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

(11) EP 1 003 193 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.05.2000 Bulletin 2000/21

(51) Int. Cl.[7]: **H01H 73/34**, H01H 15/10

(21) Application number: **98121837.3**

(22) Date of filing: **17.11.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

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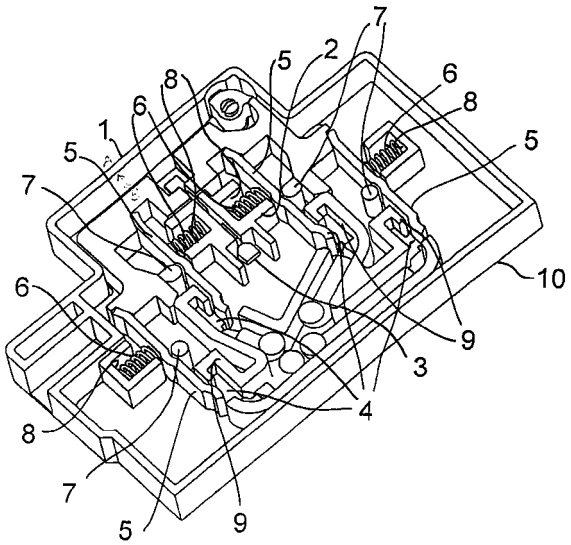
(54) Safety circuit breaker

(57) The present invention relates to a safety circuit breaker which mechanically interrupts a circuit upon a certain driving signal, if a fault current has occurred and if the normally provided means for cutting off the circuit upon detection of such a fault current fails. A circuit breaker is disclosed that employs a fuse wire (3). In a casing (10) a fixed piece (2) and a mobile piece (1) are provided. Furthermore, there are provided a fixed electrical contact (4) being connected with a wire from outside and a mobile electrical contact (5) being connected with another wire leading outside the casing (10). The mobile electrical contact is movable between a closed position and an open position. In the closed position the mobile electrical contact (5) is in contact with the fixed electrical contact (4). In the open position, the mobile electrical contact (5) is disconnected from the fixed electrical contact (4). This is caused by the movement of the mobile piece (1) which serves as a support plane of the mobile electrical contact (5). Furthermore, the mobile electrical contact (5) is urged against the mobile piece (1) by an urging means (6). If the fuse wire (3) which clamps the fixed piece (1) and the movable piece (2) together, is broken, the mobile piece (1) is urged away from the fixed piece (2) and takes its open position and the mobile electrical contact (5) loses its contact to the fixed electrical contact and a circuit is broken.

Fig. 2



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Description

[0001] The present invention relates to a safety circuit breaker which mechanically interrupts a circuit upon a certain driving signal.

[0002] Such a safety circuit breaker is provided in order to ensure that a current flow is stopped immediately, if a fault current has occurred and if the normally provided means for cutting off the circuit upon detection of such a fault current fails in order to prevent any dangers caused by the fault current, above all to people's health. Conventional safety circuit breakers interrupt a circuit in a residual manner, i.e. the circuit must be manually restored.

[0003] However, conventional circuit breakers can fail in proper working, in particular it can happen that the mechanical parts thereof do not operate correctly.

[0004] This is a great risk so that, accordingly, it is an object of the present invention to provide a residual safety circuit breaker which ensures a faultless performance if a fault current is detected and if the normally provided circuit breaker fails in proper working. In particular, it is an object of the present invention to provide an additional irreversible disconnection device placed next to a conventional residual current disconnector, said additional irreversible disconnection device working when the head mechanism fails.

[0005] This problem is solved by a circuit breaker comprising the features according to claim 1. Further advantageous design measures of the subject-matter according to the present invention are indicated in the dependent claims.

