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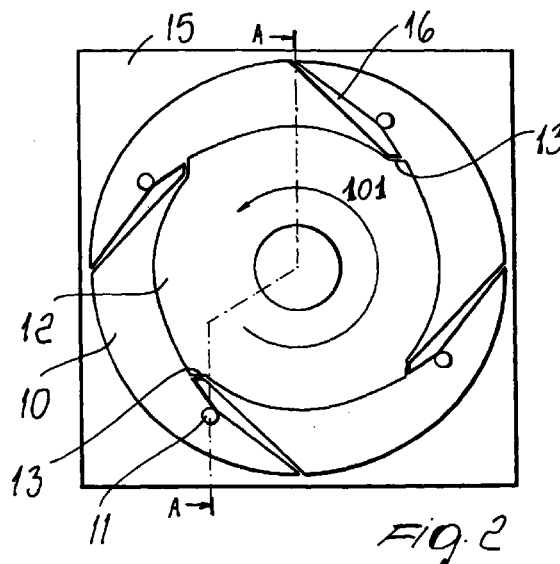
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(54) **System for controlling traffic**

(57) A release device for mechanical actuators of medium-voltage switches, whose particularity consists of the fact that it comprises a disk-shaped element provided with at least one pin element which protrudes from it and is suitable to be actuated by an actuator;

- a toothed wheel element, which has at least one tooth and is operatively connected to a kinematic chain for opening a MV circuit breaker;

a frame provided with at least one flexible element which is suitable to engage the at least one tooth of the toothed wheel element, the at least one pin element of the disk-shaped element being suitable to produce the disengagement of the at least one flexible element from the at least one tooth of the toothed wheel element in the opening condition of the release device.



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Description

[0001] The present invention relates to an improved medium-voltage (MV) circuit breaker (i.e. for voltage values from 1KV to 35 KV).

[0002] It is known that a MV circuit breaker generally comprises at least a fixed contact and a movable contact that are mutually coupled/uncoupled, respectively during the closing/opening operations of the MV circuit breaker.

[0003] Generally, a MV circuit breaker comprises also a release device, which is operatively connected to the movable contact (by means of a kinematic chain), and an actuator. More particularly, as shown in figure 1, the mentioned release device (reference 50 of figure 1) generally employs two rockers 1. The rockers 1 are mutually parallel and mutually connected by means of a central pivot 2, a first bearing 3 (at one end) and a second bearing 4 (at the opposite end). The bearing 3 engages a tooth 5, which is rigidly coupled to a shaft 6 that is turned by the actuator (not shown).

[0004] The second bearing 4, instead, engages a tooth 7 of a crank 8. In practice, the actuator provokes the rotation of the shaft 6, on which the tooth 5 is fitted, and the rotation of the tooth 5 disengages the coupling with the bearing 3. The crank 8 applies to the rocker 1 a force 9, which is produced by means of springs, operatively connected to the rocker 1. This force 9 provokes, on the bearing 4, a contact force, which produces, on the rocker 1, a force 11 around the pivot 2.

[0005] The rotation of the rocker 1, now disengaged by the tooth 5, allows also disengaging the coupling with the bearing 4. The kinematic chain (not shown), operatively connected to the rocker 1, can therefore move freely.

[0006] Traditional MV circuit breakers are characterized by some drawbacks.

[0007] In fact, the sliding bearing 3 and the rolling bearing 4 make the rocker 1, as a whole, relatively very expensive, due to the intrinsic cost of the components, to the number of parts that compose it, and to the consequent need for assembly.

[0008] The bearings, furthermore, require lubrication, which increases the maintenance cost and in some cases, due to the deterioration of the lubricant, can cause the rocker to malfunction.

[0009] Further, the tooth 5 is fitted on a metallic shaft, which is connected to the frame of the circuit breaker with two roller bearings that are particularly expensive.

