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(54) **Vacuuminterrupter**

(57) The invention concerns to a Vacuuminterrupter. Vacuuminterrupter with at least one movable contact piece which is connected with a vacuumchamber by a bellow. In order to prevent surface irregularities induced

by arc-induced damages on the contact piece surfaces, the radial ribs of the bellow or at least a part of these ribs of the bellow are arranged in an angle that differs from the perpendicular orientation of the long axis.

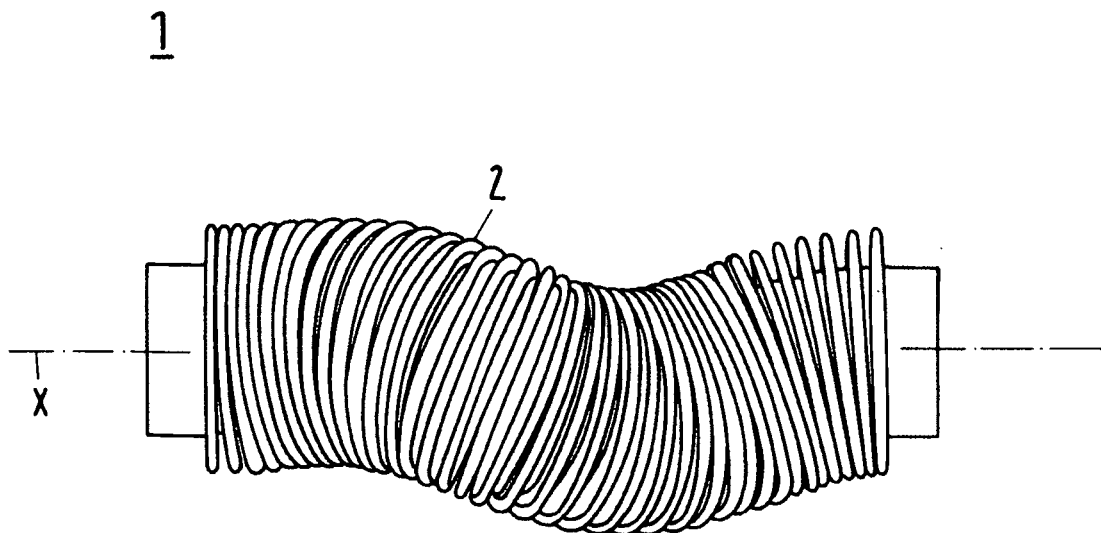


Fig.1

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Description

[0001] The invention relates to a vacuum interrupter with at least one movable contact piece which is connected with a vacuum chamber by a bellow.

[0002] Circuit breakers are used in electrical networks to make and break currents; i.e. short circuit currents as well as load currents under different load impedances. In the medium voltage range (rated voltages up to 72 kV), current interruption in vacuum is the dominant technology.

[0003] The working principle to interrupt currents is by separating the two contacts conducting these currents. One of the contacts is generally fixed, while the other moves vertically. In order to insure the vacuum sealing on the moving contact, a bellow is needed. It connects the non moving lid to the moving contact. The design of the bellow is made to insure a vertical linear motion of the contact only.

[0004] A rotatable contact is already known from EP 1 760 743. It is an object of this invention to create a very progressive realisation of this in a circuit-breaker with vacuum chamber.

[0005] It is a further object of the invention to prevent surface irregularities induced by arc-induced damages on the contact piece surfaces.

[0006] Therefore a vacuum interrupter in this invention has a special bellow, characterized in that the radial ribs of the bellow are arranged in an angle that differs from the perpendicular orientation of the long axis. By this potential mechanical energy of rotation of the bellow itself is implemented and will be set free if the bellow is stretched, and will be rotated back if the bellow is compressed back. So if the movable contact piece will be moved linear in order to open the electrical contact, a rotation of the movable contact piece, which is connected with it, will be effected simultaneously. So the linear opening movement is combined or superimposed by a rotation movement. This prevents burning damages in the surface structure of the contact piece.