[0006] The circuit breaker according to the invention guarantees that the circuit is surely interrupted if a fault current is detected, namely in that a fuse wire is controlled so that a peak current is led therethrough for a short predetermined period in order to fuse it. Thus, the mobile piece and the fixed piece, which were clamped together by means of the fuse wire, will be separated from each other, since the mobile piece is urged by the urging means apart from the fixed piece. The disconnection of the circuit is irreversible so that it would be necessary to replace the fused wire manually by a new fuse wire to be able to close the contacts again to restore the circuit or to replace the whole circuit breaker by a new one.

[0007] The circuit breaker according to the invention is positioned within an electric circuit, i.e. there is at least one line leading into the circuit breaker and at least one line leading out of the circuit breaker. Furthermore, the circuit breaker is connected to another electrical line providing a control current which is connected to the fuse wire. This electrical line is provided to supply a driving current being sufficient to blow the fuse wire if a fault current is detected, i.e. if the normally provided circuit breaker fails. The control current is controlled by an electronic printed circuit board that decides when a peak current shall pass through the fuse wire during a short predetermined period so as to blow the fuse wire.

[0008] The mechanical solution according to the invention for actuating the mobile piece if necessary is easy and reliable by the provision of the mobile piece with an inclined contact surface portion against which the inclined contact surface portion of the mobile electrical contact is urged by the urging means.

[0009] Thus, there are two positions of the mobile piece standing for two conditions of the circuit breaker. The first, closed position is held if the mobile piece is clamped together with the fixed piece by the fuse wire. The second, open position is held if the fuse wire is blown so that the urging means urges the mobile piece apart from the fixed piece. By means of the movement of the mobile piece in this second, open position, the movable electrical contact is disconnected from the fixed electrical contact. Thus, the circuit is broken.

[0010] The fuse wire is formed as a longitudinal member having thickened end portions, respectively, and a thin middle portion. The thickened end portions can be inserted in recesses provided in the mobile piece and the fixed piece, respectively, when the mobile piece is brought in its closed position. If the fuse wire is inserted, it clamps both pieces together and holds the mobile piece in its closed position. The thin wire portion between both thickened end portions is fusable by a predetermined current passing therethrough. If this predetermined current is supplied then the fuse wire breaks and the mobile piece is not clamped thereby any longer but it moves in its opened position.

[0011] The mobile electrical contact is formed as a longitudinal member being pivotally supported by an axle which is fixed in the casing. Thus, the mobile electrical contact can be pivotally turned about the axle in two positions. Due to the fact that the mobile electrical contact is urged by urging means so that a torque is generated around the turning axle, the mobile electrical contact is urged in one direction so as to be pushed against the mobile piece. However, the mobile piece cannot be moved as long as it is clamped by the fuse wire. Thus, the fuse wire is held under a certain tension.

[0012] The mobile electrical contact is formed with a slanted portion which is provided on one side opposite to the mobile piece. The mobile piece comprises a corresponding slanting portion being in contact with the slanting portion of the mobile electrical contact. The urging force urging the mobile electrical contact against the mobile piece is tranferred at the slanted portions. Therefore, a component is generated causing that the mobile piece is urged in a direction apart from the fixed piece (which is prevented by the fused wire as outlined above).

[0013] By designing the mobile piece and the fixed piece in an appropriate manner symmetrically, i.e. comprising two slanted portions, two circuits can be broken. However, the shape of the mobile piece is not limited to a symmetrical design. The circuit breaker can be designed such that the mobile piece and the fixed piece

are designed so that three or more circuits can be broken.

Brief description of the drawings

[0014]

Figure 1 shows an exploded view of an embodiment of a circuit breaker according to the present invention.

Figure 2 shows a perspective view of the embodiment of the circuit breaker according to the present invention without a cover.

Figure 3 shows a mobile piece used in the embodiment of the circuit breaker according to the present invention.

Figure 4 shows a partially enlarged view of a detail of the embodiment of the circuit breaker according to the present invention.

Figure 5 shows a partially enlarged view of a detail of the embodiment of the circuit breaker according to the present invention.

Figure 6 shows a partially enlarged view of a detail of the embodiment of the circuit breaker according to the present invention.

