

(19)



(11)

EP 2 178 101 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

21.04.2010 Bulletin 2010/16

(51) Int Cl.:

H01H 71/74 (2006.01)

(21) Application number: **09171999.7**

(22) Date of filing: **01.10.2009**

(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 MK MT NL NO PL
PT RO SE SI SK SM TR**

Designated Extension States:

AL BA RS

(30) Priority: **15.10.2008 IT MI20080335 U**

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(54) **Low voltage circuit breaker**

(57) There is described a low voltage circuit breaker (1) for opening and closing electrical contacts, provided with a thermal safety system (3) of the bimetal type with a release lever (5) capable of operating opening means (2) suitable to force opening of the electrical contacts and a bimetal (4) with a constrained portion (4a) and a free portion (4b) capable of intercepting the insertion lever (5); calibration means (6) are provided to calibrate the position of the bimetal (4) which comprise a pusher (7) thrusting the bimetal (4) so as to set the position of the bimetal (4); the pusher (7) is movable both by axial intrusion and by peripheral action.

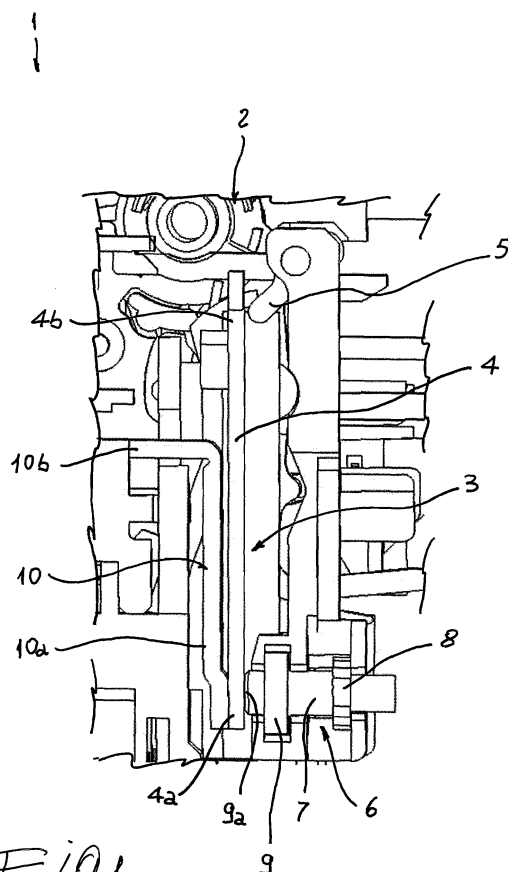


Fig. 1

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Description

[0001] The present invention relates to a low voltage circuit breaker.

[0002] There is known a circuit breaker, in particular for low voltages and for domestic environments for connection between a distribution network upstream and loads downstream. This circuit breaker is positionable between a closed position, in which it creates an electrical and mechanical contact between movable contact elements and fixed contact elements, and an open position, such that electrical and mechanical contact is inhibited.

[0003] A circuit breaker of this kind comprises safety means capable of detecting potentially hazardous situations and of autonomously opening said circuit breaker.

[0004] Between the safety means there is known a bending thermal safety system with a bimetal strip, capable of detecting the presence of overloads for a pre-determined period of time and of opening the contacts as a result of this detection. Operation of this system is based on the difference in the coefficient of thermal expansion of different metals. A safety system of this kind uses a bimetal formed by two metal strips, made of different materials, mutually fastened and through which electrical current passes, which flows through the contacts and heats, by Joule effect, the two strips, which tend to expand according to lengths corresponding to the relative coefficients of thermal expansion. This causes bending of the bimetal, which bends until it intercepts a release lever of opening means, which are tripped to take the contacts to an open position.

[0005] It is clear that the mutual position between bimetal and the insertion lever is of critical importance for correct operation of the thermal safety system, and is achieved through calibration operations which are not easy.

[0006] Moreover, it must be considered that an increasing number of circuit breakers are housed in irreversibly sealed enclosures, and therefore a thermal safety system already housed in a sealed enclosure cannot be re-calibrated.

[0007] The purpose of the present invention is to simplify mutual positioning operations and to simplify calibration of a thermal safety system.

