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This application was filed on 15-09-2010 as a divisional application to the application mentioned under INID code 62.

(54) **Molded case multipole circuit breaker and kits of parts including said circuit breaker**

(57) A molded case multipole electrical circuit breaker (Sw-sx) is described, including an outer shell (2) comprising a front wall (2a) on which a primary control member (L-sx) is provided which is movable between an activation position (ON) and a deactivation position (OFF) of the circuit breaker, a pair of opposite side walls (2b, 2c), an upper side (2d), a lower side (2e), and a rear wall (2f) intended to be connected to a support member. The circuit breaker further includes:
- an opening (10) on at least one of said opposite side walls (2b, 2c); and
- a rotatable activation member (17a) which is arranged internally to the outer shell (2), the rotatable activation member including at least one hole (17c) facing said opening (10).

The circuit breaker is **characterized in that**:
- said rotatable activation member carries electrical contacts for the switching of the circuit breaker between a closed state and an open state; and
- said opening (10) provided on at least one of said opposite side walls (2b, 2c) of the circuit breaker outer shell (2) is a bent slot.

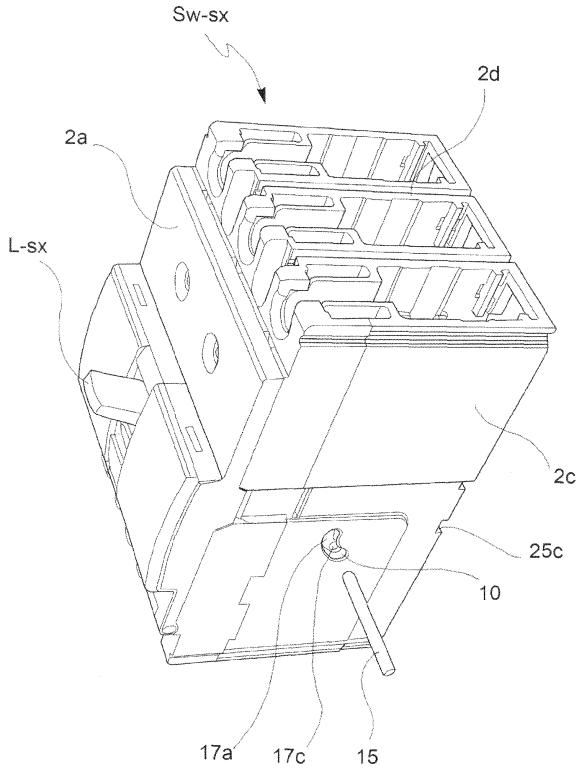

FIG. 3

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Description

[0001] The present invention relates to the technical field of the electrical apparatuses and, particularly, it relates to a molded case multipole circuit breaker as defined in the preamble of the first claim.

[0002] In the technical field of the industrial electrical apparatuses, it is known to use mechanical interlock devices that are associated with electrical circuit breakers, for example, in order to prevent an undesired simultaneous activation of two energy sources intended to operate in a mutually excluding manner (such as, for example, a primary source and an auxiliary source).

[0003] Particularly, "front" interlock devices are known which are suitable to frontally act by mechanical interference with the front control levers of the electrical circuit breakers to be interlocked. However, such devices compromise the possibility to frontally apply front implements such as, for example, a motorization device to the circuit breakers.

[0004] "Rear" interlock devices are further known which are intended to be mounted inside an electric panel or box at the back of the circuit breakers to be interlocked. However, such devices, while allowing the application of front implements to the circuit breakers, have other types of drawbacks. In fact, since they are located in the rear part of the electric panel, in which conductive electrical parts under tension are present, they have the main drawback to necessitate cutting out the voltage to the electric panel during the maintenance operations for the interlock devices. Furthermore, the "rear" interlock devices generally have a complex structure which is characterized by a high number of pieces, they occupy much room in the thickness of the electric panel, and require periodic adjustment operations.

[0005] The object of the present invention is to provide a molded case multipole circuit breaker which is able to obviate the above-discussed drawbacks relative to the prior art.

[0006] Such object is achieved by a molded case multipole circuit breaker as generally defined in the annexed claim 1.

[0007] Advantageous embodiments of a molded case multipole circuit breaker according to the present invention are as defined in the annexed dependent claims.

[0008] Further objects of the present invention are to provide kits of parts as defined in the claims 4 and 5.

[0009] Further characteristics and the advantages of the invention will be clear from the following detailed description, given only by way of non-limiting example, with reference to the annexed drawings, in which:

- Fig. 1 is a front perspective view of a kit of parts including a first and a second electrical circuit breakers, and an interlock device, where the kit of parts is shown in a first operative configuration;
- Fig. 2 is a front perspective view of the kit of parts of Fig. 1 in a second operative configuration;
- Fig. 3 is a perspective view of an electrical circuit breaker of the kit of parts of Fig. 1, and of a component of the interlock device of Fig. 1;
- Fig. 4 is a perspective view of an inner member of the electrical circuit breakers of Fig. 1 which is coupled to the interlock device component represented in Fig. 3;
- Fig. 5 is a perspective view of the kit of parts of Fig. 1, in which one of the circuit breakers has been removed, and in which the interlock device is represented in a third configuration;
- Fig. 6 is a perspective view of the kit of parts of Fig. 5, in which a first lid of the interlock device can be seen;
- Fig. 7 is a front perspective view of the interlock device of Fig. 1, in which an additional component of such device is shown;
- Fig. 8 is a perspective view of the kit of parts of Fig. 1, in which a second lid of the interlock device can be seen;
- Fig. 9 is a rear perspective view of the kit of parts of Fig. 1.

[0010] In the following description, the terms "high", "low", "right", "left", "upper", "lower", "horizontal", "vertical", "clockwise", "counter clockwise" are referred to an observer of Fig. 1 as presented and not being rotated in any manner.

[0011] With reference to the Fig. 1, a kit of parts is illustrated, which comprises: an interlock device 1, a first Sw-sx and a second Sw-dx electrical circuit breakers. The circuit breakers are molded case multipole electrical circuit breakers which are intended to be installed on a support member, such as, for example, a respective insertion strip, or a support plate which is fixed or securable inside an electric panel, in order to be actuated in a mutually excluding manner. For example, the Sw-sx and Sw-dx electrical apparatuses functionally correspond to two separate sources, which are connected in parallel to a load, one of which is the primary source, and the other one is the auxiliary source which is provided so as to operate in the event of a failure or malfunction of the primary source.

[0012] The Sw-sx circuit breaker comprises an outer shell 2 including a front wall 2a, on which a control lever L-sx for the circuit breaker operation is provided, a pair of opposite side walls 2b, 2c, an upper side 2d, a lower side 2e, and a rear wall 2f (Fig. 9) which is intended, in use, to be connected for example to a support plate (not shown).

[0013] Similarly, the Sw-dx circuit breaker comprises an outer shell 3 including a front wall 3a, on which a L-dx control lever analogue to L-sx is arranged, a pair of opposite side walls 3b, 3c, an upper side 3d, a lower side 3e, and a rear wall 3f (Fig. 9) which is intended to be connected for example to a support plate (not shown).

