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

(11) Publication number: **0 189 887 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **08.01.92**

(51) Int. Cl.5: **H01H 71/44**, H01H 77/10

(21) Application number: **86101066.8**

(22) Date of filing: **27.01.86**

(54) **Closing delay arrangement for current limiting circuit breaker contacts.**

(30) Priority: **29.01.85 IT 1927985**

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

(45) Publication of the grant of the patent:
08.01.92 Bulletin 92/02

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

(56) References cited:
FR-A- 1 551 832
FR-A- 2 400 761
US-A- 3 469 216

(73) Proprietor: **CGE- COMPAGNIA GENERALE ELETTROMECCANICA 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)

EP 0 189 887 B1

Description

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 short circuit currents 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 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 occurence 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".

In the prior art, as depicted for example in FR-A-1 551 832, disclosing and claiming an electric circuit breaker provided with at least a first contact arm controlled by an actuating handle and by a thermo-electromagnetic tripping mechanism and a second uncontrolled contact arm, it has been proposed, in case of contact opening by electrodynamic repulsion due to short circuit currents, to keep said contacts open by means of overcenter spring mechanisms provided on both contact arms and to subsequentely remove said contact opening by means of the intervention of a usual electromagnetic tripping device acting directly on the first contact arm and indirectly on the second contact arm through an insulating movable member interposed between said tripping mechanism and the overcenter spring mechanism of the second contact arm (see figures 2-4).

Said system works rather well, as regards the circuit breaking safety and the current limiting features, because of the very fast intervention of the electrodynamic repulsion. However, has the serious drawback for short circuits lasting for a time shorter than the response time of the tripping or operating mechanism, to cause, in case of a single-phase transitory short circuit, a definite opening of a single pole of a circuit breaker without the intervention of the tripping mechanism itself providing to open all the poles of the circuit breaker, which results in the above mentioned dangerous condition of "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 that the short circuit lasts for a time longer than the reclosing delay.

The invention consists essentially of a contact delay arrangement wherein a first contact arm bearing a first contact and a second contact arm bearing a second contact are both free to rotate around their respective pivot pins, the first pivot pin being connected to a contact arm support cam which is driven by the circuit breaker operating mechanism, the second pivot pin being housed in a contact arm support, the contacts being held closed by a pair of springs and being separated by means of electrodynamic repulsion upon the occurrence of a short circuit, said delay arrangement being characterized in that:

it includes a spring loaded ratchet for locking the second contact arm by engaging a pawl pin attached to the second contact arm when the arm is driven by electrodynamic repulsion toward a stops to prevent the arm from returning to a closed position after striking against the step;

a release lever releasing the ratchet through driving a bottom bumper of the release lever against a pin extending through the bottom of the spring loaded ratchet, thereby moving the ratchet out of engagement with the pawl pin and thereby allowing the second contact arm to return to its closed position, the release lever being operated by a post attached to the first contact arm when the first contact arm returns towards its closed position after the contacts have been separated, and the release lever being operated by a surface of the support cam when the support cam driven by the circuit breaker operating mechanism moves the first contact arm to the open position.

According to a preferred embodiment the ratchet is characterized by a pivot pin, around which it can rotate, by a detent engaging the corresponding pin of the second contact arm by said pin drivable by the bottom of said release lever and by a spring driving the detent of said ratchet causing it to engage the pawl pin of the second contact arm.

According to another preferred embodiment the release lever is characterized by a pin pivotally supported by a pair of sockets formed in an in-

sulating hood that surrounds both the contact arm support as well as part of the second arm;
by the top bumper in the nature of a reinforced upper extension designed to receive both the post attached to the first contact arm, and the rear surface of the cam upon operation of the breaker operating mechanism and by the bottom bumper comprising a reinforced lower extension designed to contact the ratchet pin to release the ratchet, thereby unlocking the second contact arm.

According to the most preferred embodiment of the present invention, the ratchet locking the second contact arm and the release lever are formed by two members arranged one on each side of the second contact arm and spanning the width of the arm itself. 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 contancs 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 represtend by an arrow 30 is applied when it is desired to cause cam 24 to rotate the shaft 26 for moving 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 am 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 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 pest 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 contacts 14, 16 are shown in a closed position.

