Sept. 8, 1936. W. A. ATWOOD 2,053,934

CIRCUIT BREAKER

Filed July 2, 1935

Fig. 1.

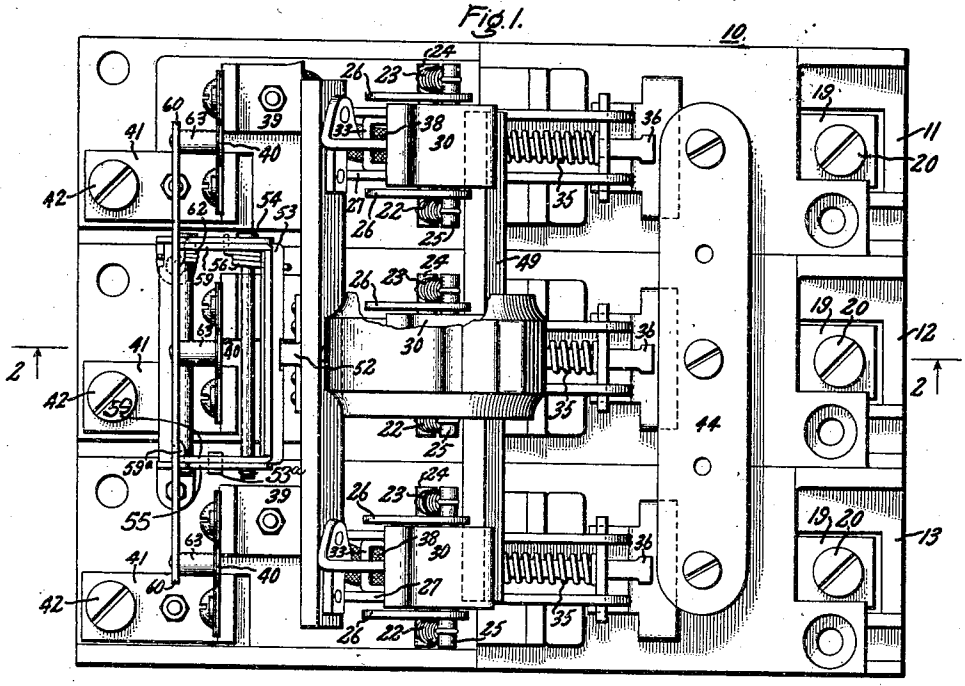
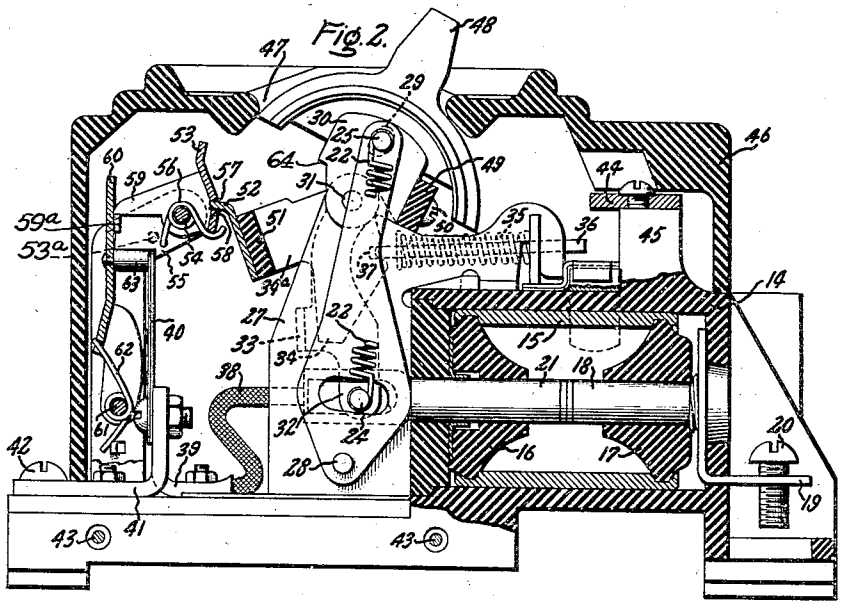


Fig. 2.