[0014] Particularly, the control levers L-sx, L-dx of the circuit breakers Sw-sx, Sw-dx are independently mova-

ble between a first activation position ON, corresponding to a closed state of the circuit breaker, and a second deactivation position OFF, corresponding to an open state of the circuit breaker.

[0015] With reference to the Fig. 6, the interlock device 1 includes a box-shaped main shell 4 intended to be sandwiched between the side walls 2c and 3b of the outer shells 2, 3, which are mutually facing in the operative conditions of the device. Thereby, the interlock device 1 is arranged between the two circuit breakers Sw-sx, Sw-dx.

[0016] The main shell 4 of the device 1 includes two opposite side faces (of which, only one, indicated with 5, is visible in Fig. 6) which operatively face the side walls 2c and 3b, respectively, of the circuit breakers Sw-sx, Sw-dx.

[0017] The main shell 4 includes, particularly, a box-like portion 6 (Fig. 5), and a front lid 7 (Fig. 6) which is removably secured to the box-like portion, for example, by means of screws. In this case, the side face 5 is preferably defined by both the box-like portion 6 and the front lid 7 (Fig. 6).

[0018] The main shell 4 further has two communication openings 8, 9, each of which extends partially frontally on the front lid 7 and partially on a respective side face of the main shell 4.

[0019] Particularly, each of the portions of the two communication openings 8, 9 which frontally extend on the front lid 7, extends horizontally from the edge of the lid 7 towards a central vertical axis of the same lid 7.

[0020] The portions of the two communication openings 8, 9 which extend on the side faces of the main shell 4 have, in the exemplary case, a generally enlarged shape which extends on the respective wall and, particularly, operatively face respectively two openings, preferably manufactured under the shape of two bent slots 10, 11 (Figs. 1 and 3) which are provided on the side walls 2c and 3b, respectively, of the outer shells 2, 3 of the circuit breakers Sw-sx, Sw-dx. Optionally, other two slots which are identical to the slots 10, 11 are further provided on the side walls 2b and 3c, respectively, of the shells 2, 3, that is on the side walls which, in the illustrated embodiment, do not face the interlock device 1.

[0021] With reference to the Fig. 1, the device 1 comprises locking means which consist of, in the exemplary case, a rocker 12 which is rotatable around a horizontal support pivot between a first (left) and a second (right) angular positions, which are distinct and predetermined. Particularly, the rocker includes two teeth 13a, 13b angularly spaced apart from each other around the support pivot, which comprise a first 14a and a second 14b engagement surfaces (Fig. 7), respectively, the function of which will be explained herein below.

[0022] The device 1 further comprises secondary control members consisting of a first 15 and a second 16 control pins in the currently preferred embodiment. Each of the control pins 15, 16 is movable between a lower operative position and an upper operative position associated to the ON, OFF positions of the respective control lever L-sx, L-dx, and is suitable to cooperate with the rocker 12 in order to prevent to the circuit breakers Sw-sx, Sw-dx to be both in a closed state.

[0023] Particularly, the control pins 15, 16 are such as to cooperate with the rocker 12, so that, when the first pin 15 is in the upper operative position (Fig. 2), the rocker and, consequently, the second pin 16, are in the second angular position and in the lower operative position, respectively.

[0024] On the other hand, when the second pin 16 is in the upper operative position (Fig. 1), the rocker and, consequently, the first pin 15, are in the first angular position and in the lower operative position, respectively.

[0025] Particularly, each of the first 15 and the second 16 control pins is intended to be rotationally integral to a respective rotatable activation member or contact carrier shaft 17a, 17b (Figs. 3 and 4) located inside the shell of the first Sw-sx and the second Sw-dx circuit breakers. The rotatable activation members carry the movable electrical contacts for the switching of the circuit breakers between the closed state and the open state, and are actionable through the control levers L-sx, L-dx, respectively.

[0026] In the particular example considered herein, respective holes 17c, 17d are provided on the rotatable activation members 17a, 17b, which respectively face the bent slots 10, 11, inside which the pins 15, 16 are suitable to be fitted. Optionally, each of the rotatable activation members can comprise a further hole intended to face a respective slot of the two slots optionally obtained on the side walls 2b, 3c of the outer shells 2, 3.

[0027] Furthermore, it is appropriate to notice that, by means of the rotatable activation members 17a, 17b, the lower and upper operative positions of the first 15 and second 16 control pins correspond to the OFF and ON positions, respectively, of the control levers L-sx, L-dx.

[0028] In accordance with an embodiment, the device 1 can comprise positioning means of the rocker 12. In the exemplary embodiment, such rocker positioning means comprise, particularly, a spring 18 (Fig. 7) which is suitable to cooperate with the teeth 13a, 13b in order to bring the rocker to a preset intermediate angular position when the control levers L-sx, L-dx are both in the OFF position. Such intermediate position of the rocker is preferably centred relative to the first and second angular positions.

[0029] In accordance with an embodiment, the spring 18 has also the function of reducing the clearances which could be present between the tooth 13b and the second 16 control pin, when such pin 16 is in the upper operative position, and between the tooth 13a and the first 15 control pin when such pin is in the upper operative position, respectively.

[0030] In the exemplary embodiment, the spring 18 has, particularly, two elastic arms 19, 20 which are respectively supported by two spring positioning and support members 21, 22 which are provided in the main shell

4.

[0031] Particularly, the arms 19, 20 are suitable to be subjected to an upwardly flexure, under the action of the two teeth 13a, 13b, respectively, so that when the rocker 12 is in the first angular position (Fig. 1), the arm 20 has stored the maximum elastic energy while the arm 19 is unloaded, and when the rocker 12 is in the second angular position (Fig. 2), the conditions of the two arms are inverted relative to those previously described.

[0032] With reference to Fig. 8, the device 1 comprises a secondary front lid 23, intended to be connected in an overlapped manner to the front lid 7 (Fig. 6) of the main shell 4, so as to cover the front portions, if present, of the communication openings 8, 9 (Fig. 6) and to prevent the access to the screws for the connection of the front lid 7 to the box-like portion 6. Furthermore, each of the front lid 7 and the secondary front lid 23 has two opposite eyelets (particularly, only the eyelets 24 of the front lid 7 in Fig. 6 are visible), the eyelets being two by two aligned when the two lids are overlapped. This allows the insertion of a protective closing means, such as a wire with lead seal, through each pair of aligned eyelets.

[0033] Finally, in order to accurately position the interlock device 1 relative to the circuit breakers Sw-sx, Sw-dx on the main shell 4 of the device 1, centring means are provided which, in the exemplary case, are obtained by means of two tongues 25a, 25b which are projecting from the main shell 4 of the device 1. Such centring means are, particularly, suitable to engage in respective conjugated centring means respectively provided on the outer shells 2, 3 of the circuit breakers Sw-sx, Sw-dx.

