Oct. 14, 1958 R. MANG 2,856,487

CUTOUT SWITCH

Filed April 16, 1957 2 Sheets-Sheet 1

Fig. 1

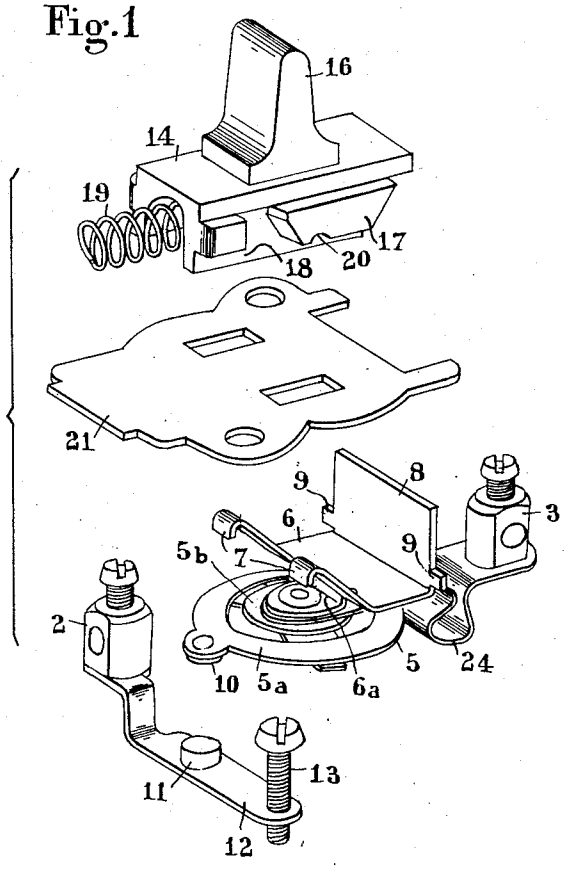

Fig. 2

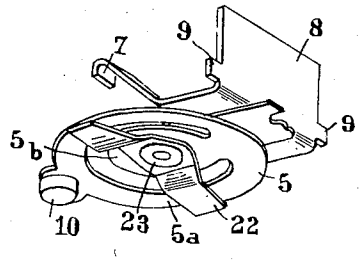

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Fig. 3

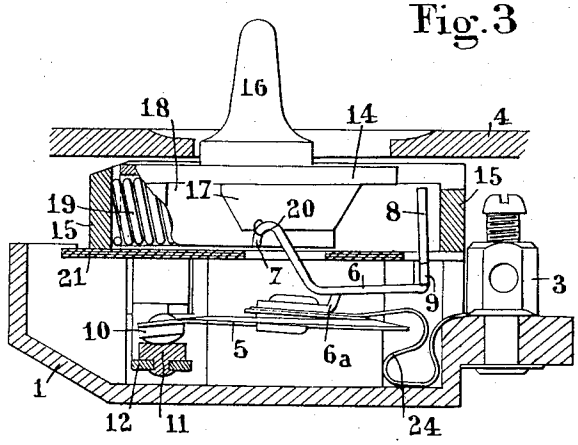


Fig. 4

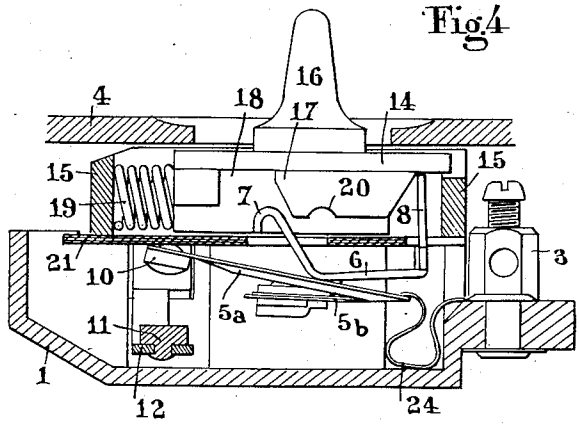
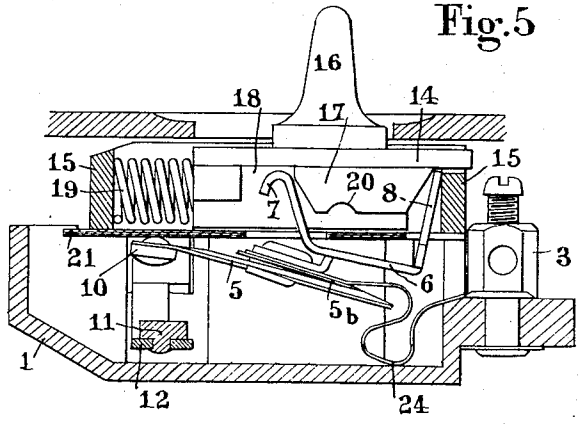


