(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 003 191 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
11.01.2006 Bulletin 2006/02

(51) Int Cl.:
H01H 71/52 *(2006.01)*

(21) Application number: **98203874.7**

(22) Date of filing: **19.11.1998**

(54) **Thermomagnetic circuit-breaker**

Thermomagnetischer Schutzschalter

Interrupteur magnétothermique

(84) Designated Contracting States:
AT BE CH DE ES FR GB LI NL

(43) Date of publication of application:
24.05.2000 Bulletin 2000/21

(73) Proprietor: **ABB Sace S.p.A.**
20124 Milano (IT)

(72) Inventor: **Jacovino, Elio**
20052 Monza (MI) (IT)

(74) Representative: **Giavarini, Francesco et al**
ZANOLI & GIAVARINI S.r.l.
Viale Bianca Maria, 35
20122 Milano (IT)

(56) References cited:
EP-A- 0 046 841
DE-A- 3 721 069
US-A- 4 687 891
US-A- 4 740 770

EP 1 003 191 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a thermomagnetic circuit-breaker with means for adjusting the motion of the movable contacts.

[0002] As it is known, thermomagnetic circuit-breakers may feature, in accordance with the regulations in force, a so-called dependent closing movement, which in essence means that the movement of the movable contacts depends on the movement of an operating knob or lever. In the first part of rotation, said operating knob brings the movable contact closer to the fixed contact; then, electrically coupling between contacts is achieved by means of a subsequent elastic thrust on the movable contact in order to increase the tightness of contact and generate the contact pressure.

[0003] With circuit breakers of this type, the interruption of a closing operation for any reason and at any angle of travel of the operating knob could happen when the movable contact has already reached a position close to the fixed contact or even is yet in contact with it without the necessary pressure; in this cases, damages to the contacts could occur.

[0004] Moreover, in cases of very slow operation, the contact pressure could be insufficient, inevitably creating contact wear if they are subjected to multiple electrical operations.

[0005] Thermomagnetic circuit-breakers have already been launched on the market that have a dependent operation in a first part until reaching a predetermined stop distance of the movable contact in relation to the fixed contact, said distance being then exceeded with a tripping movement that performs the closing.

[0006] This solution, which is valid from a design standpoint, has been found difficult to apply in practice in that, in order to keep the movable contact at a certain distance from the fixed contact during the operating travel, a cam is used; this cam engages in special seatings in the plastic parts of the movable contacts with a configuration that is not able to guarantee the minimum stopping distance and, therefore, undue electrical discharges could occur.

[0007] In addition, with this embodiment it is necessary to have the movable contacts made in two parts, namely a metal part and a plastic part.

[0008] A further drawback is in addition constituted by the fact that the operating lever or knob and the operating lever need to have opposing directions of rotation, thus creating considerable manufacturing complications and significant limitations regarding the dimensions and positioning.

[0009] The main task of the invention is precisely that of eliminating the above mentioned drawbacks providing a thermomagnetic circuit-breaker with means for adjusting the motion of the movable contacts in which it is possible to predetermine a stop distance for the movable contacts in relation to the fixed contacts that is always constant and defined by the design geometry so that one always has a safety condition.

[0010] As part of the aforesaid task, a particular object of the invention is to provide a thermomagnetic circuit-breaker in which it is possible to guarantee a minimum insulation distance between the contacts when interrupting the closing operation for any reason at any angle of travel of the knob.

[0011] Another object of the present invention is to provide a thermomagnetic circuit-breaker in which the minimum contact pressure is practically the same as the nominal pressure even with a slow closing operation, thus ensuring lower contact wear.

[0012] A further object of the present invention is to provide a thermomagnetic circuit-breaker which can be used, in its general constructional lines, as a circuit-breaker with dependent operation if desired, offering the possibility, with the addition of an easily-installed part, of increasing the functionality of the circuit-breaker with the introduction of the predetermined stopping distance of the contacts before the closing tripping movement.

[0013] A further but not last object of the present invention is to provide a thermomagnetic circuit-breaker with means for adjusting the motion of the movable contacts that can be easily obtained using common commercially-available elements and materials and that is, furthermore, competitive from a purely economic standpoint.

[0014] This task, as well as the aforementioned objects and others that shall emerge more clearly hereinafter are achieved by a thermomagnetic circuit-breaker comprising a moulded case containing a movable contact and a fixed contact, the movable contact being connected to an operating lever controlled by a trip lever and operatively associated to an operating knob, characterised by the fact that it comprises an auxiliary lever engageable with said movable contact to hold it at a predetermined distance from said fixed contact during closing operations, said auxiliary lever being operatively coupled with the operating knob to release the movable contact allowing completion of the closing operation. Document US 4 740 770 discloses a device according to the preamble of claim 1.

