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(54) **TWO-SEGMENT MAGNETIC TRIP MECHANISM AND BACKUP PROTECTOR COMPRISING SUCH A MECHANISM**

(57) A two-segment magnetic trip mechanism, comprising a coil assembly having a coil front segment a coil rear segment; and a voltage limiting element, wherein the coil front segment and the coil rear segment are electrically connected with each other, the number of turns of the coil front segment being greater than the number of turns of the coil rear segment, and the voltage limiting element is connected in parallel with the coil front segment. A backup protector comprising such a two-segment magnetic trip mechanism is also disclosed.

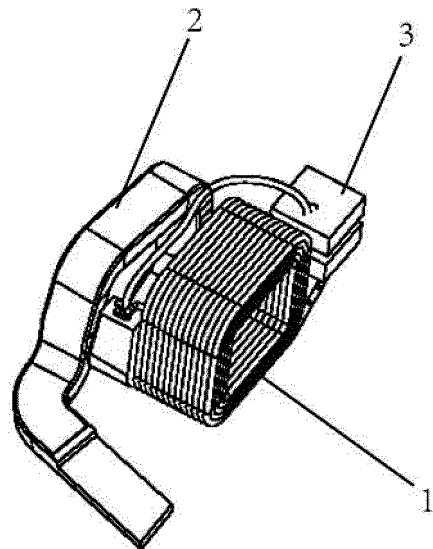


FIG. 3

## Description

### BACKGROUND

[0001] The present disclosure relates to a two-segment magnetic trip mechanism, and particularly to a backup protector comprising the two-segment magnetic trip mechanism, the backup protector is used for surge protection.

[0002] For the present, the backup protection for the traditional SPD (surge protector) uses circuit breakers and fuses, however, both of which can not protect the surge protector in the range of low fault current (5A) to 5 times the rated current of the backup protector; moreover, when a surge protector with a high discharging current rating (e.g., 100kA) is matched, the circuit breaker and the fuse are bulky which brings inconvenience to the user, therefore, a novel SPD backup protector is required in the market, which is capable of not only covering from low to high short-circuit current, but also meeting the requirements for compactness and a lower impulse discharging voltage.

### SUMMARY

[0003] In view of the deficiencies in prior art, one aspect according to the present disclosure provides a two-segment magnetic trip mechanism, wherein:

[0004] The two-segment magnetic trip mechanism comprise a coil assembly having a coil front segment a coil rear segment and a voltage limiting element; the coil front segment and the coil rear segment are electrically connected with each other; the number of turns of the coil front segment being greater than the number of turns of the coil rear segment; and the voltage limiting element is connected in parallel with the coil front segment.

[0005] The voltage limiting element is connected in parallel with the coil front segment, and the voltage limiting element and the coil front segment connected in parallel is connected in series with the coil rear segment, the static core passes through the coil front segment and the coil rear segment which are in a spiral form.

[0006] The voltage limiting element is connected in series with the coil rear segment, and the voltage limiting element and the coil rear segment connected in series are connected in parallel with the coil front segment, the static core passes through the coil front segment and the coil rear segment which are in a spiral form.

[0007] The voltage limiting element may be constituted by two metal electrodes disposed opposite to each other, and an air gap is created between the two metal electrodes disposed opposite to each other.

[0008] The voltage limiting element comprises a gravitron.

[0009] The voltage limiting element comprises a semiconductor voltage limiting element.

[0010] The voltage limiting element is connected to the coil assembly, such as, but not limited to, by means of

wires or welding etc.

[0011] The coil rear segment is connected to a static contact or a mobile contact of a backup protector.

[0012] The number of turns of the coil rear segment is 1 to 3 turns, and the number of turns of the coil front segment is greater than 3 turns.

[0013] Another aspect of the present disclosure provides a backup protector, wherein the backup protector comprises a static contact, a mobile contact and an arc extinguish chamber; the backup protector further comprises a two-segment magnetic trip mechanism as mentioned above; the coil rear segment of the two-segment magnetic trip mechanism is connected with the static contact or the mobile contact of the backup protector.

[0014] When a short-circuit current passes through the two-segment magnetic trip mechanism, the electromagnetic force generated by the coil assembly of the two-segment magnetic trip mechanism and the static core causes the mobile contact to be separated from the static contact, thus the backup protector is tripped.