Spring 18 biases 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 high enough 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 the detent 42 thereby causing ratched 38 under the urgence 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 urgence of spring 20 to the position shown at 12b and is held from further motion by the trapment of post 44 under the detent 42.

The clockwise rotation of ratchet 38 has moved the post 46 upwards withing the radial slot 48 striking the bottom reinforced bumper 66 causing the lever 62 to rotate counterclockwise about pin 60 to the position shown in fig. 2. With the lever 62

and the 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 against the the 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 the 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 the slot 48 forcing the rachet 38 to rotate counter-clockwise against the urgence of spring 50, releasing the post 44 from under the detent 42. The contact arm 12 is returned to the original position shown in fig. 1 under the urgence of the spring 20 while the contact arm 10 returns to its original position under the urgence of the spring 18, the result being 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 the post 28 as shown in fig. 3, the 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 the pin 46 and releasing the post 44 from the detent 42.

The contact arm 12 returns from the position 12b to the initial position shown in figs. 1 and 3 under the urgence of the spring 20. The 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 to the position against the stop 74 indicated in solid lines at 10 a which is the fully opened position of the contact 14.

It is thus seen that the arrangement of the pivotally arranged lever 62 and spring-loaded ratched 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 a 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), the first pivot pin (22) being connected to a contact arm support cam (24) which is driven by the circuit breaker operating mechanism, the second pivot pin (32) being housed in a contact arm support (36), the contacts (14, 16) being 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) for 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 towards a stop (76) to prevent the arm from returning to the closed position after striking against the stop (76);
a release lever (62) releasing the ratchet (38) through driving a bottom bumper (66) of the release lever (62) against a pin (46) extending through the bottom of the spring loaded ratchet (38), thereby moving the ratchet (38) out of engagement with the pawl pin (44) and thereby allowing the second contact arm (12) to return to its closed position, the release lever (62) being operated by a post (68) attached to the first contact arm (10) when the first contact arm (10) returns towards its closed position after the contacts have been separated, and the release lever (62) being operated by a surface (78) of the support cam (24) when the support cam driven by the circuit breaker operating mechanism moves the first contact arm (10) to the open 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 pawl pin (44) of the second contact arm (12) by said pin (46) drivable by the bottom bumper (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 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);
by the top bumper (64) comprising a reinforced upper extension designed to receive both post (68) attached to the first contact arm (10), and 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 ratchet (38) locking the second contact arm (12) and the release lever (62) are formed by two members arranged one on each side of the second contact arm (12) and spanning the width of the arm (12) itself.

Revendications

1. Agencement de contacts à retard pour un disjoncteur de circuit à limitation de courant dans lequel un premier bras de contact (10) portant un premier contact (14) et un second bras de contact (12) portant un second contact (16) sont tous deux libres pour tourner autour de leurs axes de pivotement respectifs (22, 32), le premier axe de pivotement (22) étant relié à une came (24) de support de bras de contact qui est entraînée par le mécanisme d'actionnement du disjoncteur de circuit, le second axe de pivotement (32) étant logé dans un support (36) de bras de contact, les contacts (14, 16) étant maintenus fermés par une paire de ressorts (18, 20) et étant séparés au moyen d'une répulsion électrodynamique lors de l'apparition d'un court-circuit, cet agencement à retard (9) étant caractérisé en ce qu'il comporte un cliquet (38) chargé par un ressort pour bloquer le second bras de contact (12) par engagement d'un téton d'encliquetage (44) attaché au second bras de contact (12) lorsque le bras est entraîné par répulsion électromagnétique vers une butée (76) pour empêcher le bras de retourner à la position fermée après percussion contre la butée (76) ; un levier de libération (62) libérant le cliquet (38) par entraînement d'un amortisseur inférieur (66) du levier de libération (62) contre un téton (46) s'étendant à travers la partie inférieure du cliquet chargé par ressort (38), déplaçant ainsi le cliquet (38) hors de contact avec le téton d'encliquetage (44) et permettant ainsi au second bras de contact (12) de retourner à sa position fermée, le levier de libération (62) étant actionné par un téton (68) fixé au premier bras de contact (10) lorsque le premier bras de contact retourne vers sa position fermée après séparation des contacts, et le levier de libération (62) étant actionné par une surface (78) de la came de support (24) lorsque la came de support entraînée par le mécanisme d'actionnement du disjoncteur de circuit déplace le premier bras de contact (10) vers la position ouverte.

