

## OPERATING MECHANISM OF A MINIATURE ELECTRICAL CIRCUIT BREAKER.

### **Description**

The invention relates to an operating mechanism of a miniature electrical circuit breaker with an insulated case housing a pair of stationary and movable contacts, said movable contact being supported by a contact arm actuated by the mechanism, which comprises :

- a manual operating handle coupled to a transmission rod to form a toggle,
- a support lever of the contact arm articulated on a pivot of a rotating plate, a relative pivoting movement of small amplitude being allowed between the plate and the support lever due to the presence of a contact pressure spring,
- a breakable mechanical link arranged between the plate and the transmission rod,
- and a trip rod articulated on the plate and being controlled by the trip device to bring about breaking of said mechanical link in the event of a fault occurring, resulting in automatic tripping of the mechanism, independently from the handle.

A device of this kind is known from the document EP-A-244,396, in which the breakable mechanical link is constituted by a notch of the plate designed to cooperate directly with the cylindrical end of the rod in the loaded position of the mechanism. A mechanism of this kind is perfectly suited to circuit breakers with low ratings, but for higher ratings the tripping force required to break the mechanical link would be too great, and would lead to oversizing of the trip device, which is impossible because of the small dimensions of the case.

According to the documents EP-A-144,691, DE-A-1,904,731 and DE-U-7,500,060, an intermediate latching ratchet and the trip lever of the mechanism are articulated directly on the contact arm. Such an assembly requires great precision of the mechanism components to achieve a good contact pressure.

The object of the invention consists in simplifying the achievement of a miniature circuit breaker mechanism having a reduced tripping force and a good contact pressure.

The mechanism according to the invention is characterized in that the breakable mechanical link is formed by a retaining catch of the trip lever cooperating with a latching hook pivotally mounted on a spindle of the plate, and that the transmission rod is coupled to the latching hook at an intermediate articulation point located between the spindle of the plate and the nose of said latching hook.

The intermediate articulation point moves in an aperture of the plate when tripping takes place, said blind or open aperture being advantageously shaped as a circular sector centered on the axis of the latching hook.

The mechanical link with latching hook constitutes a gearing-down stage in the tripping transmission system of the mechanism enabling the tripping force coming from the magnetic and thermal trip device to be reduced.

According to a development of the invention, the bimetal strip is connected to the trip lever by a rotating tie-rod with unidirectional transmission arranged to constitute a rigid transmission link without friction with the trip lever when the bimetal strip drives the tie-rod in the event of overload tripping, said link being automatically interrupted when the plate is moved to the open position of the contacts, or when the striker acts on the trip lever in the event of short-circuit tripping.

According to another development of the invention, the mechanism latching hook cooperates after tripping with a ratcheting hangup

point arranged in the trip lever in such a way as to block the latching hook in a fault indication position.

Two indications of a fault after tripping are possible :

- one direct by the latching hook having a mark coming opposite an indicator of the case,
- the other by the handle which is blocked positively by the rod in a stable intermediate position located between the closed and open positions, when the latching hook is locked by the ratcheting point, after tripping, non-automatic resetting of the mechanism being performed by moving the handle manually from the intermediate position to the open position leading on the one hand to re-establishment of the mechanical link between the handle and the plate, and on the other hand to clearing of the fault indication.

Other advantages and features will become more clearly apparent from the following description of two illustrative embodiments of the invention, given as non-restrictive examples only and represented in the accompanying drawings in which :

- Figure 1 is a block diagram of a first embodiment of the mechanism according to the invention, represented in the closed position of the circuit breaker ;
- Figure 2 is an identical view to that of figure 1, in the open position of the circuit breaker;
- Figure 3 is an identical view to that of figure 1, in the tripped position on a fault with the handle held;
- Figure 4 represents an alternative embodiment of a mechanism with a tripping indicator.

In figures 1 to 3, the operating mechanism 10 of a miniature electrical circuit breaker with a molded insulating case 12 is of the type described in European Patent application EP-A-224,396 filed by the applicant. The mechanism 10 actuates a movable contact arm 14 whose free end supports a contact part 16 cooperating with a stationary contact 18. An opening 20 is arranged in the front panel 22 of the case 12 for the passage of a handle 24 mounted with limited pivoting on a spindle 26 between a closed position (figure 1) in which the contacts 16, 18 are closed, and an open position (figure 2) corresponding to separation of the contacts 16, 18. The handle 24 is equipped with an internal base coupled to a transmission rod 28 to constitute a toggle device 30 whose articulation 32 is eccentric with respect to the fixed spindle 26 of the handle 24.