Fig. 5



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CUTOUT SWITCH

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6 Claims. (Cl. 200—116)

This invention relates to circuit-breakers and more particularly to cutout switches and it is the chief object of this invention to provide an improved electrical apparatus designed for acting either as an ordinary switch for making and breaking a contact, or as a cutout for automatically opening the circuit when the current flowing through this circuit exceeds a predetermined value.

It is already known to construct current-limiting cutouts wherein a bimetallic control strip carries one or more movable contacts, the current flowing through this strip. This current-responsive element consists of a bimetallic strip or disc preset to a curved shape and adapted to have its curvature inverted with a snap action when heated by the Joule effect for a predetermined current strength, so as to actuate the movable contacts and open the circuit. Moreover, these cutouts comprise adequate control means acting on the current-responsive element to reclose the circuit when the cause having determined the cutout action has disappeared.

The apparatus according to this invention comprises similarly a bimetallic element which opens the circuit automatically in case of overcurrent, but it is so designed that the automatic control means for reclosing this element may also act as manual control means for moving the movable contact carried by said current-responsive element so that the apparatus may operate not only as a cutout but also as a switch.

In fact, the apparatus according to this invention is characterized essentially in that the bimetallic current-responsive element which carries a movable contact at its free end is supported in turn by a movable member mounted for tilting movement in the casing of the apparatus and adapted to be actuated by means of a sliding push-member provided with a control knob. This sliding push-member is adapted to cause the movable member and consequently the movable contact carried thereby to tilt in one or the other direction for either separating the movable contact from the fixed contact or moving the former towards the latter, this last-mentioned operation serving the purpose of reclosing the switch as a consequence either of a voluntary switch-opening movement, or of an automatic separation of the contacts due to a snap reversing of the curvature of the current-responsive element in case of overcurrent.

The movable member consists of a plate bent substantially to a U shape on the side opposite to the current-responsive element, the latter being secured on one edge of this U shaped plate the other edge of which carries side trunnions pivoting on the casing of the apparatus.

The sliding push-member comprises on its lower face a projection located substantially between the branches of the U-shaped movable member, each end of this projection engaging a corresponding branch of the movable member to tilt same in one or the other direction according to the direction of motion of the push member.

Other features and advantages of this invention will appear as the following description proceeds with reference to the accompanying drawings illustrating diagrammatically by way of example a typical embodiment of the cutout switch of this invention and forming part of the specification.

In the drawings:

Figure 1 is a perspective "exploded" view showing the essential component elements of an apparatus according to this invention;

Figure 2 is a perspective view showing the current-responsive element assembled with the movable member; and

Figures 3, 4 and 5 are fragmentary sectional views showing an apparatus constructed in accordance with the teachings of this invention, the control members and component elements thereof being shown in different operating positions.

The apparatus illustrated in the drawings comprises an insulating base **1** carrying a pair of input and output terminals **2**, **3** and a cover **4** adapted to fit over the base to form a case. This apparatus contains a bimetallic control element **5** which may consist of a strip or disc having a suitable preset curvature adapted to be reversed with a snap action when heated by the Joule effect when the current flowing therethrough attains a predetermined value. Preferably, this bimetallic element consists of a curved, dished metal disc of non-developable configuration which is formed with an annular cut-out portion so as to comprise an external annulus **5***a* and a central portion *5b* connected by a junction zone.

