

(19)



(11)

EP 2 131 376 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
09.12.2009 Bulletin 2009/50

(51) Int Cl.:
H01H 3/40 (2006.01) **H01H 71/70 (2006.01)**
H01H 3/46 (2006.01)

(21) Application number: **08017546.6**

(22) Date of filing: **07.10.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

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(30) Priority: **03.06.2008 IT MI20081009**

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(54) Control device for circuit breakers

(57) A control device for circuit breakers comprises a casing which can be coupled to an electrical device, such as a residual current operated circuit breaker provided with a control for opening and closing the contacts. The casing comprises a drum, which is kinematically as-

sociated with the control for opening and closing the contacts of the circuit breaker. The control device includes a single electric motor, which is adapted to actuate a gear train by means of a worm screw. The gear train is suitable to turn the drum in one direction or the other by a rotation switching means.

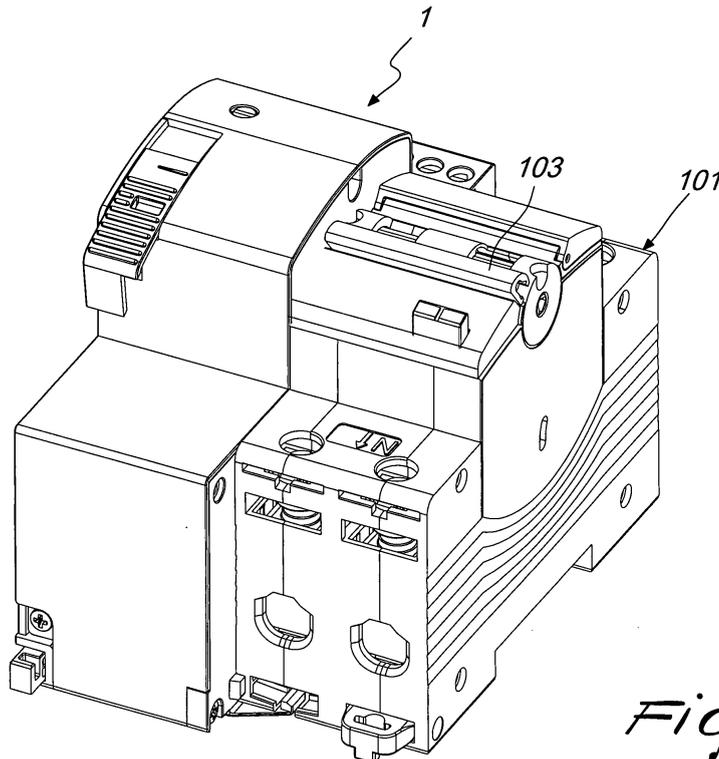


Fig. 1

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Description

[0001] The present invention relates to a control device for circuit breakers.

[0002] More particularly, the invention relates to a device for resetting automatically a residual current operated circuit breaker or another similar apparatus.

[0003] As is known, electrical systems are provided with circuit breakers adapted to prevent a fault current from causing danger for users and for the loads connected to the electrical line. When the presence of the fault current is detected, a residual current operated circuit breaker releases the line, thus interrupting the supply of power to the load or loads arranged downstream.

[0004] After the release of the circuit breaker, and once the correct operating conditions for the system have been restored, the residual current operated circuit breaker must be reset.

[0005] Motorized devices are known which are adapted to reset a circuit breaker or to release it by means of a remote control.

[0006] The prior art devices generally include a motor with a double winding, which is capable of rotating an actuation mechanism provided with a worm screw, in one direction or in the other depending on whether it is necessary to close or open the circuit breaker.

[0007] The resetting devices are generally contained in a casing, which can be associated with the circuit breaker so that the actuation mechanism acts on the drum of the handle of the circuit breaker.

[0008] The aim of the present invention is to provide a control device for circuit breakers which is improved functionally and constructively with respect to the devices of the prior art.

[0009] An object of the invention is to provide a control device that is much smaller than the prior art devices having an equal performance.

[0010] Another object of the invention is to provide a device that is significantly cheaper from the production standpoint.

[0011] Another object is to provide a device which, by virtue of its particular constructive characteristics, is capable of ensuring the greatest assurances of reliability and safety in use.

[0012] This aim and these and other objects, which will become better apparent hereinafter, are achieved by a control device for circuit breakers, comprising a casing, which can be coupled to an electrical device, such as a circuit breaker provided with a control for opening and closing the contacts, said casing comprising a drum, which is kinematically associated with said control for opening and closing the contacts of said circuit breaker; **characterized in that** said control device comprises a single electric motor which actuates a gear train by means of a worm screw, said gear train being adapted to turn said drum in one direction or the other by means of a rotation switching means.

[0013] Further characteristics and advantages will be-

come better apparent from the description of preferred but not exclusive embodiments of the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

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Figure 1 is a perspective view of the control device according to the invention, coupled to a residual current operated circuit breaker;

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Figure 2 is an exploded perspective view of the control device and of the residual current operated circuit breaker of the preceding figure;

Figure 3 is a top plan view of the control device coupled to the residual current operated circuit breaker of the preceding figures;

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Figure 4 is a partially sectional side view of the control device according to the present invention, illustrating the open position of the closure control;

Figure 5 is a view, similar to the preceding one, illustrating the step for closing the closing control;

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Figure 6 is a view, similar to the preceding one, illustrating the closed position of the closing control;

Figure 7 is a view, similar to the preceding one, illustrating the closed position of the opening control;

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Figure 8 is a view, similar to the preceding one, illustrating the opening of the opening control;

Figure 9 is a view, similar to the preceding one, illustrating the open position of the opening control;

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Figure 10 is a cutout perspective view of the control device according to the present invention, illustrating the open position of the closing control;

Figure 11 is a view, similar to the preceding one, illustrating the step of closing the opening control;

Figure 12 is a view, similar to the preceding one, illustrating the closed position of the closing control;

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Figure 13 is a longitudinally sectional side view, seen from the opposite side with respect to the preceding figures, of the control device according to the present invention, illustrating the release mechanism in the open condition;

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Figure 14 is a view, similar to the preceding one, illustrating the release mechanism in the closed condition;

Figure 15 is a view, similar to the preceding one, illustrating the release mechanism in the tripped condition;

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Figure 16 is a longitudinally sectional side view of the disconnection assembly in the electrically closed position;

Figure 17 is a view, similar to the preceding one, illustrating the disconnection assembly in an electrically open position;

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Figure 18 is a view, similar to the preceding one, illustrating the disconnection assembly in the electrically open and lockable position;

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Figure 19 is a cutout perspective view of the control device according to the present invention, illustrating the control and indication system with the release mechanism in the closed condition;

Figure 20 is a view, similar to the preceding figure, illustrating the control and indication system with the release mechanism in the tripped condition; Figure 21 is an electrical diagram of the control and indication system of the control device according to the invention.

[0014] With reference to the cited figures, the device according to the invention, generally designated by the reference numeral 1, comprises a casing 2, which has the classic standardized shape and forms, at the rear face 3, a means for coupling to other apparatuses associated with an omega rail (not shown), according to DIN standards.

[0015] At its front face the casing 2 has a protrusion 4 in which an actuation drum 5 is arranged.

[0016] The device 1 is studied to be arranged laterally adjacent to other modules and in particular to a circuit breaker 101.

[0017] The mechanism of the reset device is connected to the mechanism of the circuit breaker 101 by means of a bar 102, which has a triangular cross-section and constitutes the rotation axis of the drum 5, so that the rotation of the drum 5 corresponds exactly to the rotation of the drum of the circuit breaker 101, which is provided with the usual external actuation lever or handle 103.

[0018] The device 1 according to the present invention has the actuation drum 5 associated with a gear train 6 by means of a bar 7.

[0019] The bar 7 has an end which is pivoted to the first gear 61 of the gear train 6 and the other end which can slide in a slot 8 of a member which is rotatably associated with the drum 5.

[0020] The gear train 6 draws its motion from a worm screw 9 driven by an electric motor 10, namely a single-phase synchronous motor.

[0021] The system includes a one-way or freewheeling bearing, which allows the worm screw to rotate in a single direction. The single-phase synchronous motor might in fact start rotating in either direction, but it is preferable for the gear train to always rotate in a preset direction in order to better exploit the torque of the motor.

[0022] The gear train 6 moves the bar 7, which turns the drum 5 alternately in one direction or the other, by the action of two contoured oscillating members, respectively designated by the reference numerals 12 and 13.

[0023] The first oscillating member 12 is pivoted in an upper region in a fulcrum 14 and has a bevelled end 16, which is pushed toward the axis of the drum 5 by a contrast spring 18.

[0024] The second oscillating member 13 is pivoted in an upper region in a fulcrum 15 and has a bevelled end 17, which is pushed toward the axis of the drum 5 by the contrast spring 18.

[0025] The contoured oscillating members 12 and 13 act on the upper end of the bar 7 so that it moves in one direction or in the opposite direction, depending on whether the drum must be turned in the direction of the

opening rotation of the handle 103 of the breaker or in the direction of the closing rotation of the handle 103.

[0026] Figures 4-9 illustrate the steps of closing and opening the circuit breaker by the device according to the present invention; the position of the handle 103 is shown in broken lines.

[0027] Figures 4-6 show the steps of closing the circuit breaker.

[0028] Figure 4 shows the position of the mechanism of the device that corresponds to the position in which the breaker is open.

[0029] As can be seen in Figure 4, the end 16 of the first oscillating member 12 is in a lower position than the end of the bar 7, while the end 17 of the second oscillating member 13 is located at the end of the bar 7.

[0030] When the first gear 61 turns, the upper end of the bar 7 moves to the left, with reference to Figure 4, because the end 17 of the second oscillating member prevents its movement to the right.

[0031] The bar 7 moves beyond the first oscillating member 12 and turns the drum 5 clockwise, to the closing position of the breaker, shown in Figure 5.

[0032] As the rotation of the first gear 61 continues, the drum 5 remains stationary, while the upper end of the bar 7 slides along the slot 8 and reaches the position shown in Figure 6, in which the position of the slot 8 and of the oscillating members 12 and 13 is symmetrically opposite to the initial position.

[0033] Figure 6 shows the condition of the device 1 that corresponds to the condition in which the circuit breaker is closed.

[0034] Figures 7-9 illustrate the steps of the opening of the circuit breaker.

[0035] Figure 7 is a view of the condition of the device that corresponds to the situation in which the circuit breaker is closed. The position of the device in Figure 7 is identical to the one shown in Figure 6.

[0036] As can be seen in Figure 7, the end 17 of the second oscillating member 13 is in a lower position than the end of the bar 7, while the end 16 of the first oscillating member 12 is at the end of the bar 7.

[0037] When the first gear 61 turns, the upper end of the bar 7 moves to the right, with reference to Figure 7, because the end 16 of the first oscillating member prevents its movement to the left.

[0038] The bar 7 moves beyond the second oscillating member 13 and turns the drum 5 counter clockwise to the open position of the circuit breaker, which is visible in Figure 8.

[0039] As the rotation of the first gear 61 continues, the drum 5 remains stationary, while the upper end of the bar 7 slides along the slot 8 and reaches the position shown in Figure 9, in which the position of the slot 8 and of the oscillating members 12 and 13 is symmetrically opposite to the initial position of the opening procedure.

[0040] The condition of the device in Figure 9 is identical to the condition shown in Figure 4.

[0041] Figures 10-12 are perspective views that cor-

respond to the steps of the operations of closing the circuit breaker shown in Figures 4-6.

[0042] Figures 13-15 illustrate the release mechanism of the device according to the present invention.

[0043] The release mechanism comprises a linkage 20, which is actuated by the drum 5 and acts on a set of levers constituted by a double actuation lever 21, a tripping lever 22, a rocker lever 23 and a selection lever 24.

[0044] The selection lever 24 acts on an indicator microswitch 25, while the rocker lever 23 acts on an open/close control microswitch 26 and on a reset control microswitch 27, that are arranged laterally adjacent to the indicator microswitch. The rocker lever 23 also acts on the indicator microswitch 25, as shown more clearly in Figures 19 and 20.