The handle 24 is biased counterclockwise to the open position by a return spring (not shown). The stationary contact 18 is fixedly secured to the body of the electromagnetic trip device only the striker 34 of which is represented in the figures. The contact arm 14 is fixed to a support lever 36 made of insulating material, articulated on a pivot 38 of a rotating plate 40. In the closed position of the contacts 14, 16, a contact pressure spring (not shown), inserted on the pivot 38, allows a relative pivoting movement of small amplitude between the plate 40 and support lever 36.

A trip lever 42 operated by the electromagnetic trip device striker 34, and the bimetal strip 44 of the thermal trip device, is pivotally mounted on a spindle 46 supported by the plate 40 with a preset stagger with respect to the pivot 38.

A breakable mechanical link 48 is arranged between the transmission rod 28 and the drive plate 40 of the contact arm 14. In the locked position, the link 48 enables manual control

of the mechanism 10 by the handle 24. Movement of the trip lever 42 to the tripped position due to the action of the trip device causes the mechanical link 48 to be momentarily broken, leading to automatic tripping of the mechanism 10, independently from the handle 24. The trip lever 42 is associated with a return spring (not shown) designed to perform automatic re-establishment of the mechanical link 48 when the handle 24 is actuated to the open position, following tripping of the mechanism 10 on a fault.

Operation of an operating mechanism of this kind is well-known to those specialized in the art, and it is not necessary to describe it in greater detail here.

According to the invention, the breakable mechanical link 48 comprises a latching hook 50 pivotally mounted on a spindle 52 of the plate 40. Opposite the spindle 52, the nose of the latching hook 50 cooperates in the locked position of the link 48 with a retaining catch 54 located on the upper arm of the trip lever 42.

The transmission rod 28 is coupled to the latch 50 at an articulation point 56 capable of moving in an aperture 58 of the plate 40 when tripping occurs. The aperture 58 is blind or open and is shaped as a circular sector centered on the spindle 52. The intermediate articulation point 56 is located between the spindle 52 and the nose of the latching hook 50. The link 48 constitutes a gearing-down stage in the transmission system of the mechanism 10, enabling the tripping force from the magnetic and thermal trip device to be reduced.

The bimetal strip 44 of the thermal trip device cooperates with the trip lever 42 by means of a rotating tie-rod 60 with uni-directional transmission (see figures 1 and 2). The tie-rod 60 is formed by an elbow lever having one end freely coupled to the

lower arm of the trip lever 42 at an articulation point 62. The curved intermediate part of the transmission lever bears on a boss 64 of the trip lever 42 so as to drive the latter to the tripped position when the bimetal strip 44 is deflected to the right in the event of an overload current flowing in the pole. During this overload tripping phase, the tie-rod 60 forms a rigid transmission link between the bimetal strip 44 and the trip lever 42. The absence of nuisance friction between the tie-rod 60 and trip lever 42 enables the tripping force transmitted by the bimetal strip 44 to be notably reduced. The articulation point 62 is arranged between the boss 64 and the pivoting axis 46 of the trip lever 42.

When the mechanism 10 is actuated manually or automatically to the open position, the end 66 of the tie-rod 60 opposite the articulation point 62 is capable of coming up against a protuberance of the case 12, with breaking of the transmission link with the trip lever 42. The plate 40 can pivot counterclockwise around the pivot 38, and the intermediate zone of the tie-rod 60 is then separated from the boss 64 (figure 2). It can be noted that if the link remained rigid between the tie-rod 60 and the trip lever 42, total opening of the mechanism 10 would be rendered impossible.

The articulation point 62 of the tie-rod 60 could naturally be the same as the pivoting axis 46 of the trip lever 42.

In the event of magnetic tripping following a short-circuit, the electromagnetic trip device striker 34 acts on the lower arm of the trip lever 42 to perform unlocking of the latching hook 50 by releasing it from the retaining catch 54. The trip lever 42 is thus moved counterclockwise to the tripped position, without any braking reaction of the overload trip tie-rod 60 which remains inactive due to the presence of the flexible link with the bimetal strip 44.

Figure 3 shows the mechanism 10 after tripping on a fault, the handle 24 being held manually in the right-hand position, against the return force of its spring. This position of the handle 24 corresponds to the closed position in figure 4, but the rod 28 does not allow the mechanical link 48 of the latching hook 50 with the catch 54 of the trip lever 42 to be re-established, and the mechanism 10 remains tripped. The mechanical link 48 is re-established automatically as soon as the manual locking action of the handle 24 is released.

