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(54) **MULTI-PHASE SELECTOR-PRESELECTOR APPARATUS FOR ON-LOAD TAP CHANGER**

(57) A multi-phase selector-preselector apparatus (10) for an on-load tap changer comprises an insulation tube (100) enclosing an insulation compartment (110); a preselector (200) disposed along an outer wall of the tube; a selector device (300) disposed inside the insulation compartment, and comprising a first selector arm (310) and a second selector arm (320), wherein the first selector arm (310) includes, per each phase (LI, L2, L3), an odd moving contact element (315-1, 315-2, 315-3), and wherein the second selector arm (320) includes, per each phase (LI, L2, L3), an even contact element (325-1, 325-2, 325-3); and a drive mechanism (400) for operating the selector device (300), the drive mechanism (400) comprising a mounting element (410) on which the first (310) and second (320) selector arms are commonly mounted such that they are moved in common by the drive mechanism (400).

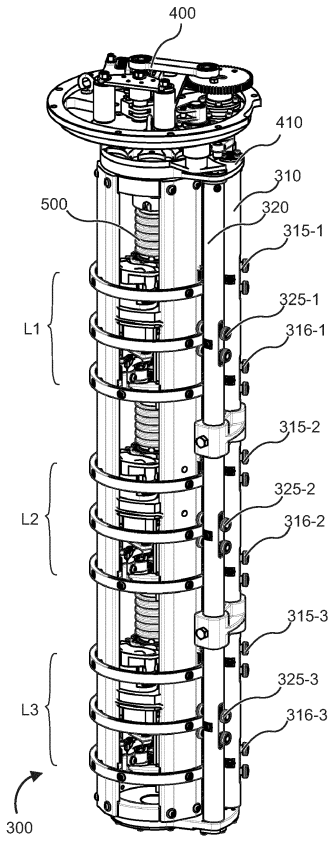

Fig. 1

EP 3 758 034 A1

Description

TECHNICAL FIELD

[0001] The disclosure relates to a multi-phase selector-preselector apparatus for an on-load tap changer.

BACKGROUND ART

[0002] An on-load tap changer is part of a power transformer and used to switch a tapping of the transformer to regulate an output high voltage when the power transformer is in full operation, i.e. in an on-load condition. With the use of an on-load tap changer, the output power, or power supply, need not be interrupted, resulting in a substantially continuous supply of output power even when the output voltage has to be regulated. The tap changer includes a set of fixed contacts, each fixed contact being connectable to a number of taps of a regulating winding of the power transformer. By selecting the taps to be connected or disconnected as needed, the output voltage of the transformer can be regulated. Typical on-load tap changers have a configuration for simultaneously changing the tapping of multiple phases, e.g. three phases in a star connection configuration of the transformer windings.

[0003] A known configuration of an on-load tap changer comprises a multi-phase selector-preselector apparatus in which an insulation tube encloses an insulation compartment. A selector device of the selector-preselector apparatus is installed inside the insulation tube. A preselector device of the selector-preselector apparatus is mounted on an outer wall of the tube, i.e. sideways of the tube.

[0004] There are known selector devices that comprise vertical insulation bars, or selector arms, for selectively bridging stationary contact rings that are mounted on the tube, for selecting the desired tapping. For example, document BG 112740 A describes a selector device having two selector arms for selecting an even electrical fixed contact or an odd electrical fixed contact, respectively. The two selector arms are disposed separate from one another and operated independently from each other. A synchronization of the selector arms' respective movement is thus complicated in the conventional system, while the configuration occupies a large amount of space.

[0005] Hence, there is a desire for a selector-preselector apparatus that is compact and/or provides for an easy synchronization of the movement of the selector arms.

