July 15, 1969 J. ELLENBERGER 3,456,225

PUSHBUTTON ACTUATED OVERLOAD CIRCUIT BREAKER

Filed Dec. 11, 1967

FIG. 1

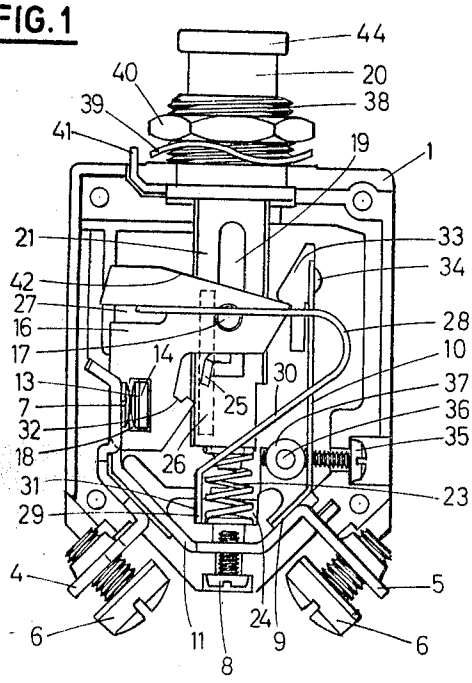


FIG. 3

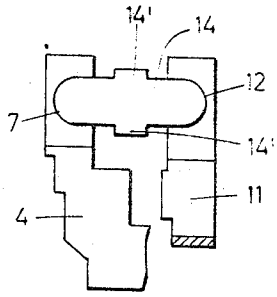


FIG. 2

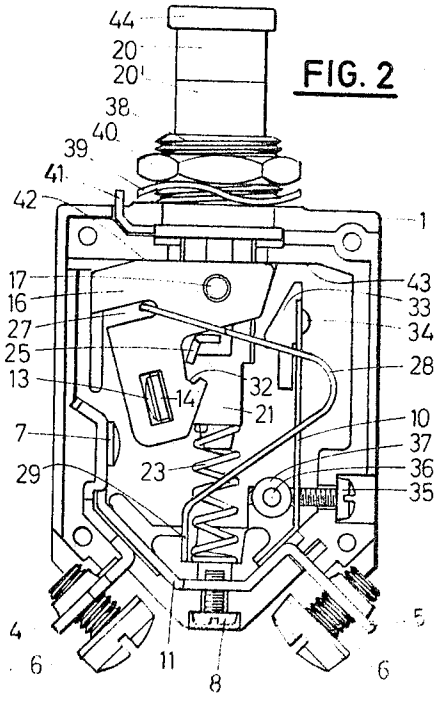


FIG. 4

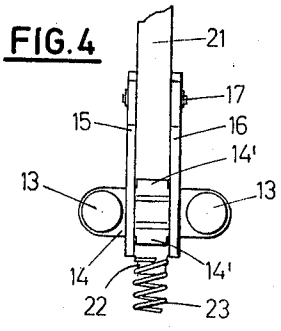


FIG. 5

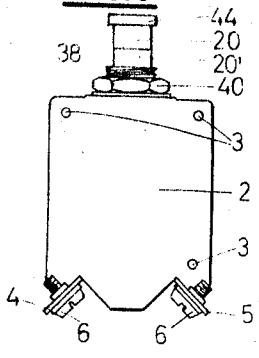
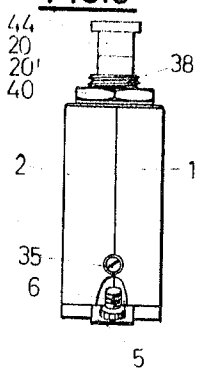


FIG. 6



INVENTOR:
JAKOB ELLENBERGER

by Otto John Munz

ATTORNEY

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PUSHBUTTON ACTUATED OVERLOAD CIRCUIT BREAKER

Jakob Ellenberger, Altdorf, near Nuremberg, Germany, assignor to Firma Ellenberger & Poensgen G.m.b.H., Altdorf, near Nuremberg, Germany, a firm of Germany

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Int. Cl. H01h 71/16, 71/58
U.S. Cl. 337—75 7 Claims

ABSTRACT OF THE DISCLOSURE

A pushbutton actuated overload circuit breaker of very small outer dimensions which is designed so as to quench the arcing as effectively as possible and therefore permits it to be employed for switching off very high excess currents.