[0008] In accordance with the invention, this problem is solved by a low voltage circuit breaker for opening and closing electrical contacts, provided with a thermal safety system of the bimetal type with:

- opening means suitable to force opening of said electrical contacts,
- a release lever suitable to operate said opening means,
- a bimetal with a constrained portion and a free portion suitable to intercept said insertion lever so as to operate said opening means;

provided with calibration means to calibrate the position

of said bimetal, said calibration means comprising a pusher thrusting said bimetal so as to set the position of said bimetal, **characterized in that** said pusher is movable both by axial intrusion and by peripheral action.

[0009] In this manner, it is possible to perform pre-calibration through an instrument with axial intrusion, and fine calibration/re-calibration through a peripheral action.

[0010] Preferably, the pusher is supported by a fixed support through a threaded coupling, so as to allow axial movement of the pusher by rotation of said pusher.

[0011] Preferably, said peripheral action for movement of the pusher is obtained by means of a toothed wheel emerging peripherally so as to allow a peripheral action of rotation of the pusher. Preferably, this toothed wheel has a greater radius with respect to the radius of the pusher and is positioned in proximity to the housing of the circuit breaker, in a position that can be reached from the outside through an opening produced in the housing. In this manner, the toothed wheel can also be operated from the outside, once the enclosure has been closed.

[0012] Preferably, said axial intrusion is obtained through a screwing means, preferably of the Allen key type, such as an electrical Allen key, which is inserted in an internal axial cavity of the pusher.

[0013] Preferably, the constrained portion of the bimetal is fastened to a striker support which exerts an elastic reaction force to the thrust of the pusher so as to hold the constrained portion tightly between the pusher and the striker support. Preferably, the free portion of the bimetal is located at one end of said bimetal facing the insertion lever. Preferably, the constrained portion of the bimetal is located at the other end of the bimetal.

[0014] Further characteristics and advantages of the present invention will be more apparent from the description of preferred, but not exclusive, embodiments of the present invention shown by way of example in the accompanying drawings, wherein:

- Fig. 1 shows an internal view of a low voltage circuit breaker (1), according to the present invention in a pre-calibration position;
- Fig. 2 shows a three-dimensional view of some particulars of Fig. 1;
- Fig. 3 shows an internal view of the low voltage circuit breaker (1) in a calibrated position;
- Fig. 4 shows a three-dimensional view of some particulars of Fig. 3.

[0015] With reference to the accompanying figures, the number 1 indicates as a whole a low voltage circuit breaker 1, hereinafter also indicated simply as circuit breaker 1. This circuit breaker 1 is capable of opening and closing electrical contacts in a known manner.

[0016] The circuit breaker 1 also comprises a thermal safety system 3 of the bimetal type.

[0017] The thermal safety system 3 comprises a bimetal 4 formed by a tongue with double metal strip in two different metals and with different coefficient of thermal

expansion. This bimetal 4 is suitable to allow an electrical current to pass through it so that it bends as a result of the heat caused by the electrical current and by the subsequent different expansion between the two strips forming the bimetal.

[0018] This bimetal 4 (which in the drawings extends vertically) has a free portion 4b, located at one end of the bimetal 4 (in the upper position in the accompanying drawings) and a constrained portion 4a, located on another end of the bimetal 4 (in the lower position in the accompanying drawings).

[0019] The constrained portion 4a is fastened to a striker support 10, which in the present example is composed of an L-shaped metal support with a fixed arm 10b (positioned horizontally in the drawings) and an elastic arm 10a (positioned vertically in the drawings), and is capable of supporting the bimetal 4. The elastic arm 10a is capable of elastically opposing thrust forces acting on the bimetal 4 (as can be understood from the drawings, when the constrained portion 4a is thrust to the left, an elastic reaction force is exerted to the right).

[0020] The free portion 4b projects in the opposite direction to the constrained portion (projecting upward in the drawings).

[0021] The free portion 4b is facing the release lever 5, capable of operating in rotation (counter-clockwise in the accompanying drawings), which operates opening means 2 which force opening of the electrical contacts of the circuit breaker 1.

[0022] The bimetal 4 is suitable to bend (clockwise in the drawings), and to intercept the release lever 5, so as to force opening of the electrical contacts.

[0023] Calibration means 6 are provided to calibrate the position of the bimetal 4.