[0010] Therefore, the aim of the present invention is to provide a medium-voltage circuit breaker, which is provided with a release device that allows drastically simplifying the release mechanism, so as to reduce its cost and at the same increase its reliability.

[0011] Within the scope of this aim, an object of the present invention is to provide a medium-voltage circuit breaker, which is provided with a release device that

allows reducing the number of components.

[0012] Another object of the present invention is to provide a medium-voltage circuit breaker, which is provided with a release device that allows eliminating the actuation shaft, the tooth rigidly coupled to the shaft and the sliding and rolling bearings.

[0013] Another object of the present invention is to provide a medium-voltage circuit breaker, with allows achieving a significant reduction in assembly costs.

[0014] Another object of the present invention is to provide a medium-voltage circuit breaker, whose maintenance is greatly reduced with respect to the release devices of the prior art.

[0015] Another object of the present invention is to provide a medium-voltage circuit breaker, which is highly reliable, relatively simple to manufacture and at competitive costs.

[0016] Thus, the present invention provides a MV circuit breaker comprising:

- at least a fixed contact and a movable contact that are mutually coupled/uncoupled respectively during the closing/opening operations of the MV circuit breaker; and
- a release device operatively connected to the movable contact by means of a kinematic chain; and
- an actuator operatively connected to the release device.

[0017] The MV circuit breaker, according to the present invention is characterized in that the release device comprises a toothed wheel element, comprising at least a tooth element, which is operatively connected to the kinematic chain. The MV circuit breaker, according to the present invention, further comprises a frame provided with at least a flexible element. This frame is suitable to engage said one tooth element. Further, the MV circuit breaker, according to the present invention, further comprises a disk-shaped element provided with at least a pin element protruding from the disk-shaped element. The pin element is operatively connected to the actuator and is suitable to produce the disengagement of the flexible element from the tooth element, during an opening operation of the MV circuit breaker.

[0018] Further characteristics and advantages of the invention will become apparent from the description of preferred but not exclusive embodiments of the release device according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic sectional view of a conventional release device; and

Figure 2 is a plan view of the first embodiment of the release device according to the present inven-

tion; and

Figure 3 is a sectional view, taken along the multiple planes A-A of Figure 2;

Figure 4 is a plan view of a second embodiment of the release device according to the present invention; and

Figure 5 is a sectional view, taken along the multiple planes B-B of Figure 4.

[0019] With reference to the above mentioned figures 2-5, the MV circuit breaker, according to the present invention, comprises at least a fixed contact and a movable contact (not shown) that are coupled/uncoupled respectively during the closing/opening operations of the MV circuit breaker. Further, the MV circuit breaker, according to the present invention, comprises a release device 100 operatively connected to the movable contact by means of a kinematic chain (not shown) and an actuator (not shown), operatively connected to the release device 100.

[0020] In a first embodiment of the present invention shown in Figures 2 and 3, the release device 100 comprises a disk-shaped element 10, which is suitable to be connected to the actuator (not shown). The disk-shaped element 10 comprises one or more pin elements 11, arranged substantially at right angles to the surface of the disk-shaped element 10.

[0021] The disk-shaped element 10 is preferably arranged so as to face a toothed wheel element 12, which is provided with one or more tooth elements 13.

[0022] Advantageously, the number of tooth elements 13 is a multiple of the number of pin elements 11.

[0023] The toothed wheel element 12 is operatively connected to spring means (not shown) that are arranged, so as to apply a constant torque 101 to the toothed wheel element 12.

[0024] A frame 15 encloses the disk-shaped element 10 and the toothed wheel element 12, and is provided with one or more flexible elements 16, which are preferably arranged at an angle with respect to an axis of symmetry of the frame 15.

[0025] The flexible elements 16 are suitable to engage the tooth elements 13 of the toothed wheel element 12 and are kept in position, as described in detail hereinafter, by the pin elements 11.

[0026] Conveniently, the frame 15 is rigidly coupled to the casing of the MV circuit breaker, according to the present invention.