[0015] Figure 1 shows an exploded view of an embodiment of the circuit breaker according to the present invention. The reference no. 10 indicates a casing in which all members are inserted as can be seen by the dashed lines in Figure 1. Above all, a base plate 14 is inserted into the casing. On the base plate 14 all other components are deposited or partly integrally formed therewith. E.g. a fixed piece 2, axles 7, spring recesses 8 and fixed contact holding portions 9 are integrally formed on the base plate 14. This can be done by one single forming process allowing a cost saving manufacturing method.

[0016] On the base plate 14 a mobile piece 1 can be deposited. The shape of the mobile piece 1 is very specific and the fixed piece 2 formed on the base plate 14 has a corresponding shape so that the mobile piece 1 only has to be inserted in predetermined locations so that a wrong assembly can easily be avoided. As can be seen above the mobile piece 1 in Figure 1, there is provided a fuse wire 3, which is insertable into the mobile piece 1 and in the fixed piece 2 as will be explained later.

[0017] Furthermore, there are provided four mobile electrical contacts 5 in this embodiment, each being urged by a spring 6 as an urging means. The spring 6 and the mobile electrical contacts 5 are also inserted in prepared recesses and locations within the base plate 14. With reference to Figure 2, the whole assembly can be clearly seen. It shall be noted that the mobile piece 1 and the fixed piece 2 are designed in such a specific and complicated structure in order to enable that four electric contacts can be broken at the same time when the fuse wire is blown. However, it should be a matter of course that the present invention can also be embodied by a circuit breaker being provided only for one or any other number of electric contacts.

[0018] With reference to Figure 3, the mobile piece 1 shall be explained in more detail. The mobile piece 1 is a substantially longitudinal member having two end portions respectively. As can be seen from the Figure 3, the mobile piece 1 is designed in a symmetrical manner wherein the symmetry plane extends at the middle of a groove 15 standing rectangular to the upper surface of the mobile piece as viewed in Figure 3. Hence, in the following only one symmetrical part of the mobile piece 1 will be explained. Of course, the same is valid for the other portion of the mobile piece 1. The end portion is shaped with a contact surface portion 16 which is slightly slanted having a specific function as will be explained later. Furthermore, there is provided a stop portion 17 and the function thereof will also be explained later. The mobile piece 1 can be moved between a closed position and an opened position. The moving direction is indicated by an arrow A-B in Figure 2. Figure 2 shows the mobile piece in its closed position. With reference to Figures 5 and 6, the mobile piece 1 is shown in its opened position, i.e. the mobile piece 1 has been moved to the left hand side, as can be seen from the Figures 5 and 6. In this condition, the mobile electrical contact 5 which is designed as a kind of a rocker button has no contact with the contact surface portion 16 but has contact with the stop portion 17.

[0019] The function of the circuit breaker will now be described.

[0020] Figure 2 shows a condition in which the circuit breaker is in a kind of stand-by condition allowing the current to pass therethrough. In this condition, the fuse wire 3 is undamaged. The fuse wire consists of a longitudinal member having thickened end portions and a small thin middle portion. As can be seen from Figure 2, the end portions are inserted in certain recesses 18 provided in the mobile piece 1 and the fixed piece 2, respectively. Thus, the fuse wire 3 is in a fixed position and clamps the mobile piece 1 and the fixed piece 2 together. The thin middle portion of the fuse wire 3 is provided in a groove 15 which is provided also in both the mobile piece 1 and the fixed piece 2.

