



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.10.2010 Bulletin 2010/43

(51) Int Cl.:
H01H 9/00 (2006.01) *H01F 29/04 (2006.01)*

(21) Application number: **09158243.7**

(22) Date of filing: **20.04.2009**

(84) Designated Contracting States:
**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 SE SI SK TR**

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(54) **Tap changer**

(57) The present invention relates to providing electrical contact in a tap changer of a transformer. A tap changer with contacts is provided, which contacts contributes to a compensation of tolerances and wear. The tap changer comprises a cylinder (1), and a shaft (2), wherein the shaft is rotatably arranged inside the cylinder. The cylinder is provided with a plurality of fixed contacts (3), and the shaft is provided with a pair of contact fingers (4,5), which pair of contact fingers are arranged

to selectively connect to a selected one of the fixed contacts of the cylinder, upon rotation of the shaft. The tap changer also comprises a spring (6) that is arranged to bias both fingers of the pair of contact fingers towards the selected fixed contact. Preferably, the tap changer comprises a support (19) for the contact fingers, the support being arranged to support the contact fingers when the pair of contact fingers is disconnected from the fixed contact.

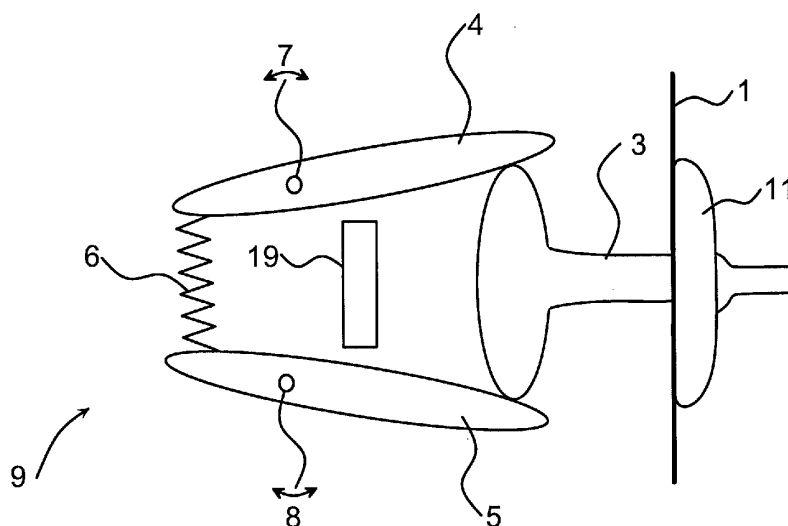


Fig. 1

Description

Technical Field

[0001] The present invention relates generally to a tap changer of a transformer, and in particular to providing electrical contact in a tap changer of a transformer.

Background

[0002] Tap changers for selecting tap of a winding in a transformer exists in different configurations, such as cylindrical tap changers wherein an insulated cylinder is provided with fixed tap contacts at different tap levels and a rotatable shaft provided with corresponding movable contact parts is arranged inside the cylinder. Rotation of the shaft is performed to bring the movable contacts into contact with the a corresponding one of the fixed contacts of the cylinder.

[0003] Mechanical contacts having a pair of two contact fingers have been used as movable contacts for connecting to a fixed contact between the fingers of the pair. An example of such a previously known mechanical contact is illustrated in figure 3. This contact includes two L-shaped fingers 44, 45 of a shaft making contact with a fixed contact 43 of a surrounding cylinder. The fixed contact 43 is connected on the opposite side to the terminals on the cylinder, whereas the each of the contacts 44, 45 is connected to cables arranged on that shaft, which details have been omitted in the drawing. Each of the two fingers 44, 45 are pivotally arranged around a respective axis 46, 47. To provide a reliable contact between each finger and the fixed contact 43, each finger contact 44, 45 is biased by means of a respective spring 48, 49 resting on a fixed wall 50 secured to the shaft.

[0004] A disadvantage with such biased spring contacts where each finger 44, 45 is biased by a spring 48, 49 is that an offset of any of the contacts, such as the fixed contact 43, results in a different contact pressure from each of the fingers 44, 45 and uneven forces between the fingers. This can also lead to different wear of the contacts 43, 44, 45. Another disadvantage is that each spring and finger combination can require skill and labour to be correctly arranged in the limited space between shaft and cylinder during the manufacturing of the tap changer.