[0015] Further characteristics and advantages shall emerge more clearly from the description of a preferred but not exclusive embodiment of a thermomagnetic circuit-breaker with means for adjusting the motion of the movable contacts illustrated purely by way of example and without limitation with the aid of the attached drawings in which:

Figure 1 is a diagrammatic side view of the thermomagnetic circuit-breaker as in the invention;

Figure 2 shows a section along the line II-II of Figure 1;

Figure 3 shows a section along line III-III of Figure 1;

Figure 4 shows a detail of the movable contact in the open position;

Figure 5 shows a detail of the movable contact during the closing phase, stopped at a predetermined dis-

tance from the fixed contact;

Figure 6 shows the movable contact during the initial closing tripping movement phase;

Figure 7 shows the movable contact in the closing position;

Figure 8 shows a detail of the release lever and operating lever from the front;

Figure 9 shows a section along line IX-IX of Figure 8.

[0016] With reference to the aforesaid figures, the thermomagnetic circuit-breaker according to the invention includes a moulded case overall indicated by reference number 1 which substantially has a standardised conformation typical of thermomagnetic circuit-breakers for connection to omega-shaped bars.

[0017] Movable electric contacts, indicated by 2 for the phase contact and 3 for the neutral contact, are provided inside the moulded case 1.

[0018] The movable contacts are connected to an operating lever 4 that is controlled by a trip lever 5 and associated with an operating knob or lever 7 by means of a U bolt 6.

[0019] The movable contacts 2 and 3 are available for contact with corresponding fixed contacts 8 defined inside the moulded case.

[0020] A spring associated to the trip lever 5 indicated overall by 10 acts between the operating lever 4 and the trip lever 5; said spring 10 has the distinctive feature of being of the hairpin type with an axial appendix 10a held in a corresponding seat of the trip lever 5 and a radial appendix 10b that engages with a catch projection 11. The projection 11 is defined on the operating lever 4 at the moment of assembly of the lever 5 and the operating lever 4 itself.

[0021] The movable contacts 2 and 3 have contact springs, indicated by 15, also of the hairpin type, that interact with a catch projection 16 located on the operating lever and with an appendix 17 defined by the movable contact.

[0022] The thermomagnetic circuit-breaker, as it is usual in the practice, features an opening release that operates by means of the relative rotation of the operating lever in relation to the trip lever 5; the operation can occur by means of the action of a thrust pin 18 connected to a relay 19 that acts on the trip lever, for example in case of a high fault current (short circuit). In addition a bimetallic strip 20 is provided that acts on a thermal trip lever 21 in the event of an overload; this strip 20 transmits the movement to the trip lever.

[0023] It is also possible to provide external accessories that engage in recesses 22 in the trip lever, obtaining an action directly on the trip lever by means of slots located in the two sides of the circuit-breaker.

[0024] The distinctive feature of the invention is constituted by the fact that an auxiliary lever 30 is provided that pivots alongside the axis of the operating lever and has the function of movably stopping the movable electric contacts during closing operations at a predetermined distance from the fixed contact 8.

[0025] The auxiliary lever has a body 31 that terminates in a head 32 and defines, on the part facing the movable contacts, a recess 33 in which a prominence 34 of the movable contacts engages.

[0026] The head 32 features a protuberance 35 that extends from the opposite side in relation to said recess 33 and is designed to interact with a cam 36 that is connected to the operating knob 7.

[0027] In open circuit-breaker conditions, as illustrated in Figure 4, the movable contacts are positioned at a distance from the fixed contact, and the prominence 34 is engaged with the auxiliary lever close to the pivoting zone; as illustrated, the lever 30, pushed by a spring 40, associated to the lever 30 itself, is held against the prominence 34 in a lower area of the recess 33.

[0028] Acting on the knob 7 to execute closing, the rotation of the knob causes the operating lever to rotate at a speed dependent on that of the knob 7 by means of a U bolt 6, bringing the movable contacts close to the fixed contact 8 until stopping at a predetermined distance due to the engagement of the prominence 34 with a catch projection defined by the head 32 at the end of the recess 33.

[0029] From the above conditions on the movement of the mobile contacts becomes independent of the motion of the knob 7; in fact, the subsequent rotation of the operating knob 7, as illustrated in fig.6, leads the cam 36 to engage the protuberance 35, causing a rotation of the auxiliary lever contrasting with the spring 40, with consequent starting of disengagement between protuberance 34 and recess 33.

[0030] The end of rotation of the operating knob 7, as illustrated in Figure 7, disengages the protuberance 34 and the head 32, consequently making it possible to obtain the closing trip movement of the movable contacts towards the fixed contacts at a speed that is dependent solely on the loading of the spring 15 (independent motion).

[0031] The pressure action applied is therefore substantially constant and, even in cases where slow operation is executed, the pressure applied is still substantially the same as the nominal pressure.

