Aug. 7, 1945. H. LANGSTROTH 2,381,294

CIRCUIT BREAKER

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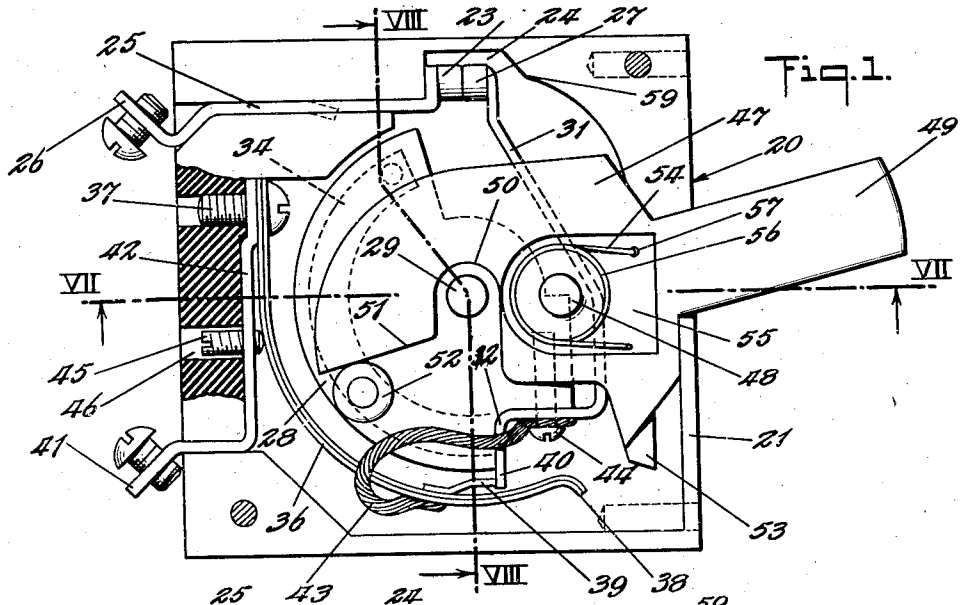


Fig. 1.

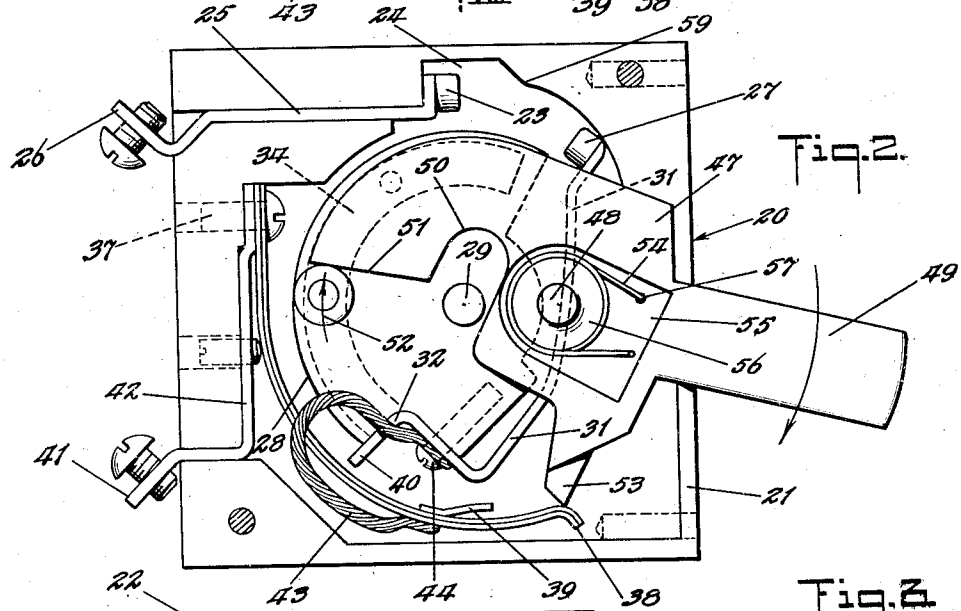


Fig. 2.