2. Agencement de contact à retard selon la revendication 1, dans lequel le cliquet (38) est caractérisé par un axe de pivotement (40), autour duquel il peut tourner, par une détente (42) s'engageant avec le téton d'encliquetage (44) correspondant du second bras de contact (12), par le téton (46) entraînable par l'amortisseur inférieur (66) du levier de libération (62) et par un ressort (50) entraînant la détente (42) du cliquet (38) l'obligeant à s'engager avec le téton d'encliquetage (44) du second bras de contact (12).

3. Agencement de contacts à retard selon la revendication 1, dans lequel le levier de libération (62) est caractérisé par un téton (60) supporté de façon pivotante par une paire de supports formés dans un capot isolant (56) qu'entoure à la fois le support (36) de bras de contact ainsi qu'une partie du second bras (12) ;

par l'amortisseur supérieur (64) comprenant un prolongement supérieur renforcé conçu pour recevoir à la fois le téton (68) fixé au premier bras de contact (10), et la surface arrière (78) de la came (24) lors du fonctionnement du mécanisme d'actionnement du disjoncteur, et par l'amortisseur inférieur(66) comprenant un prolongement inférieur renforcé conçu pour entrer en contact avec le téton d'encliquetage (46) pour libérer le cliquet (38), déverrouillant ainsi le second bras de contact (12).

4. Agencement de contacts à retard selon la revendication 1, caractérisé en ce que le cliquet (38) bloquant le second bras de contact (12) et le levier de libération (62) sont formés de deux éléments agencés un de chaque côté du second bras de contact (12) et enjambant la largeur du bras (12) lui-même.

Patentansprüche

1. Kontaktverzögerungsanordnung für einen Strombegrenzungsschalter, wobei ein erster Kontaktarm (10), der ein erstes Kontaktstück (14) trägt, und ein zweiter Kontaktarm (12), der ein zweites Kontaktstück (16) trägt, beide frei sind für eine Drehung um ihre entsprechenden Drehstifte (22, 32), wobei der erste Drehstift (22) mit einer Kontaktarm-Halterungsnocke (24) verbunden ist, die durch den Schalterbetätigungsmechanismus angetrieben wird, der

zweite Drehstift (32) in einer Kontaktarmhalterung (36) untergebracht ist, die Kontaktstücke (14, 16) durch zwei Federn (18, 20) geschlossen und durch elektrodynamische Abstoßung beim Auftreten eines Kurzschlusses getrennt werden, gekennzeichnet durch
eine federbelastete Sperrklinke (38) zum Verriegeln des zweiten Kontaktarmes (12) durch Eingriff mit einem an dem zweiten Kontaktarm (12) befestigten Klinkenstift (44), wenn der Arm durch elektrodynamische Abstoßung in Richtung auf einen Anschlag (76) bewegt wird, um zu verhindern, daß der Arm nach dem Aufprall gegen den Anschlag (76) in die Schließstellung zurückkehrt,
einen Freigabehebel (62), der die Sperrklinke (38) freigibt, indem ein unterer Dämpfer (66) des Freigabehebels (62) gegen einen Stift (46) bewegt wird, der sich durch die Unterseite der federbelasteten Sperrklinke (38) erstreckt, wodurch die Sperrklinke (38) sich aus einem Eingriff mit dem Klinkestift (44) bewegt und dadurch dem zweiten Kontaktarm (12) gestattet, in seine Schließstellung zurückzukehren, wobei der Freigabehebel (62) durch einen Zapfen (68), der an dem ersten Kontaktarm (10) befestigt ist, betätigt wird, wenn der erste Kontaktarm (10) in Richtung auf seine Schließstellung zurückkehrt, nachdem die Kontaktstücke getrennt worden sind, und der Freigabehebel (62) durch eine Oberfläche (78) der Halterungsnokke (24) betätigt wird, wenn die durch den Schalterbetätigungsmechanismus angetriebene Halterungsnocke den ersten Kontaktarm (10) in die Öffnungsstellung bewegt.

