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The present invention relates to a lock mechanism for a limiting contact maker, of the kind comprising, in a manner as described in French patent FR-A-2 570 872 filed in the name of the applicant which served to delimit the preamble of the independent claims 1 and 2 of the present application, at least one set of switches which can be closed and opened by a control electromagnet, which forms its contact making function, or else opened only by a device which, associated with an overload detector, provides rapid opening corresponding to the limiting function.

The limiting function has priority over the contact making function, which means that in the case of closure on a short circuit, the process of opening the switches must take place as rapidly as possible. For this, the control for opening the switches is provided by an appropriate mechanism, cut-off of the power supply to the electromagnet only taking place so as to confirm the cut-off.

From US patent US-A-2 229 981, one further knows a cam-operated multi-position switch.

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An object of the invention is to provide a mechanism of the kind described in the above-mentioned French patent

which is extremely reliable and with high speed operation, while being relatively inexpensive.

5 A further object of the invention is such a mechanism which may also be associated with a change-over limiting contact maker formed by two limiting contact makers mounted side by side.

10 An additional object is a mechanism of this type which may assume three stable positions, namely "stop", "go", "tripped" and a transitory resetting position.

15 According to the invention, these objects are attained through a lock mechanism for a limiting contact maker comprising two sets of power switches, each being able to be closed and opened by a control electromagnet, by means of a pusher block which are also acted upon by the lock mechanism occupying at least two stable positions : a locked automatic operational position which allows the
20 closing of the sets of switches by the control electromagnets and a tripped position wherein the lock mechanism maintains the two sets of switches in the open position, passing from the locked position to the tripped position being effected energetically.

25 According to the invention, said lock mechanism is characterized in that it comprises :

30 - two first levers, each being respectively articulated about a first fixed shaft, the first two fixed shafts being parallel, each of said two levers acting respectively on the pusher block associated therewith, each of said levers comprising a roller, and

35 - first resilient means which apply said rollers on the profile of a rotary cam having, in line with the rollers, a maximum width in said locked position, and a minimum width in said tripped position,

- means for moving said rotary cam from the locked position where it maintains the first levers separated

from the pusher blocks, to the tripped position where the first levers act upon the pusher blocks for maintaining the sets of switches in the open position.

- 5 The invention also concerns a lock mechanism for a limiting contact maker as described in claim 2, wherein the two levers act on the same pusher block.

10 It should be noted that, in the locked position, the mobile contacts of the switches may be brought into a normally closed position by means of return springs and actuated through the action on the pusher block of an electromagnet providing the contact making function.

- 15 In an advantageous embodiment of the invention, the rotary cam is mounted freely on a second shaft, perpendicular to the first parallel shafts of said first levers and has a heel which allows it to be maintained in said locked position by a first trigger which may be
20 retracted to free the cam which is then energetically returned to said tripped position by resilient means applied to said first levers.

25 It will be understood that, when the rotary cam of this device is unlocked, which is free to rotate about its shaft which is perpendicular thereto, the rollers which bear thereon grip it with their resilient return means and bring it towards its position of smallest width. The rollers which bear thereon are simultaneously brought
30 together while causing the levers to rock, whose free ends push the pusher block in the opening direction of the switches.

- 35 In an advantageous embodiment of this mechanism, each of the above specified levers has the form of a Z, it is articulated in the vicinity of a bend of the Z, its free end situated on the same side as its articulation carries a corresponding roller and its other free end is situated

opposite the pusher block. With this arrangement, an energetic and well geared-down action is obtained on the pusher blocks and their switches.

5 Preferably, the cam of the mechanism of the invention has the form of an S, and its rollers bear on its external contour.

10 Advantageously, the shaft of rotation of the cam is fast with a control knob at one end, which has three locking and control cams and which is returned to a "stop" position by a helical spring which surrounds it. It is by rotating this knob that the mechanism is caused to pass to the "stop" "automatic" and "reset" positions.

15 Furthermore, this control knob may be fast with a first finger capable of urging the rotary cam towards its locked position, in which position it engages with the first trigger and is locked against rotation. The rotary
20 cam may then be released by actuating this first trigger by means of one or more fault detection relays.

25 Advantageously, the central shaft of the above specified device carries a first control cam whose periphery has a notch into which, under the action of second resilient means, a second finger may penetrate which is mounted on a second lever which, in this position, causes closure of a switch mounted in series with the circuit energizing the electromagnets providing the "contact maker"
30 function. This corresponds to the "automatic operational" position of the device.

