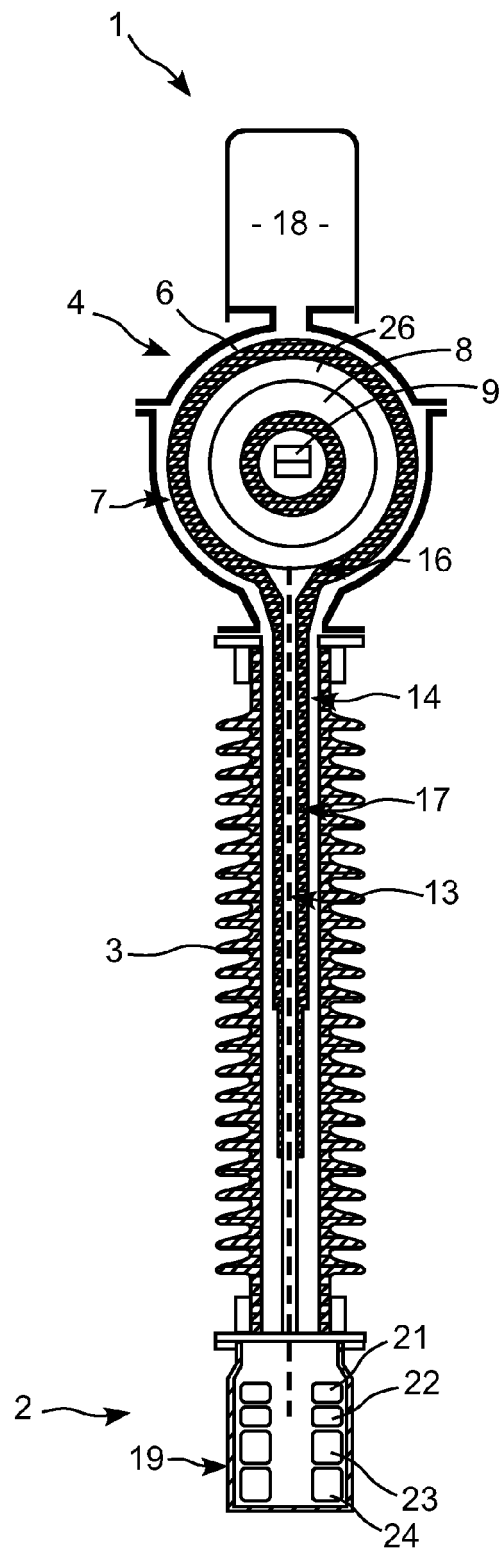


FIG. 2



EUROPEAN SEARCH REPORT

 Application Number
 EP 16 15 6195

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X	US 3 668 513 A (TSUBOUCHI DENJI ET AL) 6 June 1972 (1972-06-06)	1,2,4,5	INV. H01F38/30
A	* figures 1,2 * * column 1, line 54 - column 2, line 17 * * column 2, line 41 - line 69 * * column 3, line 72 - line 75 *	3	
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A	EP 2 565 884 A2 (ABB SP ZO O [PL]) 6 March 2013 (2013-03-06) * abstract; figure 1 *	1	
A	US 2 413 195 A (SCHWAGER AUGUST C) 24 December 1946 (1946-12-24) * the whole document *	1	TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 July 2016	Examiner 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
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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