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CIRCUIT BREAKER

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6 Claims. (Cl. 200—116)

My invention relates to multi-pole circuit breakers, more particularly to multi-pole circuit breakers of the trip-free type in which the circuit controlling contacts are manually operable between open and closed circuit positions and are automatically operable to the open circuit position upon the occurrence of predetermined abnormal current conditions, and has for an object the provision of a simple, reliable and inexpensive circuit breaker of this character.

As is well known, present manufacturing methods are so adapted to large quantity production that the manufacturing cost per item decreases as the quantity of production increases. For obvious reasons the demand for single-pole circuit breakers is considerably greater than the demand for multi-pole circuit breakers, and consequently, the cost of the single-pole circuit breaker parts is comparatively low. In order to decrease the cost of multi-pole circuit breakers, it has heretofore been proposed to construct such circuit breakers by using, insofar as possible, the same parts as are used in constructing single-pole circuit breakers. In all cases with which I am familiar, however, resort has been had to arrangements in which a single, rugged operating mechanism is arranged simultaneously to operate the contacts of the individual poles by means of a common crossbar connected to the contacts of each pole, and the single, rugged mechanism is provided with tripping means for operating the crossbar to open the contacts upon the occurrence of overload conditions. Although such an arrangement has many advantages when applied to large size circuit breakers, I have found it unsuitable for small size circuit breakers of certain types.

In my copending application Ser. No. 667,855, filed April 25, 1933, entitled "Circuit breakers" and in the copending application of Ludwig S. Walle Ser. No. 667,856, filed April 25, 1933, entitled "Circuit breakers," both of which applications are assigned to the same assignee as the present invention, circuit breakers are disclosed which depend to a large extent on the self-generation of high gas pressures within a sealed compression chamber for the successful interruption of currents of short-circuit magnitude. In these circuit breakers, the contacts move within the compression chamber, and the high gas pressures are of course applied to the face of the movable contact and exert upon it an accelerating force of great magnitude. Since the pressure developed within the compression chamber may be as high as 5000 lbs. per square inch, it will be appreciated that the force exerted on the movable contact will be of such magnitude as to drive the movable contact to the open circuit position at a high speed. In fact, as pointed out in my above referred to application, it has been found advisable to provide a special type of frame for absorbing the blow incident to the expulsion of the movable contact from the compression chamber by the pressure generated therein.

If the above referred to arrangement for constructing multi-pole circuit breakers from single-pole circuit breaker parts is utilized to construct small size circuit breakers of the compression chamber type, i. e. 10 to 100 amperes, the cost is prohibitive, due to the necessity of specially designing the single operating mechanism to withstand the forces developed and to meet the space requirements. Furthermore, when the contacts are connected directly to a common crossbar, as described above, the force exerted on the crossbar, when the movable contact of one pole is expelled by the high pressures generated within the compression chamber, will often twist the crossarm laterally to such an extent as to prevent the opening of the other poles of the circuit breaker. Accordingly, much is yet to be desired in small size multi-pole circuit breakers of this type, and it is a further object of my invention to provide a multi-pole circuit breaker of the compression chamber type which is constructed substantially entirely of single-pole circuit breaker parts, which is economical to construct and which is efficient and reliable in its operation.

In carrying out my invention in one form, I provide a multi-pole circuit breaker, each pole of which comprises a single-pole circuit breaker unit having a movable contact resiliently connected to an operating member for operation between open and closed circuit positions, the resilient connection providing for operation of the contact to its open circuit position irrespective of the position of the operating member. Each single-pole unit also includes a current-responsive element and tripping means releasable to operate the movable contact to open circuit position. In order to provide for simultaneous opening and closing of all of the poles of the circuit breaker, I provide a rigid crossbar connected to the respective operating members of the single-pole units and a rigid crossbar connected to the tripping means of each unit, the last-mentioned crossbar being provided with a latch which is operable by the current-responsive elements of one or more of the single-pole units to release the crossbar whereby the tripping means connected thereto operate the contacts to the open circuit position upon the occurrence of overload conditions.