Summary

[0005] It is an object of the invention to provide a tap changer for a transformer without the drawbacks of the prior art and provide a contact having contact fingers, which contact contributes to a compensation of tolerances and wear. The invention improves cylindrical tap changers for transformers comprising a cylinder, and a shaft, which shaft is rotatably arranged inside the cylinder, which cylinder is provided with a plurality of fixed contacts, and which shaft is provided with a pair of contact

fingers, which pair of contact fingers is arranged to selectively connect to a selected one of the fixed contacts of the cylinder, upon rotation of the shaft.

[0006] It is also an object of the invention to provide a tap changer having mechanical contacts of a reliable construction.

[0007] It is also an object of the invention to provide mechanical contacts that contributes to facilitating the manufacturing of the tap changer.

10 [0008] It is also an object of the invention to provide mechanical contacts that can align itself and balance the forces in the contact fingers when an offset due to wear or harsh manoeuvring otherwise would affect the electrical connection.

15 [0009] For these purposes the invention provides a tap changer for a transformer having at least one pair of finger contacts for connection to a fixed contact, which fingers are biased towards the fixed contact when connected to the fixed contact. The invention improves cylindrical tap changers by arranging one spring to bias both fingers of the pair of contact fingers towards the selected fixed contact.

20 [0010] Having the finger contacts interconnected by a common spring provide a reliable and adaptable bias of each of the fingers towards the fixed contact.

25 [0011] The spring of such a solution can be relatively long, without requiring more space, e.g. one common spring for a pair of fingers can be twice as long as two springs arranged for a pair of fingers, without requiring more space. Having a longer length, a lower spring constant can be used, which results in a lower variation of the contact pressure due to tolerances and wear. Also, the common spring balances the contact forces so that the finger contacts can provide the same pressure even if, for example, the fixed contact is offset towards one of the fingers. Moreover, having one common spring for two fingers instead of two separate springs reduces the number of components and can reduce manufacturing costs, especially for tap changers having many contacts.

30 [0012] Preferably, each of the contact fingers is pivotally and fixed to the shaft. The pivot can be used for leverage to control the pressure and having a space economic construction. Preferably, the pair of the contact fingers is fixed to the shaft, so that the pair moves together with the shaft, and preferably the contact fingers faces towards the cylinder. Preferably, the spring, the shaft and the cylinder extends in the same direction, which is the vertical direction inside the transformer. In this way the available space can be utilised effectively when the spring extends along the shaft. Preferably, the spring interconnects the fingers of the contact finger pair and extends from one of the contact fingers to the other contact finger.

35 [0013] The tap changer can also include a support for the contact fingers, which support is arranged to support the contact fingers when the pair of contact fingers is disconnected from the fixed contacts.

[0014] The tap changer of the invention is suitable for

medium and high voltages, above 1 kV, for example 3 kV or higher voltage; or approximately 6 kV and higher.

[0015] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the element, apparatus, component, means, step, etc." are to be interpreted openly as referring to at least one instance of the element, apparatus, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

Brief Description of the Drawings

[0016]

Figure 1 illustrates a contact arrangement in a tap changer in accordance with the invention.

Figure 2 illustrates a tap changer for a transformer of the cylindrical type suitable for the contact arrangement of the invention.

Figure 3 illustrates a contact arrangement in a tap changer in accordance with prior art.

Detailed Description

[0017] Figure 1 illustrates a contact arrangement in a tap changer 4, which tap changer is illustrated in figure 2. The tap changer 4 is a cylindrical tap changer 4, as illustrated in figure 2, and comprises an outer cylinder 1 surrounding an interior shaft 2. The shaft 2 is rotatably arranged inside the cylinder 1. The tap changer is adapted for three phases and has terminal arrangements 10, 20, 30 for each of the three phases arranged at three heights following the circumference at three levels 10, 20, 30 of the cylinder 1. Each level includes a plurality of spaced apart tap terminals 11, 21, 31, on the outside of the cylinder 2, for providing connections to a plurality of different taps of regulating windings (not illustrated) of the transformer. Each of the terminals 11, 21, 31 around the cylinder provides an electrical connection to corresponding fixed contacts (3 in figure 1) inside the cylinder 2. These fixed contacts face inwardly towards the shaft 2 at the centre of the cylinder 1. The shaft 2, in turn, is provided with contact arrangements facing outward 12, 22, 32 towards the fixed contacts of the cylinder. The shaft includes three such contact arrangements 12, 22, 32, one for each phase. The contact arrangements 12, 22, 32 comprise mechanical contacts (9 in figure 1) attached to the shaft, and movable upon rotation of the shaft into contact with the fixed contacts (3) of the cylinder, so that a specific winding can be chosen by rotating the shaft 2 so that each contact arrangement 12, 22, 32 of the shaft is brought into mating contact with a corresponding fixed contact in the cylinder 1 for each phase. The contact arrangements 12, 22, 32 suitably also include vacuum cells (not illustrated) in series with the