[0027] With reference now in detail to the first embodiment shown in Figures 2 and 3, the release device 100, according to the present invention, operates as follows.

[0028] In locking conditions, the toothed wheel element 12, which acts as a crank for the kinematic chain, which is operatively connected to the movable contact,

is motionless and subjected to a torque, which is generated by the mentioned spring means (not shown). In this manner, it is geared-down by the kinematic chain itself, producing a torque around its axis.

[0029] This torque (having for example a direction 101) is contrasted by the flexible elements 16, which are rigidly coupled to the frame 15 and exchange with the toothed wheel element 12 a force, which is orientated along the interface plane between the tooth elements 13 and the flexible elements 16.

[0030] It should be noted that the tooth elements 13 are shaped so as to have a surface, which is appropriately inclined with respect to a radius of the toothed wheel element 12. Likewise, the flexible elements 16 have an end, which is suitable to engage the tooth 13 and is shaped complementarily. In particular, the contact surface, in the embodiment of Figure 2, can be substantially parallel to the radial direction of the toothed wheel element 12. Alternatively, in the embodiment of Figure 4, the contact surface can be substantially inclined, so as to form an obtuse angle with respect to the radial direction of the toothed wheel element.

[0031] The torque 101 would tend to flex inward the flexible elements 16 and disengage them with respect to the tooth elements 13, so as to release the toothed wheel element 12.

[0032] The flexible 16 elements are restrained by the presence of the pin elements 11, which contrast the flexing of the flexible elements 16 and, therefore, prevent the opening of the circuit breaker of the MV circuit breaker, according to the present invention.

[0033] When instead the actuator applies to the disk-shaped element 10 a torque, which is orientated in the same direction 101, as the torque applied to the toothed wheel element 12, the pin elements 11, by rotating with the disk-shaped element 10, disengage the flexible elements 16. The flexible elements 16, by virtue of the force applied by the tooth elements 13 on them, flex upward. In this manner, they disengage the tooth elements 13 and, accordingly, the toothed wheel element 12 can rotate freely, due to the torque that acts on it, which is produced by the spring means (not shown) of the MV circuit breaker.

[0034] Essentially, the application to the disk-shaped element 10 of a torque, which is opposite to the torque 101, keeps the MV circuit breaker in a locked condition.

[0035] On the contrary, the application of a torque to the disk-shaped element 10 in the same direction as the torque 101 turns the toothed wheel element 12 and consequently provokes the opening of the MV circuit breaker, according to the present invention.

[0036] Figure 4 is a view of a second embodiment of the release device 100, in which identical reference numerals designate identical elements.

[0037] The embodiment of Figure 4 differs from the embodiment of Figure 2 in that the flexible elements 16 are rigidly coupled to the frame 15. In this manner, they

prevent the rotation of the toothed wheel element 12, engaging the tooth elements 13 of the toothed wheel element 12. Therefore, the disk-shaped element 10 is motionless and the pin elements 11 of the disk-shaped element 10 are arranged on the inside of the flexible elements 16, with respect to the center of rotation of the toothed wheel element 12.

[0038] Essentially, in locked conditions, the disk-shaped element 10 is motionless and the pin elements 11 transmit no force to the flexible elements 16. The flexible elements 16 lock the tooth elements 13 of the toothed wheel element 12 and, therefore, lock the toothed wheel element 12 in the opening condition, due to the fact that the pin elements 11 cause the disengagement of the flexible elements 16.

[0039] It should be noted that, in this embodiment of the present invention, it is important that the direction of the contact force does not flex inward the flexible elements 16.

[0040] The toothed wheel element 12 is rigidly coupled to the crank of the kinematic chain and is subjected to a torque 101 produced by the spring means (not shown) of the MV circuit breaker. The torque 101 is sustained by the flexible elements 16 as an axial load and by the frame 15.

