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(54) Auxiliary contact device for magnetothermal circuit breaker

(57) An auxiliary contact accessory device for a magnetothermal circuit breaker, particularly of the bipolar type with phase and neutral poles, which is associated therewith, comprising an insulating casing which contains fixed contacts and a corresponding moving contact, connection terminals, and a kinematic mechanism, characterized in that the kinematic mechanism comprises:

-- means for coupling to the circuit breaker;
-- means for actuating the moving contact;
-- means for the local visual indication of an open circuit breaker state;
-- means for testing the correct operation of said fixed and moving contacts.

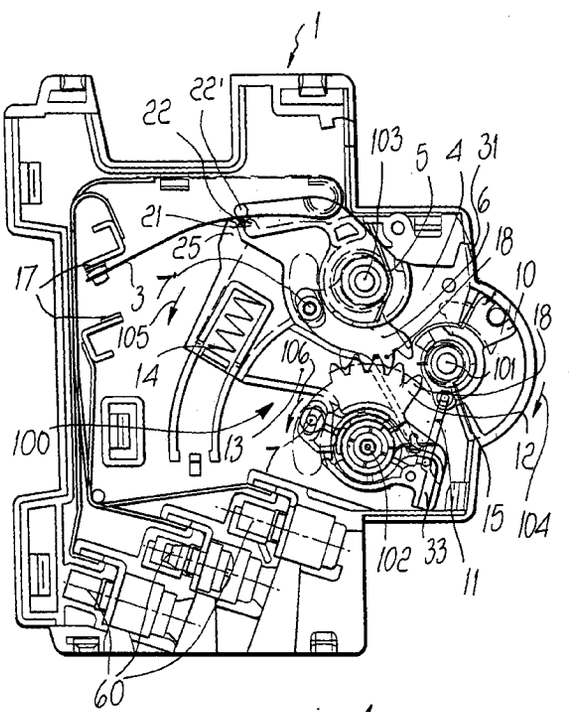

Fig. 1

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Description

[0001] The present invention relates to a driven-type accessory device, particularly to an auxiliary contact accessory device for a magnetothermal circuit breaker associated therewith.

[0002] The magnetothermal circuit breaker to which reference is made herein is of the bipolar type with phase and neutral poles and is disclosed in the Italian patent application no. MI97A002544 in the name of the same Applicant; the description of said application is assumed included herein as reference.

[0003] It is known that magnetothermal circuit breakers are generally constituted by an insulating casing inside which moving contacts are provided which mate with corresponding fixed contacts. In the case of bipolar circuit breakers, the moving contacts comprise phase contacts and neutral contacts which are mechanically different from each other and which, depending on the applications and/or on the applicable national statutory provisions, can be located alternatively on the right side or on the left side of said circuit breaker when viewed from the front.

[0004] Accessory devices are externally associated with said circuit breakers and are conventionally of two kinds, respectively driving and driven, depending on whether they act on the circuit breaker, actuating an action thereof, or perform an action as a function of a command received from said circuit breaker.

[0005] A driving accessory device can be constituted by a relay which, for example, when it detects a network voltage value which is lower than a certain preset threshold, supplies an opening command to the circuit breaker associated therewith. By way of this command, the circuit breaker changes its state from a condition in which its contacts are closed to one in which its contacts are open, and by means of appropriate lever systems it triggers a kinematic mechanism inside a device for indicating the state of the circuit breaker associated therewith, which accordingly constitutes a driven device. Said driven device then provides the operators with a signal which corresponds to the current state of the circuit breaker.

[0006] In order to facilitate users, driving accessory devices are always installed on the same side of the circuit breaker, for example on the left of the associated circuit breaker, while driven ones, to which the present invention relates, are installed on the other side, i.e., on the right.

[0007] In the case of bipolar circuit breakers with neutral and phase poles, there is the severe drawback that since the device for indicating the state of the circuit breaker is a driven accessory, it is generally always installed on the same side of the circuit breaker, for example on the right. In the current state of the art, this entails the need to provide two separate series of indicator devices, depending on whether they must be coupled to circuit breakers in which the neutral pole is on the right or on the left. This leads to increased constructive complexity and higher production costs. Moreover, when the driven accessory device is coupled to a circuit breaker, the kinematic mechanisms for opening the contacts of the circuit breaker can be negatively affected by the corresponding kinematic systems of the accessory device; in particular, the opening speed of the circuit breaker might be reduced, consequently leading to misfunctioning or even breakage of said circuit breaker.