mechanical contacts. Each contact arrangements 12, 22, 32 comprises at least two mechanical contacts, for example three mechanical contacts.

[0018] The mechanical part (9) of one of the contact arrangements 12, 22, 33 of the shaft and the fixed contact 3 of the cylinder is illustrated in figure 1. The fixed contact 3 inside the cylinder 1 is electrically connected to a tap terminal 11 on the outside of the cylinder. The contact arrangement of a the tap changer for a transformer comprises a fixed contact 3 extending from the cylinder and a mechanical contact 9 comprising contact fingers 4, 5 secured to the shaft (2 in figure 1) for mating the fixed contact 3 when the shaft is rotated. Each of the fingers is pivotally fixed to the shaft around a pivot axis 7, 8, each axis 7, 8 of each pivot extends in the circumferential direction of the shaft. The fingers 4, 5 are interconnected by a spring 8. The spring 8 is vertically arranged, i.e. in the direction of the shaft, between the fingers 4, 5. The spring biases the fingers 4, 5 against the fixed contact 3. The mechanical contact is also provided with a finger support or rest 19 for the fingers 4, 5. The rest 19 provides a support for the fingers when disconnected from a fixed contact 3. When the shaft is rotated and the mechanical contact 9 is opened, i.e. the fingers 4, 5 loses contact with the fixed contact 3 of the cylinder, the spring 6 forces the fingers 4, 5 towards each other until each of the fingers meet the rest 19. Each of the fingers 4, 5 are supported by the rest 19 until they during the rotation meet the next fixed contact 3 of the next tap 11. Each of the fingers 4, 5 are electrically connected by means of a cable (not illustrated) on the opposite side of the fixed contact, which cables are arranged at the shaft. Moreover, each contact arrangement 12, 22, 32 suitably includes at least two pair of fingers 4, 5, one of which loses contact with the fixed contact 3 before the other, and connects to the next fixed contact 3, the next tap level (11, 21, 31), before the other. Both, or all of these, mechanical contacts 9 with fingers 4, 5 comprises suitably one spring 6 for each pair of two fingers 4, 5.

Claims

1. A tap changer for a transformer comprising a cylinder (1), and a shaft (2),
the shaft being rotatably arranged inside the cylinder (1), the cylinder (1) being provided with a plurality of fixed contacts (3),
the shaft (2) being provided with a pair of contact fingers (4, 5),
which pair of contact fingers (4, 5) are arranged to selectively connect to a selected one of the fixed contacts (3) of the cylinder, upon rotation of the shaft (2),
characterised in comprising a spring (6) arranged to bias both fingers (4, 5) of the pair of contact fingers (4, 5) towards the selected fixed contact (3).

2. A tap changer according to claim 1, wherein each of the contact fingers (4, 5) is pivotally fixed.
3. A tap changer according to claim 1 or 2, wherein the pair of the contact fingers (4, 5) is fixed to the shaft (2), and faces towards the cylinder (1). 5
4. A tap changer according to any of the preceding claims, wherein the fixed contact (3) is arranged on the inside of the cylinder (1) facing inwards. 10
5. A tap changer according to any of the preceding claims, wherein the spring (6), the shaft (2) and cylinder (1) extends longitudinally in a vertical direction. 15
6. A tap changer according to any of the preceding claims, wherein the spring (6) interconnects the fingers (4, 5) of the contact finger pair and extends from one of the contact fingers (4) to the other contact finger (5). 20
7. A tap changer according to any of the preceding claims, comprising a support (19) for the contact fingers (4, 5), the support (19) being arranged to support the contact fingers (4, 5) when the pair of contact fingers (4, 5) is disconnected from the fixed contacts (3). 25