[0007] A first embodiment of the invention is supported by that the orientation of the ribs of the bellow are mechanically induced by winding or rotating the bellow around its long axis for at least a part of a full 360° angle. By this, the bellow will be deformed at least partly reversibly, in order to store mechanical potential energy, which will be set free, when the bellow will be stretched or elongated by opening the contact. By this a rotational movement will be superimposed to the linear movement of the movable contact piece. That means, this bellow begins as a normal bellow, then it is forced to twist during manufacturing until it buckles. Once it buckles, it can be twisted further with relatively little additional effort, because torsional stiffness has dropped). This is, what is meant by "torsion admitting". It requires much less effort to twist it than it would take to twist a standard linear bellow that had not been pre-buckled.

[0008] A further alternative embodiment of the inven-

tion is supported by that the orientation of the ribs of the bellow are implemented screwlike around its long axis. In this embodiment, the bellow itself cause a rotational movement between the two flanges of the bellow, if it is compressed or elongated. So the rotational component of the movement will be caused easily by compressing or elongating the bellow during switching operation.

[0009] The amount of the winding angle is implemented by a kind of screwing back in a winded rotation position when closing the contacts (the contact pieces) and the so implemented potential energy is set free simultaneously by the opening movement of the contacts, so that the linear opening movement is superimposed with a rotational movement.

[0010] The disclosed invention here is a new design of a bellow, that allows a linear motion superimposed with a rotational motion. This rotational motion is naturally produced by the helical structure of the bellow and does not need any external acting force for the torsion. It means that a vacuum interrupter equipped with this new bellow will be able to operate by a standard linear mechanical drive system, which only needs to be able to accommodate the rotation. We can say that the bellow is "torsion generating" and the drive is "torsion admitting".

[0011] The advantage of such a bellow, allowing a linear and rotational motion of the moving contact, is to afford more flexibility for certain applications of vacuum circuit breakers (possibly for applications such as capacitive switching or for moving faster the initial arc during a current interruption phase). In the document EP1760743 is already described a system for a "rotatably mounted movable contact".

[0012] But with this new "helical bellow" disclosed here in this new application, it is a very progressive realisation of a rotatable contact.

[0013] A further embodiment is, that a part of a bellow, or one of the bellows of a serial bellow arrangement of several bellows is constructed with the aforesaid features.

[0014] A further embodiment is that the bellow or the bellows is made, e.g. are made of metal.

[0015] A further embodiment is that the bellow ribs have a round edge contour in the cross-section.

[0016] A further embodiment is that the bellow ribs have a sharp edge contour in the cross section.

[0017] The aim with the screw-like or the winded bellow as well is to have produced a geometry of the bellow, that generates automatically a rotational movement when a linear movement is imposed.

[0018] Alternative embodiments of this inventions are shown in the figures.

Figure 1: winded bellow

Figure 2: Screwlike bellow

Figure 3: a switch in which the new designed bellow is implemented

[0019] Figur 1 shows one embodiment of the invention, in which the bellow 1 is a winded or twisted one. This first design of a bellow 1 allows a linear superimpose with a rotational motion. This rotational motion is force from the outside (i.e. it must be driven). So it could be said, that the drive must be "Torsion Generating", while the bellow 1 is "Torsion Admitting".

[0020] The bellow 1 itself begins manufacture as a normal linear bellow. Then it is subjected to a torsion that permanently buckles the bellow. At this point, the stiffness of the bellow to torsional deformation is drastically reduced, and so it can be relatively easily deformed by the drive to produce a twist of the moving contact. The bellow retains its flexibility in the linear direction. Its application as an interface between air and vacuum for vacuum interrupters is new.

[0021] Figur 2 shows an also very effective design in the sense of the invention.

According to this figure 2, that means the screwlike bellow, the numerical simulations of the new bellow design have shown that for a vertical motion of 12 mm, it can be possible to twist the contact of about 40°, with an extreme bellow geometry such as presented in Fig 2.