[0008] Another inherent drawback of known devices for indicating the state of the circuit breaker associated therewith consists in that when the circuit breaker opens for any reason, for example because of a short-circuit current or a thermal overload, the accessory device, by changing its state from closed to open, sends a corresponding alarm signal, which can be of the visual type, for example by lighting a lamp on a panel, or of the acoustic type, by means of an alarm siren. If the circuit breaker opens, triggering due to a fault, in the current state of the art driven accessory devices are not provided with means for local visual indication which allow an operator to immediately identify which circuit breaker has been triggered and to reset the device itself in order to stop the alarm signal without acting on the triggered circuit breaker.

[0009] Another drawback consists in that known driven accessory devices do not have means which, without coupling them to a circuit breaker, allow to test them in order to check, for example, the true continuity of contact switching, which might occur incorrectly if the contacts are dirty. Moreover, once the accessory device has been installed in any system, the need may arise to test the auxiliary functions of the system of which the device is an integral part. In the current state of the art, in order to meet this need it is necessary to operate the circuit breaker associated with the device, connect power to the system and artificially induce a fault, for example a thermal overload, and this is particularly troublesome.

[0010] The aim of the present invention is to provide an auxiliary contact accessory device for a magnetothermal circuit breaker associated therewith, in which coupling to the circuit breaker occurs fully independently of the position of the poles inside said circuit breaker. Within the scope of this aim, an object of the present invention is to provide an auxiliary contact accessory device for a magnetothermal circuit breaker associated therewith, wherein the coupling to the circuit breaker does not affect at all the kinematic mechanisms of said circuit breaker, accordingly leaving its design characteristics unchanged, particularly in terms of contact opening times.

[0011] Another object of the present invention is to provide an auxiliary contact accessory device for a magnetothermal circuit breaker associated therewith in which there is a local visual indication of an open state of the circuit breaker.

[0012] Another object of the present invention is to provide an auxiliary contact accessory device for a mag-

netothermal circuit breaker associated therewith in which it is possible to test the device itself before coupling to the circuit breaker.

[0013] Another object is to provide an auxiliary contact accessory device for a magnetothermal circuit breaker associated therewith in which, after the device has been installed in a system, it is possible to test the auxiliary functions of said system without having to set the circuit breaker associated therewith to the closed position (thus connecting the main system to the power supply): "blank test".

[0014] Another object of the present invention is to provide an auxiliary contact accessory device for a magnetothermal circuit breaker associated therewith which is highly reliable, relatively easy to manufacture and at competitive costs.

[0015] This aim, these objects and others which will become apparent hereinafter are achieved by an auxiliary contact accessory device for a magnetothermal circuit breaker, particularly of the bipolar type with phase and neutral poles, which is associated therewith, comprising an insulating casing which contains fixed contacts and a corresponding moving contact and connection terminals, and a kinematic mechanism, characterized in that said kinematic mechanism comprises:

-- means for coupling to the circuit breaker;
-- means for actuating the moving contact;
-- means for the local visual indication of an open circuit breaker state;
-- means for testing the correct operation of said fixed and moving contacts.

[0016] Further characteristics and advantages of the invention will become apparent from the description of preferred but not exclusive embodiments of the accessory device according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

- Figure 1 is a schematic side view of the accessory device according to the present invention in a position which corresponds to the one in which the associated circuit breaker is closed;
- Figure 2 is a schematic side view of the accessory device according to the present invention, in a position which corresponds to the one in which the associated circuit breaker is open;
- Figure 3 is a schematic side view of the accessory device according to a preferred embodiment, in a position which corresponds to the one in which the associated circuit breaker is open;
- Figure 4 is an exploded view of the kinematic mechanism used in the accessory device according to the invention.

[0017] With reference to the above Figures, the accessory device according to the invention comprises an insulating casing 1 inside which fixed contacts 17 are provided which operatively couple to a moving contact 3 (changeover contact); said contacts are connected to connection terminals 60. In the illustrated embodiment and merely by way of example, the moving contact 3 is of the laminar type.

[0018] The moving contact 3 is actuated by means of a suitable kinematic mechanism which is generally designated by the reference numeral 100 and is in turn actuated by a corresponding change of state of the contacts of the associated magnetothermal circuit breaker, which is not shown in the Figures. Said kinematic mechanism 100 comprises means for coupling to the circuit breaker, means for actuating the moving contact, means for the local visual indication of an open circuit breaker state and means for testing the correct operation of said fixed and moving contacts.