[0045] Figure 13 shows the release mechanism in the condition that corresponds to the open breaker position.

[0046] Figure 14 shows the release mechanism in the condition that corresponds to the closed breaker position.

[0047] Figure 15 shows the release mechanism in the condition that corresponds to the position of the breaker in the tripped condition.

[0048] The control device 1 also comprises an actuation and indication system, which is visible in Figures 19-21. Figures 13-14 also show some components of the indication system.

[0049] The control and indication system comprises the already mentioned microswitches 25, 26 and 27 and an additional motor position microswitch 28, which is controlled by a cam provided on a disk 29 which is jointly connected for rotation to the first gear 61.

[0050] The system comprises an indication option selector 30, which acts on the selection lever 24, which closes the indication microswitch 25.

[0051] When the selector 30 is arranged in the tripped indication position, it is capable of indicating that the breaker has tripped, as shown in Figure 14.

[0052] The control device according to the invention also comprises a disconnection system, better viewed in Figures 16-18.

[0053] The disconnection system comprises a disconnection lever 31, which is pivoted in a fulcrum 32 to the casing 2 and is provided with an operating end 33 and with a control end 36.

[0054] The operating end 33 acts, in contrast with a spring 34, on a pair of laminar contacts 35, that produce the bipolar disconnection of the circuit, i.e., both the phase and the neutral.

[0055] The control end 36 is actuated by a manual control slider 37, which defines three operating positions of the control device, shown in Figures 16, 17 and 18.

[0056] Figure 16 shows the disconnection system in the electrically closed position in which the coupled breaker 101 can be actuated both by means of the control device 1 and manually.

[0057] Figure 17 shows the disconnection system in the electrically open position in which the coupled breaker 101 can be actuated only manually.

[0058] Figure 18 shows the disconnection system in the electrically open and lockable position. In this position, the coupled breaker 101 cannot be actuated in any way. The slider 37 can be padlocked, by using a hole 38 in which the bolt of a padlock is inserted in order to prevent the slider from being movable into the operating positions.

[0059] The action for moving the lever 37 in the lockable position causes in any case the opening of the breaker if it was not opened beforehand.

[0060] The operation of the control device according to the present invention is controlled by means of control buttons that include, as can be seen in the diagram of Figure 21, an opening button 39, a closing button 40 and a reset button 41.

[0061] Figure 21 illustrates operation of the control and indication system of the device.

[0062] In practice it has been found that the invention achieves the intended aim and objects.

[0063] The control device according to the present invention is extremely compact: its dimensions are in fact reduced to the equivalent of just two modules, as shown schematically in Figure 3, in which the width of a module, according to DIN standards, is designated by the reference letter M.

[0064] Such small dimensions have been achieved first of all by virtue of the adoption of a single motor, of a winding, and of the particular actuation mechanism, which allows reversal of the direction of rotation of the actuation drum.

[0065] This application claims the priority of Italian Patent Application No. M12008A001009, filed on June 3, 2008, the subject matter of which is incorporated herein by reference.

Claims

1. A control device for circuit breakers, comprising a casing, which can be coupled to an electrical device, such as a circuit breaker provided with a control for opening and closing the contacts, said casing comprising a drum, which is kinematically associated with said control for opening and closing the contacts of said circuit breaker; **characterized in that** said control device comprises a single electric motor which actuates a gear train by means of a worm screw, said gear train being adapted to turn said drum in one direction or the other by means of a rotation switching means.
2. The control device according to claim 1, **characterized in that** it comprises a release mechanism, which defines at least three distinct conditions: a condition that corresponds to the open breaker position, a condition that corresponds to the closed breaker position, and a condition that corresponds to the position in which the breaker is in the tripped condition.

3. The control device according to claim 1 or 2, **characterized in that** it comprises a control and indication system.
4. The control device according to one or more of the preceding claims, **characterized in that** it comprises a disconnection system, which defines at least three operating positions of the control device: an electrically closed position, in which said breaker can be actuated both by the control device and manually; an electrically open position, in which said breaker can be actuated only manually; an electrically open and lockable position, in which said breaker cannot be actuated in any way.
5. The control device according to one or more of the preceding claims, **characterized in that** the said casing has a standardized shape, according to DIN standards, and forms, at a rear face, a means for coupling to other devices which are associated with an omega rail.
6. The control device according to one or more of the preceding claims, **characterized in that** said casing has, at the front face, a protrusion in which said actuation drum is positioned.
7. The control device according to one or more of the preceding claims, **characterized in that** said actuation drum is connected to the mechanism of the breaker by means of a bar which has a triangular cross-section and constitutes the rotation axis of said drum, so that the rotation of the drum corresponds exactly to the rotation of a drum of the breaker which is provided with an external actuation lever or handle.
8. The control device according to one or more of the preceding claims, **characterized in that** said actuation drum is associated with said gear train by means of a bar; said bar has a first end which is pivoted to a first gear of said gear train and a second end which can slide within a slot of a member which is jointly connected to said drum.
9. The control device according to one or more of the preceding claims, **characterized in that** said gear train draws motion from said worm screw actuated by said electric motor constituted by a single-phase synchronous motor.
10. The control device according to one or more of the preceding claims, **characterized in that** it comprises a one-way or freewheel bearing, which allows the worm screw to turn in a single direction.
11. The control device according to one or more of the preceding claims, **characterized in that** said gear train moves said bar, which turns said drum alternately in one direction or the other, by the action of two contoured oscillating members; a first oscillating member is pivoted in an upper region in a fulcrum and has a bevelled end, which is pushed in the direction of the axis of the drum by a contrast spring; a second oscillating member is pivoted in an upper region in a fulcrum and has a bevelled end which is pushed in the direction of the axis of said drum by a contrast spring; said contoured oscillating members act on said second end of the bar so that it moves in one direction or in the opposite direction, depending on whether said drum has to be turned in the direction of rotation of opening the handle of the breaker or in the direction of rotation of closing said handle.
12. The control device according to one or more of the preceding claims, **characterized in that** said release mechanism comprises a linkage, which is actuated by said drum and acts on a set of levers constituted by a double actuation lever, a tripping lever, a rocker lever and a selection lever; said selection lever acts on an indication microswitch; said rocker lever acts on an open/close control microswitch and on a reset control microswitch, that are laterally adjacent to said indication microswitch; said rocker lever also acts on said indication microswitch.
13. The control device according to one or more of the preceding claims, **characterized in that** said control and indication system comprises said open/close control, reset control and indication microswitches and also comprises a motor position microswitch, which is actuated by a cam provided on a disk which is jointly connected to said first gear for rotation; said control and indication system comprises an indication option selector acting on said selection lever which closes said indication microswitch, in the condition in which the breaker has tripped, when the selector is arranged in the tripped indication position.
14. The control device according to one or more of the preceding claims, **characterized in that** said disconnection system comprises a disconnection lever, which is pivoted to said casing at a fulcrum and is provided with an operating end and with an actuation end; said operating end acts, in contrast with a spring, on a pair of laminar contacts which provide the bipolar disconnection of the circuit, i.e., both the phase and the neutral.
15. The control device according to one or more of the preceding claims, **characterized in that** said actuation end is actuated by a manual control slider, which defines said three operating positions of the control device.
16. The control device according to one or more of the

preceding claims, **characterized in that** in said electrically open and lockable position, said slider can be padlocked by using a hole within which the bolt of a padlock is inserted in order to prevent the slider from being movable into the operating positions. 5

17. The control device according to one or more of the preceding claims, **characterized in that** the operation of the device is controlled by means of control buttons which comprise an opening button, a closing button and a reset button. 10

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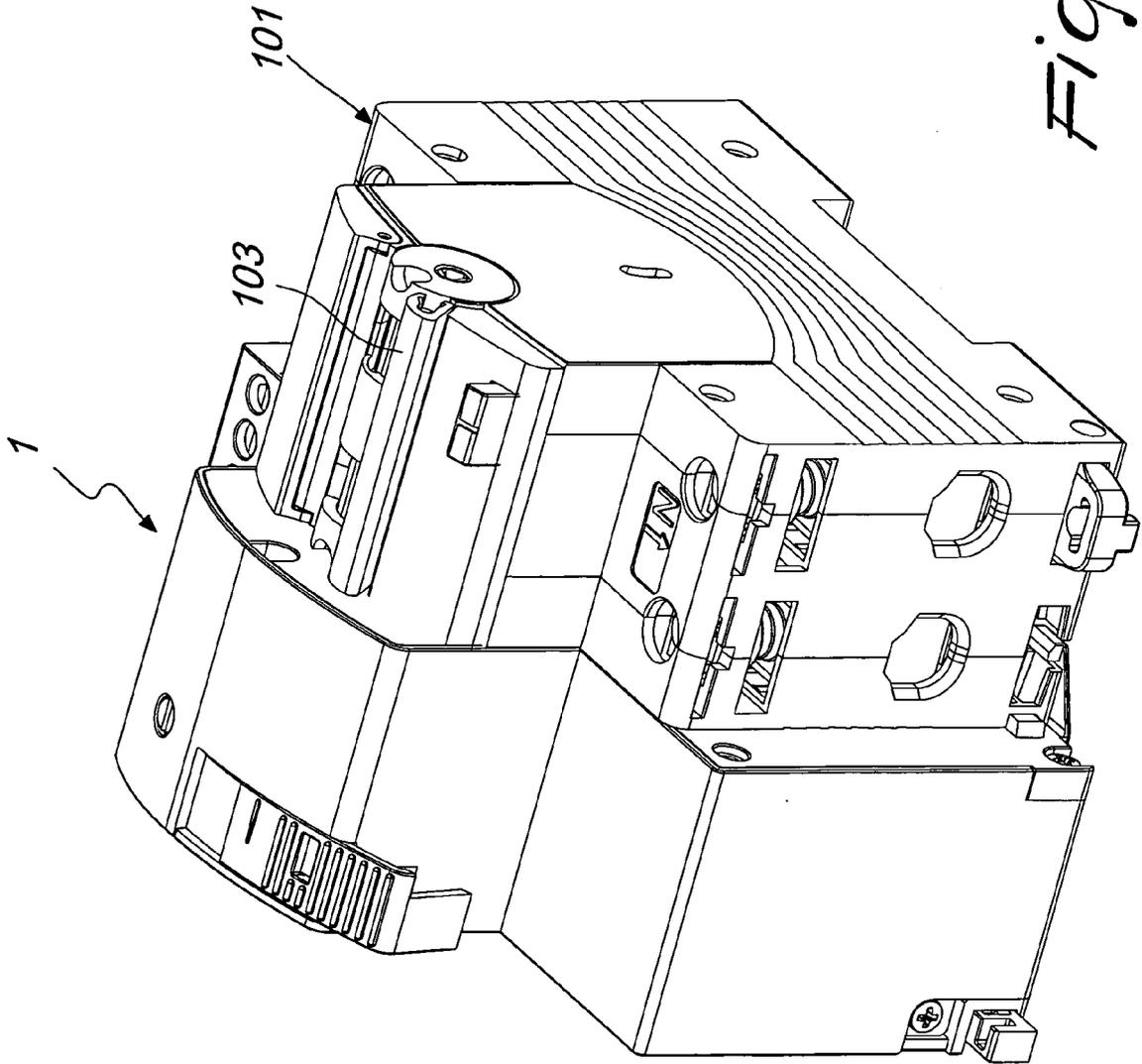


