

(19)



(11)

EP 2 590 202 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

08.05.2013 Bulletin 2013/19(21) Application number: **11306408.3**(22) Date of filing: **02.11.2011**

(51) Int Cl.:

H01H 89/08 (2006.01) *H01H 3/46* (2006.01)
H01H 71/04 (2006.01) *H01H 71/08* (2006.01)
H01H 71/24 (2006.01) *H01H 71/44* (2006.01)
H01H 71/46 (2006.01) *H01H 73/24* (2006.01)

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
 GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
 PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA ME

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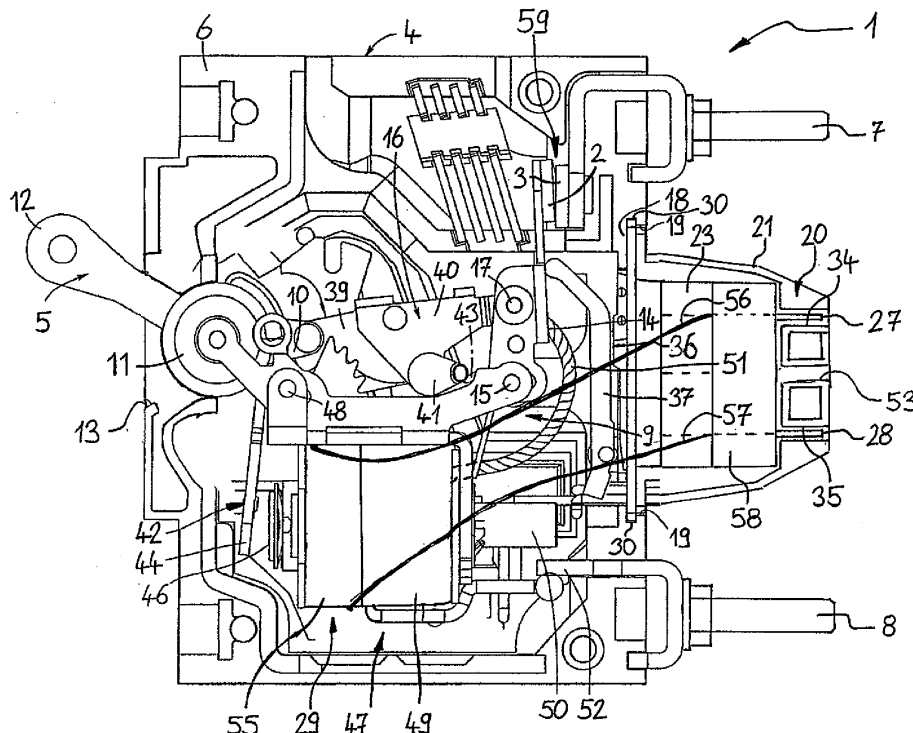
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(54) **Electromagnetic circuit breaker**

(57) An electromagnetic circuit breaker comprising a main case (4), a pair of contacts (2, 3) enclosed by said main case (4), a circuit breaker assembly (9) to move one of the contacts (2, 3) between a closed position and an open position an electromagnetic main assembly (38) for actuating said circuit breaker assembly upon the occurrence of predetermined electrical conditions, and an auxiliary switch (23) responsive to movements of said

circuit breaker assembly (38) for indicating whether said contacts (2, 3) are open or closed, wherein the auxiliary switch (23) has switch terminals (24, 25, 26), characterized in, that a control assembly (54) is provided for actuating said circuit breaker assembly (38) upon an external electrical signal, wherein said control assembly (54) has control terminals (27, 28) and that a switch case (20) is provided carrying said switch terminals (24, 25, 26) and said control terminals (27, 28).

**FIG.1****EP 2 590 202 A1**

Description

[0001] The invention relates to an electromagnetic circuit breaker comprising a main case, a pair of contacts enclosed by said main case, a circuit breaker assembly to move one of the contacts between a closed position and an open position, an electromagnetic main assembly for actuating said circuit breaker assembly upon the occurrence of predetermined electrical conditions and an auxiliary switch responsive to movements of said circuit breaker assembly for indicating whether said contacts are open or closed, wherein the auxiliary switch has switched terminals.