35 In an advantageous embodiment, the mechanism of the invention comprises a dog mounted for pivoting on a third fixed shaft against a spring and which may be locked by two triggers, each of which may be unlocked by a fault detection relay. One of these triggers may be the one which also locks the main above specified S-shaped cam

and which is controlled by another fault detection relay, whereas the other is controlled by another fault detection relay, a connection existing between these triggers or not.

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When the mechanism of the invention is to operate as a change-over limiting contact maker, the above specified levers act simultaneously on the pusher blocks corresponding to the assembly of switches to be actuated.

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The following description which has no limitative character will better show how the present invention may be put into practice. It should be read in conjunction with the following drawings, in which :

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Figure 1 shows a schematic side view of the lock mechanism of the present invention, associated with two contact makers ;

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Figures 2 to 5 show the mechanism of figure 1, certain parts of which have been cut away and shown in a top view, respectively for the four positions of its rotary control knob ;

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Figure 6 shows a partial schematic side view of a limiting contact maker of the invention ; and

Figure 7 shows a device for unlocking the mechanism of the invention.

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As can be seen in figure 1, the mechanism of the invention serves for opening and closing two sets of three switches 1a and 1b, the mobile contacts of each group being actuated simultaneously by a pusher block 2a or 2b respectively. This latter pushes the three corresponding contacts in the opening direction shown in the figure, against springs 3a or 3b which tend to

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return their groups of respective mobile contacts 1a and 1b in the closing direction.

5 The members associated with the two pusher blocks 2a and 2b are symmetrical and, for the sake of simplicity, they will be designated by the same reference followed or not by the letter a or b respectively.

10 Each pusher block 2 may be pushed or released by an electromagnet A or B through a lever A' or B' and against a spring A" or B", the switches 1 being closed when the corresponding electromagnet is energized.

15 Each pusher block 2 may be also pushed towards switches 1 by one end of a lever 4. For this, this lever has the form of a recumbent Z and it is articulated about a shaft 5 which is perpendicular to its plane and which is situated in the vicinity of the tip of the Z opposite the pusher concerned. The other end of this lever 4 carries a
20 roller 6 whose shaft extends substantially in the plane of the lever and in the extension of the leg of the Z which carries it. Each of the two rollers 6 bears on a rotary cam 7 which is common thereto, which extends substantially in the plane of rollers 6 and which is
25 mounted freely on a shaft 8 perpendicular to shafts 5. Rollers 6 are applied to the profile of the rotary cam 7 by traction springs 9 and are each guided in their movements by a disk D, respectively D', which rolls freely on a running track R, R' parallel to the axis of
30 the rollers.

A rotary control knob 10 may be fixed to the other end of shaft 8 which may thus be rotated as shown by arrow F1 against a helical return spring 11 which surrounds it and
35 which tends to bring it back to the "stop" position. Finally, shaft 8 is fast with a cam 12 having three tracks perpendicular to the shaft and with a finger 13

which is parallel to shaft 8 and which projects in the plane of the rotary cam 7.

Reference will now be made to figures 2 to 5 in which can be seen the pusher blocks 2 of switches 1, the Z levers 4 and, this time in an exploded top view, the rollers 6 following the external profile of the rotary cam 7. There can also be seen, also in a top view, the tracks 14, 15 and 16 of the three track cam as well as the control knob 10 in its four positions. Shaft 8 which connects this latter to cams 14, 15 and 16 is shown schematically by a vertical chain-dotted line.

The tripping cam 7 has substantially the shape of an S mounted at its centre on shaft 8 so that its width, taken along a fixed line contained in the plane of figure 1, may pass from a low value (figure 4) in which rollers 6 are close to one another to a higher value (figures 2, 3 and 5) by moving the rollers 6 away from each other and causing the legs of the Z-shaped levers 4 which carry the rollers 6 to pivot outwardly against springs 9. The result is that the opposite leg of the Z moves away from the associated pusher block 2, this latter moves away from the mobile contacts of the switches 1 and the latter close under the effect of springs 3.

It is in this position that the tripping cam 7 may be blocked by a nose-piece of a trigger 17 which engages in a heel 18 formed in the external profile of cam 7. Trigger 17 is articulated on a shaft 19 perpendicular to the plane of cam 7, whereas its nose-piece, pushed towards the latter by a spring 20, may be released from heel 18 by a fault detection relay, not shown, which causes the trigger to rotate in the direction of arrow F2 against spring 20.