[0024] These calibration means 6 comprise a pusher 7, in the form of an externally threaded cylinder. Said pusher 7 is supported by an internally threaded fixed support 9: axial movement of the pusher 7 (to the right/left in the drawing), is therefore achieved by axial rotation of the pusher 7.

[0025] The pusher 7 has a flaring in the forward position, which terminates with a thrust surface 9a suitable to abut against the constrained portion 4a of the bimetal 4.

[0026] It must be noted that this abutting is opposed by the elastic force exerted by the striker support 10, so that the constrained portion 4a of the bimetal 4 is held tightly between the pusher 7 and the striker support 10, which bends to allow movement of the bimetal 4 so as to allow calibration of the position of the bimetal 4.

[0027] According to the invention, the pusher 7 is axially hollow internally with a cavity capable of receiving an Allen key or other screwing means inserted axially.

[0028] Moreover, the pusher 7 comprises a toothed wheel 8 emerging peripherally so as to allow a peripheral action to rotate the pusher 7 also in the absence of the Allen key.

[0029] This toothed wheel 8 is more radially extended with respect to the pusher 7, and projects from a calibration opening produced on the housing of the circuit breaker:

in this manner, the toothed wheel 8 can be reached from the outside through the calibration opening and can be rotated with a toothed wheel tool couplable with the toothed wheel 8.

[0030] The calibration opening (not visible in the drawings as of obvious structure) allows access only to the toothed wheel 8, so that it is not possible to tamper with other devices of the circuit breaker 1.

[0031] The calibration operations can therefore be summed up as:

- a pre-calibration operation, which is achieved by screwing the pusher 7 with axial intrusion of the Allen key; at the end of this operation, the bimetal 4 is in a pre-calibrated position shown in Figs. 1 and 2;
- a subsequent fine calibration operation, which is achieved by screwing the pusher 7 through peripheral action on the toothed wheel 8, without axial intrusions; at the end of this operation, the bimetal 4 is in a calibrated position, shown in Figs. 3 and 4, in which the free portion 4b of the bimetal 4 is in contact without pressure with the release lever 5.

[0032] Advantageously, the measures described allow pre-calibration both performed with an automatic and rapid Allen key, while fine calibration is performed with the toothed wheel with radial dimensions as large as possible, so as to allow high precision adjustment.

[0033] Advantageously, in this manner it is possible during production of the circuit breaker 1, to perform pre-calibration first during pre-assembly of said circuit breaker 1, and instead perform fine calibration of the circuit breaker 1 only after it has been housed in its enclosure with irreversible seal. Therefore, it is also possible to recalibrate the circuit breaker after a long period of operation, moreover without requiring to open the casing of the circuit breaker 1 and therefore without requiring a skilled technician.

[0034] On the basis of the description provided, other characteristics, modifications or improvements are possible and evident to a person skilled in the art. These characteristics, modifications and improvements should therefore be considered a part of the present invention. In practice, the materials used and the contingent dimensions and forms can be any, according to requirements and to the state of the art.

Claims

1. A low voltage circuit breaker (1) for opening and closing electrical contacts, provided with a thermal safety system (3) of the bimetal type with:

- opening means (2) suitable to force opening of said electrical contacts,
- a release lever (5) suitable to operate said

opening means,

- a bimetal (4) with a constrained portion (4a) and a free portion (4b) capable of intercepting said release lever (5) so as to operate said opening means (2);

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provided with calibration means (6) to calibrate the position of said bimetal (4), said calibration means (6) comprising a pusher (7) thrusting said bimetal (4) so as to set the position of said bimetal (4), **characterized in that** said pusher (7) is movable both by axial intrusion and by peripheral action.