The central portion *5b* of the disc is secured on a lug *6a* of a movable member **6** consisting of a bent, substantially U-shaped plate the branches of which extend in a direction opposite to the disc **5**. Thus, this bent plate **6** comprises two side branches **7**, **8**, the branch **7** being notched in its middle to form a pair of side arms, as shown. These arms are slightly inclined on the side opposite to the branch **8** and their free ends are bent back, as shown. The fixation lug *6a* of the bimetallic disc corresponds to the notch formed in the branch **7**, so that the disc is secured in the vicinity of one of the corners of this movable member. Adjacent to the other corner of this movable member are a pair of lateral trunnions **9** pivotally mounted in suitable bearing-forming cavities of the base **1**, so that the movable member may tilt freely therein.

The disc **5** carries a movable contact **10** on its external annulus *5a*, on the side opposite to the zone where this annulus is connected to the central portion *5b*, this zone being adjacent to the trunnions **9**, as shown in Fig. 2. A fixed contact **11** is provided under the movable contact **10**. This fixed contact is secured substantially centrally of a flexible strip **12** constituting an electrical connection between the terminal **2** and the fixed contact. One end of this strip **12** is clamped between the terminal and the base **1**, and the other end has screwed through it a micrometric screw **13** engaging the base **1** so that the pressure between the contacts **10**, **11** may be adjusted with precision by screwing in or out the screw **13**.

The apparatus also comprises a push-member **14** adapted to actuate the movable member **6**. This push-member **14** is slidably mounted in a frame **15** secured on the base **1** and carries on its upper face a control button **16** projecting externally from the cover **4** of the apparatus through a suitable slot. The lower face of the sliding push-member comprises a projection **17** lying between the branches **7** and **8** of the movable member **6** when the component elements of the apparatus are in their inoperative position (see Fig. 5). As the lateral branch **7** of the movable member **6** is divided into two arms, the projection **17** of the push-member is also divided into two corresponding portions disposed on either side of a central portion **18**. This central portion comprises on the other hand a cavity adapted to receive a coil spring

19 bearing with one end against the aforesaid frame 15 and with its other end the push-member on the side of the branch 8 of the movable member.

As already set forth hereinabove the control members of the apparatus are inoperative in the position shown in Fig. 5. In fact, the spring 19 urges the push-member 14 and the latter acts through its projection 17 on the branch 8 of the movable member so as to tilt same about its trunnions 9. The disc 5 is thus lifted, so that the movable contact 10 is held away from the fixed contact 11. Of course, the disc in its normal position has its concavity on its lower face, that is, towards the fixed contact 11.

To close the cutout switch it is sufficient to move the push-member 14 in the direction to compress the spring 19, that is, to the left when considering the Figure 3. During this movement, the push-member engages through its projection 17 the two arms 7 of the movable member, thereby tilting the latter to the position in which the contacts 10 and 11 are closed. When the push-member 14 is pushed home against the spring 19 its projection 17 overlies the curved ends of the arms 7 of the movable member, suitable notches 20 being provided for receiving these arm ends. As the disc 5 is in its normal position and ensures a sufficient pressure between the contacts, this pressure is transmitted to the end of the arms 7 of the movable member which are thus held in the notches 20 of the push-member. Consequently, the latter is releasibly held in this position against the pressure of the compression spring 19 (see Fig. 3).

However, the locking action just described is of such nature that it is possible nevertheless to open the switch by moving the push-member in the opposite direction, that is, to the right when considering Figs. 3 to 5, the arms 7 being easily released from the notches 20 whereafter the projection 17 of the push-member engages the opposite branch 8 of the movable member to tilt same and move the contact 10 away from the fixed contact 11 (see Fig. 5).

This release of the arms 7 from the notches 20 occurs similarly but automatically when the curvature of the disc 5 is reversed by the heat developed by the Joule effect due to an overcurrent in the circuit. The minimum overcurrent value required to reverse the curvature of the disc 5 in a given time period may be pre-adjusted by means of the screw 13. When the disc is reversed the external annulus 5*a* thereof is raised and causes a snap movement of the movable contact 10 away from the fixed contact 11. The central portion 5*b* on the other hand tends to move very slightly downwards and as the disc does not exert any pressure on the arms 7 the spring 19 moves the push-member to the position shown in Fig. 4.

