

①②

EUROPEAN PATENT APPLICATION

②① Application number: 86101066.8

⑤① Int. Cl.⁴: **H 01 H 71/44**

②② Date of filing: 27.01.86

③① Priority: 29.01.85 IT 1927985

④③ Date of publication of application:
06.08.86 Bulletin 86/32

⑧④ Designated Contracting States:
AT BE CH DE FR GB LI NL SE

⑦① Applicant: **CGE- COMPAGNIA GENERALE
ELETTRMECCANICA S.p.A.**
Via Tortona 27
I-20144 Milan(IT)

⑦② Inventor: **Banfi, Claudio**
Via Como 1
I-22070 Rovello Porro -Como(IT)

⑦④ Representative: **Michelotti, Giuliano et al,**
c/o SAIC BREVETTI S.r.l. Viale Bianca Maria 15
I-20122 Milano(IT)

⑤④ Closing delay arrangement for current limiting circuit breaker contacts.

⑤⑦ A control arrangement to prevent or delay the closing of current limiting circuit breaker contacts after opening by repulsion due to a short circuit is disclosed. A first contact arm (10) and a second contact arm (12) are operatively associated with a ratchet (38) for locking the second contact arm (12). A release lever (62) operatable by the first contact arm (10) and the breaker operating mechanism releases the ratchet (38) after a delay period greater than the duration of the short circuit or the operating time of the breaker operating mechanism.

The invention relates to a device for preventing the transitory reclosing of the contacts of a current limiting circuit breaker after opening by a electrodynamic repulsion caused by a short circuit current before the current is extinguished. Interruption of the short circuit current can be due to two distinct causes: namely, a transitory rapid contact separation, or by the positive operation of the circuit breaker trip mechanism to hold the contacts open indefinitely.

In current limiting circuit breakers, the two arms bearing the contacts are free to separate due to electrodynamic repulsion under intense short circuit currents. Opening of the contacts is subsequently completed by the circuit breaker operating mechanism, if the short circuit current is maintained for a time sufficiently long enough to articulate the operating mechanism.

The high separation speed of the contacts necessary to provide the current limitation can result in a rebound of the contacts upon separation resulting in a transitory reclosing of the contacts before the operating mechanism has had sufficient time to operate. When the short circuit occurrence is shorter than the response time of the operating mechanism, there is no need to open the contacts indefinitely. It is important however, to ensure continuity of circuit current in the absence of a real fault condition. With 3-phase loads protected by 3-pole breakers, it is essential to prevent a single-phase transitory short circuit occurrence from opening only one pole of the breaker, resulting in a dangerous condition known as "single phasing".

The purpose of this invention is to delay reclosing of the circuit breaker contacts, after a short circuit interruption, for a period of time sufficient to allow the operating mechanism to open the contacts indefinitely providing the short circuit lasts for a time longer than the delay.

The invention consists essentially of a contact delay arrangement (9) wherein a first contact arm (10) bearing a first contact (14) and a second contact arm (12) bearing a second contact (16) are both free to

0189887

rotate around their respective pivot pins (22,32), being the first pivot pin (22) connected to a contact arm support cam (24) which is operated by the circuit breaker operating mechanism and being the second pivot pin (32) housed in a contact arm support (36), being the contacts held closed by a pair of springs (18,20) and being separated by means of electrodynamic repulsion upon the occurrence of a short circuit, said delay arrangement (9) being characterized in that:

it includes a spring loaded ratchet (38) locking the second contact arm (12) by engaging a pawl pin (44) attached to the second contact arm (12) when the arm is driven by electrodynamic repulsion toward a stop (76) to prevent the arm from returning to a closed position after striking against the step (76);

a release lever (62) operated either by a post (68) attached to the first contact arm (10) when the first arm (10) moves towards its closed position or by a rear surface (78) of the support cam (24) driven by the circuit breaker operating mechanism;

and when the support cam (24) moves the first contact arm (10) to the open position, it drives a bottom bumper (66) of the release lever (62) against a pin (46) extending through the bottom of the spring loaded ratchet (38), moving the ratchet out of the engagement with the pawl pin (44) thereby allowing the second contact arm (12) to return to its initial position.