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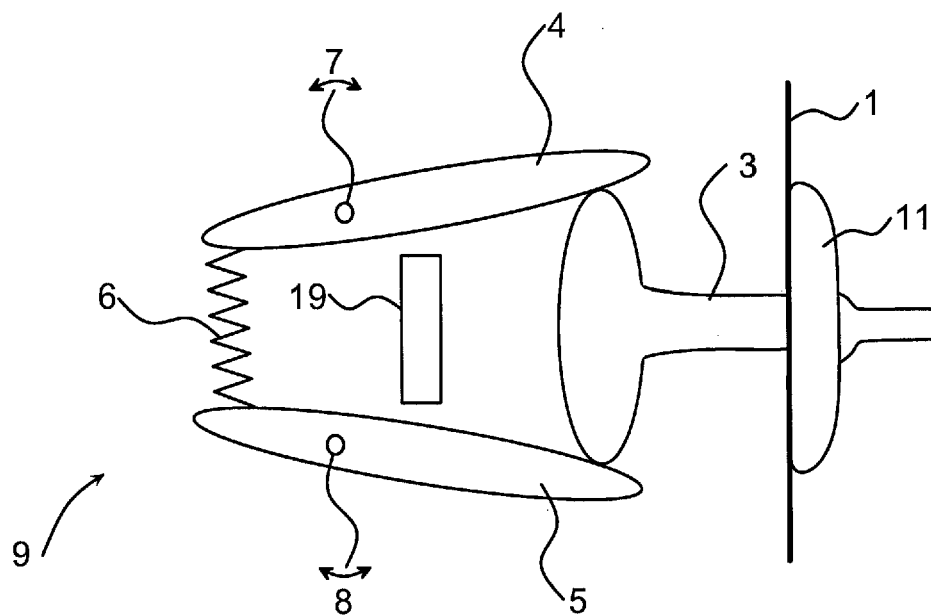