[0032] A further aspect worthy of emphasis is constituted by the fact that the operating knob and the operating lever rotate in the same direction, thus significantly simplifying the structure of the device.

[0033] From that which has been set out above it is possible therefore to see that the invention achieves the objectives set and in particular it is to be emphasised that the closing operation, which is dependent for a part and then substantially independent, makes it possible to obtain a predetermined and constant closing speed and force.

[0034] Moreover, it should be noted that the additional functionality is obtained simply by the presence of the auxiliary lever and related spring, which are elements that can be added to a thermomagnetic circuit-breaker

that would behave like a traditional device without the presence of such a lever.

[0035] Furthermore, in the event of tripping in opening of the device, the design and implementation of the cams together with the operating knob and auxiliary lever ensure that the movable contacts do not encounter obstacles in their opening travel that could be the cause of jamming or loss of performance in the event of a short circuit.

[0036] A further important aspect is in addition constituted by the fact that the spring of the trip lever acts between the trip lever and the operating lever, thus having greater speed of response in use.

Claims

1. Thermomagnetic circuit-breaker comprising a moulded case containing a movable contact (2,3) and a fixed contact (18), the movable contact being connected to an operating lever controlled by a trip lever and operatively associated to an operating knob (7), **characterised by** the fact that it comprises an auxiliary lever (30) engageable with said movable contact to hold it at a predetermined distance from said fixed contact during closing operations, said auxiliary lever being operatively coupled with the operating knob to release the movable contact allowing completion of the closing operation.

2. Thermomagnetic circuit-breaker as in claim 1 **characterised by** the fact that said auxiliary lever has a body terminating in a head that defines, in the part facing towards said movable contact, a recess for engaging with a prominence of the movable contact itself.

3. Thermomagnetic circuit-breaker as in claim 2 **characterised by** the fact that said head has a protuberance that extends from the opposite side in relation to said recess, said protuberance being designed to interact with a cam connected to the operating knob.

4. Thermomagnetic circuit-breaker as in one or more of the previous claims **characterised by** the fact that it includes a spring associated to the auxiliary lever designed to press the auxiliary lever towards the movable contact.

5. Thermomagnetic circuit-breaker as in one or more of the previous claims **characterised by** the fact that said auxiliary lever is pivoted alongside the axis of said operating lever.

6. Thermomagnetic circuit-breaker as in one or more of the previous claims **characterised by** the fact that said operating knob and said operating lever rotate in the same direction.

7. Thermomagnetic circuit-breaker as in one or more of the previous claims **characterised by** the fact that it includes a spring associated to the trip lever that interacts with said trip lever and said operating lever.

8. Thermomagnetic circuit-breaker as claim 7 **characterised by** the fact that said spring associated to the trip lever is a hairpin spring having an axial appendix that can be lodged in a seat defined by said trip lever and a radial appendix that can engage in a catch projection defined on said operating lever.

Patentansprüche

1. Thermomagnetischer Trennschalter, umfassend ein gegossenes Gehäuse, das einen beweglichen Kontakt (2, 3) und einen ortsfesten Kontakt (18) aufweist, der bewegliche Kontakt ist verbunden mit einem Bedienhebel, der durch einen Schalthebel kontrolliert wird, und operativ mit einem Bedienknopf (7) verbunden ist, **gekennzeichnet durch** die Tatsache, dass er einen Hilfshebel (30) umfasst, der mit dem beweglichen Kontakt eingreifbar ist, um ihn bei einem vorbestimmten Abstand von dem ortsfesten Kontakt während Schließoperationen zu halten, der Hilfshebel ist operativ gekoppelt mit dem Bedienknopf, um den beweglichen Kontakt freizugeben, erlaubend die Vervollständigung der Schließoperation.

2. Thermomagnetischer Trennschalter wie in Anspruch 1, **gekennzeichnet durch** die Tatsache, dass der Hilfshebel einen Körper aufweist, der in einem Kopf endet, der in einem Teil, das dem beweglichen Kontakt gegenüberliegt, eine Aussparung zum Eingreifen mit einem Vorsprung des beweglichen Kontakts selbst definiert.

3. Thermomagnetischer Trennschalter wie in Anspruch 2, **gekennzeichnet durch** die Tatsache, dass der Kopf eine Ausstülpung aufweist, die von der gegenüberliegenden Seite in Bezug zu der Aussparung hervorragt, die Ausstülpung ist gestaltet, um mit einer Schulter Wechsel zu wirken, die mit dem Bedienknopf verbunden ist.

4. Thermomagnetischer Trennschalter wie in einem oder mehreren der vorhergehenden Ansprüche, **gekennzeichnet durch** die Tatsache, dass er eine Feder einschließt, die mit dem Hilfshebel verbunden ist, gestaltet, um den Hilfshebel gegen den beweglichen Kontakt zu drücken.