[0002] Circuit breakers of the electromagnetic type having an auxiliary switch are well-known, for example, one such circuit breaker is shown in EP 1 511 055 A2. The described circuit breaker comprises a moveable contact, mounted on a moveable arm, and a rigidly mounted stationary contact. An operating handle link is coupled to the moveable arm which is part of the circuit breaker assembly. The circuit breaker assembly comprises a collapsible toggle assembly. The moveable contact is operated between an open position and a closed position through rotation of the operating handle. The circuit breaker further contains an electromagnetic assembly which, in response to predetermined electrical conditions, collapses the toggle assembly to thereby electrically trip "open" the contacts. EP 1 511 055 A2 further provides for an arrangement which indicates the condition of the circuit breaker as being "closed" or "open". The arrangement for indicating the condition of the circuit breaker comprises an auxiliary switch located within a switch case and responsive to the distinctive movements of the circuit breaker linkage mechanism. The switch is located approximately intermediate of main terminals of the circuit breaker with the terminals of the switch extending generally in the same direction as the main terminals. The switch indicates the normal "on" and "off" conditions of the circuit breaker and is therefore mechanically linked to the circuit breaker assembly.

[0003] The object of the invention is to externally control such an electromagnetic circuit breaker while the circuit breaker has a compact design.

[0004] The object is solved by an electromagnetic circuit breaker comprising a main case, a pair of contacts enclosed by said main case, a circuit breaker assembly to move one of the contacts between a closed position and an open position, an electromagnetic main assembly for actuating said circuit breaker assembly upon the occurrence of predetermined electrical conditions, and an auxiliary switch responsive to movements of said circuit breaker assembly for indicating whether said contacts are open or closed, wherein the auxiliary switch has switch terminals, wherein a control assembly is provided for actuating said circuit breaker assembly upon an external electrical signal, said control assembly has control terminals, and wherein a switch case is provided carrying said switch terminals and said control terminals.

[0005] In accordance with the invention, the electromagnetic circuit breaker comprises a control assembly for actuating said circuit breaker assembly upon an external electrical signal, wherein said control assembly has control terminals. The control terminals of the control assembly can be electrically connected to an external switch or a computer system in order to externally actuate the electromagnetic circuit breaker for tripping the circuit. In order to provide for a compact design the electromagnetic circuit breaker comprises a switch case carrying both the switch terminals and the control terminals.

[0006] One advantage of this solution is the compact design. The circuit breaker cases contain the electromagnetic main assembly, the control assembly as well as the auxiliary switch. Therefore, the electromagnetic circuit breaker according to the invention can be provided in the form of a one-pole circuit breaker having several functions, which are the function of tripping the circuit upon the occurrence of predetermined electrical conditions such as current overloads and the function of externally controlling the circuit breaker (trip-off) while at the same time providing an external signal via an auxiliary switch (indicating the tripping of the breaker - whether by mechanical, electrical or tripping-from-a-remote-location). It is not necessary to provide a two-pole circuit breaker with two mechanically interconnected circuit breaker assemblies wherein one circuit breaker assembly is actuated by an electromagnetic main assembly and another circuit breaker assembly is actuated by a control assembly. According to the invention a much compacter design is achieved. In addition, all terminals of the auxiliary switch and the control assembly are carried by one single switch case. This also provides for a compact design.

[0007] Each of the contacts is connected to a main terminal wherein the circuit breaker assembly comprises a main coil connected in series to said terminals. The main coil moves a core by means of an electromagnetic flux in a well-known manner in order to actuate the circuit breaker assembly when predetermined electrical conditions such as a current overload occurs.

[0008] The control assembly can be of the electromagnetic type comprising a control coil electrically connected to the control terminals. The control coil can move the core of the main coil or a separate coil in response to current lead through the control coil for actuating the circuit breaker assembly.

[0009] Preferably the main case and the switch case are made of electrically insulating material. The main case and the switch case can be manufactured as separate cases which are connected to each other. For instance, the main case can be formed of at least a pair of half-cases jointly defining a space within which the mechanism of the circuit breaker is received. The main case and the switch case are then provided with interfitting wall portions to be connected jointly together.

[0010] The switch case can be provided with terminal cavities receiving the terminals, i. e. the switch terminals and the control terminals. The cavities are open to one

side of the switch case for receiving counter terminals to be connected to the terminals in the switch case. This design provides for protected terminals which are completely encapsulated by the switch case. Therefore, an unintentional electrical contact is avoided. Further, the terminals are well protected against bending.

[0011] The electromagnetic circuit breaker further can comprise an operating handle extending out of the main case for manually actuating said circuit breaker assembly.

[0012] The circuit breaker assembly preferably comprises a collapsible mechanism to move one of the contacts.