[0019] In particular, said means for actuating the moving contact comprise a contact actuation lever 13 and a transmission lever 10. The transmission lever 10 is pivoted to a point 101 of the casing 1 and is held in an inactive position (which corresponds to a closed state of the associated circuit breaker) by a spring 15. The transmission lever 10 is detachably connected, by means of a U-shaped element 11, to the contact actuation lever 13 and to a disengagement lever 12 which belongs to said means for coupling to the circuit breaker. Said contact actuation lever 13 and the disengagement lever 12 are pivoted in a point 102 of the casing 1; a spring 14 acts on the contact actuation lever 13. In an inactive position, which corresponds to the position in which the circuit breaker is closed, the contact actuation lever 13 has an end 25 which is directly in contact with the lamina 3; moreover, on the contact actuation lever 13 a slot 33 is provided in which the U-shaped element 11 can slide. In particular, said end 25 can have a round-shaped profile as shown in Figure 4, or a polygonal-shaped profile as shown in Figures 1-3.

[0020] As shown in figure 4, the disengagement lever 12 comprises a pin 7 for coupling to the mechanism for actuating the circuit breaker and has the particularity that it has a toothed sector 18, whose function will be described hereinafter. Said means for actuating the moving contact further comprise a reset and indication lever 4 which is pivoted to a fixed point 103 of the insulating casing 1 and is held in the inactive position by a spring 5. The reset and indication lever 4 has, on its surface, a slot 21 with circular raised portions 22 and 22', in which a portion of the lamina of the moving contact 3 is inserted; the raised portions 22 and 22' an interact alternatively with the lamina as a consequence of a corresponding state of the associated circuit breaker. This interaction helps to keep the reset and indication lever 4 in the inactive position or to turn it respectively in a closed/open state of the associated circuit breaker.

[0021] Advantageously, said means for coupling to the circuit breaker comprise an additional coupling lever 6 which is pivoted in a point 103 which has a pin 7' for

optional coupling to the mechanism of the associated circuit breaker, and a toothed sector 18', which is operatively coupled to the toothed sector 18 of the disengagement lever 12. In practice, once the kinematic mechanism 100 has been actuated by a corresponding change of state of the associated circuit breaker, the two toothed sectors 18 and 18' mesh together, rotating with respect to each other in mutually opposite directions.

[0022] This constructive solution allows the coupling of the accessory device to the circuit breaker to be rendered fully independent of the position of the poles inside it, i.e., regardless of whether the phase pole or the neutral pole is on the right. If the position of the poles in the circuit breaker changes, the coupling between the accessory device and said circuit breaker can in fact be performed alternatively on the pin 7 or on the pin 7'. Moreover, the change in the direction of rotation of the mechanism of the circuit breaker as a function of the position of the poles is rendered irrelevant in terms of the operation of the circuit breaker-device coupling by the presence of the two contrarotating toothed sectors 18 and 18'.

[0023] It should be noted that with this solution, the movement of the kinematic system inside the device has no effect at all on the corresponding movement in the circuit breaker, so that the operating performance of said circuit breaker is not altered in any way.

[0024] Another important advantage of the accessory device according to the invention is the fact that, in a preferred embodiment illustrated in the attached Figures, the reset and indication lever 4 has a shaped projection 30 which, when the circuit breaker opens, protrudes from a corresponding opening 31 formed in the casing 1 and thus allows to provide a local visual indication that the circuit breaker associated therewith is open and that the movable auxiliary contact has correctly moved from one fixed contact 17 to the other. Moreover, the projection 30, once it has protruded from the casing, readily constitutes a button on which an operator can act directly, for example to test the auxiliary functions without having to act on the associated circuit breaker, which thus remains open. The reset and indication lever 4 therefore simultaneously acts as a means for the local visual indication that the circuit breaker is open and that the auxiliary contacts have switched. In further embodiments, not shown in the Figures, said projection 30 might be associated with other levers of the kinematic mechanism 100.

[0025] The operation of the device according to the invention is now described starting from the operating condition shown in Figure 1, which corresponds to a position in which the associated circuit breaker is closed.

[0026] When the circuit breaker is opened manually, the mechanism of the circuit breaker transmits the movement to the transmission lever 10, which rotates in the direction indicated by the arrow 104, pulling the U-shaped element 11 and reaching, at the end of its actuation, the position shown in Figure 2.