DESCRIPTION OF THE INVENTION

[0006] According to an aspect, a multi-phase selector-preselector apparatus for an on-load tap changer is provided. The apparatus comprises an insulation tube, a preselector, a selector device, and a drive mechanism. The insulation tube enclosed an insulation compartment. The preseletor is disposed along an outer wall of the insulation tube. The selector device is disposed inside the insulation compartment and comprises a first selector arm and a second selector arm. The first selector arm includes per each phase an odd moving contact element. The second selector arm includes per each phase an even moving contact element. The drive mechanism is configured for operating the selector device. The drive mechanism comprises a mounting element on which the first selector arm and the second selector arm are commonly mounted such that they are moved in common by the drive mechanism.

[0007] Typically, the mounting element is configured such that it provides a direct mechanical link between the mounted first selector arm and the mounted second selector arm. A direct mechanical link is typically free from any gearing, pivot members, joint members and the like. In embodiments, the mounting element is a one-piece member, preferably a one-piece metal member.

[0008] By the common movement through intermediation of the mounting member, it is possible to mount the first and second selector arms close to each other, leading to a compact configuration.

[0009] Typically, but without limitation, the apparatus has a three-phase configuration. As such, the first selector arm includes a first-phase even contact element, a second-phase even contact element, and a third-phase even contact element. Likewise, the second selector arm comprises a first-phase odd contact element, a second-phase odd contact element, and a third-phase odd contact element.

[0010] According to another aspect, an on-load tap changer is provided. The on-load tap changer comprises the multi-phase selector-preselector apparatus as described herein.

[0011] According to yet another aspect, a power transformer is provided. The power transformer includes an on-load tap changer. The on-load tap changer comprises the multi-phase selector-preselector apparatus as described herein.

[0012] Further embodiments and aspects are apparent from the detailed description, as well as from the dependent claims.

[0013] In embodiments, the first selector arm and the second selector arm are mounted side-by-side on the mounting element. Unlike in conventional configurations, where multiple selector arms are typically mounted to be located substantially at opposite positions on the outer circumference, the present configuration which employs a side-by-side arrangement of the two selector arms makes it easy to have a particularly small-sized and comparatively stiff mounting element, which improves the compactness and the synchronization even further.

[0014] In further embodiments, the first selector arm and the second selector arm are arranged such that they each extend along an outer surface of the selector device from the top side to the bottom side.

[0015] In further embodiments, the drive mechanism comprises a Geneva drive. The Geneva drive is config-

ured to advance a selector position of the first selector arm and the second selector arm in a step-wise manner. For example, and not by way of limitation, the Geneva drive advances the selector position by rotating, e.g. in eight positions or more, typically ten positions or twelve positions. According to this embodiment, in a certain configuration, the Geneva drive comprises a Geneva gear and an input shaft. The input shaft is configured to drive the Geneva gear such that the selector position of the first selector arm and the second selector arm is advanced.

[0016] In further embodiments, one of the first selector arm and the second selector arm comprises per each phase a common moving contact element, or common terminal. In the exemplary, non-limiting three-phase configuration mentioned above, the respective one of the first selector arm and the second selector arm comprises a first-phase common moving contact element, a second-phase common moving contact element, and a third-phase common moving contact element.

[0017] Each of the even moving contact elements, the odd moving contact elements, and the common moving contact elements may have a contact bridge configuration. Every contact bridge may be configured such that it makes a connection between fixed terminals, e.g. fixed terminal rings disposed on a diverter switch, and fixed output contacts of the selector that are fastened on an inner side of the insulation compartment.

[0018] In embodiments, the apparatus further comprises a diverter switch that has stationary terminals. Each contact element is configured to establish an electrical contact with a corresponding one of the stationary terminals depending on a selector position of the first selector arm and the second selector arm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] In the following, embodiments of the present disclosure will be described with reference to the drawings in which:

Fig. 1 is a schematic perspective illustration of a selector device of a selector-preselector apparatus according to an embodiment;

Fig. 2 is a schematic perspective illustration of the selector device of Fig. 1, when seen from a different viewing angle;

Fig. 3 is a schematic perspective illustration of a selector-preselector apparatus according to an embodiment;

Fig. 4 is a schematic perspective partial view of the selector-preselector apparatus of Fig. 3;

Fig. 5 is a schematic perspective illustration of a preselector;

Fig. 6 is a sectional top view of a drive mechanism used in a selector-preselector apparatus according to an embodiment; and

Fig. 7 is a sectional top view through a selector-preselector apparatus according to an embodiment.