According to a preferred embodiment the ratchet (38) is characterized by a pivot pin (40), around which it can rotate, by a detent (42) engaging the corresponding pin (44) of the second contact arm (12) by said pin (46) drivable by the bottom (66) of said release lever (62) and by a spring (50) driving the detent (42) of said ratchet (38) causing it to engage the pawl pin (44) of the second contact arm (12).

According to another preferred embodiment the release lever (62) is characterized by a pin (60) pivotally supported by a pair of sockets formed in an insulating hood (56) that surrounds both the contact arm support (36) as well as part of the second arm (12);

0189887

by the top bumper (64) in the nature of a reinforced upper extension designed to receive the post (68) attached to the first contact arm (10), or the rear surface (78) of the cam (24) upon operation of the breaker operating mechanism and

by the bottom bumper comprising a reinforced lower extension designed to contact the ratchet pin (46) to release the ratchet (38), thereby unlocking the second contact arm (12).

According to the most preferred embodiment of the present invention, the ratchet (38) locking the second contact arm (12) and the release lever (62) are formed by two side-by-side placed members spanning the contact arm (12).

These and other objects and advantages will be made clear by the following detailed description of the invention accompanied by the annexed drawings wherein:

fig. 1 is a side view in partial section of the delay arrangement of the invention applied to a pair of circuit breaker contacts in a closed condition;

fig. 2 is a side view of the arrangement of fig. 1 with the pair of contacts opened by repulsion due to a short circuit, and

fig. 3 is a side view of the arrangement of fig. 1 with the pair of contacts opened by means of the operating mechanism.

The delay arrangement 9 is shown in the figures with a contact arm 10 and a contact arm 12 carrying contacts 14, 16 held in a closed position by springs 18 and 20 respectively. The contact arm 10 rotates about a pin 22 supported by an operating cam 24 which, in turn rotates around an operating shaft 26 fitted with a post 28 to which a force represented by arrow 30 is applied when it is desired to cause cam 24 to rotate the shaft 26 to move the contact arm 10 into the fully open position shown in fig. 3.

The contact arm 12 rotates around a pin 32 captured within an elongated slot 34 formed in the contact arm support 36. Also mounted on the contact arm support is a double ratchet 38, one on each side of the contact arm, only one of which is shown for purposes of clarity. The ratchet 38

0189887

rotates around a pin 40 through the contact arm support and has a detent 42 formed at the end opposite pin 40 which engages a post or pawl pin 44 attached to the contact arm 12. A pin 46 attached to the bottom of ratchet 38 is captured within radial slot 48 formed in the side of support 36 and is biased upwards within the slot by a compression spring 50 which is captured between the bottom of the ratchet 38 and the bottom circuit breaker support 52. A projection 54 is formed on each side of the contact arm support 36 for engaging the post 44 on contact arm 12 to stop movement of the arm against the bias exerted by spring 20.

The whole contact arm support 36 is enclosed within an insulating hood 56 fitted with a cover 58. The cover 58 is provided with a hole on either side of the contact arm 12 to receive a pair of pins 60 formed on the exterior surface of a pair of release levers 62. One lever is arranged on each side of the contact arm and both levers are provided with top and bottom reinforced bumpers 64, 66. The reinforced bumper 64 is engaged by a post 68 extending from both sides of contact arm 10, as shown in fig. 2, or by the rear surface 78 of the cam 24, as shown in fig. 3.

Referring back to fig. 2 the cam 24 has a notch 70 formed on a bottom surface for receiving the post 68, as indicated in phantom at 68a, during opening of the contact arm under repulsion due to short circuit current as indicated in phantom at 10a. An extension 72 on the top of cam 24 serves as a support for the spring 18 which is associated with contact arm 10.

A pair of stops 74, 76 limit the travel of the contact arms 10 and 12, respectively. When subjected to repulsion force due to short circuit current, the contact arms 10, 12 move into the positions indicated in phantom as 10a and 12a, respectively.

