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(54) **Interlocking device for interlocking at least a first and a second electrical circuit breaker**

(57) An interlocking device (2) is described for interlocking at least a first and a second electrical circuit breaker (3R, 3L), that is, for preventing such circuit breakers (3R, 3L) from simultaneously assuming a closed state, comprising:  
a first and a second actuating lever (10R, 10L) independently movable between a first and a second actuating lever operating position (A\_DOWN, A\_UP), the first and the second actuating lever (10R, 10L) being operatively connectable respectively to the first and to the second electrical circuit breaker (3R, 3L),  
characterised in that  
said device comprises a first and a second kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R; 22L, 24L, 26L, 28L, 30L, 32L) respectively actuatable through the first and the second actuating lever (10R, 10L) and each

suitable for assuming a first and a second operating configuration;  
each actuating lever (10R, 10L) being suitable for assuming:  
- a first operating state, wherein the actuating lever (10R) allows actuating the respective kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R) so that when such lever assumes the first or the second actuating lever operating position (A\_DOWN, A\_UP) the respective kinematic mechanism respectively assumes the first or the second operating configuration; and  
- a second operating state, in which the actuating lever (10R) is a substantially idle lever movable between the first and the second actuating lever operating position (A\_DOWN, A\_UP).

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## Description

**[0001]** The present invention concerns the technical field of electrical apparatuses and, more in particular, it concerns an interlocking device as defined in the preamble of the first claim.

**[0002]** In the technical field of electrical apparatuses it is known to use interlocking devices that can be associated with electric circuit breakers, for example for preventing an undesired simultaneous connection of a load to two electrical supply networks intended to operate in a mutually exclusive manner (like, for example, a primary power supply network and an auxiliary power supply network).

**[0003]** Interlocking devices are known comprising a pair of inhibiting levers suitable for being rigidly coupled with respective front manoeuvring levers of the electric circuit breakers to be interlocked. Each of such inhibiting levers is independently mobile between a first and a second operating position and is suitable for being alternatively and selectively locked, through a locking element that can slide between a first and a second locking position, in one of such operating positions. In such a way, the manoeuvring lever of the circuit breaker that is coupled with the locked inhibiting lever, is in turn locked in a desired operating position of the manoeuvring lever. Therefore, one of the circuit breakers associated with the interlocking device can be maintained for example in the open state, while the other circuit breaker can be manoeuvred freely between the respective open and closed states. An Interlocking device of the aforementioned type is described for example in the document EP1916682.

**[0004]** A general purpose of the present invention is that of providing an alternative solution of an interlocking device with respect to the solutions of the prior art described above.

**[0005]** This and other purposes are achieved through an interlocking device as defined in the attached claim 1 in a general embodiment and in the dependent claims in some particular embodiments.

**[0006]** A group of parts as defined in claim 12 also forms the object of the present invention.

**[0007]** Further characteristics and advantages of the invention shall become clearer from the following detailed description, given purely as an example and not for limiting purposes, with reference to the attached drawings, in which:

- figure 1 is an axonometric view in which the front side of a group of parts is visible including a first and a second electrical circuit breaker between which an interlocking device is interposed according to a currently preferred embodiment, the group of parts being represented in a first operating configuration;
- figure 2 is a perspective view of the group of parts of figure 1 represented in a second operating configuration;
- figure 3 is an axonometric view of the interlocking

device represented in a first operating configuration;

- figure 4 is an axonometric view of the interlocking device represented in a second operating configuration;

- figure 5 is an axonometric view of the interlocking device in which such a device is seen from a side substantially opposite with respect to that of figures 3 and 4;

- figure 6 is an axonometric view of some components of the interlocking device;

- figure 7 is a top side plan view of the interlocking device in which a side wall of such a device, which in particular is shown in figure 3, has been removed so as to make a first kinematic mechanism of the interlocking device, represented in a first operating configuration, more visible;

- figure 8 is a top side plan view of the interlocking device, in which the first kinematic mechanism is represented in a second operating configuration;

- figure 9 is a top side plan view of the interlocking device similar to that of figure 7, in which also the first kinematic mechanism and a support element represented for example in figure 6 have been removed, so as to show a second kinematic mechanism of the interlocking device represented in a first operating configuration;

- figure 10 is a top side plan view in which the second kinematic mechanism is represented in a second operating configuration;

- figure 11 is a top side plan view in which the second kinematic mechanism is represented in a third configuration and in which a member of the second kinematic mechanism has been removed and a member of the first kinematic mechanism has been represented;

- figure 12 is a top side plan view in which the second kinematic mechanism is represented in a fourth configuration and in which a member of the second kinematic mechanism has been removed and a member of the first kinematic mechanism has been represented;

- figure 13 is an axonometric view in which two members of the interlocking device can be seen;

- figure 14 is an axonometric view of a member of the interlocking device visible in figure 6 that is represented coupled with a member of one of the electric circuit breakers of figure 1; and

- figure 15 is an axonometric view of a further member of the interlocking device.

**[0008]** In the present description and in the attached figures, the terms "right", "left", "lower" and "upper", shall be used with the sole purpose of making the description clearer. Therefore, such words should not be taken to limit the invention in any way.

**[0009]** Figure 1 represents a group of parts, generally indicated with reference numeral 1. The group 1 comprises an interlocking device 2 according to a currently

preferred embodiment. Such a device is operatively interposed between a first electrical circuit breaker, or right circuit breaker 3R, and a second electrical circuit breaker, or left circuit breaker 3L, for interlocking such circuit breakers. The circuit breakers 3R, 3L respectively comprise a first manoeuvring lever, or right manoeuvring lever 5R, and a second manoeuvring lever, or left manoeuvring lever 5L. Each of such levers is independently mobile between a first manoeuvring lever operating position, or lower manoeuvring position M\_DOWN, and a second manoeuvring lever operating position, or upper manoeuvring position M\_UP. The lower and upper manoeuvring positions respectively correspond to an open state and to a closed state of the relative circuit breaker. In the example of figure 1, the circuit breakers 3R, 3L are two identical modular electrical circuit breakers, each of which is in particular made up of four unipolar circuit breakers stably coupled with one another.

**[0010]** It should be observed, that for the purposes of the present description, with the expression interlocking device, we mean, in general, a device that is suitable for preventing at least a first and a second electrical circuit breaker, between which such a device is operatively interposed, from simultaneously being in a closed state. A typical example of application of devices of this type is the one used during the installation of protection devices of the continuity groups. In these applications, the interlocking device is used for preventing a load from being simultaneously connected to two power supply networks.

**[0011]** More in particular, it is worth underlining that for the purposes of the present description, by interlocking device we mean a device in which the interlocking function does not necessarily have to be obtained through a mechanical locking of the manoeuvring levers of the circuit breakers to be interlocked.

**[0012]** In the example of figure 1, the interlocking device 2 is also a modular device.

**[0013]** With reference to figures 3-5, it can be observed that the interlocking device 2 comprises a first actuating lever, or right actuating lever 10R, and a second actuating lever, or left actuating lever 10L.

**[0014]** Each of such levers 10R, 10L is independently movable between a first actuating lever operating position, or lower actuating position A\_DOWN, and a second actuating lever operating position, or upper actuating position A\_UP. In figures 3 and 4, the right actuating lever 10R is represented in the lower actuation position A\_DOWN and in the upper actuating position A\_UP, respectively. In figure 5, where the interlocking device is seen from a side that is substantially opposite with respect to that visible in figures 3 and 4, the left actuating lever 10L is represented in the upper actuating position A\_UP.

**[0015]** The right and left actuating levers 10R, 10L, can be operatively coupled to the right circuit breaker 3R and to the left circuit breaker 3L, respectively.

**[0016]** For such a purpose, it can be seen that the actuating levers 10R, 10L preferably comprise respective

interconnection appendices 12R, 12L, which in the example respectively partially project from two opposite side walls 14R, 14L of a device body 15 of the interlocking device. The appendices 12R, 12L are mobile through respective movement openings 16R, 16L, in the example shaped like segments of a circular crown, provided on the side walls 14R, 14L.

**[0017]** The appendices 12R, 12L are suitable for being inserted into respective interconnection openings 18 (figure 2) that are provided laterally on at least one side of the right and left manoeuvring levers 5R, 5L for rigidly coupling each actuating lever 10R, 10L to the respective manoeuvring lever 5R, 5L. Once such levers are coupled so as to be fixedly attached to one another, when the manoeuvring lever of one of the circuit breakers 3R, 3L respectively assumes the lower M\_DOWN or upper M\_UP manoeuvring position, the actuating lever coupled with such a manoeuvring lever assumes the lower A\_DOWN or upper A\_UP actuation position, respectively.

**[0018]** In the example of figure 2, only one of the openings can be seen 18 provided on a side of the right manoeuvring lever. An analogous opening is however provided also on the opposite side of such a manoeuvring lever so as to receive the interconnection appendix 12R.

**[0019]** With reference to figures 7 and 9, it can be seen that the interlocking device comprises a first kinematic mechanism or right kinematic mechanism 22R, 24R, 26R, 28R, 30R, 32R (figure 7) and a second kinematic mechanism or left kinematic mechanism 22L, 24L, 26L, 28L, 30L, 32L (figure 9). The right kinematic mechanism and the left kinematic mechanism are independently actuable through the right actuating lever 10R and the left actuating lever 10L, respectively. In particular, each of such kinematic mechanisms is suitable for assuming a first operating configuration and a second operating configuration. In the case of the right kinematic mechanism, the first (figure 7) and the second (figure 8) operating configuration can be respectively associated to the open state and to the closed state of the right circuit breaker 3R. Analogously, in the case of the left kinematic mechanism, the first (figure 9) and the second (figure 10) operating configuration can be respectively associated to the open state and to the closed state of the left circuit breaker 3L.

**[0020]** It is worth observing that each actuating lever 10R, 10L is suitable for assuming a first operating state, or actuation state, and a second operating state, or idle state. More in particular, as shall be made clearer in the rest of the description, in the actuation state, each actuating lever allows the actuation of the respective kinematic mechanism so that when such a lever respectively assumes the lower actuating position A\_DOWN or the upper actuating position A\_UP such a kinematic mechanism respectively assumes the first or the second operating configuration. In the idle state, on the other hand, each actuating lever is a substantially idle lever movable between the lower and upper actuation positions. Again more in particular, it is worth observing that each actuat-

ing lever 10R, 10L is suitable for assuming the idle state when the other of such actuating levers simultaneously assumes the actuation state and the upper actuating position A\_UP.