[0021] As can further be seen from Figure 2, the mobile electrical contacts 5 are designed as longitudinal flat members having a slanted end portion at the side opposite to the slanted surface portion 16 of the mobile piece 1, respectively. Furthermore, the mobile electrical contact 5 can be supported by an axle 7 serving as a pivotal axis for turning the mobile electrical contact 5. However, in the normal operational standby condition as

seen in Figure 4, the mobile electrical contact 5 is not supported on the axle 7, but there is a certain gap between the axle 7 and the mobile electrical contact 5, since the contact 5 is supported on the slanted surface contact portion 16 on the one side and on the fixed electrical contact 4 on the other side. In this condition, it is ensured that the mobile electrical contact 5 has a good electrical contact with the fixed electrical contact 4. A spring 6 as an urging means urges the mobile electrical contact in a direction against the slanted surface portion 16. The spring is supported in a spring recess 8. Thus, the mobile electrical contact 5 urges the mobile piece 1 with its slanted end portion and a component of the urging force is pressing the mobile piece in a direction "a" as can be seen from Figure 4 (see arrow a) and another component of the urging force presses the mobile piece 1 in a direction "b" (see arrow b) as can be seen from Figure 4. Therefore, the mobile piece 1 is in a tension state being only held by the clamping fuse wire 3. The inclination angle of the slanted portions of the mobile electrical contact 5 and the mobile piece 1 in this embodiment is about 20°. As can be seen from Figure 4, in the closed position, the mobile electrical contact 5 is in contact with the fixed electrical contact 4 and the circuit is not broken. This is because at the mobile electrical contact a further electrical contact (not shown) is provided which leads out of the casing and continues the electrical circuit (not shown). This means that the condition of Figure 4 and also of Figure 2 is the standby mode in which the current passes through and a normal operation of the circuit is possible.

[0022] If a fault current is detected and if is determined that the normally provided circuit breaker fails, an electrical driving signal is transmitted to the fuse wire by a terminal (not shown). This signal is a peak current between 200 and 500A which passes through the fuse wire during 0,5 ms. With this energy, the fuse wire blows and is destroyed. This means that the fuse wire does not clamp the mobile piece 1 and the fixed piece 2 together anymore. Then, the urging force caused by the spring 6 and transmitted through the mobile electrical contact 5 to the mobile piece 1 causes the mobile piece 1 to leave its closed position leftwards in Figure 2 to reach its opened position.

[0023] In this case, the mobile electrical contact 5, in particular the slanted surface portion thereof, disengages from the slanted contact surface portion 16 of the mobile piece 1 and the urging force of the spring 6 pushes the mobile electrical contact 5 until it will be stopped by the contact with the stop portion 17 of the mobile piece 1. However, in this case the mobile electrical contact 5 will be turned about the pivotal axis 7 and it will lose its electrical contact with the fixed electrical contact 4. Please note that only then the mobile electrical contact 5 is in contact with the pivotal axis 7 and that in the former condition (closed position of the mobile piece) there is a gap between the axis 7 and the mobile electrical contact 5 in order to ensure that there is a good electrical contact of the mobile electrical contact and the fixed electrical contact (cf. Figure 4). Thus, the electrical circuit is broken. Please note that the force urging the mobile piece 1 away from the fixed piece 2 caused by the mobile electrical contact 5 due to the spring force of the spring 6 is additionally depending on the friction of both surfaces being in contact so that the friction can also be selected properly.

[0024] In the present embodiment the mobile electrical contact 5 is made of copper and the contact portion of the fixed electrical contact 4 is made of AgC being welded directly to the wire leading outside of the casing.

[0025] The present invention relates to a safety circuit breaker which mechanically interrupts a circuit upon a certain driving signal, if a fault current has occurred and if the normally provided means for cutting off the circuit upon detection of such a fault current fails. A circuit breaker is disclosed that employs a fuse wire (3). In a casing (10) a fixed piece (2) and a mobile piece (1) are provided. Furthermore, there are provided a fixed electrical contact (4) being connected with a wire from outside and a mobile electrical contact (5) being connected with another wire leading outside the casing (10). The mobile electrical contact is movable between a closed position and an open position. In the closed position the mobile electrical contact (5) is in contact with the fixed electrical contact (4). In the open position, the mobile electrical contact (5) is disconnected from the fixed electrical contact (4). This is caused by the movement of the mobile piece (1) which serves as a support plane of the mobile electrical contact (5). Furthermore, the mobile electrical contact (5) is urged against the mobile piece (1) by an urging means (6). If the fuse wire (3) which clamps the fixed piece (1) and the movable piece (2) together is broken, the mobile piece (1) is urged away from the fixed piece (2) and takes its open position and the mobile electrical contact (5) loses its contact to the fixed electrical contact and a circuit is broken.