The present invention relates to an overload circuit breaker for high currents.

There has always been and still is a considerable need for smaller and more economic circuit breakers which have a high capacity. This is especially due to the progress in electrification whereby the occurrence of high short-circuit currents in public power lines has increased considerably. It is therefore often necessary to switch off a much higher than the normal power. If in existing circuits the capacity of the circuit breakers is insufficient for this purpose, it is necessary to replace them by new circuit breakers which, if not smaller, should at least not require any larger space and should comply with the increased requirements and be capable of switching off the high short-circuit currents which might occur in the power lines.

More particularly, the invention relates to an overload circuit breaker which is actuated by a pushbutton and provided with a thermal release and/or an electromagnetic release and is adapted to switch the current on or off instantaneously, and which is further provided with a trip-free release and with a contact bridge which is adapted to connect two fixed contacts to each other and is pivotable relative to a control rod which is rigidly connected to the pushbutton. Under the action of a spring, this contact bridge is also movable in a direction parallel to the axis of the control rod. When the circuit breaker is switched off, the contact bridge is moved by the spring to a position in which, when the circuit breaker is again switched on, a projection on the control rod will engage with and take along the contact bridge to its on position in which it will be held by a holding detent on the thermal or electromagnetic releasing means.

In my prior United States patent, No. 3,143,617, I have disclosed an overload circuit breaker of the type as mentioned above in which one fixed contact is mounted at one side of the control rod on the end of the heated bimetal strip of the thermal release, while the other fixed contact is mounted in a stationary position at the opposite side of the control rod. These two fixed contacts are therefore spaced at a considerable distance from each other. In order to have only one actual disconnecting point, the fixed contact on the bimetal strip is connected to the arm of the angular lever-shaped contact bridge which extends parallel to the control rod by means of a flexible conductor. For avoiding the formation of conductive bridges on the inner walls of the housing by deposits of fine metal particles caused by the precipitation of the metal vapor as produced at the occurrence of arcs, these walls are povided in the vicinity of the stationary contact with ribs which completely surround this fixed contact and extend

substantially vertical to the connecting lines between the fixed contact and the movable contact in its off position, that is, to the connecting lines between the current-carrying metal parts. The flexible conductor has the disadvantage that it renders the production of the circuit breaker more difficult and especially also that it interferes with the free movability of the contact bridge. Since the disconnecting point between the fixed contact on the bimetal strip and the contact bridge is bridged by the flexible conductor, the entire circuit-breaking capacity is concentrated within a single arc of such a strength that it may only be quenched with difficulty.

It is an object of the present invention to improve an overload circuit breaker of the last-mentioned type and to design it so as to take up the smallest possible space, to be easily manufactured, to have a high safety of operation and a long durability, and especially so as to have a high circuit-breaking capacity.

This object is attained according to the invention by mounting the two fixed contacts side-by-side and at one side of the control rod opposite to the side where the holding detent is located, by mounting the contact bridge within an insulating contact-bridge carrier, and by connecting this bridge carrier to the control rod so as to be freely pivotable thereon as well as slidable by the action of the spring in the axial direction of and relative to the control rod. The circuit breaker according to the invention is further designed so that, when it is switched off, the contact bridge carrier is pivoted to a position in which a stop member on the bridge carrier is located within the area of movement of a projection on the control rod so that, when the circuit breaker is being switched on, this projection will engage with the stop member and thereby take along the bridge carrier and move the same over and in locking engagement with the holding detent on the end of the bimetal strip and thereby move the contacts of the contact bridge in engagement with the fixed contacts.

When the circuit breaker according to the invention is being switched off, two arcs will occur on the two disconnecting points. Since the currents of these arcs flow in opposite directions, the two arcs will repel each other and come into intimate connection with the cold walls of the housing, and are thereby quenched very quickly. The circuit breaker according to the invention can therefore reliably switch off very high currents, for example, 6000 amperes at 24 volts of direct current or 3500 amperes at 115 volts of alternating current. Since the two fixed contacts are mounted side-by-side, the contact bridge may be made more easily and of a more simple and reliable construction than the contact bridge of the ciruuit breaker as previously described which is made in the form of an angular lever.