DETAILED DESCRIPTION

[0020] Fig. 1 shows a selector device 300 of a selector-preselector apparatus 10 according to an embodiment of the present disclosure in a perspective view. Fig. 2 shows the selector device 300 from a different viewing angle. The following explanation refers commonly to Figs. 1 and 2 for the ease of explanation.

[0021] The column-type selector device 300 of the embodiment shown in Figs. 1 and 2 has a three-phase configuration, i.e. is built and configured to perform a synchronous tapping selection of a first phase L1, a second phase L2, and a third phase L3. In the configuration shown, a diverter switch 500 that is attributed to the apparatus is disposed radially inside the column of the selector device 300. The diverter switch has fixed terminals whose contacting the selector 300 is about to select.

[0022] A first selector arm 310 and a second selector arm 320 are arranged side-by-side and each extend from a top side of the selector device 300 to a bottom side of the selector device 300. The first and second selector arms 310, 320, are made of an insulating material, i.e. the first and second selector arms 310, 320 are each configured as an insulation bar.

[0023] A first-phase (L1) odd moving contact element 315-1, a second-phase (L2) odd moving contact element 315-2 and a third-phase (L3) odd moving contact element are disposed on the first selector arm 310. Likewise, a first-phase (L1) even moving contact element 325-1, a second-phase (L2) even moving contact element 325-2, and a third-phase (L3) even moving contact element 325-3 are disposed on the second selector arm 320. The moving contact elements 315-1, 315-2, 315-3; 325-1, 325-2, 325-3 have a contact bridge configuration. During assembly of the selector device 300, both insulation bars 310, 320 (first selector arm 310, second selector arm 320) are rotated by a defined angle to ensure a proper pass-over of the moving contact elements 315-1, 315-2, 315-3; 325-1, 325-2, 325-3 with their fixed contact counterparts.

[0024] In the embodiment shown in Figs. 1 and 2, in addition to the odd moving contact elements 315-1, 315-2, 315-3 provided on the first selector arm 310 and the even moving contact elements 325-1, 325-2, 325-3 provided on the second selector arm 320, a first-phase (L1) common moving contact element 316-1, a second-phase (L2) common moving contact element 316-2, and a third-phase (L3) common moving contact element 316-3 are provided on the first selector arm 310. In certain embodiments not depicted in the drawings, a first-phase (L1) common moving contact element, a second-phase

(L2) common moving contact element, and a third-phase (L3) common moving contact element may also be provided on the second selector arm 320.

[0025] The first selector arm 310 and the second selector arm 320 are mounted on a mounting element 410 that is coupled to a drive mechanism 400. The mounting state of the first and second selector arms 310, 320 is a common mounting state, i.e. a selector position of the first and second selector arms 310, 320 is commonly controlled, and the mounting element 410 is devoid of any joint, gear or the like between the first and second selector arms 310, 320. In a tap selection process, the first and second selector arms 310, 320 are thus rotating around a central axis. The mounting element 410 may also be referred to as a selector frame, wherein the selector frame carries the two insulation bars (odd, even), i.e. the first selector arm 310 and the second selector arm 320.

[0026] The drive mechanism 400 typically comprises a spring energy accumulator for providing the rotational action. As apparent e.g. from the sectional view of Fig. 6, in the embodiment, the drive mechanism 400 comprises a Geneva gear 450 and an input shaft 460. The selector frame is driven by means of the Geneva gear 450. The Geneva gear 450, in turn, is driven by means of the input shaft 460. The Geneva gear 450 and the input shaft 460 form a Geneva drive which advances a selector position of the first selector arm 310 and the second selector arm 320 in a step-wise manner.