2. Kontaktverzögerungsanordnung nach Anspruch 1, dadurch gekennzeichnet, daß die Sperrklinke (38) einen Drehstift (40) aufweist, um den sie sich drehen kann, ein Zahn (42) an dem entsprechenden Klinkenstift (44) des zweiten Kontaktarms (12) angreift, der Stift (46) durch den unteren Dämpfer (66) des Freigabehebels (62) verschiebbar ist und eine Feder (50) den Zahn (42) der Sperrklinke (38) bewegt, damit dieser mit dem Klinkenstift (44) des zweiten Kontaktarms (12) in Eingriff kommt.

3. Kontaktverzögerungsanordnung nach Anspruch 1, dadurch gekennzeichnet, daß der Freigabehebel (62) einen Stift (60) aufweist, der durch zwei Sockel schwenkbar gehaltert ist, die in einer Isolierhaube (56) ausgebildet sind, die sowohl die Kontaktarmhalterung (36) als auch einen Teil des zweiten Arms (12) umgibt, und daß der obere Dämpfer (64) eine verstärkte obere Verlängerung aufweist, die so ausgestaltet ist, daß sie sowohl den Zapfen (68), der an dem ersten Kontaktarm (10) befestigt ist, als auch die rückseitige Oberfläche (78) der Nokke (24) bei einer Betätigung des Schalterbetätigungsmechanismus aufnimmt, und daß der untere Dämpfer (66) eine verstärkte untere Verlängerung aufweist, die so gestaltet ist, daß sie den Sperrklinkenstift (46) kontaktiert, um die Sperrklinke (38) freizugeben, wodurch der zweite Kontaktarm (12) entriegelt wird.

4. Kontaktverzögerungsanordnung nach Anspruch 1, dadurch gekennzeichnet, daß die Sperrklinke (38), die den zweiten Kontaktarm (12) verriegelt, und der Freigabehebel (62) durch zwei Teile gebildet sind, von denen jeweils einer auf jeder Seite des zweiten Kontaktarms (12) angeordnet sind und die die Breite des Arms (12) selbst überspannen.

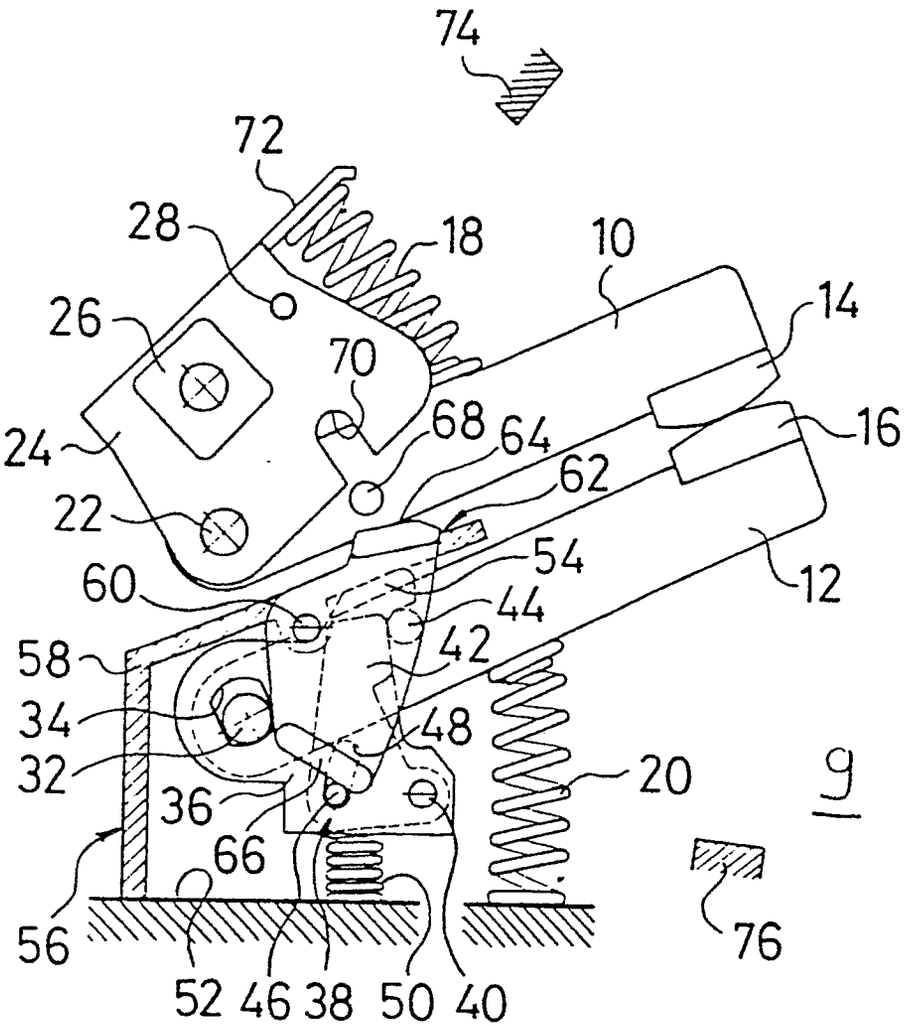
74
72
28
18
10
14
26
70
68
64
16
24
62
22
54
60
44
12
58
42
34
48
32
20
36
66
56
76
52
46
38
50
40