Fig. 1

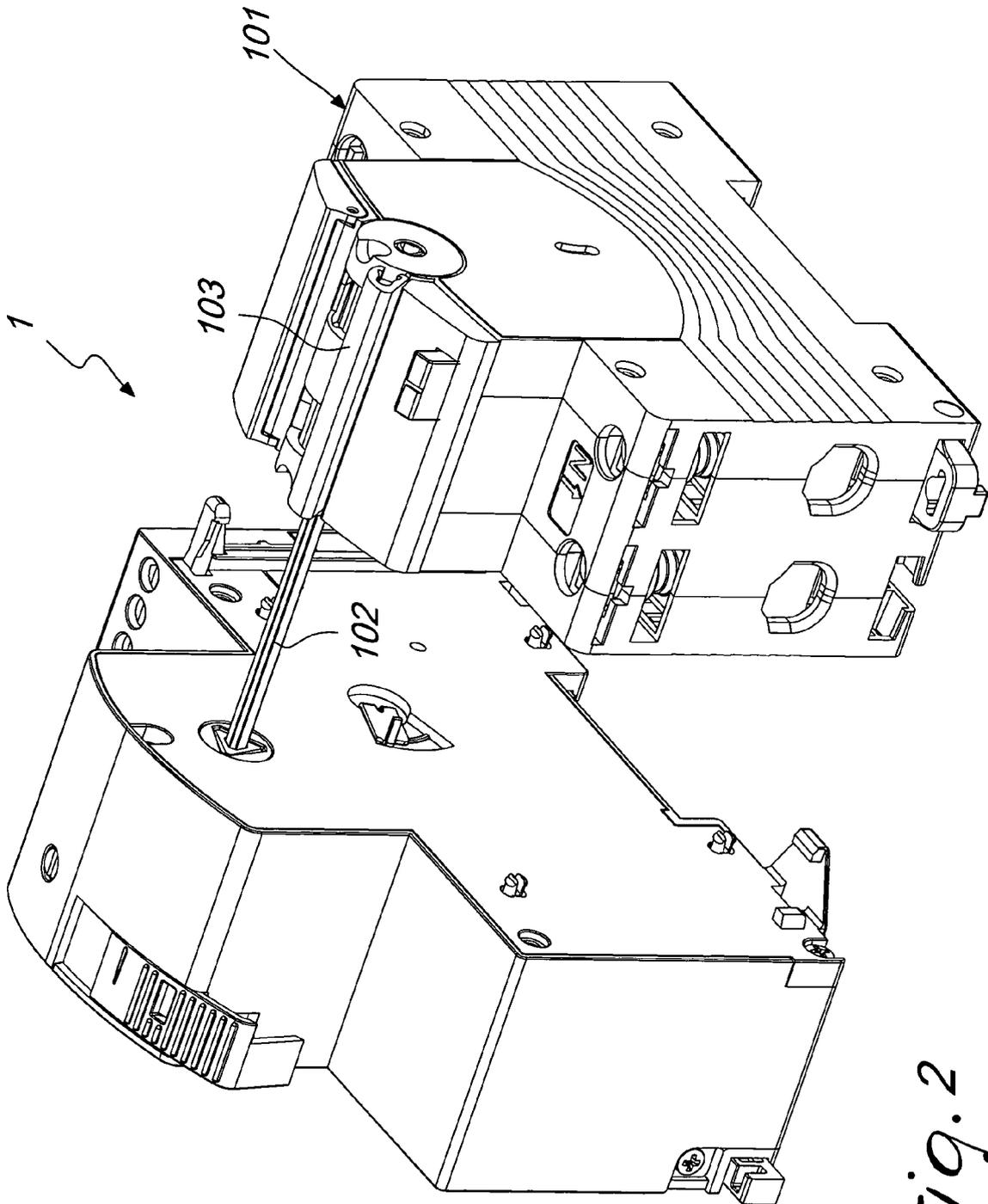


Fig. 2

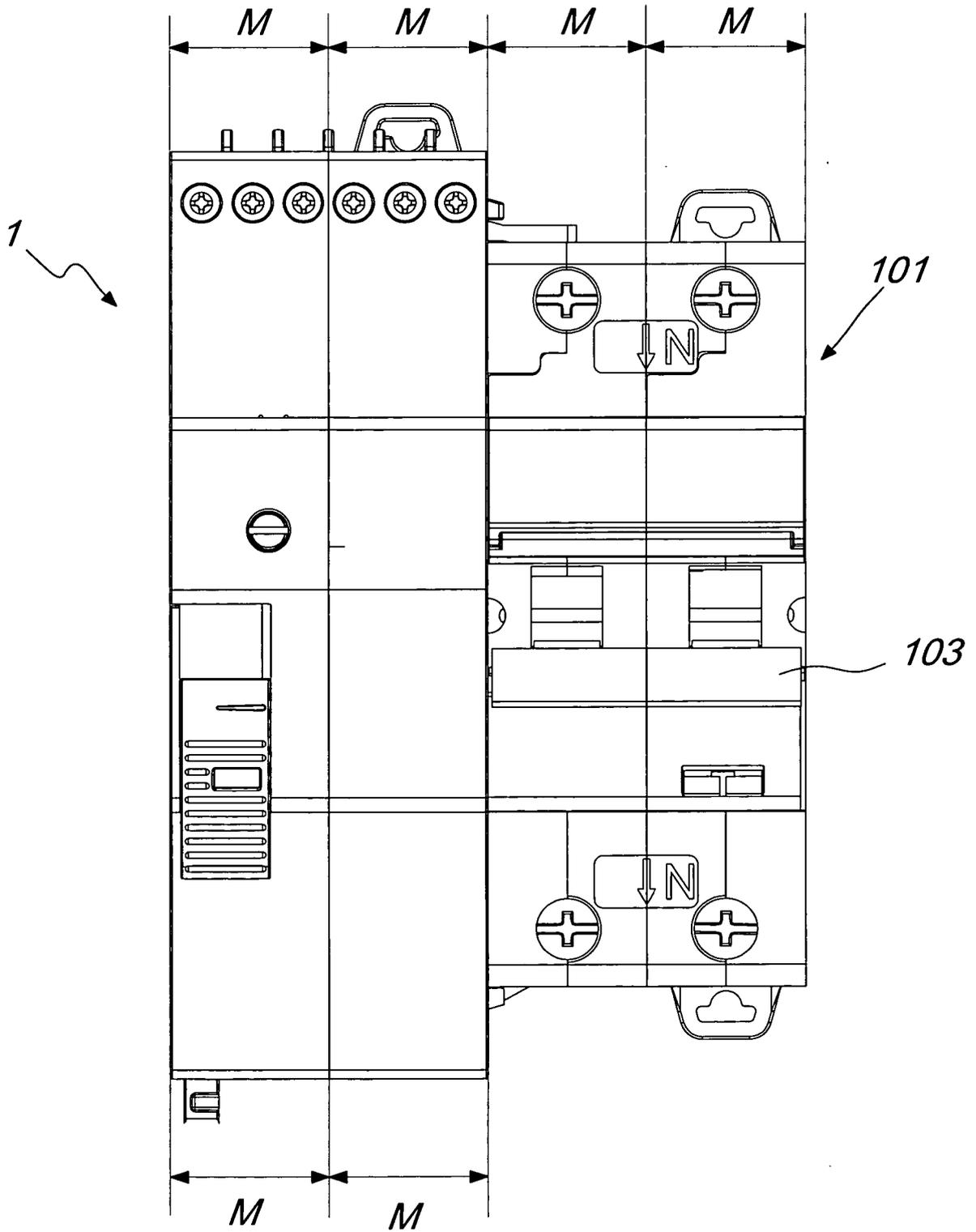
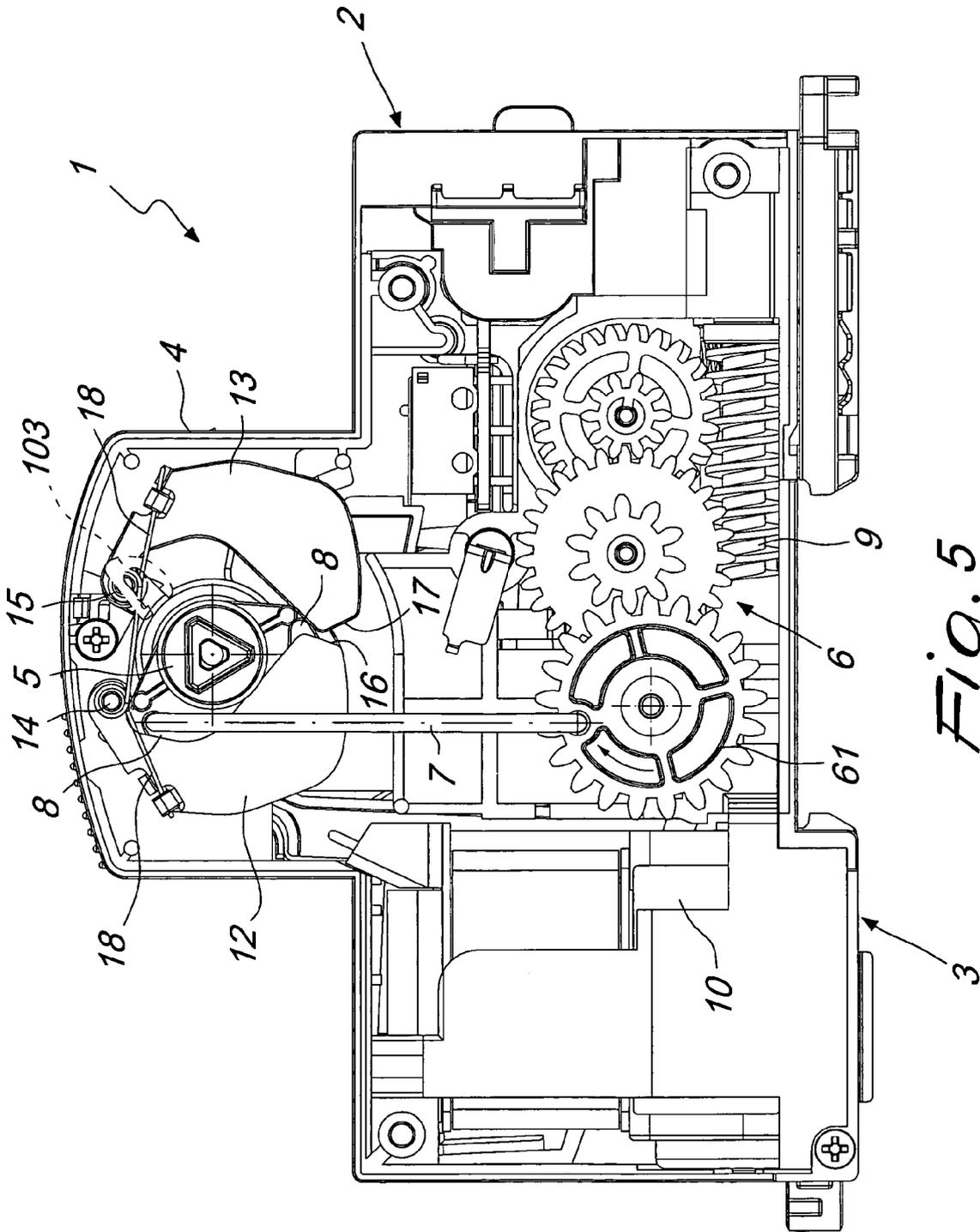