[0013] For sensing the position of the circuit breaker assembly the auxiliary switch is mechanically interoperating with the circuit breaker assembly.

[0014] In a preferable embodiment each of the contacts is connected to main terminal, wherein said main terminals extend substantially in the same direction from the main case. The switch case is located substantially intermediate the main terminals with the switch terminals and the control terminals extending generally in the same direction as the main terminals.

[0015] In a preferred embodiment the electromagnetic main assembly comprises a main coil about a tube for moving a core of magnetizable material movable in said tube so that the main coil can trip the circuit breaker assembly. Further, the control assembly comprises a control coil which is arranged about said same tube for moving said same core within the tube. This provides for a very compact design of the coils which constitute a single component with two functions.

[0016] A preferred embodiment is described in the following description and the accompanying drawings, wherein:

Figure 1 is a longitudinal section view of the circuit breaker with contacts in a closed position and with a switch case according to the invention;

Figure 2 is a longitudinal section view of the circuit breaker according to Figure 1 with contacts in an open position;

Figure 3 is a side view of the circuit breaker according to Figure 1 schematically showing terminals of a control assembly;

Figure 4 is a side view of the opposite side of the circuit breaker according to Figure 3 schematically showing terminals of an auxiliary switch; and

Figure 5 is a back view of the circuit breaker according to Figure 1;

[0017] Figures 1 and 2 show the circuit breaker 1 with a pair of contacts, a first contact 2 and a second contact 3. In Figure 1 the contacts 2, 3 of the circuit breaker 1

are in a closed position with the contacts 2, 3 being in contact to each other in order to close a circuit. In Figure 2 the circuit breaker 1 is tripped and the contacts 2, 3 are in an open position for breaking a circuit.

[0018] The circuit breaker 1 comprises an insulating main case 4 formed by abutting half-cases 6, 54 (shown in Figures 5), an operating handle 5, and main terminals, in particular a line terminal 7 to be connected to a line of a circuit and a load terminal 8 to be connected to a load. The circuit breaker 1 further comprises a circuit breaker assembly 9 mounted within the main case 4 and having various linkages rotatably supported therein. An actuable member 10 is moved by an internal actuator 11 attached to the operating handle 5, wherein it is rotatably supported relative to the main case 4. The operating handle 5 also has an external portion 12 protruding through an opening 13 of the main case 4. At the other end of the main case 4 is a movable contact support 14 carrying the movable first contact 2 pivotally supported to rotate about a pin 15. The movable contact support 14 is joined to an linkage mechanism 16 by a pin 17, which allows the movable contact support 14 to be moved down (with respect to Figure 2), in order that the movable first contact 2 closes against a fixed second contact 3 as shown in Figure 1. The fixed second contact 3 is supported on the half-case 6 and is electrically connected to the external line terminal 7. The movable first contact 2 is electrically connected through a conductive circuit to the external load terminal 8. These external terminals 7, 8 are the mechanism by which the breaker 1 is electrically connected into a protected circuit (not shown).

[0019] The main case 4 supports a switch receptacle 18. The half-case 6 is molded integrally with one half of the switch receptacle 18 of the same insulating material. Similarly, the other half of the receptacle (shown in Figures 3 to 5) is molded integrally with the other half-case 54. The half-cases 6 mate to form the completed receptacle 18 when the half-cases 6, 54 are assembled. The receptacle 18 is provided with recesses 19, preferably conforming to the shape and size of a switch case 20.

[0020] The switch case 20 is molded of the same insulating material as the main case 4 and consists of two half-cases 21, 22, as can be seen best in Figure 5. The switch case 20 accommodates an auxiliary switch 23 (shown in Figure 4) having three switch terminals 24, 25, 26. In addition the switch case 20 accommodates a connection case 58 in the same size as the auxiliary switch 23 and having two control terminals 27, 28 which are electrically connected to a control assembly 29 as will be described later. In Figures 1 and 2 the connection case 58 and the control terminals 27, 28 cover the auxiliary switch 23 and the switch terminals 24, 25, 26 because the auxiliary switch lies underneath the connection case 58 in Figures 1 and 2. All switch terminals 24, 25, 26 and the auxiliary switch 23 itself are schematically shown in Figure 4 depicting the other side of the circuit breaker 1. The switch case 20 is a separate case from the main case 4. The switch case 20 is accommodated within the

switch receptacle 18 and is fixed with protrusions 30 in the recesses 19 of the switch receptacle 18.