**[0021]** Figure 7 represents a plan view in which the side wall 14R (figure 3) of the device body 15 has been removed to show the right kinematic mechanism 22R, 24R, 26R, 28R, 30R, 32R. In figure 9, on the other hand, together with the wall 14R, also the right kinematic mechanism and a support element 40 have been removed to show the left kinematic mechanism 22L, 24L, 26L, 28L, 30L, 32L. The preferably plate-shaped support element 40, is interposed between the right kinematic mechanism and the left kinematic mechanism and it is provided to support at least one of such kinematic mechanisms. In the example, the support element or support plate 40, visible in greater detail in figure 6, is suitable for supporting the right kinematic mechanism.

**[0022]** It should be observed that the left kinematic mechanism has a substantially identical operation to that of the right kinematic mechanism. In the example, the left kinematic mechanism is also structurally substantially the same as or in any case structurally very similar to the right kinematic mechanism. In other words, in the example, the shape of one or more members of the left kinematic mechanism can also differ to a certain extent from that of corresponding members of the right kinematic mechanism (for example the members 32R and 32L represented in figure 13 can be seen). In such a case, the operation of such members of the left kinematic mechanism remains, in any case, substantially identical to that of corresponding members of the right kinematic mechanism right. Again in other words, unless specified otherwise, what shall be described hereafter in relation to the right kinematic mechanism, applies, *mutatis mutandis*, also for the left kinematic mechanism. Therefore, in the present description, a detailed description of the left kinematic mechanism has been omitted.

**[0023]** Again with reference to the figure 7, according to a currently preferred embodiment, the right kinematic mechanism comprises a first movement lever or right movement lever 22R, a first release member or right release lever 24R, a first transmission member or right transmission lever 26R, a first coupling lever or right coupling lever 28R, a first slider or right slider 30R and a first selection member or right selection lever 32R.

**[0024]** With reference to figure 9, according to such an embodiment, the left kinematic mechanism (figure 9) correspondingly comprises a second movement lever or left movement lever 22L, a second release member or left release lever 24L, a second transmission member or left transmission lever 26L, a second coupling lever or left coupling lever 28L, a second slider or left slider 30L and a second selection member or left selection lever 32L.

**[0025]** Returning to figure 7, it can be observed that the right movement lever 22R is hinged at a respective intermediate portion of movement lever 42R to rotate around a first device pin 43 fixedly attached to the device

body 15.

**[0026]** The movement lever 22R comprises a first end portion of movement lever to which the right release lever 24R is preferably hinged so as to rotate around an axis parallel to the first device pin 43. As shall be made clearer in the rest of the description, such a release lever is in particular actuatable to make the respective actuating lever, that is to say the right actuating lever 10R, assume the aforementioned idle state. The right movement lever 22R also comprises a second end portion of movement lever suitable for being coupled, preferably in resting relationship, with the right coupling lever 28R. As can be observed in figure 7, the first end portion of movement lever comprises an engagement portion 44R, preferably hook-shaped. In particular, the right release lever 24R is coupled with a release lever spring, which is not represented in the figures, which is suitable for actuating the right release lever towards the engagement portion 44R of the right movement lever 22R. Advantageously, the release lever 24R and the movement lever 22R are suitable for defining a movement space or movement slot 46R between them.

**[0027]** The right transmission lever 26R is hinged to the device body 15 preferably so as to be able to rotate, independently from the movement of the right lever 22R, around the first device pin 43. It is worth observing that the right transmission lever is suitable for engaging the left selection lever 32L. More in particular, the transmission lever 26R comprises a release portion or release tooth 47R and a portion of mechanical interference or interference tongue 49R. The release tooth 47R is suitable for engaging a thrust portion 51R, preferably flat, of the right release lever 24R. The interference tongue 49R, on the other hand, is suitable for engaging an inhibiting portion 53L, in the example a free end portion, of the left selection lever 32L. With reference to figure 9 it can be seen that the left transmission lever 26L analogously comprises a release portion or release tooth 47L and a portion of mechanical interference or interference tongue 49L that are suitable for respectively engaging with a thrust portion 51L of the left release lever 24L and an inhibiting portion 53R of the right selection lever 32R (such a lever is not illustrated in figure 9). Concerning this, it is worth observing that the support plate 40 comprises at least a support element through opening 55 (figure 7), which is suitable to be operatively concurrently crossed by the left selection lever 32L and by the right selection lever 32R.

**[0028]** In figure 14, in which the right transmission lever 26R is represented in greater detail, it can be observed that such a lever preferably comprises a housing seat 56, for example defined between a pair of walls of such a transmission lever, which is suitable for receiving the intermediate portion of the movement lever 42R (figure 7).

**[0029]** The coupling lever 28R comprises a first end portion of coupling lever suitable, in the example, for resting on the second end portion of movement lever, and a

second end portion of coupling lever hinged to a second device pin 58, fixedly attached to the device body 15. Moreover, the right coupling lever 28R comprises an intermediate portion of coupling lever, constrained in an articulated manner to the right slider 30R. Preferably, the intermediate portion of coupling lever is provided with a elongated coupling lever slot 62R that is suitable for receiving a first slider pin 64R that is fixedly attached to the right slider 30R.

**[0030]** The right selection lever 32R is also constrained in an articulated manner to the slider 30R. Preferably, the right selection lever comprises a first end portion of selection lever that is equipped with an elongated selection lever slot 66R. Such a slot is in particular suitable for receiving a second slider pin 68R fixedly attached to the right slider 30R. In the example, the right selection lever 32R comprises, in addition to the inhibiting portion 53R, a respective intermediate portion of selection lever hinged to rotate around a third device pin 72 fixedly attached to the device body 15.

**[0031]** A contrast spring 74R or an equivalent elastic element is provided, preferably fitted onto an end portion of the slider 30R, so as to oppose such a slider in a sliding direction. An analogous contrast spring 74L is provided, preferably fitted onto an end portion of the slider 30L, so as to oppose such a slider in a sliding direction.

**[0032]** It is worth observing that the first pin 43, the second pin 58, the third pin 72, the first slider pin 64R and the second slider pin 68R have pin axes that are parallel to one another.

**[0033]** Going back to the right transmission lever 26R, in figure 14, it can be observed that such a lever comprises at least a first coupling element or right coupling recess 82R, preferably a coupling hole, which is suitable for cooperating with at least one first interconnecting element or right interconnection pin 84R for coupling such a pin to the right kinematic mechanism.

**[0034]** At least a second coupling element or left coupling recess 82L (figure 5) is provided on the left transmission lever 26L. The recess 82L is in the example a slotted hole. However, according to a further embodiment, such a recess could be a hole which is the same as the hole 82R. The coupling recess 82L is suitable for cooperating with a second interconnecting element or left interconnection pin (not represented in the figures) for coupling such a pin to the left kinematic mechanism. The right pin 84R is suitable for being operatively interposed between the right kinematic mechanism and a mechanism for releasing or for opening the right circuit breaker. In figure 14, the pin 84R, in particular, has a first end portion that is coupled with the right transmission lever 26R and a second end portion that is coupled with a circuit breaker member 86 that is part of the releasing mechanism of the right circuit breaker. Analogously, the left pin is suitable for operatively being interposed between the left kinematic mechanism and a release or opening mechanism of the left circuit breaker. In that regard it should be noted that in order to allow the coupling

of the interlocking device 2 with the right and left circuit breakers through the right and left interconnection pins, both the side walls 14L, 14R of the device body 15 and at least the walls of the circuit breakers intended to operatively be facing such walls 14L, 14R, are equipped with suitable interconnection through openings or interconnection slots 88, 92 (figures 2, 3 and 5).

**[0035]** In the example, the release mechanisms (not represented) of the right and left circuit breakers are quick release mechanisms. Such mechanisms are suitable for making the manoeuvring lever of the respective circuit breaker snap towards the lower manoeuvring position M\_DOWN, so as to obtain the quick opening of the circuit breaker. This occurs in particular, when a predetermined intermediate position of the manoeuvring lever is past, when such a lever is actuated, for example manually, from the upper manoeuvring position M\_UP towards the lower manoeuvring position M\_DOWN. This type of quick release mechanism is widely known to a man skilled in the art and therefore shall not be described in further detail.

**[0036]** According to an embodiment, the right kinematic mechanism is connected to the actuating lever 10R through a first connection member or right connection strip 94R. Such a strip is represented in greater detail in figure 15.

**[0037]** With cross reference to figures 7 and 15, the strip comprises, in particular, a first portion of strip or first arm 95 that is suitable for being hinged to the right actuating lever 10R and a second strip portion or second arm 96 that is suitable for being operatively interposed between the right release lever 24R and the engagement portion 44R. When the right actuating lever assumes the actuation state, the second arm 96 of the strip is in particular clamped between the right release lever and the engagement portion 44R. A projection of the release lever 24R in particular avoids that the strip 94R snaps into the movement slot 46R when the right actuating lever assumes the actuation state.

**[0038]** A second connection member or left connection strip 94L, having the same operation and preferably the same shape of the right strip 94R, is provided between the left actuating lever 10L and the left release lever 24L to connect the actuating lever 10L to the left kinematic mechanism.

**[0039]** It is worth emphasising that when the right kinematic mechanism respectively assumes the first (figure 7) and the second (figure 8) operating configuration, the right transmission lever 26R is suitable for respectively assuming a first (figure 7) and a second (figure 8) transmission member operating position, while the right selection lever is suitable for assuming respectively a stand-by operating position (figure 7) and an inhibition operating position (figure 8, 11, 12). Analogously, when the left kinematic mechanism respectively assumes the first and the second operating configuration, the left transmission lever is suitable for assuming respectively a first (figure 9) and a second (figure 10) transmission member oper-

ating position, while the left selection lever is suitable for assuming respectively a stand-by operating position (figure 9) and an inhibition operating position (figure 10).

**[0040]** It should also be observed that each of the right 84R and left pins, when coupled with the respective transmission lever 26R, 26L, is suitable for assuming a first interconnection position, or lower interconnection position I\_DOWN, and a second interconnection position, or upper interconnection position I\_UP (figures 3-5). In particular, each interconnection pin is suitable for assuming respectively the lower or upper interconnection position when the transmission lever to which such a pin is coupled respectively assumes the first transmission member operating position (figures 7 and 9) or the second transmission member operating position (figures 8 and 10). Such lower and upper interconnection positions can be operatively associated respectively with the open state and with the closed state of the circuit breaker 3L, 3R to which each interconnection pin is coupled.

**[0041]** With reference to figure 11, it can be observed that the right selection lever 32R, when it assumes the inhibition position, is suitable for being engaged by the left transmission lever 26L for preventing that such a transmission lever assumes the second transmission member operating position. It should be observed that in figure 11, even though the left kinematic mechanism is shown, with the purpose of representing a configuration engagement between the right selection lever 32R and the left transmission lever 26L, neither the left selection lever 32L nor the support plate 40 have been represented. In such a figure, on the other hand, the right selection lever 32R has been represented in the inhibition position.