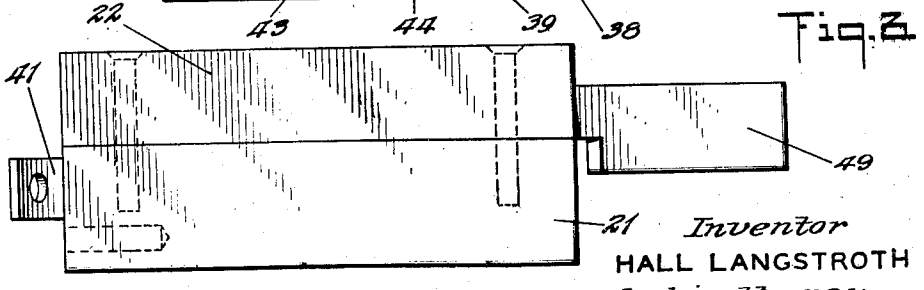


Fig. 3.

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Fig. 4.

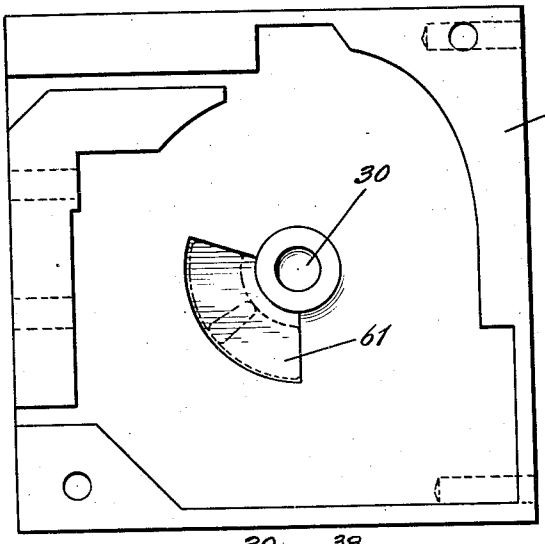


Fig. 5.

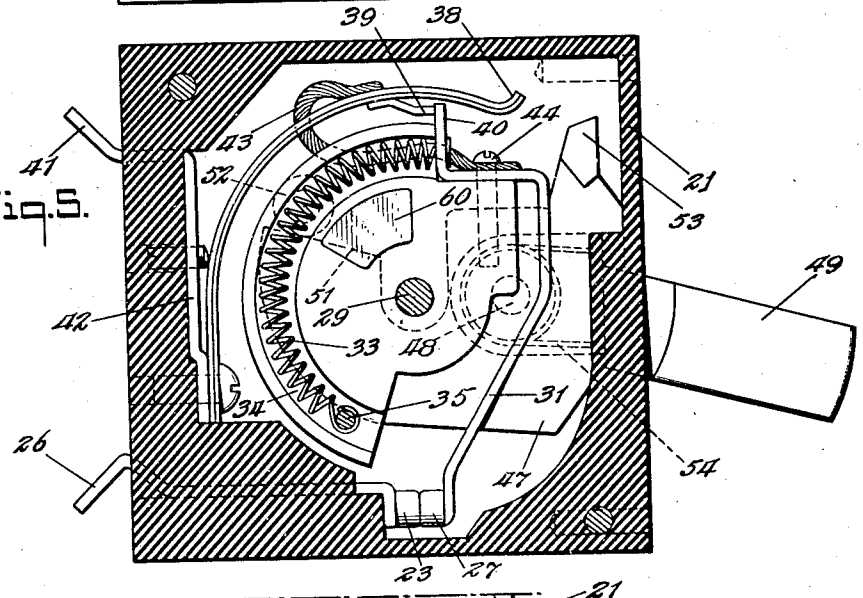
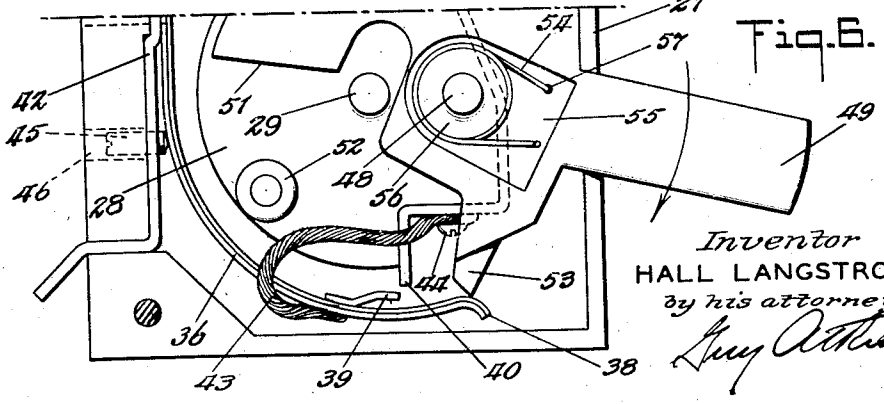


Fig. 6.