[0015] When a surge current passes through the two-segment magnetic trip mechanism, a voltage drop will occur in the coil assembly, when the voltage drop is greater than the voltage limit threshold of the voltage limiting element of the two-segment magnetic trip mechanism, the voltage limiting element will be turned on, thereby shunting the surge current.

[0016] The operation principle of the present disclosure will now be described with reference to the above two aspects.

[0017] The present disclosure generally employs a two-segment magnetic trip mechanism and a backup protector comprising such a mechanism, in which the coil front segment is connected in parallel with the voltage limiting element (for example, a semiconductor voltage limiting element, a gas gap or a gravitron) to limit the voltage across the coil when the surge current passes, thereby reducing the value of the impulse discharging voltage. The short-circuit current passes through the two-segment magnetic trip mechanism and through the backup protector to control the circuit breaker body and to cut the short-circuit current; thus the functions of surge current discharging and short-circuit current breaking are met.

[0018] In particular, when the surge current is generated, current passes through the coil front segment, when the voltage of the coil front segment is greater than the voltage limit threshold of the voltage limiting element, the voltage limiting element, such as the air gap, will discharge the surge current so that the protector has a lower residual voltage there across; the subsequent current flows through the coil rear segment and the static contact and the mobile contact and finally into the followed SPD, achieving surge current discharging.

[0019] When the short-circuit current is generated, and when the short-circuit current is small (e.g., 3A), the current passes through the coil front segment, since the front segment has more turns (more than 3 turns), it forms a

large electromagnetic force with the static core (the coil front segment having more turns is mainly to achieve low short-circuit current protection, that is, it will operate when a small short-circuit current passes), thus driving the backup protector to operate, the mechanism is unlocked, the mobile contact is separated from the static contact, and the arc moves into the arc extinguish chamber, thereby achieving current breaking and short-circuit protection.

**[0020]** When the short-circuit current is large (e.g., 100kA), regardless of whether the short-circuit current flows through the coil front segment or through the voltage limiting element, such as the air gap, or alternatively, through the both, the current will then pass through the coil rear segment, and the electromagnetic force formed by the coil rear segment and the static core can still drive the backup protector to operate (the coil rear segment having less turns is mainly to achieve a high short-circuit current protection, usually only 1 to 3 turns, so as to ensure that the magnetic trip mechanism can operate normally when a large short-circuit current passes there through), the mechanism is unlocked, the mobile contact is separated from the static contact, and the arc enters into the arc extinguish chamber, finally cutting the current and achieving the short-circuit protection.

**[0021]** Furthermore, by using a two-segment magnetic trip mechanism rather than a circuit breaker and a fuse, the requirements for compactness and lower impulse discharging voltage are met.

**[0022]** Thus far, for an even better understanding of the detailed description of present disclosure herein as well as for an even better apprehension of the contribution brought by the present disclosure to the prior art, the present disclosure has already outlined extensively the contents of the present disclosure. Of course, the embodiments of the present will be described in the following and would form the subject matter of the appended claims.

**[0023]** Likewise, those skilled in this art will recognize that the concept, on which the present disclosure is based, may be readily used as a basis for designing other structures, methods and systems for carrying out several objects of the present disclosure. It is therefore important that the appended claims is considered to include such equivalent constructions as long as they do not go beyond the spirit and scope of the disclosure.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0024]** The present disclosure will be better understood by those skilled in the art from the following drawings, which more clearly embrace the advantages of the present disclosure. The drawings described herein are for illustrative purposes only and are not intended to be exhaustive of the present invention, and are also not intended to limit the scope of the disclosure.

Fig.1 is a schematic view of a first embodiment ac-

cording to the present disclosure;

Fig.2 is a schematic view of a second embodiment according to the present disclosure;

Fig.3 is a three-dimensional assembly view of a first embodiment according to the present disclosure;

Fig.4 is a three-dimensional exploded view of a first embodiment according to the present disclosure;

Figs. 5 and 6 are a side view and a three-dimensional view of the backup protector comprising a two-segment magnetic trip mechanism according to the present disclosure, respectively.

#### DETAILED DESCRIPTION

**[0025]** Hereinafter, specific embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

**[0026]** The general concept of the present disclosure is to provide a two-segment magnetic trip mechanism, wherein the two-segment magnetic trip mechanism comprises a coil assembly having a coil front segment and a coil rear segment, and comprises a voltage limiting element; the coil front segment and the coil rear segment are electrically connected with each other; the number of turns of the coil front segment being greater than the number of turns of the coil rear segment; and the voltage limiting element is connected in parallel with the coil front segment.

