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(54) A pole part of a circuit-breaker arrangement with a heat sink element

(57) The invention relates to a pole part of a circuit-breaker arrangement comprising an insulation housing (1) for accommodating a vacuum interrupter (5) containing a pair of corresponding electrical switching contacts (4, 6), wherein a movable lower electrical contact (6) is connected to a lower electrical terminal (3) of the insulation housing (1) via an electrical conductor (7) which is operated by a pushrod (8) and a fixed upper electrical contact (4) is connected to an upper electrical terminal (2) molded in the insulation housing (1), on which a heat sink element (9) is arranged for transferring the operation heat (Q) generated by the vacuum interrupter (5) via the upper electrical terminal (2) to the environment, wherein the heat sink element (9) comprises elastically damping means disposed between the upper electrical terminal (2) and the heat sink element (9) in order to reduce the bouncing effect at the switching contacts (4, 6) of the vacuum interrupter (5).

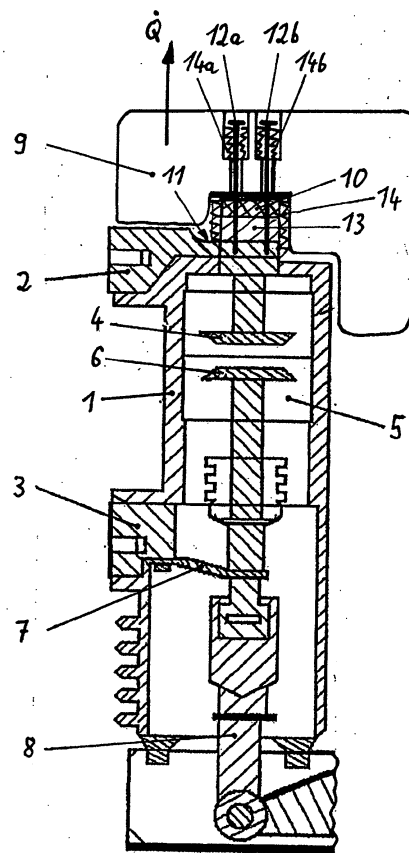


Fig.1

Description

Field of the invention

[0001] The invention relates to a pole part of a circuit-breaker arrangement comprising an insulation housing for accommodating a vacuum interrupter insert containing a pair of corresponding electrical switching contacts, wherein a movable lower electrical contact is connected to a lower electrical terminal of the insulation housing via an electrical conductor which is operated by a pushrod and a fixed upper electrical contact is connected to an upper electrical terminal molded in the insulation housing, on which a heat sink element is arranged for transferring the operation heat generated by the interrupter insert via the upper electrical terminal to the environment.

Background of the invention

[0002] A circuit-breaker pole part is usually integrated in a medium-voltage to high-voltage circuit-breaker arrangement. Especially, medium-voltage circuit-breakers are rated between 1 and 72 kV of a high current level. These specific breakers interrupt the current by creating and extinguishing the arc in a vacuum interrupter. Inside the vacuum interrupter a pair of corresponding electrical interrupter contacts is accommodated. Modern vacuum circuit-breakers attend to have a longer life expectancy than former air circuit-breakers. Although, vacuum circuit-breakers replace air circuit-breakers, the present invention is not only applicable to vacuum circuit-breakers but also for air circuit-breakers or modern SF₆ circuit-breakers having a chamber filled with sulfur hexafluoride gas instead of vacuum.

[0003] For actuating a circuit-breaker, usually a magnetic actuator with a high force density is used which moves one of the electrical contacts of a vacuum interrupter insert for purpose of electrical power interruption. Therefore, a mechanical connection between a movable armature of the magnetic actuator and an axially movable electrical contact inside the vacuum interrupter insert is provided.

[0004] The document WO 2012/007172 A1 discloses a circuit-breaker pole part comprising an external insulation housing made of a solid synthetic material for supporting and housing a vacuum interrupter insert for electrical switching a medium voltage circuit, wherein an adhesive material layer is applied at least on the lateral area of the interrupter insert.

[0005] The pole part comprises an upper electrical terminal and a lower electrical terminal for electrically connecting the circuit-breaker. The lower electrical terminal is connected to an electrical contact which is movable between the closed and the opened position via a jackshaft. This jackshaft internally couples the mechanical energy of a bistable magnet or spring driven actuator to the pole part. The pole part further comprises a threaded bolt on the upper electrical terminal for fastening the in-

terrupter insert on the upper electrical terminal. At the same time, the electrical connection is provided.

