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

(11) EP 2 221 844 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.08.2010 Bulletin 2010/34

(21) Application number: **09153480.0**

(22) Date of filing: **24.02.2009**

(51) Int Cl.:
H01H 33/16 *(2006.01)* *H01H 31/32* *(2006.01)*
H01H 33/64 *(2006.01)*

(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
Designated Extension States:
AL BA RS

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

(72) Inventors:
- **Holaus, Walter**
  CH-8047, Zürich (CH)
- **Kostovich, Jadran**
  CH-5430 Wettingen (CH)
- **Garcia, Miguel**
  CH-8600, Dübendorf (CH)
- **Kruesi, Urs**
  CH-8046, Zürich (CH)

(74) Representative: **ABB Patent Attorneys**
C/o ABB Schweiz AG
Intellectual Property (CH-LC/IP)
Brown Boveri Strasse 6
5400 Baden (CH)

(54) Switching device

(57) A switching device is provided, which includes a housing filled with an insulating gas, a first contact element including a first main contact and a first arcing contact, and a moveable second contact element including a second main contact and second arcing contact, said second contact element being movable from a first position, where the first and the second main contacts as well as the first and the second arcing contacts are in direct contact, to a second position, where neither the first and the second main contacts nor the first and the second arcing contacts are in direct contact, said second contact element further including an impedance element electrically connecting the second main contact with the second arcing contact.

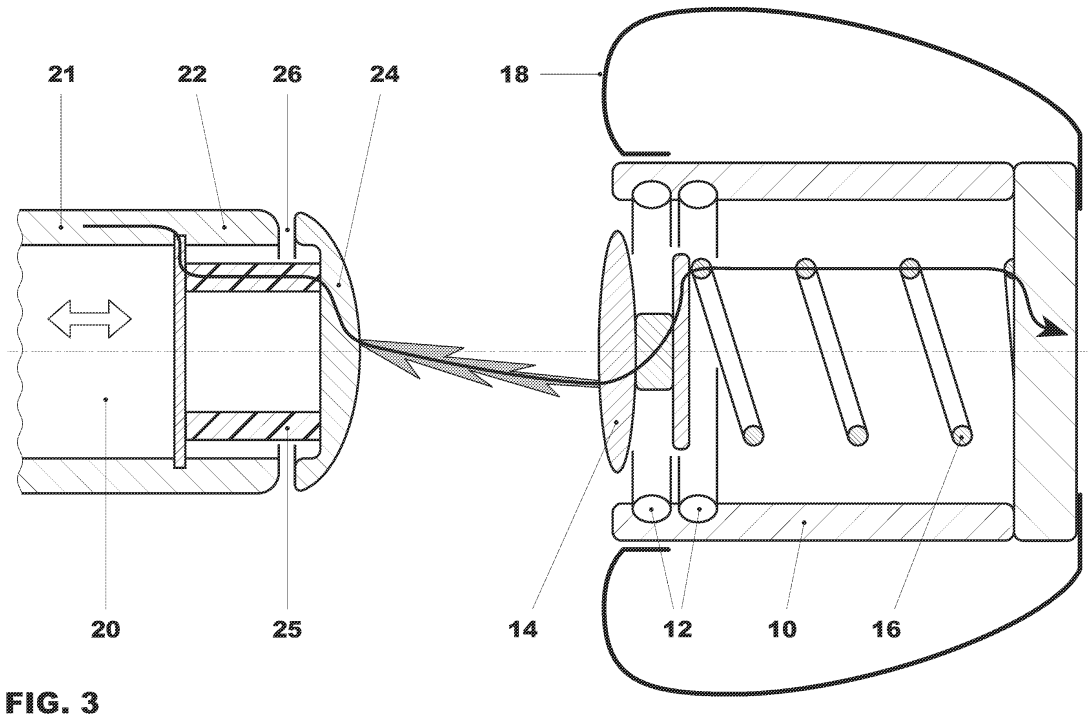

FIG. 3

EP 2 221 844 A1

Description

BACKGROUND

[0001] The present disclosure generally relates to a switching device.

