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- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
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[Continued on next page]

(54) **Title:** AN ENHANCED LATCH MECHANISM FOR USE IN CIRCUIT BREAKERS

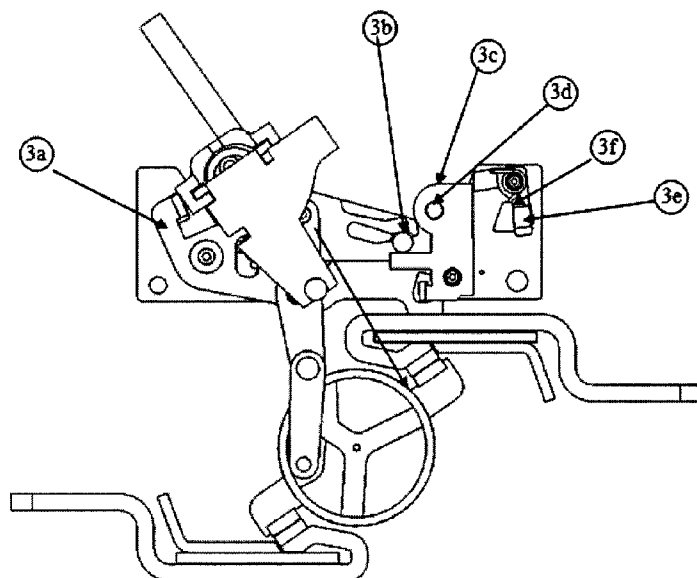


Fig. 4

(57) **Abstract:** The present invention relates to an enhanced latch mechanism for use in molded case circuit breakers. The mechanism comprises latch bracket means (3c) comprising plurality of slot means (8), latch link means (3a) comprising plurality of slot means (7) being movably engaged with latch bracket means (3a) and locking trip plate means (3e). The latch means is engaged with conventional moving contact of the circuit breaker.

**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

AN ENHANCED LATCH MECHANISM FOR USE IN CIRCUIT BREAKERS**Field of the invention**

The present invention relates to circuit breakers. More particularly, the invention relates to an enhanced latch mechanism for use in molded case circuit breakers which trip the circuit breakers with decreased trip force.

Background and the prior art

Circuit breakers are mechanical switching devices capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal conditions. A circuit breaker basically consists of a pair of separable contacts and an interrupting medium. The function of the contacts is to conduct the electrical current when the breaker is closed and to withstand the arcs while interrupting. Generally the electrical contacts have a stationary part and a moving part. By bringing the moving contact to touch the stationary contact, an electric current flows and the breaker is closed. By driving the moving contact away from the stationary contact, an electric arc is developed and by quenching the electrical arc, the flow of electrical current is stopped and the breaker is opened.

US6727788 discloses an apparatus for operating a circuit breaker. The circuit breaker includes a housing, a cradle mounted in the housing and coupled to a handle and to a movable contact. The apparatus comprises a latch frame mounted in the circuit breaker housing. A reset pin is mounted on the cradle. A latch member is configured to selectively engage the reset pin and the latch member is rotatably coupled to the latch frame. A latch shaft assembly is rotatably mounted in the latch frame and selectively engaged by the latch member. Upon rotation of the latch shaft assembly, the latch shaft assembly will disengage from the latch member and cause the movable contact to move.

US6218919 discloses a decreased mechanical trip time latching system for use in a molded case circuit breaker assembly. The latching system comprising a quick release primary latch

having a first primary latching surface and a second primary latching surface. Where the second primary latching surface engages a first secondary latching surface located on an interactive secondary latch, to prevent the rotation of the quick release primary latch. The first primary latching surface engages a cradle latching surface, located on a cradle, to prevent the rotation of the cradle. Assembled to the interactive secondary latch is a trip bar. Activation of the trip bar rotates the secondary latch so that the first secondary latching surface moves out of contact with the second primary latching surface just prior to the interactive secondary latch making physical contact with the quick release primary latch. The quick release primary latch then rotates moving the first primary latching surface out of contact with the cradle latching surface thereby releasing the cradle. The cradle rotates and the operating system is activated to terminate current flow.

US7268654 discloses a latching mechanism for a movable member mounted for movement between first and second positions. The latching mechanism includes a primary latching mechanism mounted for movement between a latched position where the primary latching mechanism engages the movable member to allow the movable member to move between the first and second positions, and an unlatched position where the movable member is disengaged for movement to the second position. A secondary latching element engages the first latching mechanism to hold the primary latching mechanism in the latched position, the secondary latching element being movable to move the primary latching mechanism to the unlatched position while remaining in engagement with the primary latching mechanism.

