

April 10, 1934.

W. H. FRANK ET AL

1,954,588

CIRCUIT BREAKER

Filed Sept. 9, 1932

2 Sheets-Sheet 1

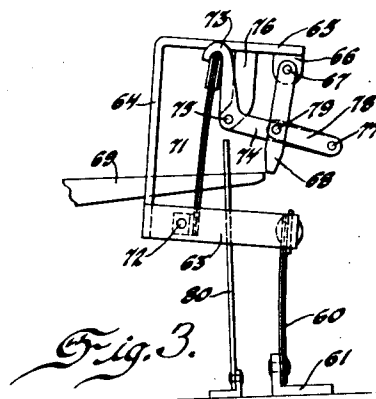
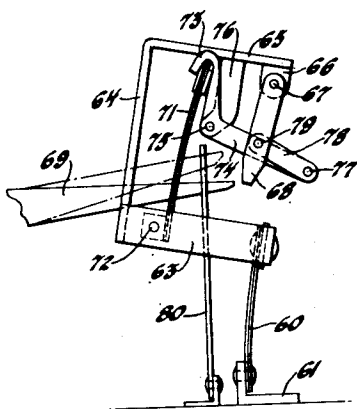
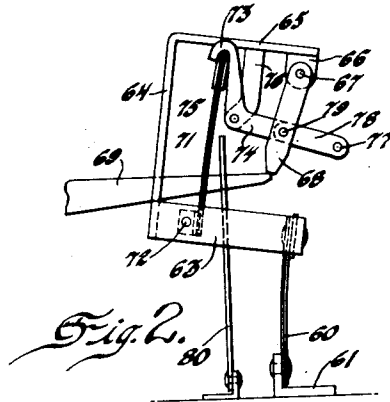
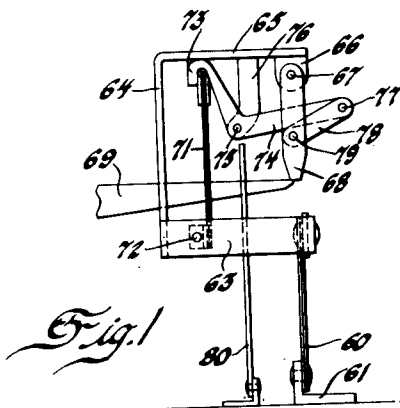


Fig. 4.

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2 Sheets-Sheet 2

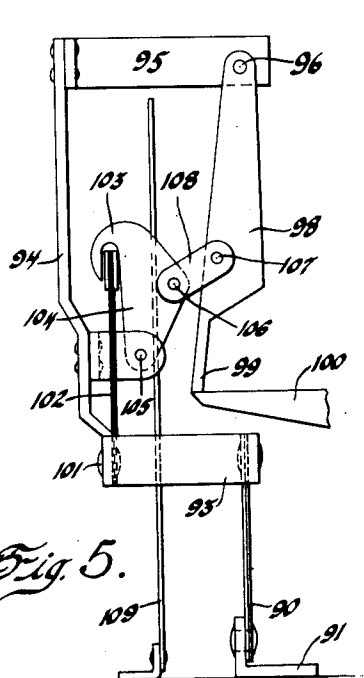


Fig. 5.

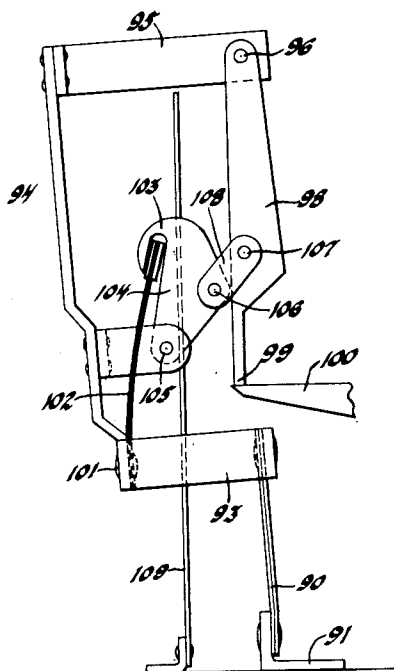


Fig. 6.