5. Thermomagnetischer Trennschalter wie in einem oder mehreren der vorhergehenden Ansprüche, **gekennzeichnet durch** die Tatsache, dass der Hilfshebel entlang der Achse des Bedienhebels

schwenkbar ist.

6. Thermomagnetischer Trennschalter wie in einem oder mehreren der vorhergehenden Ansprüche, **gekennzeichnet durch** die Tatsache, dass der Bedienknopf und der Bedienhebel in die gleiche Richtung rotieren.

7. Thermomagnetischer Trennschalter wie in einem oder mehreren der vorhergehenden Ansprüche, **gekennzeichnet durch** die Tatsache, dass er eine Feder einschließt, die mit dem Schalthebel verbunden ist, die mit dem Schalthebel und dem Bedienhebel Wechsel wirkt.

8. Thermomagnetischer Trennschalter wie in Anspruch 7, **gekennzeichnet durch** die Tatsache, dass die Feder, die mit dem Schalthebel verbunden ist, eine Haarnadelfeder ist, die einen axialen Anhang aufweist, der in einem Sitz hinterlegt werden kann, der durch den Schalthebel definiert ist, und einen radialen Anhang, der in einen Fangvorsprung eingreifen kann, der auf dem Bedienhebel definiert ist.

Revendications

1. Disjoncteur magnétothermique comprenant un boîtier moulé contenant un contact mobile (2,3) et un contact fixe (18), le contact mobile étant connecté à un levier d'actionnement commandé par un levier de déclenchement et associé fonctionnellement à un bouton d'actionnement (7), **caractérisé en ce qu'**il comprend un levier auxiliaire (30) pouvant s'engager avec ledit contact mobile pour le maintenir à une distance prédéterminée dudit contact fixe durant les opérations de fermeture, ledit levier auxiliaire étant couplé opérationnellement avec le bouton d'actionnement pour libérer le contact mobile et permettre la terminaison de l'opération de fermeture.

2. Disjoncteur magnétothermique selon la revendication 1, **caractérisé en ce que** ledit levier auxiliaire possède un corps qui se termine par une tête qui définit, dans la partie située face audit contact mobile, un renfoncement dans lequel s'engage une saillie du contact mobile lui-même.

3. Disjoncteur magnétothermique selon la revendication 2, **caractérisé en ce que** ladite tête comporte une protubérance qui s'étend à partir du côté opposé dudit renfoncement, ladite protubérance étant conçue pour interagir avec une came connectée au bouton d'actionnement.

4. Disjoncteur magnétothermique selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend un ressort associé au levier auxiliaire, conçu pour presser le levier auxiliaire vers le contact mobile.

5. Disjoncteur magnétothermique selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit levier auxiliaire pivote le long de l'axe dudit levier d'actionnement.

6. Disjoncteur magnétothermique selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit bouton d'actionnement et ledit levier d'actionnement tournent dans le même sens.

7. Disjoncteur magnétothermique selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend un ressort associé au levier de déclenchement qui interagit avec ledit levier de déclenchement et ledit levier d'actionnement.

8. Disjoncteur magnétothermique selon la revendication 7, **caractérisé en ce que** ledit ressort associé au levier de déclenchement est un ressort en épingle à cheveux possédant un appendice axial qui peut être logé dans un siège défini par ledit levier de déclenchement et un appendice radial qui peut s'engager dans une projection d'entraînement définie sur ledit levier d'actionnement.

