Jan. 26, 1971 W. KOENNECKE ETAL 3,559,119

CIRCUIT BREAKER

Filed March 4, 1969

Fig. 1

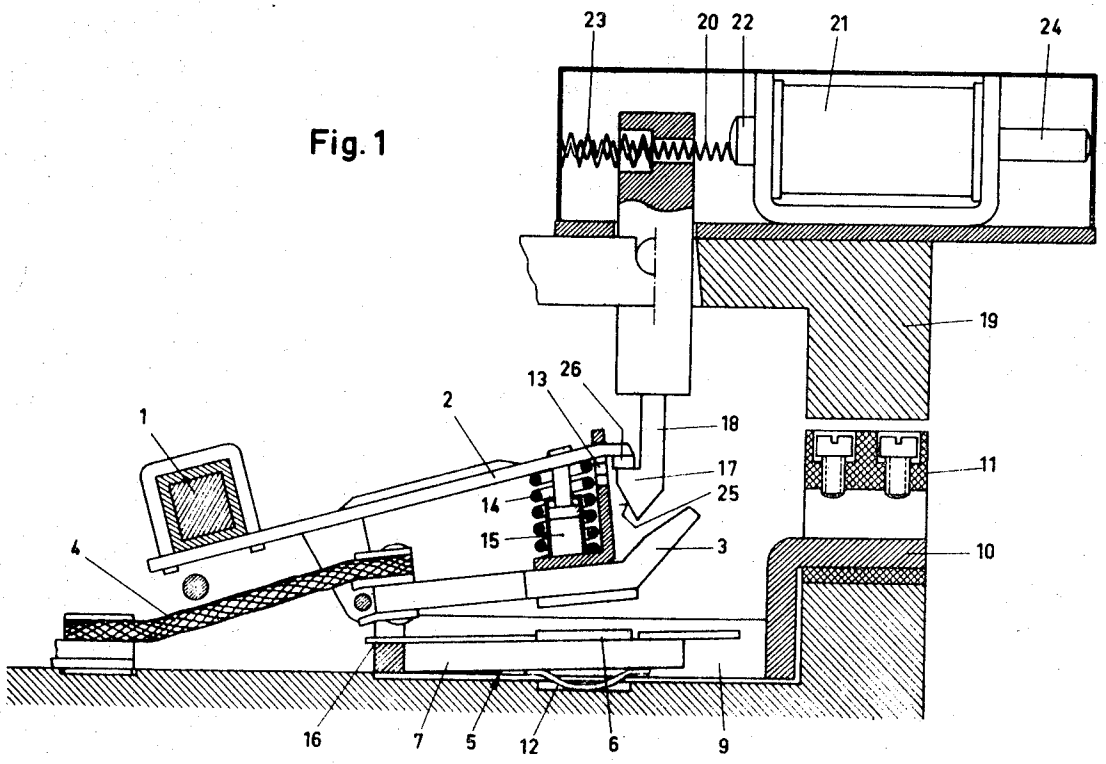


Fig. 3

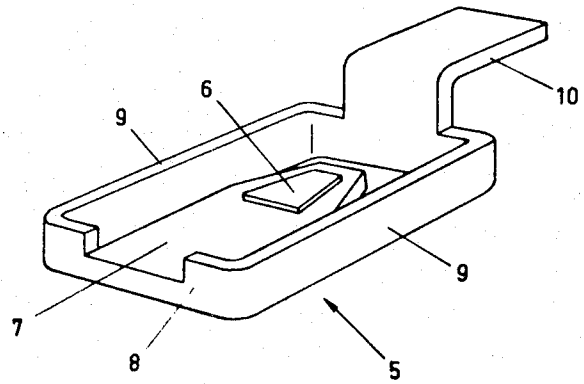
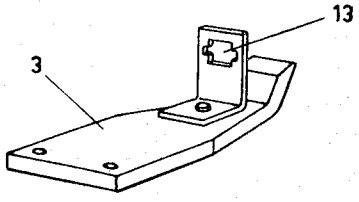