[0006] The product brochure "ADVACTM technical guide - Advanced design vacuum circuit-breakers" (ABB Inc., print no. 1VAL050501-TG, Rev A from March 2011) discloses a medium voltage circuit-breaker comprising three single pole parts for switching a three-phase grid. Each pole part consists of an interrupter insert and current carrying parts completely embedded in a proprietary epoxy resin. Thermal performance of the interrupter is improved as the epoxy resin draws heat away from the hot spots for a more even heat distribution.

[0007] For the purpose of an effective heat transfer of the operation heat generated by the interrupter insert to the environment a heat sink element (page 3) is mounted on the top of the pole part, which is mechanically connected to the upper electrical terminal by screwing elements. The operation heat will be conducted via the upper electrical terminal through the insulation housing to the heat sink element. A mounting surface of the heat sink element directly contacts a corresponding mounting surface on the top of the upper electrical terminal.

[0008] Usually, during closing operation of the electrical switching contacts the bouncing time has to be limited to less than 2 ms. If the vacuum interrupter insert is accommodated inside an embedded insulation housing the whole arrangement will be stiffer than a conventionally assembled embodiment of the pole part, wherein the vacuum interrupter insert is open installed inside the insulation housing. An additional heat sink which is mounted on the top of the pole part will further increase the stiffness. Moreover, a high stiffness result in a longer bouncing time with more than 2 ms.

Summary of the invention

[0009] It is an object of the present invention to decrease the stiffness of a pole part which is equipped with an additional heat sink element mounted on the top of the insulation housing in order to reduce the bouncing time to the desired limit.

[0010] According to the invention the heat sink element comprises elastically damping means which are disposed between the upper electrical terminal and the heat sink element in order to reduce the bouncing effect, namely the bouncing time, at the switching contacts of the vacuum interrupter.

[0011] With other words, the idea of the invention is to reduce the stiffness of the pole part by using a heat sink element with an integrated damping system between the heat sink element and the insulation housing on which the heat sink element is mounted.

[0012] The elastically damping means of the present invention can be realized in various ways. According to first embodiment the elastically damping means comprise a rubber element which is attached to the mounting surface of the upper electrical terminal on which the heat sink element is attached. Preferably, the heat sink ele-

ment is attached by at least one screwing element running through the heat sink element and the rubber element and screwed in the upper electrical terminal which is usually made of a copper material.

[0013] According to a second embodiment of the elastically damping means they comprise a piston-cylinder-arrangement, wherein the cylinder is filled with a compressible medium. In that case the cylinder can be integrated in the heat sink element and the corresponding piston can be attached to the mounting surface of the upper electrical terminal. Preferably, the compressible medium inside the cylinder is a gas or an elastomeric material, e.g. a rubber material. The heat transfer from the upper electrical terminal to the heat sink element is realized by the metallic contact of the piston to the inner wall of the corresponding cylinder.

[0014] According to a third preferred embodiment the elastically damping means comprise an elastically deformation area on the heat sink element which is preferably connected to the mounting surface of the upper electrical terminal. The heat transfer from the upper electrical terminal to the heat sink element is provided by the elastically deformation area which consists of the same material like the heat sink element.

[0015] If a direct heat transfer from the upper electrical terminal to the heat sink element is not technical feasible, additional heat transfer means are suggested in order to bypass the heat transfer over the elastically damping means.

[0016] According to a first preferred embodiment of such additional heat transfer means, they comprise at least one metal spiral element disposed in the heat transfer path between the upper electrical terminal and the heat sink element. Instead of a metal spiral element it is also possible to use friction, spiral or multi contact lamella made of metal material or the like.

[0017] If a metal spiral element is used for heat transferring, it preferably surrounds the rubber element for conducting the heat from the upper electrical terminal via the metal spiral element to the heat sink element. Alternatively, it is also possible to dispose the metal spiral element around the at least one screwing element which is used for attaching the heat transfer element to the upper electrical terminal.

Brief description of the drawings

[0018] The foregoing and other aspects of the invention will become apparent following the detailed description of the invention when considered in conjunction with the enclosed drawings.

Figure 1 shows a side view of a medium-voltage circuit-breaker pole part according to the invention,

Figure 2 shows another embodiment of a heat transfer element with integrated elastically damp-

ing means, and

Figure 3 shows a third embodiment of a heat transfer element with integrated elastically damping means.

[0019] All drawings are schematic.

Detailed description of the drawings

[0020] The medium-voltage circuit-breaker as shown in Figure 1 principally consists of an insulation housing 1 with an embedded upper electrical terminal 2 and a lower electrical terminal 3 forming an electrical switch for a medium-voltage circuit.