For a more complete understanding of my invention, reference may now be had to the drawing in which Fig. 1 is a plan view of a three-pole circuit breaker embodying my invention, the cover of the circuit breaker having been removed to show the operating mechanism; and Fig. 2 is a sectional, elevational view taken along the line

2—2 of Fig. 1 certain parts being shown in elevation more clearly to illustrate the mechanism.

Referring now to the drawing, I have shown my invention in one form as applied to a multi-pole circuit breaker 10 comprising a plurality of single-pole circuit breaker units 11, 12 and 13 each of which is identical in construction. As shown best in Fig. 2, each of the single-pole units of which only the unit 12 will be described, comprises a base formed of insulating material, which base includes a housing 14 formed integrally therewith for supporting a compression chamber interrupter of the type described and claimed in the above-identified Walle application. This interrupter comprises a casing 15 formed of suitable pressure-resistant material such, for example, as brass and a pair of insulating bushings 16 and 17 formed of kerosene-free fiber. Supported by the insulating bushing 17 is a stationary contact 18 connected by a conductor 19 to a terminal 20. Slidably journaled in the bushing 16 for movement between open and closed circuit positions, is a movable contact 21, the extending end of which is connected to the circuit breaker operating mechanism.

As shown, the operating mechanism comprises a pair of overcenter springs 22 and 23, the respective lower ends of which are connected to the opposite ends of a pin 24 which extends through a vertical slot (not shown) provided in the extending end of the movable contact 21. The other ends of the overcenter springs are connected to a pin 25, the opposite ends of which are supported by a pair of levers 26. As shown, these levers are pivotally mounted on the opposite sides of a U-shaped frame 27 by means of a pin 28, and the pin 25 extends through a slot 29 formed in an operating member 30 pivoted on a pin 31 supported by the frame 27. In order to provide for reciprocal, longitudinal movement of the contact 21, a guide arm 32 is arranged with one end pivoted on the pin 31 and its opposite end connected to the pin 24. Intermediate the ends of the guide arm 32 is a crossportion 33 arranged in cooperating relation with one arm 34 of a bifurcated tripping member which is normally biased to an open circuit position by means of a compression spring 35. As is more fully described in my above referred to copending application, the compression spring 35 operates against a plunger rod 36, one end of which engages a notch 37 formed in the tripping member. As shown, the movable contact 21 is electrically connected by means of a flexible conductor 38 to an L-shaped conductor 39 which is connected to one leg of a substantially U-shaped thermal element 40, the other leg of the thermal element being connected by means of an L-shaped conductor 41 to a terminal 42.

The single-pole units 11, 12 and 13 as thus far described are identical in construction and as shown in Fig. 1, the units are assembled in side-by-side relation and the bases of the units secured together in any suitable manner, as by the rivets 43 which extend through the bases of the three units and by a tie bar 44 secured to suitable posts 45 formed integrally with the respective bases. A single cover 46 formed of insulating material is provided which extends over the three units, and is provided with an aperture 47 through which extends an insulated handle 48 which is secured to the operating member 30 of the single-pole unit 12.

In order to provide for simultaneous operation of the movable contacts 21 of each of the single-pole units, I provide a crossbar 49 formed of insulating material which is secured to the operating members 30 of the respective units by suitable screws 50. It will be apparent now that when the operating handle 48 is moved in a left-hand direction, as viewed in the drawing, from its "on" position, shown, to its "off" position, the operating member 30 of the single-pole unit 12 will be rotated in a counterclockwise direction about the pivot pin 31, and this counterclockwise direction will be transmitted by the crossbar to the corresponding operating members of the single-pole units 11 and 13. Accordingly, the overcenter springs 22 and 23 of each unit will be carried overcenter relative to the pins 31, and the movable contacts 21 of each unit will be operated to the open circuit position with a snap action. Similarly, the movable contacts 21 of each unit may be operated to the closed circuit position by returning the handle 48 to the "on" position shown in the drawing.