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Fig. 2.

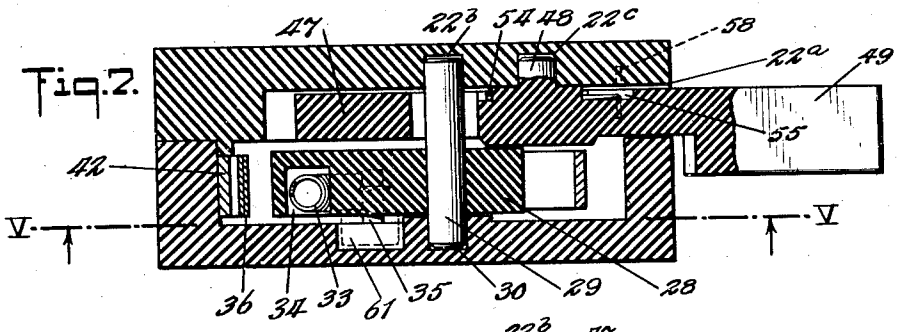


Fig. 8.

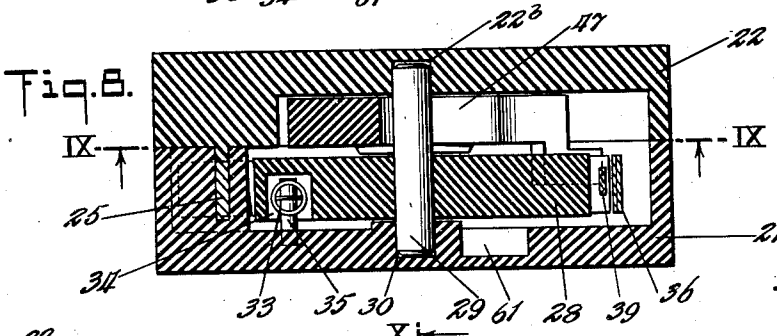


Fig. 10.

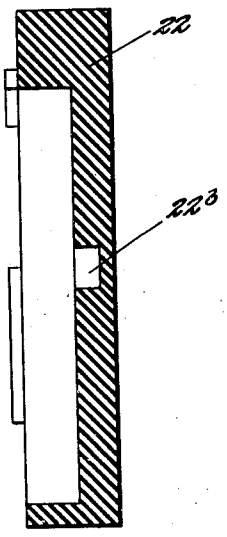
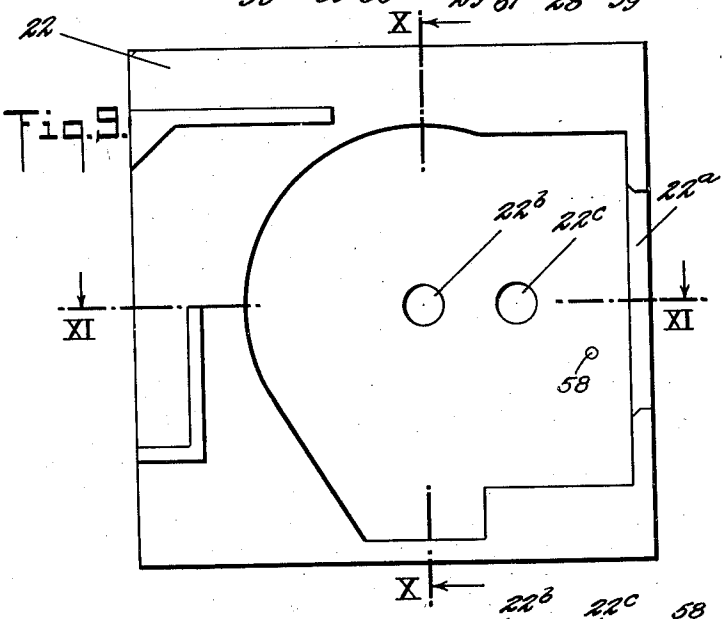


Fig. 9.