Fig. 3



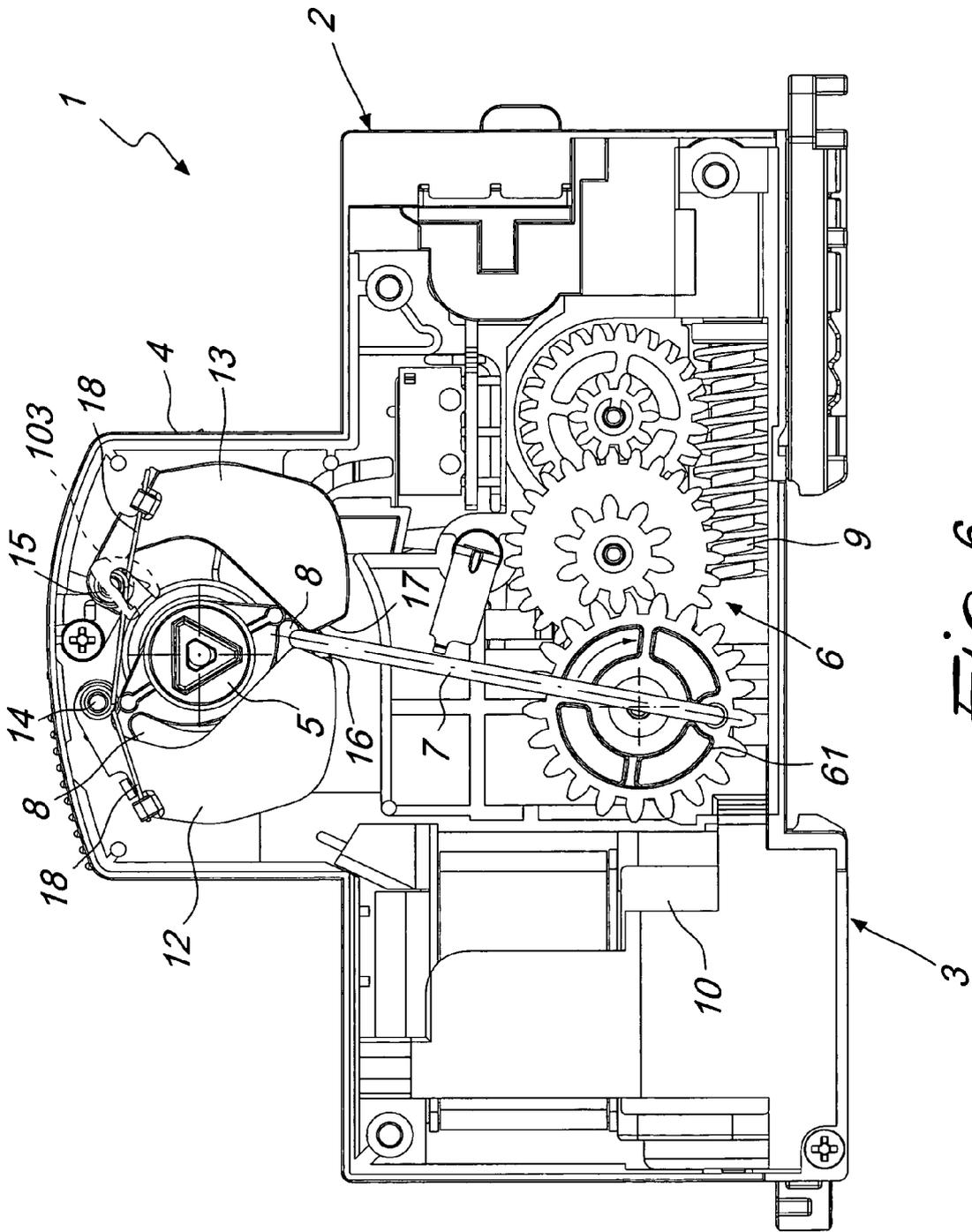
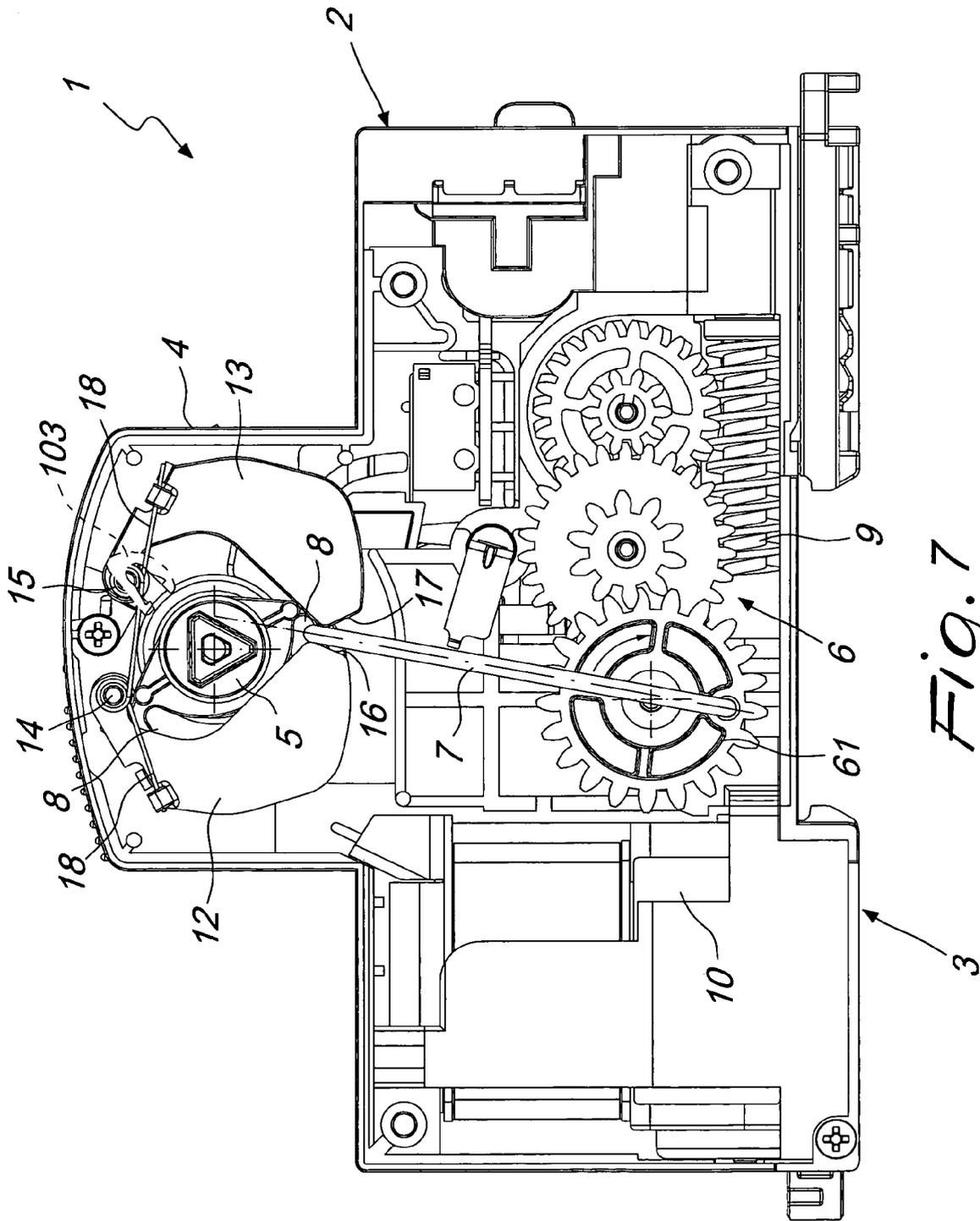
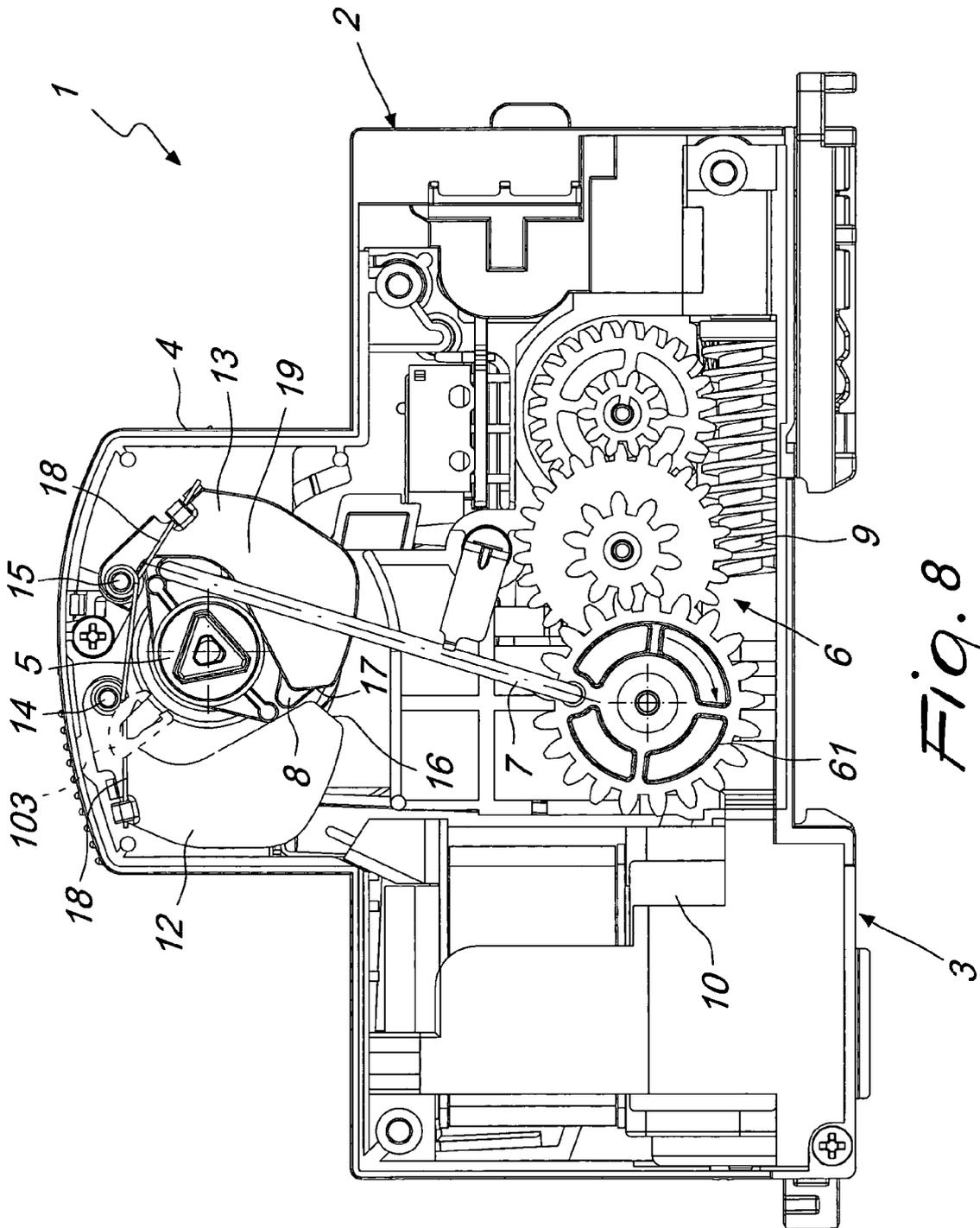