Fig. 2



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United States Patent Office 3,559,119 Patented Jan. 26, 1971

3,559,119

CIRCUIT BREAKER

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Filed Mar. 4, 1969, Ser. No. 804,158
Claims priority, application Germany, Mar. 8, 1968, P 16 38 042.0
Int. Cl. H01h 77/10
U.S. Cl. 335—16 11 Claims

ABSTRACT OF THE DISCLOSURE

A circuit breaker having a box-like guard to the bottom of which is attached a fixed contact and having an input buss integral with and extending from one end wall.

BACKGROUND OF THE INVENTION

Exceptionally high current values may occur on circuit breakers during short circuiting when the electrical circuit has a correspondingly small internal resistance and when the switch-off time of the switch reaches values which permit a completed build-up of the short circuit current. To avoid such high short-circuit peak current loadings, circuit breaker contact arrangements are known by which the two contacts belonging to one phase are always running parallel a short distance from each other from their current supply to the contact elements making the contact. When peak currents appear, they activate electromagnetic forces which, united with other effects, lift the contact pieces within a short time from each other and unlock the switch lock controlling these contacts. It is also well known to arrange coils of low inductance within the supply lines to flatten the sides of steeply-increasing short-circuit currents. The desired fast switch-off may be achieved by the common contact arrangement when peak currents occur; also, the ascending electric arc created during switch-off may be caught within an explosion chamber. However, such designs require a relatively large space and may not be used for compact switches. Furthermore, the known circuit breakers have to be mounted in a particular position to secure fast extinguishing of the electric spark. The use of remote-controlled equipment at installations with short circuit off-switches requires powerful driving devices, consequently using up a larger space. These larger driving devices following a release have to be controlled or automatically switched on again, because with an immediate switch-off, the switch lock of the switch was released. The required driving combinations, such as fast starting motor of high output and, consequently, larger space requirement, do not require only high switch, resp. control forces. However, the tendency against their use is a compact design of switch installations. These and other difficulties experienced with the prior art devices have been obviated in a novel manner by the present invention.

It is, therefore, an outstanding object of the invention to provide a circuit breaker having an automatic peak current cut-off of small, compact form.

Another object of this invention is the provision of a circuit breaker of inexpensive construction.

A further object of the present invention is the provision of a circuit breaker having a construction that permits the use of a relatively small cut-out actuator.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

SUMMARY OF THE INVENTION

In general, the present invention consists of arranging the connecting means (the current supply of the stationary contacts) opposite the current supply to the movable contacts and arranging the contact elements of the stationary contacts each on a tongue-shaped plate extending in the direction of the current supply of the movable contact. The plates are closed by horizontal walls, and to their ends are attached two current guide bars or walls which are arranged at the side of the plate in opposite direction to the connecting terminal. It was proven to be of advantage to have the current guide bars extending above the plane of the plate and cover the plates and the current bars with insulating material.

The space requirements are kept small by having support members which are kept in tension by a spring and arranged in the path of the movable contacts and their supports. It has been proven to be of advantage in this case to equip the support members with hooks sloped in the direction of the operational position of the movable contacts and also to design the support members as crank levers. The support members can be equipped with manual operating devices activating the release and/or closure, and it is also of advantage to connect power-driven release devices to the support members, preferably operated by an electric motor.

Furthermore, it was determined that it is not necessary to provide a support member for each pair of contacts of the switch. It is sufficient, for example, that one contact support act together with one support member. To achieve a symmetric loading, it is recommended that the support member operate on the center contact support. It was also well to guide the support member through the cover of the circuit breaker. The release device is preferably arranged at the outside of the cover and connected to it.