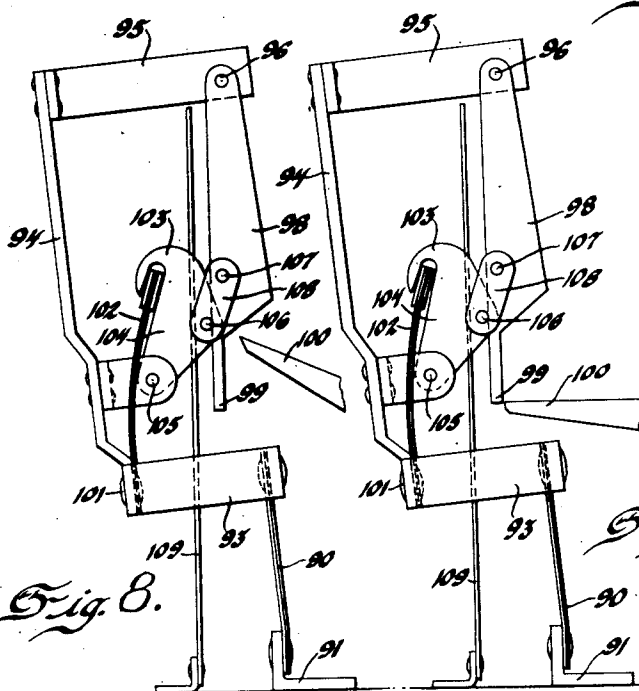


Fig. 8.

Fig. 7.

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CIRCUIT BREAKER

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Application September 9, 1932, Serial No. 632,284

23 Claims. (Cl. 200—116)

This invention relates to circuit interrupting devices commonly known as circuit breakers, and more particularly to holding means for the tripping levers of the same.

5 A well known form of circuit breaker has a tripping lever which forms a latch for the contact arm of the breaker, which tripping lever is normally held in untripped or closed circuit position by a bi-metallic or thermostatic holding element adapted to warp on overload to release the tripping lever and permit a breaker spring to move the contact arm for circuit breaking.

15 In the prior application Serial No. 614,362, filed May 31, 1932, by William H. Frank and Joseph Messing there are disclosed various improved holding elements of circuit breakers. The present application discloses other improved holding elements of circuit breakers.

20 In the present application there are disclosed means for providing a great movement of a trip lever holding part despite a slight movement of the warping or bi-metallic part.

25 One object of the invention is to provide a breaker having an ambient temperature compensation means, one which opposes tripping at low ambient temperature and which reverses itself to aid the tripping of the breaker at high ambient temperature.

30 Other objects of the invention will become apparent upon reference to the following detailed description of embodiments of the same and upon reference to the appended drawings showing such embodiments.

35 In these drawings. Figures 1-4 show a trip lever holding mechanism in four different positions corresponding respectively, to four different conditions; normal; slight increase in ambient temperature; greater increase in ambient temperature; and overload or short circuit, as well as great increase in ambient temperature.

40 Figures 5-8 are similar views of a second mechanism.

45 In Figs. 1-4 there is disclosed a holding device, constructed to trip on the advent of a high ambient temperature and also on overload, there being means for compensating for small increases in ambient temperature. In the construction of Figs. 1-4 the holding mechanism includes a bi-metallic thermal element or warping portion 60, preferably in the load circuit, and mounted on a conventional bracket 61. To the upper end of the element 60 is secured a frame part 63 having an upwardly projecting frame portion 64 and a horizontal frame portion 65 to whose lug 66 is

pivotaly connected at 67, a holding part 68, the tip of the latter engaging the end of the trip lever 69 to hold the same in untripped position. For compensating for temperature variations, a second bi-metallic part 71 is provided, and the same is secured to the frame part 63 by a screw or rivet 72. The upper end of part 71 is disposed within the hook part 73 of a bell crank 74 pivotally mounted at 75 on a lug 76 projecting downwardly from the frame part 65, the end of the bell crank, at 77, having a link 78 pivotally secured at 79 to the holding part 68.

The operation of this device is as follows: Under normal conditions the parts are in the condition of Fig. 1 with the holding part 68 holding trip lever 69. Upon a small rise in the ambient temperature the part 60 will warp to the right to move the frame in its entirety a few degrees clockwise from its normal position. The compensating bi-metallic part 71 also moves to the right, not only with the frame but also still further, independently of the frame, to move the hook end 73 upwardly in such a manner as to cause bell crank and linkage 74 and 78 to maintain the end of holding part 68 towards the left, in holding relation with the end of the trip lever 69, as disclosed in Fig. 2 this being the desired effect on a small ambient temperature rise, unaccompanied by an overload.