Fig. 1

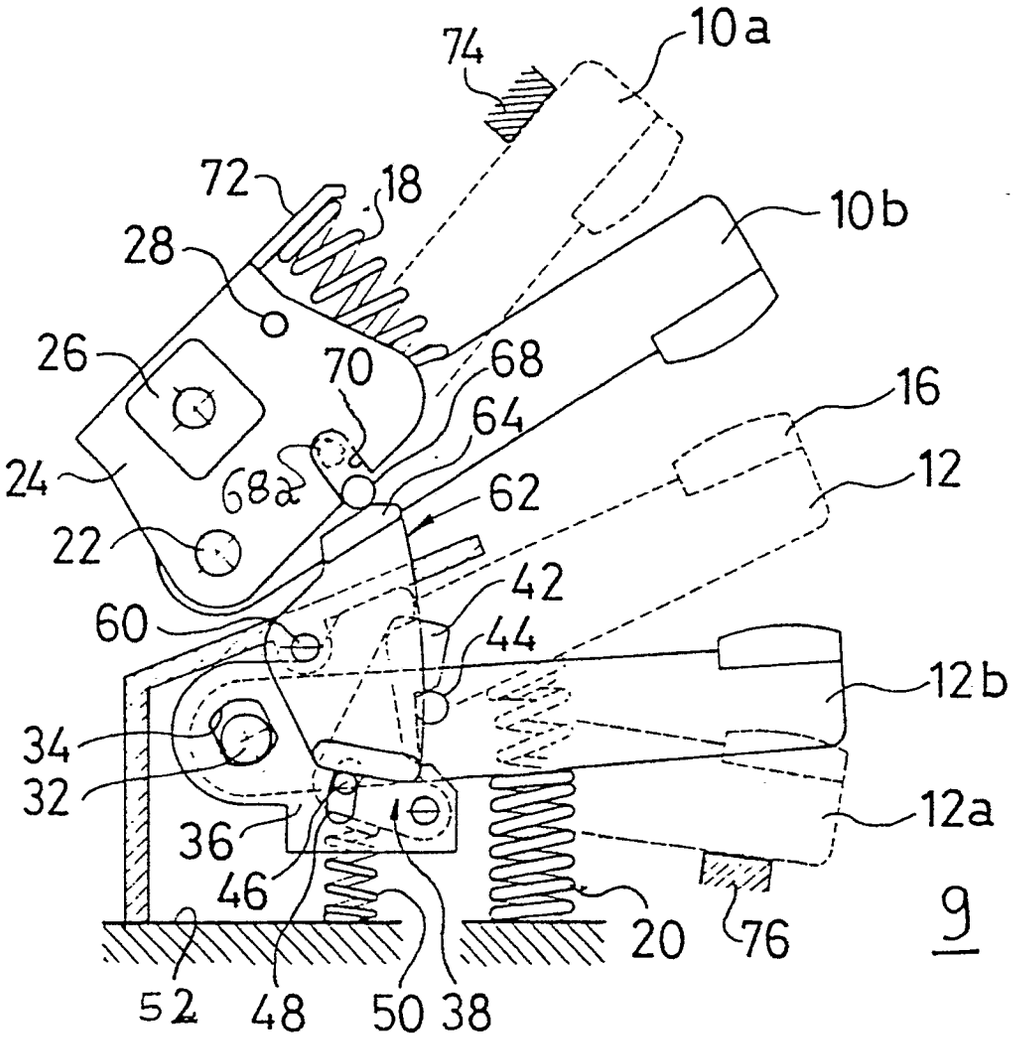
74
10a
72
18
10b
28
26
70
68
16
64
24
68a
62
12
22
42
60
44
12b
34
32
12a
36
46
20
76
9
52
48
50
38