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2. The low voltage circuit breaker according to claim 1, **characterized in that** said pusher (7) is supported through a fixed support (9) with threaded coupling, so as to allow axial movement of said pusher (7) by rotation of said pusher (7). 15
3. The low voltage circuit breaker according to claim 2, **characterized in that** said pusher (7) comprises a toothed wheel (8) emerging peripherally so as to allow a peripheral action of rotation of said pusher (7). 20
4. The low voltage circuit breaker according to claim 3, **characterized in that** said toothed wheel (8) is more radially extended with respect to said pusher (7). 25
5. The low voltage circuit breaker according to claim 4, **characterized in that** said toothed wheel (8) is positioned in proximity to the housing of said low voltage circuit breaker (1) and can be reached from the outside through a calibration opening produced in said housing. 30
6. The low voltage circuit breaker according to one of claims 2-5, **characterized in that** said pusher (7) is internally hollow so as to receive a screwing means with axial insertion, such as an Allen key. 35
7. The low voltage circuit breaker according to one of the preceding claims, **characterized in that** said constrained portion (4a) is fastened to a striker support (10) capable of bending and exerting an elastic reaction force to the thrust of said pusher (7) so as to hold said constrained portion (4a) tightly between said pusher (7) and said striker support (10). 40
8. The low voltage circuit breaker according to one of the preceding claims, **characterized in that** said free portion (4b) is positioned at one end of said bimetal (4) facing said release lever (5). 45
9. The low voltage circuit breaker according to one of the preceding claims, **characterized in that** said constrained portion (4b) is positioned at another end of said bimetal (4). 50

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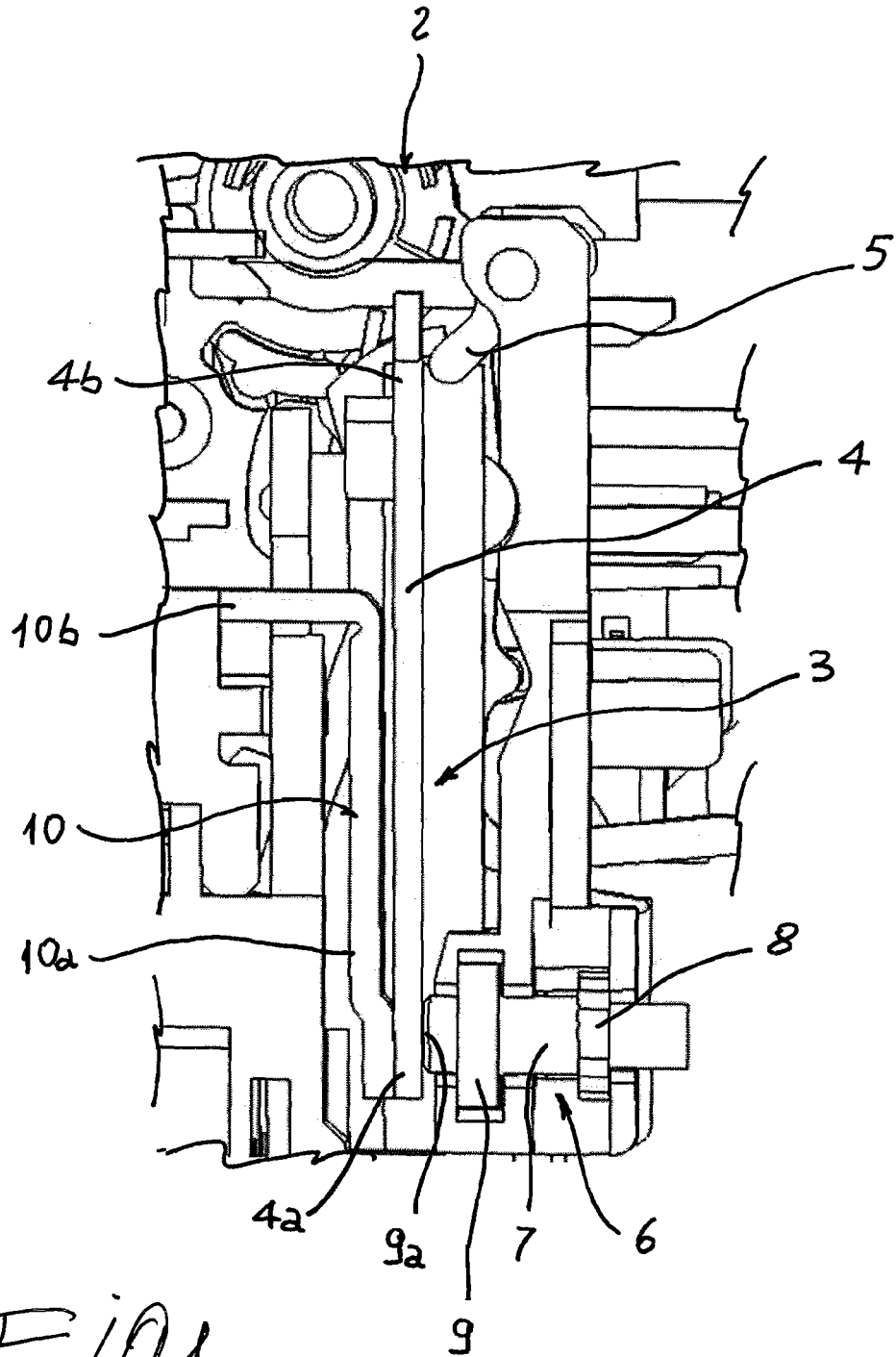