[0002] Switching devices, like disconnectors, in high-voltage gas-insulated switchgear above 420 kV can be equipped with a resistor that limits the very fast transients (VFT) that may be generated during the closing and the opening of the disconnector. In known designs this resistor is designed as bulk ohmic resistor with high energy absorption cabability and placed on the fixed contact side. Resistance values of several 100 Ohms up to 1 kOhms are applied. Using such resistors inside the fixed contact requires to nearly double the stroke of the moving part, as the voltage drop along this resistor is approximately as high as the rated voltage.

SUMMARY

[0003] In view of the above, a switching device is provided, which includes a housing filled with an insulating gas, a first contact element including a first main contact and a first arcing contact, and a moveable second contact element including a second main contact and second arcing contact, said second contact element being movable from a first position, where the first and the second main contacts as well as the first and the second arcing contacts are in direct contact, to a second position, where neither the first and the second main contacts nor the first and the second arcing contacts are in direct contact, said second contact element further including an impedance element electrically connecting the second main contact with the second arcing contact.

[0004] According to an embodiment an impedance element is added to the moving contact of the switching device. By doing so, the impedance element will be active during the closing and the opening of the switching device to reduce VFT peak and rate-of-rise. During opening, the impedance element will be active to improve the bus transfer switching behavior of the switching device. The impedance may include an inductive element and/or may include a resistor element, both inside the moving contact of the switching device.

[0005] According to a preferred embodiment the resistance of the resistive element lies in the range between 0,01 and 10,0 Ohm. Preferably, the inductivity of the inductive element lies in the range between 1,0 and 50,0 nH. Due to the low values of the resistor and the inductance, only a small insulating gap between the arcing contact and the main contact on the moving contact element and therefore no additional stroke for the moving contact element will be required.

[0006] According to a preferred embodiment the resistive element exhibits a positive temperature coefficient. Preferably, the resistive element exhibits a skin effect. Furthermore, it is preferred that the resistive element comprises a ceramic material. A proper choice of resistor material allows to make use of the skin effect in the resistor, so the resistance value is higher for VFT damping at high frequencies than it is during opening at rated frequency.

[0007] According to a preferred embodiment the inductive element and the resistive element integrally form a single impedance element. Preferably, the voltage drop over the impedance element is lower than 1/10 of the rated voltage of the switching device.

[0008] Further exemplary embodiments are according to the dependent claims, the description and the accompanying drawings.

DRAWINGS

[0009] A full and enabling disclosure, including the best mode thereof, to one of ordinary skill in the art is set forth more particularly in the remainder of the specification including reference to the accompanying drawings wherein:

Fig. 1 shows a plan view of a section through a switching device according to the invention, which may be installed in an encapsulated switchgear assembly;

Fig. 2 shows a detailed illustration of a contact region marked out in Fig. 1 in a closed position of the switching device;

Fig. 3 shows a detailed illustration of a contact region marked out in Fig. 1 in an open position of the switching device;

Fig. 4 shows a schematic circuit diagram of the switching device according to Fig. 1.

DETAILED DESCRIPTION

[0010] Reference will now be made in detail to the various exemplary embodiments, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation and is not meant as a limitation. For example, features illustrated or described as part of one embodiment can be used on or in conjunction with other embodiments to yield yet a further embodiment. It is intended that the present disclosure includes such modifications and variations.

[0011] A number of embodiments will be explained below. In this case, identical structural features are identified by identical reference symbols in the drawings. The structures shown in the drawings are not depicted true to scale but rather serve only for the better understanding of the embodiments.

[0012] For the purposes of this application, high-voltage switching devices include high-voltage and high-power switches, switches with or without arc quenching,

disconnectors, grounding devices as well as further switching devices from the field of high-voltage technology.

[0013] Fig. 1 shows a switching device according to the invention in an open position. The switching device illustrated in Fig. 1 is in the form of a module of a gas-insulated, metal-encapsulated switchgear assembly and has a metal housing 1 filled with insulating gas and having two main openings 2 and 3. The openings 2 and 3 are each sealed in a gas-tight manner by a barrier insulator, which, in a manner which is electrically insulated from the housing 1, in each case supports a current conductor 5 and 6, respectively, which can have a high voltage applied to it. Instead of barrier insulators, post insulators with gas passage openings may also be used, if appropriate.