**[0027]** Fig.1 illustrates a schematic view of the first embodiment according to the present disclosure, in which the two-segment magnetic trip mechanism comprises a coil assembly having a coil front segment 1 and a coil rear segment 2, and a voltage limiting element 3.

**[0028]** The coil front segment 1 is electrically connected with the coil rear segment 2.

**[0029]** The number of turns of the coil front segment is greater than the number of turns of the coil rear segment, Fig.1 shows that the coil front segment has a plurality of turns (more than 3 turns), and the number of turns of the coil rear segment is 1 to 3.

**[0030]** The voltage limiting element 3 is connected in parallel with the coil front segment 1, the voltage limiting element 3 and the coil front segment 1 connected in parallel is connected in series with the coil rear segment 2.

**[0031]** The static core 4 passes through the coil front segment 1 and the coil rear segment 2 which are in a spiral form.

**[0032]** Fig.2 illustrates a schematic view of the second embodiment according to the present disclosure, in which the two-segment magnetic trip mechanism comprises a coil assembly having a coil front segment 1 and a coil rear segment 2, and a voltage limiting element 3.

**[0033]** The coil front segment 1 is electrically connected with the coil rear segment 2.

**[0034]** The number of turns of the coil front segment 1 is greater than the number of turns of the coil rear segment 2, Fig.2 shows that the coil front segment 1 has a plurality of turns (more than 3 turns), and the number of

turns of the coil rear segment 2 is 1 to 3.

**[0035]** The voltage limiting element 3 is connected in series with the coil rear segment 2, and the voltage limiting element 3 and the coil rear segment 2 connected in series are connected in parallel with the coil front segment 1.

**[0036]** The static core 4 passes through the coil front segment and the coil rear segment which are in a spiral form.

**[0037]** According to the first and second embodiments of the present disclosure, the voltage limiting element 3 is constituted by two metal electrodes 3-1 and 3-2 disposed opposite to each other (see Figs. 4 and 6), and an air gap is created between the two metal electrodes 3-1, 3-2 disposed opposite to each other.

**[0038]** Figs. 3 and 4 are a three-dimensional assembly view and a three-dimensional exploded view of the first embodiment according to the present disclosure respectively, in which the two-segment magnetic trip mechanism comprises a coil assembly having the coil front segment 1 and the coil rear segment 2, and the voltage limiting element 3.

**[0039]** The coil front segment 1 is electrically connected with the coil rear segment 2.

**[0040]** The number of turns of the coil front segment 1 is greater than the number of turns of the coil rear segment 2, Fig.3 shows that the coil front segment 1 has a plurality of turns (more than 3 turns), and the number of turns of the coil rear segment 2 is 1 to 3.

**[0041]** The voltage limiting element 3 is connected in parallel with the coil front segment 1, the voltage limiting element 3 and the coil front segment 1 connected in parallel are connected in series with the coil rear segment 2.

**[0042]** The static core 4 (see Fig.6) passes through the coil front segment 1 and the coil rear segment 2 which are in a spiral form.

**[0043]** The voltage limiting element is constituted by two metal electrodes 3-1 and 3-2 disposed opposite to each other, and the two metal electrodes, disposed opposite to each other, form an air gap therebetween, and are connected to the coil assembly by means of a wire 5 (not limited to the wire, welding and the like is also possible), that is, the metal electrode 3-1 is wired to one end of the coil front segment 1, and the metal electrode 3-2 is wired to another end of the coil front segment 1.

**[0044]** In Figs. 3 and 4, the metal electrodes 3-1 and 3-2 are connected in parallel with the coil front segment 1 through the wire 5, and after being connected in parallel, they are connected in series with the coil rear segment 2.

**[0045]** The coil rear segment 2 may be connected to the static contact 6 of a backup protector 8 (see Fig.5).

**[0046]** According to the first and second embodiments of the present disclosure, the voltage limiting element may be a gravitron, a semiconductor voltage limiting element.

**[0047]** Figs. 5 and 6 illustrates the backup protector 8 comprising the two-segment magnetic trip mechanism according to the present disclosure, in which the backup

protector comprises a static contact 6, a mobile contact 7 and an arc extinguish chamber 9.