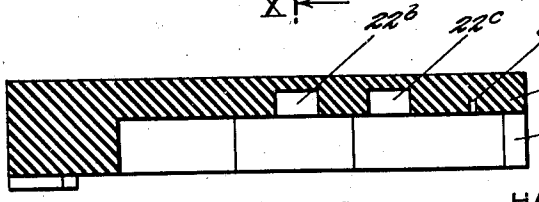


Fig. 11.

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Patented Aug. 7, 1945 2,381,294

UNITED STATES PATENT OFFICE

2,381,294

CIRCUIT BREAKER

Hall Langstroth, Greenwich, Conn., assignor to Maguire Industries, Incorporated, a corporation of New York

Application April 13, 1943, Serial No. 482,843

10 Claims. (Cl. 200—116)

My invention relates to a circuit breaker, and more particularly to a small circuit breaker having manually operated reset and release mechanism, together with automatically operated release mechanism. The invention is particularly useful in its application to automotive units, especially airplanes, to which use, however, it is not restricted.

One object of the invention is to provide a small, compact circuit breaker which may be conveniently mounted at points where little space is available. Another object is the provision of such a circuit breaker which may be operated to break the circuit either by an overload or conveniently by hand, and which may be reset by hand with equal ease and convenience. Still another object is the provision of a mounting for a movable contact in such form that relative movement may be effected between the mounting and the contact without pivoted or sliding parts. A further object is the provision of such a small, compact circuit breaker which may be held in circuit closing position by hand. Still a further object is the provision of such a circuit breaker wherein the operating handle has but two positions, whereby it will be obvious at a glance whether the contacts are in open or closed position. Other objects of the invention will be apparent upon consideration of the present specification.

One form of the invention is illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of a circuit breaker constructed in accordance with the invention, one part of the casing being removed to show the mechanism, and the elements being shown in circuit closing position,

Fig. 2 is a view similar to Figure 1, showing the elements in open circuit position,

Fig. 3 shows the circuit breaker as seen from below, the casing being assembled and the handle being shown,

Fig. 4 is an elevation similar to Figure 1, the operating elements of the circuit breaker being removed from the casing,

Fig. 5 is a cross section taken on the line V—V of Fig. 7, the elements being shown in circuit closing position,

Fig. 6 is a fragmental view similar to Figure 1, the elements being shown at the moment the circuit breaker is tripped by hand,

Fig. 7 is a horizontal mid-section of the circuit breaker taken on the line VII—VII of Figure 1,

Fig. 8 is a vertical section taken on the line VIII—VIII of Figure 1,

Fig. 9 shows the interior of the casing with all operating elements removed, as viewed on the line IX—IX of Fig. 8,

Fig. 10 is a vertical mid-section taken on the line X—X of Fig. 9, and

Fig. 11 is a horizontal mid-section taken on the line XI—XI of Fig. 9.

An important problem in designing a circuit breaker is that of providing a breaker in such sturdy form that it may be used with confidence for a variety of purposes when made in a variety of sizes. Another important problem is that of providing such a breaker which may be tripped with minimum force to give a quick break, and which will maintain full contact pressure up to the time of breaking. I have found that such results may be obtained if butt engagement is made between the contacts, under pressure, and if substantially frictionless multiplication of the resetting or tripping force is effected, which is advantageous in a small breaker.

The particular embodiment of the invention illustrated in the drawings shows a two part casing **20** in which all of the operating parts are inclosed. Thus, the entire assembly may be fitted together in a containing part **21** of the casing with only certain elements projecting therefrom. A cover **22**, complementary to the containing part **21**, completes the casing, and provides an opening **22a** and sockets **22b** and **22c** to accommodate certain parts, as will be subsequently explained.

A stationary contact **23** is fixed in a recess **24** in the containing part **21** of the casing, and is connected by a lead **25** to a terminal **26** outside of the casing. As here shown, the lead **25** and the terminal **26** are unitary, but such is not necessarily the case.

A movable contact **27** is also contained within the casing **20**, and when in closed circuit position, meets the fixed contact **23** in butt engagement where it is held in position under pressure. The movable contact **27** is carried by a support, here shown as a rotor **28** pivoted in the casing. The rotor **28** is formed of insulating material and has a pivot or stem **29** extending on either side thereof. The stem **29** is journaled at one end in the socket **22b** in the cover **22**, and at the other end in a socket **30** in the containing part **21**. Thus the rotor is free to turn about its pivot **29** within the casing **20**.

