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(54) **Electrical apparatus with remote-controlled switch**

(57) The apparatus (100) comprises a switch (106) with an operating organ (110) capable of moving from an opening position to a closing position and vice versa, an actuator (103) associated with the switch (106) comprising an electric motor (11) and dragging means operated by the electric motor to bring the operating organ (110) from the opening position to the closing position, and remote control means (Pa, Pc). The switch (106) comprises rapid-detachment means (114) capable of being operated from outside to open the contacts and bring the operating organ (110) from the closing position to the opening position. The actuator (103) comprises a two-way switch (13) operated by the motor (11) and means (160) of coupling to the rapid-detachment means (114) operated by the motor (11) in such a way as to assume a first position (A) corresponding to the activation of the rapid-detachment means (114) or a second position (C) in which the rapid-detachment means (114) are not activated. The remote control means (Pa, Pc,) comprise a closing push-button (Pc) series-connected, by means of one way of the two-way switch (13), to the supply line of the electric motor (11), and an opening switch (Pa) series-connected, by means of the other way of the two-way switch (13), to the supply line of the electric motor (11).

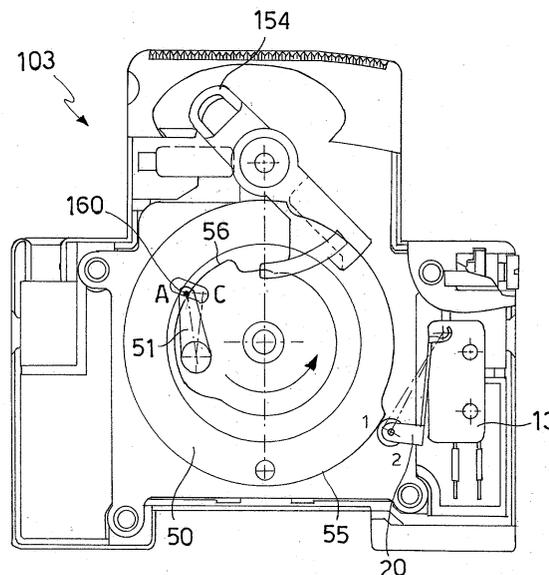


FIG. 2

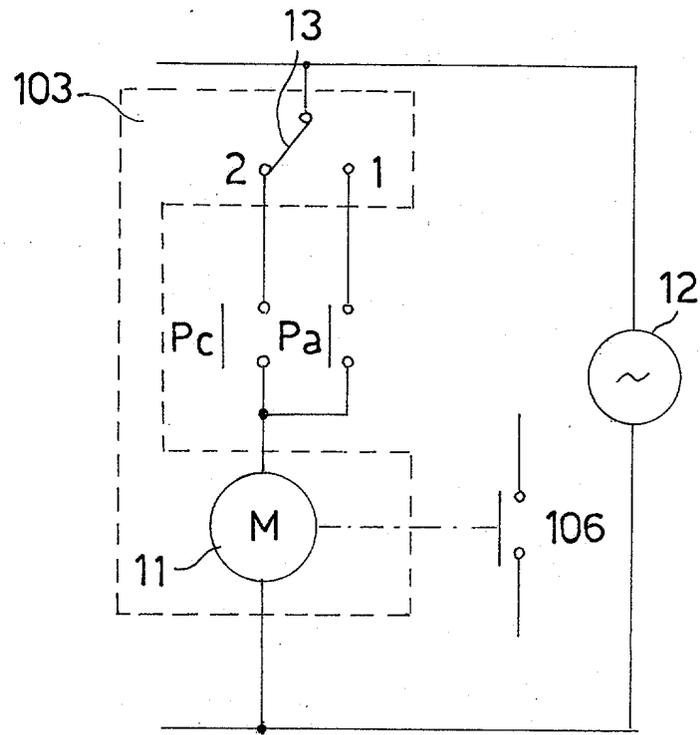


FIG. 3

Description

[0001] The present invention relates to an electrical apparatus comprising a switch and an actuator device associated with the switch and, in particular, an electrical apparatus as defined in the preamble of Claim 1.

[0002] In certain applications, for example in electrical installations in which switches are located in places that are not readily accessible, or where, for reasons of safety, rapidity of intervention or similar, it is useful for one or more switches to be remote-controlled, it is a common practice to use actuator devices associated with the switches that are to be remote-controlled. An actuator carries out the switching operations (opening or closing) of a switch by using a form of energy other than manual. Typically, actuators use an electric motor to move the operating lever of the switch from the opening position to the closing position, and vice versa, in response to a corresponding control signal.