**[0048]** The backup protector further comprises a two-segment magnetic trip mechanism as mentioned above.

**[0049]** The coil rear segment 2 of the two-segment magnetic trip mechanism is connected with the static contact 6 (or the mobile contact) of the backup protector.

**[0050]** When the surge current is generated, the current passes through the coil front segment 1, when the voltage of the coil front segment 1 is greater than the voltage limit threshold of the voltage limiting element 3 (the metal electrodes 3-1, 3-2), the voltage limiting element, such as the air gap, will discharge the surge current so that the protector has a lower residual voltage there across; the subsequent current flows through the coil rear segment 2 and the static contact 6 and the mobile contact 7 and finally into the followed SPD, achieving surge current discharging.

**[0051]** When the short-circuit current is generated, and when the short-circuit current is small (e.g., 3A), the current passes through the coil front segment 1, since the front segment has more turns (more than 3 turns), it forms a great electromagnetic force with the static core 4, thus driving the backup protector to operate, the mechanism is unlocked, the mobile contact 7 is separated from the static contact 6, and the arc moves into the arc extinguish chamber 9, thereby achieving current breaking and short-circuit protection.

**[0052]** When the short-circuit current is large (e.g., 100kA), regardless of whether the short-circuit current flows through the coil front segment 1 or through the voltage limiting element 3, such as the air gap, or alternatively, through the both, the current will then passes through the coil rear segment 2, and the electromagnetic force formed by the coil rear segment 2 and the static core 4 still can drive the backup protector to operate, the mechanism is unlocked, the mobile contact 7 is separated from the static contact 6, and the arc enters into the arc extinguish chamber 9, finally cutting the current and achieving the short-circuit protection.

**[0053]** In the backup protector 8, the coil front segment 1 is connected in parallel with the voltage limiting element 3 (taking an air gap formed by the metal electrodes 3-1, 3-2 as an example), the coil rear segment 2 is connected with the static contact 6, the coil front segment 1 having more turns (more than 3 turns) is mainly to achieve a low short-circuit current protection, that is, it will operate when a small short-circuit current passes; and the coil rear segment 2 having less turns is mainly to achieve a high short-circuit current protection, usually only 1 to 3 turns, to ensure that the magnetic trip mechanism can operate normally when a large short-circuit current passes, so as to allow the backup protector to cut the short-circuit current.

**[0054]** Referring to the specific embodiments, although the present disclosure has already been described in the Description and the drawings, it should be appreciated that the skilled person in this art could make various alteration and various equivalent matter could

substitute for various elements therein without departing from the scope of the present disclosure defined by the attached claims. Moreover, the combinations and mating of technical features, elements and/or functions among the specific embodiments herein are clear and well-defined, thus according to these disclosed contents, those skilled in the art will appreciate that the technical features, elements, and/or functions in the embodiments may be incorporated into another embodiment as appropriate unless the foregoing description is otherwise described. In addition, in accordance with the teachings of the present disclosure, many changes may be made to adapt to particular circumstances or materials without departing from the spirit of the disclosure. Accordingly, the present disclosure is not limited to the specific embodiments illustrated in the drawings, and the specific embodiments in the specification described as the optimal embodiment conceived for carrying out the present disclosure, but the present disclosure is intended to cover all embodiments falling within the scope of the foregoing specification and the appended claims.

## Claims

1. A two-segment magnetic trip mechanism, comprising:

a coil assembly having a coil front segment a coil rear segment; and  
a voltage limiting element,  
wherein the coil front segment and the coil rear segment are electrically connected with each other, the number of turns of the coil front segment being greater than the number of turns of the coil rear segment, and the voltage limiting element is connected in parallel with the coil front segment.

2. The two-segment magnetic trip mechanism according to claim 1, wherein  
the voltage limiting element is connected in parallel with the coil front segment, and the voltage limiting element and the coil front segment connected in parallel are connected in series with the coil rear segment.
3. The two-segment magnetic trip mechanism according to claim 1, wherein  
the voltage limiting element is connected in series with the coil rear segment, and the voltage limiting element and the coil rear segment connected in series are connected in parallel with the coil front segment.
4. The two-segment magnetic trip mechanism according to claim 2 or 3, wherein  
the voltage limiting element is constituted by two

metal electrodes disposed opposite to each other, and an air gap is created between the two metal electrodes disposed opposite to each other.