According to the alternative embodiment of the mechanism 100 in figure 4, the same reference numbers will be used to designate similar parts to those of the mechanism 10 in figures 1 to 3. In addition to its two extreme open and closed positions, the rocking handle 24 can occupy a stable intermediate position (case of figure 4) after tripping on an overload or short-circuit fault. The trip lever 42 comprises a ratcheting hangup point 102 capable of blocking the latching hook 50 after tripping and breaking of the mechanical link 48. Opposite the nose there is located a coloured indicator mark 104 designed to indicate the tripped position of the latching hook 50 via an indicator flag 106 arranged in the front panel 22 of the case 12. Blocking of the latching hook 50 by the hangup point 102 enables the fault to be continuously indicated, both by the indicator flag 106 and by the handle 24 which occupies the intermediate stable position. The fault indicator function is thus integrated in the circuit breaker.

Non-automatic resetting of the mechanism 100 is achieved by manual movement of the handle 24 counterclockwise from the intermediate position to the open position (see arrow R), resulting in the mechanical link 48 between the handle 24 and the plate 40 being re-established, and the mechanism 100 returning to the open switchgear status of figure 2. The fault

indication is cleared and the switchgear device is ready to be reclosed by pivoting of the handle 24 to the closed position (figure 1).

## **CLAIMS:**

**1. An operating mechanism of a miniature electrical circuit breaker with a molded case (12) housing a pair of stationary (18) and movable (16) contacts, said movable contact (16) being supported by a contact arm (14) actuated by the mechanism (10, 100), which comprises:**

**- a manual operating handle (24) coupled to a transmission rod (28) to form a toggle (30),**

**- a support lever (36) of the contact arm (14) articulated on a pivot (38) of a rotating plate (40), a relative pivoting movement of small amplitude being allowed between the plate (40) and the support lever (36) due to the presence of a contact pressure spring,**

**- a breakable mechanical link (48) arranged between the plate (40) and the transmission rod (28),**

**- and a trip lever (42) articulated on the plate (40) and being controlled by the trip device to cause breaking of said mechanical link (48) in the event of a fault occurring, resulting in automatic tripping of the mechanism (10, 100), independently from the handle (24),**

**characterized in that the breakable mechanical link (48) is constituted by a retaining catch (54) of the trip lever (42) cooperating with a latch (50) pivotally mounted on a spindle (52) of the plate (40), and in that the transmission rod (28) is coupled to the latch (50) at an intermediate articulation point (56) located between the spindle (52) of the plate and the nose of said latch.**

**2. The operating mechanism according to claim 1, characterized in that the trip lever (42) is pivotally mounted on a spindle (46) supported by the plate (40) with a preset stagger with respect to the pivot (38), characterized in that the intermediate articulation point (56) moves in an aperture (58) of the plate**



(40) when tripping occurs, the blind or open aperture (58) being shaped as a circular sector centered on the axis (52) of the latch (50).

3. The operating mechanism according to claim 1 or 2, characterized in that the trip device comprises a thermal overload trip device with a bimetal strip (44) and/or an electromagnetic trip device with a striker (34), characterized in that the bimetal strip (44) is connected to the trip lever (42) by a rotating tie-rod (60) with unidirectional transmission arranged to constitute a rigid frictionless transmission link with the trip lever (42) when the bimetal strip (44) drives the tie-rod (60) in the event of overload tripping, said transmission link being automatically interrupted when the plate (40) is moved to the open position of the contacts (16, 18), or when the striker (34) acts on the trip lever (42) in the event of magnetic tripping.

4. The operating mechanism according to claim 3, characterized in that the rotating tie-rod (60) is formed by an elbow lever having one end freely articulated on the trip lever (42), and a curved intermediate part bearing on a boss (64) of the trip lever (42) in the active position of said transmission link.

5. The operating mechanism according to claim 4, characterized in that the articulation point (62) of the rotating tie-rod (60) is located between the boss (64) and the pivoting axis (46) of the trip lever (42), and that the opposite end (66) of the tie-rod (60) is capable of coming up against a protuberance of the case (12) to break said transmission link with the trip lever (42).

6. The operating mechanism according to one of the claims 1 to 5, characterized in that the latch (50) of the mechanism (100) cooperates after tripping with a ratcheting hangup point (102) arranged on the trip lever (42) so as to block the latch (50) in a fault indication position.

7. The operating mechanism according to claim 6, characterized in that the latch (50) comprises a mark (104) coming opposite an indicator (106) of the case (12) in said fault indication position.



8. The operating mechanism according to claim 6 or 7, characterized in that the handle (24) is blocked positively by the rod (28) in a stable intermediate position located between the closed and open positions, when the latch (50) is locked by the hangup point (102) after tripping , non-automatic resetting of the mechanism (100) being achieved by manual movement of the handle (24) from the intermediate position to the open position leading on the one hand to the mechanical link (48) between the handle (24) and the plate (40) being re-established, and on the other hand to the fault indication being cleared.



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