The movable contact is carried by one end of a resilient metal arm **31**, the other end of which is

bent to form an angle 32 which is firmly held in a recess formed in the support or rotor 28. In consequence of this arrangement, when the rotor 28 is turned in contraclockwise direction, as viewed in Figs. 1 and 2, face-to-face meeting or butt engagement is made between the contact 23 and 27. If the rotor 28 is turned through a greater angular distance than the contact 27, then by reason of the flexibility or resilience of the arm 31, engagement of the contacts is made under pressure. Thus relative movement is possible between the movable contact 27 and the rotor 28 without the use of pivoted or sliding connection between the movable contact and the rotor.

Means is provided for normally urging the rotor in a clockwise direction as viewed in Figs. 1 and 2: that is to say, into open circuit position. In the embodiment here shown this means comprises a tension spring 33 housed in an arc-shaped channel 34 in the rotor 28. One end of the spring 33 is attached to the rotor adjacent the angle 32. The other end of the spring is attached to a post 35 fixed to the containing part 21 of the casing 20. Thus the spring 33 always tends to move the rotor into open circuit position, as illustrated in Fig. 2.

Releasable means is also provided for holding the movable contact in circuit closing position. As shown in the drawings this means comprises a bi-metal strip 36 fastened at one end in the containing part 21 of the casing as by a screw 37. This bi-metal strip curves around the rotor and its free end 38 extends beyond the angle 32 formed on the arm 31, in all positions of the rotor. A leaf spring 39 is fixed to the inside of the curved bi-metal strip 36 in a position to engage an end 40 of the arm 31 which projects beyond the rotor from the point 32 at which the arm 31 is attached to the rotor. Thus, as the rotor is turned to bring the contacts into circuit closing position, the end 40 rides over the leaf spring 39 bowing the resilient bi-metal strip 36 slightly away from the rotor. After the contacts 23 and 27 have been closed, the rotor continues to turn until the end 40 passes beyond the spring 39, whereupon the resiliency of the bi-metal strip 36 brings the spring 39 up behind the end 40 to hold the rotor in circuit closing position. (See Figure 1.)

The circuit passes through the bi-metal strip 36 from a terminal 41 outside of the casing, through a lead 42 which passes into the containing part 21 of the casing and is connected to the bi-metal strip 36 at the screw 37. A pigtail 43 is attached at one end to the bi-metal strip, preferably adjacent the leaf spring 39, as shown in the drawings, and is also attached at the other end to the resilient metal arm 31 near the angle 32. As shown in Figs. 1, 2, 5 and 6, a screw 44 attaches the pigtail 43 to the arm 31, and at the same time attaches the arm 31 to the rotor 28. Obviously other means might be employed for this purpose.

Operation of the apparatus as so far described is as follows: With the elements in the position shown in Figure 1, current passes from the terminal 41, through the lead 42 to the bi-metal strip 36, thence through the pigtail 43 to the arm 31 to the contact 27, to the contact 23, the lead 25 and the terminal 26.

The bi-metal strip 36 is so constructed that the rotor will be held in the position illustrated in Figure 1, against the action of the spring 33, for all ordinary loads. An overload upon the circuit, however, will tend to straighten the bi-metal strip, according to well-known principles the metal having the greater coefficient of expansion being positioned on the inside of the bi-metal strip. As this straightening occurs, the leaf spring 39 will be moved out of engagement with the end 40, whereupon the spring 33 will snap the rotor into open circuit position.

Means is provided for adjusting the action of the bi-metal strip 36. In the embodiment illustrated a set screw 45 is disposed in a channel 46 in the containing part 21 of the casing 20, and is threaded through the lead 42 to bear against the outer face of the bi-metal strip 36. Accordingly the circuit may pass from the lead 42 to the bi-metal strip 36 through the set screw 45 thereby shortening the length of the bi-metal strip subject to overload heat. Furthermore, the distance of the bi-metal strip from the rotor may be affected by pressure of the set screw 45. Finally, distortion of the bi-metal strip will be effected beyond the point of contact with the set screw instead of beyond the screw 37, when pressure is applied to the bi-metal strip by the set screw. Thus a simple and effective means of calibration is provided.

