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CIRCUIT BREAKER

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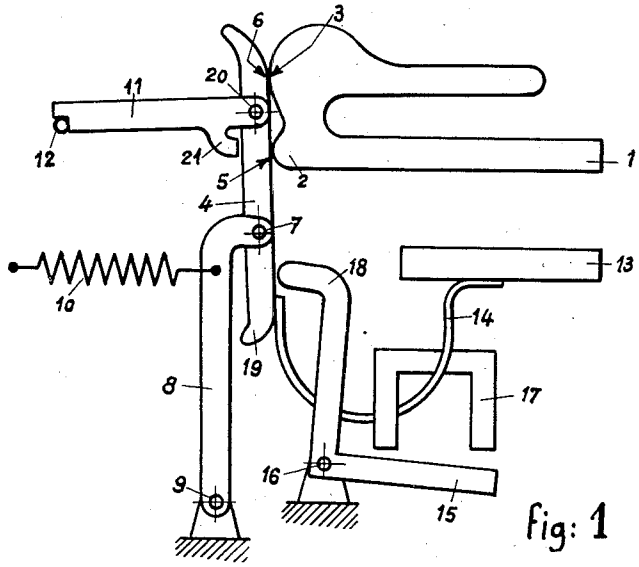


Fig: 1

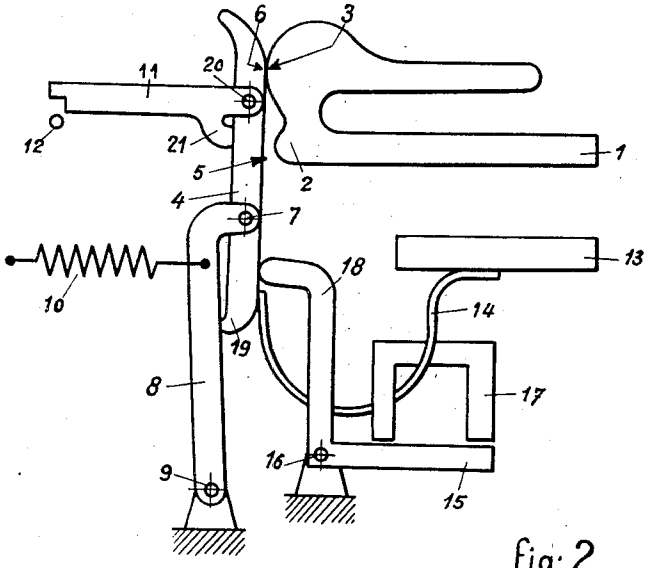


Fig: 2

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CIRCUIT BREAKER

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The present invention relates to low-voltage circuit breakers of the rapid-action type, and more particularly to a control mechanism of the contacts for a circuit breaker of this type.

Under low voltage conditions the circuit breakers must be able to interrupt or cut very rapidly large short-circuit currents, whereby the time during which the current is cut or interrupted is required to be the shorter the larger the current is. Circuit breakers of this type are generally provided with a set of principal or main contacts protected by a set of auxiliary arcing contacts or arc arresters placed thereabove, whereby the principal or main contacts open before opening of the auxiliary arcing contacts. The assembly consisting of principal contacts-arcing contacts-movable contact forms a loop which tends to open itself under the action of the electrodynamic forces developed by the current traversing the same; the force of repulsion may be such that the auxiliary or arcing contacts separate themselves ahead of the principal contacts and, by this fact, cannot protect the principal contacts.

In order to remedy or offset this defect the contact pressure might be considerably increased so as to neutralize the electrodynamic forces. However, such increase in spring pressure necessitates a reinforcement of the various parts, and, consequently, brings with it the disadvantage that the energy necessary to effect closure becomes greater, the inertia of the apparatus larger and, consequently, the operation of the apparatus less rapid.

Accordingly, it is an object of the present invention to remedy these defects of the prior art.

Another object of the present invention resides in the provision of a low-voltage, rapid action circuit breaker which neutralizes the electrodynamic forces which occur particularly under short-circuit conditions.

Still another object of the present invention resides in the provision of a low-voltage, rapid action circuit breaker and control mechanism therefor which obviates the need for reinforcement of parts thereof, keeps the overall weight and therewith the resulting inertia forces as low as possible so as to assure reliable rapid action under short circuit conditions.

Another object of the present invention is the provision of a control mechanism for the contacts of low voltage circuit breakers of rapid action, characterized by the fact that it comprises an arrangement which produces the increase in the contact pressure of the arcing contacts as the density of the current to be cut or interrupted increases, thereby avoiding the separation of the arcing contacts before opening of the principal contacts and therewith eliminating the appearance of pitting on the contacts or welding thereof which result therefrom during opening under short-circuit conditions. This contact pressure of the arcing contacts increases proportionally to the traversing current.