The contact bridge carrier may be made in a very simple manner of a pair of equal parallel insulating plates which are spaced from each other and connected by a rivet or the like which passes through a slot which extends in the axial direction of the control rod. The two insulating plates are provided with two equal apertures in alignment with each other into which the flat plate-shaped contact bridge is inserted so as to be loosely disposed therein. It is held in a fixed position in these apertures by being provided with projections between the insulating plates. It is evident from this description that the contact bridge as well as the bridge carrier are of a very simple and inexpensive construction and may be easily assembled and installed. For further facilitating the manufacture and assembly of the new circuit breaker, the invention provides that the spring which is required to act upon the contact bridge carrier consists of a spring wire which is bent to a U-shape. The transverse part connecting the two arms of

this spring extends through corresponding narrow slots in both insulating plates of the bridge support, and the two arms are bent to an equal V-shape and extend within parallel planes and their free ends opposite to the transverse connecting part are inserted into and held in a fixed position within corresponding recesses in the inner walls of the housing. This spring which serves for the trip-free release of the circuit breaker has the advantage that it may be very easily made and installed and that it takes up very little space.

In order to insure that the control rod which is rigidly connected to the pushbutton as well as the bridge carrier on which the contact bridge is mounted will be properly guided, the driving projection on the control rod which, when the circuit breaker is being switched on, takes along the bridge carrier together with the contact bridge, is provided on the opposite sides from the control rod and its free ends are guided in grooves which are provided in the opposite inner walls of the housing and extend parallel to the axis of the control rod. The stop members on the two insulating plates of the bridge carrier with which these projections engage when the circuit breaker is being switched on are provided in the form of equal notches in these two insulating plates into which these projections are securely hooked during the downward movement of the control rod so that the bridge carrier and the contact bridge thereon will always be properly moved to the on position.

For shifting the bridge carrier at the end of the releasing movement of the control rod so that, when the pushbutton is subsequently depressed to switch on the circuit breaker, these notches in the insulating plates of the bridge carrier will be located within the direction of movement of the projections on the control rod, the upper side of the bridge carrier facing the pushbutton is obliquely inclined relative to the axis of the control rod so that, when this inclined surface engages under the action of the spring against a wall surface of the housing which extends at right angles to the axis of the control rod, the bridge carrier will be pivoted about the axis of its rivet and the notches in the bridge carrier will thereby be moved into alignment with the driving projections on the control rod. The outer end of this inclined side of the bridge carrier serves as a projection over which the holding detent on the end of the bimetal strip engages when the circuit breaker is in its on position. Due to the inclination of the upper side of the bridge carrier, the latter will slide off and disengage from the holding detent on the resilient bimetal strip so that the circuit breaker will be released when the pushbutton is pulled outwardly by hand.

For preventing the bridge carrier of insulating material from being damaged by the heated bimetal strip, the holding detent on the end of this strip is made of a heat-resistant insulating material. For the same reason the invention provides a setting member of a heat-resistant insulating material for adjusting the holding detent to its proper position. This setting member may be pressed against the bimetal strip by means of a setscrew which is adjustable from the outside of the housing. These highly heat-resistant insulating parts also have the advantage of increasing the heat resistance of the entire circuit breaker.

The features and advantages of the present invention will become further apparent from the following detailed description thereof which is to be read with reference to the accompanying drawings, in which:

FIGURE 1 shows a front view of an overload circuit breaker according to the invention in the on position and without the front part of the housing;

FIGURE 2 shows a similar view of the circuit breaker but in the off position;

FIGURE 3 shows a top view of the contact bridge and the terminal strips carrying the fixed contacts;

FIGURE 4 shows a view of the contact bridge carrier as seen from the left of FIGURE 1;

FIGURE 5 shows a front view of the circuit breaker according to FIGURE 1 in its closed condition and in its substantially actual size; while

FIGURE 6 shows a side view of the circuit breaker as seen from the right of FIGURE 5.