5. The two-segment magnetic trip mechanism according to claim 2 or 3, wherein  
the voltage limiting element comprises a gravitron.
6. The two-segment magnetic trip mechanism according to claim 2 or 3, wherein  
the voltage limiting element comprises a semiconductor voltage limiting element.
7. The two-segment magnetic trip mechanism according to claim 1, wherein  
the coil rear segment is connected to a static contact or a mobile contact of a backup protector.
8. The two-segment magnetic trip mechanism according to claim 2 or 3, wherein  
a static core passes through the coil front segment and the coil rear segment which are in a spiral form.
9. The two-segment magnetic trip mechanism according to claim 3, wherein  
the number of turns of the coil rear segment is 1 to 3 turns, and the number of turns of the coil front segment is greater than 3 turns.
10. A backup protector, comprising:  
a static contact, a mobile contact and an arc extinguish chamber; and  
the two-segment magnetic trip mechanism according to any one of the above claims, wherein the coil rear segment of the two-segment magnetic trip mechanism is connected to the static contact or the mobile contact.

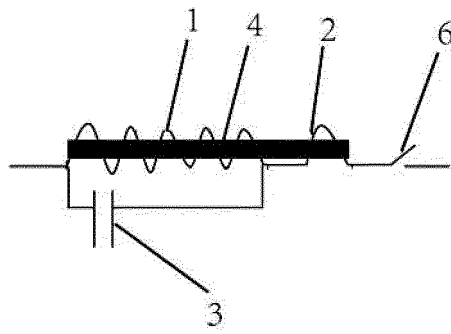


FIG. 1

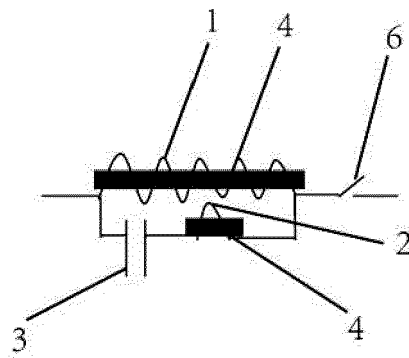


FIG. 2

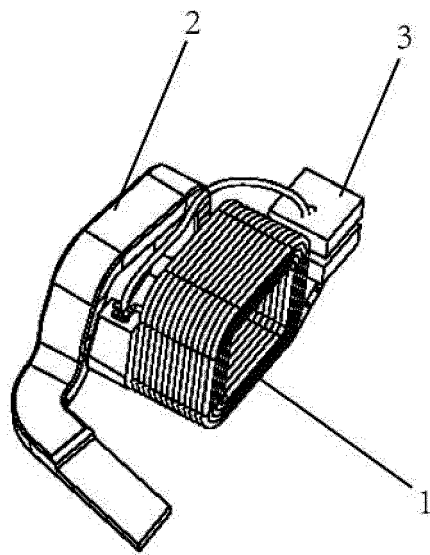


FIG. 3

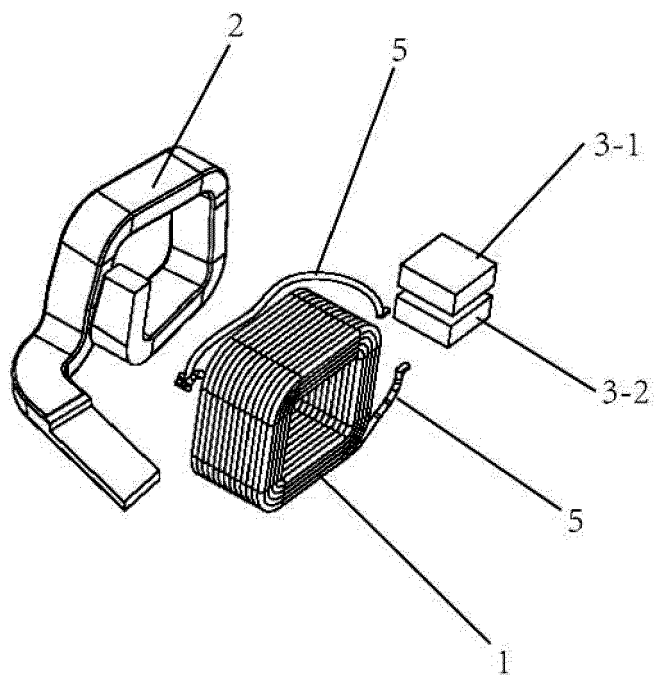


FIG. 4

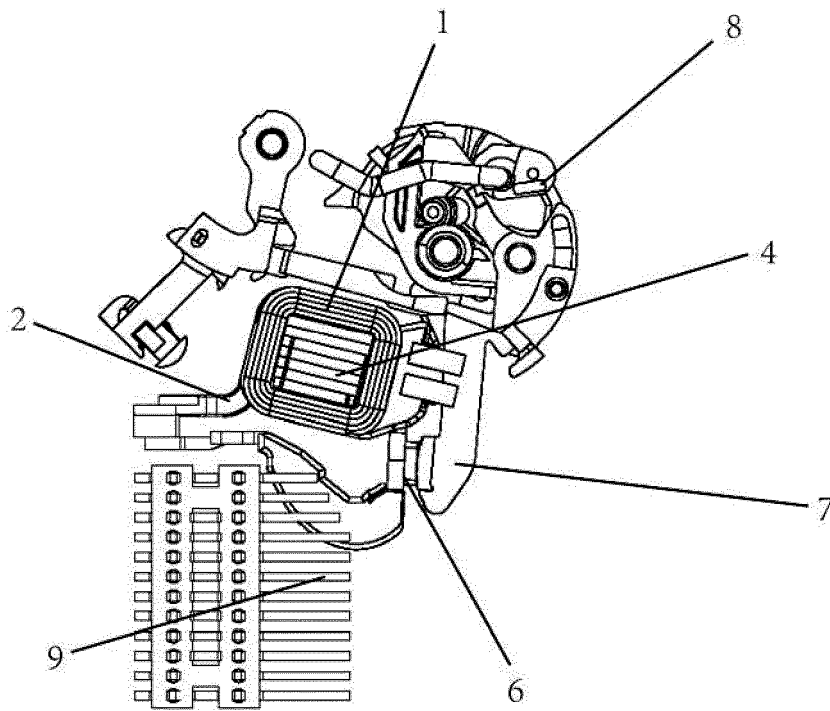


FIG. 5

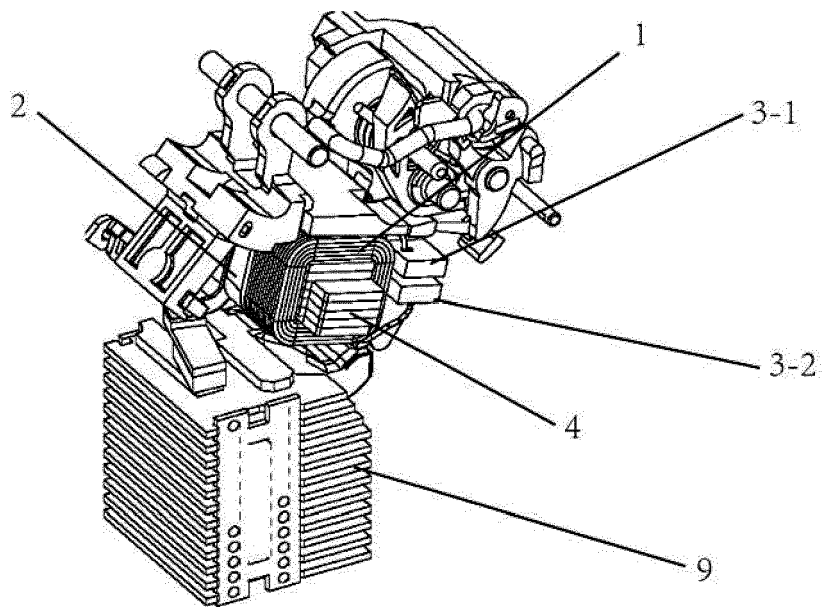


FIG. 6



## EUROPEAN SEARCH REPORT

Application Number  
EP 17 30 5534

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                           |                                                             |                                            |
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| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | * paragraph [0003] *                                                                                                      | 3,8,9                                                       |                                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | * paragraph [0006] *                                                                                                      |                                                             |                                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | * paragraph [0022] - paragraph [0025] *                                                                                   |                                                             |                                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | * paragraph [0030] *                                                                                                      |                                                             |                                            |
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| Place of search<br><b>Munich</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                           | Date of completion of the search<br><b>21 December 2017</b> | Examiner<br><b>Bilard, Stéphane</b>        |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                           |                                                             |                                            |

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