Claims

1. Circuit breaker, comprising

a casing (10) which contains
a fixed piece (2) relatively fixed to the casing (10);
a mobile piece (1) movably arranged in relation with the fixed piece (2) and the casing (10);
a fixed electrical contact (4) connected with a wire from outside;
a mobile electrical contact (5) being connected with another wire leading outside the casing (10), movably supported between said mobile piece (1) and said fixed piece (2),

said mobile electrical contact (5) being movable between a closed position in

which it is in contact with said fixed electrical contact (4) when said mobile piece (1) is in a first position, and an opened position in which it is disconnected from said fixed electrical contact (4) when said mobile piece (1) has moved in a second position; wherein

an urging means is provided urging said mobile electrical contact so that said mobile electrical contact (5) urges said mobile piece (1) from said first position to said second position distant from said fixed piece (2), wherein

said mobile piece (1) is held in its first position by means of a releasing means (3) which clamps said fixed piece (1) and said movable piece (2) together against said urging force applied to said mobile piece (1), and which takes its opened position when said releasing means (3) is in a releasing state.

2. Circuit breaker according to claim 1, characterized in that said mobile piece (1) comprises an inclined contact surface portion (16) and in that said mobile electrical contact (5) comprises a corresponding inclined contact surface (5a) portion wherein said urging means (6) urges said mobile electrical contact (5) against said mobile piece (1).

3. Circuit breaker according to claim 1 or 2, characterized in that said releasing means is a fuse wire (3).

4. Circuit breaker according to claim 3, characterized in that said fuse wire (3) comprises thickened end portions, respectively being insertable in two recesses provided in said mobile piece (1) and said fixed piece (2), respectively, so as to clamp both pieces together.

5. Circuit breaker according to any of the preceding claims 3 and 4, characterized in that said fuse wire (3) comprises a thin wire portion between both thickened end portions which is fusable by a predetermined current passing therethrough.

6. Circuit breaker according to any of the preceding claims 3 to 5, characterized in that said mobile piece (1) and/or said fixed piece (2) comprises a groove (15) into which said thin portion of said fuse wire (3) is insertable.

7. Circuit breaker according to any of the preceding claims, characterized in that

said urging means (6) is adapted to urge said mobile electrical contact (5) so as to generate a torque around a turning axle (7) fixedly provided on a base plate (14) within said casing (1).

8. Circuit breaker according to any of the preceding claims, characterized in that said urging means (6) is a spring being supported in a spring recess (8) provided in said fixed piece (2).

9. Circuit breaker according to any of the preceding claims, characterized in that

said mobile electrical contact (5) is pivotally supported about a turning axle (7) provided in said casing (10).

10. Circuit breaker according to any of the preceding claims, characterized in that

said mobile piece (1) and said fixed piece (2) are symmetrically designed so that two circuits can be broken.

11. Circuit breaker according to any of the preceding claims, characterized in that

said mobile piece (1) and said fixed piece (2) are designed so that three or more circuits can be broken.