Referring to the drawings, the circuit breaker according to the invention comprises a housing of insulating material which consists of two substantially equal parts **1** and **2** which are connected to each other by rivets **3**. For electrically connecting the circuit breaker, two terminal strips **4** and **5** are provided which project from the housing and have connecting screws **6** on their outer ends. Terminal strip **4** is inserted into a corresponding recess in the housing part **2** and carries a fixed contact **7**.

Terminal strip **5** is inserted into a corresponding recess in the housing part **1** and is secured in a fixed position therein by a screw **8**. Terminal strip **5** carries the front arm of a U-shaped bimetal strip which is welded or soldered thereto at **9** and the other arm of which is mechanically and electrically connected to or integral with a contact bar **11**. As shown particularly in FIGURE 3, this contact bar **11** extends to the area laterally adjacent to the fixed contact **7** on the terminal strip **4** and it is adequately spaced from the latter and provided with a fixed contact **12**. Both fixed contacts **7** and **12** are operatively associated with contacts **13** on a contact bridge **14** which is a stamped flat part and mounted in a contact bridge carrier which, as illustrated in FIGURE 4, consists of two parallel plates **15** and **16** of insulating material which are spaced from each other and connected to each other by a hollow rivet **17**. These two insulating plates **15** and **16** are provided with corresponding apertures **18** into which the contact bridge **14** is loosely inserted. For preventing the contact bridge **14** from shifting laterally within the bridge carrier, it is provided with projections **14'** between the two insulating plates **15** and **16**. Rivet **17** extends through a longitudinal slot **19** in a control rod **21** which is rigidly connected to the pushbutton **20**. By means of this rivet **17**, the bridge carrier **15**, **16** of the contact bridge is therefore slidable in the axial direction on control rod **21** as well as pivotable relative thereto. On its lower end, control rod **21** is provided with a reduced projection **22** for holding one end of a return spring **23** the other end of which engages upon the bottom of a recess **24** in the two housing parts **1** and **2**.

Control rod **21** has an aperture in which a drive member **25** is rigidly secured, the ends of which project from its opposite sides and are guided in longitudinal grooves **26** in the two housing parts **1** and **2**. The two insulating plates **15** and **16** have corresponding slot-shaped recesses **27** into which the connecting web of the two arms of a U-shaped spring **28** of spring wire engages. The two arms **30** of this spring of which only the front arm can be seen in FIGURES 1 and 2 are bent substantially to a V-shape and their free ends **29** engage into corresponding slots **31** in both housing parts **1** and **2** in which they are thus secured in a fixed position. This spring **28** serves for effecting a trip-free release of the circuit breaker.

Both insulating plates **15** and **16** have corresponding notches **32** into which the drive member **25** is adapted to engage. When the circuit breaker is in its on position in which the contacts **13** on contact bridge **14** engage upon the fixed contacts **7** and **12**, the contact bridge carrier **15**, **16** will be held in an arrested position by a holding detent **33** which consists of a heat-resistant insulating material, for example, of ceramics, and is secured by a rivet **34** to the free end of the U-shaped bimetal strip **10**. For adjusting the bimetal strip **10** so that its holding detent **33** will be in the proper position, a setscrew **35** is provided which is screwed into an adjusting member **36** which has an annular part **37** of a heat-resistant, for example, ceramic, insulating material on each side of setscrew **35**. These parts **37** engage upon the two arms of the U-shaped bimetal strip **10**. When the setscrew **35** is tightened, the bimetal strip **10** will be pivoted toward the right, as seen in FIGURE 1.

Both housing parts **1** and **2** are further provided with suitable equal recesses into which a bushing **38** is inserted which has an external screw thread and in which the control rod **21** is guided. Bushing **38** carries a curved spring washer **39** and a nut **40**. For securing the circuit breaker on a mounting plate so as not to be able to turn when the nut **40** and washer **39** are tightened, an angular piece **41** is inserted into corresponding recesses in the two housing parts **1** and **2**, and the end of this angular piece **41** which projects from the housing **1, 2** is inserted into a bore or recess which is provided in the mounting plate.

