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

(11) Publication number: **0 248 342**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **87107697.2**

(22) Date of filing: **26.05.87**

(51) Int. Cl.³: **H 01 H 9/42**
H 01 H 9/46

(30) Priority: **31.05.86 GB 8613263**

(43) Date of publication of application:
09.12.87 Bulletin 87/50

(84) Designated Contracting States:
AT CH DE ES FR GB IT LI

(71) Applicant: **CRABTREE ELECTRICAL INDUSTRIES LIMITED**
Lincoln Works Walsall
West Midlands, WS1 2DN(GB)

(72) Inventor: **Bowen, Peter William**
34 Birch Croft Road
Sutton Coldfield West Midlands, B75 6BP(GB)

(74) Representative: **Lally, William et al,**
FORRESTER & BOEHMERT Widenmayerstrasse 4/I
D-8000 München 22(DE)

(54) **Circuit breakers, and a method of increasing the breaking capacity of a circuit breaker.**

(57) A miniature circuit breaker of the kind comprising two arc runners (20, 22) which diverge towards an arc stack (24), onto which an arc is transferred as contacts of the circuit breaker are opened.

A supplementary runner (30) is provided, onto which the arc is transferred from the first of said runners (20), so that the arc extends between the second (22) and the supplementary runner (30). The supplementary runner (30) is connected into the circuit through a high impedence, so that the rate of increase of arcing current is reduced as the arc travels into the arc stack.

EP 0 248 342 A2

Title: "Circuit breakers, and a method of increasing the breaking capacity of a circuit breaker"

This invention is concerned with improvements relating to the circuit breakers, particularly of the kind known as "miniature" circuit breakers.

A conventional miniature circuit breaker (hereinafter referred to as being of the kind specified) comprises a first contact (conventionally fixed) and a second contact movable relative to the first between an open position and a closed position, a manually operable control member to move the movable contact between open and closed positions, and a tripping mechanism to move the movable contact from its closed to its open position in the event of an overload.

Conventionally the tripping mechanism comprises two overload devices to open the circuit in the event of overload.

The first of these is a bimetal device the temperature of which rises under overload conditions, and which moves in consequence of such temperature rise to open the switch, usually under the action of a spring. However such devices are slow to operate and are used only to open the circuit under moderate overloads.

On short circuit overloads a solenoid device is used, through which current passing through the circuit breaker flows, and which, under short circuit conditions, produces a magnetic field to move a tripping element (conventionally termed a "slug") to open the switch, the slug moving to delatch a tripping mechanism and physically to move the movable contact to an open circuit position.

Circuit breakers are limited by the current overload they can accommodate and still be re-usable, the current overload being known as the "breaking capacity". This however makes it desirable that the circuit breaker be capable of moving to an open circuit condition in a very short time (typically 5 milliseconds).

On the movement of a conventional circuit breaker to an open condition under short circuit conditions, the movable contact is physically moved away from a fixed contact at high speed. However current still passes between the contacts in the form of an arc, and conventionally the circuit is arranged so that the arc is subjected to pressure to move from the two contacts onto

"arc runners", which diverge and lead the arc into an arc stack, at which the arc is extinguished.

Thus in a conventional circuit breaker, one arc runner is electrically integral with the fixed contact, and the other is engaged by the movable contact on tripping.

Whilst adequate magnetic forces may be generated by the solenoid to disengage the movable contact from the fixed contact in sufficiently short periods of time, increasing the breaking capacity of circuit breakers is presently limited by the difficulties of transferring the arc to the arc runners and quenching in the arc stack, and it is one of the various objects of this invention to provide a means by which the arc may be extinguished more rapidly than is presently practiced.

It is to be noted that in larger circuit breakers, for example the type known as the moulded case circuit breaker, it is known to split to arc between three arc runners. However whilst such a technique may be used to advantage where the operating parameters are as present in the moulded case circuit breaker (including a higher breaking capacity, typically 25 kA to 100 kA, and a breaking time of 10 to 30 ms) this technique cannot be used to advantage in a miniature circuit breaker, in view of the requirements of small size and higher response speed (specifically less than 5 ms).

According to this invention there is provided a circuit breaker of the kind specified wherein the arc is transferred to an arc runner which provides a higher impedence to the flow of electric current.

The said arc runner may be electrically connected into the circuit at a point therein on the side of the solenoid which is remote from the fixed contact.

The said arc runner may be afforded by a supplementary runner, to which the arc is transferred from a primary runner integral with the fixed contact.

Preferably there is no direct physical connection between the primary arc runner and said supplementary arc runner.