[0003] It is known that during the opening of a switch in which current is flowing an electric arc will be drawn between the contacts that are being pulled apart and that this will cause ionisation phenomena associated with overheating and corrosion of the contacts. These phenomena are particularly intense when the current that has to be interrupted is due to an overload and, more particularly, a short circuit. With a view to attenuating the harmful effects of these phenomena, the switches are provided with a rapid-detachment mechanism: in particular, when the operating lever is moved from the closing position to the opening position, this mechanism is activated as soon as a predetermined intermediate position is reached and imparts a sudden acceleration upon the mobile contact and the operating lever and thus to render the opening action of the switch more rapid.

[0004] A drawback of the known equipment consists of the fact that the actuator devices call for the use of very fast and relatively powerful motors in order to take due account of the high opening speed of the switch. Indeed, if slower motors were to be used, though always sufficient for correct performance of the closing operation, the rapid detachment mechanism would tend to drag the motor to a high speed or the motor to tend to act as a brake for the detachment mechanism and slow down the opening operation. In any case the equipment would experience a malfunction that could cause damage to the switch or the motor.

[0005] As a general rule, moreover, the known actuators do not permit normal manual operation of the switch. This may constitute a serious difficulty in some application, for example in the case of the main switch of the electrical installations of an apartment: in this case, in fact, when the power supply to the electric motor of the actuator comes to lack, the user should still be able to operate the switch manually, at least for opening it.

[0006] One aim of the present invention is to provide

an electric apparatus of the type defined at the beginning in which the actuator does not call for an electric motor more powerful than would be necessary for closing the switch and in which the switch can also be operated manually.

[0007] Another purpose of the invention is to propose an electric apparatus of the type defined at the beginning in which the switch can be opened by means of a remote command and in such a way that it will not be possible to close it again.

[0008] These and other purposes are attained by realizing the electrical apparatus defined and characterized in general terms in Claim 1.

[0009] The invention will be more clearly understood from the following detailed description of an embodiment thereof, together with two variants, the description making reference to the attached drawings, of which:

- Figure 1 shows a perspective view in two detached parts of the electrical apparatus in accordance with the invention in a particular embodiment with a bipolar switch;
- Figure 2 shows a section through the actuator of the electrical apparatus in accordance with Figure 1 in an operating position corresponding to the open position of the switch,
- Figure 3 is a layout illustrating the electrical connections of the actuator and the remote control means in the operating position in accordance with Figure 2,
- Figure 4 is a view similar to the one of Figure 2 of the actuator in an operating position corresponding to the closed position of the switch,
- Figure 5 is a layout similar to the one shown in Figure 3 but corresponding to the operating position in accordance with Figure 4, and
- Figures 6 and 7 illustrate, by means of layouts similar to the one of Figure 3, variants of the electrical apparatus in accordance with the invention.

[0010] Referring to Figure 1, an electrical apparatus 100 comprises a bipolar electrical switch 106 and a motor-operated actuator device 103.

[0011] The switch 106 is enclosed in a box-like body 107 having two pairs of openings 109 (only one pair can be seen in the drawing) on two opposite sides to give access to corresponding terminals of the switch. An operating lever 110, projecting from the front surface of the body 107, is mobile and can rotate about an axis 11 between a position 110' and a position 110" (shown by means of broken lines) corresponding, respectively, to the open position and the closed position of the switch. Inside the body 107 the switch comprises a rapid-detachment mechanism (known as such and not shown on the drawing) that, whenever the to e operating lever is moved from the closed position 110" towards the open position 110' until it reaches an intermediate release position 110" ' (represented by means of broken lines), im-

parts a sudden acceleration upon the operating lever 110 in such a way as to avoid or reduce to a minimum the formation of an electric arc between the switch contacts.

[0012] A slot 113 on each of the sides of the body 107 grants access to a control organ of the rapid-detachment mechanism. This organ has a bed 114 that, when the operating lever becomes displaced from the opening position 110' to the closing position 110" becomes likewise displaced from an opening position 114' (represented by means of a continuous line) to a closing position 114" (represented by means of a broken line). When the operating lever 110 moves from the closing position 110' to the opening position 110", the control organ does not move until the control lever has reached the release position 110"', after which it performs a snap movement, so that the bed comes to find itself in the opening position 114'. A small stress of the control organ that tends to shift the bed from the closing position to the opening position will cause the rapid-detachment mechanism to snap into action and therefore a rapid opening of the switch.