**[0042]** Analogously, the left selection lever 32L, when it assumes the inhibition position, is suitable for being engaged with the right transmission lever 26R for preventing that such a transmission lever assumes the second transmission member operating position.

**[0043]** More in particular, the interference tongue 49R, 49L of each of the transmission levers 26R, 26L is suitable for engaging the selection lever of the other kinematic mechanism when such a selection lever assumes the inhibition position. It should also be observed that, as shall be made clearer from the rest of the description, the release tooth 47R, 47L of each of the transmission levers 26R, 26L is suitable for engaging the release lever 24R, 24L of the respective kinematic mechanism for actuating such a release lever and making the respective actuating lever 10R, 10L assume the idle state.

**[0044]** Again more in particular, following an actuation of the right actuating lever 10R from the lower actuating position A\_DOWN towards the upper actuating position A\_UP and while the left kinematic mechanism assumes the second operating configuration, the release tooth 47R and the interference tongue 49R are suitable for simultaneously engaging respectively the release lever 24R and the left selection lever 32L. Analogously, with reference for example to figure 11, following an actuation of the left actuating lever 10L from the lower actuating

position A\_DOWN towards the upper actuating position A\_UP and while the right kinematic mechanism assumes the second operating configuration, the release tooth 47L and the interference tongue 49L of the left transmission lever 26L are suitable for simultaneously engaging respectively the left release lever 24L and the right selection lever 32R.

**[0045]** It should be observed that each of the selection levers, right and left, is removably lockable in the inhibition position when the respective actuating lever, that is to say the actuating lever associated with the same kinematic mechanism of the selection lever, simultaneously assumes the upper actuating position A\_UP and the actuation state. Moreover, it should be observed that each selection lever can be released to switch from the inhibition position to the stand-by position, when the respective actuating lever assumes the actuation state and is actuated to switch from the upper actuating position A\_UP to the lower actuating position A\_DOWN.

**[0046]** It is worth observing that the interlocking device 2 can comprise elements for communicating/detecting the electrical state of the group 1, and more in particular of the circuit breakers 3R, 3L. In the example such elements, for each of the kinematic mechanisms right and left, comprise an electrical contact plate 101 that is mobile between two electrical contacts 103, 105 that can be respectively associated with the open and closed state of a respective electrical circuit breaker 3L, 3R. For such a purpose, one or more electrical terminals 107, in the example three terminals for each kinematic mechanism, are provided in the interlocking device. The control of the electrical contact plates 101 is associated with the translation of the sliders 30R, 30L. The electrical state of the group 1 can thus be detected through the commutation of the plates between the respective pairs of electrical contacts 103, 105.

**[0047]** Now that the structure of the interlocking device 2 has been described, we shall now describe its operation.

**[0048]** Let us assume that the group of parts 1 is initially in the configuration illustrated in figure 1. In figure 1 both the manoeuvring levers 5L, 5R, are represented in the lower manoeuvring position M\_DOWN. Therefore both the circuit breakers 3R, 3L are in an open state. In such a configuration, the right and left actuating levers 10R and 10L assume the lower actuating position A\_DOWN (figure 3). Moreover, in such a configuration, both the actuating levers assume the actuation state. More in particular both the right kinematic mechanism and the left kinematic mechanism assume the first operating configuration (figures 7 and 9).

**[0049]** From the configuration of figure 1, assuming for example that the right manoeuvring lever 5R is actuated from the lower manoeuvring position M\_DOWN to the upper manoeuvring position M\_UP, the right circuit breaker will assume a closed state while the left circuit breaker will remain in the respective open state (figure 2). Passing from the position M\_DOWN to the position

M\_UP, the right manoeuvring lever carries along the right actuating lever 10R, rigidly connected to it. Therefore, the right actuating lever switches from the position A\_DOWN to the position A\_UP (figures 3 and 4). Since, during such switching, the right actuating lever is still in the actuation state, in the configuration of figure 2, the right kinematic mechanism assumes the second operating configuration (figure 8). More in particular, following such an actuation of the actuating lever 10R, the right transmission lever 26R switches from the first position of transmission member (figure 7) to the second position of transmission member (figure 8) and the right interconnection pin 84R consequently switches from the lower interconnection position I\_DOWN (figure 3) to the upper interconnection position I\_UP (figure 4).

**[0050]** In other words, once the position A\_UP has been reached by the right actuating lever, the interlocking device 2 assumes, in general, the configuration illustrated in figure 4. It is worth observing that in such a configuration, the right actuating lever again assumes the actuation state.

**[0051]** The left kinematic mechanism, on the other hand, remains in the first operating configuration (figure 9).

**[0052]** It is worth observing that during the switching of the actuating lever 10R from the position A\_DOWN to the position A\_UP, while such a lever assumes the actuation state, the right strip 94R exerts a thrusting action on the engagement portion 44R of the right movement lever 22R. Such a movement lever consequently cooperates with the right coupling lever so as to determine a sliding of the right slider 30R in contrast with the spring 74R so as to load such a spring. Such a sliding of the slider 30R allows the right selection lever to assume the inhibition position (figures 8, 11, 12) once that the right kinematic mechanism has taken up the second operating configuration.

**[0053]** It should also be noted that, during the switching of the right kinematic mechanism from the first to the second operating configuration, the switching of the right transmission lever from the first (figure 7) to the second (figure 8) transmission position member is determined by the thrusting action of the thrust portion 51R against the release tooth 47R.

**[0054]** Once the second operating configuration has been assumed, the right kinematic mechanism is removably locked in such a configuration thanks to the action of the spring 74R and of the right strip 94R. From this condition, by actuating the actuating lever 10R towards the lower actuating position, such an actuating lever and the right kinematic mechanism are suitable for snapping, thanks to the action of the spring 74R, respectively in the lower actuating position A\_DOWN and in the first operating configuration. In other words, both the right actuating lever 10R and the right kinematic mechanism assume the configuration illustrated in figure 7 again.

**[0055]** Let us now hypothesise, from the first configuration of figure 2, to actuate the left manoeuvring lever 5L

in a way such as to make such a lever switch from the position M\_DOWN to the position M\_UP. This could occur due to an unintentional actuation of the left manoeuvring lever, for example a manual actuation or an actuation through a motorised device associable to the left circuit breaker. Switching from the lower manoeuvring position to the upper manoeuvring position, the left manoeuvring lever 5L sets the left actuating lever 10L in rotation. In this case, however, the right selection lever 32R is in the inhibition position and therefore prevents the left transmission lever 26L from assuming the second transmission position member (figure 10). It is worth observing that in the configuration of figure 2, between the selection lever 32R and the interference tongue 49L there is preferably a small space for the recovery of the clearances (not represented). Before the left transmission lever can assume the second transmission member position, the interference tongue 49L is suitable for abutting against the inhibiting portion 53R of the right selection lever 32R (figure 12) so as to lock the rotation of the left transmission lever. Once this abutment condition has been reached, continuing to actuate the left actuating lever towards the upper actuating position, the release tooth 47L, cooperating with the thrust portion 51L, causes a displacement or backward movement of the release lever 24L against the action of the aforementioned release lever spring (not represented). This determines the snapping of the left strip 94L inside the movement slot 46L. From this moment, the actuating lever 10L assumes the idle state. It is worth observing that in figure 11 we have tried to represent a condition that is immediately before the snapping of the strip 94L into the movement slot 46L, in particular emphasizing the displacement of the release lever 24L due to the release tooth 47L. In figure 12, on the other hand, we have tried to represent a condition in which the strip 94L has snapped into the movement slot 46L. In other words, once such an idle state has been assumed, the left actuating lever is mobile between the lower actuating position A\_DOWN and the upper actuating position A\_UP without substantially actuating the left kinematic mechanism and substantially determining only one movement of the left strip 94L along the movement slot 46L. Again in other words, the left actuating lever is substantially uncoupled or released by the left kinematic mechanism. In that regard, it is worth underlining that in the example, when the left actuating lever assumes the idle state, it is suitable for assuming the upper actuating position A\_UP and a plurality of intermediate positions between such an actuation position and the lower actuating position A\_DOWN. In particular, it is worth observing that when the left actuating lever 10L assumes the upper actuating position in the idle state, the left kinematic mechanism does not assume the second operating configuration. On the other hand, when the left actuating lever is taken back into the first actuation position from the idle state, the left strip, cooperating with the release lever 24L, is automatically locked between such a release lever and the engagement portion 44L so

that the actuating lever 10L assumes the actuation state again.

[0056] It is worth emphasising that when the interference tongue 49L abuts against the inhibiting portion 53R, also the left interconnection pin is consequently prevented from assuming the upper interconnection position I<sub>UP</sub>. This ensures that such a pin mechanically interferes with the release mechanism of the left circuit breaker preventing such a circuit breaker from assuming the closed state. More in particular, the left interconnection pin, mechanically interfering with the release mechanism of the left circuit breaker, substantially determines an uncoupling of the left manoeuvring lever 5L by the release mechanism of the left circuit breaker. In other words, the left manoeuvring lever is able to assume the upper manoeuvring position but the left circuit breaker does not assume the consequent closed state.

[0057] In summary, when from the configuration of figure 2 the left manoeuvring lever is actuated towards the upper manoeuvring position, the left actuating lever assumes the actuation state until there is the mechanical interference between the left transmission lever and the right selection lever. Subsequently, continuing the actuation of the left manoeuvring lever towards the upper manoeuvring position, such a manoeuvring lever is substantially uncoupled or released by the release mechanism of the left circuit breaker preventing the latter from assuming the closed state, while the left actuating lever assumes the idle state. In such a way the interlocking device 2 makes it possible to interlock the right and left circuit breakers.

[0058] In particular, it should be observed that the interlocking device 2 makes it possible to interlock the circuit breakers 3R, 3L without mechanically locking the manoeuvring levers 5R, 5L, but by achieving a particular kinematic condition of operation of the interlocking device itself.

[0059] It should also be observed that, since the actuation levers 10R, 10L, do not undergo substantial stress even when the manoeuvring lever of the circuit breaker to be interlocked is actuated towards the upper manoeuvring position, such levers can advantageously be made with materials having a modulus of elasticity and/or a yield point that is lower with respect to that of the materials with which inhibiting levers of the interlocking devices of the prior art are normally made.