The operation of the instant invention can be seen by referring back to fig. 1 wherein the contactst 14, 16 are shown in a closed position. Spring 18 bias contact arm 10 in a clockwise direction whereas the spring 20 biases contact arm 12 in a counter-clockwise direction to hold the respective contacts in counter-balanced relation to each other.

When the current is sufficiently intense, such as upon the occurrence of a short circuit, the contact arms 10 and 12 are pushed apart by electrodynamic forces and move to positions 10a and 12a, indicated in phantom in fig. 2, where they strike against their respective stops 74 and 76 and rebound away from them.

When contact arm 12 is repulsed into position 12a the attached post 44 slides under detent 42 thereby causing ratchet 38 under the urging of spring 50 to rotate clockwise about pin 40, as indicated. Contact arm 12 after reaching position 12a, rebounds away from stop 76 and returns in a counter-clockwise direction under the urging of spring 20 to the position shown at 12b and is held from further motion by the trapment of post 44 under detent 42.

The clockwise rotation of ratchet 38 has moved post 46 upwards withing the radial slot 48 striking the bottom reinforced bumper 66 causing lever 62 to rotate counterclockwise about pin 60 to the position shown in fig. 2. With lever 62 and ratchet 38 in the indicated positions, the following events are now provided for. Should the overcurrent condition cease before the circuit breaker operation mechanism responds, cam 24 is not acted upon by the operating mechanism. Contact arm 10, after striking from stop 74, as indicated in phantom at 10a, is urged by spring 18 in the clockwise direction until post 68 strikes the top reinforced bumper 64 driving lever 62 clockwise about pin 60 which, in turn, drives the bottom reinforced bumper 66 into contact with pin 46. Pin 46 is driven downwards within slot 48 forcing ratchet 38 to rotate counter-clockwise against the urging of spring 50, releasing post 44 from under detent 42. Contact arm 12 is returned to the original position shown in fig. 1 under the urging of spring 20 while contact arm 10 returns to its original position under the urging of spring 18 the result in the closed condition of contacts 14, 16. The time elapsed between the separation of the contacts from the open position in fig. 2 to their subsequent return to the closed position shown in fig. 1 is sufficient to transfer the arc formed between the contacts 14 and 16 to an arc chute (not shown) for extinction. Extinction of

the arc and reclosing of the contacts returns the circuit breaker to normal operation after the circuit current has been interrupted by the fast repulsion of the contacts.

Should the overcurrent persist long enough for the breaker operating mechanism to respond, as represented by the force arrow 30 applied to post 20 as shown in fig. 3, cam 24 is rotated counter clockwise bringing its rear surface 78 against the top reinforced bumper 64 thereby driving the lever 62 clockwise and bringing the bottom reinforced bumper 66 against pin 46 and releasing post 44 from under detent 42.

Contact arm 12 returns from position 12b to the initial position shown in figs. 1 and 3 under the urging of spring 20. Contact arm 10 is carried by the action of the circuit breaker operating mechanism on cam 24 from the position indicated in phantom at 10b up to the position against stop indicated in solid lines at 10a which is the fully opened position of contact 14.

It is thus seen that the arrangement of the pivotally arranged lever 62 and spring-loaded ratcheted 38 provide a sufficient delay to the closing of the circuit breaker contacts after short circuit repulsion to thereby prevent deleterious reclosing and single phasing conditions.

CLAIMS

1. Contact delay arrangement for current limiting circuit breaker wherein a first contact arm (10) bearing a first contact (14) and a second contact arm (12) bearing a second contact (16) are both free to rotate around their respective pivot pins (22, 32) being the first pivot pin connected to a contact arm support cam (24) which is operated by the circuit breaker operating mechanism and being the second pivot pin (32) housed in a contact arm support (36), being the contact held closed by a pair of springs (18,20) and being separated by means of electrodynamic repulsion upon the occurrence of a short circuit, said delay arrangement (9) being characterized in that:

it includes a spring loaded ratchet (38) locking the second contact arm (12) by engaging a pawl pin (44) attached to the second contact arm (12) when the arm is driven by electrodynamic repulsion toward a stop (76) to prevent the arm from returning to a closed position after striking against the stop (76);

a release lever (62) operated either by a post (68) attached to the first contact arm (10) when the first arm (10) moves toward its closed position or by a rear surface (78) of the support cam (24) driven by the circuit breaker operating mechanism;

and when the support cam (24) moves the first contact arm (10) to the open position, it drives a bottom bumper (66) of the release lever (62) against a pin (46) extending through the bottom of the spring loaded ratchet (38), moving the ratchet out of the engagement with the pawl pin (44) thereby allowing the second contact arm (12) to return to its initial position.