[0013] Acces to the control organ through the slot 113 makes possible an emergency opening of the switch contacts by means of the insertion of a control pin into the bed 114 of the organ. For example, the switch may be coupled with a protection device that, mounted by the side of the switch with a pin in the bed 114, will respond to an overload situation by moving the pin in such a way as to cause the opening of the associated switch.

[0014] The actuator device 103, which likewise is provided with a box-like body 117, on one side has an opening 118 with elements for connecting it to a supply source and a remote control device and a bar 154 capable of rotating about an axis that, when the device is mounted by the side of the switch, coincides with the axis of rotation of the operating lever 110. The bar 154 is shaped in such a way as to have a longitudinal channel 157 in which the end of the operating lever 110 can be inserted. A side 158 of the box-like body 117 is provided with a slot 159 from which there projects a pin 160 that, when the actuator device 103 is mounted by the side of the switch 106, becomes engaged with the bed 114 of the control organ of the rapid-detachment mechanism of the switch.

[0015] The switch 106 and the actuator device 103 are normally mounted on a rail (not shown) and kept together by a rigid L-shaped element 166 that on one side is inserted in an opening 172 of the body 107 of the switch 106 and, on the other side, is fixed to the body 117 of the actuator device 103 by means of a screw 181.

[0016] The actuator device 103 comprises an electric motor 11 (Figure 3) that rotates in one direction only, kinematic coupling mechanisms between the motor axis and the rotatable bar 154 that make it possible to drag the operating lever 110 into the closing position without preventing its manual operation either before or after the position change, a disk 50 operated by the motor, a di-

verter or two-way switch 13 with a control lever 20 and a pivotable support arm 51 of the pin 160. These parts of the actuator device, with exclusion of the motor and the kinematic coupling mechanisms, known as such, can be seen in Figure 2.

[0017] Figure 3 shows the electrical connections needed for controlling the closing and opening of the switch 106 through remote control means, in this example two push-button switches Pc and Pa accessible to the user of the installation fed via the switch 106. The latter is coupled with the actuator device 103, which is connected to a supply source 12. As can be seen in Figure 2, the two-way diverter switch 13 is operated by the motor 11 via a cam 55 formed on the disk 50: its position depends on the angular position of the disk 50. In Figure 2 the diverter 13 is shown with its lever 20 in the position it assumes when the switch is open following an opening action by the motor. In this position, indicated by the reference number 2 in Figure 3, the diverter 13 connects a first terminal of the source 12 to a terminal of the closing push-button Pc. The other terminal of the push-button Pc is connected to a first terminal of the motor 11. The second terminal of the motor 11 is connected to the second terminal of the source 12. The second position of the lever 20 of the diverter 13 is the position it assumes when the switch is closed by closing action of the motor. In this position (Figure 5) the diverter 13 connects the first terminal of the source 12 to a terminal of the opening push-button Pa. The other terminal of the push-button Pa is connected the first terminal of the motor 11.

[0018] As can be seen in Figure 2, the disk has a second cam 56 that, depending on the angular position of the disk 50, will either keep the pin 160 fixed in a first position (A) that corresponds to the opening or detachment position of the switch or will leave it free to move between this first position and a second position (C) that corresponds to the closing position of the switch.

[0019] Let us now consider in some detail the manner of functioning of the apparatus that has just been described. Figures 2 and 3 show the situation in which the switch 106 is open after an opening action by the motor. More particularly, the diverter 13 is in the position 2 and the pin 160 is in the position A corresponding to the open condition of the switch: in this position a manual displacement of the operating lever 110 of the switch or of the bar 154 towards the closing position will not permit the switch to be closed, because the detachment mechanism of the switch is activated by the pin 160 fixed in position A corresponding to the opening position of the switch. The closing of the switch is possible only by means of the control motor. More particularly, the closing of the closing push-button Pc will permit the following actions to be performed in succession: energization of the motor 11, rotation of the disk 50, which will bring the cam 56 into an angular position in which the pin 160 is free to move to the position in which the detachment mechanism is not activated, operation of the kinematic mechanism (not shown), which - acting on the bar 154

- brings the operating lever into the closing position of the switch and displacement of the diverter 13 into the position 1, because the cam 55 rotates as far as an angular position in which no load acts on the command lever 20. In this situation, represented in Figures 4 and 5, it is possible for the switch to be both opened and closed manually.