[0060] Based upon what has been discussed above, it is clear that if initially the configuration of the group of parts 1 were inverted with respect to that of figure 2, that is to say, if the right and left manoeuvring levers initially assumed the lower manoeuvring position and the upper manoeuvring position, respectively, the operation of the group 1 would also be inverted with respect to that described above. More in particular, in such a case, following an actuation of the right manoeuvring lever from the lower manoeuvring position to the upper manoeuvring position, the right actuating lever would assume the idle state while the right manoeuvring lever would be uncou-

pled from the release mechanism of the right circuit breaker.

[0061] As far as the elements for detecting/communicating the electrical state of the group 1 are concerned, it can also be observed that, for the purposes of correct operation of the interlocking device, it is necessary that the release of the right and left strips occurs before the possible commutation of the respective electrical contact plates 101 so as to not cause a variation in the electrical state at the terminals 107 of the interlocking device.

[0062] Based upon what has been described above, it is thus possible to understand how an interlocking device according to the present description is such as to be able to achieve the aforementioned purposes.

[0063] Without affecting the principle of the invention, the embodiments and the manufacture details may be widely varied with respect to what has been described and illustrated purely as a non limiting example, without for this reason departing from the scope of the invention as defined in the attached claims.

## Claims

1. Interlocking device (2) for interlocking at least a first and a second electrical circuit breaker (3R, 3L), that is, for preventing such circuit breakers (3R, 3L) from simultaneously assuming a closed state, comprising:

a first and a second actuating lever (10R, 10L) independently movable between a first and a second actuating lever operating position (A<sub>DOWN</sub>, A<sub>UP</sub>), the first and the second actuating lever (10R, 10L) being operatively connectable respectively to the first and to the second electrical circuit breaker (3R, 3L),

### characterised in that

said device comprises a first and a second kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R; 22L, 24L, 26L, 28L, 30L, 32L) respectively actuatable through the first and second actuating lever (10R, 10L) and each suitable for assuming a first and a second operating configuration; each actuating lever (10R, 10L) being suitable for assuming:

- a first operating state, wherein the actuating lever (10R) allows actuating the respective kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R) so that when such lever assumes the first or the second actuating lever operating position (A<sub>DOWN</sub>, A<sub>UP</sub>) the respective kinematic mechanism respectively assumes the first or the second operating configuration; and
- a second operating state, wherein the actuating lever (10R) is a substantially idle le-

ver movable between the first and the second actuating lever operating position (A\_DOWN, A\_UP).

2. Interlocking device (2) according to claim 1, wherein each actuating lever (10L) is suitable for assuming the second operating state when the other actuating lever (10R) simultaneously assumes the first operating state and the second actuating lever operating position (A\_UP). 5
3. Interlocking device (2) according to claims 1 or 2, wherein the first kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R) comprises a first transmission member (26R) and a first selection member (32R) and wherein the second kinematic mechanism (22L, 24L, 26L, 28L, 30L, 32L) comprises a second transmission member (26L) and a second selection member (32L), the first transmission member (26R) being suitable for engaging the second selection member (32L) and the second transmission member (26L) being suitable for engaging the first selection member (32R). 10
4. Interlocking device (2) according to claim 3, wherein: 25
  - when the first kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R) respectively assumes said first and second operating configuration, the first transmission member (26R) is suitable for respectively assuming a first and a second transmission member operating position and the first selection member (32R) is suitable for respectively assuming a stand-by operating position and an inhibition operating position; and 30
  - when the second kinematic mechanism (22L, 24L, 26L, 28L, 30L, 32L) assumes said first and second operating configuration, the second transmission member (26L) is suitable for respectively assuming a first and a second transmission member operating position and the second selection member (32L) is suitable for respectively assuming a stand-by operating position and an inhibition operating position; 35
5. Interlocking device (2) according to claim 4, wherein 40
  - the first selection member (32R), when it assumes said inhibition position, being suitable for being engaged by the second transmission member (26L) for preventing such transmission member (26L) from assuming said second transmission member operating position, and 45
  - the second selection member (32L), when it assumes said inhibition position, being suitable for being engaged by the first transmission member (26R) for preventing such transmission member (26R) from assuming said second transmission member operating position. 50

each of said selection members (32R) is removably lockable in said inhibition position when the respective actuating lever (10R) simultaneously assumes the second actuating lever operating position (A\_UP) and the first operating state, and is releasable to switch from said inhibition position to said stand-by position, when the respective actuating lever (10R) assumes the first operating state and is actuated to switch from the second actuating lever operating position to the first actuating lever operating position.

6. Interlocking device (2) according to claim 4 or 5, wherein: 15
  - each of said kinematic mechanisms (22R, 24R, 26R, 28R, 30R, 32R) comprises a release member (24R) actuatable to make the respective actuating lever (10R) assume said second operating state; and
  - said transmission members (26R, 26L) comprise each a mechanical interference portion (49R, 49L) and a release portion (47R, 47L), the mechanical interference portion (49L) of each of said transmission members (26L) being suitable for engaging the selection member (32R) of the other of said kinematic mechanisms (22R, 24R, 26R, 28R, 30R, 32R) when such member (32R) assumes said inhibition position, and the release portion (47L) of each of said transmission members (26L) being suitable for engaging the release member (24L) of the respective kinematic mechanism (22L, 24L, 26L, 28L, 30L, 32L) for actuating such release member (24L) and make the respective actuating lever (10L) assume said second operating state. 20
7. Interlocking device (2) according to claim 6, wherein: 25
  - following an actuation of the first actuating lever (10R) from the first actuating lever operating position towards the second actuating lever operating position, and while the second kinematic mechanism (22L, 24L, 26L, 28L, 30L, 32L) assumes the second operating configuration, the release portion (47R) and the mechanical interference portion (49R) of the first transmission member (26R) are suitable for simultaneously engaging respectively the release member (24R) of the first kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R) and the selection member (32L) of the second kinematic mechanism (22L, 24L, 26L, 28L, 30L, 32L); and 30
  - following an actuation of the second actuating lever (10L) from the first actuating lever operating position towards the second actuating lever operating position, and while the first kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R) 35

assumes the second operating configuration, the release portion (47L) and the mechanical interference portion (49L) of the second transmission member (26L) are suitable for simultaneously engaging respectively the release member (24L) of the second kinematic mechanism (22L, 24L, 26L, 28L, 30L, 32L) and the selection member (32R) of the first kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R).

8. Interlocking device (2) according to any one of claims 3 to 7, wherein the first and the second transmission members (26R, 26L) respectively comprise at least a first and at least a second coupling element (82R, 82L) suitable for respectively cooperating with at least a first and at least a second interconnecting element (84R) for coupling said interconnecting elements (84R) to said kinematic mechanisms (22R, 24R, 26R, 28R, 30R, 32R; 22L, 24L, 26L, 28L, 30L, 32L), the first interconnecting element (84R) being suitable for being operatively interposed between the first kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R) and a mechanism for releasing or opening said first circuit breaker (3R) and the second interconnecting element being suitable for being operatively interposed between said second kinematic mechanism (22L, 24L, 26L, 28L, 30L, 32L) and a mechanism for releasing or opening said second circuit breaker (3L).
9. Interlocking device (2) according to any one of claims 3 to 8, comprising at least one support element (40) for at least one of said kinematic mechanisms (22R, 24R, 26R, 28R, 30R, 32R; 22L, 24L, 26L, 28L, 30L, 32L), the support element (40) being interposed between the first (22R, 24R, 26R, 28R, 30R, 32R) and the second kinematic mechanism (22L, 24L, 26L, 28L, 30L, 32L) and including at least one support element through opening (55) suitable for being operatively concurrently crossed by the first and by the second selection member (32R, 32L).
10. Interlocking device (2) according to any one of the previous claims, wherein the first and the second kinematic mechanism (22R, 24R, 26R, 28R, 30R, 32R; 22L, 24L, 26L, 28L, 30L, 32L) have a substantially identical operation.
11. Interlocking device (2) according to any one of the previous claims, comprising elements for detecting the electrical state (101, 103, 105, 107) of said circuit breakers.
12. Group of parts (1) comprising a first electrical circuit breaker (3R), a second electrical circuit breaker (3L) and an interlocking device (2) as defined in any one of the previous claims for interlocking such circuit breakers (3R, 3L).