85 If the ambient temperature continues to rise beyond the safe range of rise, as in the case of a fire, the bell crank 74 will be moved downwardly by the warping of elements 60 and 71 and will pass the link 78, to assume the position of Fig. 3, thus tending to move holding part 68 to the right for trip lever release, all this taking place despite the fact that there is no overload to cause trip lever release.

95 When an overload occurs however, whether it be on high or low ambient temperature the part 60 will warp to the right to move the frame in its entirety, also to the right, as in Fig. 4, and the tip of holding part 68 will move to the right, with the frame. The holding element will therefore release trip lever 69, as is desired on overload.

100 It will be observed that in this embodiment a mica shield 80 is provided between the warping part 60 and the warping element 71 so as to prevent the latter from becoming affected by the heating of part 60 on overload.

110 It will be observed that the range of movement of the tip of holding element 68 is much greater than the range of movement of the tip of part 60, which corresponds to the range of movement

of the tips of holding elements of conventional embodiments. It will also be observed that the bell crank and linkage provides an amplified, faster, and more nearly positive movement for the holding part, than is provided in conventional devices.

In Figs. 5 to 8 there is disclosed a device which, in its major aspects, resembles the device in Figs. 1 to 4. The device of Figs. 5 to 8 includes a bi-metallic warping element 90 mounted on a bracket 91 and disposed in the load circuit. To the upper end of the element 90 is secured a horizontal frame part 93 which carries a vertical frame part 94 and another horizontal frame part 95 to which at 96 is pivoted a holding part 98, the latter having a tip 99 for engaging and holding the trip lever 100. Secured to the frame part 94 by rivets 101 is a second bi-metallic warping part 102 whose upper end is disposed within the hook 103 of a bell crank 104, the latter being pivoted at 105 to the frame.

Connecting bell crank 104 and holding part 98, and pivotally secured to both of them at 106—107 is a link 108. Between holding elements 90 and 102 is a mica shield 109.

The operation of the device is as follows:

Under normal conditions of load and temperature the parts are in the position of Fig. 5 with tip 99 holding lever 100. Upon a slight rise in temperature, the bi-metallic warping element 90 warps to the left carrying the frame with it a few degrees counter-clockwise. At the same time bi-metallic element 102 warps to the right and prevents part 98 from moving to the left, through the operation of the bell crank and linkage shown, as in Figure 6.

Upon a great rise in ambient temperature, as in case of a fire, part 102 moves far enough to the right so that pivot 106 passes beyond the line connecting pivots 105—107. This reverses the toggle action and starts to pull part 98 to the left for trip lever release, as in Figure 7, all this taking place without the occurrence of an overload.

When an overload occurs, however, (see Fig. 8) the part 90 warps to the left, due to the heating influence of such overload and carries the frame over to the left. Such movement of the frame, moves holding part 98 to the left for release of the trip lever. This construction is like that of Figs. 1-4 and possesses the same advantages and characteristics of that form.

Now having described the inventions and the several embodiments of the same, reference will be had to the following claims which determine the scope of the inventions, it being clearly understood that the same are not to be limited to the details disclosed.

What I claim is:

1. In a circuit control device, a bi-metallic warping element, a second bi-metallic warping element carried by the first, a holding element, also carried by the first warping element, a movement-amplifying means connecting the second warping element and the holding element, the first warping element being affected by load conditions, the second warping element being unaffected by load conditions.

2. In a circuit control device, a bi-metallic warping element, a second bi-metallic warping element carried by the first, a holding element, also carried by the first warping element, a movement-amplifying means connecting the second warping element and the holding element, the first warping element being affected by load con-

ditions, the second warping element being unaffected by load conditions, the second warping element, the holding element, and the means being part of a frame carried by the first warping element.

3. A circuit controller comprising relatively independently operating, thermally responsive elements, one of which carries the other and is arranged to be affected by load conditions to a greater extent than the other, said thermally responsive elements being arranged to produce no circuit opening effect on a slight rise in ambient temperature, and to produce a circuit opening effect on a greater rise in ambient temperature and also on the arising of an overload.

4. A circuit control device having circuit controlling means arranged to maintain the circuit closed despite a slight increase in ambient temperature, and arranged to open the circuit on a greater rise in ambient temperature or on the arising of an overload, the holding means including movement-amplifying means.