[0020] If the switch is to be opened by the motor starting from the situation of Figures 4 and 5, it is sufficient to close the push-button switch Pa. More particularly, the following successive actions will take place: the motor is energized, the diverter 13 is brought back into position 2 by the cam 55 and the pin 160 is brought back and maintained in the opening position A, i.e. in the position in which the detachment of the switch takes place; the action of detachment brings the operating lever 110 of the switch 106 into the opening position, and at the same time also drags the bar 154 into the opening position: that is to say, the system returns into the situation of Figures 2 and 3.

[0021] In the case in which, following a motor closure, the switch is opened by hand, the electrical connections are such that the closure of the push-button Pc will not have any effect at all, because the diverter 13 is in position 1, as is shown in Figure 5. To close the switch it is therefore necessary to first close the opening push-button Pa, thereby operating the motor 11 and therefore also the cam 55, until the diverter 13 has been brought back into position 2 (Figures 2 and 3), and then close the closure button Pc. If it is to be possible to close the switch by operating in any case only the closing push-button Pc, according to a variant of the invention there is also provided a bypass switch 14 connected in parallel with the opening push-button Pa, as shown in Figure 6. The bypass switch 14 is operated directly or indirectly by the switch 106 in such a way as to be closed when the switch 106 is open and open when the switch 106 is closed. For example, the bypass switch can be incorporated in the actuator device 103 - in a manner that is known as such and not therefore shown on the drawings - to be operated directly by the bar 154. As can be seen from the layout of Figure 6, which shows the situation immediately after a manual opening of the switch 106, the motor is energized via the diverter 13 in position 1 and via the bypass switch 14 until such time as the cam 55 will not have brought the diverter 13 in position 2. The system thus returns to the situation represented in Figures 2 and 3 and the switch 106 can be closed by operating the closing push-button Pc.

[0022] As is made clear by what has just been explained, with the apparatus in accordance with the invention the switch 106 is controlled by the motor only for closing purposes, i.e. when the operating speed is not critical, while it is controlled by the rapid detachment mechanism when its contacts have to be opened. It should be noted that the same detachment mechanism is utilized for bringing the actuator device 103 back into the starting position for motor-operated closure. Conse-

quently, the apparatus in accordance with the invention can be realized by using a relatively small motor and is therefore economic and does not occupy a great deal of space.

[0023] In the variant of the invention illustrated by Figure 7, where elements equal to those of Figure 3 are indicated by the same reference numbers or symbols, there are also provided means for opening the switch 106 by means of a remote command distinct from the opening switch Pa and with a view to rendering the open state irreversible, i.e. preventing the switch from being closed manually or by the motor. To this end, a switch Pg, normally open, is connected in parallel with the opening push-button Pa. In the present example the switch Pg is operated by a control device 140 connected to the supply source 12, which can be the same electricity distribution network, to obtain an energy supply and control signals from it, for example signals sent by the electricity supplier by means of waves conveyed through the supply network itself. By means of a timed actuator 142, the control device acts 140 also on an enabling switch 141, inaccessible to the user and placed in series with the motor 11.

[0024] When conditions occur in which the electricity supplier decides to interrupt the supply, an opening signal is sent to the control device 140. If the switch 106 happens to be closed, so that the two-way switch 13 will be in position 1, the opening command will cause the motor 11 to become energized, the opening of the switch 106 (as in the case when the opening push-button is operated) and the activation of the timed actuator 142. After a predetermined interval of time, at least equal to the time needed for a motor-operated opening of the switch 106, the timed actuator 142 causes the permanent opening of the enabling switch 141. From this moment onwards, the switch 106 can no longer be closed by the user either by means of the motor, because the motor can no longer be energized, or by hand, because the pin 160 is in position A corresponding to the condition of an open switch, that is to say, in the position in which a manual operation of the operating lever 110 does not cause the switch to close, because the detachment mechanism continues to be active. If the apparatus is to be brought back to normal functioning, the enabling switch 141 must first be closed and this can be done only by the intervention of the personnel of the electricity supply undertaking, preferably by means of a remote control device.

[0025] Though only a single embodiment and two variants have here been illustrated and described, it is clear that numerous other variants are possible within the same inventive concept. For example, to render possible also a manual closing of the switch 106 after a motor-operated opening, the cam 56 may be omitted, so that the pin 160 will always be free to move between the positions (A and C) corresponding to the opening and closing positions of the switch; furthermore, with a view to signalling a detachment of the switch 106 due to an

overload there may be provided an acoustic or light signal device that becomes activated by a microswitch controlled by a lever mechanism operated by the pin 160.