[0021] Each terminal 24, 25, 26, 27, 28, which in the present embodiment are in the form of male terminals, is located in a terminal cavity 31, 32, 33, 34, 35. The terminal cavities 31, 32, 33, 34, 35 are open to a backside of the switch case 20 for receiving counter terminals (not shown), in the present embodiment in the form of female terminals, to be connected to the terminals 24, 25, 26, 27, 28. The terminals 24, 25, 26, 27, 28 are entirely encapsulated within the switch case 20 protected from unintentionally coming into electrical contact with other electrical elements.

[0022] The mains terminals 7, 8 extend substantially in the same direction from the main case 4. The switch case 20 is located intermediate the main terminals 7, 8 with the terminals 24, 25, 26, 27, 28 extending in the same direction as the main terminals 7, 8. So all electrical terminals of the circuit breaker 1 can be reached from one side of the main case 4.

[0023] The auxiliary switch 23 includes an operating member, such as a spring-loaded switch actuator, such as plunger 36. A spring (not shown) urges the plunger 36 into an extended position as shown in Figure 2, representing one condition of the auxiliary switch 23, which corresponds to the open position of the contacts 2, 3. When depressed inwardly against the loading of its internal spring, the plunger 36 produces the other condition of the auxiliary switch 23, which corresponds to the closed position of the contacts 2, 3 of Figure 1. Between the plunger 36 and the movable contact support 24, and more specifically a surface 24a thereof, is a pivotally mounted actuator arm 37. The actuator arm 37 is designed to be moved towards the plunger 36, in order to change the auxiliary switch condition. In this embodiment, the spring of the plunger 36 will return such plunger and the actuator arm 37 to its rest position of Figure 2 when the movement of the circuit breaker assembly 9 permits.

[0024] Pivotally connected to the operator handle 5 is the linkage mechanism 16. The movable contact support 14 is pivotally connected to the linkage mechanism 16. The linkage mechanism 16 and the movable contact support 14 jointly comprise the circuit breaker assembly 9 of the circuit breaker 1.

[0025] The linkage mechanism 29, which includes a first link 39 and a second link 40, is pivotally connected at its right (with respect to Figures 1 and 2) end to the movable contact support 14 and at its left (with respect to Figures 1 and 2) end to the operating handle 5.

[0026] For locking the linkage mechanism 16 in the overcenter position during automatic resetting, the linkage mechanism 16 includes a latch mechanism comprising a spring biased latch 41 carried by the second link 40. The latch 41 is tripped by a pivotal armature 42 having three legs, namely, a first or unlatching leg 43, a second or attractable leg 44 and a third or substantially balancing leg (not shown). The unlatching leg 43 engages (as

shown in phantom line drawing in Figure 1) the latch 41 and turns it (counter clockwise with respect to Figures 1 and 2) to unlatch the linkage mechanism 16, thereby allowing the linkage mechanism 16 to collapse under the bias of an opening spring 45 (Figure 2) when the attractable leg 44 is pivoted sufficiently toward a pole piece 46 of an electromagnet 47 (upon predetermined overload) to bring the unlatching leg 43 into engagement with the latch 41. Further, the armature 42 pivots about a pin 48.

[0027] The electromagnet 47 comprises a main coil 49 about a tube 50. The tube 50 is of non-magnetic material and houses a movable core (not shown) of magnetizable material biased by a spring (not shown) disposed toward the right (with respect to Figures 1 and 2) end of the tube 50. The moveable core is retarded in its left (with respect to Figures 1 and 2) movement by a liquid, preferably a silicone oil, within the tube 50 to provide a time delay below certain overload currents before tripping of the circuit breaker 1 takes place. The main coil 49 has one end electrically connected to the movable contact support 14 by a flexible conductor 51 and the other end connected by a conductor 52 to the load terminal 8. Thus, an electromagnetic main assembly 38 is formed by the main coil 49, the tube 50, the movable core within the tube 50, and the armature 42 for tripping the circuit breaker 1 after a time delay period at certain overloads or substantially instantaneously at higher overloads.

[0028] Further, the main case 4 houses a control assembly 54. The control assembly 54 comprises a control coil 55 which is coaxial to the main coil 49 about the tube 50. The control coil 55 has one end electrically connected to one of the control terminals 27 by a flexible conductor 56 and the other end connected by a conductor 57 to the other of the control terminals 28. Thus, the control assembly 54 is formed by the control coil 55, the tube 50, the movable core within the tube 50 and the control terminals 27, 28. When the control coil 55 is electrically energized the core moves within the tube 50 in the same manner as it would if an overload occurs so that the circuit breaker 1 is tripped and the contacts 2, 3 are moved to their open position.