Fig.2

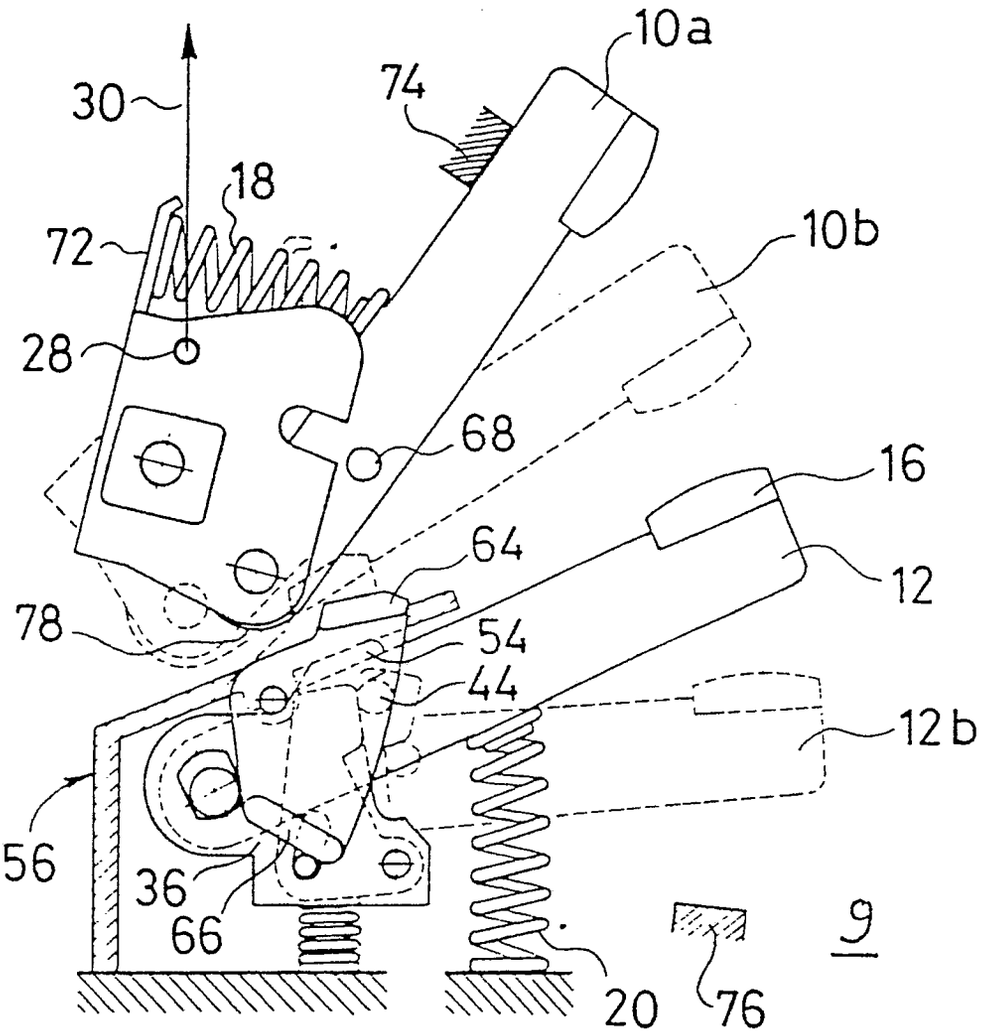

Fig. 3