In this position the curvature of the disc 5 is still reversed, of course. The closing of the cutout switch will occur only when the disc has actually been reversed.

Now two different types of bimetallic discs may be used in this cutout switch:

(1) The so-called "thermostatic" discs which resume automatically their initial position when their temperature has fallen to a value approximating the ambient value;

(2) The so-called "non-thermostatic" discs which cannot resume their initial shape, even when the temperature has resumed its normal value, unless they are reversed by exerting a mechanical effort thereon.

Let us assume that the cutout switch of this invention is provided with a "thermostatic" disc. A few moments after its reversing, when the temperature of the disc has fallen to a sufficient degree, the disc will automatically resume its initial position. Nevertheless, the cutout switch remains in its open position (Fig. 5).

Now one of the essential advantageous features of the apparatus of this invention will become apparent; as the disc resumes automatically its initial shape or position, it will not reclose a circuit in which abnormal operating conditions still prevail. In fact, to reclose the circuit, the switch must be actuated by moving the push member 14 against the resistance of the spring 19. Thus, the user may actuate this push member after having eliminated the cause of trouble from the circuit.

Now let us assume that the cutout switch is equipped with a "non-thermostatic" disc. After a short-circuit, as the disc does not resume its initial shape when the ambient temperature is restored therein, a mechanical action must be applied to reset the disc. Now this action may be effected by the spring 19 itself.

Reference will now be made to Fig. 4 showing the apparatus after the release thereof due to an overcurrent in the circuit, and before the disc has cooled down to normal temperature.

The spring 19 in the open position of the device exerts a pressure through the medium of the push member 14 against the branch 8 of the movable member 6 and therefore against the central portion 5*b* of the disc. Now the portion of the annulus 5*a* which carries the movable contact 10 engages the corresponding portion of the insulating fixed wall 21. Thus, when the disc has cooled sufficiently the pressure of spring 19 is sufficient to reverse the curvature of the disc so that the latter resumes its initial shape.

If desired and without departing from the purpose of the invention it is also possible to provide a cutout switch wherein the bimetallic disc is reset not by the spring but by a voluntary manual or other action produced on the push-member 14 to strongly urge the projection 17 thereof against the branch 8 of the movable member 6. In this case, the spring 19 may be of relatively moderate force as the disc curvature is not reversed by the spring.

It may happen that, due to an accidental or faulty condition arising in the electrical circuit, the switch is reclosed on a short circuit. In this case the bimetallic disc would be under defective operating conditions. In fact, a normal operation of the disc would necessitate that the contacts 10, 11 be under a minimum pressure when an overcurrent occurs. Besides, this pressure must be adjusted to a well-defined value. This adjustment is normally effected by screwing in or out the micrometric screw 13. Consequently, it is evident that when the switch is closed the current begins to flow while the contacts are subjected but to a very low pressure differing very much from the adjustment pressure of the disc 5. Thus, under these conditions the breaking power of the disc is relatively reduced.

To avoid this inconvenience, the bimetallic disc or strip of any form equipping the apparatus may be provided with a suitably designed stop so mounted as to constantly keep the disc or strip under the requisite pressure and in the proper shape obtaining when the contacts are normally engaging each other during the closing of the apparatus.

In the case of a disc 5 as illustrated in this example the aforesaid stop consists of a transverse strip 22 which may be a metal strip. This strip is secured by its middle on the lower face of the central portion 5*b* of the disc and extends at right angles to the radius passing through the contact 10. Thus, this transverse strip will urge the sides of the annulus 5*a* of the disc upwards so that the latter will undergo a change in shape which is as pronounced as that to which it is subjected when it exerts the normal adjustment pressure on the contacts.

Thus, if the switch is closed during a short-circuit, the disc will already be in conditions very close to its optimum adjustment conditions when the current begins to flow therethrough. Therefore, the breaking power of the cutout is not impaired.

Preferably, the strip 22 is secured on the central portion 5*a* of the disc by the same rivet 23 which secures the lug 6*a* of the movable member, this rivet also fastening the flexible connection 24 from the centre 5*b* of the

disc to the terminal 3. According to a specific feature, this flexible connection 24, which may advantageously consist of a copper blade, is adapted to exert a spring-like action and causes through its curved shape the movable member to be urged in such a position that the contacts 10, 11 are held away from each other during the very short time required for the push member 14 to move from one position to the other position.