[0021] Therefore, the upper electrical terminal 2 is connected to a corresponding fixed upper electrical contact 4 which is stationary mounted at a vacuum interrupter insert 5. The corresponding lower electrical contact 6 is movable mounted in relation to the vacuum interrupter insert 5.

[0022] The lower electrical terminal 3 is connected to the corresponding movable lower electrical contact 6 via an electrical conductor 7, or flexible band or a piston cylinder arrangement with spiral or multicontact lamella connection. The movable lower electrical contact 6 is movable between a closed and an opened switching position by a pushrod 8. The electrical conductor 7 of the present embodiment consists of a flexible copper fiber material.

[0023] On the top of the insulation housing 1 a heat sink element 9 is arranged for transferring the operation heat Q generated inside the interrupter 5 via the upper electrical terminal 2 to the environment. The heat sink element 9 accommodates elastically damping means which are disposed between the upper electrical terminal 2 and the heat sink element 9. The said elastically damping means reduce the bouncing effect at the switching contacts 4 and 6 of the vacuum interrupter 5.

[0024] The elastically damping means according to the first embodiment of the invention comprise a rubber element 10 which is attached to a mounting surface 11 via a metal sleeve 13 by two screwing elements 12a, 12b. Both screwing elements 12a, 12b run through the heat sink element 9, the rubber element 10 and the metal sleeve 13 and they are screwed in the upper electrical terminal 2 of the pole part.

[0025] In order to transfer the operation heat Q which is generated by the vacuum interrupter 5 to the environment metal spiral elements 14a, 14b are disposed around the upper area of the corresponding screwing elements 12a and 12b. It is also possible to arrange a metal spiral element 14 around the rubber element 10 and the metal sleeve 13 for conducting the heat, emitted from the upper electrical terminal 2 via the metal spiral element 14 to the heat sink element 9.

[0026] In view of Figure 2 which shows the second embodiment of elastically damping means according to the

present invention they comprise a piston 15 to cylinder 16 arrangement. The cylinder 16 is filled with a compressible medium, e.g. a gas. The cylinder 16 is directly molded in the material of the heat sink element 9. The cylinder 16 corresponds with a piston 15 which is attached to the mounting surface 11 of the - not shown - upper electrical terminal 2 of the pole part. Additional heat transfer means are not necessary at the second embodiment.

[0027] According to Figure 3 the elastically damping means comprise an elastically deformation area 17, formed as a metal bellow, which is molded on the heat sink element 9. The heat sink element 9 is attached to the mounting surface 11 of the upper electrical terminal 2 via the said deformation area 17. The elastically deformation area 17 is formed with a special thin wall section which provides the elastically function to the heat sink element 9.

[0028] The invention is not limited by the preferred embodiments as described above which are presented as examples only but can be modified in various ways in the scope of protection defined by the patent claims.

Reference signs

[0029]

- 1 insulation housing
- 2 upper electrical terminal
- 3 lower electrical terminal
- 4 upper electrical contact
- 5 vacuum interrupter insert
- 6 lower electrical contact
- 7 electrical conductor
- 8 pushrod
- 9 heat sink element
- 10 rubber element
- 11 mounting surface
- 12 screwing element
- 13 metal sleeve
- 14 metal spiral element
- 15 piston
- 16 cylinder
- 17 deformation area

Claims

1. A pole part of a circuit-breaker arrangement comprising an insulation housing (1) for accommodating a vacuum interrupter (5) containing a pair of corresponding electrical switching contacts (4, 6), wherein a movable lower electrical contact (6) is connected to a lower electrical terminal (3) of the insulation housing (1) via an electrical conductor (7) which is operated by a pushrod (8) and a fixed upper electrical contact (4) is connected to an upper electrical terminal (2) molded in the insulation housing (1), on which a heat sink element (9) is arranged for transferring

the operation heat (Q) generated by the vacuum interrupter (5) via the upper electrical terminal (2) to the environment,

characterized in that, the heat sink element (9) comprises elastically damping means disposed between the upper electrical terminal (2) and the heat sink element (9) in order to reduce the bouncing effect at the switching contacts (4, 6) of the vacuum interrupter (5).