It will be readily understood that, when the nose-piece of trigger 17 retracts with respect to heel 18 of the cam

7, the latter rotates in the direction of the smallest width between rollers 6, for the latter are drawn together by springs 9. Cam 7 then assumes the position shown in figure 4.

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A dog 21 is articulated to a pivot 22 parallel to shaft 8, at a distance therefrom, and against a return spring 23. It comprises a finger 24 which is directed towards shaft 8 and which bears, under the effect of spring 23, on cam 14. The latter comprises successively : a heel 25 against which finger 24 abuts for locking shaft 8 in an angular position corresponding to the "stop" position against the action of spring 11, and a circular portion allowing shaft 8 to rotate through a quarter of a revolution in a clockwise direction from the "stop" position.

As for cam 15 of shaft 8, shown only in figure 4, its rotations in the anticlockwise direction, and so that of shaft 8 which is fast therewith, are blocked by another finger 26 directed inwardly at the end of dog 21 which engages with a flat 27 formed on this cam 15 in the "tripped" position.

25 Dog 21 further comprises an arcuate extension 28 which surrounds shaft 8 over about a quarter of a circle, opposite finger 26 and which comprises an external heel 29 engageable with a nose-piece of a second trigger 30. This nose-piece is pushed towards heel 29 by a spring 31, and it may be retracted therefrom by rotation of trigger 30, against this spring 31 under the effect of another fault detection means not shown which acts in the direction of arrow F2'.

35 The two triggers 17 and 30 are interlocked in their movement by a lever 32 and a judicious calculation of the lever arms makes it possible to have on each of them a different tripping force adapted to the fault detection

means used, for example, to a thermal or magnetic protection relay or to a voltage missing or voltage emission relay.

- 5 Finally, dog 21 further comprises a shoulder 33 into which may penetrate a rod 34 fast with trigger 17.

10 Cam 16 fast with shaft 8 comprises, on its periphery, a rectangular notch 35 into which may penetrate a finger 36 which is formed at one end of a lever 37 articulated at 38 and which is pushed towards cam 16 by a spring 39. The other end of lever 37 carries a pusher 40 which acts on the mobile blade 41 of a switch 42 placed in series in the circuits feeding the coils of the electromagnets.

15 When finger 36 is in the normal position on the periphery of cam 16 (figures 2, 4 and 5), pusher 40 bears on the mobile blade 41 and switch 42 is opened, whereas, when this finger 36 penetrates into notch 35 of cam 16 (figure 3), pusher 40 releases the blade 41 and switch 42 closes.

20 In addition, a pin 43 fast with dog 21 may cause lever 37 to rotate in the direction in which finger 36 comes out of notch 35 of cam 16.

25 Furthermore, and for reasons which will be explained further on, lever 37, in the bend which it forms in line with finger 36, has a recess 44 which is open outwardly on the same side as this finger by a narrow channel 45. A loop spring 46 is housed in recess 44 and both its ends

30 are anchored in the walls of lever 37 so that it tends to close channel 45 again against the resilience of the molded thermoplastic material which forms the lever in question.

35 The operating mode of this lock mechanism will now be described with reference to figures 2 to 5 which correspond respectively to the "stop", "automatic", "tripped" and "reset" positions of the control knob 10,

these positions of the knob being shown in the left hand part of each figure.

In the "stop" position of figure 2, dog 21 is held
5 against rotation in both directions by the nose-pieces of
the two triggers 17 and 30. Finger 36 of lever 37 rests
on the periphery of cam 16, outside notch 35, so that
switch 42 is open and the electromagnets A and B are not
energized. The pusher blocks 2 are then caused to bear on
10 switches 1 by levers A' and B', and switches 1 are open.
Finally, the Z levers 4 are moved away from the pusher
blocks 2 by cam 7, through rollers 6 for cam 7 presents
its largest width in line with these latter and is locked
by trigger 17 engaged with its heel 18, as well as by the
15 finger 13 fast with the control knob 10.

When in the "automatic" position of figure 3, in which
shaft 8 and cams 14, 15, 16 which are associated
therewith have rotated through 90° in a clockwise
20 direction, dog 21 remains locked by triggers 17 and 30,
its finger 24 remaining in contact with the circular
portion of cam 14. Furthermore, the S-shaped cam 7
remains locked by trigger 17, but it is freed from finger
13 fast with knob 10. Rotation of cam 16 has caused
25 finger 36 to penetrate into its notch 35 which has closed
switch 42 and causes locking in the "auto" position. The
electromagnets A and B are enabled. In this example, the
electromagnet B is energized and causes lever B' to
rotate against the corresponding spring, so that the
30 pusher block 2b has released the mobile contacts of
switches 1b which close under the effect of springs 3b.