2. Contact delay arrangement according to claim 1, wherein the ratchet (38) is characterized by a pivot pin (40), around which it can rotate, by a detent (42) engaging the corresponding pin (44) of the second contact arm (12) by said pin (46) drivable by the bottom (66) of said release lever (62) and by a spring (50) driving the detent (42) of said ratchet (38) causing it to engage the pawl pin (44) of the second contact arm

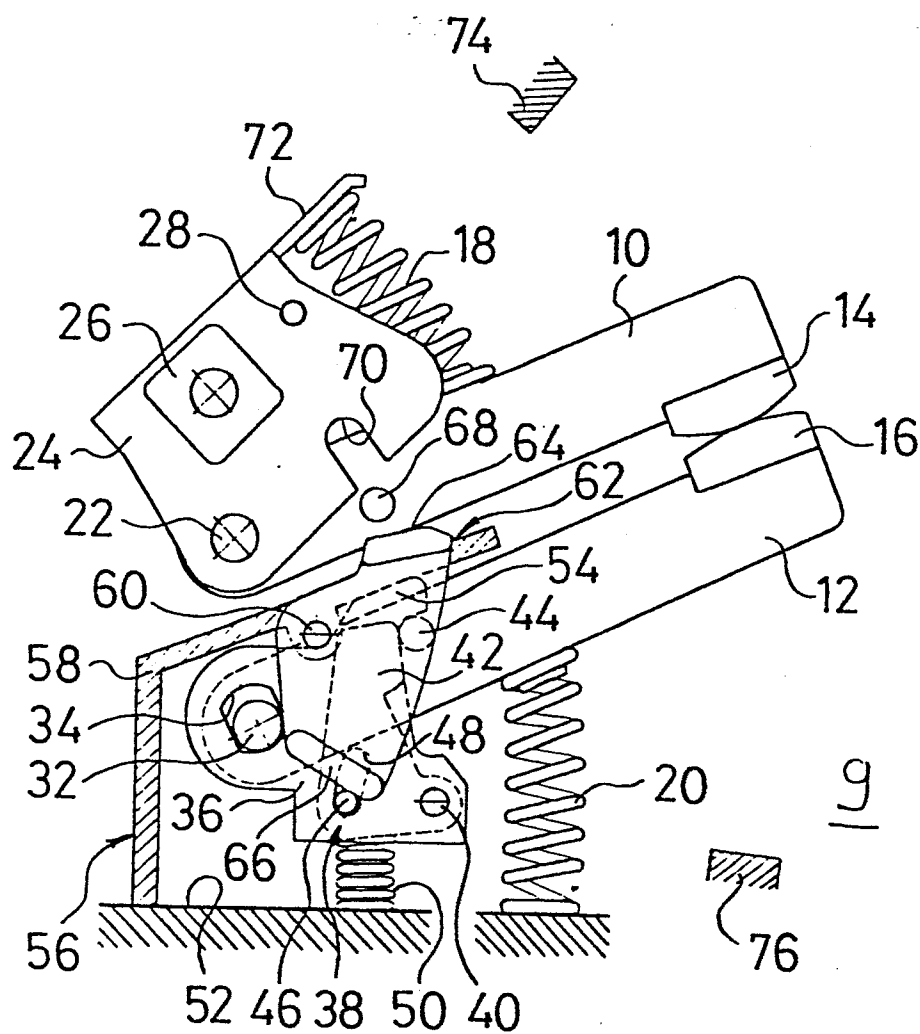
(12).