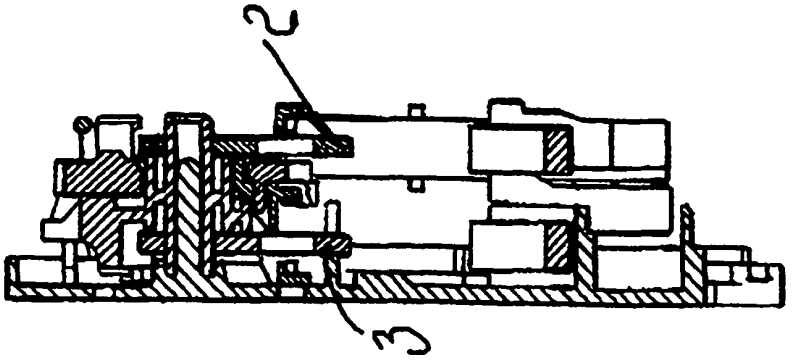


Fig. 3

Fig. 1

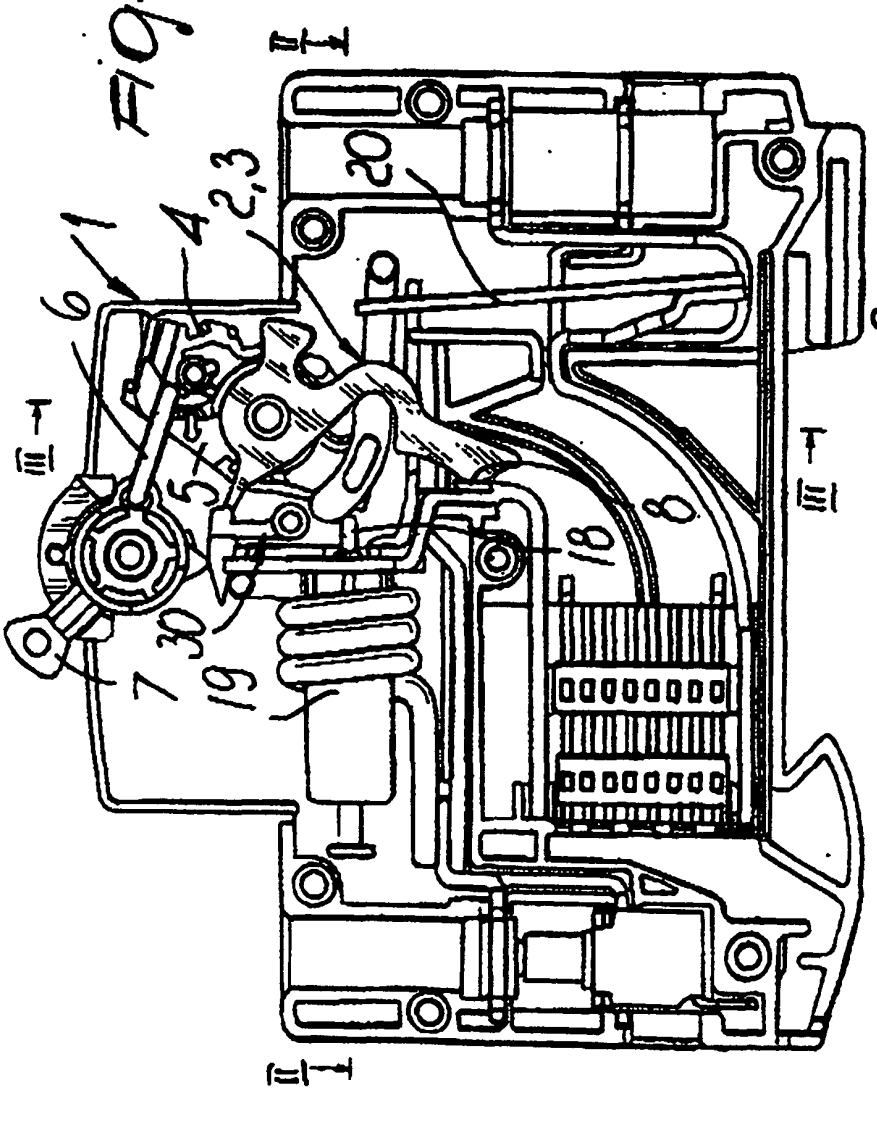
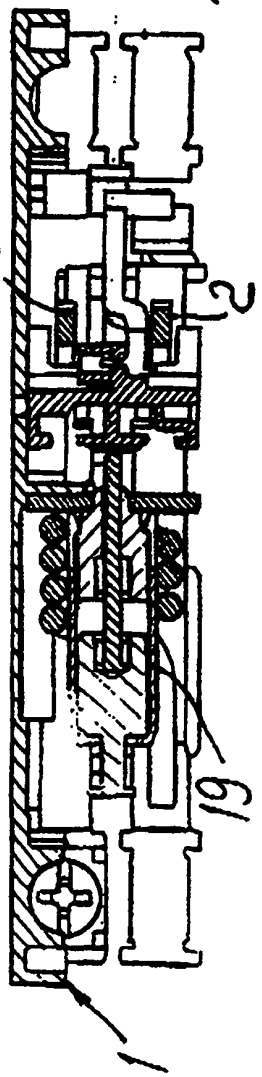