[0027] The contact actuation lever 13, pushed by the spring 14, turns about its own pivoting axis 102, in the direction indicated by the arrow 105, and reaches the position shown in Figure 2. At the same time, the lamina 3, no longer retained by the projection 25 of the contact actuation lever 13, abuts against the raised portion 22 of the reset and indication lever 4, pushing it downwards. This thrust, combined with the action of the spring 5, causes the rotation of the reset and indication lever 4 about its own pivoting axis and the consequent protrusion of the projection 30 from the casing 1; at the same time, the moving contact 3 moves from one fixed contact to the other, as shown in Figure 2.

[0028] When instead the circuit breaker opens, triggering due to a fault, the disengagement lever 12 which receives the corresponding mechanical actuation from the circuit breaker, either directly by means of the pin 7' or indirectly from the coupling lever 6 by means of the pin 7 and the meshing of the two toothed sectors 18 and 18', rotates in the direction indicated by the arrow 106; by this rotation, the disengagement lever 12 disengages the U-shaped element 11, which becomes free to slide in the slot 33 of the contact actuation lever 13; at the end of this actuation, the rotation of the transmission lever 10, which occurs in a manner similar to the one described earlier, returns the U-shaped element 11 into contact with the disengagement lever 12. The movement of the remaining components, particularly of the reset and indication lever 4 and of the contact actuation lever 13 and of the lamina of the contact 3, occurs in a manner similar to the one described earlier; accordingly, at the end of the actuation, as shown in Figure 2, the shaped projection 30 of the reset and indication lever 4 protrudes from the casing 1 through the opening 31, providing a local visual indication that the circuit breaker has opened.

[0029] In practice, the device according to the invention allows to provide a local indication that the associated circuit breaker has opened either due to manual intervention of an operator or due to a fault, and that the auxiliary contacts have switched; moreover, an operator can switch the auxiliary contacts again simply by pressing on the projection 30, without acting on the circuit breaker, which remains open ("blank test").

[0030] Moreover, the reset and indication lever 4 can perform the important role of test lever, since it allows both to test that the auxiliary contacts of the device actually switch without first coupling it to the circuit breaker and to test some functions of a system after the device has been installed and without having to close the circuit breaker associated therewith, as mentioned before ("blank test").

[0031] In a preferred embodiment of the device according to the invention, shown in Figure 3, means 50 for locking the moving contact 3 are further associated with the lever 4. In particular, said means 50 comprise, in the illustrated embodiment, an eyelet 51 which is formed on the projection 30 and in which it is possible

to insert a pin for locking the moving contact 3; in this manner it is possible to perform a "blank test" without requiring action of the operator throughout the test.

[0032] Another advantageous aspect of the invention consists in that the device thus provided allows to stack a plurality of accessories, arranging them mutually side by side, since the mechanism of the circuit breaker is replicated inside each one, particularly thanks to the transmission lever 10, the disengagement lever 12 and the coupling lever 6; in this manner, the accessory device responds to the device that is located adjacent to it as if it were directly coupled to the circuit breaker itself.

[0033] In practice it has been observed that the auxiliary contact accessory device fully achieves the intended aim, since it allows to provide a coupling with the circuit breaker in a manner which is independent of the arrangement of the poles inside the circuit breaker and without affecting its performance at all; moreover, by adopting the particular constructive refinements described above, it is possible to directly locally identify any opening of the circuit breaker, with consequent reset of the device, and to perform tests. It should also be observed that all the innovative functions and the inventive aspects of the device can be obtained by using commonly commercially available elements and materials, of extremely low costs.

[0034] The accessory device 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.

[0035] In practice, the materials and the dimensions may be any according to requirements and to the state of the art.

Claims

1. Auxiliary contact accessory device for a magnetothermal circuit breaker, particularly of the bipolar type with phase and neutral poles, which is associated therewith, comprising an insulating casing which contains fixed contacts and a corresponding moving contact, connection terminals, and a kinematic mechanism, characterized in that said kinematic mechanism comprises:

   -- means for coupling to the circuit breaker;
   -- means for actuating the moving contact;
   -- means for the local visual indication of an open circuit breaker state;
   -- means for testing the correct operation of said fixed and moving contacts.

2. Auxiliary contact accessory device according to claim 1, characterized in that said means for coupling to the circuit breaker comprise two levers, respectively for coupling and disengagement, which are operatively connected to each other, each lever comprising a pin for coupling to the circuit breaker.

3. Auxiliary contact accessory device according to claim 2, characterized in that the coupling and disengagement levers are operatively connected to each other by means of two toothed sectors which are respectively associated with the coupling lever and with the disengagement lever and mutually mesh, rotating with respect to each other in opposite directions.