It will be remembered that each unit includes a bifurcated tripping member having an arm 34 which is biased to an open circuit position by a compression spring 35, and it will be apparent that in order to provide for manual operation of the movable contacts between open and closed circuit positions, means must be provided for normally retaining the tripping members in the position shown in the drawing against the bias of the compression springs 35. In certain types of single-pole circuit breakers heretofore proposed, such, for example, as the circuit breakers disclosed in my above-identified application, the tripping member has been provided with a latch arranged normally to engage a thermal element corresponding to the thermal element 40 so that when the thermal element is heated upon the occurrence of an overload, the tripping member is released for operation by the associated compression spring to move the contacts to their open circuit position. While such an arrangement would be suitable for multi-pole circuit breakers embodying my invention where it is desired that each pole shall be opened upon overload independently of the other poles of the circuit breaker, I prefer to provide means for simultaneously operating the contacts of each unit to the open circuit position upon the occurrence of an overload in any one of the poles.

Accordingly, I have provided a crossbar 51 formed of insulating material which extends across the three units 11, 12 and 13 and is secured to the other arm 34*a* of the bifurcated tripping member of each unit. Secured to the crossbar 51 centrally thereof, is a latch 52 arranged normally to engage a U-shaped pivoted latching member 53 which is pivoted on a pin 54 supported at its opposite ends on a U-shaped frame 55. As shown, the latching member 53 is biased for rotation in a counterclockwise direction by a spring 56 and includes a latching portion 57, a resetting portion 58 and a pair of extending fingers 59, the extending fingers 59 being arranged normally to engage latching extensions 59*a* carried by a T-shaped trip bar 60 to maintain the latching member 53 in the position shown in the drawing. In order that the counterclockwise rotation of the latching member 53 under the bias of the spring 56 may be arrested in the proper position for the subsequent resetting operation to be hereinafter described, a suitable stop pin 53*a* (Fig. 1) is provided extending inwardly from one leg of the U-shaped frame 55 into the path of movement of one of the fingers 59. The section line 2—2 is so lo-

cated that the pin 53a would not ordinarily be shown in Fig. 2. I have therefore shown in broken lines in Fig. 2 a small circle which indicates the position of the pin 53a relative to the latching member 53. The lower end of trip bar 60 is pivoted, as shown, on a pin 61 supported by the frame 55, and the trip bar is normally biased to the position shown in the drawing by a torsion spring 62 which surounds the pin 61.

As shown best in Fig. 1, the trip bar 60 extends across the three single-pole units 11, 12 and 13 and is provided with a plurality of insulating buttons 63 arranged to cooperate with the thermal elements 40 of the respective single-pole units. When normal currents are flowing through the poles of the circuit breaker, the thermal elements 40, the trip bar 60 and the latching member 53 will occupy the respective positions shown in the drawing and accordingly, the bifurcated tripping members of all of the single-pole units will be retained in the position shown against the force exerted by the compression springs 35.

Upon the occurrence of overload or short-circuit conditions, sufficient heat will be generated in one or more of the thermal elements 40 to cause the free end of the thermal element or elements to move in a left-hand direction as viewed in the drawing, and rotate the trip bar 60 in a counterclockwise direction about the pin 61. As soon as the latching extensions 59a on the trip bar 60 move out from under the left-hand end of the extending fingers 59, the latching member 53 will be rotated in a counterclockwise direction to a position in which one of the fingers 59 engages the stop pin 53a by the spring 56 and by the force exerted on the latching portion 57 by the latch 52 due to the force exerted by the compression springs 35. Thereupon the latch 52 will be released and the tripping members of all of the units will be rotated in a clockwise direction about their pivots 31 so that the arms 34 will engage the cross members 33 and operate the movable contacts 21 to the open circuit position.