[0034] In the exemplary embodiment, such conjugated centring means are, particularly, two centring recesses 25c, 25d visible in Fig. 9 or, with reference to the recess 25c, in Fig. 3. Optionally, two other centring recesses can respectively be obtained on the outer shells 2, 3 of the circuit breakers Sw-sx, Sw-dx, on the side opposite that in which they are illustrated in the annexed Figures.

[0035] The installation of the kit of parts Sw-sx, Sw-dx, 1, will be described herein below, with particular reference to the case in which such kit of parts is intended to be secured inside an electric panel by means of a support plate. Such support plate can be, for example, an inner panel provided in the electric panel, or a support plate which can be secured inside an electric panel, for example including coupling means to a DIN rail.

[0036] Initially, the main shell 4 of the device 1 is secured on the support plate (not shown).

[0037] Once the main shell 4 has been secured, the first pin 15 is connected to the first circuit breaker Sw-sx by being inserted through the bent slot 10 in order to partially fit it inside the hole 17c (Fig. 3) provided on the rotatable activation member 17a.

[0038] The assembly consisting of the circuit breaker Sw-sx and the pin 15, after that the control lever L-sx has been brought in the OFF position so that the pin 15 results to be in the lower operative position, is made to slide laterally relative to the device 1 (the direction of the arrow S in Fig. 6) so that the side wall 2c of the circuit breaker Sw-sx slides along the side face of the interlock device main shell 4 and, concomitantly, the pin 15 inserts through the front portion of the communication opening 8.

[0039] In this regard, it should be noticed that the control pins 15, 16, when are in the lower operative position, turn out to face respectively the front portions of the communication openings 8, 9. In fact, in such manner one can be sure that the circuit breakers installation and removal is always accomplished when these are in an open state (OFF).

[0040] Furthermore, it should be noticed that when the control pins 15, 16 are in the lower operative position, the spring 18, when present, is suitable to cooperate with the rocker 12 so as to bring it to and maintain it in an intermediate angular position between the first and second angular positions. Particularly, the intermediate angular position is such as to prevent that, in the absence of the control pins 15, 16, rocker portions can assume positions corresponding to the communication openings 8, 9 front portions. In such manner, the spring 18 promotes the coupling of the circuit breakers Sw-sx, Sw-dx to the interlock device 1, thus allowing having the front portions of the communication openings 8, 9 free from obstacles when the control pins 15, 16 are being inserted within the main shell 4.

[0041] Once the coupling of the circuit breaker Sw-sx to the device 1 has been accomplished, the circuit breaker will be accurately positioned relative to the device 1, by causing the centring tongue 25a (Fig. 9) outwardly projecting from the main shell 4 to be engaged in the corresponding conjugated centring recess 25c (Fig. 3) which is provided on the outer shell 2 of the circuit breaker Sw-sx.

[0042] Finally, the circuit breaker Sw-sx is secured to the support plate, for example, by means of screws.

[0043] The installation of the circuit breaker Sw-dx is carried out in a similar manner as described for the circuit breaker Sw-sx, on the opposite side of the main shell 4 of device 1 relative to that of the circuit breaker Sw-sx. Particularly, in this case, the coupling between the circuit breaker Sw-dx and the interlock device is carried out by inserting first the second control pin 16 through the bent slot 11 and the hole 17d provided on the rotatable activation member 17b (Fig. 4) of the circuit breaker Sw-dx, then by inserting the pin 16 coupled to the circuit breaker Sw-dx, through the communication opening 9 front portion. The relative positioning between the circuit breaker Sw-dx and the device 1 is then accomplished by engaging the projecting centring tongue 25b (Fig. 9) in the corresponding conjugated centring recess 25d which is provided on the outer shell 3 of the circuit breaker Sw-dx.

[0044] In the end, the secondary front lid 23 is connected to the front lid 7 of the main shell 4.

[0045] The operation of the device 1 is as follows.

[0046] Let's assume that the device 1 is initially in the configuration in Fig. 1, in which the control members L-sx, L-dx are respectively in the OFF and ON positions,

considering the front lid 7 as being connected to the box-like portion 6.

[0047] In such configuration, the rotatable activation member 17b of the circuit breaker Sw-dx results to be locked, in a manner known *per se,* so that the second control pin 16 also results to be locked in the upper operative position.

[0048] When the control lever Sw-sx is moved from the OFF position to the ON position, the first control pin 15 acts in a supporting relationship against the engagement surface 14a (Fig. 7) of the tooth 13a of the rocker 12, in order to impart a clockwise rotation to the latter.

[0049] However, such clockwise rotation is prevented by the second control pin 16, which acts as an abutting member against the second engagement surface 14b belonging to the rocker tooth 13b, so that the first control pin 15 is locked in the lower operative position and, consequently, the control lever L-sx remains locked in the OFF position.

[0050] In order to unlock the rotatable activation member 17b of the circuit breaker Sw-dx, it is necessary to act upon the control lever L-dx, for example, manually, by bringing it from the ON position to the OFF position.

[0051] This movement of the control lever L-dx results, by means of the rotatable activation member 17b, in the second control pin 16 being moved from the upper operative position to the lower operative position.

[0052] Particularly, the pin 16 moves through the bent slot 11 and the side portion of the communication opening 9 covering, in the exemplary case, a curvilinear path, for example corresponding to a circumference arc.

[0053] On the basis of what has been described above, it should be understood that, once the control lever L-dx has been moved to the OFF position, the clockwise rotation of the rocker 12 is no more opposed by the control pin 16.

[0054] Thus, the control lever L-sx can be moved from the OFF position to the ON position by actuating the rotatable activation member 17a of the circuit breaker Sw-sx and, consequently, the control pin 15.

[0055] Particularly, the latter, upon moving through the bent slot 10 and the communication opening 8 side portion, passes from the lower operative position to the upper operative position, thus giving the rocker a clockwise rotation until it reaches to the second angular position (Fig. 2).

[0056] Starting from the latter configuration, in order to bring the control lever L-dx from the OFF position to the ON position, it is necessary to proceed in the reverse manner as that described above.

[0057] Particularly, in this case, in order to allow for the counter-clockwise rotation of the rocker 12, it is necessary to act upon the control lever L-sx of the circuit breaker Sw-sx by bringing it from the ON position to the OFF position. In such manner, in fact, the rotatable activation member 17a is unlocked and, consequently, the first control pin 15, which passes from the upper operative position to the lower operative position.

[0058] Once such configuration has been achieved, where the control levers L-sx, L-dx of the circuit breakers are both in the OFF position, it is therefore possible to bring the control lever L-dx to the ON position. During such movement, the second control pin 16 moves, particularly, from the lower operative position to the upper operative position while acting in a supporting relationship against the engagement surface 14b of the tooth 13b, so as to give the rocker a counter-clockwise rotation, until it achieves the first angular position (Fig. 1).

[0059] It should be understood that variations and/or additions are contemplated to what has been described and illustrated above.