2. A pole part according to Claim 1,
characterized in that, the elastically damping means comprise a rubber element (10) attached to a mounting surface (11) of the upper electrical terminal (2) on which the heat sink element (9) is attached.
3. A pole part according to Claim 2,
characterized in that, the heat sink element (9) is attached by at least one screwing element (12a, 12b) running through the heat sink element (9) and the damping material element or rubber element (10) and screwed in the upper electrical terminal (2).
4. A pole part according to Claim 1,
characterized in that, the elastically damping means comprise a piston(15)-cylinder(16)-arrangement, wherein the cylinder (16) is filled with a compressible medium.
5. A pole part according to Claim 4,
characterized in that, that the compressible medium inside the cylinder (16) is a gas or an elastomer material.
6. A pole part according to Claim 1,
characterized in that, the elastically damping means comprise an elastically deformation area (17) of the heat sink element (9).
7. A pole part according to Claim 6,
characterized in that, the elastically deformation area (17) of the heat sink element (9) is connected to the mounting surface (11) of the upper electrical terminal (2).
8. A pole part according to Claim 1,
characterized in that, heat transfer means are provided for transferring the operation heat (Q) from the upper electrical terminal (2) to the heat sink element (9).
9. A pole part according to Claim 8,
characterized in that, the heat transfer means comprise at least one metal spiral element (14; 14a, 14b) disposed in the heat transfer path between the upper electrical terminal (2) and the heat sink element (9).

10. A pole part according to Claim 9,
characterized in that, the metal spiral element (14)
surrounds the rubber element (10) for conducting
the heat from the upper electrical terminal (2) via the
metal spiral or multicontact lamella element (14) to
the heat sink element (9). 5

11. A pole part according to Claim 9,
characterized in that, the metal spiral element (14a,
14b) surrounds a corresponding screwing element 10
(12a; 12b) for conducting the heat from the screwing
element (12a; 12b) via the metal spiral element (14a;
14b) to the heat sink element (9).

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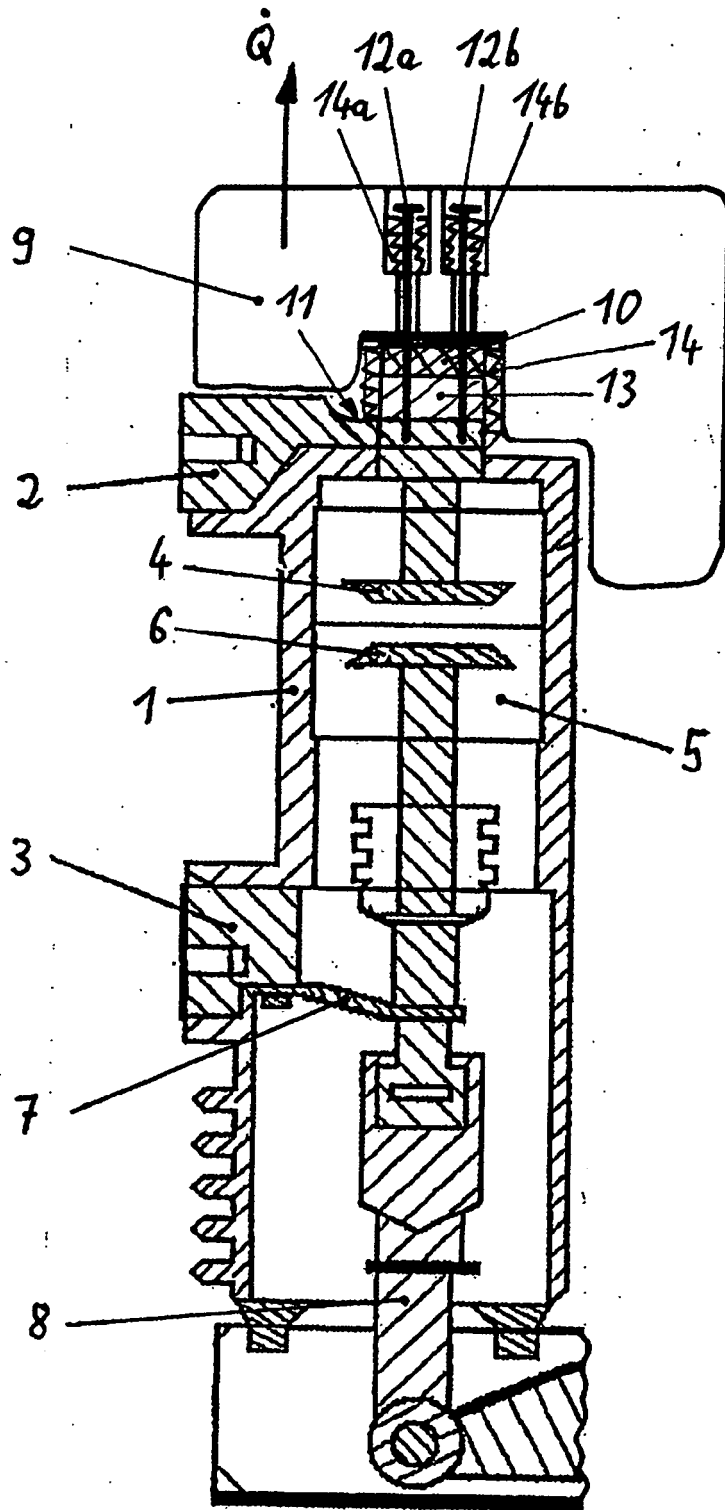