In order to reclose the circuit breaker after it has been automatically operated to the open circuit position, it is necessary first to move the handle 48 from a mid-position which it will assume upon automatic tripping of the circuit breaker to the "off" position. During this movement of the handle 48, it will be apparent that a shoulder 64 on each of the operating elements 30 will engage the arm 34a of the associated tripping member to return it to its normal position and at the same time, the latch 52 will engage the resetting portion 58 of the latching member 53 so as to rotate it in a clockwise direction about its pivot 54 against the force of the spring 56 to the position shown in the drawing, the latch 52 extending into the opening between the portions 57 and 58. If the thermal elements 40 have cooled sufficiently to permit the circuit breaker to be reclosed, the trip bar 60 will be operated by the torsion spring 62 to its normal position so that the latching extensions 59a will engage the under sides of the extending fingers 59 on the latching member 53 to retain it in the position shown. The circuit breaker may now be reclosed by moving the handle 48 to its "on" position, the tripping members of the units being retained in the position shown in the drawing by the engagement of the latch 52 with the latching member 53.

I have found that under some conditions of operation, a short-circuit current may flow through one of the poles of the circuit breaker of sufficient magnitude to produce arcing between the contacts and a resultant generation of pressures of great magnitude. When this occurs on one of the end poles of the circuit breaker, i. e., either the pole 11 or the pole 13, the force applied to the movable contact of that pole is sufficient to operate it quickly to the open circuit position, the operation of the other poles to the open circuit position occurring only after the current responsive tripping mechanism has had time to operate. Since the movable contact of each of the single-pole units is biased to its closed position solely by the resilient means comprising the overcenter springs 22 and 23, the expulsion of the movable contact of any one of the units from its compression chamber will have no effect on the remaining single-pole units of the circuit breaker. If the movable contacts had been directly connected together, however, for example, by means of a crossbar connected to the extending ends of the movable contacts or to the cross member 33, expulsion of one of the contacts due to the generation of high pressures within one of the compression chambers would exert a force on the crossbar which would tend to twist it laterally to such an extent as to prevent the other poles from opening. I am, of course, aware that it would be possible to make the crossbar and its mounting so rugged that the circuit breaker contacts could be secured directly together and operate as a unit without danger of twisting the crossbar, but such a construction is inherently more costly, and I have found it to be of particular advantage to provide each of the movable contacts with an individual resilient operating means connected to the operating handle.

It will, of course, be understood that the particular form of operating mechanism of each of the single-pole units forms no part of my present invention, and the mechanism shown should be taken simply as illustrative, since my invention is applicable generally to many different types of operating mechanism. The particular operating mechanism shown is of the type described and claimed in a copending application of David C. Prince, Serial No. 7,085, filed February 18, 1935, entitled "Circuit breakers" which application is assigned to the same assignee as the present invention.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A multi-pole circuit breaker comprising a plurality of single-pole circuit breaker units each of which includes relatively movable contacts, overcenter spring means for operating the contacts between open and closed circuit positions and overload means responsive to the current flowing through said contacts, a crossbar extending across said units and operatively connected to each of the overcenter spring means for simultaneously operating the contacts of said units between said open and closed circuit positions, a second crossbar extending across said units, a latch normally retaining said last-mentioned crossbar in a predetermined position and releasable upon operation of the overload means of one or more of said units, each of said units including means connected to said last-mentioned

crossbar for operating said contacts to open circuit position upon release of said latch.

2. A multi-pole circuit breaker comprising a plurality of single-pole circuit breaker units each of which comprises a pair of relatively movable contacts, an operating member, and resilient means connected between said contacts and said member, a crossbar extending across said units and connected to the operating members thereof for simultaneously operating the contacts of said units between open and closed circuit positions, each of said units also including a tripping member normally biased to operate said contacts to open circuit position against the force exerted by said resilient means, a crossbar extending across said units connected to said tripping members, a latch for normally holding said last-mentioned crossbar and said tripping members against the biasing force thereon and current-responsive means for releasing said latch.