[0014] The current conductor 6 is connected to a first contact element 10 which includes a first main contact 12 and a first arcing contact 14 (see Fig. 2). The current conductor 5 is connected to a second contact element 20 which includes a second main contact 22 as well as a second arcing contact 24 and which is moveable along the horizontal axis of Fig. 1. A conductor tube 21 or a hollow carrier 21 is used so as to conduct current to the current conductor 5, said conductor tube 21 or hollow carrier 21 forming a portion of the contact element 20, and constantly forming a current transfer to the current conductor 5, irrespective of its position, via two sliding contacts (not shown).

[0015] Furthermore, the switching device includes a drive element 7 to move the second contact element 20 from a first position, where the first and the second main contacts 12, 22 as well as the first and the second arcing contacts 14, 24 are in direct contact, to a second position, where neither the first and the second main contacts 12, 22 nor the first and the second arcing contacts 14, 24 are in direct contact.

[0016] As can be seen in greater detail in Fig. 2 the switching device includes first contact element 10 which is fixed to current conductor 6. The first contact element 10 includes a first main contact 12 which has the form of a contact spring. Furthermore, the first contact element 10 includes a first arcing contact 14 supported by a conductive spring element 16. A shield 18 is provided around the first contact element 10 in order to influence the field distribution in the vicinity of the first contact element 10.

[0017] The moveable second contact element 20 includes a second main contact 22 formed by a portion of the conductor tube 21 and a second arcing contact 24 formed at the front portion of the second contact element 20. An additional shield (not shown) may also be provided around the second contact element 20. Furthermore, the second contact element 20 includes an impedance element 25 electrically connecting the second main contact 22 with the second arcing contact 24.

[0018] Thus, the impedance element 25 is placed inside the moving contact between the main current contact 22 and the arcing contact 24. Preferably, the impedance element 25 includes the inductive element and a resistive element, whereby the inductive element and the resistive element integrally form a single impedance element 25. In addition, it is preferred to use a very small (cold) resistance of approx. 0.1 Ohm and inductance value of approx. 20 nH. The desired inductance value can be chosen, for example, by selecting an appropriate wire geometry. Preferably, the resistive element exhibits a positive temperature coefficient and/or a skin effect. Furthermore, it is preferred that the voltage drop along the impedance element remains below approx. 1/10th of the rated voltage.

[0019] Combining the placement of the impedance element 25 in the moving contact element 20 with the small impedance values allows a small gap 26 between the rated current contact 22 and the arcing contact 24. Therefore, the energy dissipated by the impedance 25 during opening is low and this allows the use of only very small resistor volume.

[0020] Fig. 2 illustrates the switching device in a first position, where the first and the second main contacts 12, 22 as well as the first and the second arcing contacts 14, 24 are in direct contact. Fig. 3 illustrates the switching device in a second position, where neither the first and the second main contacts 12, 22 nor the first and the second arcing contacts 14, 24 are in direct contact.

[0021] Fig. 4 shows a schematic circuit diagram of the switching device according to Fig. 1. Thereby, the first and the second main contacts 12, 22 together form the main switch 31 and the first and the second arcing contacts 14, 24 form the arcing switch 32. The impedance element 25 is composed of the PTC resistor 35 and the inductance 36. The arcing switch 32, the resistor 35 and the inductance 36 are connected in series whereas the main switch 31 is connected in parallel to the arcing switch.

[0022] Due to the design and placement of the impedance element 25 the impedance element 25 will act differently for closing and opening of the switching device.

[0023] During closing the first and second arcing contacts will close before the first and second main contacts. Prestriking will occur between the arcing contacts and the very fast transients (VFT) will be damped primarily by the resistive element. The resistance value will preferably be increased at high frequencies due to the skin effect. The resulting heat is dissipated in the resistive element.

[0024] The inductive element is also active and limits the rate-of-rise of VFT. By applying small resistor and inductance values, only 10% to 20 % of the VFT peak voltages will be damped but this damping is sufficient to keep the VFT peak well below the breakdowns strength of GIS equipment.

[0025] During opening of the switching device first and second arcing contacts will open after the first and second main contacts. Due to the low frequencies (e.g. 50 or 60Hz) involved during the bus transfer after the opening of the main contacts, only the resistive element is active.