Fig. 6





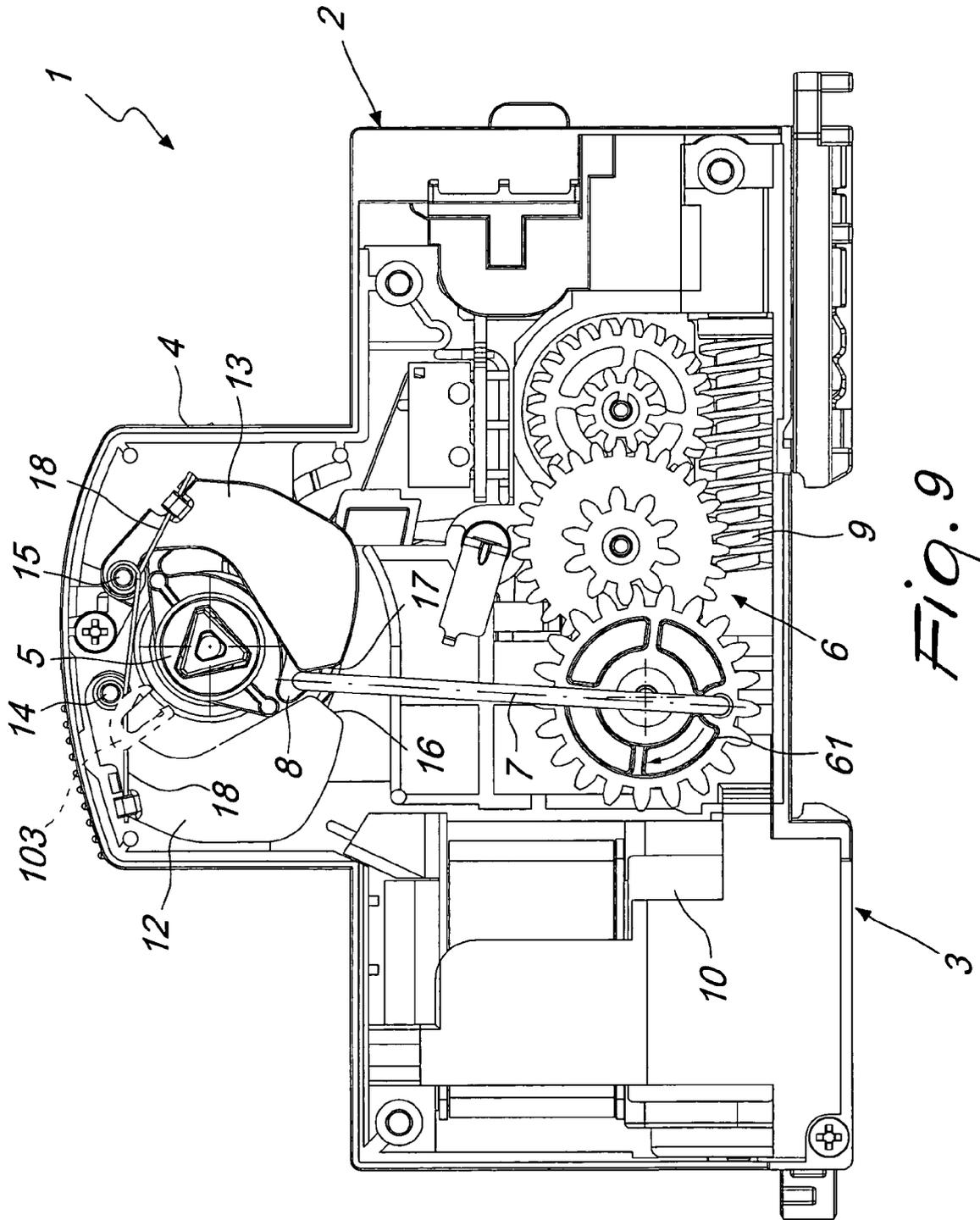


Fig. 9

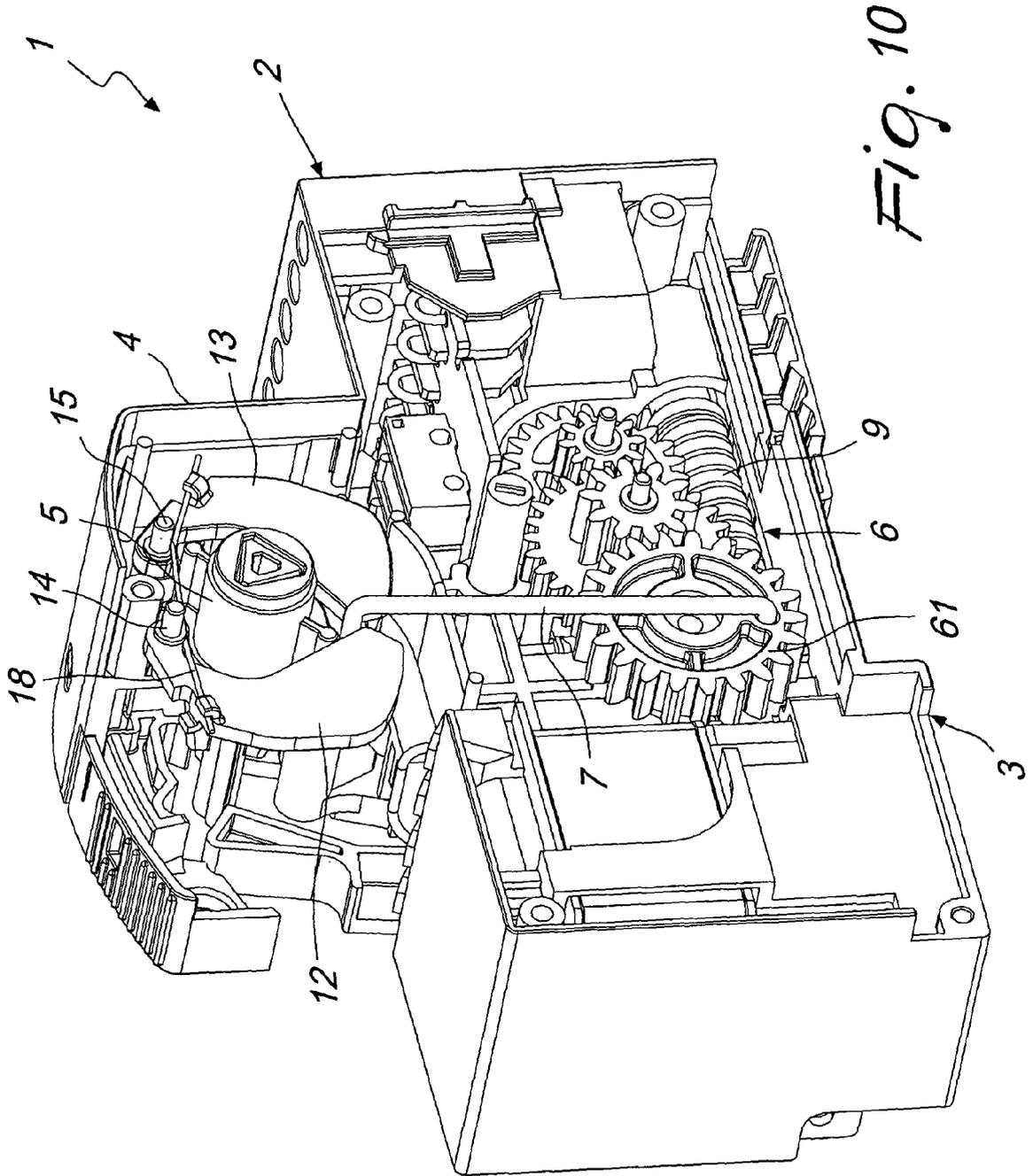


Fig. 10

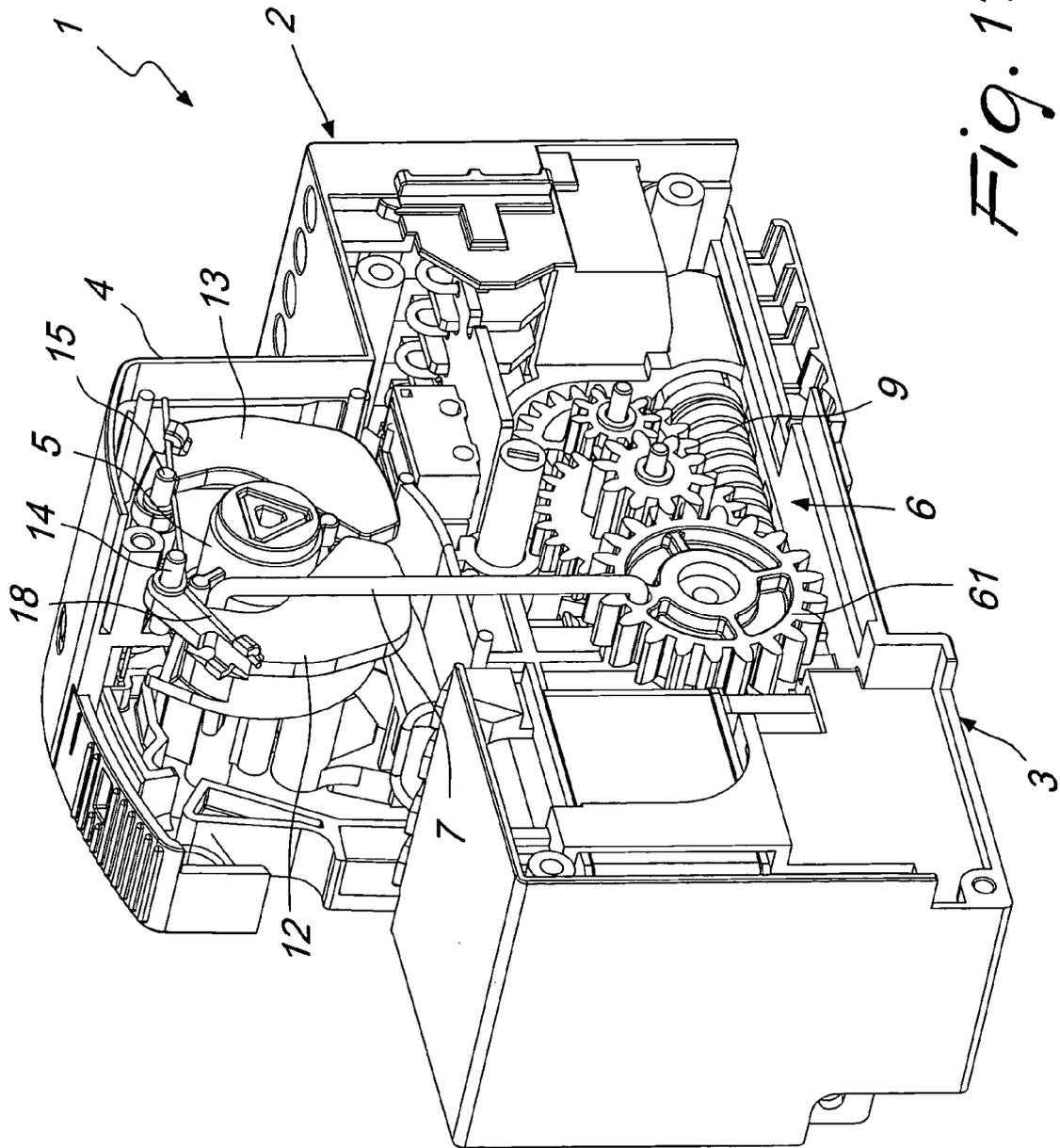


Fig. 11