[0041] Vice versa, in opening conditions, the actuator applies a torque (in opposite direction with respect to torque 101) to the disk-shaped element 10. The disk shaped element 10 turns and the pin elements 11, by turning with the disk-shaped element 10, push the flexible elements 16, which in turn rotate (in direction 101) by flexing about their section that connects them to the frame 15.

[0042] The rotation of the flexible elements 16 releases the tooth elements 13 of the toothed wheel element 12, and the toothed wheel element 12 can thus rotate freely due to the torque 101 that acts on it and is produced by the opening of the MV circuit breaker. In this case, also, in opening conditions, the pin elements 11 produce the disengagement of the flexible elements 16.

[0043] In both embodiments, the flexibility of the flexible elements 16 is determined by a reduced cross-section of the flexible elements 16 at the region, in which the flexible elements 16 connect to the frame 15. This region is provided with a reduced cross-section and, therefore, allows the flexible elements 16 to flex about their point of connection to the frame 15.

[0044] In practice, therefore, the release device be made of plastics and, furthermore, does not use rolling or sliding bearings or the like and allows to eliminate the actuation shaft 6 shown in Figure 1.

[0045] The lack of bearings and actuation shaft, furthermore, entails the advantage that it is not necessary to lubricate the release device, with consequent reduced maintenance costs.

[0046] In practice it has been found that MV circuit breaker, according to the invention, fully achieves the

intended aims, since it is provided with a simplified release device, substantially maintenance-free and with a reduced number of components.

[0047] The MV circuit breaker, according to the present invention, thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with other technically equivalent elements.

[0048] In practice, the materials used, so long as they are compatible with the specific use, as well as the dimensions, may be any according to the requirements and the state of the art.

Claims

1. A MV circuit breaker comprising:

- at least a fixed contact and a movable contact, said fixed contact and said movable contact being mutually coupled/uncoupled respectively during the closing/opening operations of said MV circuit breaker; and
- a release device operatively connected to said movable contact by means of a kinematic chain; and
- an actuator operatively connected to said release device; characterized in that said release device comprises:
 - a toothed wheel element, comprising at least a tooth element, said tooth element being operatively connected to said kinematic chain; and
 - a frame provided with at least a flexible element, said frame being suitable to engage said tooth element; and
 - a disk-shaped element provided with at least a pin element protruding from said disk-shaped element, said pin element being operatively connected to said actuator and being suitable to produce the disengagement of said flexible element from said tooth element, during an opening operation of said MV circuit breaker.

2. A MV circuit breaker, according to claim 1, characterized in that said toothed wheel element comprises a number of tooth elements, which is equal to a multiple of the number of pin elements included in said disk-shaped element.

3. A MV circuit breaker, according to one or more of previous claims, characterized in that said toothed wheel element is operatively connected to spring means, said spring means being arranged so as to apply a constant torque to said toothed wheel element.

4. A MV circuit breaker, according to one or more of

previous claims, characterized in that said disk-shaped element is arranged substantially concentrically to said toothed wheel element.