During the bus-transfer switching, the bus transfer current will generate a voltage drop on the small resistor which is several 100 V. This voltage is already higher than the arc voltage. Therefore, the bus transfer time and the corresponding contact wear will be strongly reduced. It is proposed to use resistor material with positive temperature coefficient PTC. Therefore, the energy dissipated during opening will increase the resistance value and further improves bus transfer capability.

[0026] The invention has been described on the basis of embodiments which are shown in the appended drawings and from which further advantages and modifications emerge. However, the disclosure is not restricted to the embodiments described in concrete terms, but rather can be modified and varied in a suitable manner. It lies within the scope to combine individual features and combinations of features of one embodiment with features and combinations of features of another embodiment in a suitable manner in order to arrive at further embodiments.

[0027] It will be apparent to those skilled in the art, based upon the teachings herein, that changes and modifications may be made without departing from the disclosure and its broader aspects. That is, all examples set forth herein above are intended to be exemplary and non-limiting.

LIST OF REFERENCE SYMBOLS

[0028]

1	metal housing
2,3	main openings
5,6	current conductor
7	drive element
10	first contact element
12	first main contact
14	first arcing contact
16	conductive spring element
18	shield
20	second contact element
21	contact tube; hollow carrier
22	second main contact
24	second arcing contact
25	impedance element
26	gap
31	main switch
32	arcing switch
35	resistor
36	inductance

Claims

1. A switching device comprising:

a housing (1) filled with an insulating gas;
a first contact element (10) comprising a first main contact (12) and a first arcing contact (14); and
a moveable second contact element (20) comprising a second main contact (22) and second arcing contact (24), said second contact element (20) being movable from a first position, where the first and the second main contacts (12, 14) as well as the first and the second arcing contacts (14, 24) are in direct contact, to a second position, where neither the first and the second main contacts (12, 22) nor the first and the second arcing contacts (14, 24) are in direct contact;
said second contact element (20) further comprising an impedance element (25) electrically connecting the second main contact (22) with the second arcing contact (24).

2. The switching device in accordance with claim 1 or 2, wherein the impedance element (25) comprises a resistive element (35).

3. The switching device in accordance with claim 2, wherein the resistance of the resistive element (35) lies in the range between 0,01 and 10,0 Ohm.

4. The switching device in accordance with claim 1 or 2, wherein the impedance element (25) comprises an inductive element (36).

5. The switching device in accordance with claim 4, wherein the inductivity of the inductive element (36) lies in the range between 1,0 and 50,0 nH.

6. The switching device in accordance with any one of the claims 2 to 5, wherein the resistive element (35) exhibits a positive temperature coefficient.

7. The switching device in accordance with any one of the claims 2 to 7, wherein the resistive element (35) exhibits a skin effect.

8. The switching device in accordance with any one of the claims 2 to 7, wherein the resistive element (35) comprises a ceramic material.

9. The switching device in accordance with any one of the claims 2 to 8, wherein the inductive element (36) and the resistive element (35) integrally form a single impedance element (25).

10. The switching device in accordance with any one of the preceding claims, wherein the voltage drop over the impedance element (25) is lower than 1/10 of the rated voltage of the switching device.

11. The switching device in accordance with any one of the preceding claims, wherein first contact element

(10) comprises a conductive spring element (16) connected to the first arcing contact (14).

12. The switching device in accordance with any one of the preceding claims, further comprising a drive element (7) to move the second contact element (20) from a first position, where the first and the second main contacts (12, 22) as well as the first and the second arcing contacts (14, 24) are in direct contact, to a second position, where neither the first and the second main contacts (12, 22) nor the first and the second arcing contacts (14, 24) are in direct contact.

13. The switching device in accordance with any one of the preceding claims, wherein the first main contact (12) comprises a contact spring.