Fig. 2



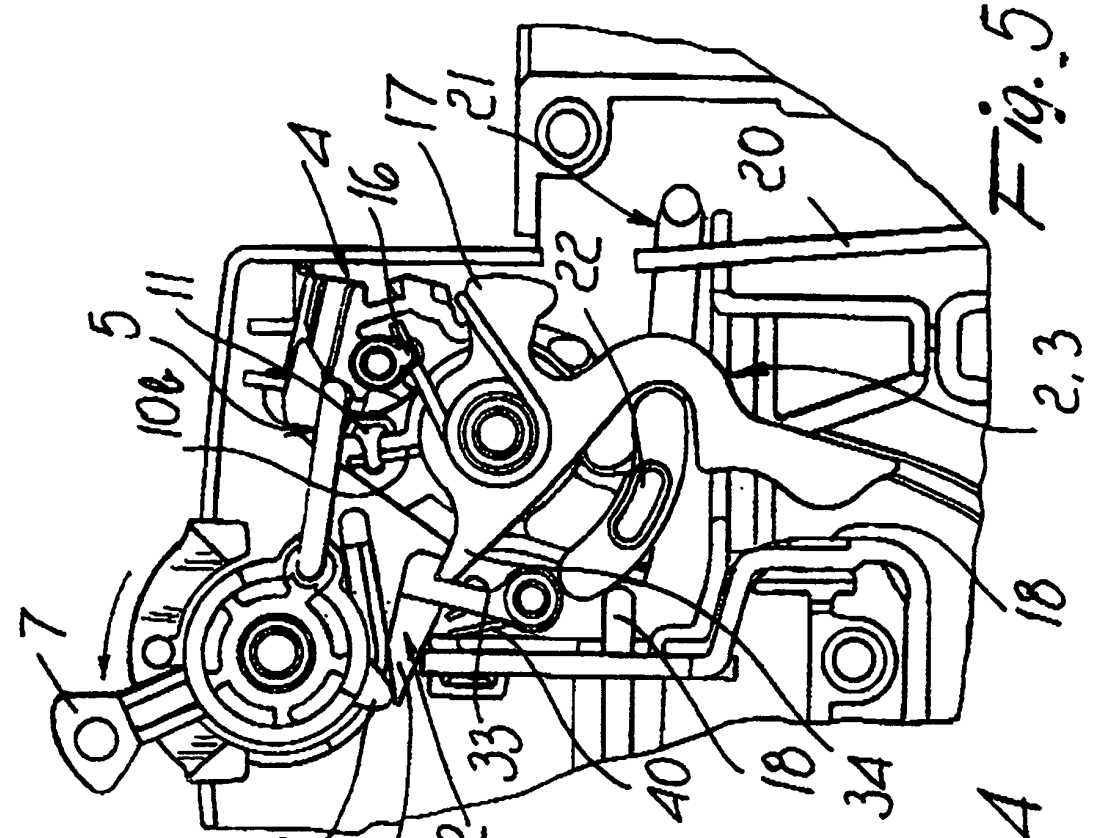

4
16
17
21
20
22
5
11
10b
2,3
7
18
33
40
18
34
36
35
32

Fig. 5