4. Auxiliary contact accessory device according to claim 1, characterized in that said means for actuating the moving contact comprise a contact actuation lever, a transmission lever, and a reset and indication lever, a spring being associated with each one of said levers.

5. Auxiliary contact accessory device according to claim 4, characterized in that the transmission lever is connected, by means of a U-shaped element, to the contact actuation lever and to the disengagement lever.

6. Auxiliary contact accessory device according to claim 5, characterized in that the contact actuation lever has a slot in which the U-shaped element slides.

7. Auxiliary contact accessory device according to claim 5, characterized in that the contact actuation lever comprises a projection which can interact directly with the moving contact.

8. Auxiliary contact accessory device according to claim 4, characterized in that said reset and indication lever comprises a slot with circular raised portions in which at least one portion of the moving contact is inserted, said raised portions being able to interact alternatively with the moving contact.

9. Auxiliary contact accessory device according to claim 1, characterized in that said means for providing a local visual indication of an open circuit breaker state are constituted by a projection of at least one of the levers that belong to the kinematic mechanism, said projection being able to protrude from the casing as a consequence of an opening of the circuit breaker.

10. Auxiliary contact accessory device according to claim 9, characterized in that said projection is constituted by an end of the reset lever, in correspondance of which the casing has an opening.

11. Auxiliary contact accessory device according to claim 1, characterized in that said means for testing

the correct operation of said fixed and moving contacts are constituted by a projection of at least one of the levers of the kinematic mechanism, said projection being able to protrude from the casing as a consequence of an opening of the circuit breaker.

12. Auxiliary contact accessory device according to one or more of the preceding claims, characterized in that said means for providing a local visual indication of an open circuit breaker state and said means for testing the correct operation of said fixed and moving contacts are constituted by a projection of at least one of the levers of the kinematic mechanism, said projection being able to protrude from the casing as a consequence of an opening of the circuit breaker.

13. Auxiliary contact accessory device according to claim 12, characterized in that said projection is constituted by an end of the reset and indication lever, in correspondance of which the casing has an opening.

14. Auxiliary contact accessory device according to one or more of the preceding claims, characterized in that said transmission, coupling and disengagement levers allow coupling to a further accessory device.

15. Auxiliary contact accessory device according to one or more of the preceding claims, characterized in that said means for testing the correct operation of said fixed and moving contacts comprise means for locking the moving contact in correspondance of an open circuit breaker position.

16. Auxiliary contact accessory device according to claim 15, characterized in that said locking means comprise an eyelet formed on said projection.

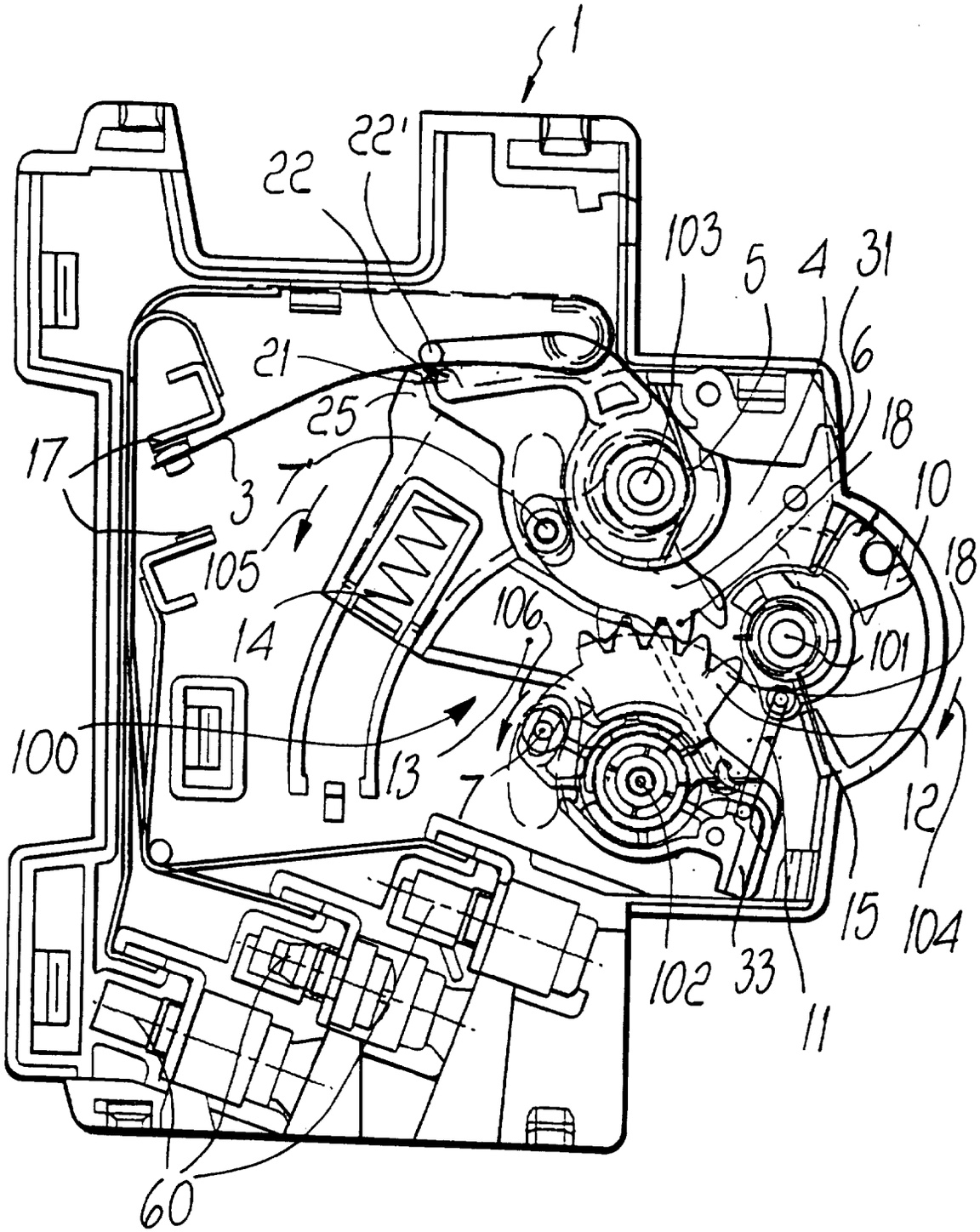
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Fig. 1