This invention is particularly useful in a miniature circuit breaker comprising specifically two arc runners which diverge relative to one another from the contacts, and onto which the arc generated is transferred as the contacts are opened, the arc being stretched as it is moved between the diverging runners towards the arc stack. Thus it is to be appreciated that the

arc is tansferred onto the supplementary runner from a first runner (so that the arc extends between the supplementary runner and the second runner), and the additional impedence reduces the rate of current build-up immediately prior to entry of the arc into the arc stack.

Thus according to this invention there is provided a method of increasing the breaking capacity of a miniature circuit breaker of the kind in which the arc is transferred from the contacts to two divergent runners which stretch the arc as it is moved towards the arc stack, wherein the arc is transferred from a first of said two divergent runners to a supplementary runner so that the arc extends between said supplementary runner and the second of the two divergent runners, the supplementary runner being connected in parallel with the said first runner and having associated therewith a higher impedence whereby the supplementary runner reduced the rate of increase of the arcing current as the arc enters the arc stack.

There will now be given a detailed description, to be read with reference to the accompanying drawings, of a circuit breaker which is the preferred embodiment of this invention, having been selected for the purposes of illustating the invention by way of example.

In the accompanying drawings:

FIGURE 1 is schematic view of a conventional circuit breaker;

FIGURE 2 is a schematic view of the circuit breaker which is the preferred embodiment of this invention; and

FIGURES 3 and 4 are enlarged views of part of the preferred embodiment.

The circuit breaker shown in Figure 1 is of the kind specified, being a miniature circuit breaker comprising a housing 6 in which is located a fixed contact 8, a movable contact 10, and a manually operable control member 12 to move the contact 10 between its open and closed positions. Located within the housing is overload mechanism, comprising in series a bimetal device 14 and a solenoid device 16, the solenoid device 16 comprising a coil 18.

Integral with the fixed contact 8 is a first arc runner 20, and engaged by the second contact 10 when it moves to its open position is a second arc runner 22, which runners diverge from their contacts towards an arc stack 24. The circuit breaker comprises terminals 26 and 28, and the primary circuit extends from the terminal 26 to the movable contact 10, the fixed contact 8, the coil 18, the bimetal element 14, and the terminal 28.

In known manner when the circuit protected by the breaker is subjected to a moderate and continuing overload, the element 14 deflects under temperature rise, and causes the tripping mechanism (not shown) to move the contact 10 to its open position. Under severe overload conditions, such as short circuit, the magnetic field produced by the coil 18 causes a tripping element to move rapidly to trip the control mechanism, and physically to move the contact 10 towards its open position. Any arc which is established between the contacts 8 and 10 is moved by flux pressure (the flow path being in the form of a U) onto the arc runners 20 and 22, and into the arc stack 24 at which the arc is extinguished.

In the circuit breaker which is the preferred embodiment of this invention, illustrated in Figures 2 to 4, similar numerals are used to denote like parts.

However as distinct from the circuit breaker shown in Figure 1, in the preferred embodiment the first arc runner 20 extends towards a supplementary arc runner 30, which is not in direct electrical contact with the runner 20. The supplementary arc runner 30 is (located adjacent to the entry into the arc stack, and is electrically connected into the circuit at a point therein on the side of the solenoid coil 18 which is remote from the fixed contact 8, preferably at a point between the solenoid coil 18 and the bimetal element 14. However between the supplementary arc runner 30 and its connection into the primary circuit, a high impedence element 32 is provided, specifically in the form of a secondary coil preferably wound around one of the formers of the solenoid 16.

As will be seen in Figure 3, the secondary coil 32 is preferably provided of high resistivity ferrous material. As will be seen in Figure 4, whilst the primary runner 20 necessarily passes close to the supplementary runner 30, desirably relatively large gaps (shown at 34) ensure that metal particles carried on the arc do not become fused to the arc runner system to provide a short circuit between the primary and supplementary runner.

Thus the arc produced on opening of the contacts is initially transferred between the first and second runners, the arc being stretched as it is moved between the diverging runners towards the arc stack. As the arc is transferred between the supplementary runner 30 and the second runner 22, it encounters higher impedence, which is effective to reduce the rate of increase of the arcing current as the arc enters the arc stack.

It has been found that by this relatively simple expedient, the time in which an otherwise conventional circuit breaker may terminate the flow of electric current may significantly be reduced, and the breaking capacity of the circuit breaker increased.