[0060] Finally, it is suitable to point out that, in accordance with the present invention, a molded case multipole electrical circuit breaker Sw-sx is provided, including:

- an outer shell 2 comprising a front wall 2a on which a primary control member L-sx is provided which is movable between an activation position ON and a deactivation position OFF of the circuit breaker, a pair of opposite side walls 2b, 2c, an upper side 2d, a lower side 2e, and a rear wall 2f intended to be connected to a support member;
- an opening 10 on at least one of the opposite side walls 2b, 2c of the outer shell 2; and
- a rotatable activation member 17a arranged internally relative to the outer shell 2 and carrying the electrical contacts for the switching of the circuit breaker between a closed state and an open state, where such rotatable activation member includes at least one hole 17c facing the opening 10 provided on at least one of the opposite side walls 2b, 2c of the outer shell 2.

[0061] Particularly, the opening 10 which is provided on at least one of the opposite side walls 2b, 2c of the outer shell 2 of the circuit breaker is manufactured under the shape of a bent slot.

[0062] According to a further embodiment of the molded case multipole electrical circuit breaker, this can include at least one centring recess 25c on the respective outer shell 2.

[0063] Finally, according to a further embodiment of the molded case multipole electrical circuit breaker, this can be suitable to be coupled to a device which is different from the interlock device, such as, for example, an outer residual current protection unit. Such residual current protection unit is put beside a side wall 2b, 2c of the molded case circuit breaker. Particularly, the coupling of the outer residual current protection unit can be accomplished through coupling means that are intended to pass through the opening 10 which is provided on the outer shell 2 of the circuit breaker Sw-sx, so as to cooperate with the hole 17c which is provided on the rotatable activation member 17a. It should be noticed that such coupling means between the circuit breaker and the residual current protection unit can be implemented through a pin

completely similar to the control pins 15, 16. In such manner, the residual current protection unit can operate an automatic opening of the multipole circuit breaker by means of such pin, following an intervention of the residual current protection, by directly acting on the rotatable activation member 17a through the pin 15, 16.

[0064] In view of what has been described above, it is therefore possible to understand how a molded case multipole circuit breaker according to the present invention is such as to solve the above-mentioned drawbacks with reference to the prior art.

[0065] Particularly, the side arrangement of the interlock device and the ability thereof to laterally act with the respective circuit breakers allows avoiding the drawbacks of the "front" and "rear" interlock devices, thus allowing obtaining a kit of parts which is suitable to receive any utility, also a front utility, which is suitable to reduce the thickness dimension inside the electric panel, and which is relatively easy, both from the point of view of the components which are employed and the operation thereof.

[0066] The principle of the invention being understood, the embodiments and implementation details may be widely varied relative to what has been described and illustrated herein by way of non-limiting example only, without thereby departing from the scope of the invention as defined in the annexed claims.

Claims

1. A molded case multipole electrical circuit breaker (Sw-sx), including an outer shell (2) comprising a front wall (2a) on which a primary control member (L-sx) is provided which is movable between an activation position (ON) and a deactivation position (OFF) of the circuit breaker, a pair of opposite side walls (2b, 2c), an upper side (2d), a lower side (2e), and a rear wall (2f) intended to be connected to a support member,
the circuit breaker further including:

- an opening (10) on at least one of said opposite side walls (2b, 2c); and
- a rotatable activation member (17a) which is arranged internally to the outer shell (2), the rotatable activation member including at least one hole (17c) facing said opening (10);

characterized in that:

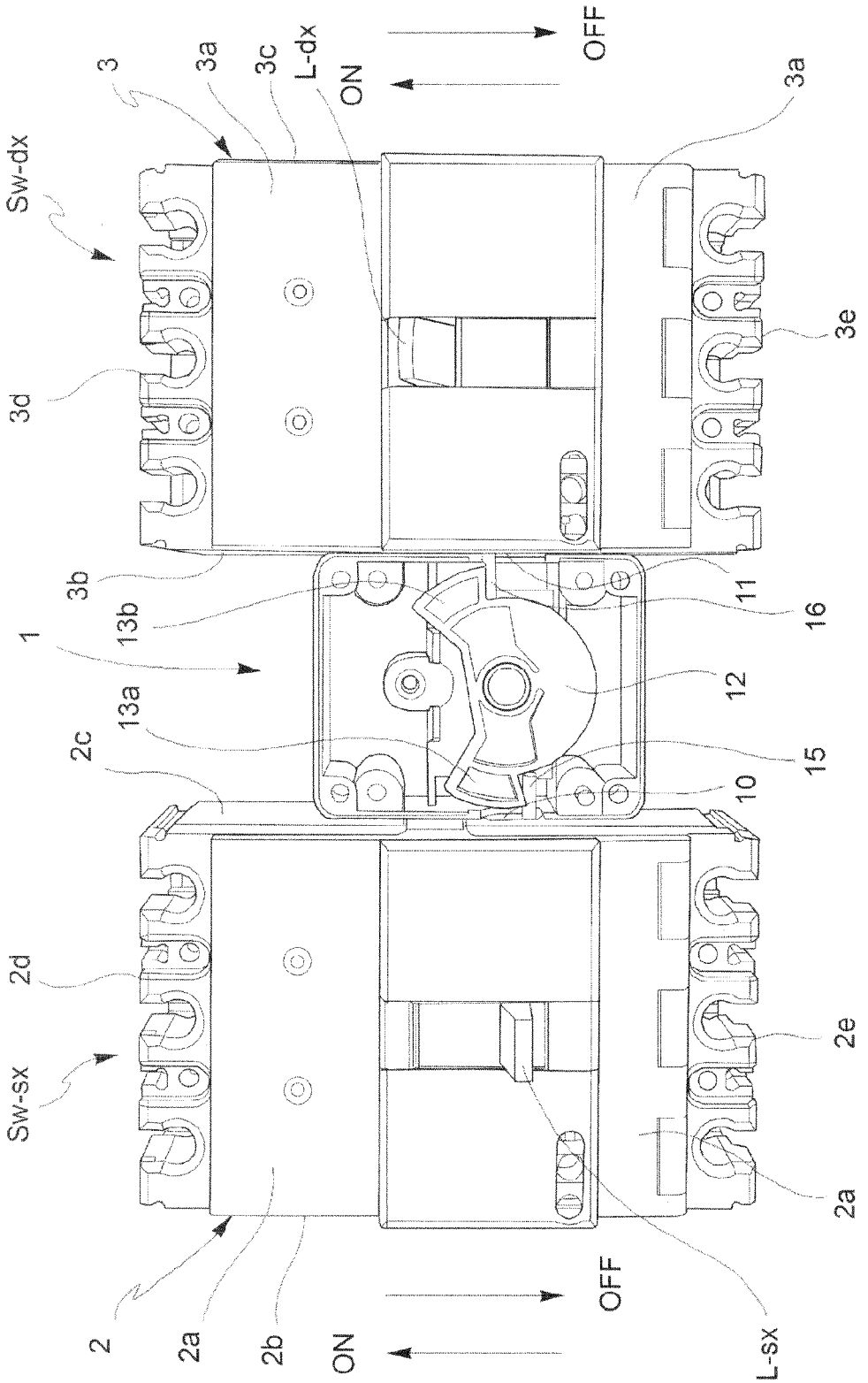
- said rotatable activation member carries electrical contacts for the switching of the circuit breaker between a closed state and an open state; and
- said opening (10) provided on at least one of said opposite side walls (2b, 2c) of the circuit breaker outer shell (2) is a bent slot.