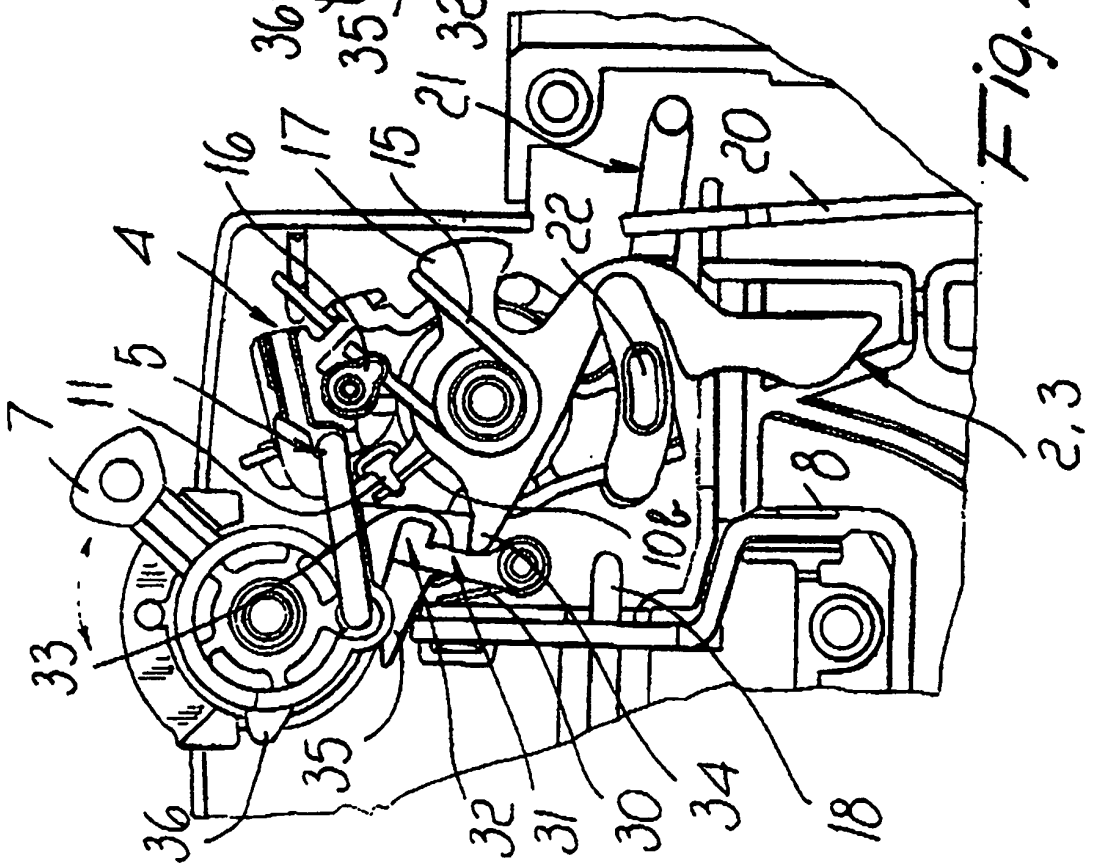

16
17
15
21
20
4
22
5
11
7
2,3
8
10b
33
35
36
32
31
30
34
18

Fig. 4

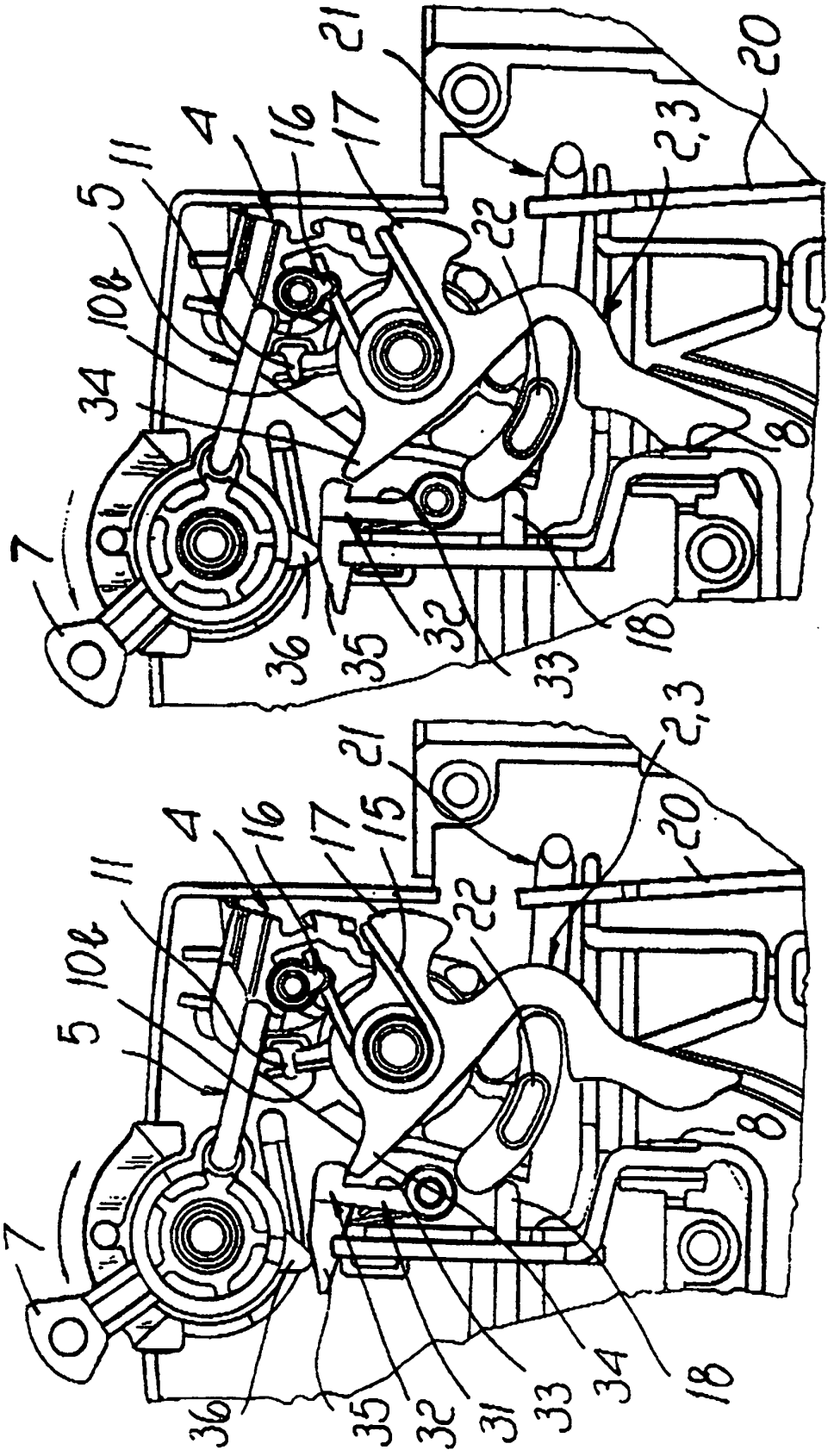