CLAIMS:

1. A circuit breaker comprising a first contact (8) and a second contact (10) movable relative to the first between an open position and a closed position, a manually operable control member (12) to move the movable contact (10) between open and closed positions, and a tripping mechanism (16) to move the movable contact (10) from its closed to its open position in the event of an overload wherein the arc is transferred to an arc runner (30) which provides a higher impedence to the flow of electric current.

2. A circuit breaker according to Claim 1 wherein the arc runner (30) is electrically connected into a circuit at a point therein on the side of the solenoid (18) which is remote from the fixed contact (8).

3. A circuit breaker according to one of Claims 1 and 2 wherein said arc runner (30) is afforded by a supplementary runner, to which the arc is transferred from a primary runner (20) integral with the fixed contact (8).

4. A circuit breaker according to Claim 3 wherein there is no direct physical connection between the primary arc runner (8) and said supplementary arc runner (30).

5. A circuit breaker according to Claim 3 or Claim 4 wherein the supplementary runner (30), and the point at which the arc is transferred to the supplementary runner, is adjacent to the entrance of the arc stack (24).

6. A method of increasing the breaking capacity of a miniature circuit breaker of the kind in which the arc is transferred from the contacts (8, 10) to two divergent runners (20, 22) which stretch the arc as it is moved towards the arc stack (24), wherein the arc is transferred from a first (20) of said two divergent runners to a supplementary runner (30) so that the arc extends between said supplementary runner (30) and the second (22) of the two divergent runners, the supplementary runner (30) having assosciated therewith a high impedence whereby the supplementary runner reduces the rate of increase of the arcing current as the arc enters the arc stack.

7. A circuit breaker constructed and arranged substantially as hereinbefore described with reference to Figures 2, 3 and 4 of the accompanying drawings.

8. A method of increasing the breaking capacity of a circuit breaker, when carried out substantially as hereinbefore described with reference to Figures 2, 3 and 4 of the accompanying drawings.