2. The molded case multipole electrical circuit breaker (Sw-sx) according to claim 1, including at least one centring recess (25c) on said outer shell (2).

3. The molded case multipole electrical circuit breaker according to anyone of claims 1 or 2, adapted to be coupled to an outer residual current protection unit through coupling means which are intended to pass through said opening (10) in order to cooperate with said hole (17c).

4. A kit of parts (1, Sw-sx, Sw-dx) including a first and second molded case electrical circuit breaker (Sw-sx, Sw-dx) as defined in anyone of the preceding claims, and an interlock device (1) suitable for cooperating with said circuit breakers (Sw-sx, Sw-dx) to prevent such circuit breakers (Sw-sx, Sw-dx) from being both in a closed state.

5. A kit of parts including a molded case electrical circuit breaker (Sw-sx) as defined in anyone of claims 1 to 3, a residual current protection unit and coupling means for coupling said protection unit to said circuit breaker (Sw-sx), the coupling means being intended to pass through said opening (10) which is provided on the outer shell (2) of the circuit breaker (Sw-sx).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L-sx

FIG. 1

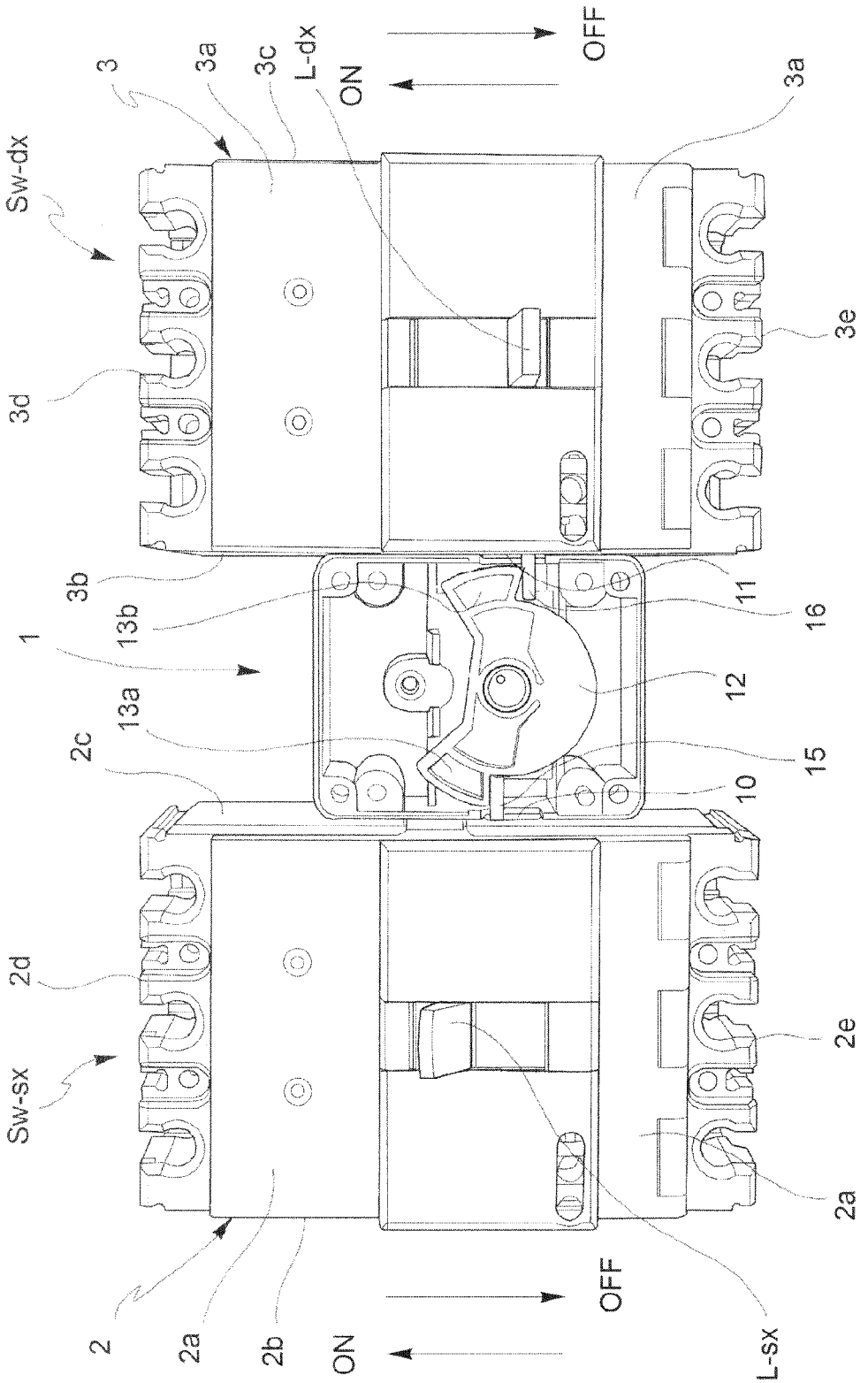
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FIG. 2