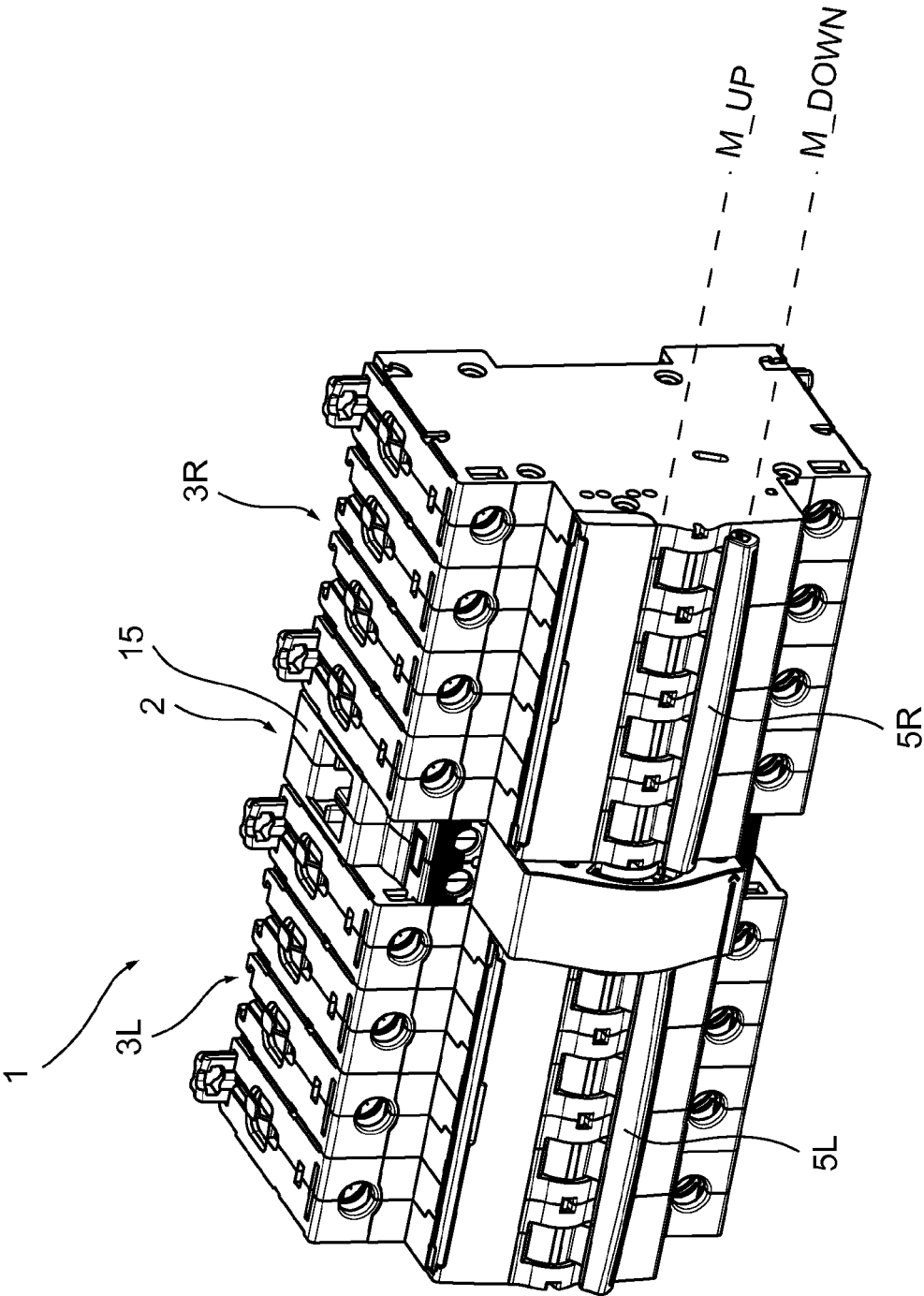


FIG. 1

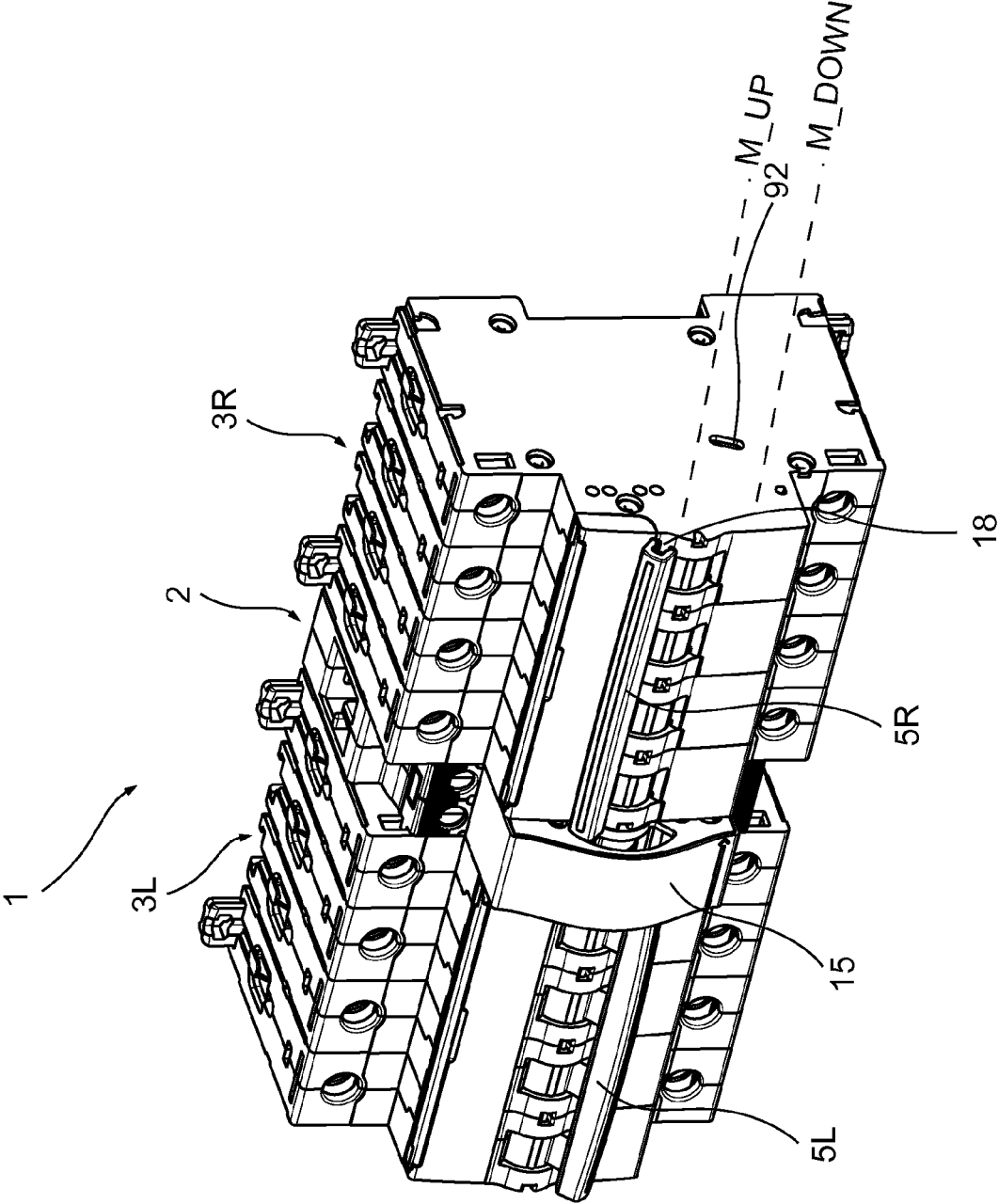


FIG. 2

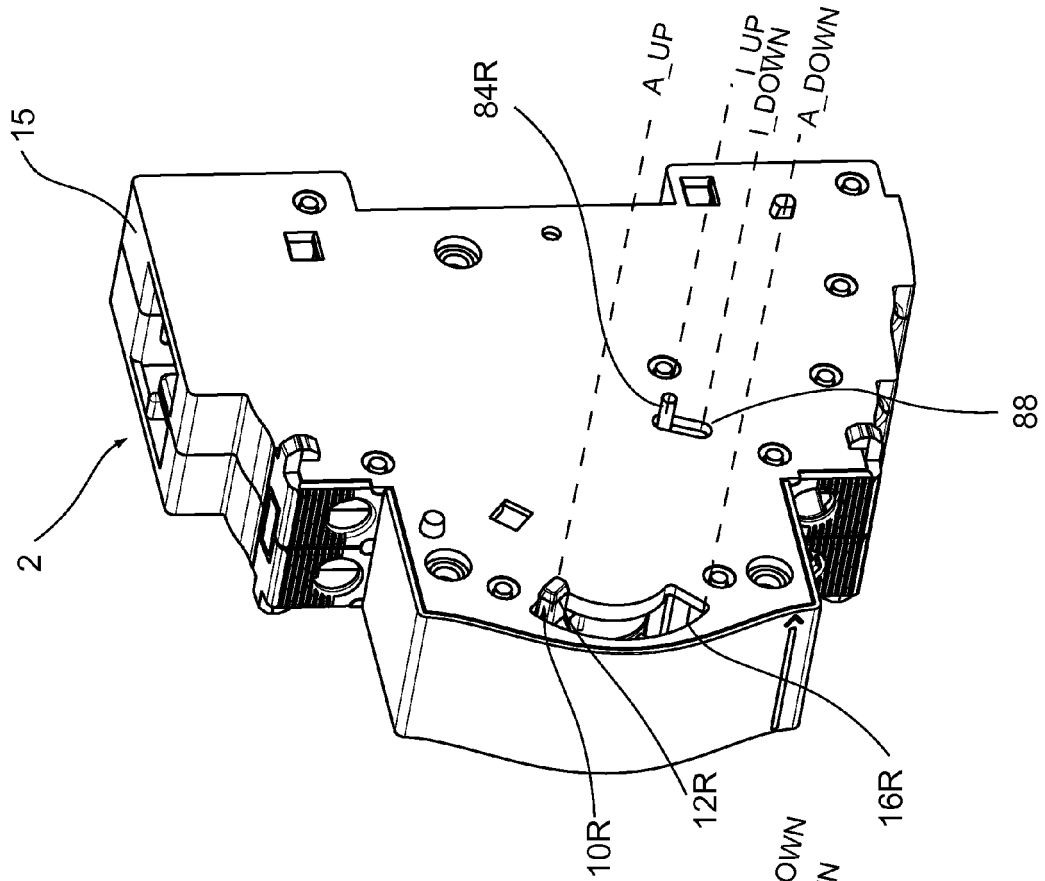


FIG. 4

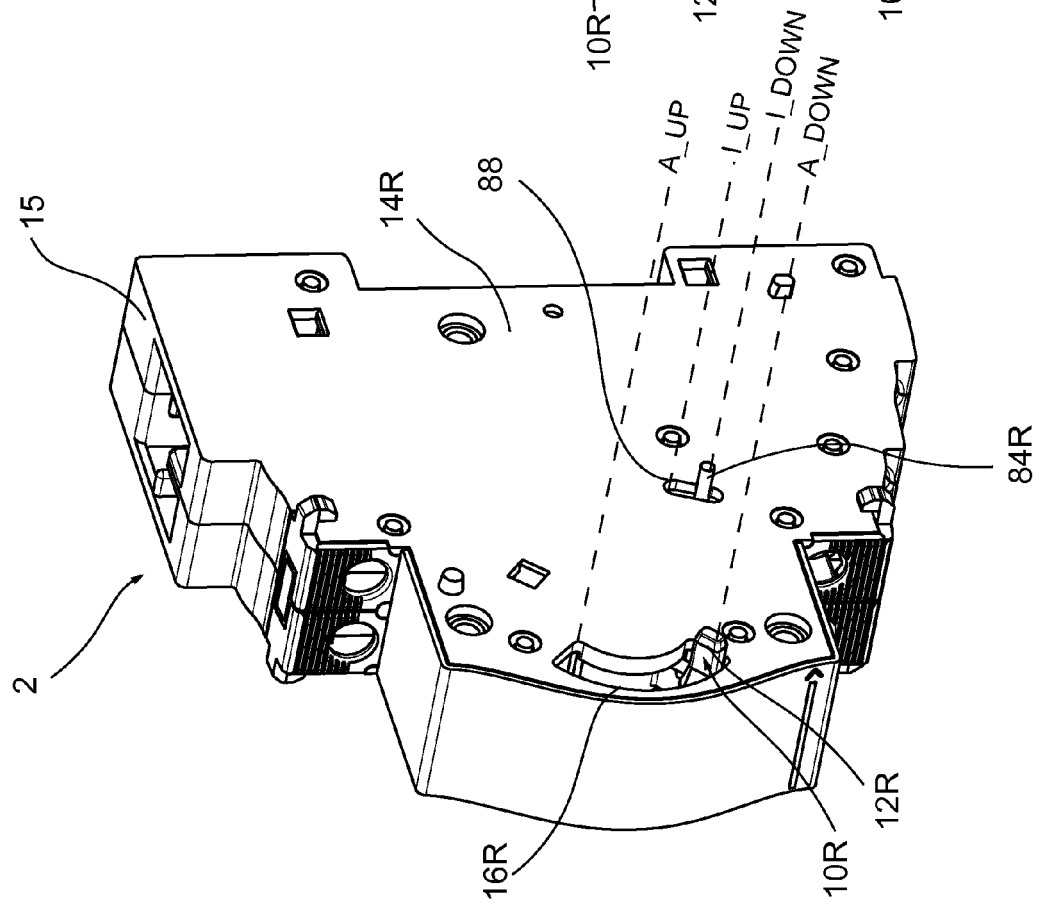