It will be further noted that the recess 44 of lever 37
and its loop spring 46 permit correct engagement in the
35 "automatic" position without hindering tripping : when
knob 10 is moved to the "stop" position, the notch 35 of
cam 16 urges finger 36 downwards which is held in

abutment by spring 39 until lever 37 escapes, rocks and opens switch 42.

5 If, now, one or other of the overload relays is tripped, by exerting a force F2 or F2' on trigger 17 or 30, this releases dog 21 which pivots through about 45° in an anticlockwise direction, under the effect of the return spring 23, until it assumes the position shown in figure 4. Concurrently, shaft 8 which is no longer retained by
10 finger 36 which escapes from notch 35, rotates under the effect of spring 11, in an anticlockwise direction until flat 27 of cam 15 is retained by finger 26. Shaft 8 and the knob are then in the "tripped" position.

15 With trigger 17 thus open, either directly by force F2 or indirectly by force F2' and the transmission lever 32, the S-shaped cam 7 may rotate under the effect of rollers 6 on which springs 9 act. The rollers draw nearer together, which causes the free ends of Z-shaped levers 4
20 to move towards the pusher blocks 2 and open switches 1. Because finger 36 of lever 37 has come out of notch 35 of cam 16, switch 42 opens, which cuts off the power supply to the electromagnets A and B which also bear on the pusher blocks 2 for opening switches 1.

25 To reset the mechanism, it is sufficient to rotate the control knob 10 by a little more than 45°, against its helical return spring 11, so that it passes slightly beyond the stop position of figure 2. Cam 7, urged by
30 finger 13 fast with knob 10, then engages by its heel 18 on trigger 17, with a slight overtravel, whereas dog 21 resumes its initial position in which it is locked by the two triggers 17 and 30, through the action of heel 25 of cam 14 which urges the finger 24 of the dog. Switch 42
35 associated with cam 16 remains open and the procedure may begin again.

The device which has just been described in its application to a change-over limiting contact maker appliance may be applied to a simple limiting contact maker, by replacing the pusher blocks 2a and 2b of figure 1 by a single pusher block 2 shown in figure 6 on which the free ends 4a and 4b of the two Z levers act.

Figure 7 shows means for carrying out an auxiliary function called "verification of opening positivity" and which use an unlocking cam 50 rotated by the control knob 10. Through a lever 51 articulated at 52 and urged by a nose-piece 53 of the unlocking cam 50, the latter acts on the pusher block(s) 2 independently of the rest of the mechanism, which, through the forced action on knob 10, eliminates foreign bodies or overcomes possible jamming.



Claims

1. A lock mechanism for a limiting contact maker, comprising two sets of power switches (1a, 1b), each
5 being closed and opened by a control electromagnet (A, B), by means of a pusher block (2a, 2b), which are also acted upon by the locking mechanism when it takes two stable positions : a locked automatic operational position which allows closing of the set of switches (1a, 1b) by the control electromagnets (A, B) and a tripped
10 position, wherein the lock mechanism maintains the two sets of switches (1a, 1b) in the open position, movement from the locked position to the tripped position being effected energetically,
15 characterized by the fact that the lock mechanism comprises :
- two first levers (4a, 4b), each of which is respectively articulated about a first fixed shaft (5a, 5b), the first two fixed shafts (5a, 5b) being parallel,
20 each of said two levers (4a, 4b) acting respectively on the pusher block (2a, 2b) associated therewith, each of said levers (4a, 4b) comprising a roller (6a, 6b), and
 - first resilient means (9a, 9b) which apply said rollers (6a, 6b) on the profile of a rotary cam (7) which
25 has, in line with the rollers (6a, 6b), a maximum width in said locked position and a minimum width in said tripped position,
 - means for moving said rotary cam (7) from the locked position, where it maintains the first levers (4a, 4b) separated from the pusher blocks (2a, 2b), towards the
30 tripped position where the first levers (4a, 4b) act on the pusher blocks (2a; 2b) for holding the set of switches (1a, 1b) in the open position.
- 35 2. Lock mechanism for a limiting contact maker, comprising a set of power switches (1) which may be closed and opened by a control electromagnet by means of a pusher block (2), which is also acted upon by the lock