[0029] Figure 3 illustrates the same view as Figure 1 and 2 of the circuit breaker 1 with a close main case 4. The other half-case 22 (Figure 5) is connected to the half-case 21 shown in Figures 1 and 2. Schematically the connection case 58 with control terminals 27, 28 is shown. Figure 3 also shows an electrical diagram illustrating, as described already above, that the line terminal 7 is connected via a main switch 59, comprising the first contact 2 and the second contact 3, with the load terminals 8. The electromagnetic main assembly 38 comprising the main coil 49 is linked with the main switch 59 via the linkage mechanism 16 to the movable first contact 2 for opening the main switch 59 in case of an overload. In addition the control assembly 29 comprising the control coil 55 is mechanically linked also via the linkage mechanism 16 with the main switch 59. By energizing or deenergizing the control coil 55 via the control terminals 27,

28 (C, D) the main switch 59 can be actuated externally.

[0030] Figure 4 illustrates the other side of the circuit breaker 1 schematically depicting the auxiliary switch 23 with switch terminals 24, 25, 26. The mains switch 59 is mechanically operating the auxiliary switch 23 via actuator arm 37. One of the switch terminals 24 is a common (C) terminal which is selectively connected with one of the other two switch terminals 25, 26. Switch terminal 25 is normally open (NO) and switch terminal 26 is normally closed (NC).

[0031] Figure 5 is a back view of the circuit breaker 1 in the direction of the terminals 24, 25, 26, 27, 28. It can be seen that the switch case 20 has six terminal cavities 31, 32, 33, 34, 35, 53, five of which accommodate one of the terminals 24, 25, 26, 27, 28 and one cavity 53 being unoccupied. The cavities 31, 32, 33, 34, 35 are arranged in two rows, on row for the terminals of the control assembly 29 and one row for the terminals of the auxiliary switch 23.

Reference numerals

[0032]

1 circuit breaker

2 movable first contact

3 fixed second contact

4 main case

5 operating handle

6 half-case

7 half-case

8 load terminal

9 circuit breaker assembly

10 actuable member

11 internal actuator

12 external protrusion

13 opening

14 movable contact support

15 pin

16 linkage mechanism

17 pin

18 switch receptacle

19 recess

5 20 switch case

21 half-case

22 half-case

10 23 auxiliary switch

24 switch terminal

15 25 switch terminal

26 switch terminal

27 control terminal

20 28 control terminal

29 control assembly

25 30 protrusion

32 terminal cavity

33 terminal cavity

30 34 terminal cavity

35 terminal cavity

35 36 plunger

37 actuator arm

38 electromagnetic main assembly

40 39 first link

40 second link

45 41 latch

42 armature

43 first leg

50 44 second leg

45 opening spring

55 46 pole piece

47 electromagnet

48 pin
 49 main coil
 50 tube
 51 conductor
 52 conductor
 53 terminal cavity
 54 half-case
 55 control coil
 56 conductor
 57 conductor
 58 connection case
 59 main switch
 31 terminal cavity

Claims

1. An electromagnetic circuit breaker comprising a main case (4), a pair of contacts (2, 3) enclosed by said main case (4), a circuit breaker assembly (9) to move one of the contacts (2, 3) between a closed position and an open position an electromagnetic main assembly (38) for actuating said circuit breaker assembly (9) upon the occurrence of predetermined electrical conditions, and an auxiliary switch (23) responsive to movements of said circuit breaker assembly (9) for indicating whether said contacts (2, 3) are open or closed, wherein the auxiliary switch (23) has switch terminals (24, 25, 26), **characterized in, that** a control assembly (54) is provided for actuating said circuit breaker assembly (9) upon an external electrical signal, wherein said control assembly (54) has control terminals (27, 28) and that a switch case (20) is provided carrying said switch terminals (24, 25, 26) and said control terminals (27, 28).
2. An electromagnetic circuit breaker according to claim 1, **characterized in, that** each of said contacts (2, 3) is connected to a main terminal (7, 8) and that said electromagnetic main assembly (38) comprises a main coil (49) connected in series to said terminals (7, 8).
3. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that**

said control assembly (54) is of the electromagnetic type comprising a control coil (55) electrically connected to the control terminals (27, 28).