[0027] In the perspective view of Fig. 3, a selector-preselector apparatus 10 according to an embodiment is shown. A detailed partial view of the selector-preselector apparatus 10 is shown in Fig. 4. The selector-preselector apparatus 10 comprises an insulation tube 100 that encloses an insulation compartment 110. Typically, the insulation compartment 110 contains a charge of insulation oil. Inside the insulation compartment 110, the selector device 300 is disposed. On an outer circumferential side of the insulation tube 100, a preselector 200 in the form of an insulation bar is disposed such that it extends along the outer wall of the tube. The preselector 200 is shown separately in a perspective view of Fig. 5. The preselector 200 comprises a first-phase (L1) preselector contact 210-1, a second-phase (L2) preselector contact 210-2, and a third-phase (L3) preselector contact 210-3.

[0028] As apparent from the sectional top view of Fig. 7, the first selector arm 310 and the second selector arm 320 are mounted side-by-side. The preselector 200 extends substantially parallel to the extension direction of the first selector arm 310 and the second selector arm 320.

[0029] It is noted that while the above description refers to specific embodiments, the skilled person will recognize that the features described therein may be combined as appropriate, and/or that one or more features thereof may be altered or omitted as appropriate, without departing from the gist of the present application whose scope is defined by the claims.

Claims

1. A multi-phase selector-preselector apparatus (10) for an on-load tap changer, comprising

   an insulation tube (100) enclosing an insulation compartment (110);
   a preselector (200) disposed along an outer wall of the tube;
   a selector device (300) disposed inside the insulation compartment, and comprising a first selector arm (310) and a second selector arm (320), wherein the first selector arm (310) includes, per each phase (L1, L2, L3), an odd moving contact element (315-1, 315-2, 315-3), and wherein the second selector arm (320) includes, per each phase (L1, L2, L3), an even moving contact element (325-1, 325-2, 325-3); and
   a drive mechanism (400) for operating the selector device (300), the drive mechanism (400) comprising a mounting element (410) on which the first (310) and second (320) selector arms are commonly mounted such that they are moved in common by the drive mechanism (400).

2. The multi-phase selector-preselector apparatus (10) according to claim 1, wherein the first (310) and second (320) selector arms are mounted side-by-side on the mounting element (410).

3. The multi-phase selector-preselector apparatus (10) according to any one of the preceding claims, wherein the first selector arm (310) and the second selector arm (320) are arranged such as to extend along an outer surface of the selector device (300) from the top side to the bottom side.

4. The multi-phase selector-preselector apparatus (10) according to any one of the preceding claims, wherein the drive mechanism (400) comprises a Geneva drive (450, 460) configured to advance a selector position of the first (310) and second (320) selector arms in a step-wise manner.

5. The multi-phase selector-preselector apparatus (10) according to claim 4, wherein the Geneva drive comprises a Geneva gear (450) and an input shaft (460), the input shaft (460) being configured to drive the Geneva gear (450) to advance the selector position of the first (310) and second (320) selector arms.

6. The multi-phase selector-preselector apparatus (10) according to any one of the preceding claims, wherein one of the first selector arm (310) and the second

selector arm (320) comprises a common contact element (316-1, 316-2, 316-3).

7. The multi-phase selector-preselector apparatus (10) according to claim 5, wherein the respective one of the first selector arm (310) and the second selector arm (320) comprises, per each phase (L1, L2, L3), a common moving contact element (316-1, 316-2, 316-3).

8. The multi-phase selector-preselector apparatus (10) according to any one of the preceding claims, further comprising a diverter switch (500) having stationary terminals, wherein each contact element (315-1, 315-2, 315-3; 325-1, 325-2, 325-3; 316-1, 316-2, 316-3) is configured to establish an electrical contact with a corresponding one of the stationary terminals depending on a selector position of the first (310) and second (320) selector arms.

9. An on-load tap changer comprising the multi-phase selector-preselector apparatus (10) according to any one of the preceding claims.

10. A power transformer including an on-load tap changer, the on-load tap changer comprising the multi-phase selector-preselector apparatus (10) according to any one of claims 1-8.