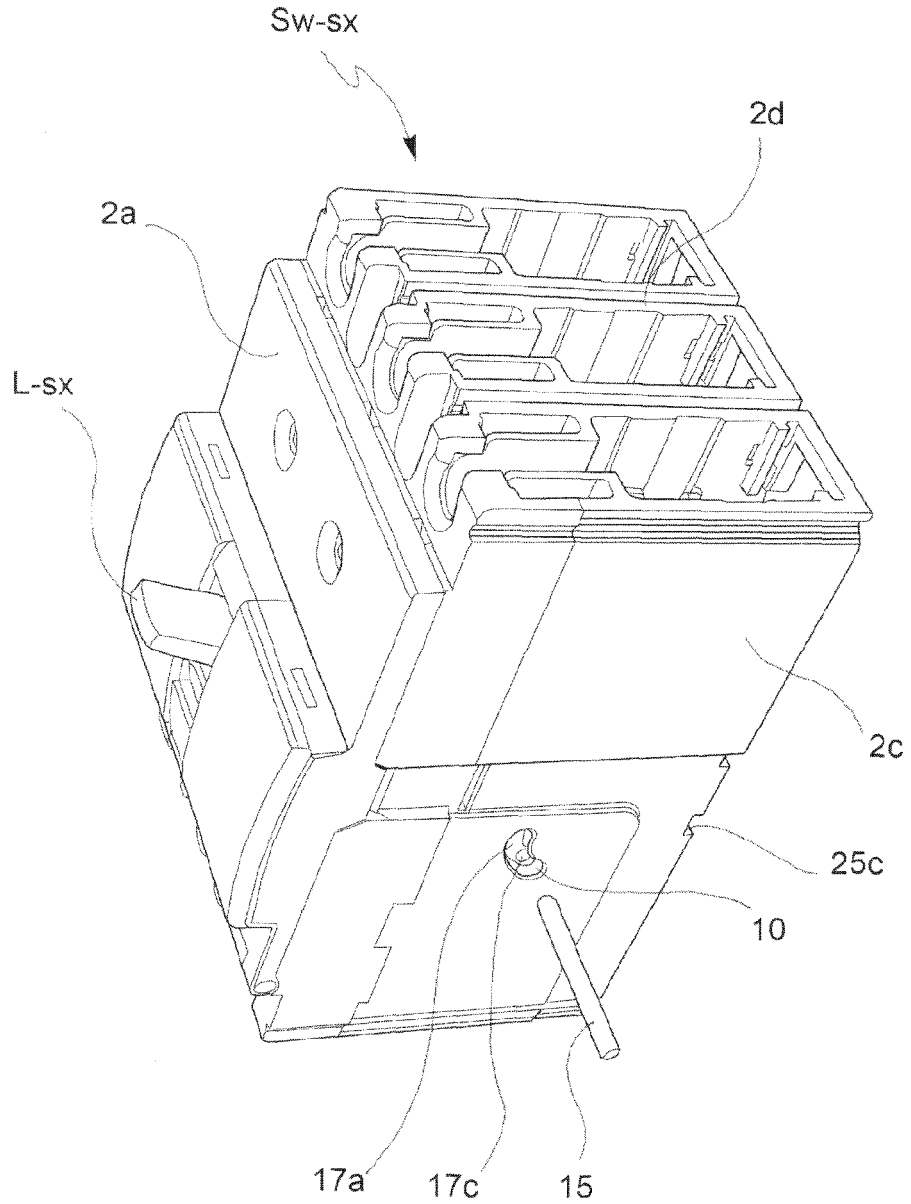

FIG. 3

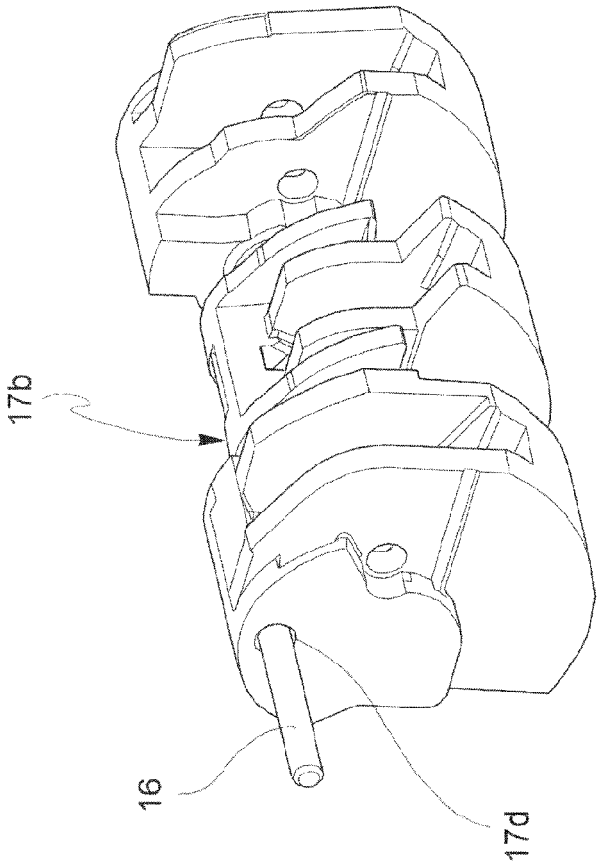

FIG. 4

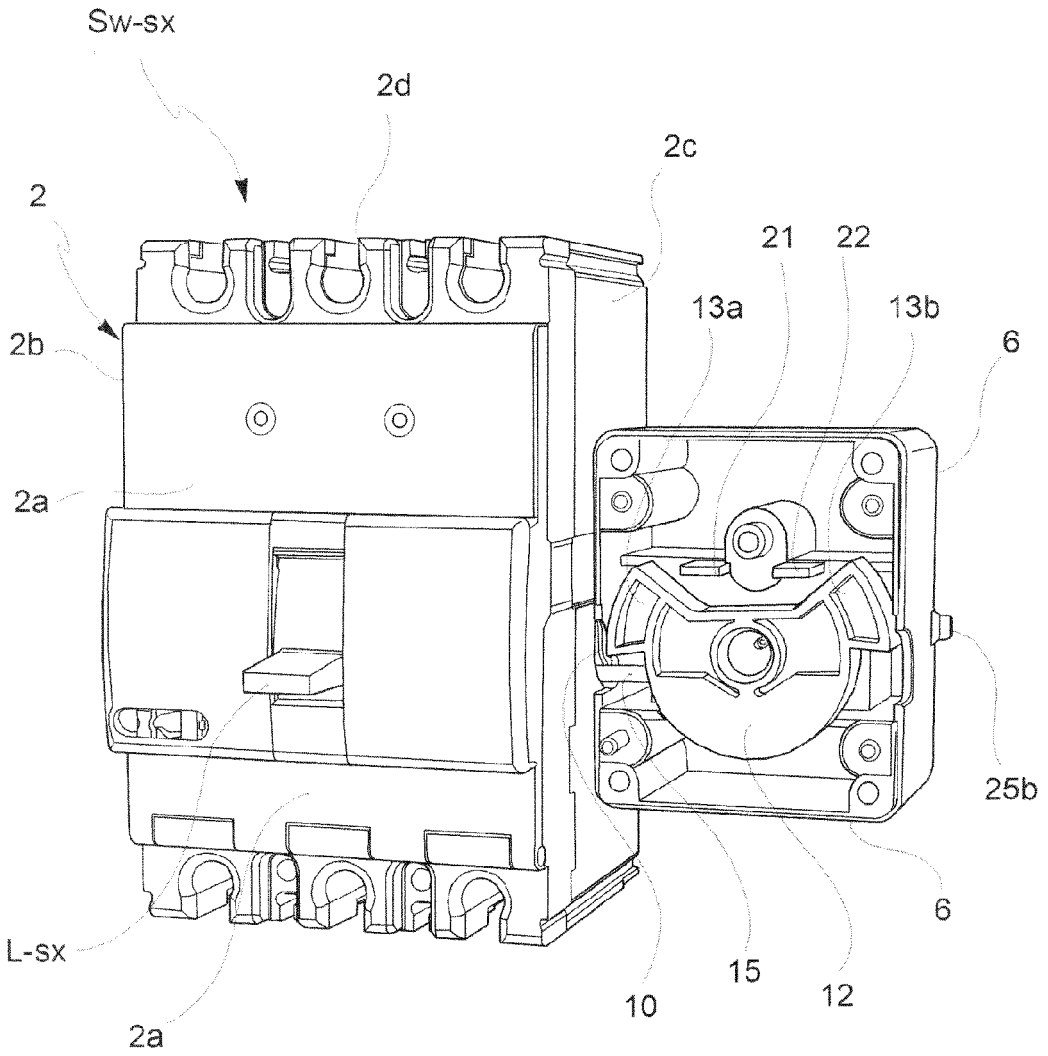

FIG. 5