Fig. 1

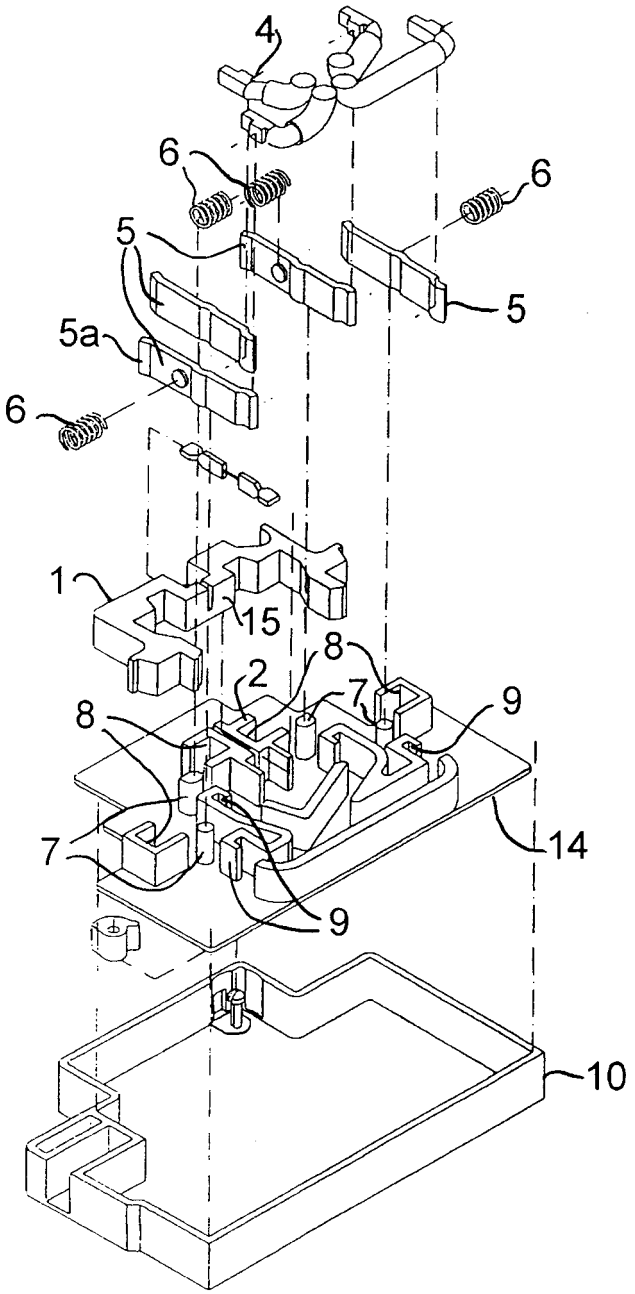


Fig. 2

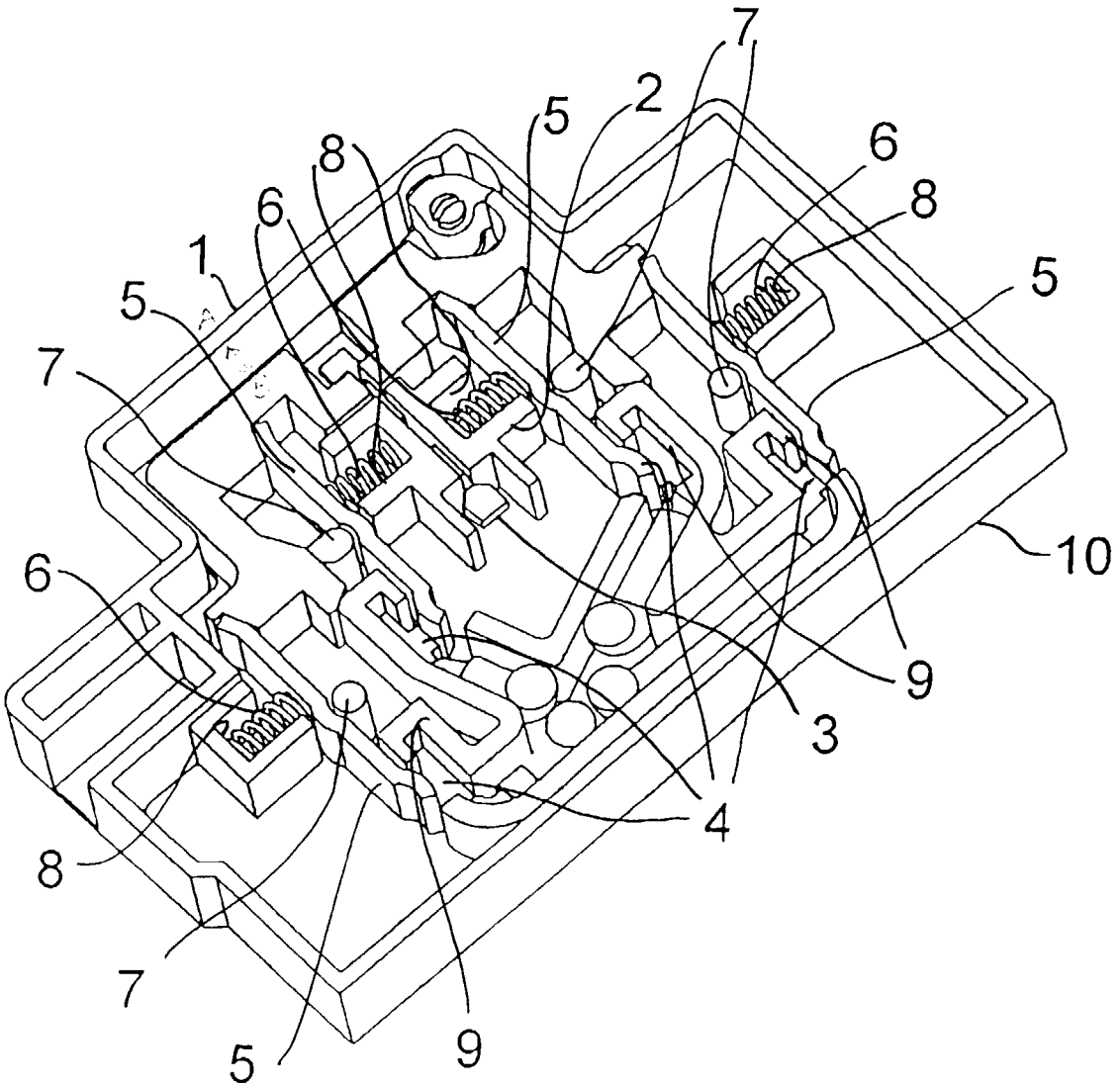


Fig. 3

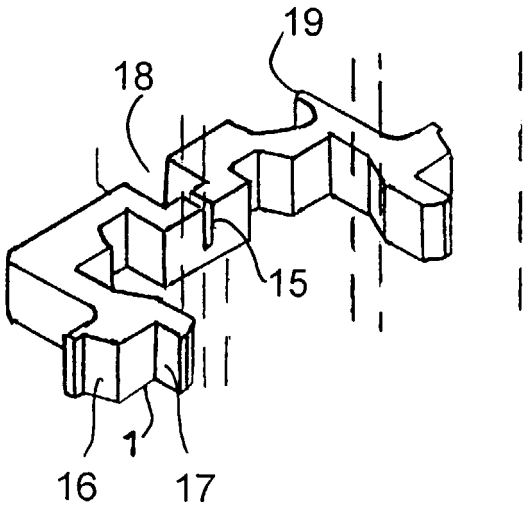


Fig. 4

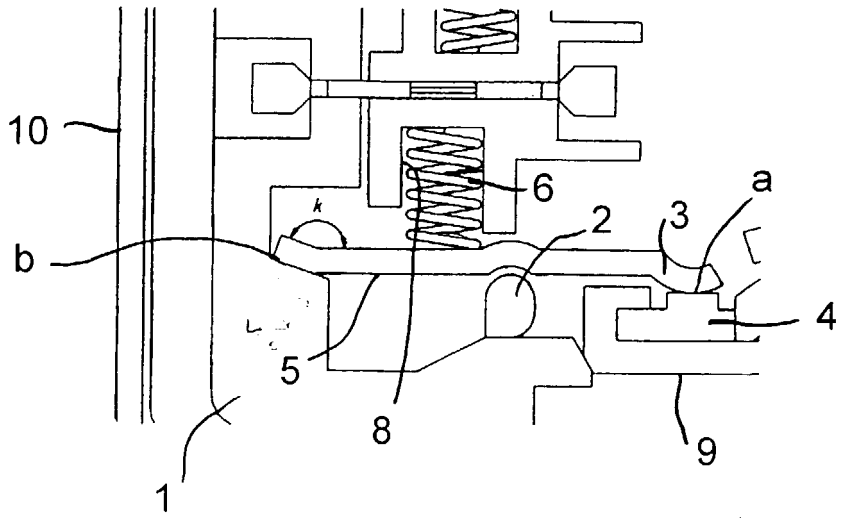


Fig. 5

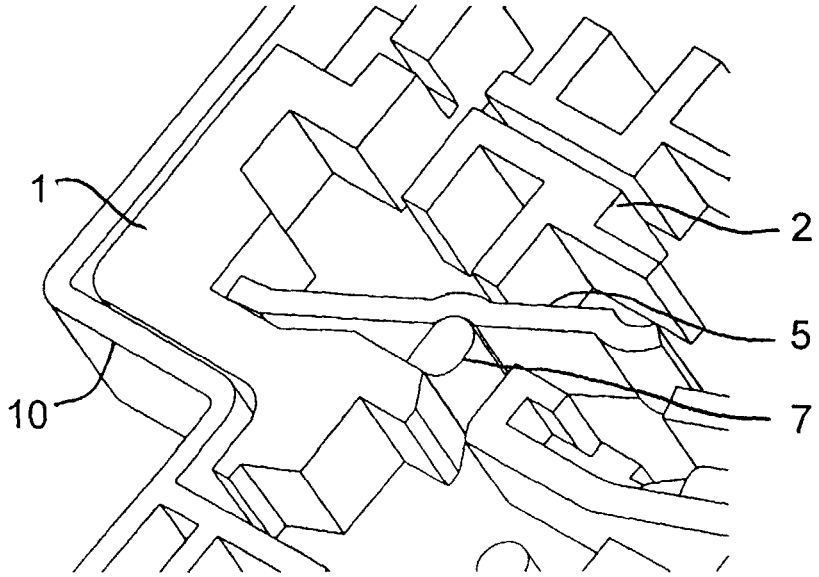
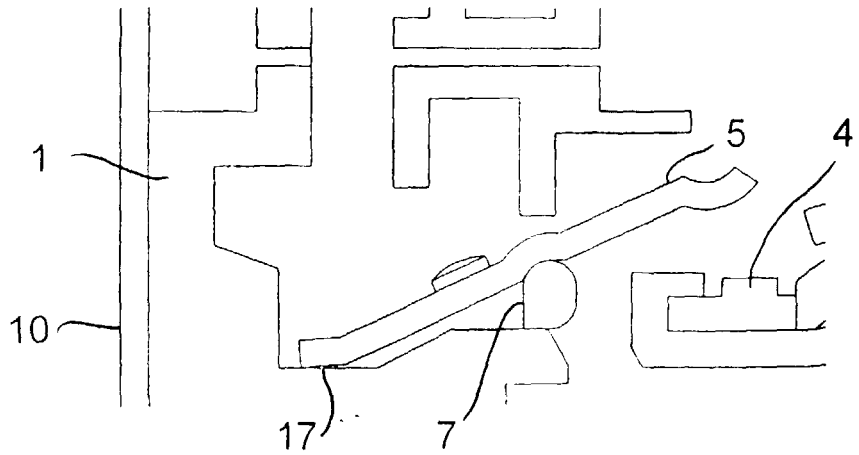


Fig. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 98 12 1837

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	US 2 470 701 A (L.JACOBS) 17 May 1949 * column 2, line 25 - line 54 * ---	1-11	H01H73/34 H01H15/10
Y	US 2 696 539 A (E.W.PETERSON) 7 December 1954 * column 2, line 10 - line 70 * ---	1-11	
Y	DE 195 42 690 A (AEG NIEDERSPANNUNGSTECH GMBH) 22 May 1997 * abstract * -----	1-11	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 April 1999	Libberecht, L

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