Of course, the apparatus of this invention is not limited to the embodiment illustrated and described herein, as many modifications may be brought thereto without departing from the spirit and scope of the invention as set forth in the appended claims.

What I claim is:

1. A cutout switch comprising an insulating case provided with an input terminal and an output terminal, a bimetallic current-responsive dished element of the curvature snap-reversing type which is connected to one of said terminals, a movable contact on said bimetallic element, a fixed contact provided in said case in front of said movable contact and connected to the other terminal, a tilting support pivoted in the case and supporting the said bimetallic element, a push-member slidably mounted in said case and adapted to actuate said support in one and the other direction, a spring urging said push member against said support on the side opposite to said movable contact of said bimetallic element, releasable locking means provided on said support and said push member respectively, said means being adapted when co-acting together on the one hand to keep said support in its tilted position with said movable contact engaging said fixed contact, and on the other hand to hold said push member against motion on the spring side, whereby said spring is held in its compressed condition.

2. A cutout switch comprising an insulating case provided with an input terminal and an output terminal, a bimetallic current-responsive dished element of the curvature snap-reversing type which is connected to the other terminal, a movable contact on said bimetallic element, a fixed contact in said case which registers with said movable contact and is connected to said other terminal, a tilting, substantially U-shaped support carrying said bimetallic element and having its branches bent on the side opposite to said bimetallic element, said bimetallic element being secured on one side of said support, the edge on the side opposite to said support comprising pivot means through which said support is pivoted on said case, a push member slidably mounted in said case to register with said support and on the same side as said bent branches, said push member being adapted to actuate either end of said support, a spring urging said push member in the direction of said first end of said support which is on the side opposite to said movable contact of said bimetallic element, locking means on said other end of said support and said push member respectively, said means being adapted when coacting together on the one hand to keep said support in its tilted position wherein the movable contact of said bimetallic element engages said fixed contact, and on the other hand to hold said push member against motion on the spring side, whereby said spring is held in its compressed condition.

3. Cutout switch as set forth in claim 2, wherein the other bent end of said support is notched to a U-shape,

the arms of the U surrounding the push member, the locking means provided on said end of the support and on said push member consisting on the one hand of a bent end portion formed on each arm of said end and on the other hand of a notch formed in said push member.

4. Cutout switch as set forth in claim 2, wherein said bimetallic element is connected to the corresponding terminal through a flexible conductor constituting a spring of moderate strength which constantly urges said movable contact of said bimetallic element away from said fixed contact.

5. Cutout switch as set forth in claim 2, comprising in addition in said case a partition of insulating material which registers with said movable contact of said bimetallic element on the side opposite to said fixed contact, said insulating partition being adapted to act as a stop for said movable contact when the curvature of said bimetallic element is reversed.

6. A cutout switch comprising an insulating case provided with an input terminal and an output terminal, a bimetallic current-responsive dished element adapted to have its curvature reversed when the current flowing therethrough exceeds a predetermined value, said bimetallic disc being connected to one of said terminals, a movable contact on the edge of one side of said bimetallic disc, a fixed contact in said case which registers with said movable contact and is connected to the other of said terminals, a U-shaped tilting support carrying said bimetallic disc by the centre of said disc, the branches of said U-shaped support being bent on the side opposite to said bimetallic disc, the edge of said support which is positioned on the side opposite to said movable contact of said bimetallic element carrying the pivot means through which said support is pivoted on said case, a push member slidably mounted in said case which registers with said support and is positioned on the same side as the bent end portions of said support, said push member being adapted to actuate either end of said support, a spring urging said push member in the direction of the first end of said support which is on the side opposite to said movable contact of said bimetallic disc, locking means provided on the other end of said support and on said push member respectively, said locking means being adapted when co-acting together on the one hand to hold said support in its tilted position wherein said movable contact of said bimetallic disc engages said fixed contact and on the other hand to hold said push member on the spring side, whereby said spring is held in its compressed condition.

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