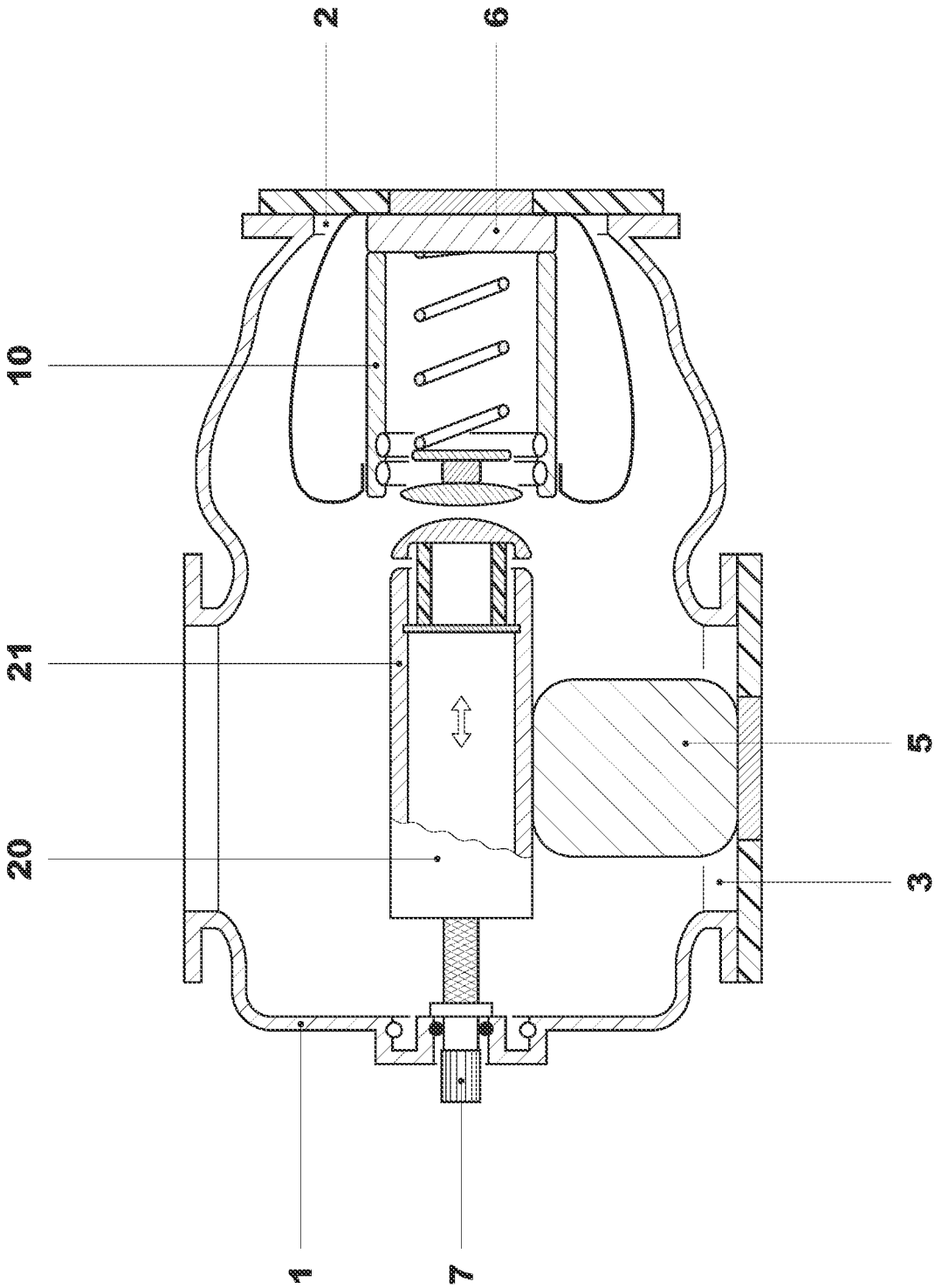

FIG. 1

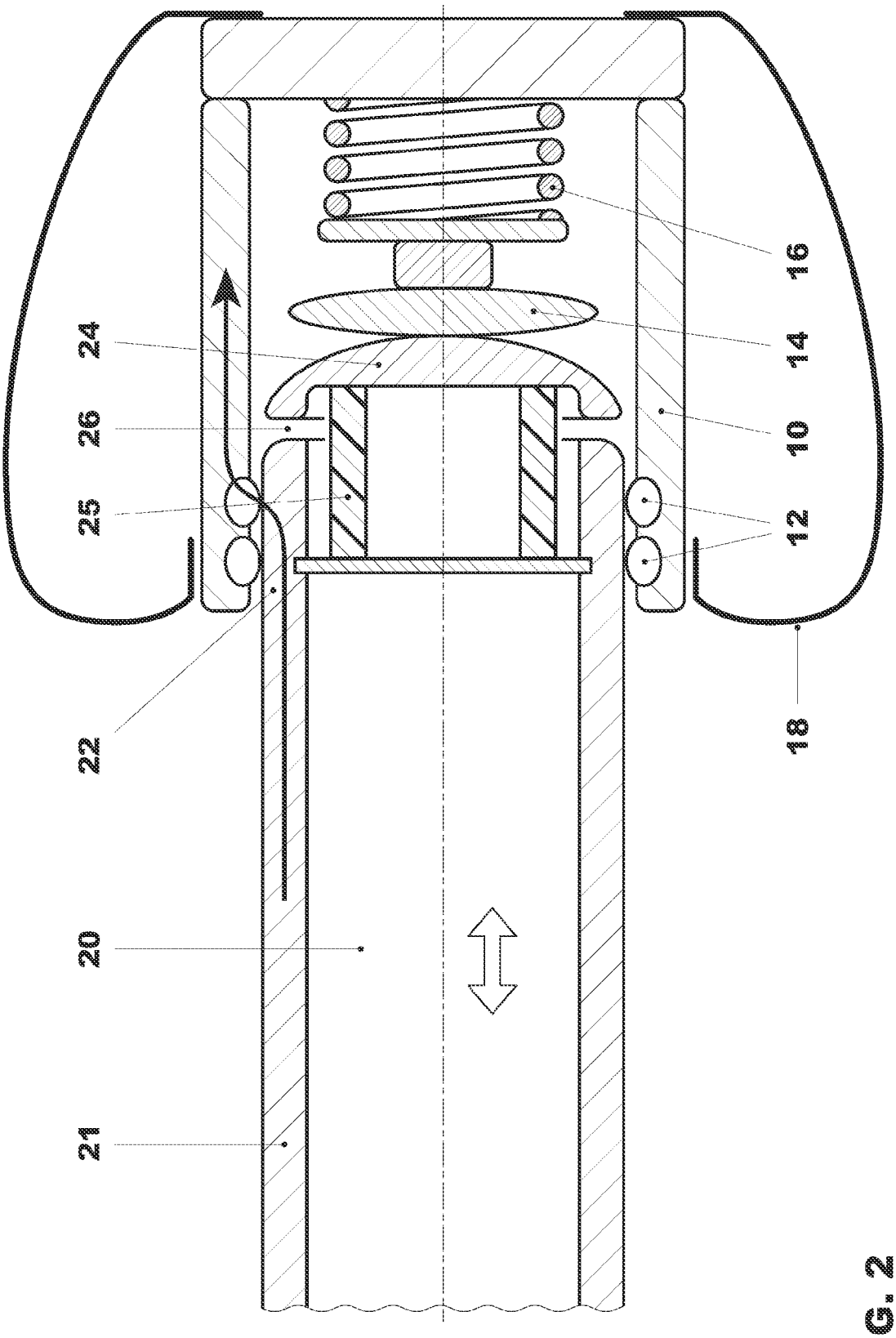

FIG. 2

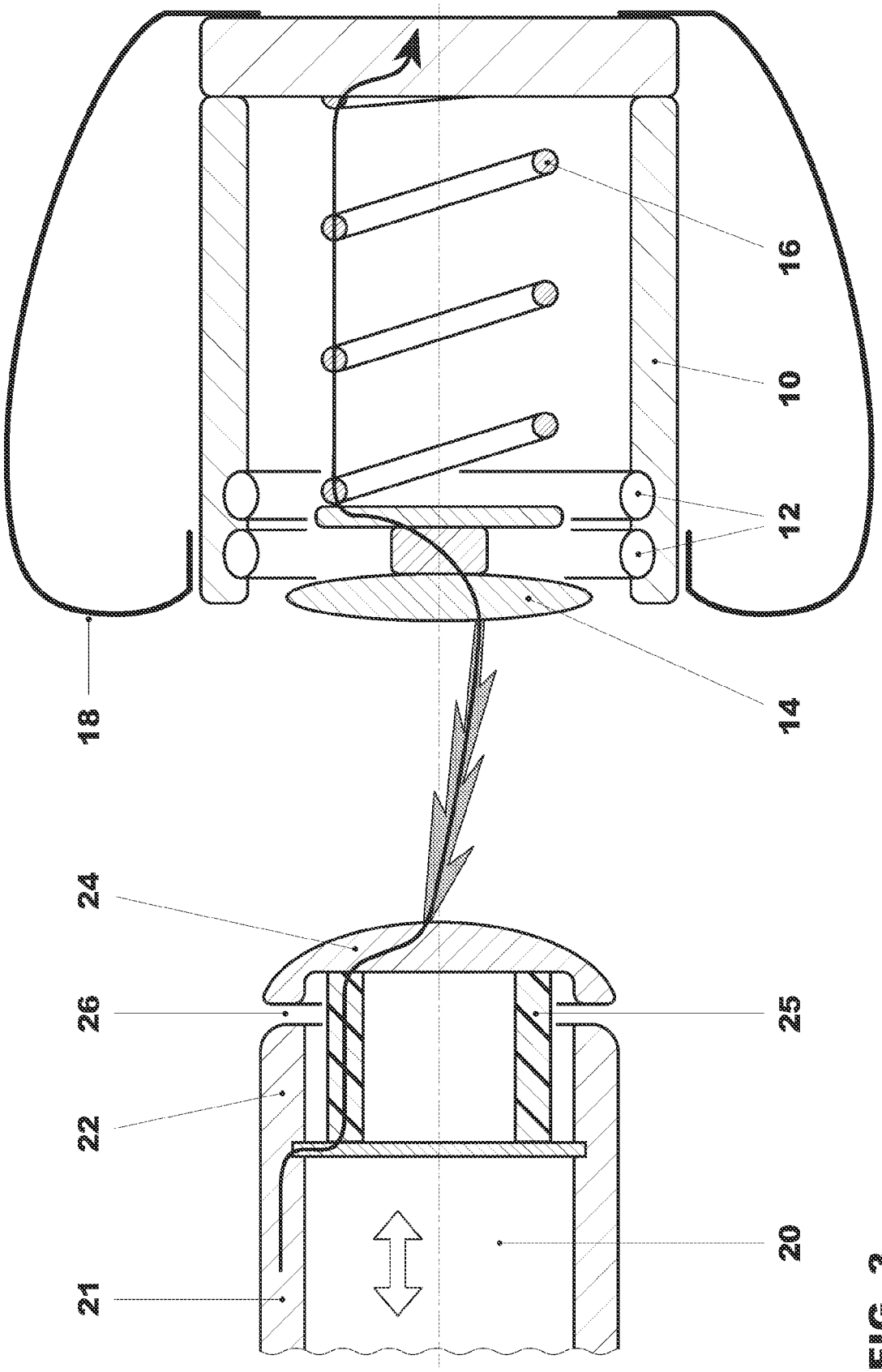

FIG. 3

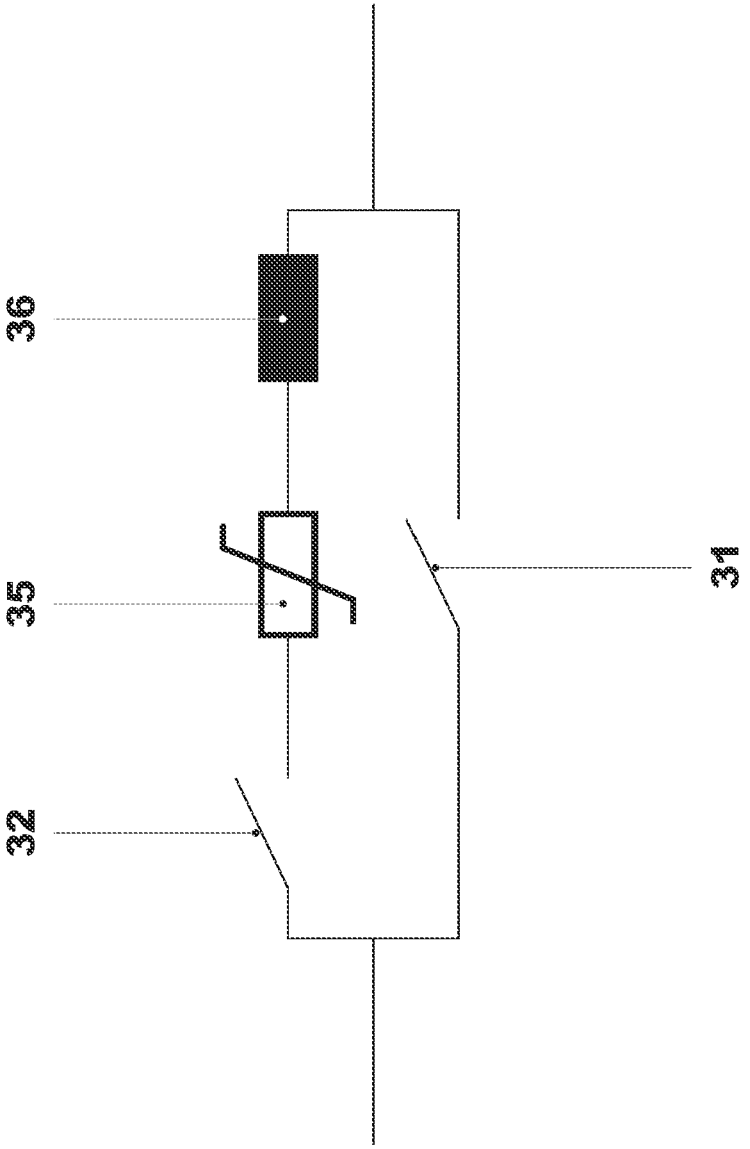

FIG. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 09 15 3480

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 Y	EP 0 348 645 A (LICENTIA GMBH [DE]) 3 January 1990 (1990-01-03) * column 2, line 5 - line 33 * * column 4, line 52 - line 56; figures 1-6 * -----	1-3,6-8, 11-13 4,5,9,10	INV. H01H33/16 ADD. H01H31/32 H01H33/64