[0022] In this design as well as in the design according to figure 1 is fulfilled that the radial ribs 2 of the bellow 1 or at least a part of these ribs of the bellow are arranged in an angle that differs from the perpendicular orientation of the long axis x. It means that in each case the ribs, or the radius of the ribs are inclined out of their perpendicular orientation of the long axis x in comparison to a normal symmetric bellow form the state of the art. This is the focus of the functional consequences in this invention.

[0023] Figur 3 shows in principle a switch for example for media voltage, in which is used a vacuumchamber 20 with at least one linear movable contact 22. The contact 21 is not movable. The new screw-like or pre-winded/-twisted bellow 1 as generates automatically a rotational movement force when a linear movement is imposed to the movable contact. So the bellow 1 will move in one rotational direction when the contact is opened, and it will be twisted back automatically when the contact ist moved again back in closing position.

The rotational movement additionally to the linear movement generates an extraordinarily effective arc extinguishing.

Claims

1. Vacuuminterrupter with at least one movable contact piece which is connected with a vacuumchamber by a bellow,
characterized in that
the radial ribs (2) of the bellow (1) or at least a part of these ribs of the bellow are arranged in an angle that differs from the perpendicular orientation of the long axis (x).

2. Vacuuminterrupter according to claim 1,
characterized in that
the orientation of the ribs (2) of the bellow (1) are mechanically induced by winding or rotating the bellow around its long axis (x) for at least a part of a full 360° angle.
3. Vacuuminterrupter according to claim 1,
characterized in that
the orientation of the ribs (2) of the bellow (1) are implemented screwlike around its long axis.
4. Vacuuminterrupter according to claim 2,
characterized in that
the value of the winding angle is implemented by a kind of screwing back in a winded rotation position when closing the contacts (the contact pieces) and the so implemented potential energy is set free simultaneously by the opening movement of the contacts, so that the linear opening movement is superimposed with a rotational movement.
5. Vacuuminterrupter according to one of the aforesaid claims,
characterized in that
a part of a bellow, or one of the bellows of a serial bellow arrangement of several bellows is constructed with the features of at least one of the aforesaid claims.
6. Vacuuminterrupter according to one of the aforesaid claims,
characterized in that
the bellow or the bellows is made, e.g. are made of metal.
7. Vacuuminterrupter according to one of the aforesaid claims,
characterized in that
the bellow ribs have a round egde contour in the cross-section.
8. Vacuuminterrupter according to one of the aforesaid claims,
characterized in that
the bellow ribs have a sharp edge contour in the cross section.