Claims

1. An electrical apparatus (100) comprising

- a switch (106) having an operating organ (110) capable of moving from an opening position to a closing position of the contacts of the switch and vice versa, 10
- an actuator device (103) associated with the switch (106) comprising an electric motor (11) and dragging means operated by the electric motor to bring the operating organ (110) of the switch from the opening position to the closing position and 15
- remote control means (Pa, Pc, Pg, 140, 142) of the actuator device (103), 20

characterized in that

- the switch (106) comprises rapid-detachment means (114) capable of being operated from outside the switch to open the contacts and bringing the operating organ (110) from the closing position to the opening position, 25
- the actuator device (103) comprises a two-way switch (13) operated by the electric motor (11) and means (160) of coupling to the rapid-detachment means (114), said coupling means (160) being operated by the electric motor (11) in such a way as to assume a first position (A) corresponding to the activation of the rapid-detachment means (114) or a second position (C) in which the rapid-detachment means (114) are not activated and 30 35
- the remote control means (Pa, Pc, Pg, 140, 142) comprise a closing switch (Pc) series-connected, by means of one way of the two-way switch (13), to the supply line of the electric motor (11), and an opening switch (Pa) series-connected, by means of the other way of the two-way switch (13, to the supply line of the electric motor (11). 40 45

2. An electrical apparatus in accordance with Claim 1, wherein the remote control means (Pa, Pc, Pg, 140, 142) comprise a further opening switch (Pg) connected in parallel with the said opening switch (Pa) and operating means (140, 142) of said further opening switch (Pg) 50 55

3. An electrical apparatus in accordance with Claim 2, wherein the remote control means (Pa, Pc, Pg, 140, 142) comprise an enabling switch (141) series-con-

nected to the supply line of the motor (11) and means (142) for the delayed operation of said enabling switch (141).

5 4. An electrical apparatus in accordance with any one of the preceding claims, comprising a bypass switch (Pg) connected in parallel with the opening switch (Pa) and means (140) of operating said bypass switch (Pg) associated with the switch (106) in such a way that the bypass switch is closed when the switch (106) is open and open when the switch (106) is closed.