A still further object of the present invention is the provision of a low-voltage, rapid-action circuit breaker which is relatively simple in structure yet extremely reliable in operation by providing a control mechanism which is operative to increase the contact pressure of the arcing contacts in proportion to the current traversing the circuit breaker so as to prevent premature opening of the arcing contacts before opening of the main contacts to thereby avoid damage to the latter.

According to one of the features of the present invention the increase of contact pressure of the arcing contacts is obtained with the aid of an electromagnet, the armature of which exercises a force on the movable contact of the circuit breaker one part of which serves as arcing contact.

The prompt disengagement or opening of the circuit breaker under short-circuit conditions is assured by the armature of the electromagnet which works without lost motion or play and thereby without appreciable time delay, the force and consequently the speed of opening are therefore directly a function of the magnitude of the short-circuit current.

The movable contact is articulated about an intermediate axis in such a manner that during disengagement or opening of the circuit breaker contacts under the action of the electromagnet the movable contact turns about the point of contact of the arcing contacts while simultaneously increasing the contact pressure thereof.

These and other features, objects and advantages of the present invention will appear from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, one embodiment of a circuit breaker in connection with the present invention, and wherein:

Figure 1 is a partial schematic view of the apparatus according to the present invention with the circuit breaker in closed position and

Figure 2 is a partial schematic view similar to Figure 1 with the circuit breaker at the beginning of the opening thereof.

Referring now more particularly to the drawing wherein like reference numerals are used throughout the various views to designate like parts, the apparatus comprises a current input terminal **1**, a principal or main stationary contact **2**, a fixed or stationary arcing contact **3**, in the shape of a prong, and a movable contact **4**, the portions **5** and **6** of which touch the principal contact **2** and the arcing contact **3** respectively. The movable contact **4** is articulately connected at **7** with the lever **8** which turns about a fixed axis **9**. A spring **10** tends to bring the movable assembly **4**, **8** toward the left as viewed in Figures 1 and 2 of the drawing.

The circuit-breaker apparatus is normally maintained in "engaged" or "closed" position by a locking mechanism of any suitable known construction schematically represented in the drawing by lever **11** and a stop or abutment member **12** which assures a sufficient contact pressure for proper operation of the circuit breaker.

The movable contact **4** is connected to the current output terminal **13** by a flexible connection **14**. An angle lever **15** which is pivotally supported about an axis **16** serves as armature for an electromagnet **17** of any suitable construction which is interconected into the circuit. The bent end portion **18** of the angle lever **15** is located adjacent the lower portion **19** of the movable contact **4**. The lever **11** is provided with an abutment member **21** against which the movable contact **4** supports itself during the separation of the contacts of the circuit breaker.

Operation

The operation of the circuit-breaker arrangement described herein above is as follows:

During normal operation the pressure between the contacts **5** and **2** is sufficient for the continuous passage of predetermined nominal current.

As soon as a short-circuit traverses the apparatus it must open or disengage very rapidly. Such rapid-action disengagement or opening takes place as follows:

The armature formed by the pivotally supported angle lever 15 is attracted toward the electromagnet 17, i. e., upwardly as seen in Figure 1 by the high current passing through the flexible coupling 14 which magnetizes the electromagnet 17. As a result of the attraction of the armature 15, which thereby rotates counter-clockwise about axis 16, the bent end portion 18 of the lever 15 abuts against the lower portion 19 of the movable contact 4 and during such counterclockwise rotation pushes the same toward the left, whereby the main contacts 5 and 2 are separated.

In contradistinction thereto, the pressure between the arcing contacts 6 and 3 is considerably increased at the same time. Such increase in contact pressure of the arcing contacts 6 and 3 is the result of an additional pressure added to the normal pressure which is normally assured by the locking mechanism 11, 12. This additional pressure is caused by the force applied at the end portion 19 by the bent end portion 18 of armature 15 and is transmitted at 6 by the movable contact 4 which forms a lever turning about the point or axis 20 which remains practically stationary or fixed as long as the locking mechanism 11, 12 maintaining the circuit breaker is not released or unhooked. This pressure is in addition to the electrodynamic force exerted on contact 4, tending to displace the latter away from the stationary input and output terminals 1 and 13, due to the current in the contact 4 and is proportional to the force transmitted by the lever 15, that is to the current traversing the circuit breaker and, from this fact, the principal contacts 2, 5 separate before the arcing contacts 3, 6 can open, whereby the phenomenon of pitting and welding on the arcing contacts need not be feared.