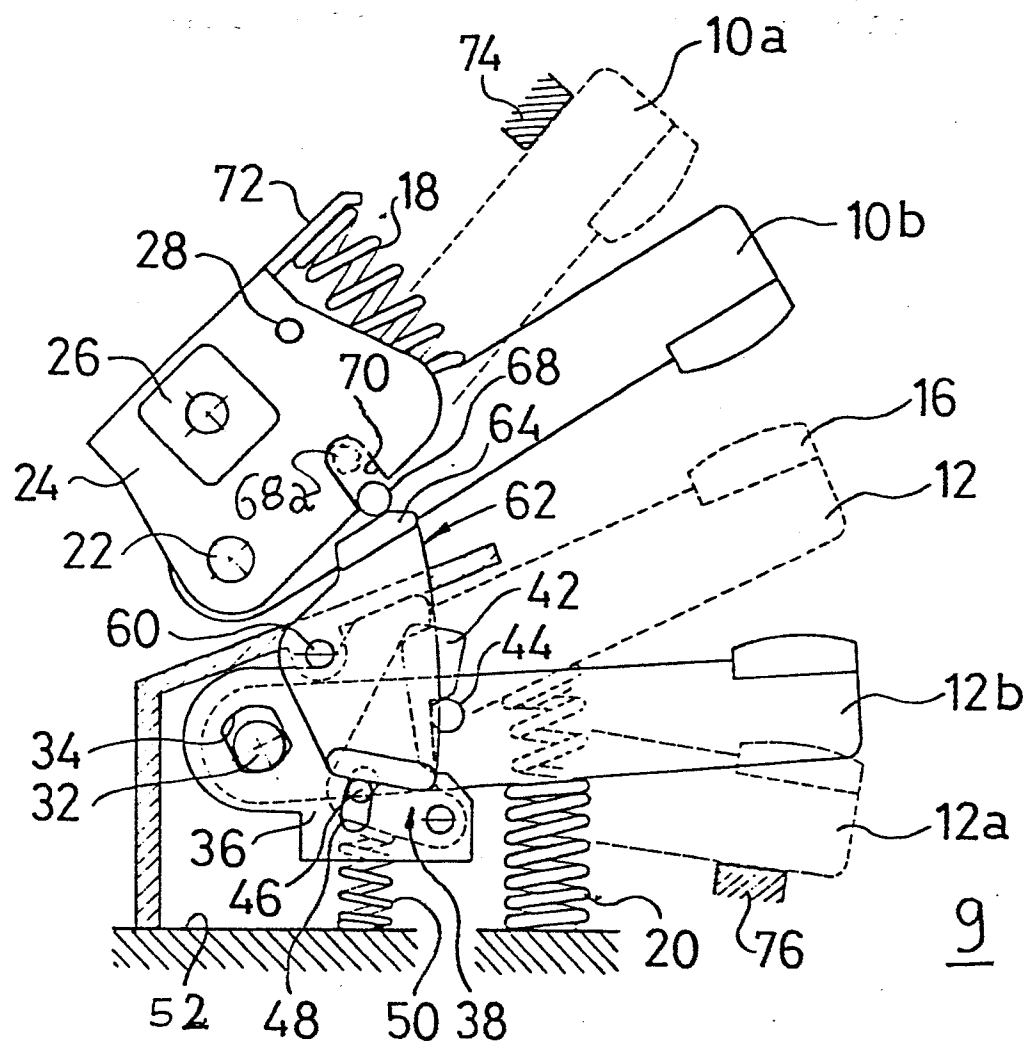
3. Contact delay arrangement according to claim 1 wherein the release lever (62) is characterized by the pin (60) pivotally supported by a pair of sockets formed in an insulating hood (56) that surrounds both the contact arm support (36) as well as part of the second arm;

by the top bumper (64) in the nature of a reinforced upper extension designed to receive the post (68) attached to the first contact arm (10), or the rear surface (78) of the cam (24) upon operation of the breaker operating mechanism, and by the bottom bumper (66) comprising a reinforced lower extension designed to contact the ratchet pin (46) to release the ratchet (38), thereby unlocking the second contact arm (12).

4. Contact delay arrangement according to claim 1, characterized in that the ratched (38) locking the second contact arm (12) and the release lever (62) are formed by two side-by-side placed members spanning the contact arm (12).

1/3

Fig. 1

Fig. 2