FIG. 3

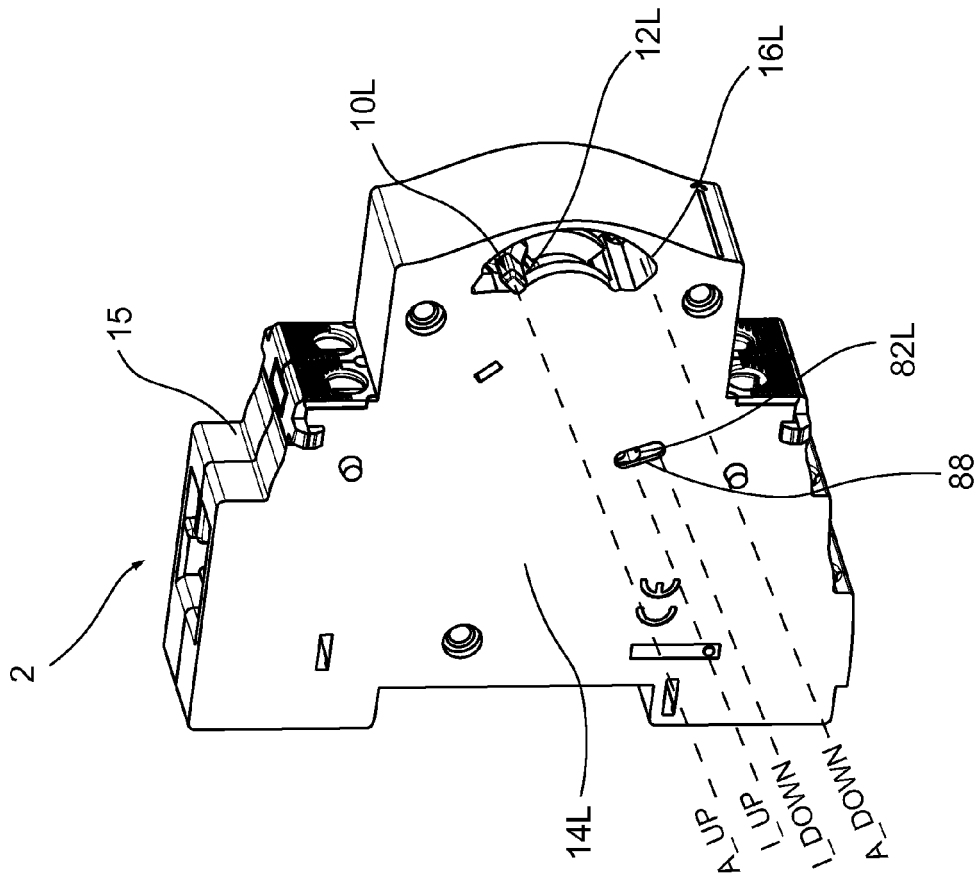


FIG. 5

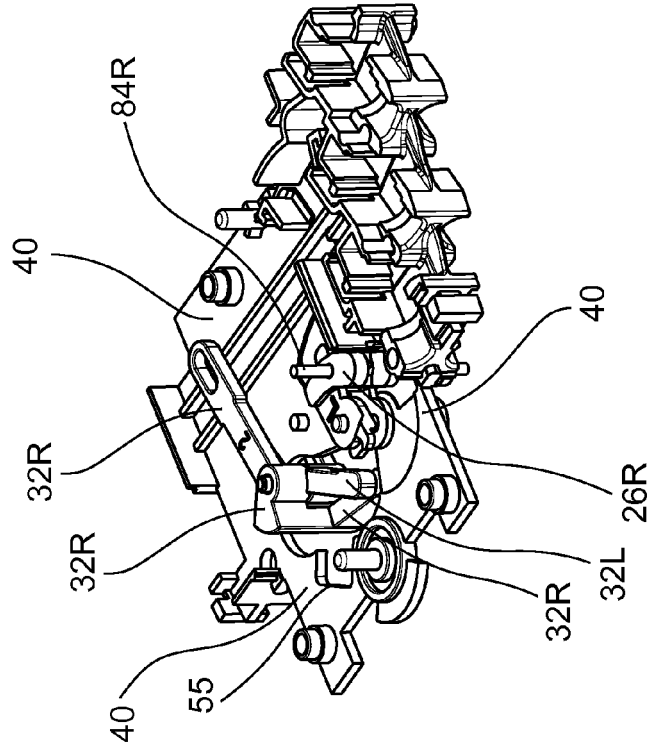
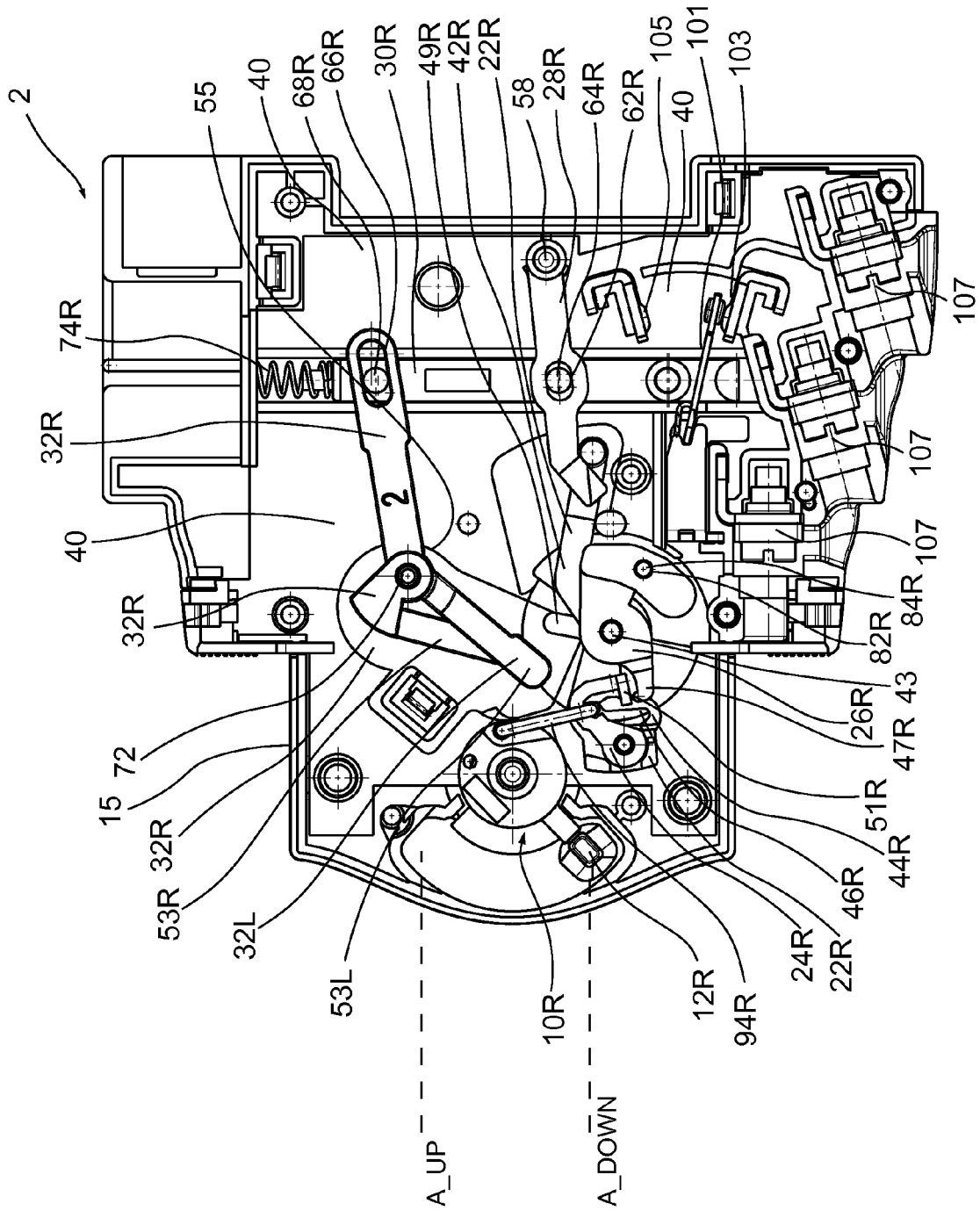
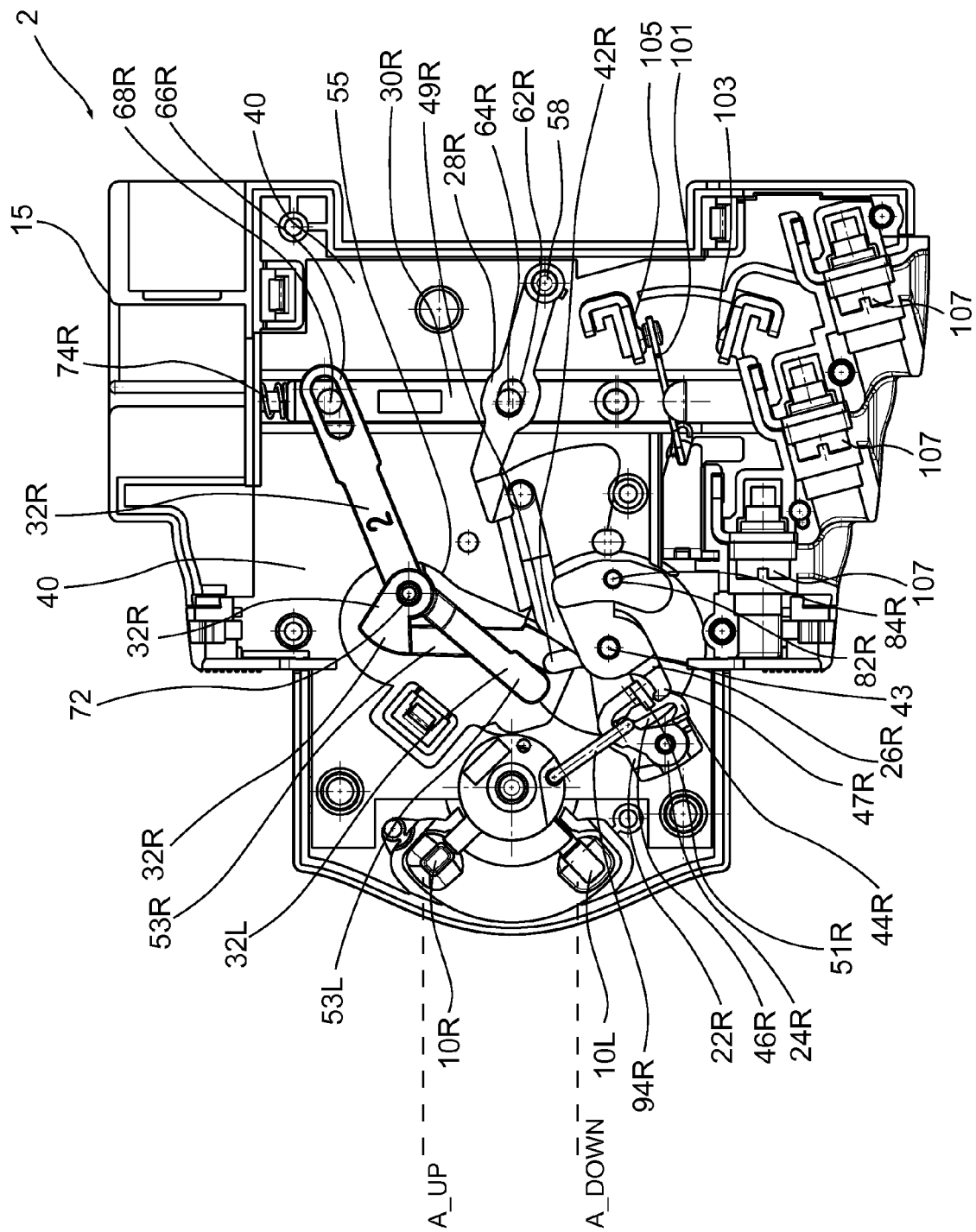