After a slight clockwise rotation of the contact 5 about the contact point 6—3, this contact 5 strikes the abutment member 21 of the lever 11 and thereby unlocks the locking mechanism 11, 12. Figure 2 represents the apparatus at that instant. Under the action of the spring 10 the arcing contacts 6 and 3 are separated, the arc jumps and is then extinguished by means of any well known method.

During closing of the circuit-breaker it is only necessary to act on the lever 11 by depressing the same, whereby at first the lower portion 19 of the contact 5 is maintained in abutment against the lever 8 by the action of the spring 10. Continuing the closing movement, the arcing contacts 6 and 3 come into contact as shown in Figure 2. Thereafter the movable contact 4 turns about the point of contact 6—3 and in spite of the opposed biasing force of the spring 10 the principal contacts 2, 5 touch each other, the locking mechanism 11, 12 finds itself in locked position and the circuit breaker apparatus is closed.

During disengagement or opening the force for unlocking the locking mechanism 11, 12 is relatively weak, inasmuch as the initial forces holding the contacts in engagement may be small because at the time of interruption of large currents the pressure at the switch contacts is substantially increased by the electromagnetic means 17. On the other hand, the impulse provided by the lever 18 is the more significant the larger the current traversing the circuit breaker, and the lever abuts permanently against the portion 19. From this fact there is no play or lost motion and therewith no appreciable time delay and the operation in case of short-circuit is extremely rapid.

While I have shown and described one specific embodiment of my invention, it is understood that the same is susceptible of various modifications and changes within the spirit of the present invention and I intend to cover all such changes and modifications except as limited by the appended claims.

I claim:

1. A control mechanism for the contacts of a rapid-action low-voltage circuit breaker comprising principal contact means, arcing contact means and movable contact means, means for pivotally supporting said movable contact means at said circuit breaker intermediate the two ends of said movable contact means to provide one end part thereof pivotally disposed adjacent said arcing contact means and adapted to be in current conducting engagement therewith, electromagnetic control means including an electromagnet with an armature for increasing the contact pressure between said one part of the movable contact means and said arcing contact means during operation of the circuit breaker to interrupt a short-circuit current, and linkage means for connecting said armature with the other end part of said movable contact means to increase said contact pressure upon energization of said electromagnet by rotation of said movable contact means about said pivot means.

2. A control mechanism for the contacts of a rapid-action, low-voltage circuit breaker comprising principal contact means and arcing contact means, and electromagnetic control means for exerting a force, other than an electrodynamic force tending to displace any electrical conductor due to the current therein, to increase the contact pressure of said arcing contact means during operation of the circuit breaker to interrupt a short circuit current, said electromagnetic control means being operative essentially without lost motion to assure rapid action of said circuit breaker.

3. A control mechanism for the contacts of a rapid-action low-voltage circuit breaker comprising principal contact means, a fixed arcing contact, a movable contact, means for pivotally mounting said movable contact in said circuit breaker to enable pivotal movement thereof about an axis intermediate its two ends, one end portion of said movable contact being adapted to be in current-conducting engagement with said arcing contact, electromagnetic control means operative in response to the current traversing said circuit breaker to be interrupted, and lever means in abutting engagement with the other end portion of said movable contact operative in response to energization of said electromagnet to increase the contact pressure between said first-mentioned end portion and said arcing contact during opening of said principal contact means to thereby prevent premature interruption of the current path provided by the contact between said arcing contact and said movable contact.

4. A control mechanism according to claim 3, wherein said electromagnet is operated by the current traversing said circuit breaker to increase said contact pressure proportional to the magnitude of the current traversing said circuit breaker.

5. A control mechanism according to claim 3, further comprising locking means connected with said movable contact for maintaining said circuit breaker in closed position including an abutment member, said movable contact abutting against said abutment member during rotation thereof about said pivot means upon energization of said electromagnet to prevent opening of said arcing contact and movable contact and to thereafter release said locking means upon further pivotal movement.

6. A control mechanism for the contacts of a rapid-action, low-voltage circuit breaker comprising a principal contact, an arcing contact and a movable current carrying contact structure having contacts engageable with said principal and arcing contacts, means for separating said movable contacts from said principal and arcing contacts, in that order, to interrupt a short-circuit current, said last-mentioned means including electromagnetic control means for increasing the pressure between the arcing contact and its associated movable contact independently

of any forces on said movable contact structure due to magnetic fields created by currents in said structure during current interrupting operation of the circuit breaker.

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