The mode of operation of the circuit breaker according to the invention is as follows:

If an excess current occurs, the bimetal strip **10** will be heated to such a temperature that it will bend in the clockwise direction, as seen in FIGURE 1, with the result that its holding detent **33** will release the contact bridge carrier **15, 16**. Spring **28** will then press this bridge carrier **15, 16** in the upward direction so that its inclined upper side **42** will engage upon the upper wall surface **43** of the two housing parts **1** and **2** and thereby cause the bridge carrier **15, 16** to pivot rapidly about the rivet **17** so that the contacts **13** of contact bridge **14** will be instantaneously disengaged from the fixed contacts **7** and **12** and the circuit will be broken within the circuit breaker. At the same time, the return spring **22** will push the control rod **21** together with the pushbutton **20** to the off position as shown in FIGURE 2.

If during the thermal release of the circuit breaker as above described the pushbutton is held depressed in the on position as shown in FIGURE 1, the bridge carrier **15, 16** together with the contact bridge **14** will still be moved by spring **28** to the off position as shown in FIGURE 2. This type of release of the circuit breaker is called the trip-free release.

Of course, in place of or in addition to the bimetal strip **10** it is possible to provide the circuit breaker with an electromagnet for an electromagnetic release. This electromagnet may then be designed so as to act upon the bimetal strip **10**. It is, however, also possible to secure the holding detent **33** to a leaf spring or to a pivotable lever which may be acted upon by the bimetal strip of the thermal release as well as by the electromagnet of the electromagnetic release.

As illustrated in FIGURE 2, the notches **32** in the contact bridge carrier **15, 16** are located within the range of movement of the drive member **25**. Thus, when the pushbutton **20** is depressed to switch the circuit breaker to the on position, drive member **25** will engage into the notches **32** and thereby move the contact bridge carrier **15, 16** together with the contact bridge **14** so far downwardly that the right end of the contact bridge carrier, as shown in FIGURE 2, will snap over and be arrested by the holding detent **33**. The contacts **13** on contact bridge **14** are then, however, still spaced from the fixed contacts **7** and **12**. If the pushbutton **20** is then released, it will move upwardly for a short distance together with the control rod **21** so that the drive member **25** will disengage from the notches **32** and the contact bridge carrier **15, 16** will be pivoted by spring **28** rapidly in the clockwise direction about the holding detent **33** and will thereby also pivot the contact bridge **14** so that its contacts **13** will engage rapidly with the fixed contacts **7** and **12**. The instantaneous release of the circuit breaker is likewise effected by spring **28**. This instantaneous engagement and release of the circuit breaker has the advantage that it will save the contacts from damage and will thus insure that the circuit breaker will remain fully operative for a very long time.

For releasing the circuit breaker more easily by hand, the pushbutton **20** is provided with a flange **44** which permits it to be more firmly gripped to be pulled out of the housing **1, 2**. Drive member **25** then takes along the contact bridge carrier **15, 16** whereby the inclined upper side of the latter will push the holding detent **33** toward the right of FIGURE 1, so that the contact bridge carrier **15, 16** will then be moved by spring **28** to the off position as shown in FIGURE 2.

When the circuit breaker is in the on position as shown in FIGURE 1 as well as when it is in the off position as shown in FIGURE 2, drive member **25** engages upon the contact bridge carrier **15, 16** under the action of the return spring **23**. In the on position, the return spring **23** increases the contact pressure which is caused by spring **28**, while in the off position the return spring **23** maintains the contact bridge carrier **15, 16** together with contact bridge **14** in this off position.

The lower part **20'** of pushbutton **20** may be made of a white color, while its upper part may be black. Thus when the circuit breaker is in the on position as shown in FIGURE 1, only the upper black part of the pushbutton will project from the bushing **38**, while when it is in the off position as shown in FIGURE 2, also the lower white part **20'** will be visible.

When the circuit breaker is in the on position as shown in FIGURE 1, there will be no connection between the control rod **21** and the contact bridge carrier **15, 16** or the spring **28** so that if pushbutton **20** is further depressed in this on position, the contact pressure which is produced by spring **28** will not be affected.