BRIEF DESCRIPTION OF THE DRAWINGS

The charatcer of the invention, however, may be best understood by reference to one of its structural forms, as illustrated by the accompanying drawings, in which:

FIG. 1 is a vertical sectional view of a circuit breaker embodying the principles of the present invention,

FIG. 2 is a perspective view of the movable contact element, and

FIG. 3 is a perspective view of the fixed contact element.

FIG. 1 shows a switch lock shaft **1** of a circuit breaker equipped with supports **2** for movable contact elements **3**. The electrical current flows to the movable contact element **3** through copper wire or buss **4** connected to it. Underneath the movable contact element **3** (shown in perspective in FIG. 2) is shown a stationary contact element **5** (which is shown in FIG. 3 in perspective). The contact part **6** making the contact is arranged on a plate **7** and is positioned underneath the movable contact element **3** extending in the direction of the current flow so that, along a longer stretch, parallel circuit passages are created, but of counter flow. As shown in FIG. 3, the plate **7** is closed off by a bar or wall **8**, from which extend conduction bars or walls **9** leading underneath the movable contact element **3** and uniting at the connection or buss **10** which, again, is in connection with a terminal **11**. To prevent sudden impacts, the plate **7** is supported by a spring **12** which gives a certain damping effect by friction with its support areas. Also, the movable contact element **3** is connected with its support by a spring because of the damping effect. The support extends through a slot **13** of the contact carrier and permits vertical play for contact element **3**. Within this permissible play, the movable contact element **3** is maintained in tension by a spring

14 to which a damping member 15 is arranged in parallel.

The commonly-used explosion chambers associated with each contact pair are not shown; however, there is shown a mica plate 16 which secures the insulation of plate 7 and circuit bars 9 and protects them also against creeping sparks.

Within the operation area of the free ends of the support 2 is arranged a hook 17 of a latch lever 18. This is mounted within the switch cover 19 and supported there. This is the limiting stop for the stroke in the direction of its action. Against this stop the latch lever 18 is maintained in tension by the spring 23. For the back swing of the latch lever out of the action area of the supports 2, an electric magnet 21 is arranged, and its rotor 22 in its base position is pushed back by a spring 20 so far that the rotor during operation first has to be accelerated against the force of spring 23 and also against its own inertia. During impact with the free end of the latch lever, it brings its own kinetic energy into action. The spring 23 supports itself within recess of the latch lever 18, and the spring 20 is guided through the spring 23 so that the latch lever may react very fast and mass and tension of the electric magnet does not strain or load the latch lever. The back end 24 of the rotor 21 has the shape of a pin and serves to guide the rotor. Handles or connecting levers for manual release can be used when such a lever or handle is not already formed by the latch lever itself within its area of operation.

Circuit breakers designed according to this invention are operating as follows: Through tension and switch-on of the switch lock, the switch lock axis 1 is swung into position as shown in FIG. 1. The free end of the support 2 engages the hook 17 of the latch lever 18 and is supported by it, although the contact elements 3 and 5 are not engaged as yet. The switch lock of the circuit breaker may also be operated manually. In the case of remote controlled circuit breakers, the switch lock may be put into tension also by pneumatic, hydraulic or electrical setting devices. Because of the closing of the support 2 by the hook 17 of latch lever 18, a pre-adjustment of the switch lock is achieved; this means that a relatively slow-operating setting device of small dimension and small capacity may be selected. For operating under remote control, small, high speed motors with correspondingly small output are sufficient and, because of their small size, take only little space, so that they may be housed easily.

The remote controlled switch-on is made by a short electric impulse introduced to the electric magnet 21 of small output. The rotor 22 moves out and, during impact with the free end of the latch lever 18, swings back the latch lever, so that the hook 17, with its contact area, slides from beneath the free end of the support 2 and releases the support. Under action of the spring of switch lock (not shown) in keeping the support in tension, the support 2 immediately swings around clockwise until the contacts reach the engagement position and the electrical circuit is closed. Because of the small traveling distance of the movable contact element 3, the result is an extremely short switch-on time.