3. A multi-pole circuit breaker comprising a plurality of single-pole circuit breaker units each of which comprises a pair of relatively movable contacts, an operating member, and resilient means connected between said contacts and said member, a crossbar extending across said units connected to the operating members thereof for simultaneously operating said resilient means to move the contacts of said units between open and closed circuit positions, each of said units also including a tripping member normally biased to operate said contacts to open circuit position and an overload member movable in response to the current through said contacts, a crossbar extending across said units connected to the tripping members of said units, a latch for normally holding said last-mentioned crossbar and said tripping members against the biasing force on said tripping members, and means operable by the overload members of one or more of said units to release said latch.

4. A multiple-pole circuit breaker comprising a plurality of single-pole circuit breaker units each of which comprises a pair of relatively movable contacts, an operating member, and resilient means connected between said contacts and said member for operating said contacts between open and closed circuit positions in response to operation of said member while providing for movement of said contacts to open circuit position irrespective of the position of said member, a crossbar extending across said units and connected to the operating members thereof for simultaneously operating the contacts between open and closed circuit positions, each of said units also including tripping means for operating the contacts of the unit to open circuit position, a crossbar extending across said units connected to said tripping means, a latch for normally retaining said last-mentioned crossbar and said tripping means in a predetermined position, and current-responsive means for releasing said latch whereby the contacts of said units are simultaneously operated to their open circuit positions by said tripping means upon the occurrence of predetermined current conditions.

5. In a multi-pole circuit breaker comprising a plurality of single-pole circuit breaker units each of which units includes walls of pressure-resistant material forming a substantially gas-tight compression chamber, a pair of contacts mounted within said chamber one of which contacts extends through one of said walls and is movable between open and closed circuit positions, an operating member movable between on and off positions, resilient means operable by said member for moving said one contact between said open and closed circuit positions with a snap action, a tripping member for operating said movable contact to said open circuit position independently of said resilient means and overload means responsive to current flow through said contacts, the volume of said compression chamber being such that under extreme short-circuit conditions gas pressures are generated therein of such magnitude as to exert a force on said movable contact sufficient to effect a quick movement of said movable contact to said open circuit position against the force of said resilient means, the combination of means for rigidly securing said circuit breaker units together in side-by-side relation, a crossbar connected to the operating member of each of said units for simultaneously operating the movable contacts between said open and closed circuit positions while permitting independent movement of any one of said movable contacts to said open circuit position under said extreme short circuit conditions, a crossbar connected to the tripping member of each of said units, a latch for holding said last-mentioned crossbar in a predetermined position and releasable to effect operation of said movable contacts to their open circuit position, and means operable by the overload means of one or more of said units for releasing said latch.

6. In a multi-pole circuit breaker comprising a plurality of single-pole circuit breaker units each of which includes contacts relatively movable between open and closed circuit positions, an operating member movable between on and off positions for causing movement of said contacts between said open and closed circuit positions, resilient means connected between one of said contacts and said member providing for movement of said contacts to open circuit position irrespective of the position of said operating member, a tripping member for operating said contacts to open circuit position against the force exerted by said resilient means, overload means responsive to the current flowing through said contacts and a sealed compression chamber surrounding said contacts, the volume of said chamber being such that under extreme short-circuit conditions gas pressures are generated therein of such magnitude as to exert a force on said one contact sufficient to effect a quick movement of said one contact to said open circuit position against the force of said resilient means, the combination of a crossbar connected to the operating member of each of said units for simultaneously operating the contacts of said units between said open and closed circuit positions while permitting independent movement of the contacts of any one of said units to said open circuit position under said extreme short-circuit conditions, a crossbar connected to the tripping members of each of said units and a latch operable by the overload means of one or more of said units for releasing said last-mentioned crossbar and said tripping members whereby interruption of the current flow through each of said circuit breaker units occurs at substantially the same time.

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