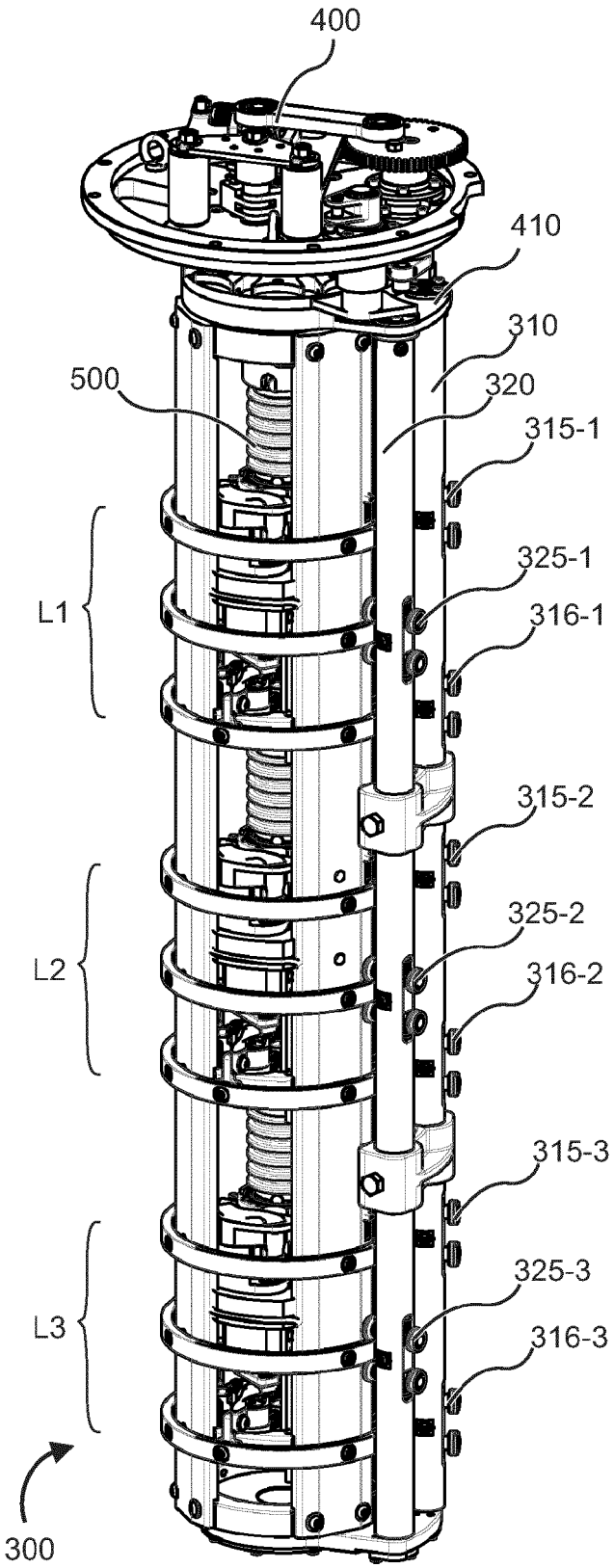
400
410
310
500
320
315-1
325-1
L1
316-1
315-2
325-2
L2
316-2
315-3
325-3
L3
316-3
300