- mechanism taking at least two stable positions : a locked automatic operational position which allows closure of the set of switches (1) by the control electromagnet and a tripped position in which the mechanism maintains the set of switches (1) in the open position, movement from the locked position towards the tripped position being effected energetically,
- 5 characterized by the fact that the lock mechanism comprises :
- 10 - two first levers (4a, 4b), each of which is respectively articulated about a first fixed shaft (5a, 5b), the first two fixed shafts (5a, 5b) being parallel, each of said two levers (4a, 4b) acting on said pusher block (2) and comprising a roller (6a, 6b), and
 - 15 - first resilient means (9a, 9b) which apply said rollers (6a, 6b) on the profile of a rotary cam (7) having, in line with the rollers (6a, 6b), a maximum width in said locked position and a minimum width in said tripped position,
 - 20 - means to move said rotary cam (7) from the locked position where it holds the first levers (4a, 4b) away from the pusher block (2), towards the tripped position where the first levers (4a, 4b) act on the pusher block (2) to maintain the set of switches (1) in the open
 - 25 position.
3. The mechanism according to one of claims 1 and 2, characterized in that the rotary cam (7) is mounted freely on a second shaft (8) perpendicular to the first parallel shafts (5a, 5b) of said first levers (4a, 4b)
- 30 and has a heel (18) enabling it to be maintained in said locked position by a first trigger (17) which is retractable in order to release the cam which is then returned energetically to said tripped position by
- 35 resilient means (9a, 9b) applied to the two first levers (4a, 4b).



4. The mechanism as claimed in one of the preceding claims,

characterized in that each of said first levers (4a, 4b) has the form of a Z, is articulated in the vicinity of a bend of the Z, its free end situated on the same side as its articulation carrying said roller (6a, 6b) and its other free end being situated opposite the pusher block (2a, 2b ; 2).

5. The mechanism as claimed in one of the preceding claims,

characterized in that said rotary cam (7) has the form of an S, and said rollers (6a, 6b) bear on its external contour.

6. 6. The mechanism as claimed in claim 5, characterized in that said rollers (6a, 6b) are each guided in their movement by a disk (D, D') which rolls freely on a running track (R, R') parallel to the axis of movement of the rollers (6a, 6b).

7. The mechanism as claimed in anyone of claims 3 to 6, characterized in that said second shaft (8) is fast with a control knob (10) at one end, carries three locking and control cams (14, 15, 16), and is returned to a "stop" position by a helical spring (11) which surrounds it.

8. The mechanism as claimed in claim 7, characterized in that said control knob (10) is fast with a first finger (13) capable of urging said rotary cam (7) towards said locked position, said first trigger (17) then engaging with said heel (18) of the rotary cam (7) and being retracted by means of an overload relay placed in series with the power switches (1a, 1b ; 1).

9. The mechanism as claimed in one of claims 7 and 8, characterized in that the first cam (16) of said three locking and control cams (14, 15, 16) is a control cam



and has on its periphery a notch (35) into which may penetrate, under the action of second resilient means (39), a second finger (36) mounted on an end of a second lever (37) whose other end acts on at least one switch (42a, 42b ; 42) to close same when said second finger (36) penetrates into said notch (35), said switch (42) being mounted in the energizing circuit of the control electromagnets (A, B).

10. The mechanism as claimed in one of claims 7 to 9, characterized in that it comprises a dog (21) mounted for pivoting on a third fixed shaft (22) against a spring (23) and which may be locked by said first trigger (17) and a second trigger (30), each of said triggers being capable to be unlocked by an overload relay.

11. The mechanism as claimed in claim 10, characterized in that the second trigger (30) is controlled by another overload relay, a mechanical drive (32) being provided between the first (17) and the second (30) trigger.

12. The mechanism as claimed in one of claims 10 and 11, characterized in that said dog (21) is locked in its travel towards said tripped position by the abutment of a third finger (26) which is fast therewith on a flat (27) formed on the second cam (15) of said three locking and control cams (14, 15, 16).

13. The mechanism as claimed in one of claims 10 to 12, characterized in that said dog (21) comprises a fourth finger (24) onto which bears a heel (25) provided on the third cam (14) of said three locking and control cams (14, 15, 16) to push said dog (21) towards said "stop" position.

14. The mechanism as claimed in one of claims 1 to 13,



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characterized in that it comprises an unlocking cam (50) which is mounted on said second shaft (8) and acts on said pusher block (2) through a third lever (51).