US 6590482 discloses a latching mechanism which includes a pair of cradles. Mechanism linkages are connected to the each cradle and these pair of cradle is connected to each other. Primary latch is engaged with the cradle. A secondary latch element is engages the primary latch which being movable to move the primary latching mechanism

Though the prior art discussed above discloses latch mechanism, use of reset pin was not known from the prior art. The constructional features of these prior art provides substantial

surface contact between latch bracket and latch Link which gives rise to sliding friction. Due to sliding friction after repeated use, there is a possibility of the latch means to wear out. Further in the prior art biasing spring is used for latch bracket. Such use of biasing springs add to the number of components. Further disadvantage of the prior art is the sliding force of friction between the latch bracket and the latch link resulting in the increase of the trip force.

Thus there is a need to provide for an enhanced latch mechanism for use in molded case circuit breakers which trip the circuit breakers with decreased trip force.

The present inventors have found that the tripping force can be decreased substantially by way of a unique design of latch mechanism which has been described in more details herein below.

Objects of the invention

One object of the present invention is to overcome the disadvantages/drawbacks of the prior art.

A basic object of the present invention is to provide a latch mechanism for the circuit breakers which enables to trip the circuit breaker when trip signal is actuated.

Another object of the present invention is to provide a latch mechanism for circuit breakers in which rolling co-efficient of friction plays role in deciding the trip force required for tripping the circuit breaker.

These and advantages of the present invention will become readily apparent from the following detailed description taken in conjunction with the accompanying drawings.

Summary of the invention

According to one aspect of the present invention there is provided an enhanced latch mechanism for use in molded case circuit breakers, said mechanism comprising :

latch bracket means comprising plurality of slot means;

- 5 latch link means comprising plurality of slot means being movably engaged with said latch bracket means; said latch means being operatively engaged with conventional moving contact of said circuit breaker through linkages.;

locking trip plate means adapted to lock said latch bracket means;

- wherein said latch link means comprising a reset pin means accommodated in said slots of
10 said latch link means such that assembly of said latch link means and reset pin means being movably located on said latch bracket means such that on rotation of said locking trip plate means actuated by a conventional trip signal, said latch bracket means get unlocked resulting in unlocking of said latch link means whereby said unlocking of latch link means being
15 performed by rolling movement of said reset pin means providing rotation of said latch link means adapted to rotate the moving contact through linkages. so as to move it away from fixed contact of the circuit breaker.

Brief Description of the accompanying drawings

Other features as well as the advantages of the invention will be clear from the following description.

- 20 In the appended drawings:

Fig. 1 illustrates Isometric view of the 3 pole Circuit Breaker cassette with breaker is in ON condition

Fig. 2 illustrates Isometric view of the single pole Circuit Breaker cassette with breaker is in ON condition

- 25 Fig.3 illustrates Isometric view of Mechanism in ON condition with breaker cassette hidden

Fig. 4 illustrates front view of Mechanism in ON position.

Fig. 5 illustrates isometric view of Latch Link

Fig. 6 illustrates isometric view of Latch Bracket

Fig. 7 illustrates isometric view of Trip Plate

Fig.8 illustrates sectional view of Mechanism in TRIP position.

Fig.9 illustrates front view of Mechanism in Trip position.

Fig.10 illustrates front view of mechanism in intermediate TRIP to RESET position.

Fig.11 illustrates sectional view of mechanism in intermediate TRIP to RESET position.

5 Fig.12 illustrates front view of mechanism in next intermediate TRIP to RESET position.

Fig.13 illustrates front view of mechanism in Reset position.

Detailed description of the accompanying drawings

10 In the following detailed description, reference is made to the accompanying drawings that form a part hereof, and illustrate the best mode presently contemplated for carrying out the invention. Further functioning of the mechanism has been discussed below to describe the way the mechanism operates. However, such description should not be considered as any limitation of scope of the present unit. The structure thus conceived is susceptible of numerous modifications and variations, all the details may furthermore be replaced with
15 elements having technical equivalence. In practice the materials and dimensions may be any according to the requirements, which will still be comprised within its true spirit.

The present invention relates to a Circuit Breaker which is a mechanical switching device, capable of making (i.e. switching ON), carrying and breaking (i.e. switching OFF) current
20 under normal circuit conditions and more specifically breaking current (Tripping) during abnormal circuit conditions such as short-circuit. Quite often, the short circuit current is sensed automatically and the signal is given to the mechanism as a TRIP command which leads to opening of the contacts by means of mechanism.

25 Elements and Construction

1: Circuit breaker cassette: It is a cassette on which circuit breaker mechanism module is mounted.

2: Rotor: It is a part which houses moving contact assembly

3: Mechanism module with Latch Mechanism: It consists of various linkages. It is a 4 bar mechanism. It also consists of Latch Mechanism.