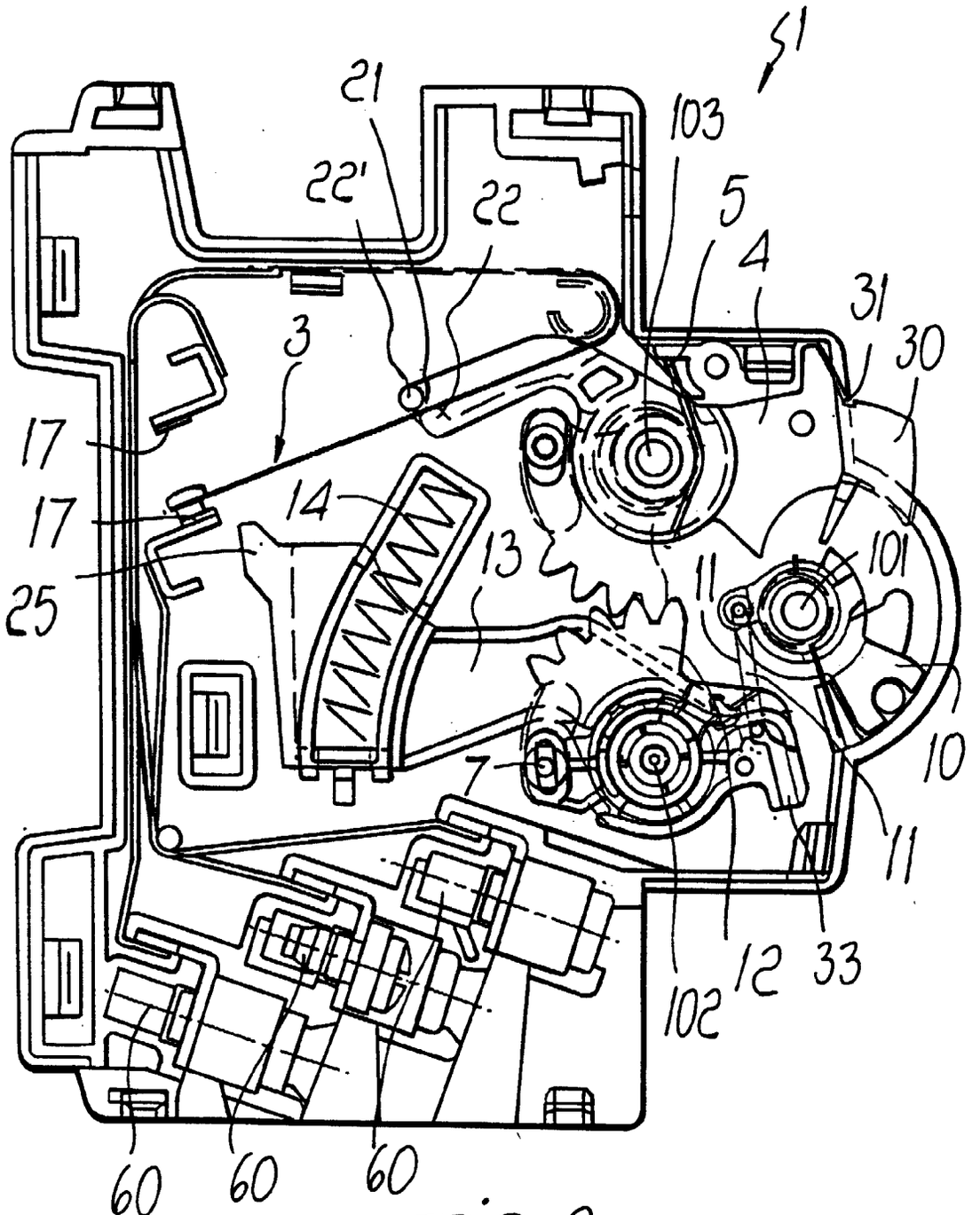
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Fig. 2