The invention also contemplates manually operable means for releasing the releasable means, as well as for moving the contacts into circuit closing position and for holding them there. In the illustrative embodiment shown in the drawings, there is employed a lever 47 of insulating material pivoted in the socket 22c by means of a nipple 48 formed thereon, and resting on its opposite side against the rotor 28 and the containing part 21, all as best shown in Fig. 7. The lever 47 has a handle 49 formed thereon which extends through the opening 22a outside of the casing. The lever is cut away, as at 50, so that it may operate in all positions without interference with the pivot or stem upon which the rotor 28 turns.

A cam surface 51 is formed upon the lever 47 on the opposite end thereof from the handle 49. This cam surface coacts with a roller 52 pivotally mounted upon the rotor 28 to turn the rotor into circuit closing position as the handle is moved from the position shown in Fig. 2 to that shown in Figure 1. The cam surface and roller contact makes it possible to close the circuit by means of the lever 47 substantially without friction.

A projection 53 is formed on the lever 47 in a position to engage the free end 38 of the bi-metal strip 36 and move the bi-metal strip away from the rotor. Thus, by moving the handle 49 from the position shown in Figure 1 to that shown in Fig. 2, the rotor may be released by hand, and the contacts brought into open circuit position through the action of the rotor spring 33. Fig. 6 shows the elements at the instant of tripping by means of the lever 47. If the breaker is tripped by an overload which distorts the bi-metal strip 36 and thereby disengages the leaf spring 39 from the end 40, the roller 52 acting against the cam surface 51 turns the lever into the position shown in Fig. 2. Whether the circuit is broken by hand or by overload, the projection 53 engages the end 38, as shown in Fig. 2, and holds the bi-metal strip 36 away from the rotor 28. The circuit breaker cannot then be reset in closed circuit position until the lever 47 is moved by means of the handle 49.

In order to maintain the lever 47 in closed circuit position (Figure 1) a spring 54 is employed. This spring is disposed in a depression 55 formed in the lever 47, and is spirally wound about a boss

56 formed in the depression concentric with the nipple 48. One end of the spring 54 is turned at a right angle and positioned in a hole 57 in the lever 47. The other end of the spring is turned in the opposite direction and positioned in a hole 58 in the cover 22. The force exerted by the spring tends to keep the lever in circuit closing position. However, this force is insufficient to overcome the force of the rotor spring 33, and merely prevents displacement of the lever by vibration or unintentional slight force upon the handle.

As the rotor is moved from open circuit position to closed circuit position the contact 27 is held momentarily by a hump 59 extending from the interior wall of the containing part 21 into its path. As the handle 49 continues to move toward closed circuit position, tension on the resilient arm 31 is increased until the movable contact 27 snaps over the hump and makes quick contact. Movement in the opposite direction, to open the circuit, is effected very quickly by the tension of the rotor spring 33, as engagement of the end 40 by the leaf spring 39 is released. The contacts are opened instantly, and the hump 59 does not appreciably retard the movable contact 27 in reaching full open circuit position. The hump 59 may, of course, be given a variety of forms. It is here illustrated rather diagrammatically because different operating requirements may call for different hump contours.

In order to prevent the rotor 28 from exceeding the desired angular travel a unitary segmental boss 60 is formed on its face farthest from the lever 47. A fan shaped trough 61 is formed in the inner surface of the containing part 21 to accommodate the segmental boss when the rotor is in place. The angular length of the trough is equal to the angular length of the boss 60 plus the angular distance which the rotor travels from open circuit to closed circuit position. The boss and trough are so positioned that the rotor is stopped in closed circuit position and in the desired open circuit position, and undue oscillations or straining of the rotor spring 33 do not occur.

A circuit breaker constructed in accordance with the invention may be constructed in small and compact form, and may then be easily mounted where limited space is available. In fact, because of the size of such small circuit breakers a number of such circuit breakers may be mounted side by side on a panel board and may be operated simultaneously by hand with ease and convenience. Furthermore, the bi-metal overload trip permits use of the circuit breaker with either A. C. or D. C. Still further, such circuit breakers are sturdy and may be used for a variety of purposes and may be constructed in a variety of sizes. Finally, minimum force is required to trip or reset this circuit breaker.

The particular form of the invention here described and illustrated in the accompanying drawings is presented merely as an example of how the invention may be applied. Other forms, embodiments and applications of the invention, coming within the proper scope of the appended claims, will readily suggest themselves to those skilled in the circuit breaker art.