Fig. 1

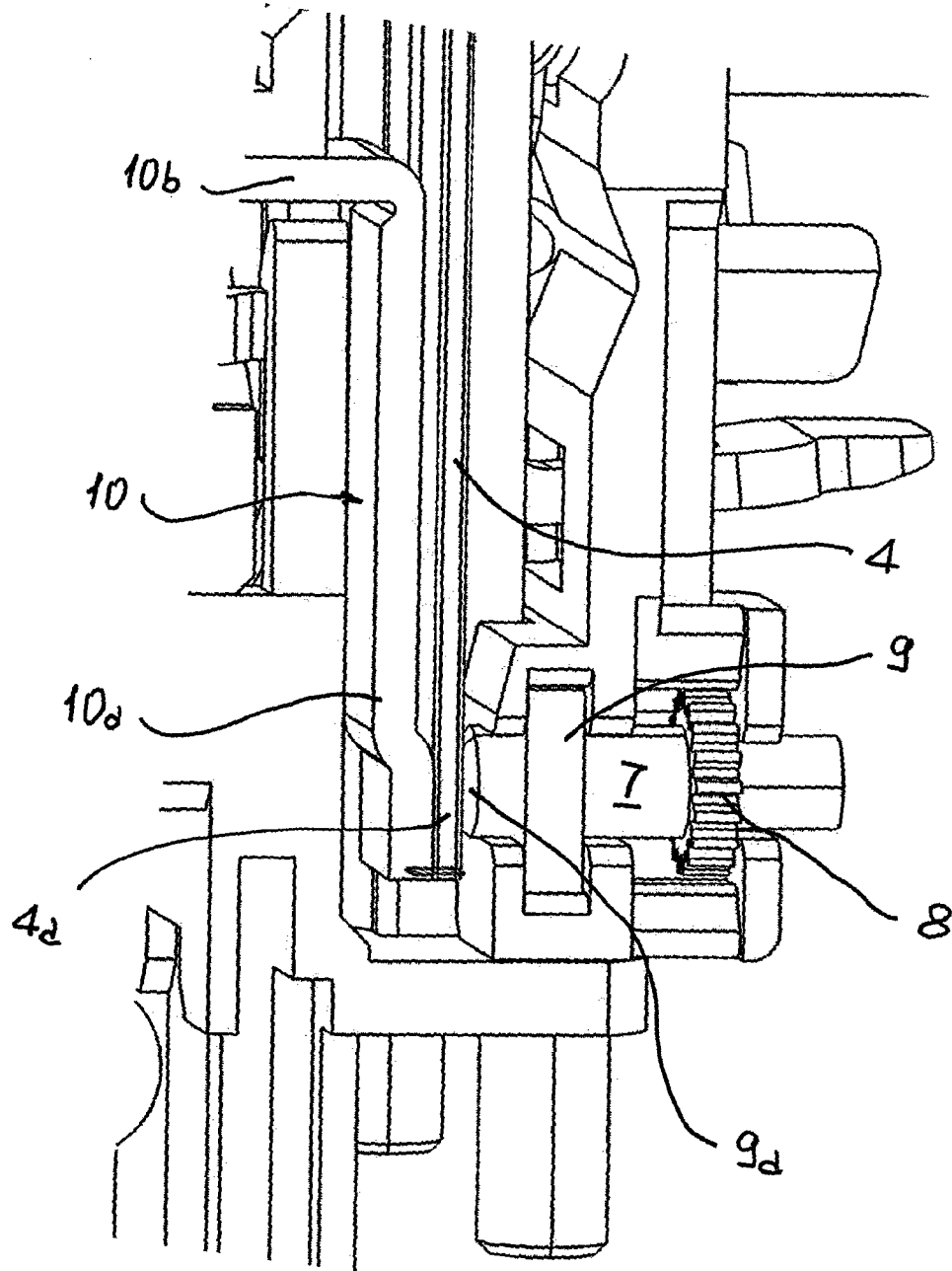


Fig. 2

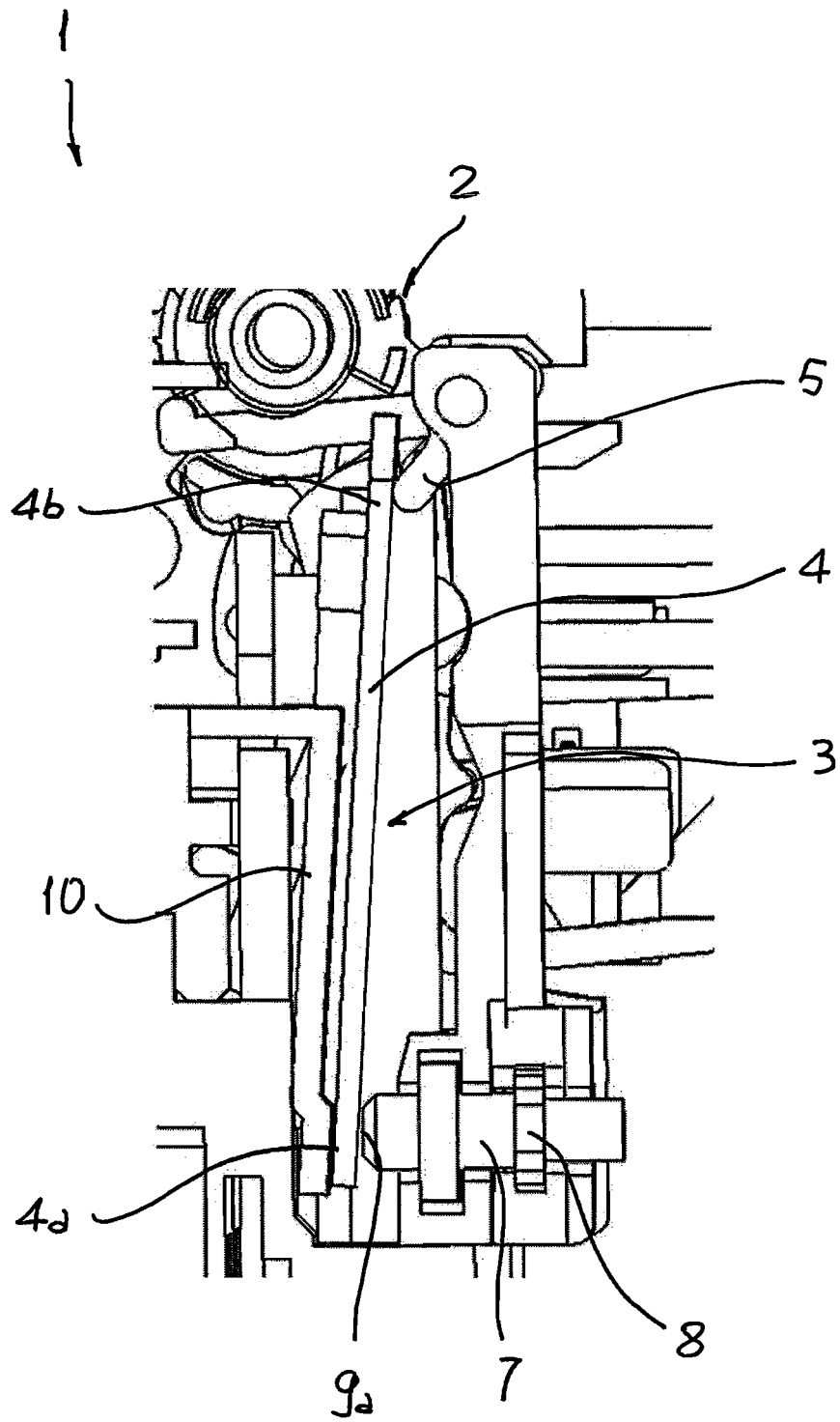
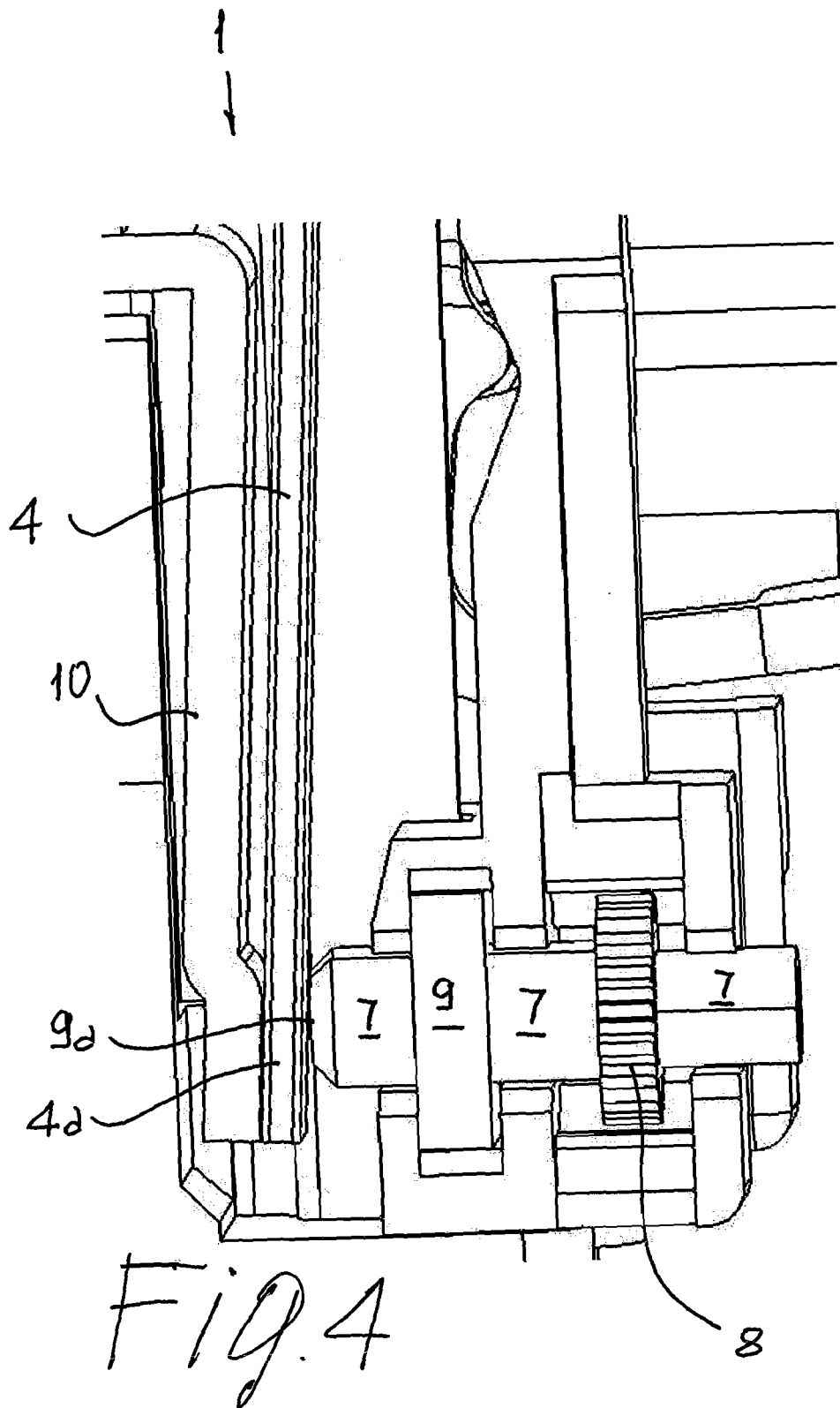


Fig. 3





EUROPEAN SEARCH REPORT

Application Number
EP 09 17 1999

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 710 973 A1 (BTICINO SPA [IT]) 8 May 1996 (1996-05-08)	1-2,7-9	INV. H01H71/74
Y	* column 4, line 29 - column 6, line 48; figures *	3-6	
Y	----- EP 1 202 317 A1 (ABL SURSUM BAYERISCHE ELEKTROZ [DE]) 2 May 2002 (2002-05-02) * paragraph [0022]; figures 9-11 *	3-6	
X	----- EP 0 338 868 A1 (HAGER ELECTRO [FR]) 25 October 1989 (1989-10-25) * column 3, line 27 - column 4, line 19; figures 1-3 *	1-2,7-9	
			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 January 2010	Examiner Findeli, Luc
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document 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 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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