- 5 4. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that** said main case (4) and said switch case (20) are made of electrically insulating material.
- 10 5. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that** said main case (4) and said switch case (20) are separate cases which are connected.
- 15 6. An electromagnetic circuit breaker according to claim 5, **characterized in, that** said main case (4) is formed of at least a pair of half-cases (21, 22) jointly defining a space within which the mechanism of the circuit breaker (1) is received and that said main case (4) and said switch case (20) are provided with interfitting wall portions (19, 30) to be connected jointly together.
- 20 7. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that** said switch case (20) is provided with terminal cavities (31, 32, 33, 34, 35) receiving the terminals (24, 25, 26, 27, 28).
- 25 8. An electromagnetic circuit breaker according to claim 7, **characterized in, that** said cavities (31, 32, 33, 34, 35) are open to one side of the switch case (20) for receiving counter-terminals to be connected to the terminals (24, 25, 26, 27, 28).
- 30 9. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that** said main electromagnetic assembly (38) is actuating said circuit breaker assembly (9) to its open position upon the occurrence of a predetermined current overload.
- 35 10. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that** an operating handle (5) extends out of the main case (4) for manually actuating said circuit breaker assembly (9).
- 40 11. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that** said circuit breaker assembly (9) comprises a collapsible linkage mechanism (16) to move one of the contacts (2, 3).
- 45 12. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that** said auxiliary switch (23) is mechanically interoperating with said circuit breaker assembly (9) for sens-
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ing the position of said circuit breaker assembly (9).

13. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that** each of said contacts (2, 3) is connected to a main terminal (7, 8), wherein said main terminals (7, 8) extend substantially in the same direction from the main case (4) and that the switch case (20) is located substantially intermediate the main terminals (7, 8) with the switch terminals (24, 25, 26) and the control terminals (27, 28) extending generally in the same direction as the main terminals (7, 8).
14. An electromagnetic circuit breaker according to any one of the preceding claims, **characterized in, that** the electromagnetic main assembly (38) comprises a main coil (49) about a tube (50) for moving a core of magnetizable material movable in said tube (59) for tripping the circuit breaker assembly (9), and that the control assembly (29) comprises a control coil (55) about said tube (50) for moving said core within said tube (59).