3a: Latch Link – It is a part of Latch Mechanism. It moves during ON to TRIP operation . It comprises of plurality of slots. Further an oblong shaped slot 7 is also present in which reset pin 3b is operatively engaged and provides rolling motion to the latch link 3a.

3b: Reset pin – It is a pin which helps in resetting of Latch Bracket..

3c: Latch Bracket: It is a part which locks the Latch link during ON-OFF and OFF-ON operation. It is locked by the Trip Plate. It comprises plurality of slots 8 for accommodating reset pin means 3d. the latch bracket means 3c comprises at least two projection 10 which help in resetting of Latch Bracket to its original position with the help of Latch Link so no Biasing spring is required to Latch Bracket..

3d: Latching roller – It is connected to the Latch Bracket. It locks the Latch Link during ON-OFF and OFF-ON operation & rolls over Latch Link while unlocking the Latch Link.

3e: Trip Plate – It locks the Latch Bracket during -OFF and OFF-ON operation by means of a projection 9. It takes Trip command from actuator during Trip and unlocks the Latch Bracket.

3f: Trip Plate Spring. – It is a biasing spring used for Trip Plate.

4: Moving Contact - It is the moving part of the current carrying circuit.

5: Fixed Contact - It is the fixed part of the current carrying circuit.

6: Dead centre- Dead centre is an equilibrium condition of actuating mechanism. In this condition the mechanism spring is fully charged and beyond this point mechanism flips & operates independently due to energy discharged by mechanism spring.

However, during normal ON-OFF and OFF-ON operation, input to mechanism is given through the rotation of knob by manual means. The rotation of knob leads to storing potential energy (spring charging) in the spring member while restricting the contact movement during the charging operation. At a specified instance the potential energy of spring is released in form of Kinetic energy through Mechanical Linkages leading rotation of

the contacts at high velocity. Circuit breaker mechanisms use dead centre based Extension spring arrangements.

Circuit breaker Latch Mechanism consists of Latch Link(3a), Reset pin (3b), Latch Bracket(3c), Latching roller(3d), Trip Plate(3e) and Trip Plate Spring(3f). During ON-OFF and OFF-On operation Latch Link(3a) is locked by Latching Roller(3d) which is connected to Latch Bracket(3c). Latch Bracket(3c) is locked by Trip Plate(3e). Fig.3 shows the mechanism in On condition.

10 When Trip signal is given to the Trip Plate (3e) by the actuator, Trip Plate rotates and unlock the Latch Bracket (3c). Unlocking of Latch Bracket (3c) results in unlocking of Latch Link(3a). Rotation of Latch Link(3a) causes rotation of Moving Contact(4) away from Fixed Contact(5) and breaker is in Trip condition as shown in the fig.8 and fig.9. Side plate work as a stopper for both Latch Link and Latch Bracket.

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When Trip Plate is rotated, Trip Spring(3f) gets charged which helps in bringing the Trip Plate(3e) in original position. Trip Spring (3f) is connected between the Trip Plate(3) and Side Plates..

20 During TRIP to RESET Latch Link(3a) is rotated by the Fork Link through Rest Pin(3b) inserted in it. Fig.10 and Fig.11 shows the intermediate position from TRIP to RESET. From TRIP to RESET operation Latch Bracket(3c) is not able to come to its original position as there is always contact between Latch Link(3a) and Latching Roller(3d).

25 Fig.12 shows next intermediate position between TRIP to RESET. AS Latch Link gets further rotated then there will be contact between Reset Pin (3b) and Latch Bracket(3c) which causes in bringing the Latch Bracket(3c) to its original position. As soon as Latch Bracket(3c) comes to original position, Trip Plate(3e) comes back to original position

because of the Trip Plate Spring(3f). and now the breaker is in RESET position. Fig.13 shows the breaker with mechanism in RESET position.

Advantages

- 5 ❖ Latching Roller pin reduces the friction between Latch Link and Latch Bracket as there exist rolling coefficient of friction.
- ❖ Contact between Latch Link and Latching Roller in TRIP condition ensures that Latch Bracket will not come back to original position before completion of TRIP to RESET operation.
- 10 ❖ Roller pin ensures the sufficient overlap area between Latch Bracket and Latch Link which not cause the unexpected unlocking of the Latch Link due to wear in contact area.
- ❖ Brining of Latch Bracket to the original position is caused be rotation of Latch Link as there is contact between both, so no Biasing Spring is required for brining Latch Bracket to original position.
- 15 ❖ Less trip force is required as there exists rolling coefficient of friction and as there is no biasing spring for Latch Bracket.
- ❖ Use of side plate which work as a stopper for Trip Plate and Latch bracket in extreme positions reduces the requirement of stopper pins for both.