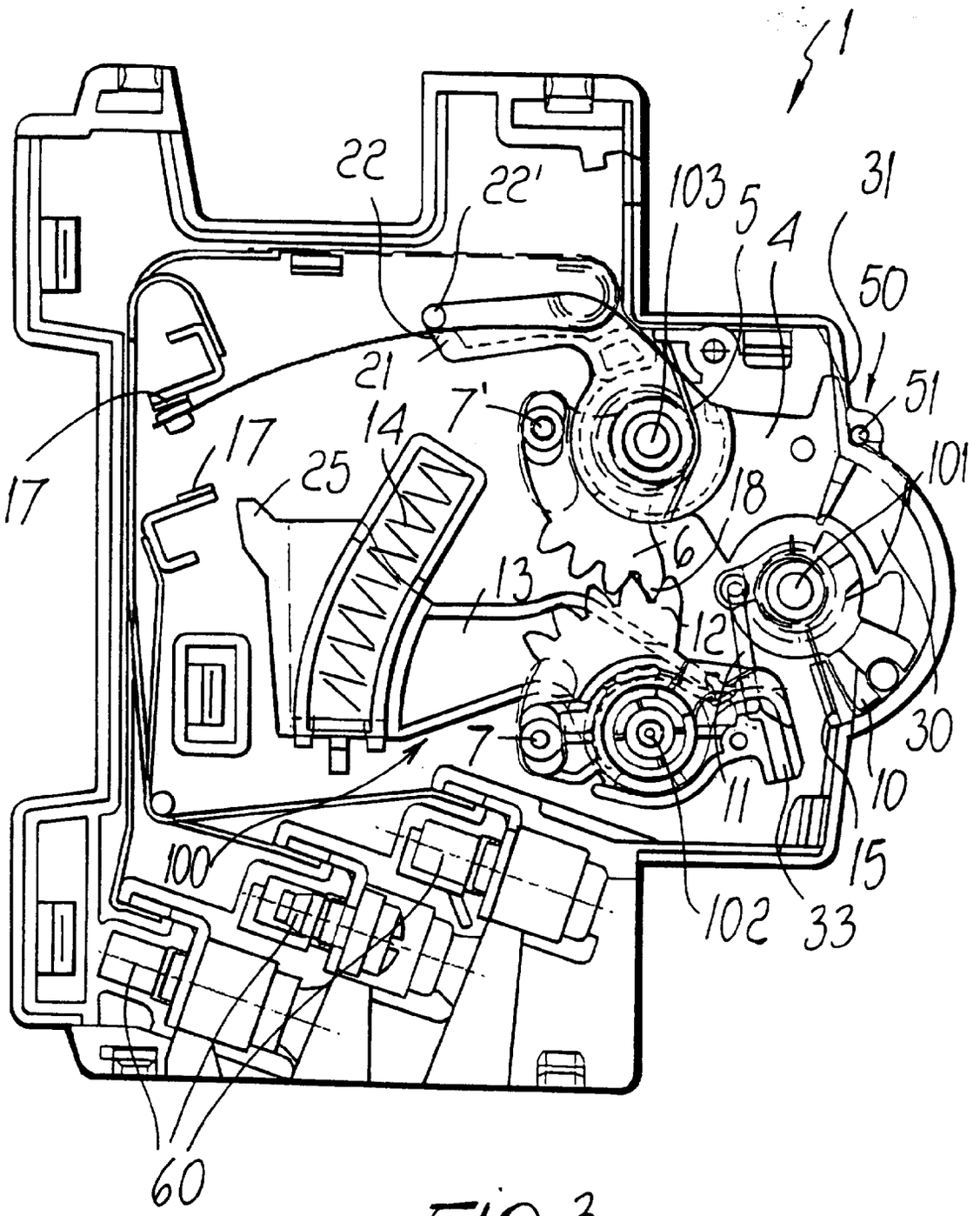
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FIG. 3