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FIG. 1

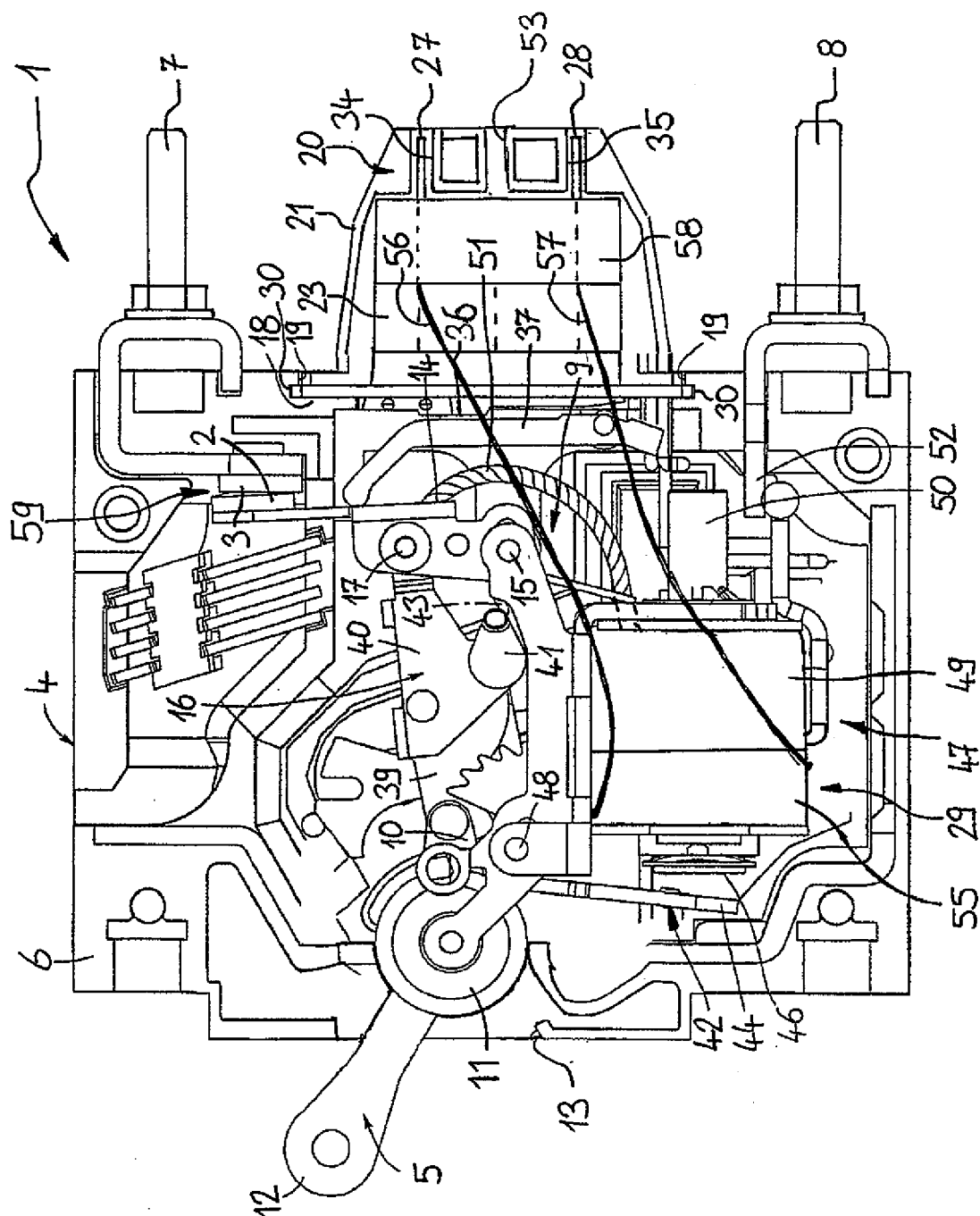
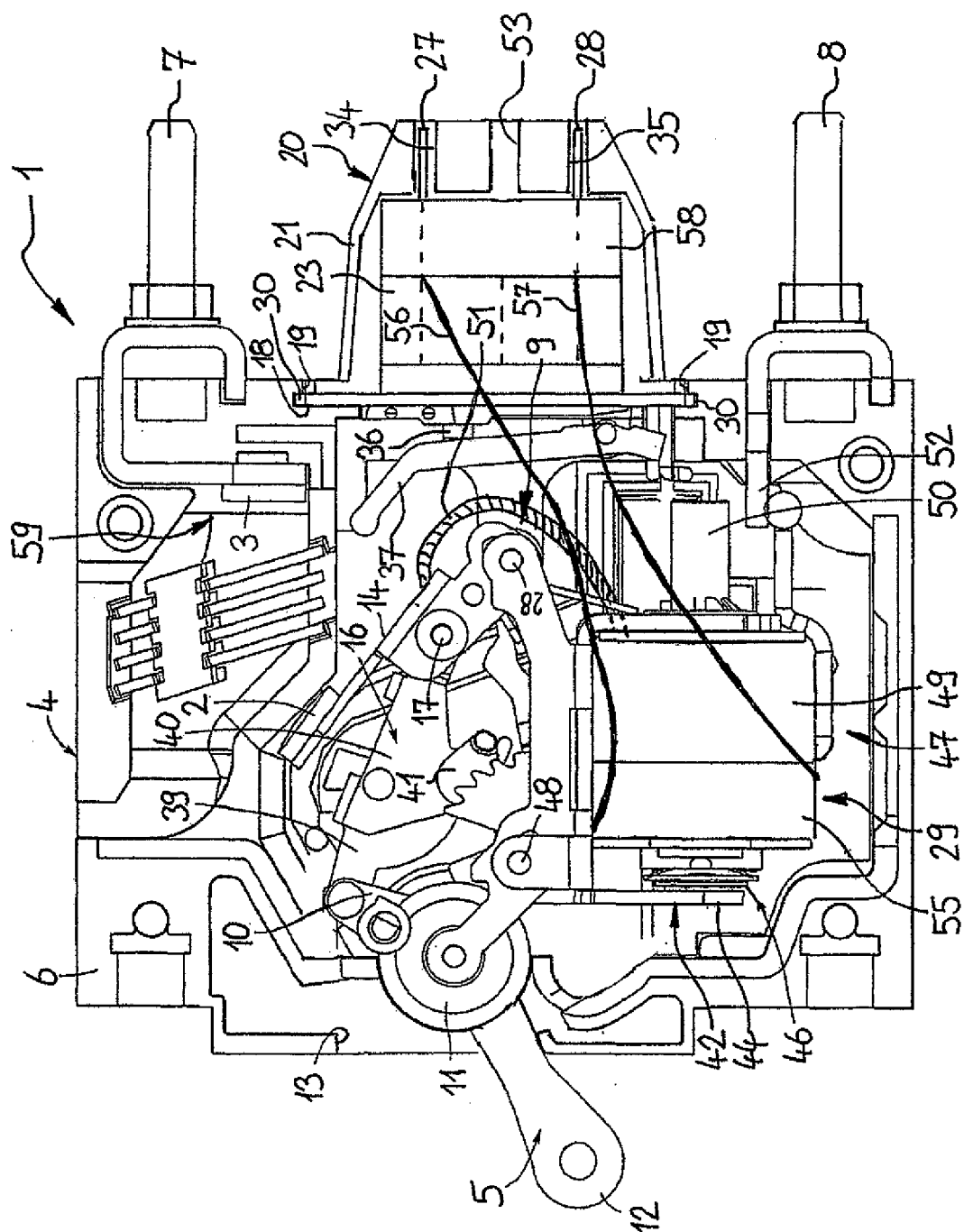