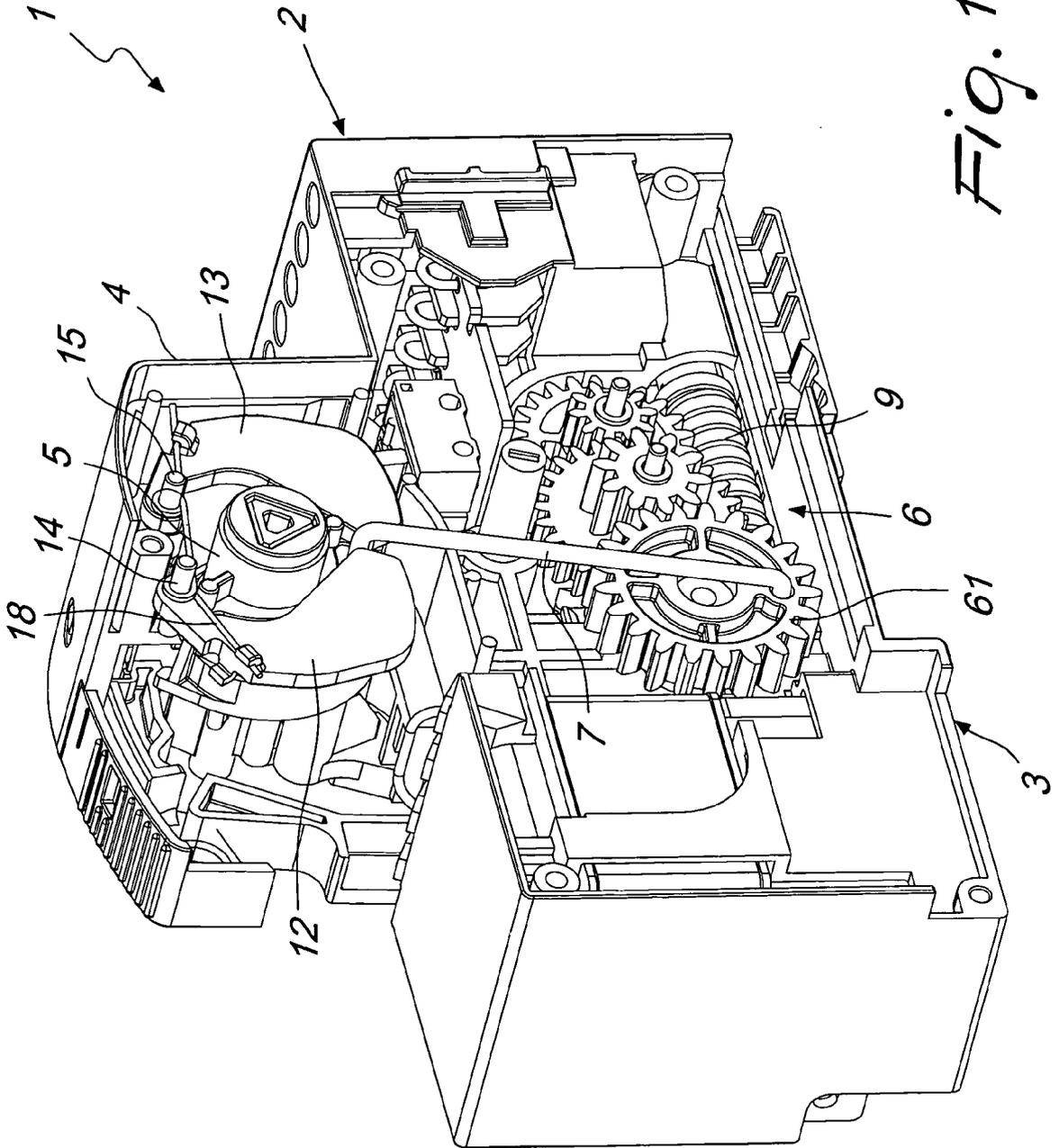


Fig. 12

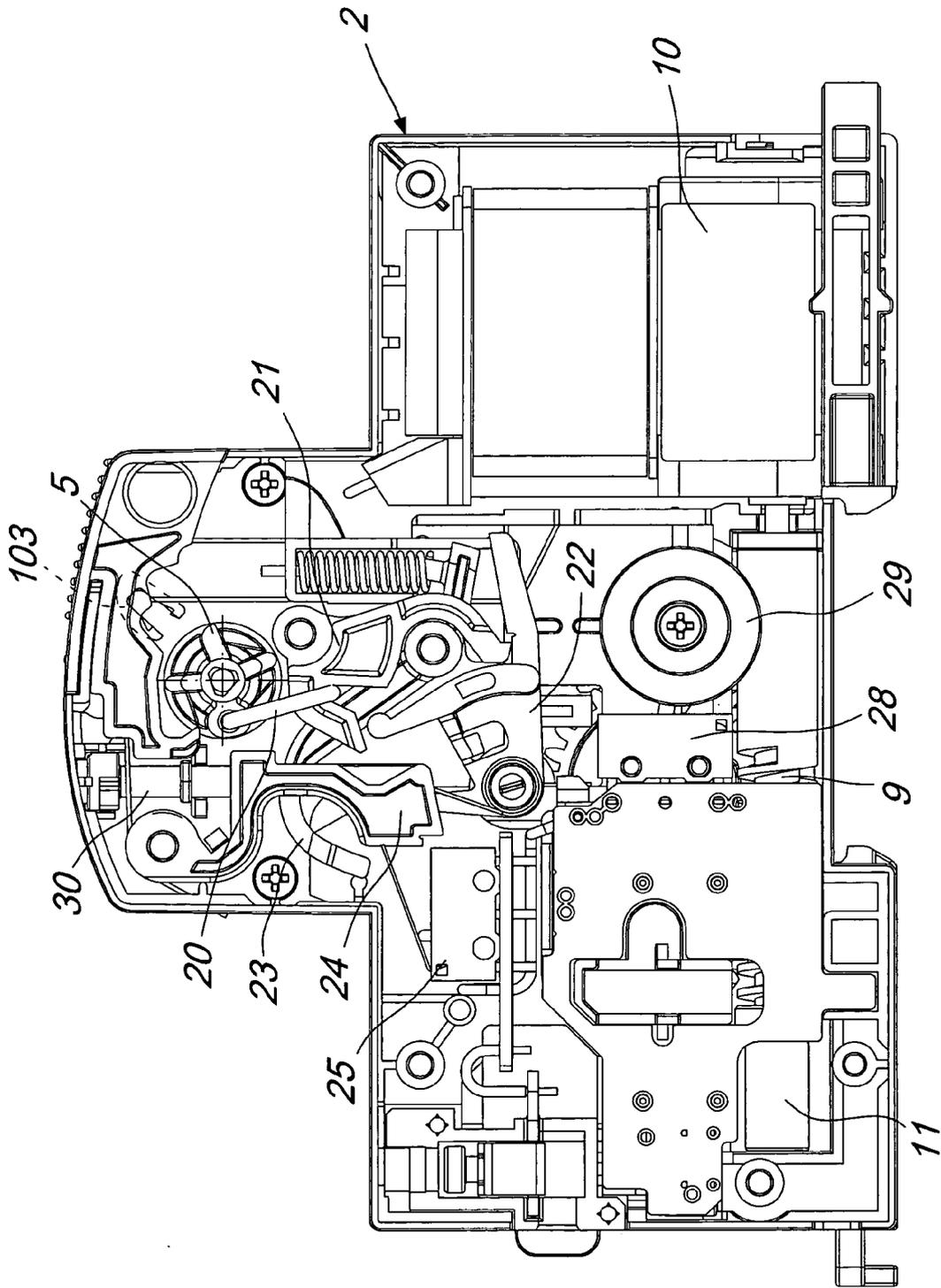


Fig. 13

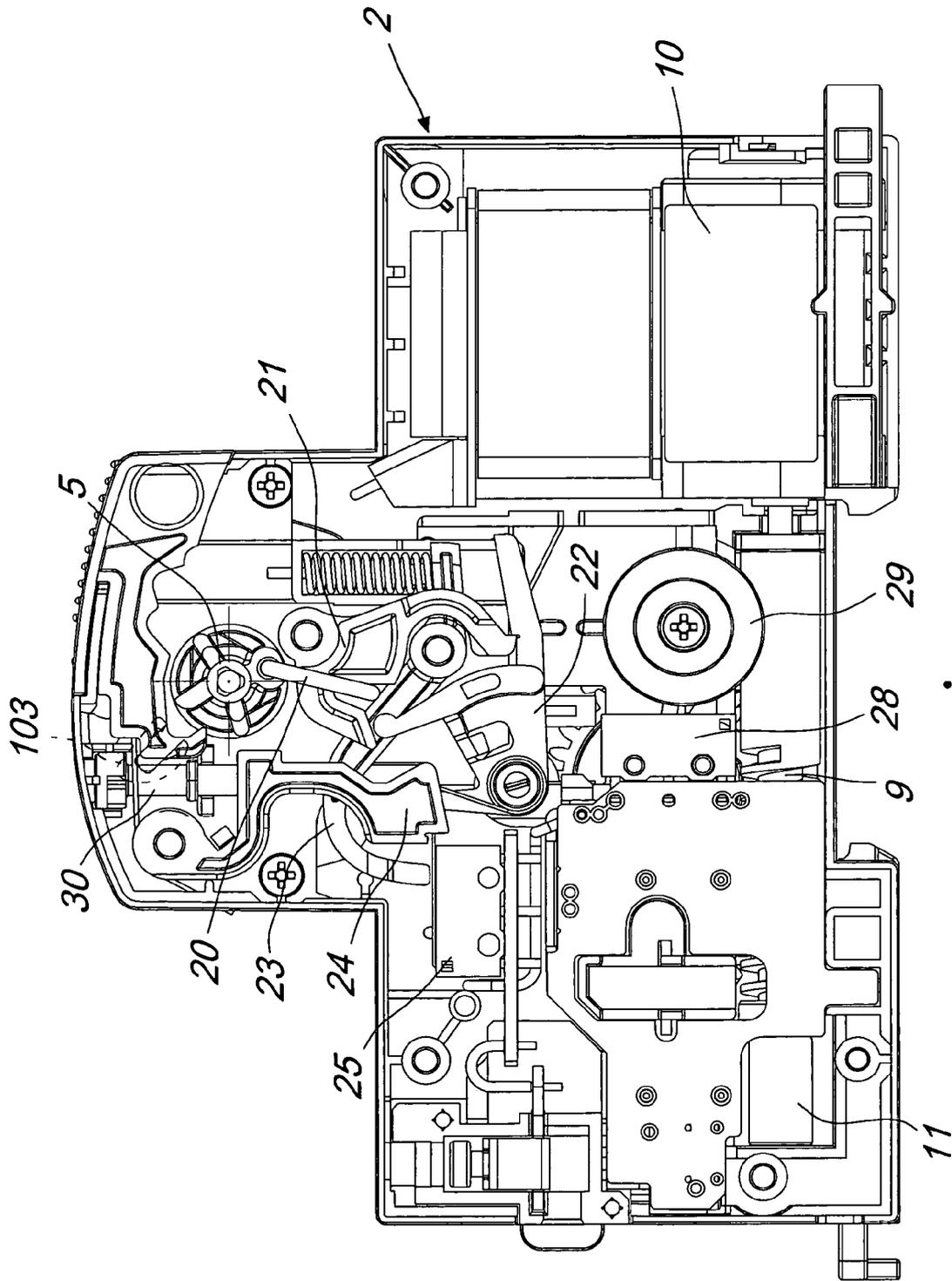


Fig. 14