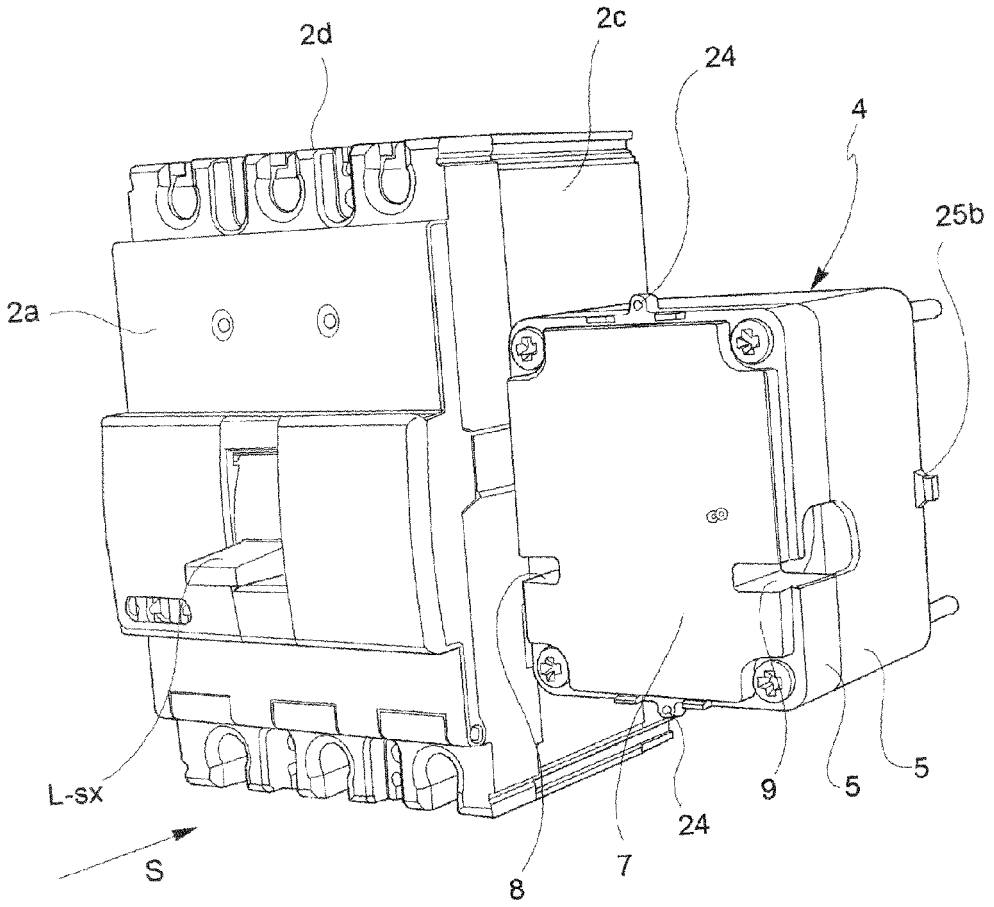

FIG. 6

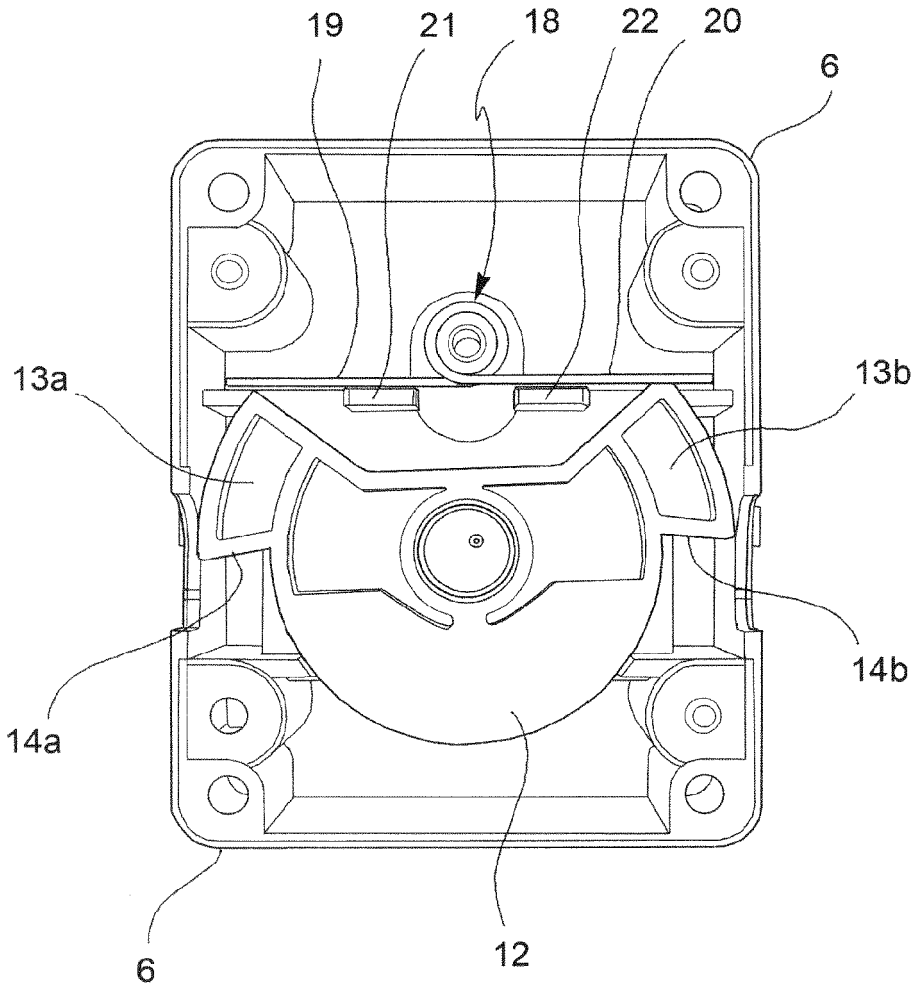

FIG. 7

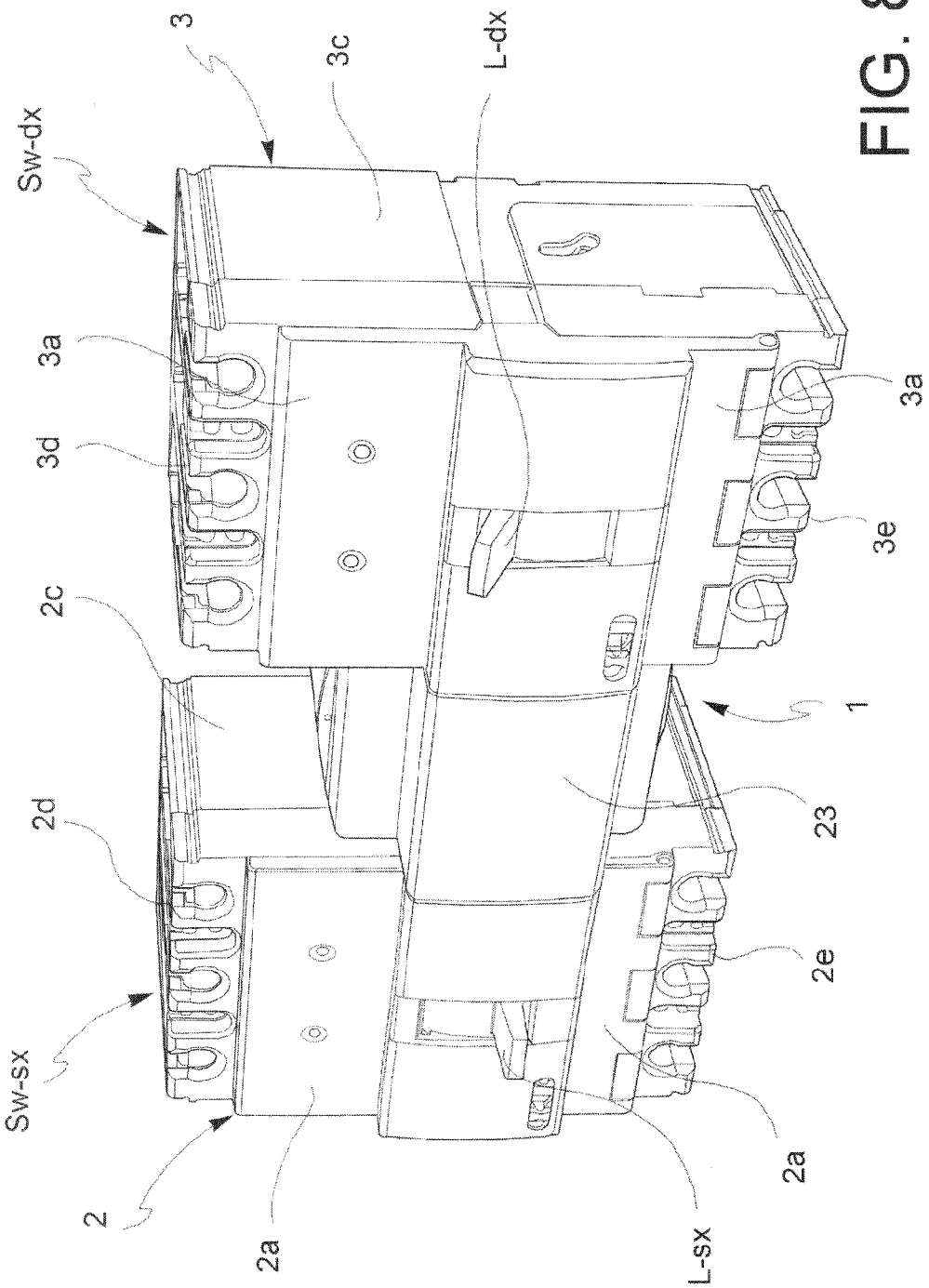

FIG. 8

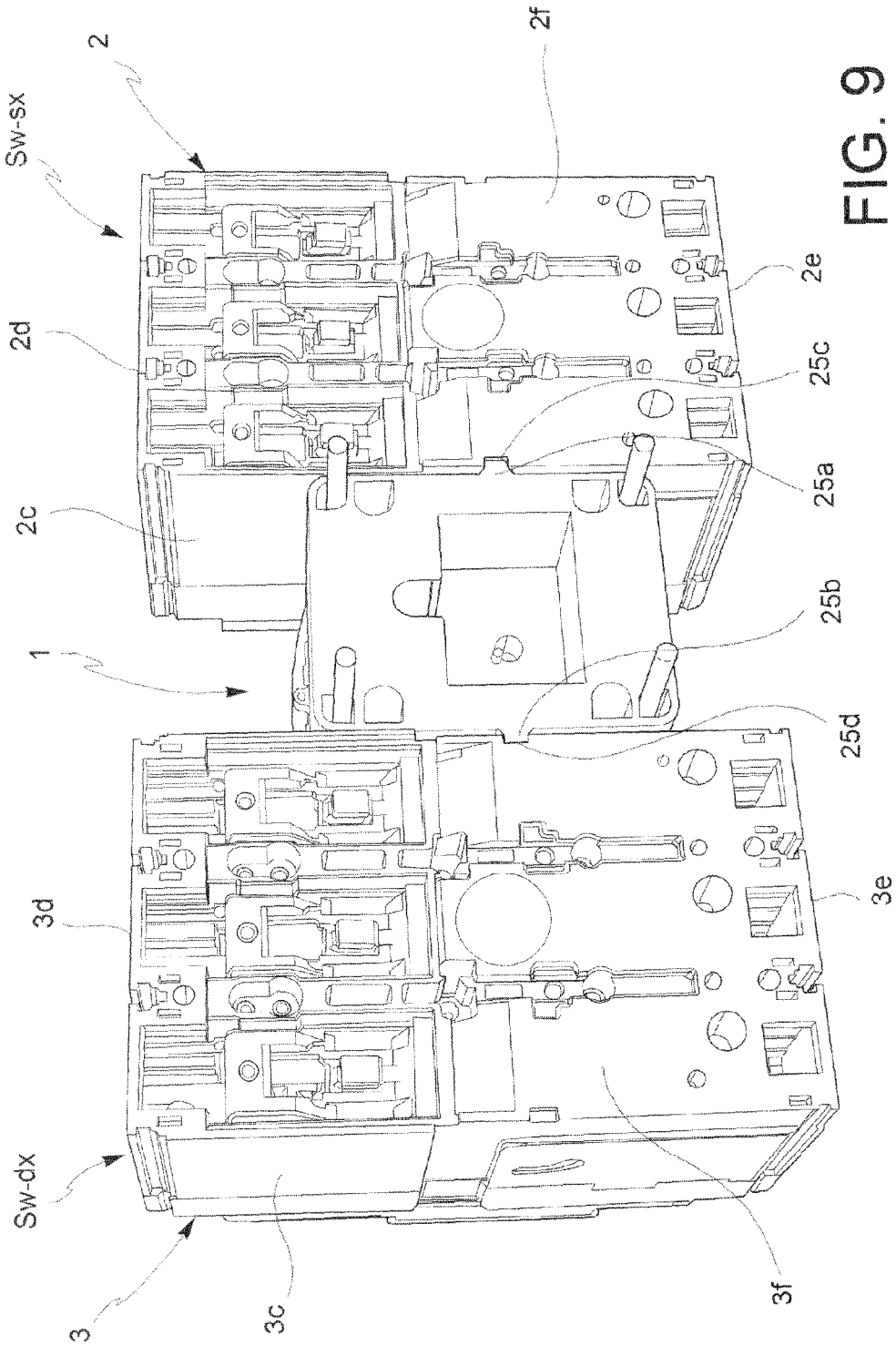

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	27 October 2010	Simonini, Stefano

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