FIG. 2



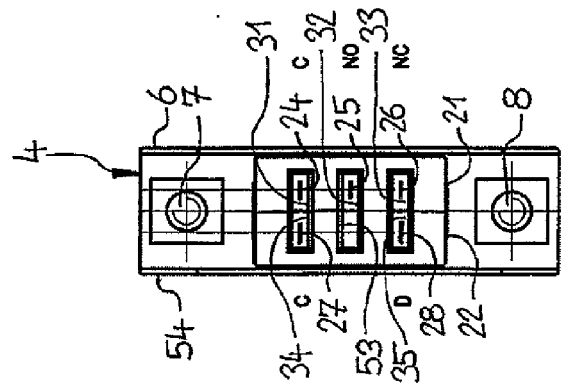


FIG. 5

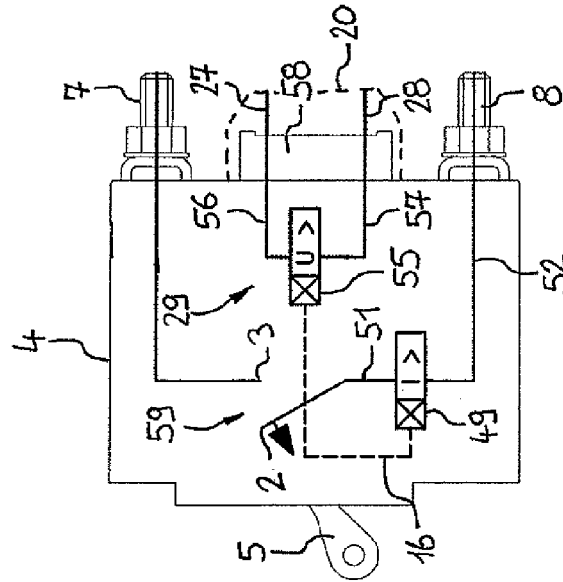


FIG. 3

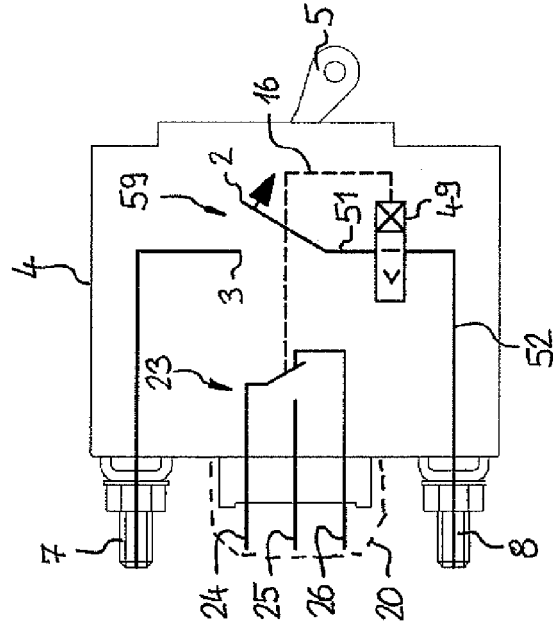


FIG. 4



EUROPEAN SEARCH REPORT

Application Number
EP 11 30 6408

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The present search report has been drawn up for all claims			
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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