Fig.1

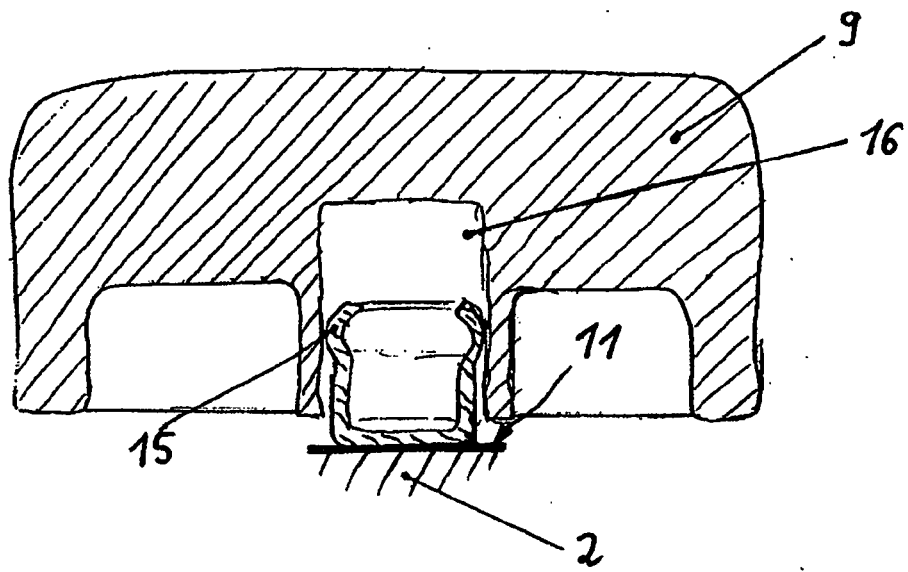


Fig.2

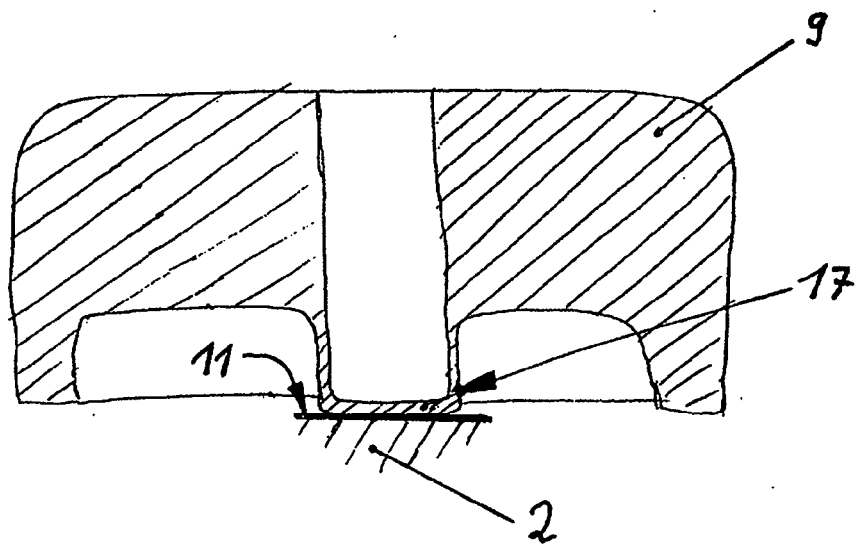


Fig.3



EUROPEAN SEARCH REPORT

Application Number
EP 12 00 7041

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X	JP 2010 272445 A (JAPAN AE POWER SYSTEMS CORP) 2 December 2010 (2010-12-02)	1-3,6-11	INV. H01H33/662
Y	* paragraph [0006] - paragraph [00023]; figures 1,2 *	4,5	
Y	----- DE 196 25 128 A1 (FACHHOCHSCHULE FUER TECHNIK UN [DE]) 18 December 1997 (1997-12-18)	4,5	
A	* column 5, line 25 - column 7, line 46; figures 1-4 *	1-3,6-11	
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A	* column 2, line 48 - column 3, line 36; figure 1 *	1-3,6-11	
Y	----- US 2005/092713 A1 (CHYLA THOMAS [DE] ET AL) 5 May 2005 (2005-05-05)	4,5	
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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		7 March 2013	Pavlov, Valeri
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 12 00 7041

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