Fig. 7

Fig. 6

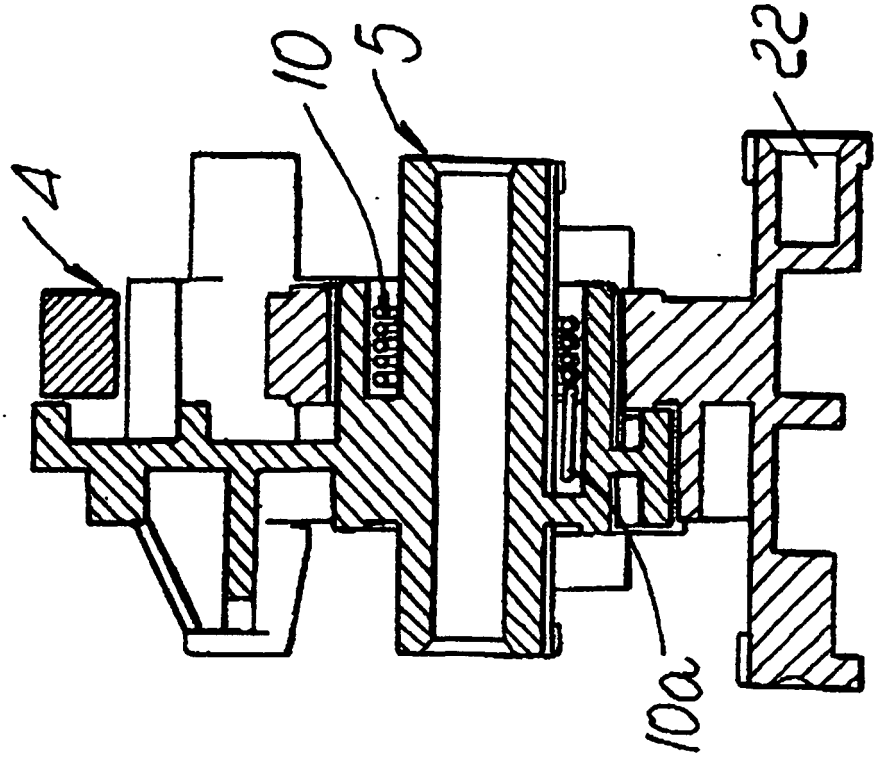


Fig. 9

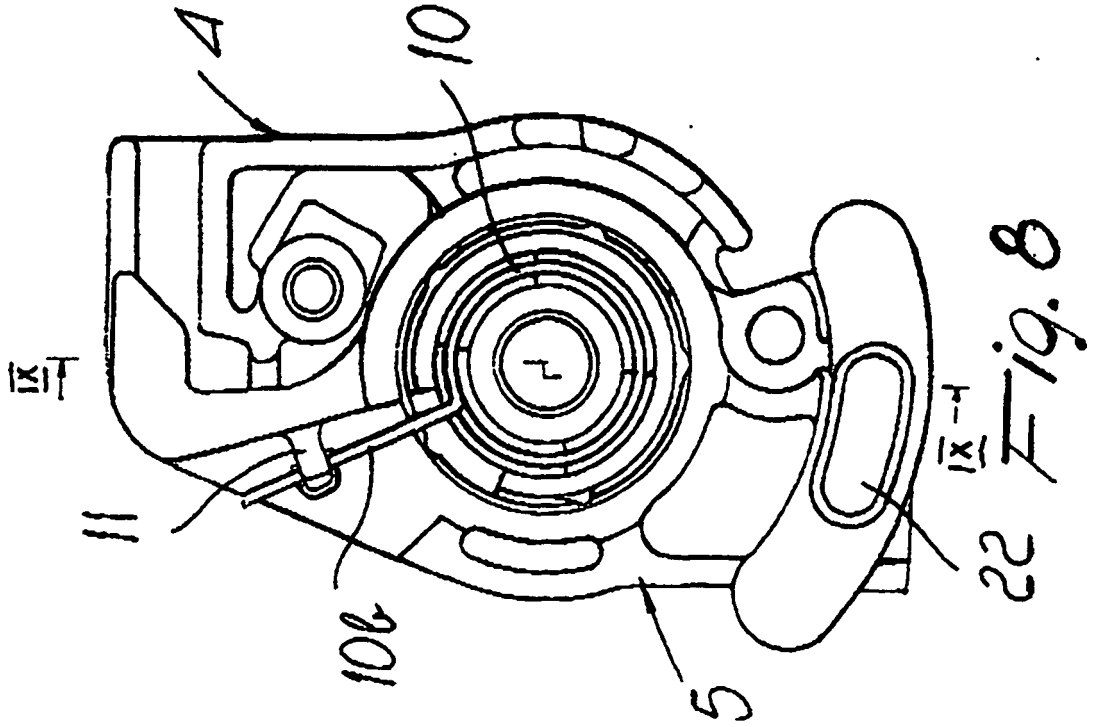


Fig. 8