X Y	JP 02 005244 U (.) 12 January 1990 (1990-01-12) * figures 3,4 * -----	1-3,6-8, 12,13 4,5,9,10	
X	EP 0 398 211 A (ALSTHOM GEC [FR]) 22 November 1990 (1990-11-22) * column 2, line 18 - column 4, line 13; figure 3 * -----	1-3,6,7, 12,13	
X Y	JP 55 040959 U (.) 15 March 1980 (1980-03-15) * figures 1-7 * -----	1-3,6-8, 12,13 4,5,9,10	
Y	JP 01 041130 A (TOKYO SHIBAURA ELECTRIC CO) 13 February 1989 (1989-02-13) * abstract; figures 1,2 * -----	4,5,9,10	TECHNICAL FIELDS SEARCHED (IPC) H01H
X Y	JP 03 081919 A (TOKYO SHIBAURA ELECTRIC CO) 8 April 1991 (1991-04-08) * abstract; figures 1-3,9,10 * -----	1-3,6-8, 12 4,5,9,10	
X Y	JP 52 071054 U (.) 27 May 1977 (1977-05-27) * figures 1,3 * -----	1-3,6-8, 12,13 4,5,9,10	
A	US 5 764 129 A (SYOUJI MORITAKA [JP] ET AL) 9 June 1998 (1998-06-09) * column 4, line 25 - line 27; claim 1 * -----	6,8	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 June 2009	Starck, Thierry

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 09 15 3480

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.

04-06-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0348645 A	03-01-1990	DE 3832171 A1	04-01-1990
JP 2005244 U	12-01-1990	JP 7054904 Y2	18-12-1995
EP 0398211 A	22-11-1990	DE 69007532 D1	28-04-1994
		DE 69007532 T2	30-06-1994
		FR 2647255 A1	23-11-1990
		US 5105058 A	14-04-1992
JP 55040959 U	15-03-1980	NONE	
JP 1041130 A	13-02-1989	NONE	
JP 3081919 A	08-04-1991	NONE	
JP 52071054 U	27-05-1977	NONE	
US 5764129 A	09-06-1998	CN 1138204 A	18-12-1996
		JP 3196003 B2	06-08-2001
		JP 8259317 A	08-10-1996

EPO FORM P0459

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