I claim:

1. In a circuit breaker, a fixed contact, a pivotally mounted movable contact for engaging said fixed contact, means for normally urging said movable contact into open circuit position, releasable means for holding said movable contact in circuit closing position, a separately pivoted manually operable member unconnected with the mounting of said movable contact for moving said movable contact into circuit closing position, and means for releasing said releasable means.

2. In a circuit breaker, a fixed contact, a pivotally mounted movable contact for engaging said fixed contact, means for normally urging said movable contact into open circuit position, releasable means for holding said movable contact in circuit closing position, a separately pivoted manually operable lever unconnected with the mounting of said movable contact movable in one direction to move said movable contact into circuit closing position and movable in the opposite direction to release said releasable means, and heat responsive means for releasing said releasable means.

3. In a circuit breaker, a fixed contact, a pivotally mounted movable contact for engaging said fixed contact, a spring for normally urging said movable contact into open circuit position, a second spring for holding said movable contact in circuit closing position, a separately pivoted manually operable lever unconnected with the mounting of said movable contact for moving said movable contact into circuit closing and open circuit position, and a bi-metal element in circuit with said movable contact for releasing said second spring and thereby releasing said movable contact from circuit closing position.

4. In a circuit breaker, a casing, a contact fixed in said casing, a rotor pivoted in said casing, a roller eccentrically pivoted to said rotor, a second contact fixed to said rotor adapted to engage said fixed contact, and a manually operable lever separately pivoted in said casing for moving said rotor into circuit closing position, a face of said lever being positioned to contact said roller for so moving said rotor.

5. A circuit breaker comprising a casing, a contact fixed in said casing, a rotor pivoted in said casing, a second contact fixed to said rotor adapted to engage said fixed contact, means for normally urging said rotor into open circuit position, releasable means for holding said rotor in circuit closing position, a manually operable member separately pivoted in said casing and unconnected with the mounting of said rotor for moving said rotor into circuit closing position, and means for releasing said releasable means.

6. A circuit breaker comprising a casing, a contact fixed in said casing, a rotor pivoted in said casing, a second contact fixed to said rotor adapted to engage said fixed contact, means for normally urging said rotor into open circuit position, releasable means for holding said rotor in circuit closing position, a manually operable member separately pivoted in said casing and unconnected with the mounting of said rotor for moving said rotor into circuit closing position, and bi-metal means for releasing said releasable means.

7. A circuit breaker comprising a casing, a contact fixed in said casing, a rotor pivoted in said casing, a second contact fixed to said rotor adapted to engage said fixed contact, means for normally urging said rotor into open circuit position, releasable means for holding said rotor in circuit closing position, and a manually operable member separately pivoted in said casing unconnected with said rotor movable in one direction to move said rotor into circuit closing position and movable in the opposite direction to release said releasable means.

8. A circuit breaker comprising a casing, a contact fixed in said casing, a rotor pivoted in said casing, a second contact fixed to said rotor adapted to engage said fixed contact, means for normally urging said rotor into open circuit position, releasable means for holding said rotor in circuit closing position, heat-responsive means for releasing said releasable means, and a manually operable member separately pivoted in said casing movable in one direction to move said rotor into circuit closing position and movable in the opposite direction to release said releasable means.

9. A circuit breaker comprising a casing, a contact fixed in said casing, a rotor pivoted in said casing, a second contact fixed to said rotor adapted to engage said fixed contact, a spring for normally urging said rotor into open circuit position, a second spring for releasably holding said rotor in circuit closing position, a heat-responsive metal strip for releasing said second spring, and a manually operable member separately pivoted in said casing movable in one direction to move said rotor into circuit closing position and movable in the opposite direction to release said second spring.

10. A circuit breaker comprising a casing formed of insulating material, a contact fixed in said casing, a rotor formed of insulating material pivoted in said casing, a second contact fixed to said rotor adapted to engage said fixed contact, a spring for normally urging said rotor into open circuit position, a second spring for releasably holding said rotor in circuit closing position, a bi-metal element included in the circuit when said circuit is closed for releasing said second spring, and a manually operable lever formed of insulating material separately pivoted in said casing movable in one direction to turn said rotor into circuit closing position and movable in the opposite direction to release said second spring, substantially as described.

HALL LANGSTROTH.