Although my invention has been illustrated and described with reference to the preferred embodiment thereof, I wish to have it understood that it is in no way limited to the details of such embodiment but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed by invention, what I claim is:

1. In an overload circuit breaker, in combination, a housing having substantially parallel opposite side walls and end walls, a pushbutton within and partly projecting outwardly of said housing and slidable axially within one end wall thereof, a control rod rigidly secured to the inner end of said pushbutton and movable in its axial direction together with said pushbutton, a return spring within said housing acting upon said control rod and tending to move the same together with said pushbutton in the outward direction, a pair of fixed contacts mounted side-by-side in said housing at one side of said control rod, releasing means comprising a bimetal strip at the opposite side of said control rod and having one end secured in a fixed position in said housing and having a holding detent on its other free end, a pair of connecting terminals secured to said housing, one of said terminals being electrically connected to one of said fixed contacts and the other terminal to the other fixed contact and also to said fixed end of said bimetal strip, a contact bridge having a pair of contacts thereon adapted to be moved from an off position spaced from said fixed contacts to an on position in engagement with said fixed contacts, a bridge carrier of insulating material carrying said contact bridge pivot means connecting said bridge carrier to said control rod so as to be pivotable relative thereto and also slidable in the axial direction relative to said control rod, a second spring acting upon said bridge carrier and tending to move the same together with said contact bridge in the direction toward said pushbutton, a stop member on said bridge carrier, and a projection on said control rod, said bridge carrier having a part adapted to engage with and to be held by said holding detent when said pushbutton is depressed, said bridge carrier when released from said holding detent and moved by said second spring in the axial direction of said control rod in the direction toward said pushbutton also being pivoted about the axis of said pivot means whereby said stop member on said bridge carrier is moved from a position out of alignment with said projection on said control rod to a position in alignment therewith so that, when said pushbutton is subsequently depressed, said projection will engage with said stop member and thereby take along said bridge carrier until it is moved

over and held by said holding detent, whereupon under the action of said second spring said bridge carrier will be pivoted about its point of connection to said holding detent so that said contacts on said contact bridge will be moved rapidly in engagement with said fixed contacts.

2. An overload circuit breaker as defined in claim 1, wherein said contact bridge carrier consists of a pair of substantially parallel equal insulating plates spaced from each other, said control rod extending through the space between said insulating plates and having a slot extending in the axial direction thereof, said pivot means comprising a pivot pin extending through said slot and securing said insulating plates to each other, each of said insulating plates having an aperture in alignment with the apertures in the other insulating plate as spaced from said pivot pin, said contact bridge consisting of a flat bar loosely inserted into said apertures and having projections between said insulating plates for holding said contact bridge in a substantially fixed position on said insulating plates, said contacts on said contact bridge being disposed at the opposite outer sides of said insulating plates.

3. An overload circuit breaker as defined in claim 2, wherein said spring acting upon said contact bridge carrier consists of a spring wire which is bent to a U-shape so as to have two arms and a crosspiece connecting said arms, said insulating plates having corresponding narrow slots, said crosspiece extending through said slots, said two arms being bent to a corresponding V-shape and extending within planes substantially parallel to each other, the free ends of said arms being secured to said housing.

4. An overload circuit breaker as defined in claim 2, wherein the inner sides of said side walls of said housing are provided with grooves extending parallel to the axis of said control rod, said insulating plates having corresponding notches forming said stop members, said projection on said control rod projecting from the opposite sides thereof and being adapted to engage into said notches when said

pushbutton is being depressed to switch on said circuit breaker, the outer ends of said projection projecting into and being slidable along and guided by said grooves in said housing walls.

5. An overload circuit breaker as defined in claim 1, wherein the upper side of said contact bridge carrier facing said pushbutton is obliquely inclined relative to the axle of said control rod and adapted to engage against a wall surface of said housing extending at right angles to said axis when said bridge carrier is released from said holding detent and moved by said second spring toward said wall surface, whereby said bridge carrier is pivoted so as to move said stop member into alignment with said projection on said control rod.

6. An overload circuit breaker as defined in claim 1, wherein said holding detent on said bimetal strip consists of a heat-resistant insulating material.

7. An overload circuit breaker as defined in claim 1, further comprising means for adjusting the position of said holding detent, said means comprising a setting member at least partly consisting of a heat-resistant insulating material, and a setscrew extending into said housing and being adjustable from the outside thereof for pressing said setting member against said bimetal strip.

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BERNARD A. GILHEANY, Primary Examiner

R. L. COHRS, Assistant Examiner

U.S. Cl. X.R.

337—66