In case peak current, due to short circuiting beyond the switch, take place, then the plates 7, which have a flow current counter and also the opposite arranged parts of the movable contacts 3, exert such strong repulsing forces against each other that the movable contact element 3 is lifted immediately and also the support 2 is lifted against the force of the switch lock. During passing of the sloped surface 25 by the hook 17, the latch lever is pushed back. After passing behind the parts of the movable contacts, the hook interlocks with a transverse bar arranged on the free end of the support 2. Since, in this case, no parts of the lock switch having large mass are moved, the separation of the contacts follows immediately and within the shortest time. Only a short

time later, the support 2 is caught by the hook 17 of latch lever 18. Repeated switch-on within a range of "selective time staggering" may be activated because the switch lock does not have to be released, and a new return spring loading is not required. It is not even necessary to wait for the interlocking of the hook 17 behind the transverse bar 26. The first repeated switch-on may be attempted immediately, so that, even during upward movements, that is, within the upper turning point of the movement of the movable contact elements, the latch lever with the electric magnets 21 is swung back and the immediately-repeated switch-on is permitted. This operation may be controlled by a pre-arranged control device, up to a certain number of switch operations determined by the device.

With the appearance of a peak of current due to a short circuiting, the two short circuit currents are flowing in opposite direction over a stretch of the effective length of plate 7 and then parallel. As already mentioned, forces are created which force the contact elements apart. Within the yoke or wall 8 closing the end of the plate, the current is divided and guided to both sides, so that it may flow further within the bars or walls 9 in the original direction. The stationary contact generally is somewhat offset in the extended direction of the movable contact and a favorable flat and compact design is achieved for the contact pairs. It has been proven that the repulsing action is not based alone on the opposed guided peak currents, but there are additional effects bringing about this action; for example, the effect of contact bridging at a place of current reduction. With the design of the stationary contacts according to this invention, further additional actions are achieved. The inductive reactance of the stationary contact is already noticeable in the damping or flattening of steep wave fronts without the use of the well-known coils. Additional space is required by such coils and they make the design of the switch more complicated and expensive. The walls 9 of the invention act as current guides in the original direction within the movable contact part in such a distance that the attraction forces that appear are considerably smaller than the repulsion forces induced between the movable contact part and the plate 7. The side walls cause only small, moment-inducing force components relative to the swing axis of the movable contact. The important components are parallel to the axis, so that they do not create momentum and are opposed to each other so that they cancel each other out. This action is supported by the fact that the live bars extend above the plate 7 and, when the switch is closed, they extend over the sides of the movable contact.

A further important effect to be considered is created through the shape of the stationary contact. This is the effect of the magnetic field caused during peak currents on the electric arc created and caused by the switch-off under load. On conventional switches, the electric arc acts through the horn-shaped design of the contacts and the required ascent of the arc to drive the arc away from the contact points into explosion chambers. These divide, cool, and de-ionize the arc. In the present invention, a magnetic field component is induced transversely of the electrical arc which directs the arc in the direction of the explosion chamber. Since this effect is independent of the mounted position of the capacity switch, the result is a considerable freedom achieved for its arrangement within the different switch gears in comparison to common switches.

The invention may be varied without leaving its technique. For example, there could be arranged a manual operating device for the latch lever with, for example, an arresting device activated by a rocker arm which allows the immediate peak current switch-off to take place with controlled repeated switch-on, for example, by operating the switch lock to close the electric circuit immediately. The immediate peak current switch-off may be activated in such a way that it can relieve and unlock the switch lock

in the known manner, for example, by magnetic quick release.