0248342

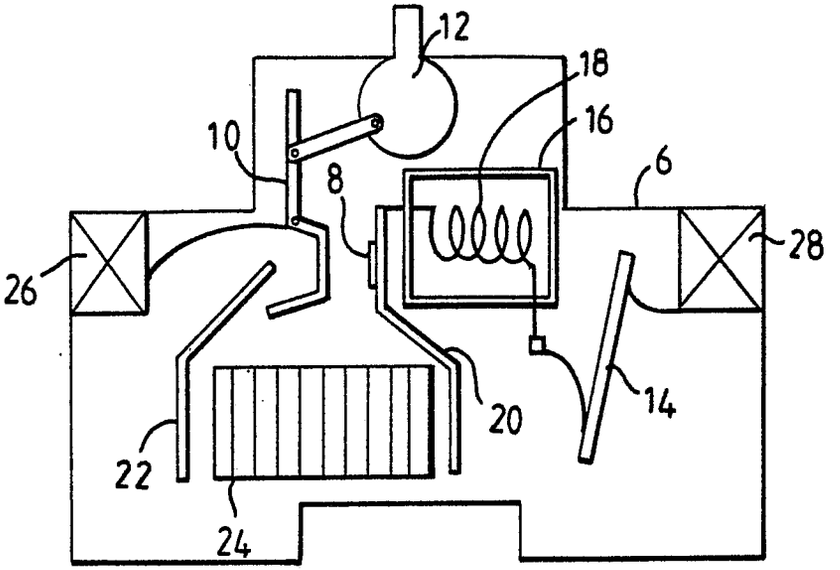

FIG 1

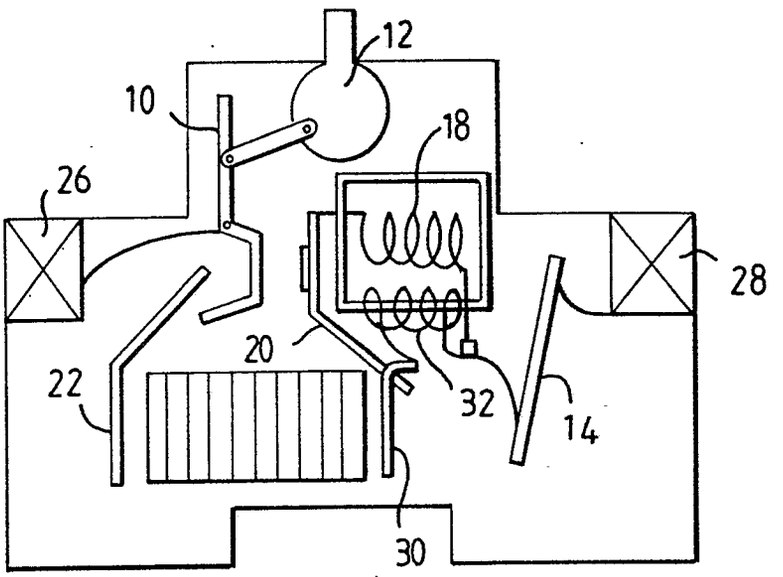

FIG 2

0248342

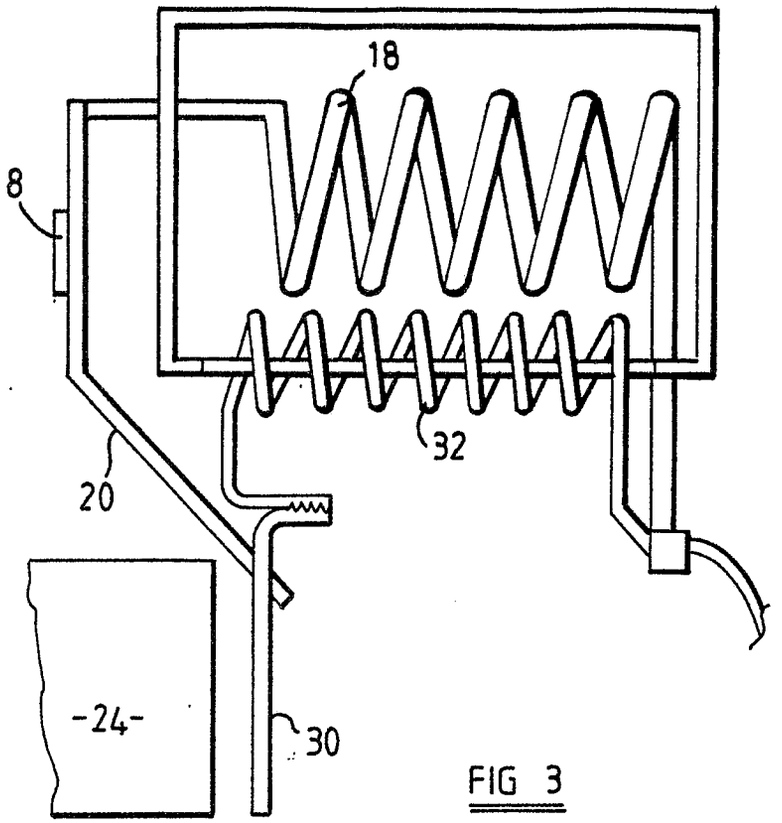

FIG 3

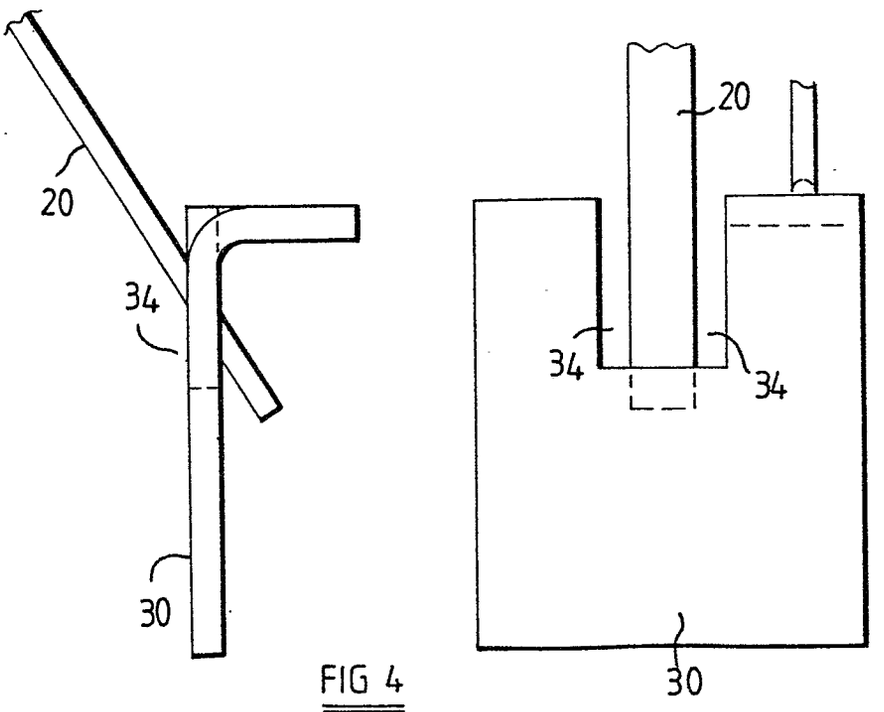

FIG 4