Fig. 1

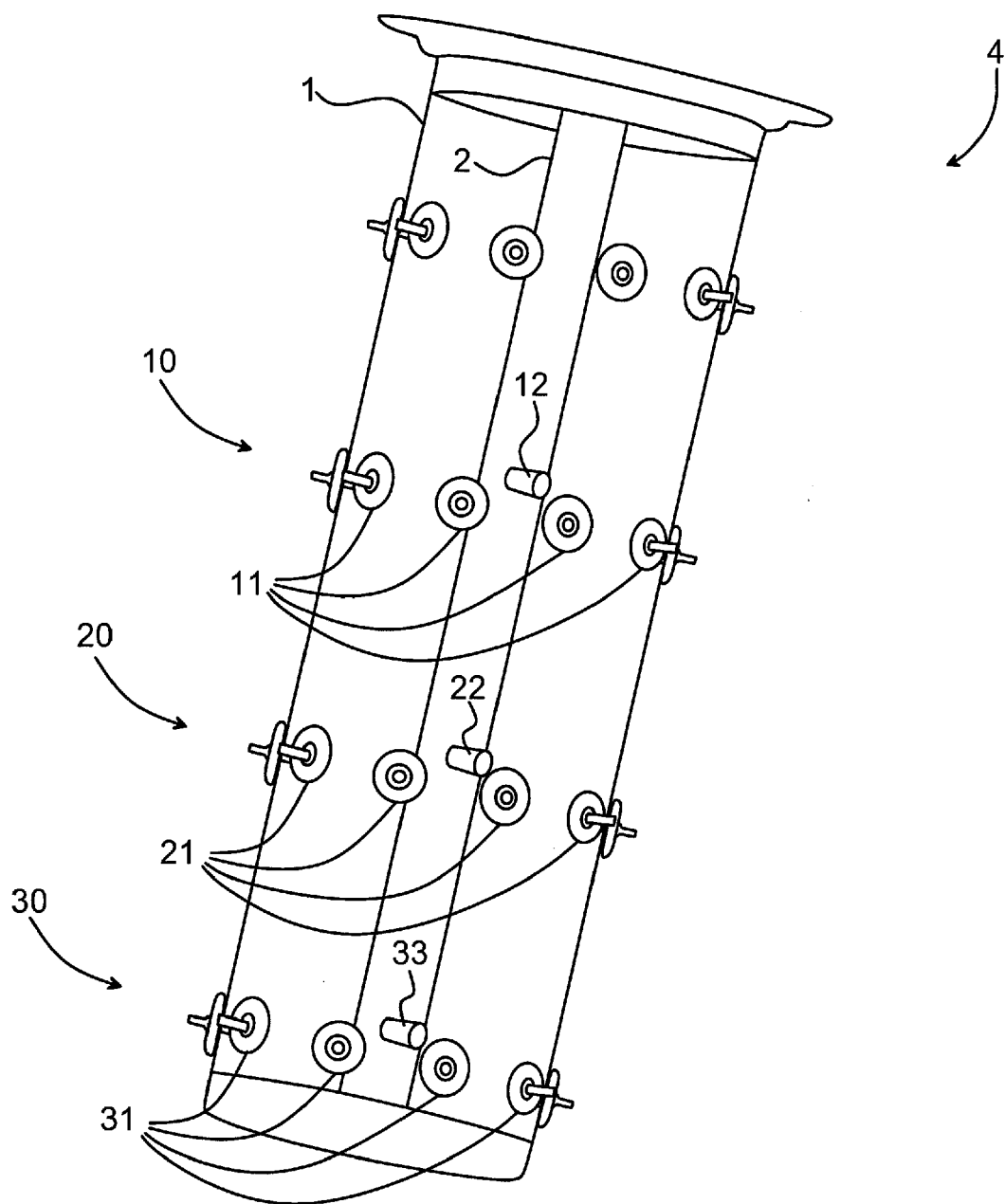


Fig. 2

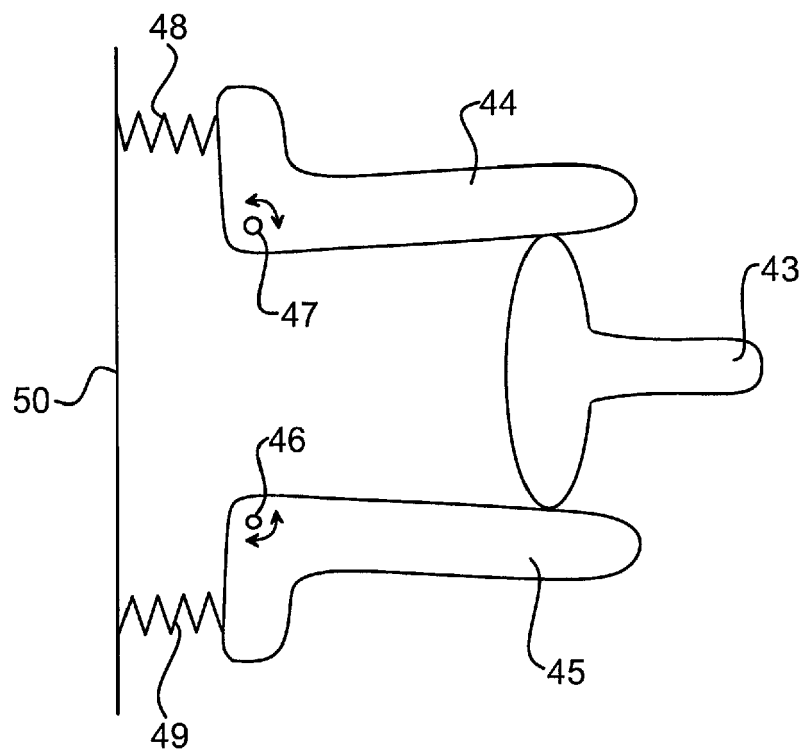


Fig. 3 (Prior Art)



EUROPEAN SEARCH REPORT

Application Number
EP 09 15 8243

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	JP 50 086628 U (?) 23 July 1975 (1975-07-23) * figures 1,2 *	1-7	
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A	JP 55 082420 A (FUJI ELECTRIC CO LTD) 21 June 1980 (1980-06-21) * figure 4 *	1,7	TECHNICAL FIELDS SEARCHED (IPC) H01H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 1 September 2009	Examiner Esmiol, Marc-Olivier
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			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 15 8243

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
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