5. In a circuit control device, circuit controlling means including relatively independently operating, thermally responsive movable elements, one of which carries the other and is affected by circuit conditions to a greater extent than the other, said means being arranged to maintain the circuit closed despite a slight rise in ambient temperature, and to open the circuit on a greater rise in ambient temperature or on the arising of an overload.

6. In a circuit control device, circuit controlling means including relatively independently operating, thermally responsive movable elements, one of which carries the other and is affected by circuit conditions to a greater extent than the other, said means being arranged to maintain the circuit closed despite a slight rise in ambient temperature, and to open the circuit on a greater rise in ambient temperature or on the arising of an overload, the holding means including movement-amplifying means.

7. In a circuit control device, thermally responsive elements, one of which is operatively connected to the controlled circuit so as to be affected by conditions thereof, and the other of which is unaffected by circuit conditions and is arranged to act as an ambient temperature compensating means for the former element, and a holding and release part operatively connected to said device, by a connection which has a reversing action of such a nature that the movements of the elements tend to neutralize each other, for ambient temperature compensation, during normal ranges of the circuit conditions and of ambient temperature conditions, and tend to enhance each other during abnormal ranges of the circuit conditions and of ambient temperature conditions, the movements of the elements, when neutralizing each other, causing said part to hold, and when enhancing each other, causing said part to release.

8. In a circuit control device, thermally responsive elements, one of which is operatively connected to the controlled circuit so as to be affected by conditions thereof, and the other of which is unaffected by circuit conditions and is arranged to act as an ambient temperature compensating means for the former element, and a holding and release part operatively connected to said device by a connection including movement-amplifying means and which has a reversing action of such a nature that the movements of the elements tend to neutralize each other, for

ambient temperature compensation, during normal ranges of the circuit conditions and of ambient temperature conditions and tend to enhance each other during abnormal ranges of the circuit conditions and of the ambient temperature conditions, the movements, when neutralizing each other, causing said part to hold, and when enhancing each other, causing said part to release.

9. In a circuit control device, thermally responsive elements, one of which is operatively connected to the controlled circuit so as to be affected by conditions thereof, and the other of which is unaffected by circuit conditions and is arranged to act as an ambient temperature compensating means for the former element, and a holding and release part operatively connected to said device by a connection including mechanical, movement-amplifying means and which has a reversing action of such a nature that the movements of the elements tend to neutralize each other, for ambient temperature compensation, during normal ranges of the circuit conditions and of ambient temperature conditions and tend to enhance each other during abnormal ranges of the circuit conditions and of the ambient temperature conditions, the movements, when neutralizing each other, causing said part to hold, and when enhancing each other, causing said part to release.

10. In a circuit control device, a part to be held or released, holding means therefor including relatively independently operating, thermally responsive movable elements, and an over-center linkage operatively connecting said part to said holding means, the linkage producing different connection actions on opposite sides of the operating center thereof.

11. In a circuit control device, a part to be held or released, holding means therefor including relatively independently operating, thermally responsive movable elements, and an over-center linkage operatively connecting said part to said holding means, the linkage producing different connection actions on opposite sides of the operating center thereof, whereby the elements enhance each other during one set of conditions and oppose each other during another set of conditions.

12. In a circuit control device, a part to be held or released, holding means therefor including relatively independently operating, thermally responsive movable elements, and an over-center linkage operatively connecting said part to said holding means, the linkage producing different connection actions on opposite sides of the operating center thereof, one of said elements being carried by the other.

13. In a circuit control device, a part to be held or released, holding means therefor including relatively independently operating, thermally responsive movable elements, and an over-center linkage operatively connecting said part to said holding means, the linkage producing different connection actions on opposite sides of the operating center thereof, whereby the elements enhance each other during one set of conditions and oppose each other during another set of conditions, one of said elements being carried by the other.

14. A circuit controller comprising relatively independently operating, thermally responsive elements, one of which carries the other and is arranged to be affected by load conditions to a greater extent than the other, said thermally re-

sponsive elements being arranged to produce no circuit opening effect on a slight rise in ambient temperature, and to produce a circuit opening effect on a greater rise in ambient temperature and also on the arising of an overload, said controller including an overcenter linkage which provides different actions for said controller on opposite sides of the operating center of the linkage.