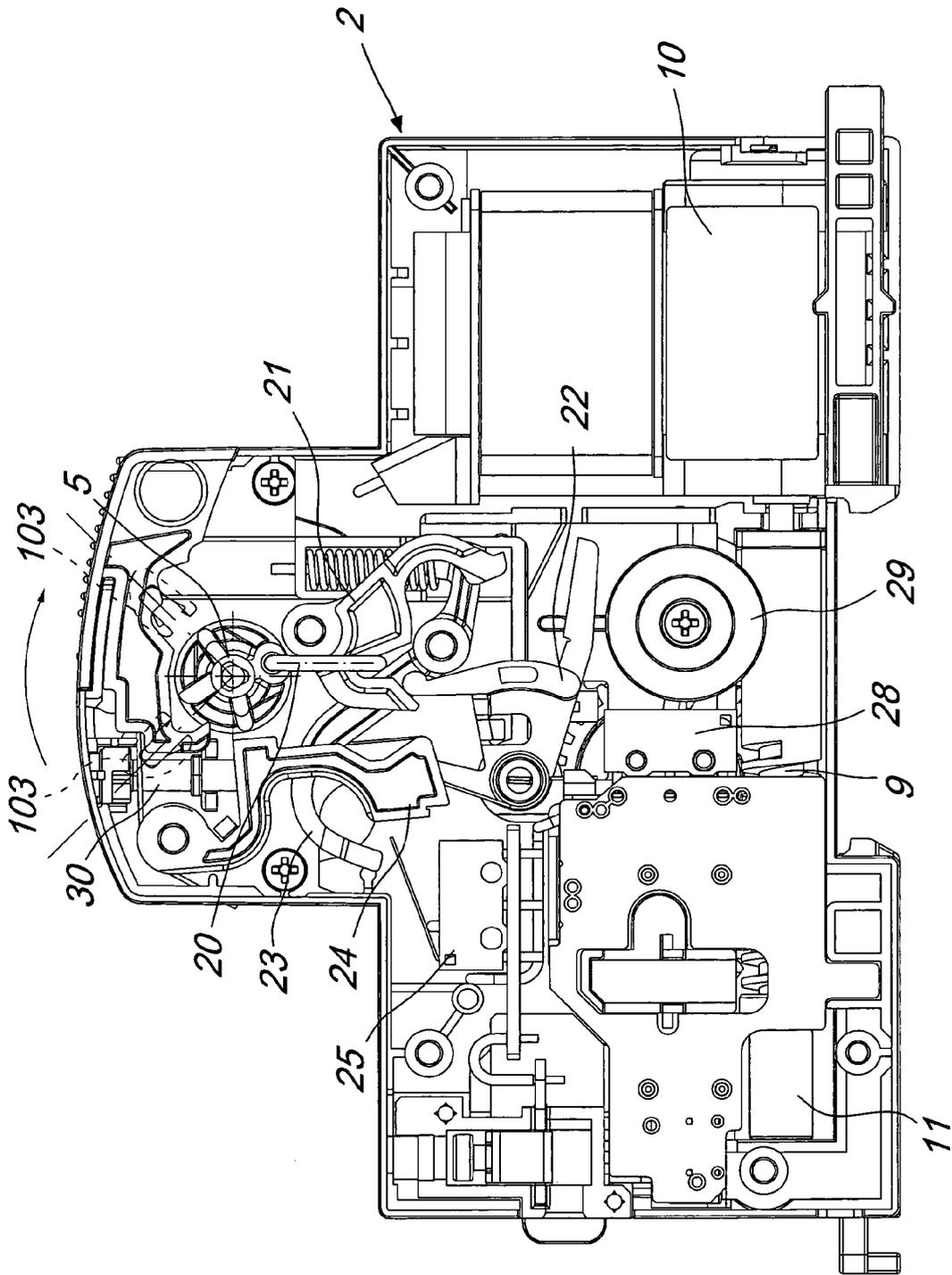
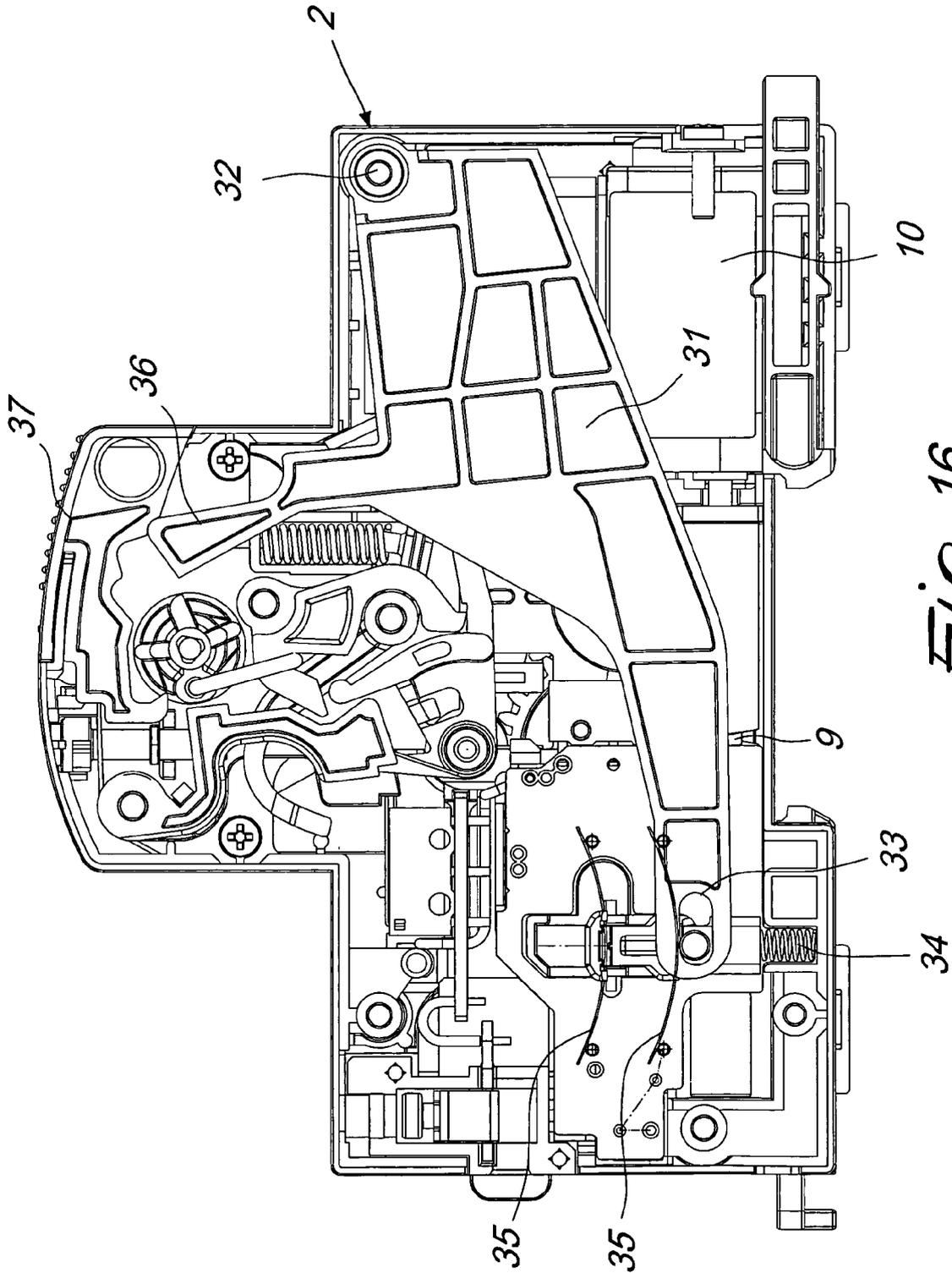


Fig. 15



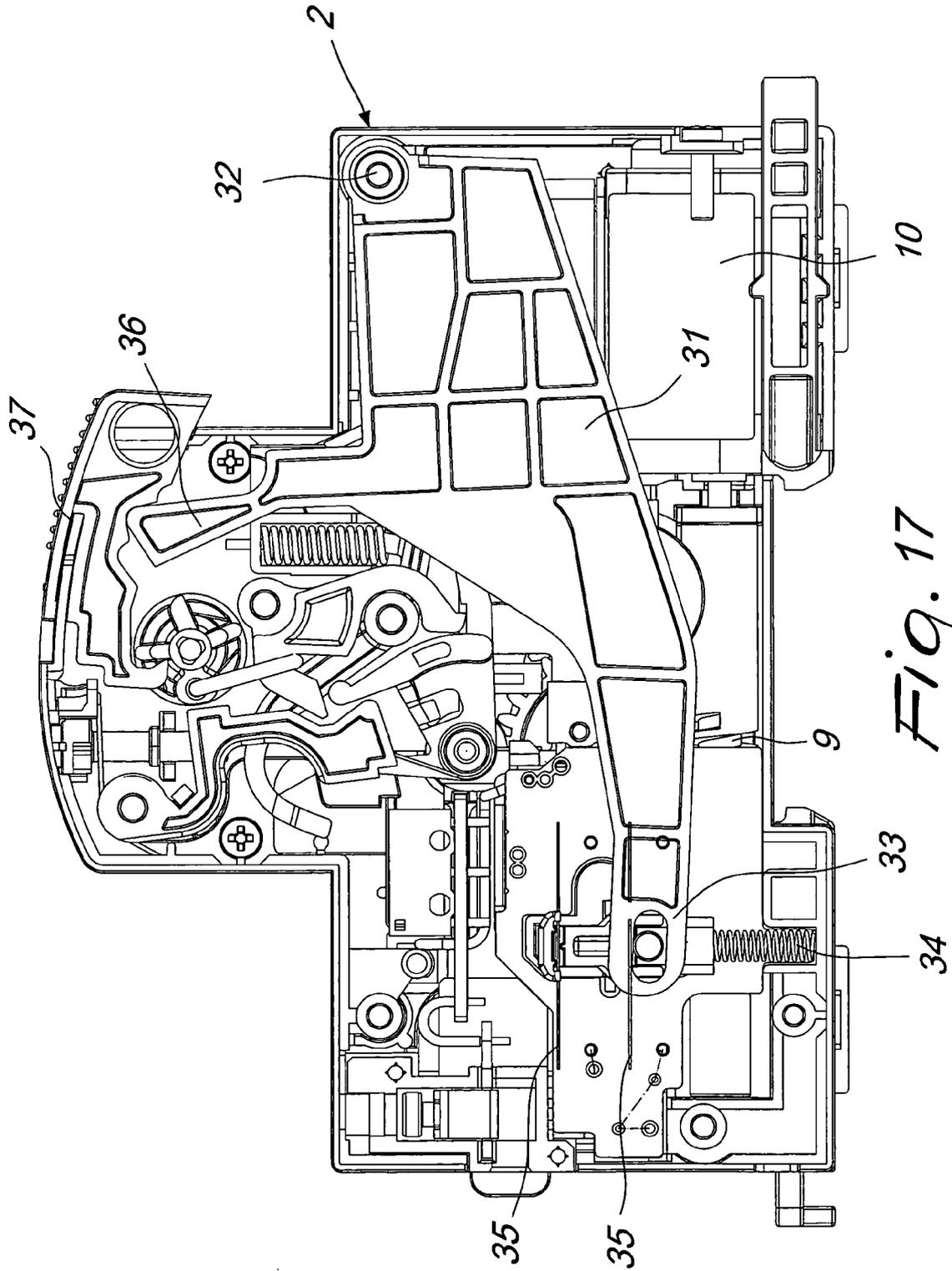
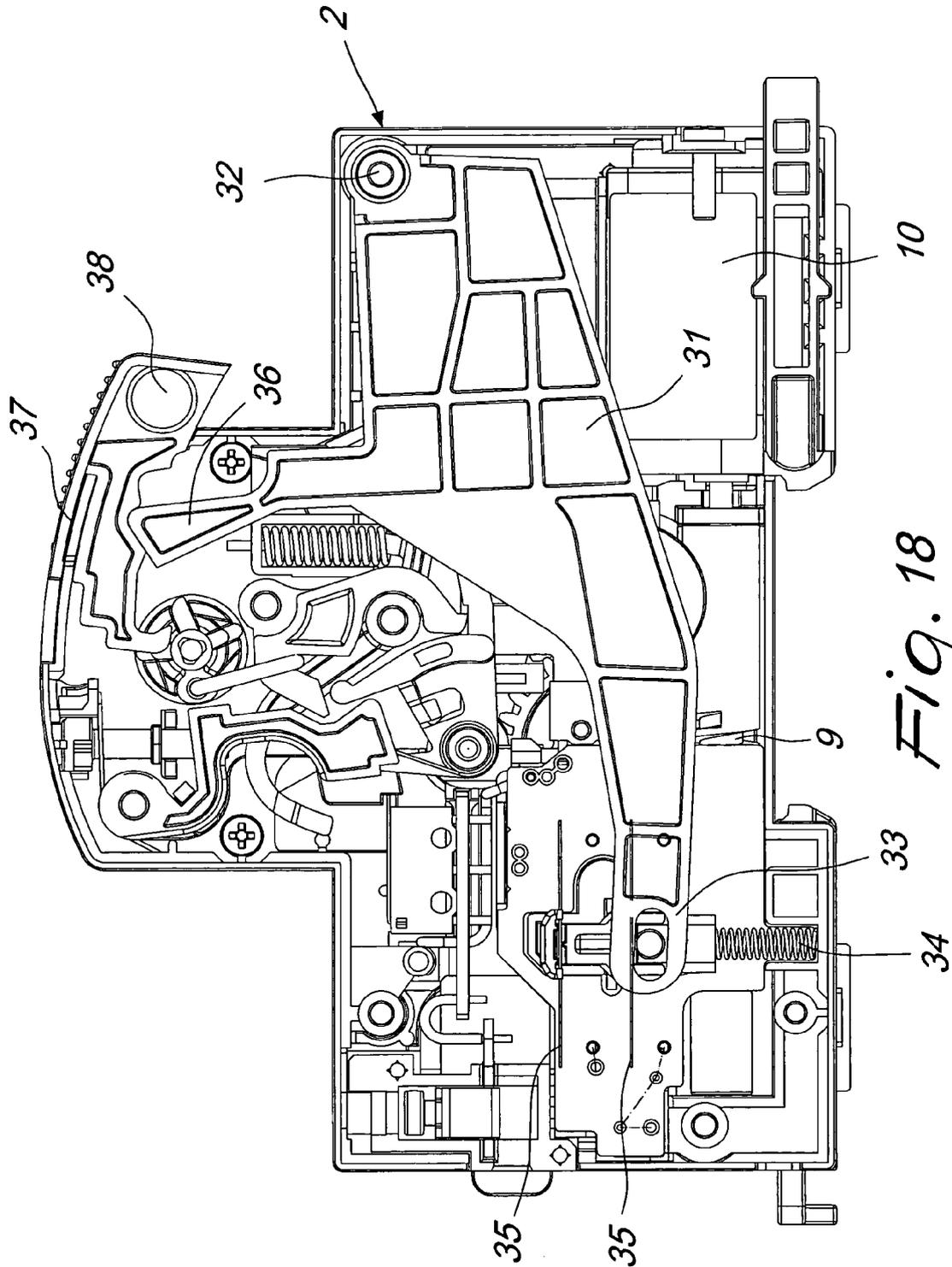