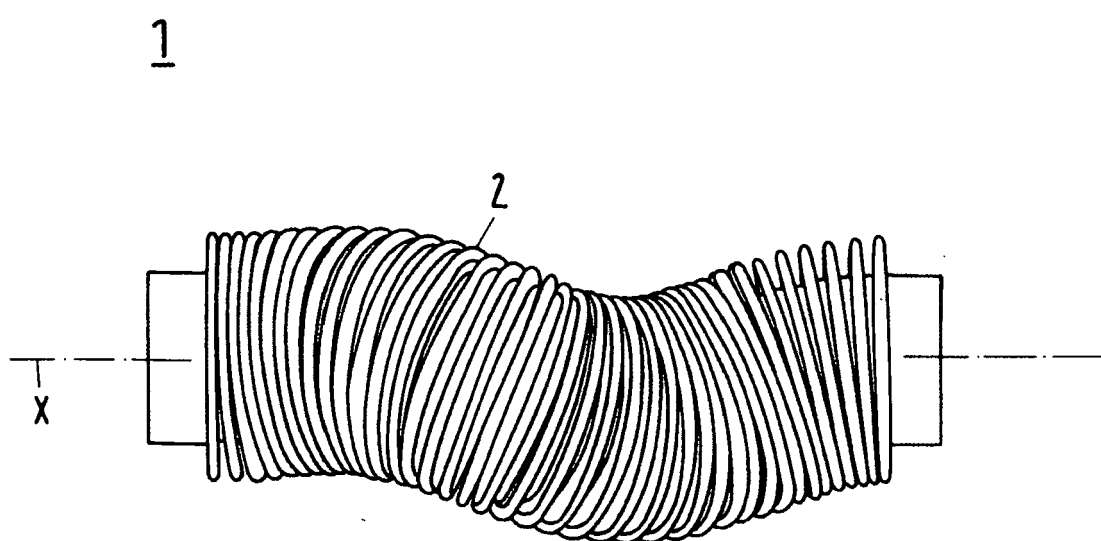


Fig.1

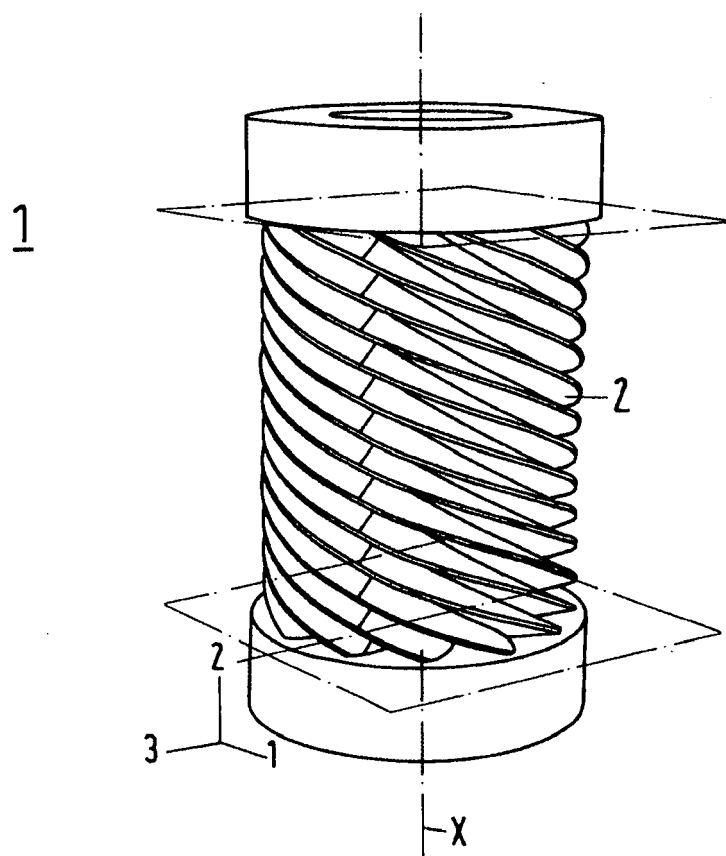


Fig.2.

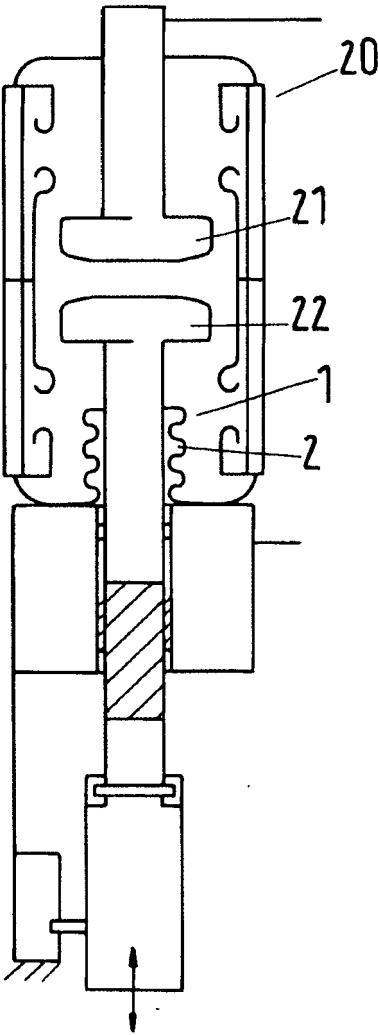


Fig.3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 02 4705

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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			H01H
Place of search		Date of completion of the search	Examiner
Munich		16 May 2008	Socher, Günther
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
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EP 07 02 4705

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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16-05-2008

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