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CLAIMS

1. An enhanced latch mechanism for use in molded case circuit breakers, said
5 mechanism comprising :
latch bracket means comprising plurality of slot means;
latch link means comprising plurality of slot means being movably engaged with said
latch bracket means; said latch means being operatively engaged with conventional
moving contact of said circuit breaker through linkages;
10 locking trip plate means adapted to lock said latch bracket means;
wherein said latch link means comprising a reset pin means accommodated in said
slots of said latch link means such that assembly of said latch link means and roller
means being movably located on said latch bracket means such that on rotation of
said locking trip plate means actuated by a conventional trip signal, said latch bracket
15 means get unlocked resulting in unlocking of said latch link means whereby said
unlocking of latch link means being performed by rolling movement of said roller
means providing rotation of said latch link means adapted to rotate the moving
contact so as to move it away from fixed contact of the circuit breaker.
- 20 2. Mechanism as claimed in claim 1 wherein said latch bracket means at least two
projection means adapted to provide support and rolling motion to said roller means.
3. Mechanism as claimed in claim 1 wherein said roller means comprising reset pin
adapted to reset latch bracket means.
- 25 4. Mechanism as claimed in claim 1 further comprising latching roller pin operatively
connected to said latch bracket means adapted to lock said latch link means during
ON-OFF and OFF-ON operation.

5. Mechanism as claimed in claim 1 wherein said slot means of the latch link means comprising substantially oblong shaped slot adapted to provide desired rolling coefficient to said reset roller pin means.

5 6. Mechanism as claimed in claim 1 wherein said latch link means is substantially U shaped.

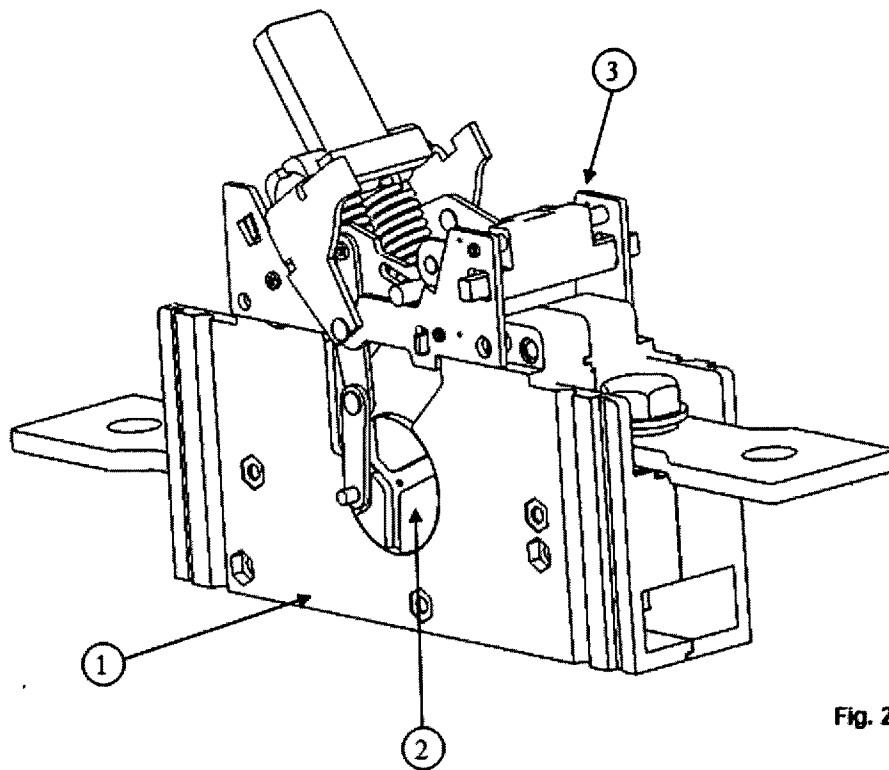
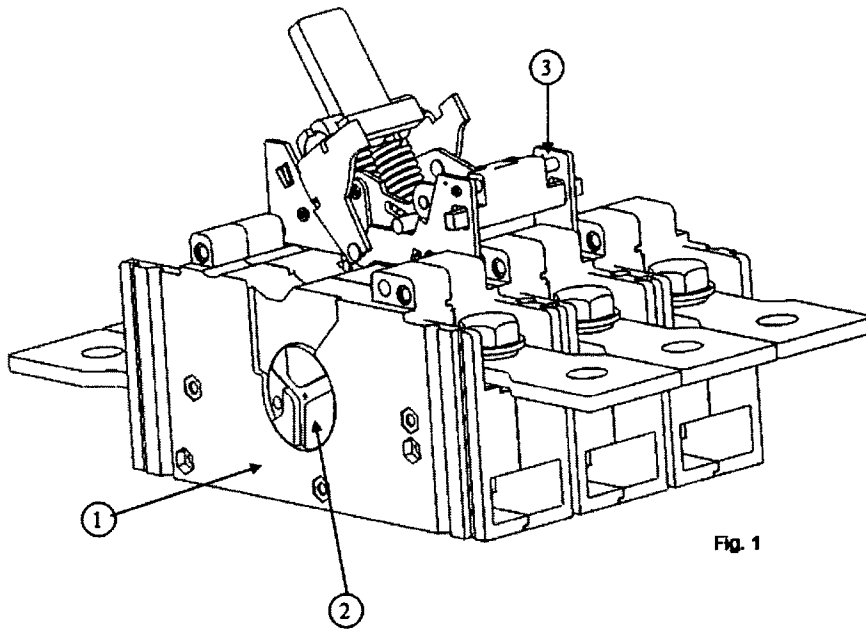
7. Mechanism as claimed in claim 1 wherein said locking double arm trip plate comprising projection means adapted to lock said latch bracket means.