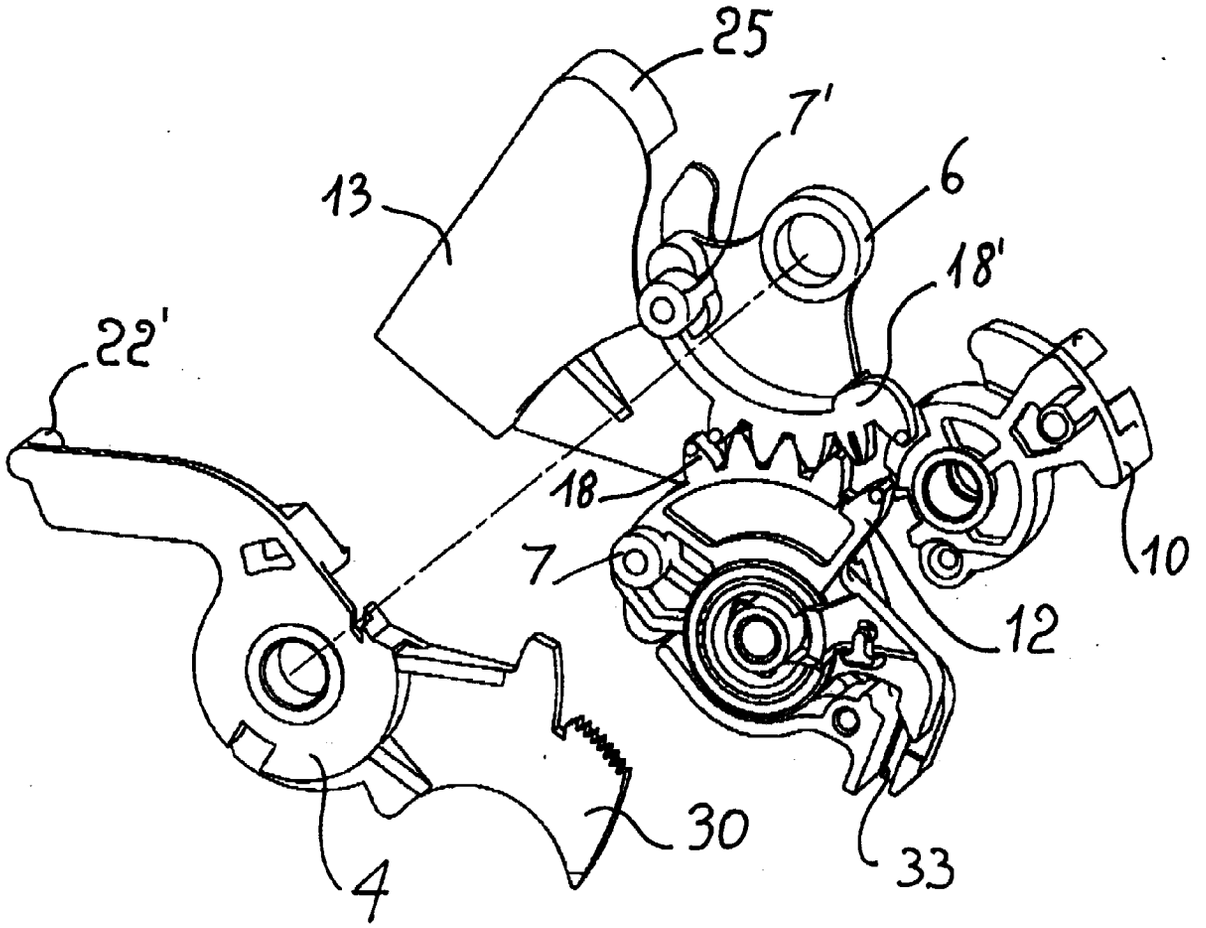

Fig. 4