Fig. 1

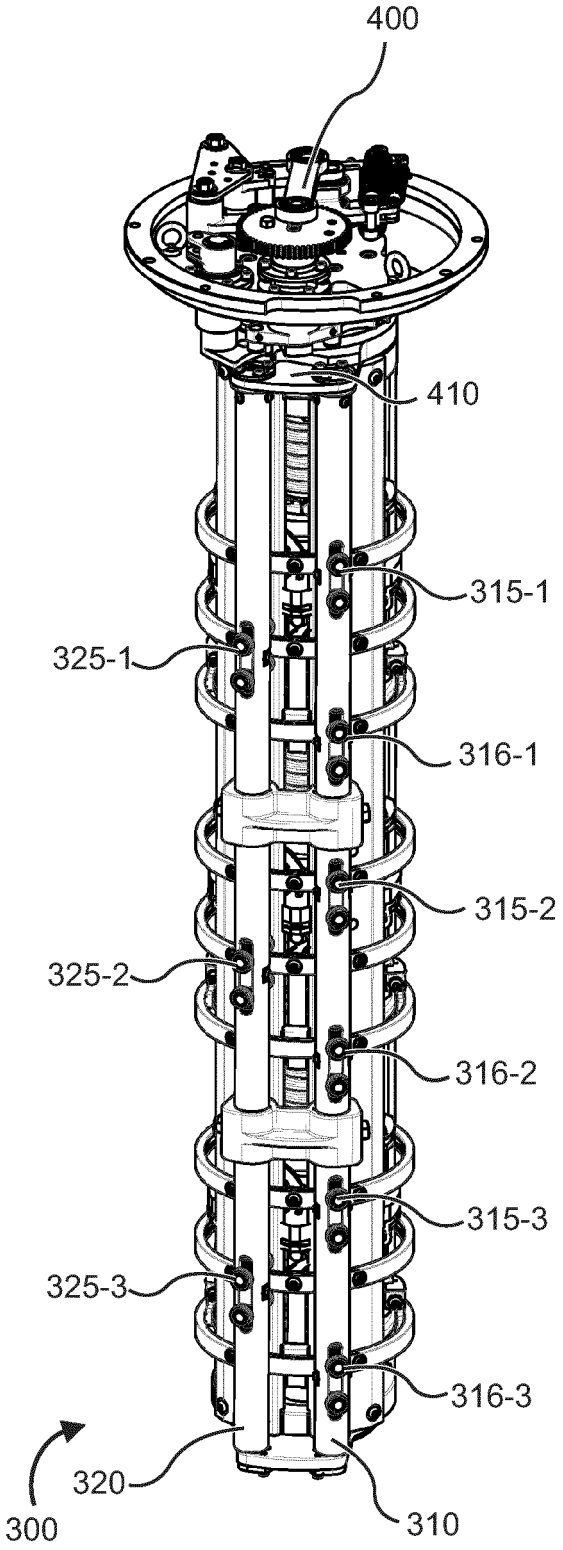
400
410
315-1
325-1
316-1
315-2
325-2
316-2
315-3
325-3
316-3
320
310
300