10

8. Mechanism as claimed in claim 1 wherein said locking double arm trip plate is spring biased.

15 9. An enhanced latch mechanism for use in molded case circuit breakers as herein substantially described and illustrated with the accompanying drawings.

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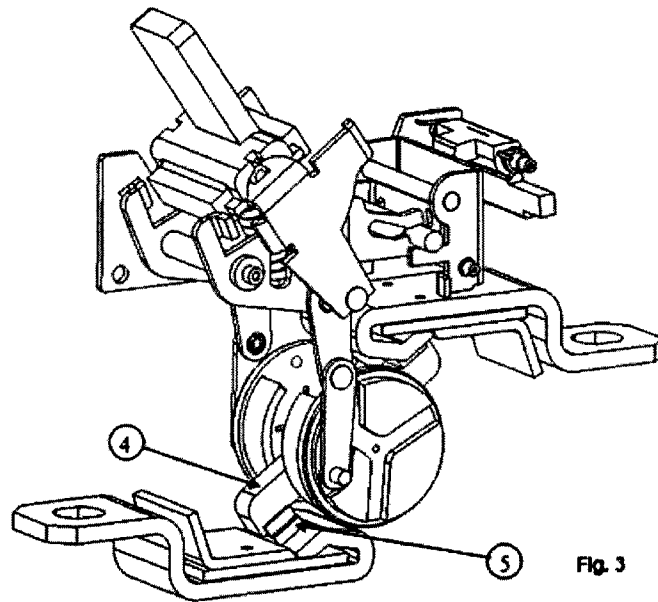