5. A MV circuit breaker, according to one or more of previous claims, characterized in that said tooth element is provided with an engagement surface, arranged at an angle with respect to a radius of said toothed wheel element. 5
- 10
6. A MV circuit breaker, according to claim 5, characterized in that, said flexible element is provided, at the end that lies opposite to the end where said flexible element is mechanically connected to said frame, with a surface, which is shaped complementarily to the engagement surface of said tooth element. 15
7. A MV circuit breaker, according to claims 5 and 6, characterized in that, said engagement surface is parallel with respect to a radius of said toothed wheel element. 20
8. A MV circuit breaker, according to claim 5, characterized in that said tooth element is provided with an engagement surface, arranged at an obtuse angle with respect to a radius of said toothed wheel element. 25
9. A MV circuit breaker, according to one or more of previous claims, characterized in that said disk-shaped element is arranged, with reference to the center of rotation of said toothed wheel element and said disk-shaped element, externally with respect to said flexible element. 30
- 35
10. A MV circuit breaker, according to one or more of previous claims, characterized in that said pin element is arranged, with reference to the center of rotation of said toothed wheel element and said disk-shaped element, internally with respect to said flexible element. 40
11. A MV circuit breaker, according to one or more of previous claims, characterized in that said frame encloses, with said flexible element thereto, said disk-shaped element and said toothed wheel element, said flexible element being arranged on the laying plane of said toothed wheel element. 45
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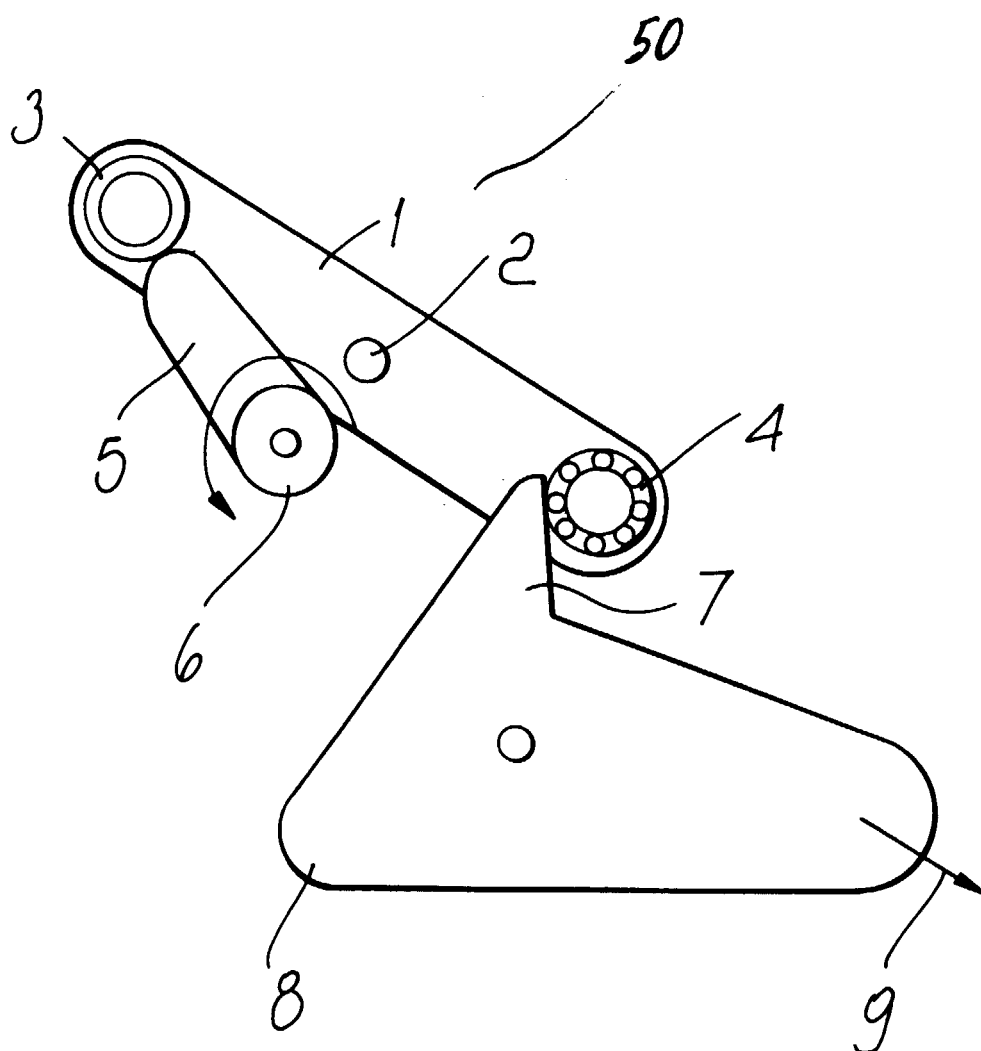


Fig. 1