Fig. 17



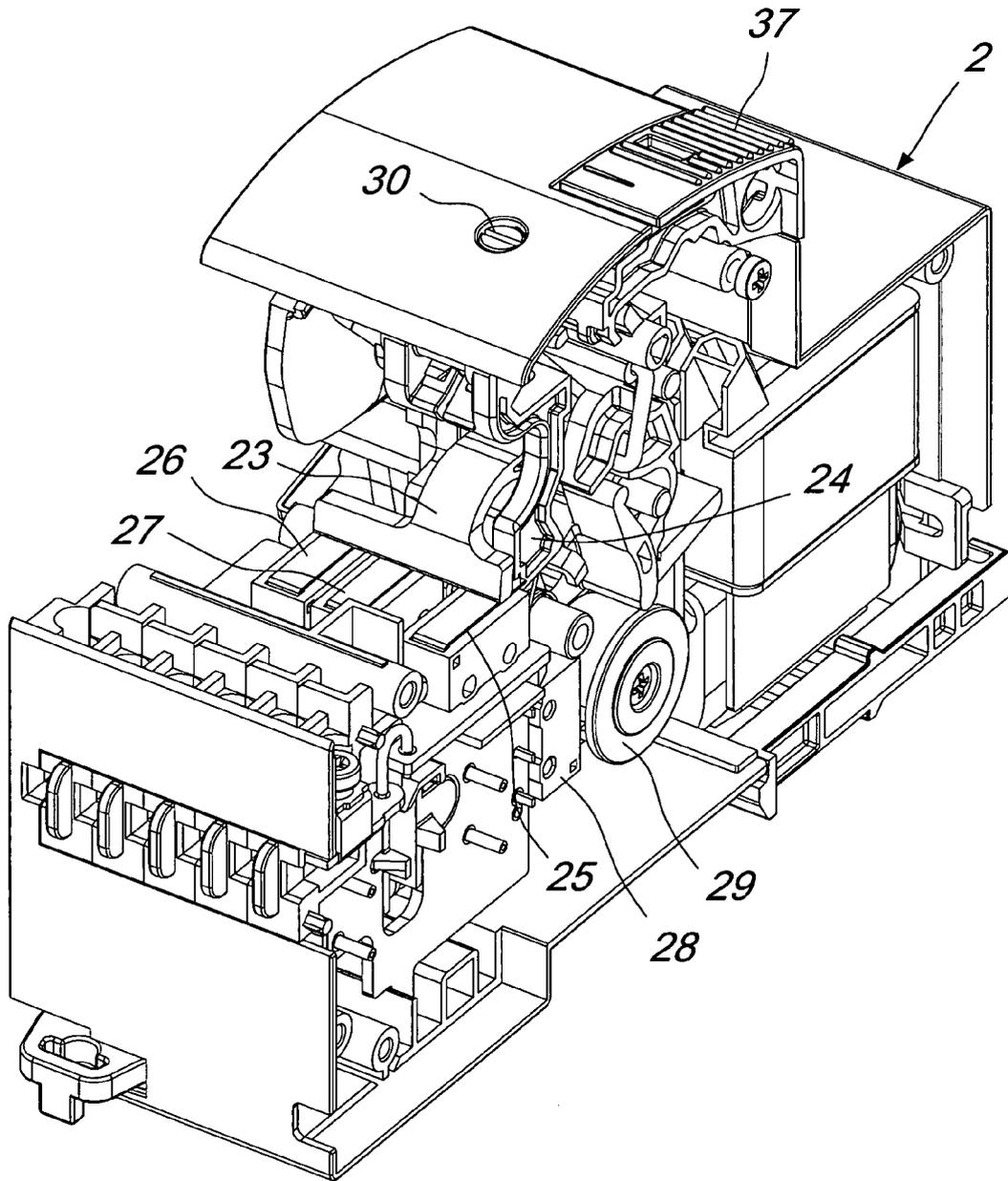


Fig. 19

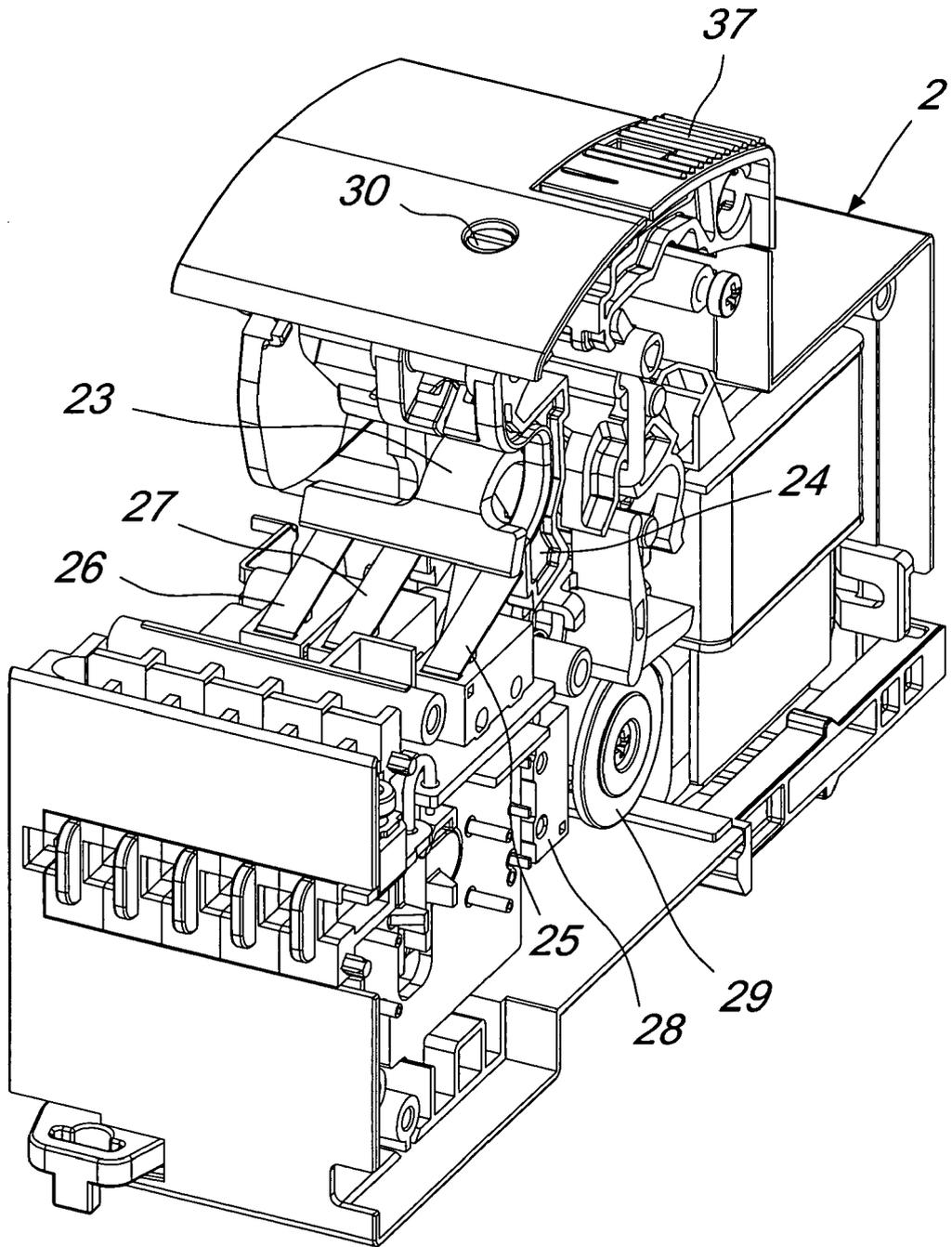


Fig. 20

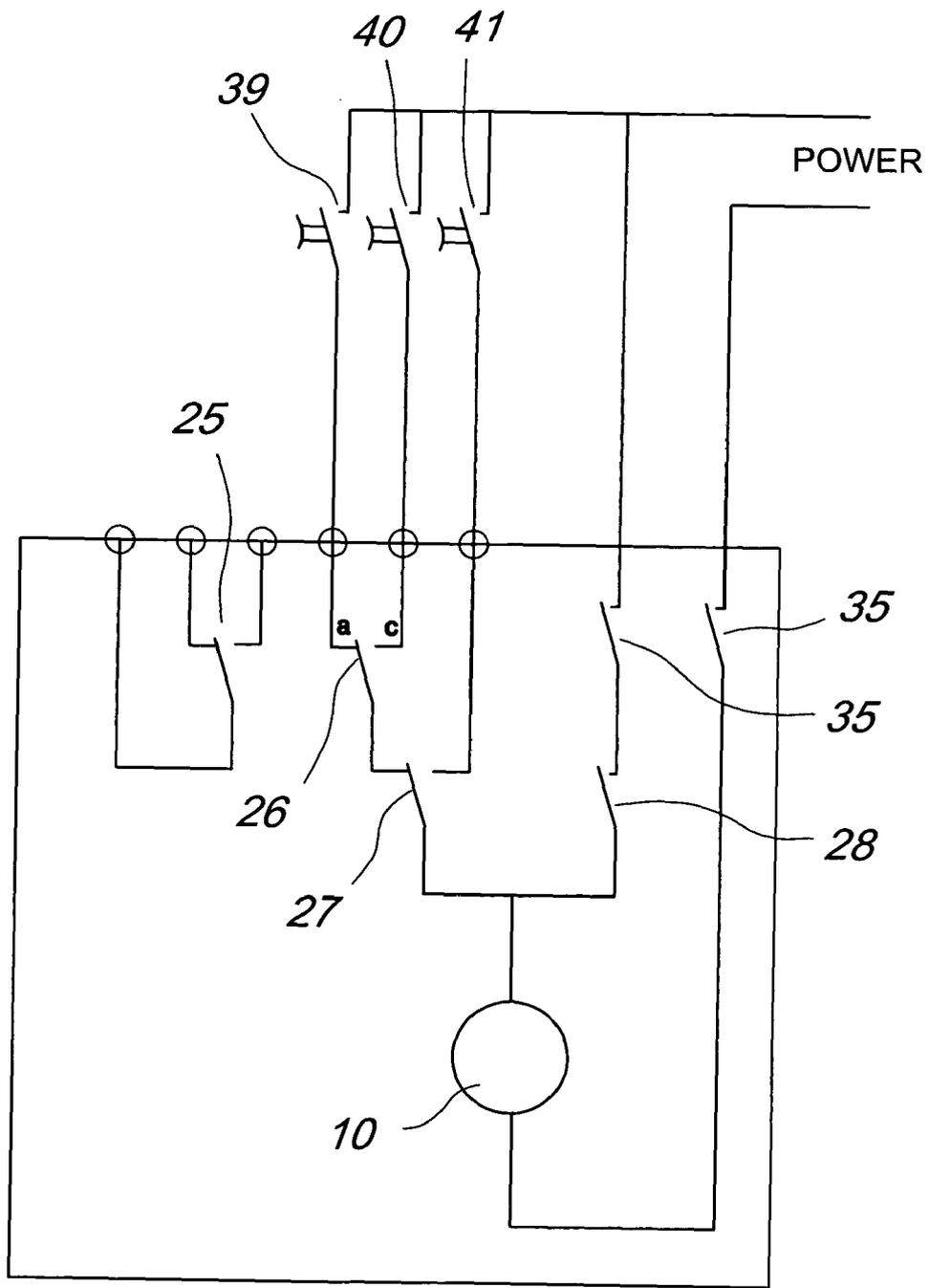


Fig. 21



EUROPEAN SEARCH REPORT

Application Number
EP 08 01 7546

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 531 938 B1 (SMITH JOSEPH R [US] ET AL) 11 March 2003 (2003-03-11)	1,5-10	INV. H01H3/40 H01H71/70 H01H3/46
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			H01H
1	Place of search Munich	Date of completion of the search 8 September 2009	Examiner Nieto, José Miguel
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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08-09-2009

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