Fig. 3

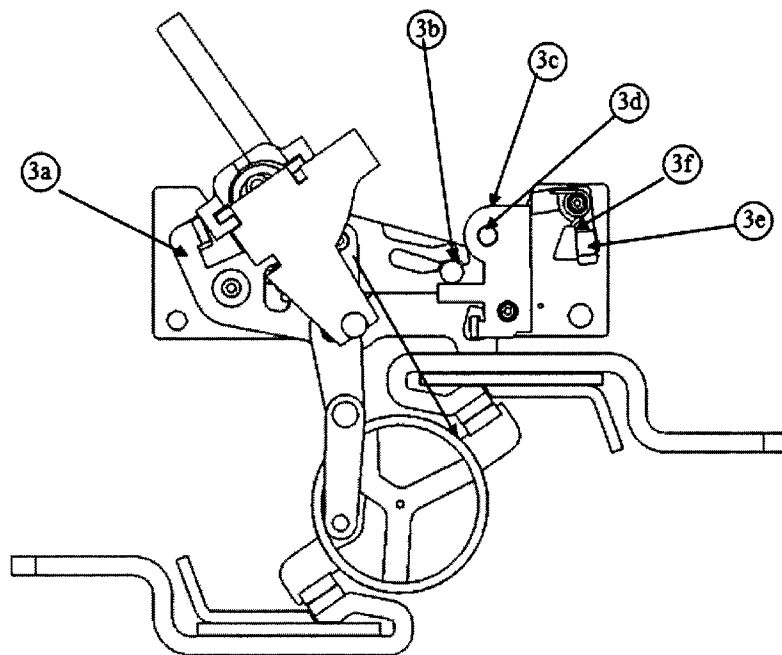


Fig. 4

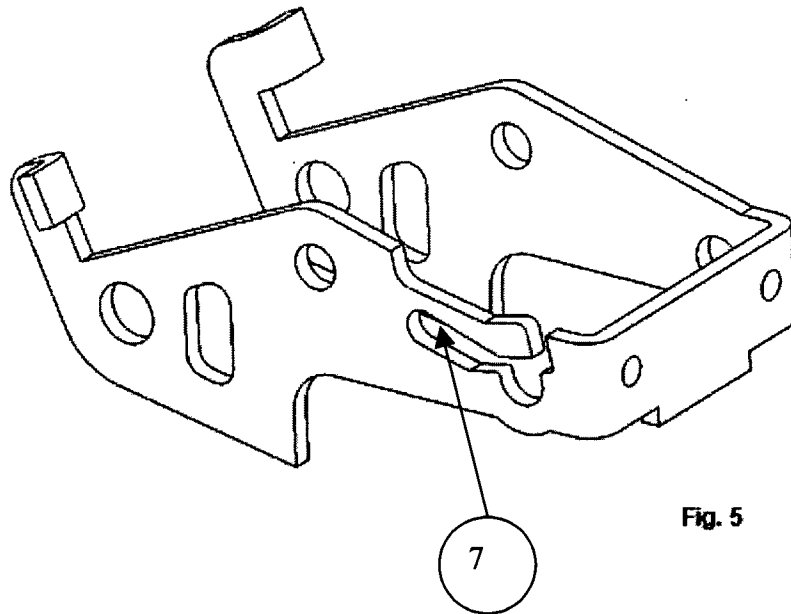


Fig. 5

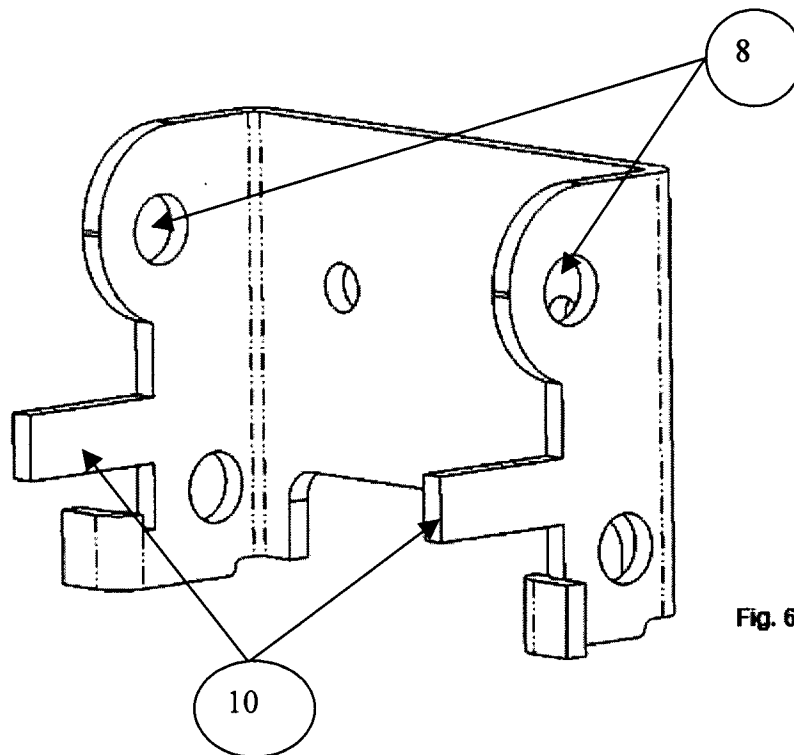


Fig. 6

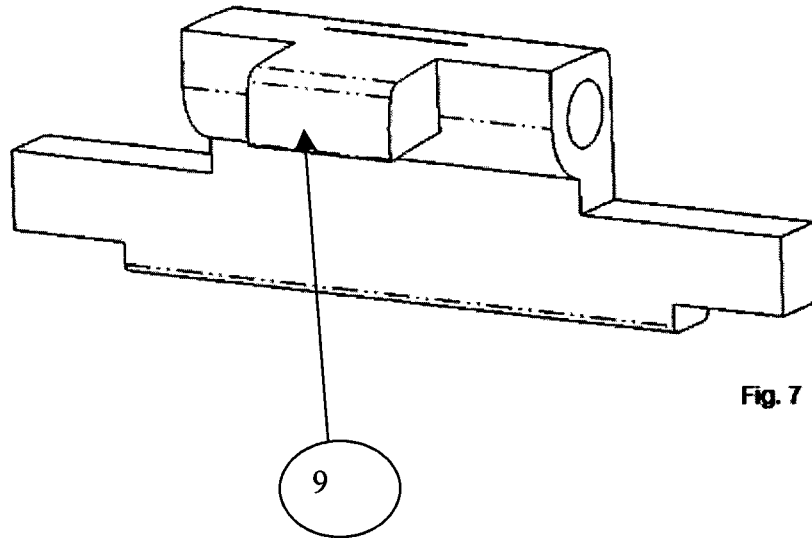


Fig. 7

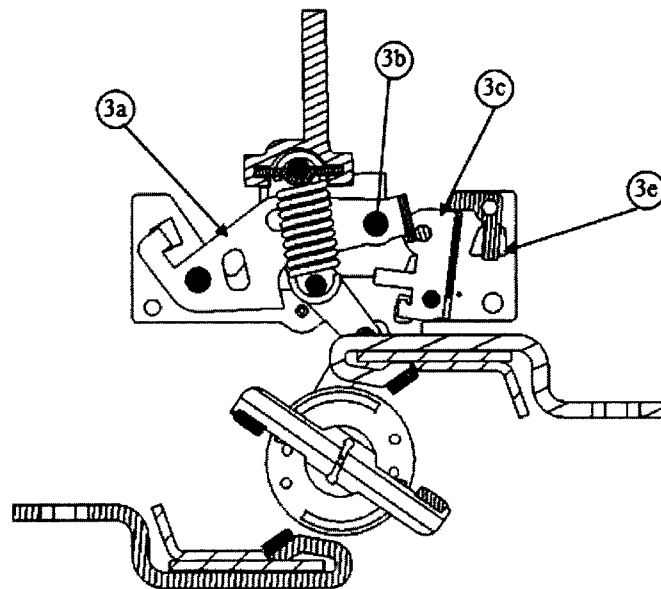


Fig. 8

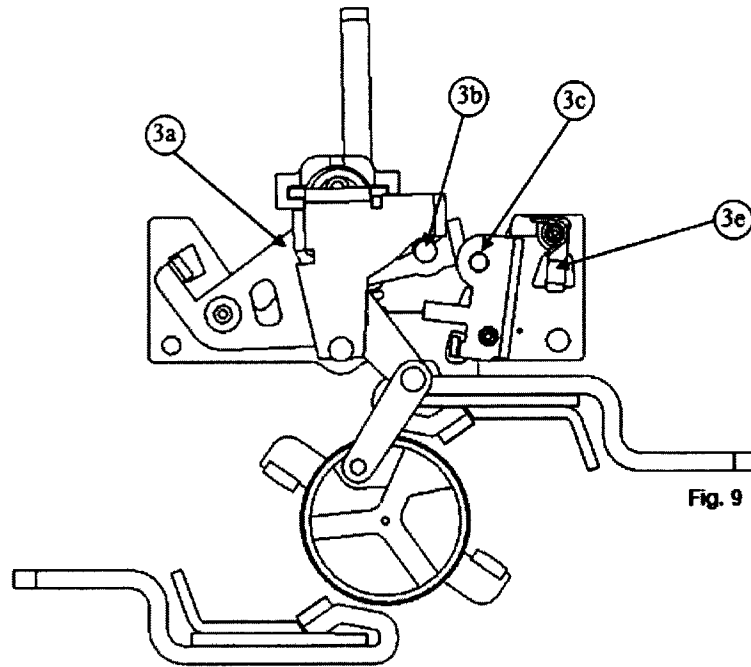


Fig. 9

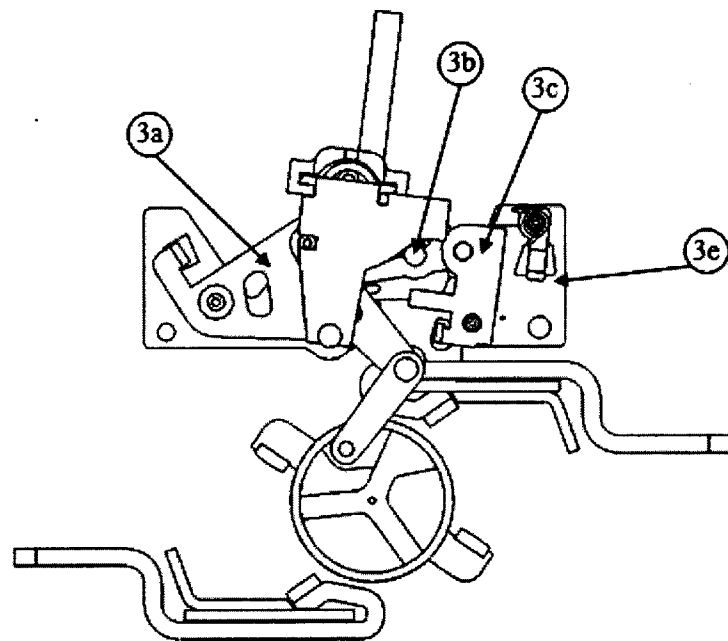


Fig. 10

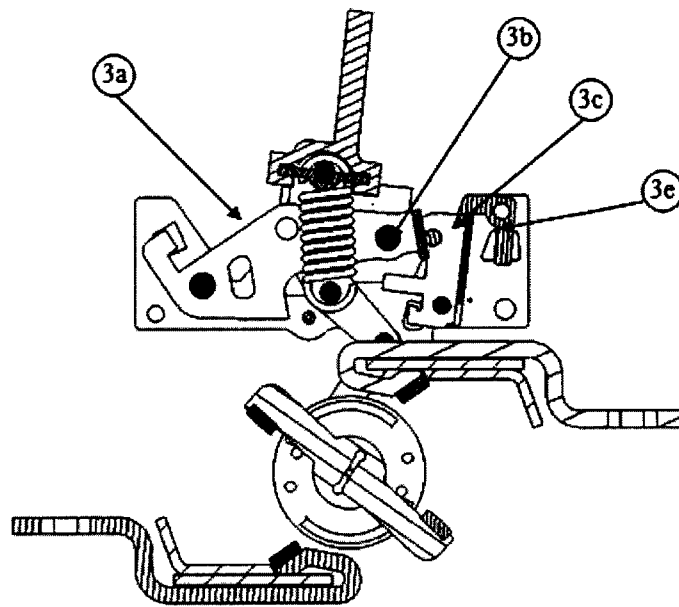


Fig. 11

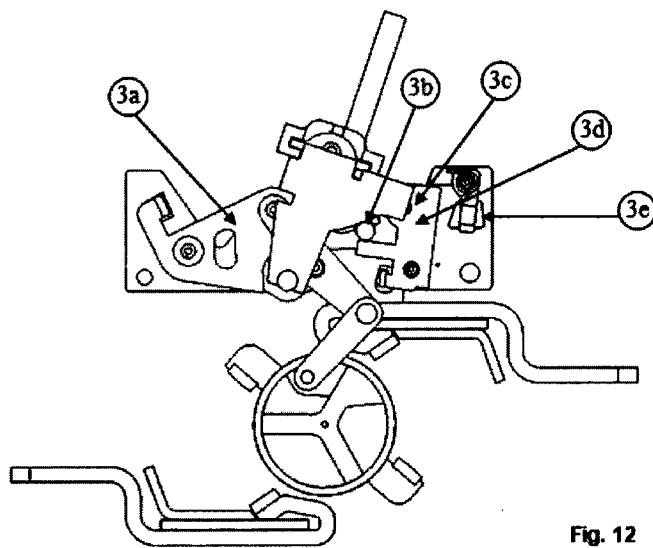


Fig. 12

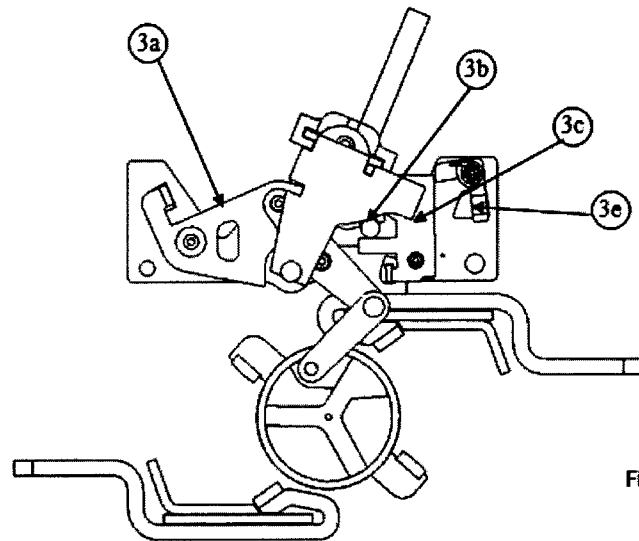


Fig. 13

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2011/001795

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01H71/50 H01H71/52 H01H1/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 798 755 A2 (EATON CORP [US]) 1 October 1997 (1997-10-01) column 5, line 10 - column 12, line 22; figures 1-6 -----	1-8
A	US 6 727 788 B1 (LAWSON ROBERT P [US] ET AL) 27 April 2004 (2004-04-27) cited in the application column 5, line 60 - column 8, line 6; figures 5-8 -----	1-8
A	EP 0 555 158 A1 (MERLIN GERIN [FR] SCHNEIDER ELECTRIC SA [FR]) 11 August 1993 (1993-08-11) abstract; figures 2-5 -----	1-8
A	EP 0 954 002 A2 (AEG NIEDERSPANNUNGSTECH GMBH [DE]) 3 November 1999 (1999-11-03) the whole document -----	1-8

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

7 December 2011

Date of mailing of the international search report

15/12/2011

Name and mailing address of the ISA/

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Authorized officer

Ernst, Uwe

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2011/001795

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 9
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of Item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2011/001795

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 9

Claim 9 does not comply with Rule 6.2 (a) PCT as it refers to subject matter from the description or drawings.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.