Fig. 2

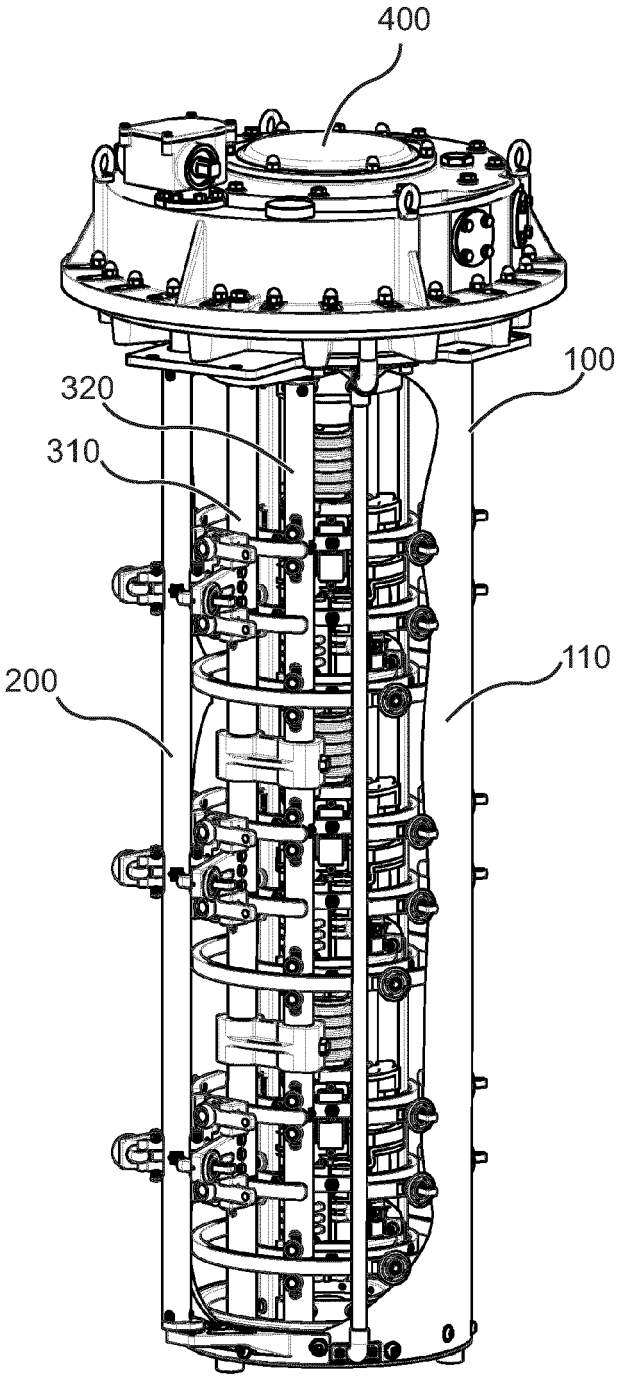

Fig. 3

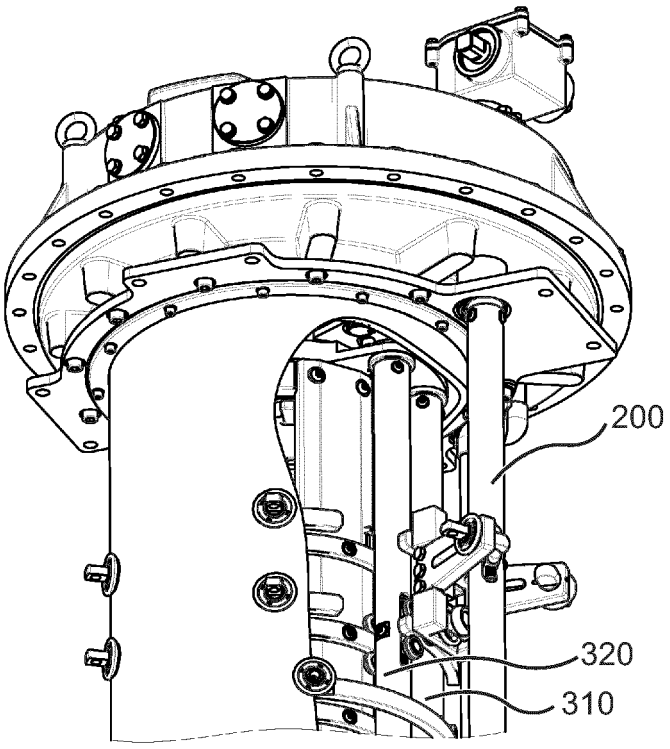

Fig. 4

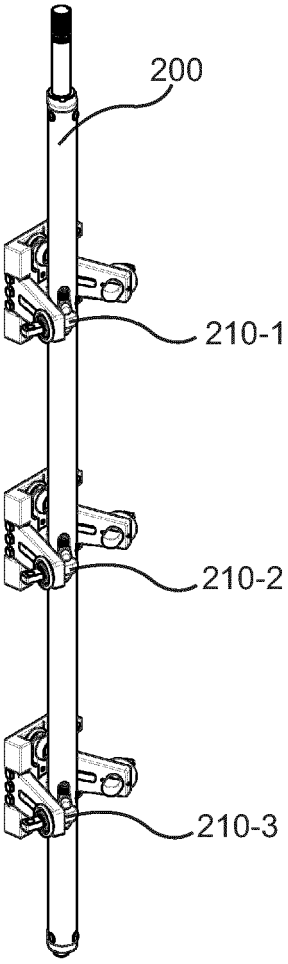

Fig. 5

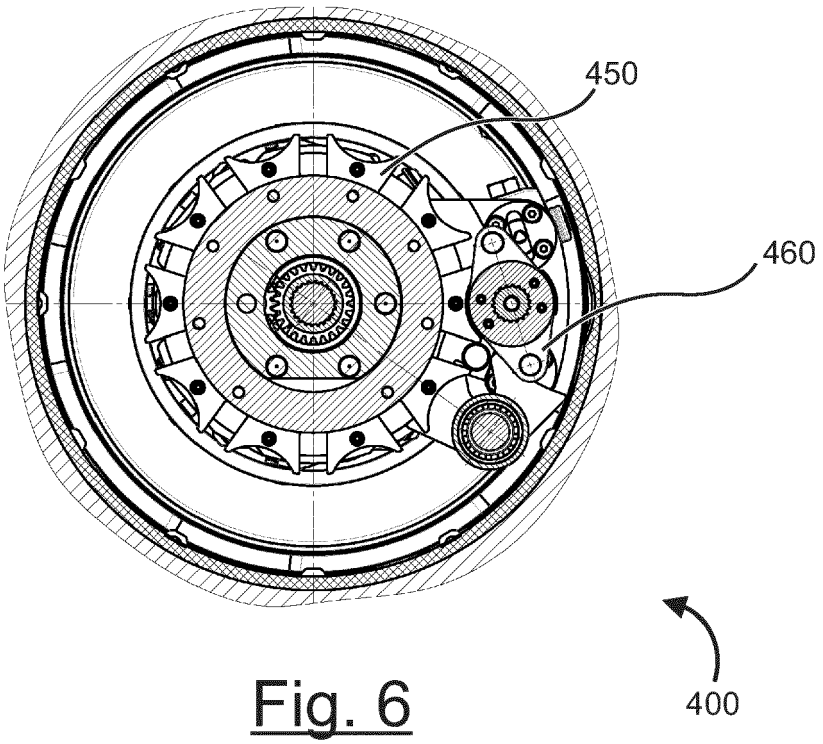

Fig. 6

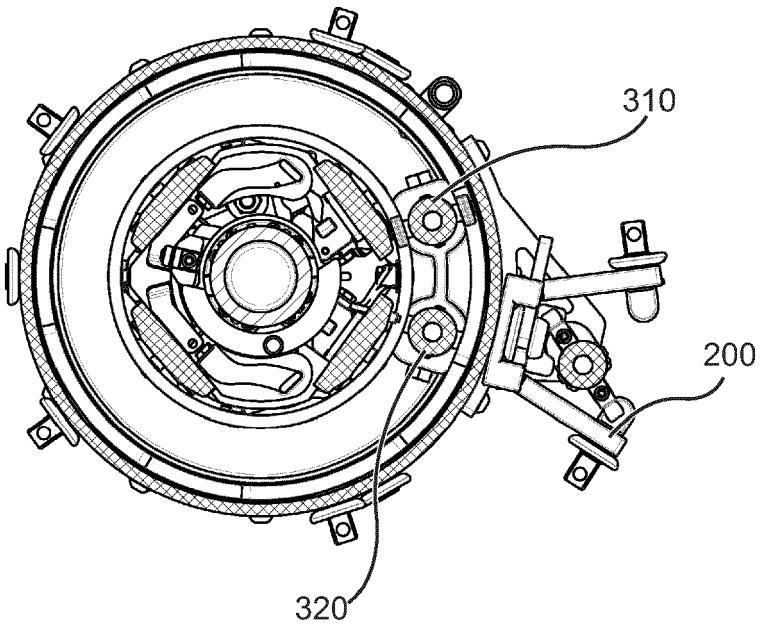

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 19 18 2352

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X	WO 2018/148811 A1 (ABB BULGARIA EOOD [BG]) 23 August 2018 (2018-08-23) * pages 6-8; figures *	1-10	INV. H01H3/44 H01F29/04 H01H9/00
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TECHNICAL FIELDS SEARCHED (IPC)

H01H
H01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 November 2019	Findeli, Luc

CATEGORY OF CITED DOCUMENTS

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