15. In a circuit control device, sets of thermally responsive circuit controlling means, arranged so that one is less powerfully affected by the condition of the controlled circuit than the other, and is arranged to act as an ambient temperature compensating means for the other, means providing a reversing action for the sets of such a nature that the movements of the sets tend to neutralize each other, for ambient temperature compensation, during normal ranges of the circuit conditions and of ambient temperature conditions, and tend to enhance each other during abnormal ranges of the circuit conditions and of ambient temperature conditions, the movements of the elements when neutralizing each other, maintaining the circuit closed, and when enhancing each other, opening the circuit.

16. In a circuit control device, sets of thermally responsive circuit controlling means, arranged so that one is less powerfully affected by the condition of the controlled circuit than the other, and is arranged to act as an ambient temperature compensating means for the other, movement amplifying means providing a reversing action for the sets of such a nature that the movement of the sets tend to neutralize each other, for ambient temperature compensation, during normal ranges of the circuit conditions and of ambient temperature conditions, and tend to enhance each other during abnormal ranges of the circuit conditions and of ambient temperature conditions, the movements of the elements when neutralizing each other, maintaining the circuit closed, and when enhancing each other, opening the circuit.

17. In a circuit control device, sets of thermally responsive circuit controlling means, arranged so that one is less powerfully affected by the condition of the controlled circuit, than the other, and is arranged to act as an ambient temperature compensating means for the other, mechanical movement amplifying means providing a reversing action for the sets of such a nature that the movements of the sets tend to neutralize each other, for ambient temperature compensation, during normal ranges of the circuit conditions and of ambient temperature conditions, and tend to enhance each other during abnormal ranges of the circuit conditions and of ambient temperature conditions, the movements of the elements when neutralizing each other, maintaining the circuit closed, and when enhancing each other opening the circuit.

18. In a circuit control device, sets of thermally responsive circuit controlling means arranged so that one is carried by and is less powerfully affected by the condition of the controlled circuit, than the other, and is arranged to act as an ambient temperature compensating means for the other, means providing a reversing action for the sets of such a nature that the movements of the sets tend to neutralize each other, for ambient temperature compensation, during normal ranges of the circuit conditions and of ambient temperature conditions, and tend to enhance each other during abnormal ranges of the circuit conditions and of ambient temperature conditions, the movements of the elements when

neutralizing each other, maintaining the circuit closed, and when enhancing each other, opening the circuit.

19. In a circuit control device sets of thermally responsive circuit controlling means arranged so that one is carried by and is less powerfully affected by the condition of the controlled circuit, than the other, and is arranged to act as an ambient temperature compensating means for the other, movement amplifying means providing a reversing action for the sets of such a nature that the movements of the sets tend to neutralize each other, for ambient temperature compensation, during normal ranges of the circuit conditions and of ambient temperature conditions, and tend to enhance each other during abnormal ranges of the circuit conditions and of ambient temperature conditions, the movements of the elements when neutralizing each other, maintaining the circuit closed, and when enhancing each other, opening the circuit.

20. In a circuit control device sets of thermally responsive circuit controlling means arranged so that one is carried by and is less powerfully affected by the condition of the controlled circuit, than the other, and is arranged to act as an ambient temperature compensating means for the other, mechanical movement amplifying means providing a reversing action for the sets of such a nature that the movements of the sets tend to neutralize each other, for ambient temperature compensation, during normal ranges of the circuit conditions and of ambient temperature conditions, and tend to enhance each other

during abnormal ranges of the circuit conditions and of ambient temperature conditions, the movements of the elements when neutralizing each other, maintaining the circuit closed, and when enhancing each other, opening the circuit.

21. A circuit controller comprising relatively independently-operating sets of thermally responsive, movable means, and including an over-center linkage which provides different actions for said circuit controller on opposite sides of the operating center of the linkage.

22. A circuit controller comprising relatively independently-operating sets of thermally responsive, movable means, and including an over-center linkage which provides different actions for said circuit controller on opposite sides of the operating center of the linkage, whereby the sets enhance each other during one set of conditions, and oppose each other during another set of conditions.

23. A circuit controller comprising relatively independently-operating sets of thermally responsive, movable means, and including an over-center linkage which provides different actions for said circuit controller on opposite sides of the operating center of the linkage, whereby the sets enhance each other during one set of conditions, and oppose each other during another set of conditions, one of the sets carrying, and being more powerfully affected by the conditions of the controlled circuit, than the other.

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