The circuit breaker of this invention does not vary in shape from the conventional ones, which is of advantage in fabrication. Most circuit breakers are equipped with a flat cover; however, the ones with immediate peak current switch-off for manual remote or automatic immediate switch-on constructed in accordance with this invention, have a cover with an opening for the latch lever **18** and can be equipped with the latch lever and its service parts. An advantage of this invention is that the necessary control forces and the power drives connected with them can be kept small. The electro-magnet **21** may be of smaller size, as well as the power drive for the lock switch. It was found, for instance, that for operating a 400 ampere capacity switch, a 4-watt electro-motor is sufficient. The long time required for placing the lock in tension through the small forces is not important because, in time of need the switch-on of the contacts may be activated suddenly by the electro-magnets **21**. As an important advantage of the low output required, the correspondingly small space for housing and also the low fabrication expenditures must be considered.

For the closing of the contacts which have previously been opened by the immediate peak current switch-off, it is possible that the support members themselves activate the movable contact. It has been proven to be of advantage to arrange each support member at the free ends of several supports. It is also possible to arrange a lever on the switch lock shaft **1** only for the engagement of support members on the switch lock shaft. There are also further steps possible, such as taking the support members out of reach of sparks or electrical arcs during switch-off in service. As shown in FIG. 1, the free end of suport **2** is equipped with a horizontal bar **26** which permits the latch lever **18** to be located outside the area of symmetry of the support **2**. It is possible to arrange it as far to the side of it as is recommended with regard to the explosion chambers and the projecting ends of the free contacts. To counter the strong forces on the hooks **17**, the horizontal bar **26** may extend over the support **2** and extend into the action range of two symmetrically-arranged latch levers **18**. In this case, the two latch levers may be connected on the same shaft, so that, for their operation, one electromagnet is sufficient. A free lever of the second latch lever may here be omitted or may serve for engagement of a second device, such as a manual release device. On the other hand, the horizontal bar may connect the supports with one another.

The invention permits equipping circuit breakers with low expenditure with immediate peak current switch-off and with the elements remote-controlled to activate a fast switch-on. The small expenditure extends also to the additional required space. According to this invention, it is also possible to design these switches with immediate peak current switch-off, basically in the same compact form, and it is considered very important for fabrication that the same individual parts as on conventional circuit breakers be used.

It is obvious that minor changes may be made in the form and construction of the invention without departing from the material spirit thereof. It is not, however, desired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent is:

1. A circuit breaker, comprising

(a) a housing,

(b) an input buss at one side of the housing,

(c) a movable contact element to which the buss is attached,

(d) an output buss at the opposite side of the housing,

(e) a fixed contact element located under the movable contact, and

(f) a mount for the fixed contact consisting of a box-like element having a rectangular bottom on which the fixed contact element is fastened and having integral side walls extending from all the edges of the bottom, the output buss being integral with and extending from one end wall.

2. A circuit breaker as recited in claim **1**, wherein the side walls extend a substantial distance above the plane of the fixed contact element.

3. A circuit breaker as recited in claim **1**, wherein the fixed contact element and the side walls are covered with insulation.

4. A circuit breaker as recited in claim **1**, wherein a support member kept in tension by a spring is located in the path of the movable contact element.

5. A circuit breaker as recited in claim **4**, wherein the support member is equipped with a hook having a sloped area extending in the direction of the working position of the movable contact element.

6. A circuit breaker as recited in claim **4**, wherein the support member equipped with a hoog is a latch lever.

7. A circuit breaker as recited in claim **6**, wherein the latch lever is equipped with a device which activates the release and the closure and is manually operational.

8. A circuit breaker as recited in claim **6**, wherein the latch lever is equipped with an electro-magnet as a power-operated release device.

9. A circuit breaker as recited in claim **4**, wherein a support member is arranged for the support of the movable contact element at its center only.

10. A circuit breaker as recited in claim **9**, wherein the support has an engagement area for the support member in the form of a horizontal bar.

11. A circuit breaker as recited in claim **10**, wherein the support member is guided through a switch cover and the release device is arranged outside of the switch cover.

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