FIG. 6




$$\frac{\infty}{E|G}$$

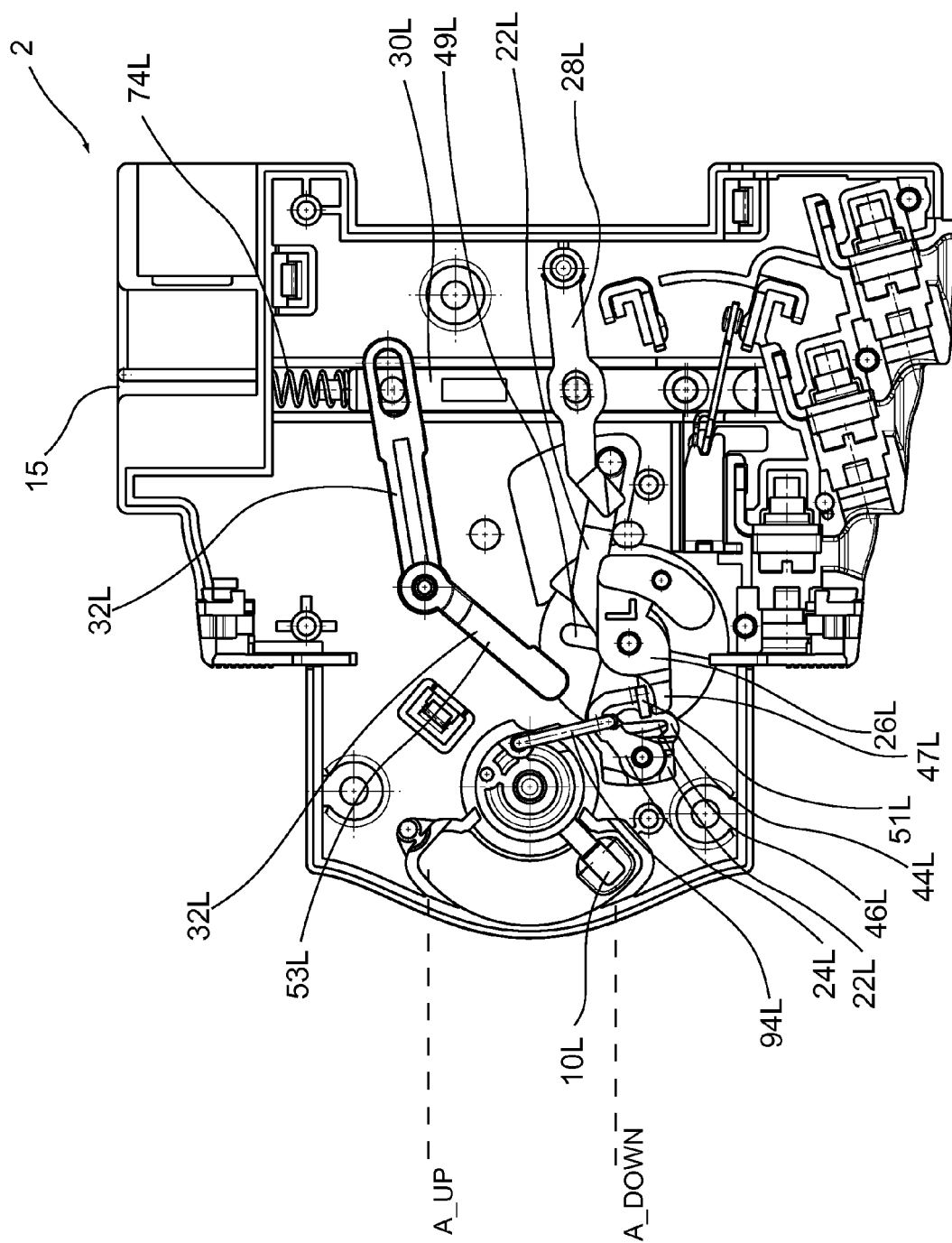


FIG. 9

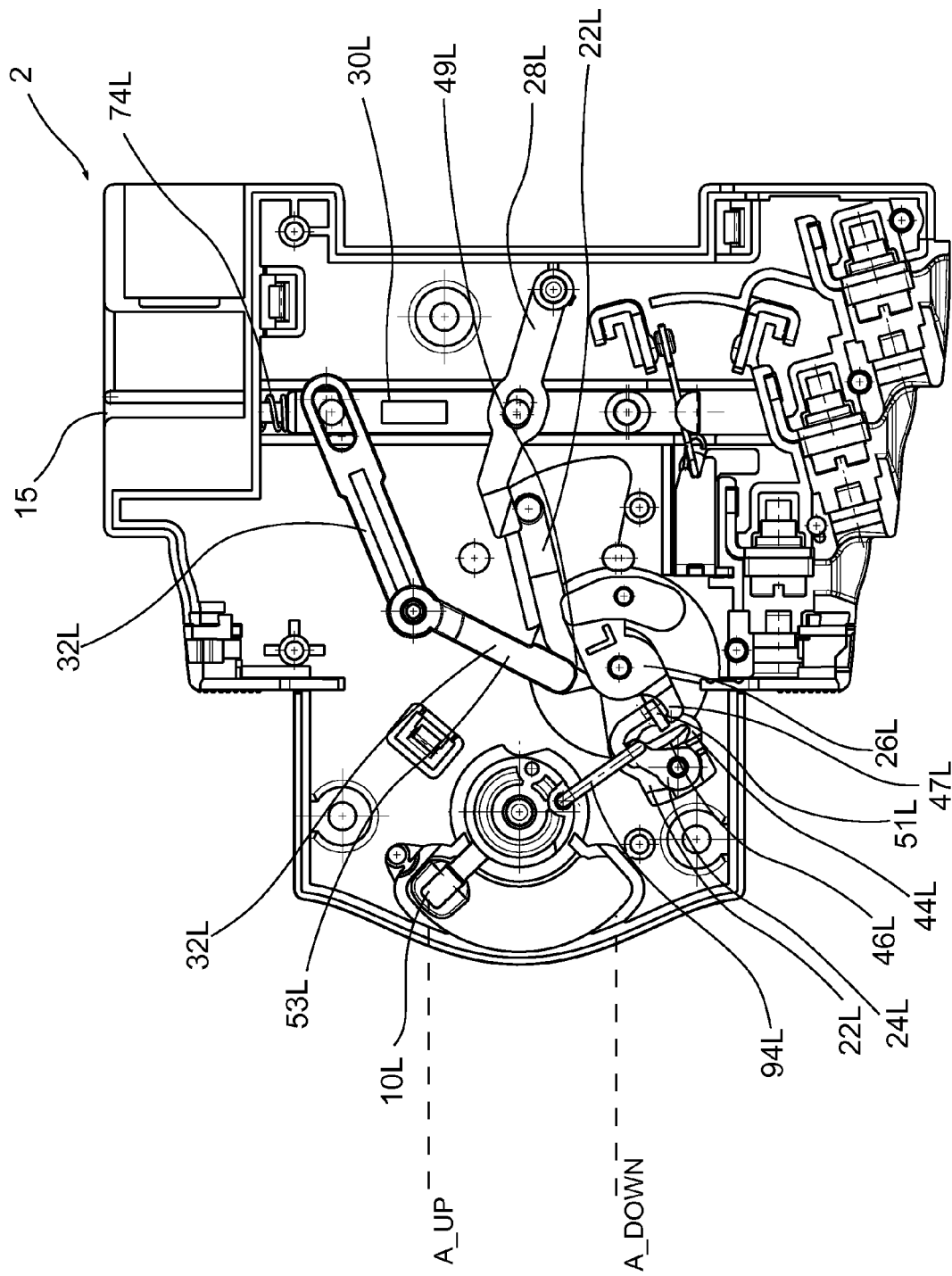


FIG. 10

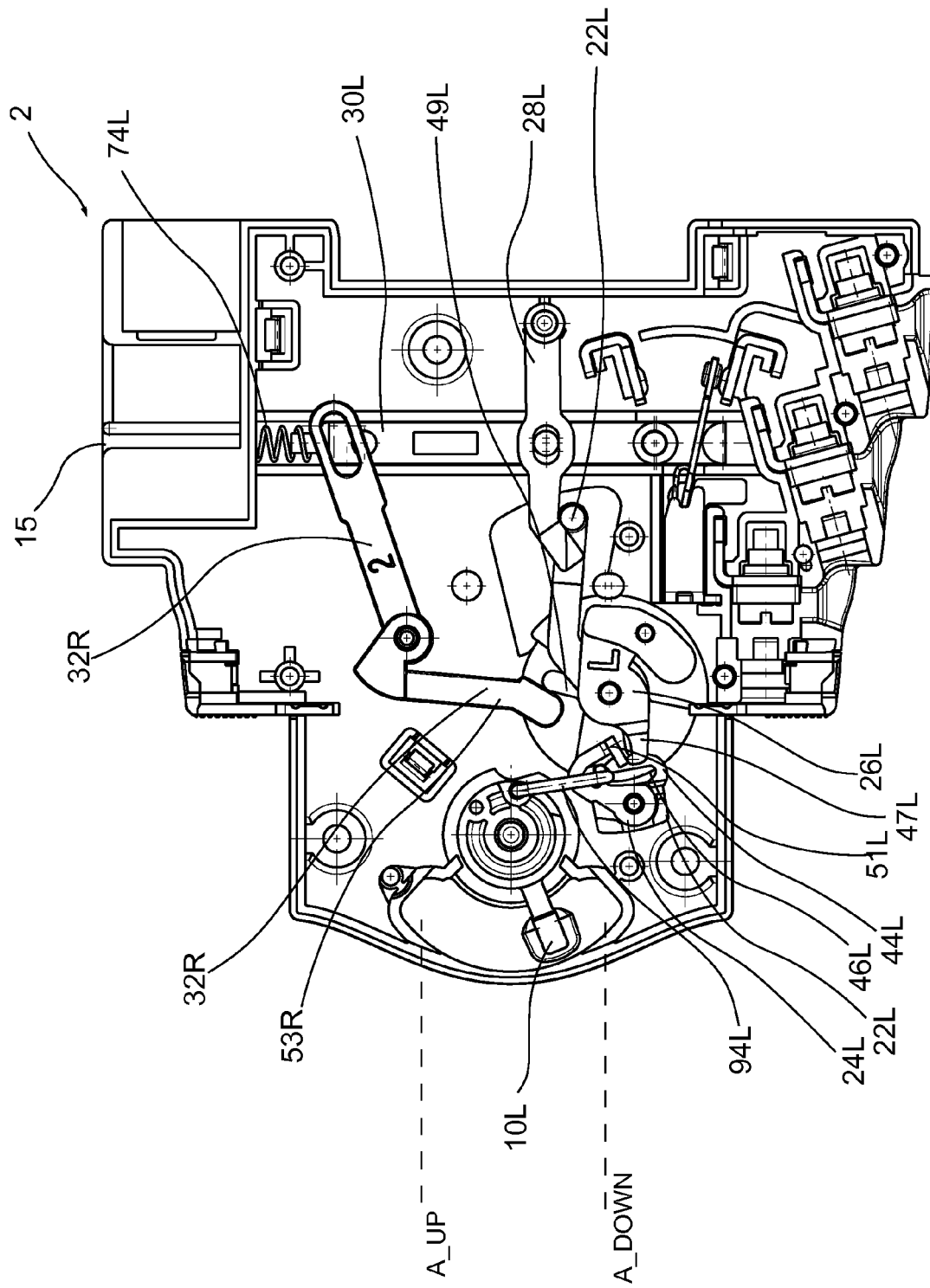


FIG. 11

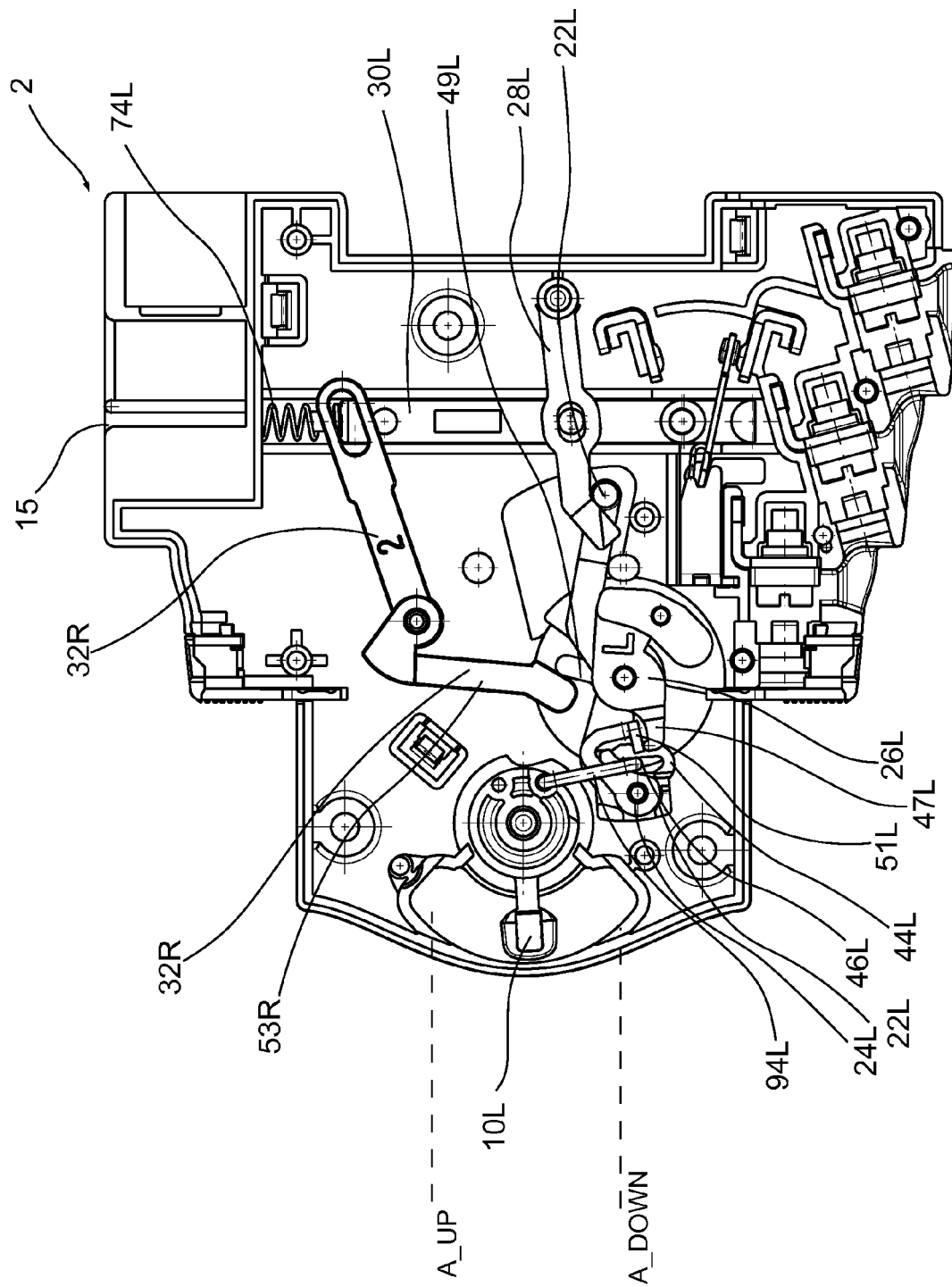


FIG. 12

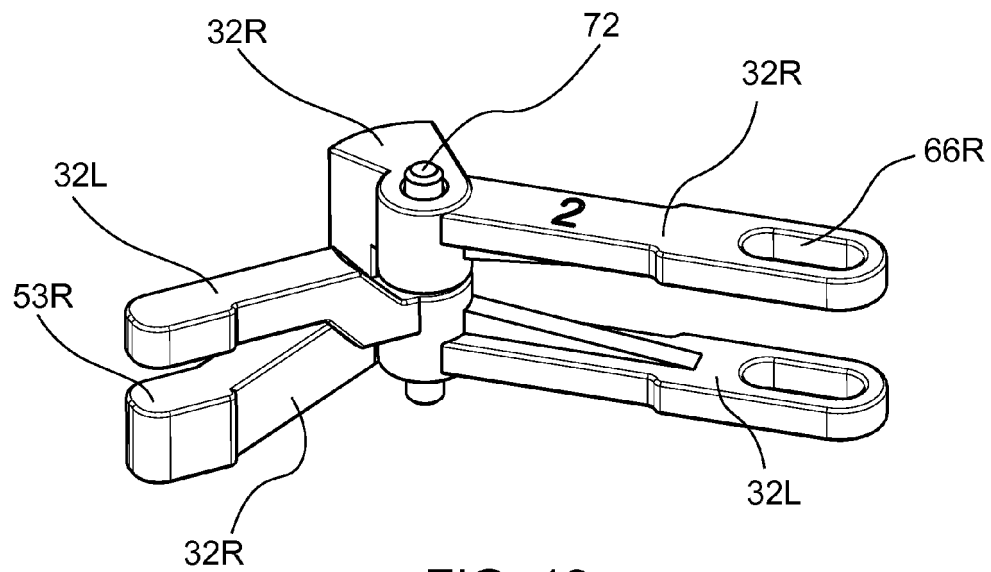


FIG. 13

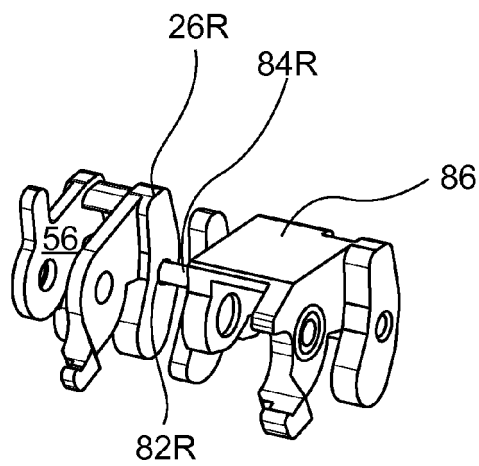


FIG. 14

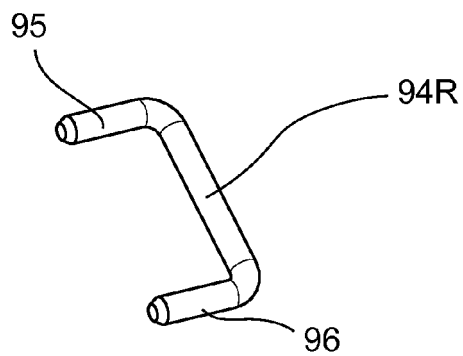


FIG. 15



## EUROPEAN SEARCH REPORT

Application Number  
EP 10 19 2734

| 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<br><b>Munich</b>                                                                                                                                                                                                                       |                                                                                                       | Date of completion of the search<br><b>1 June 2011</b>                                                                                                                                                                                                                                | Examiner<br><b>Simonini, Stefano</b>    |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                       | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>.....<br>& : member of the same patent family, corresponding document |                                         |

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 19 2734

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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01-06-2011

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