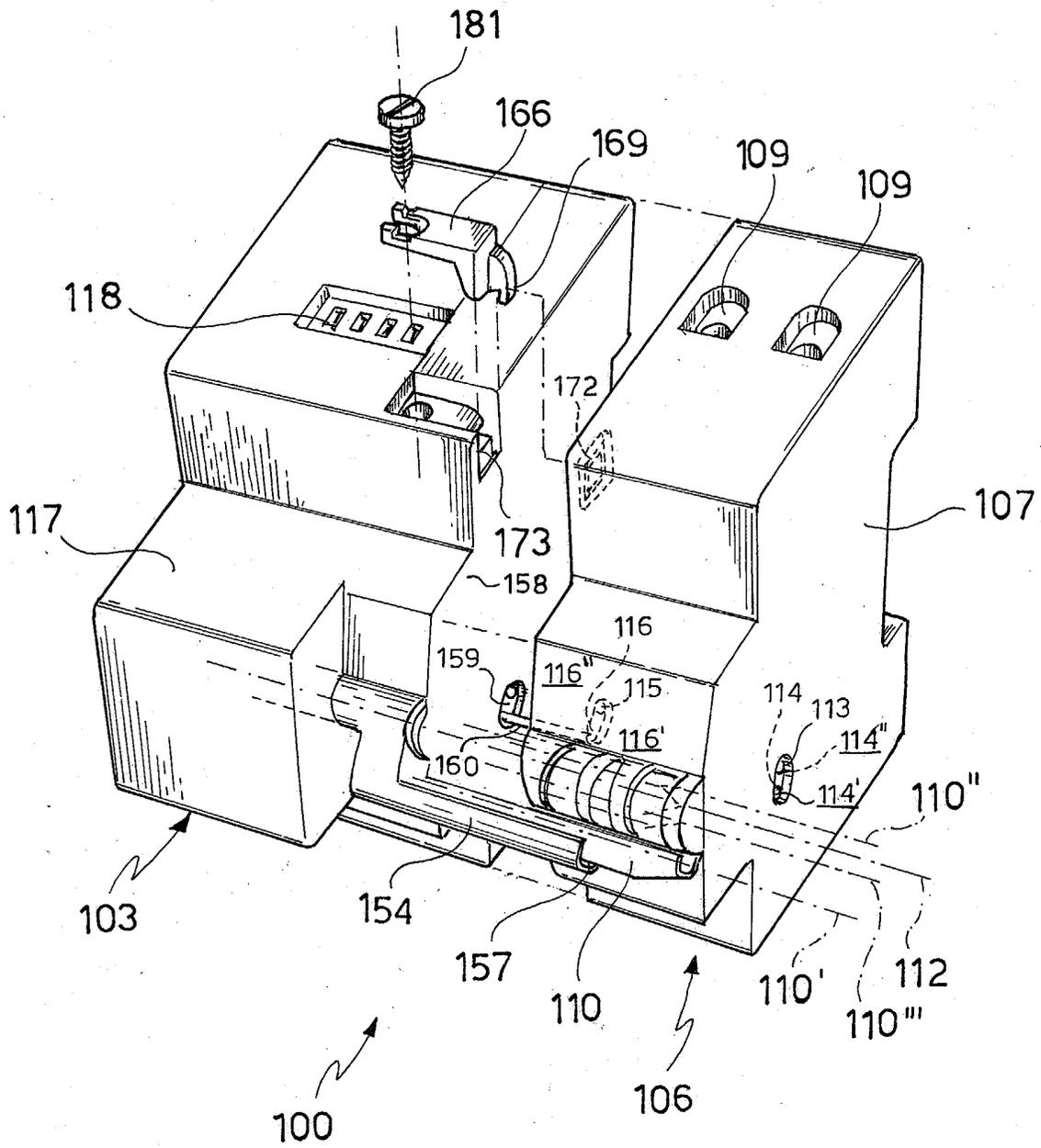


FIG. 1

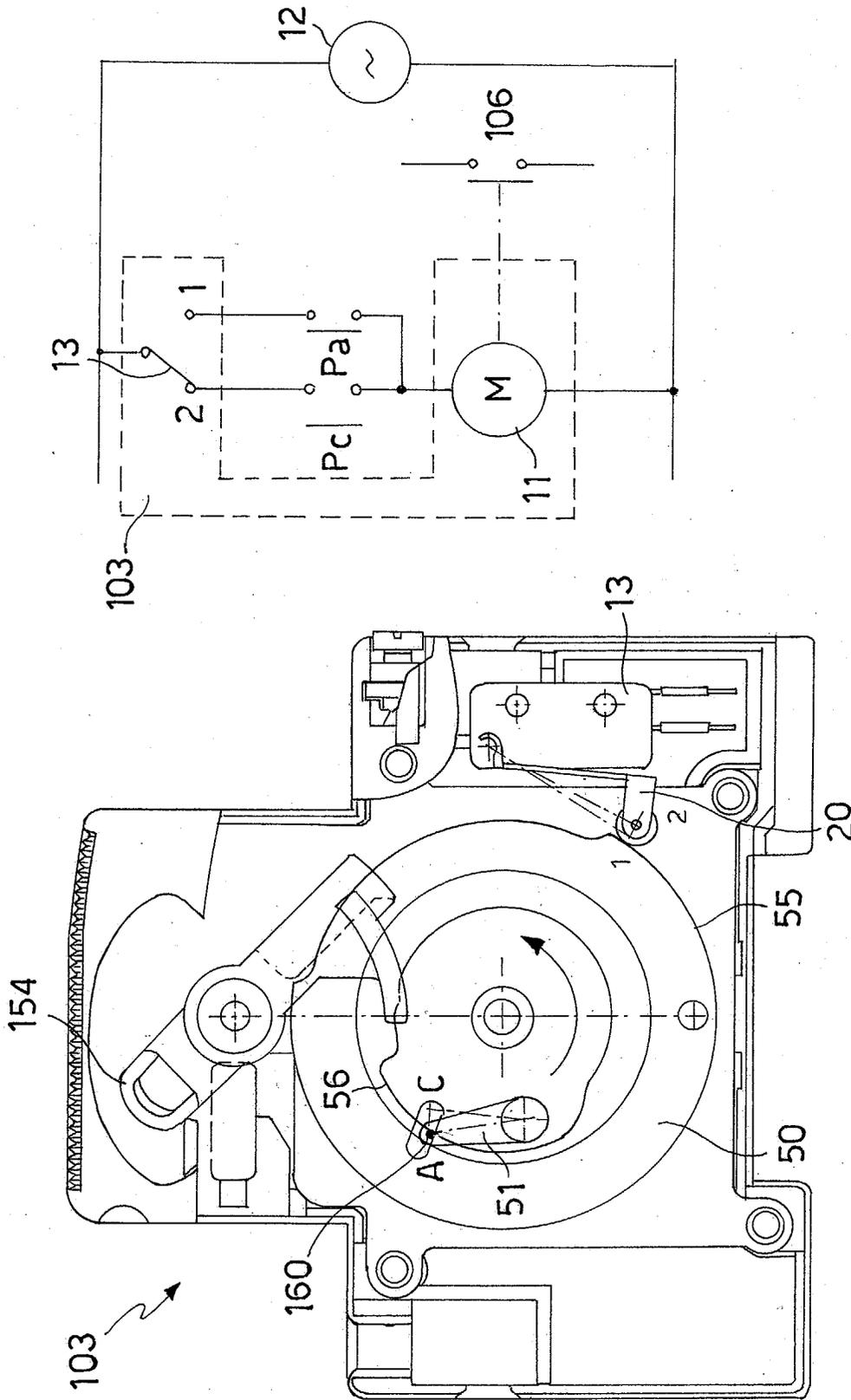


FIG. 3

FIG. 2

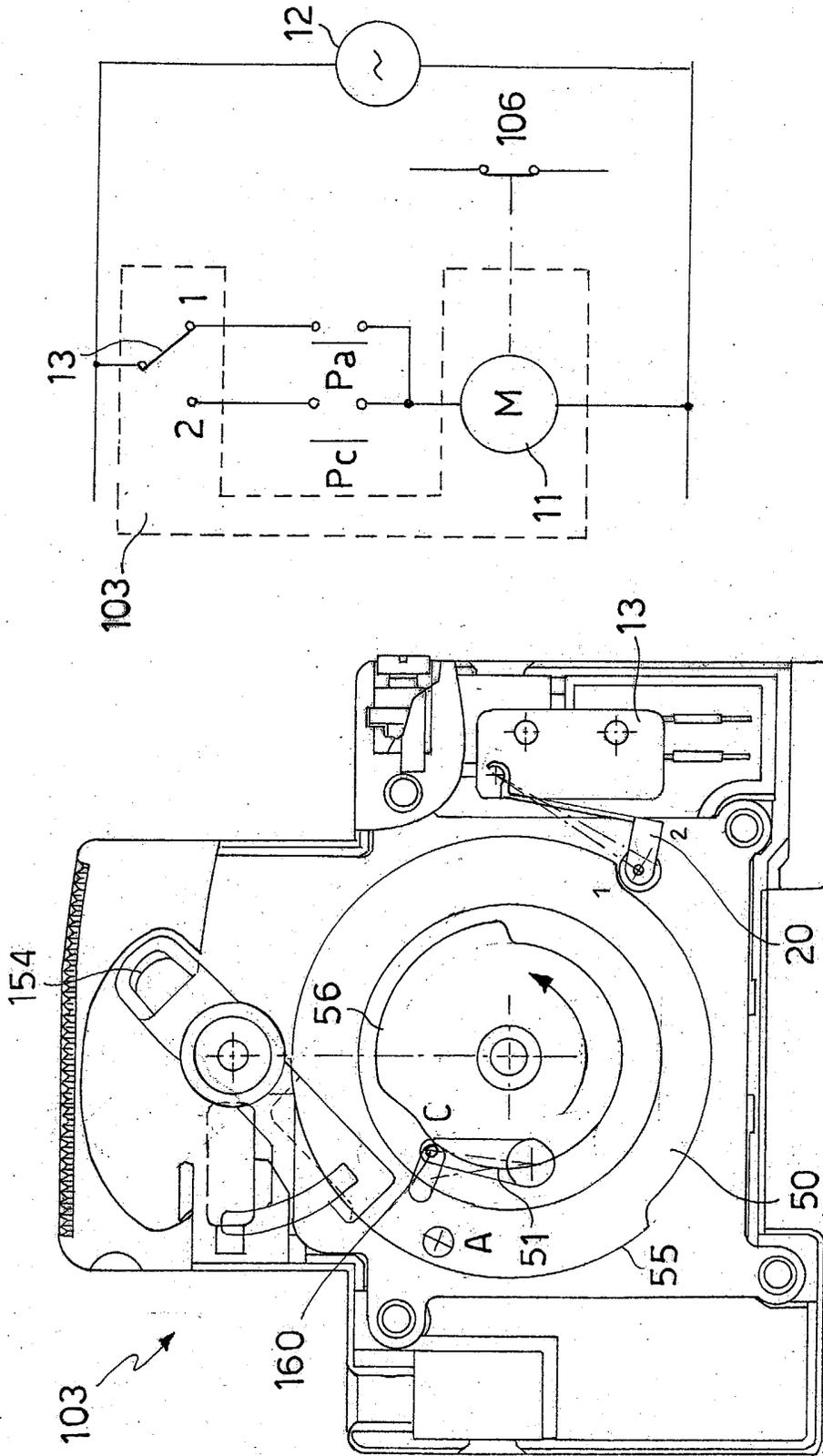


FIG.5

FIG.4

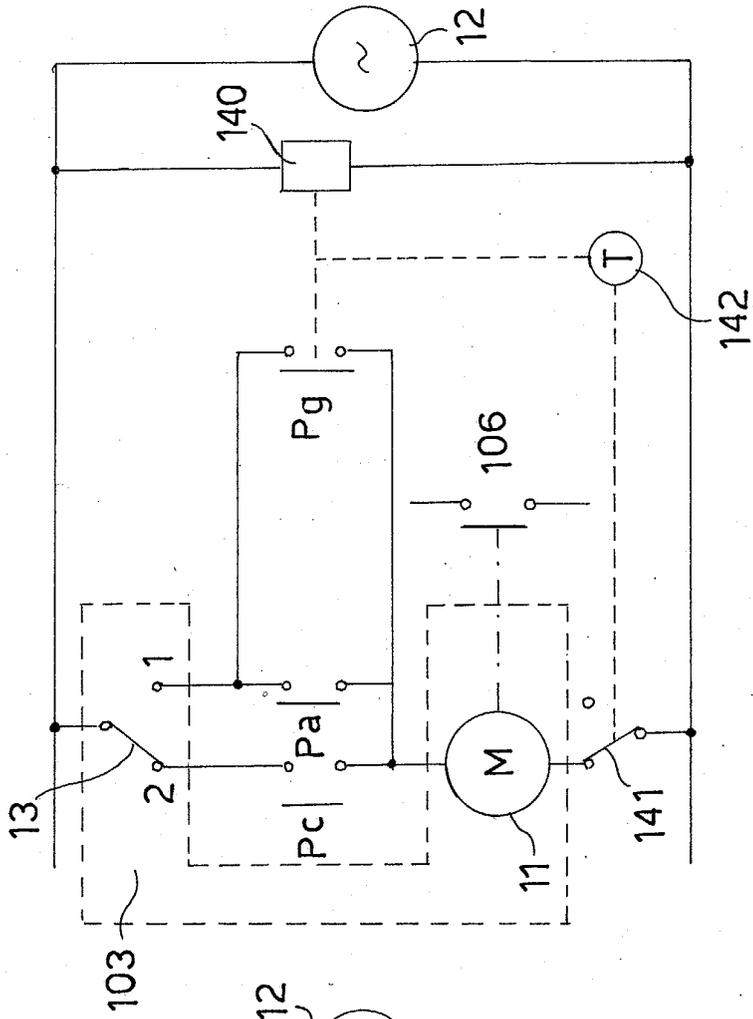


FIG. 6

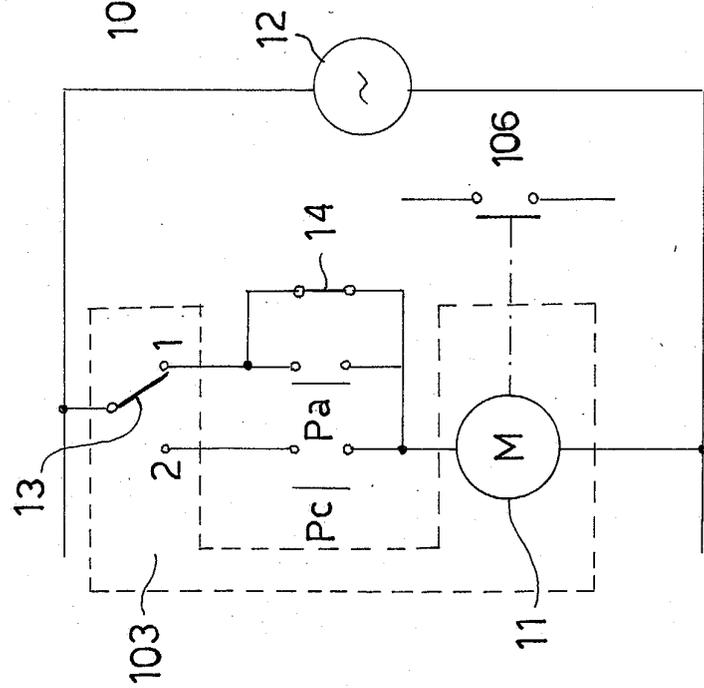


FIG. 7



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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Place of search	Date of completion of the search	Examiner	
Munich	1 April 2004	Findeli, L	
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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

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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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