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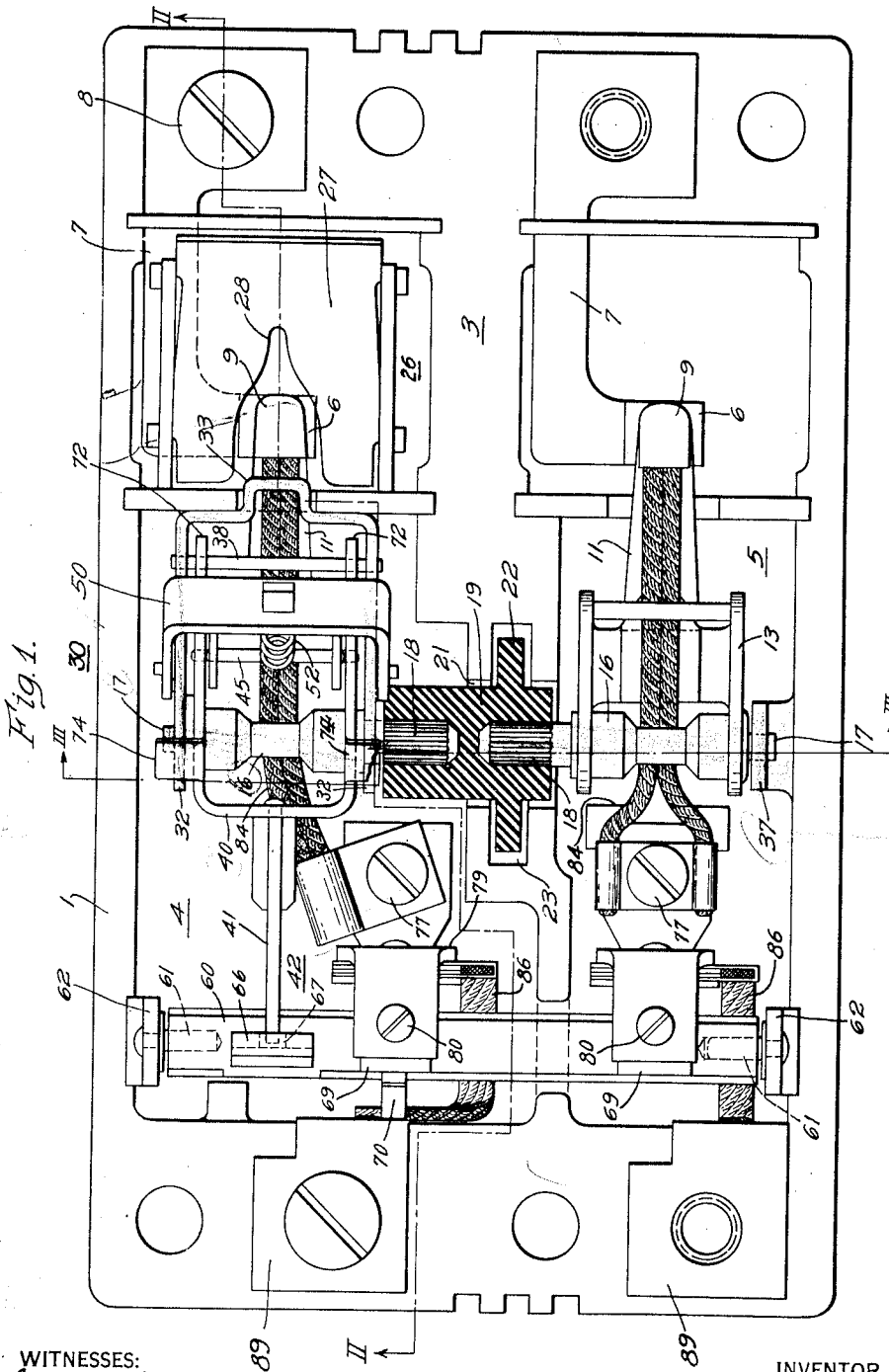
H. S. GANO

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CIRCUIT BREAKER

Filed Aug. 1, 1936

6 Sheets-Sheet 1



WITNESSES:

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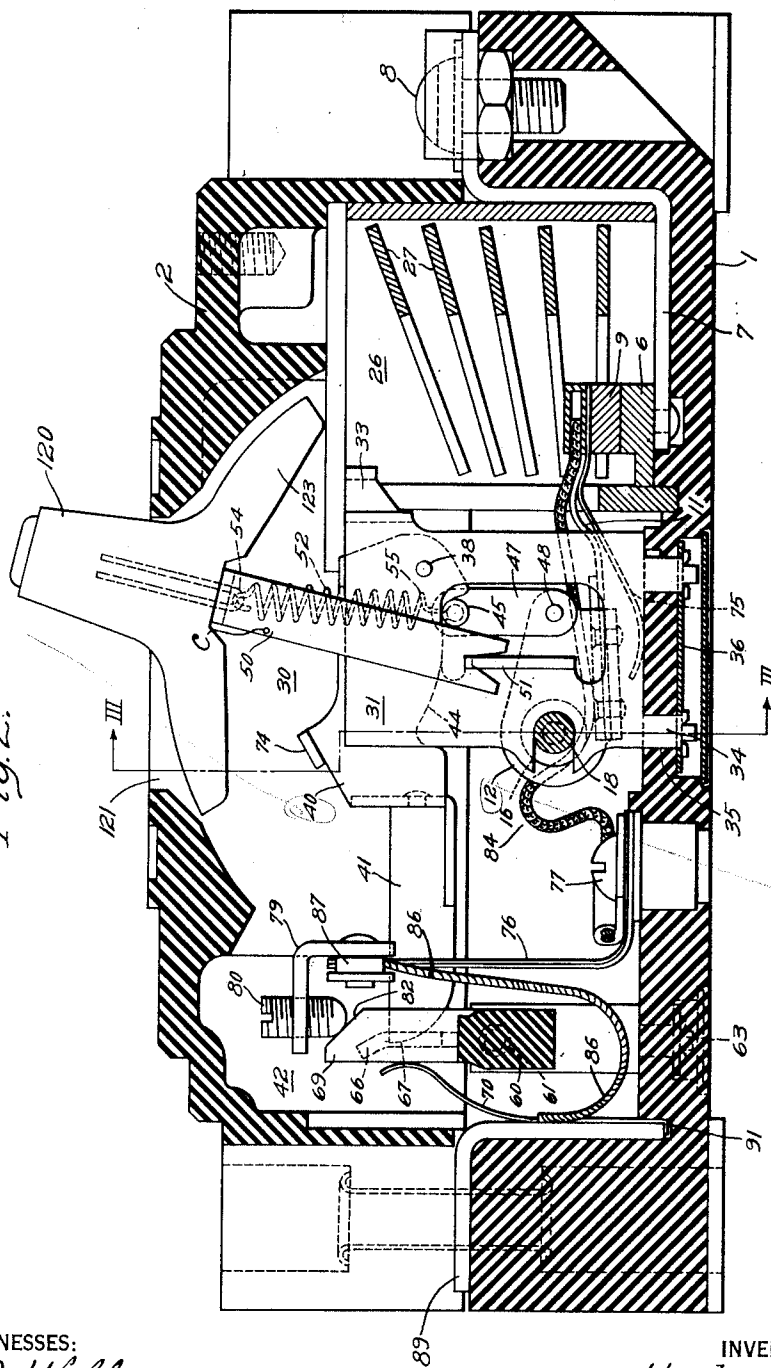
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CIRCUIT BREAKER

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6 Sheets-Sheet 2

Fig. 2.



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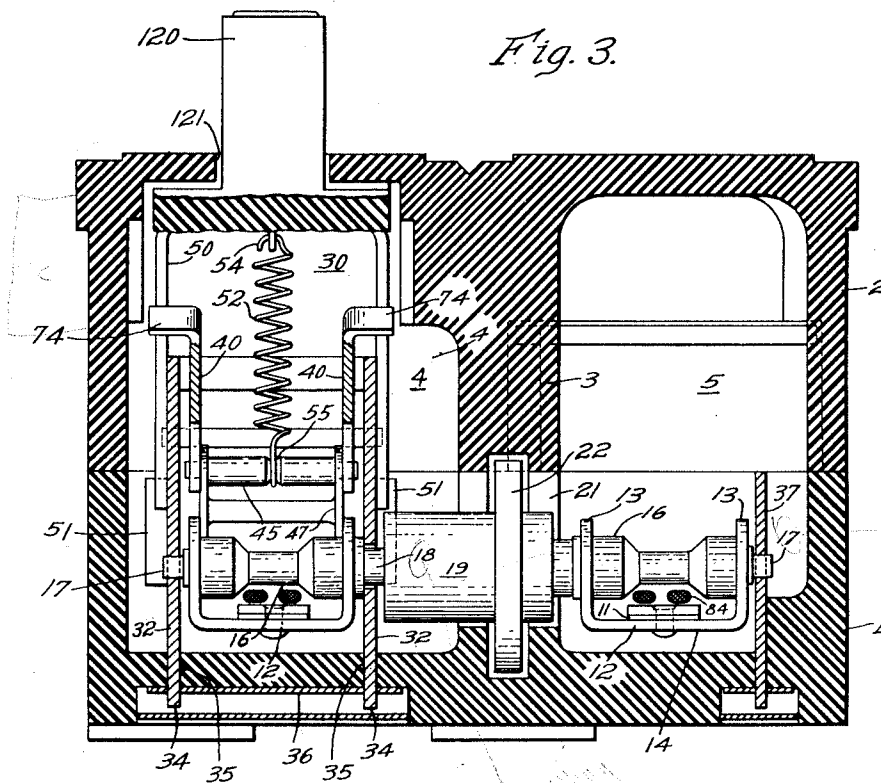
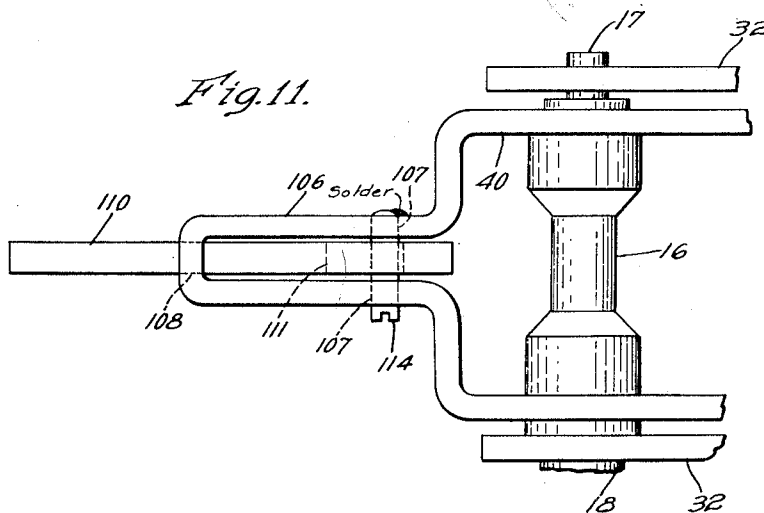
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CIRCUIT BREAKER

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6 Sheets-Sheet 3



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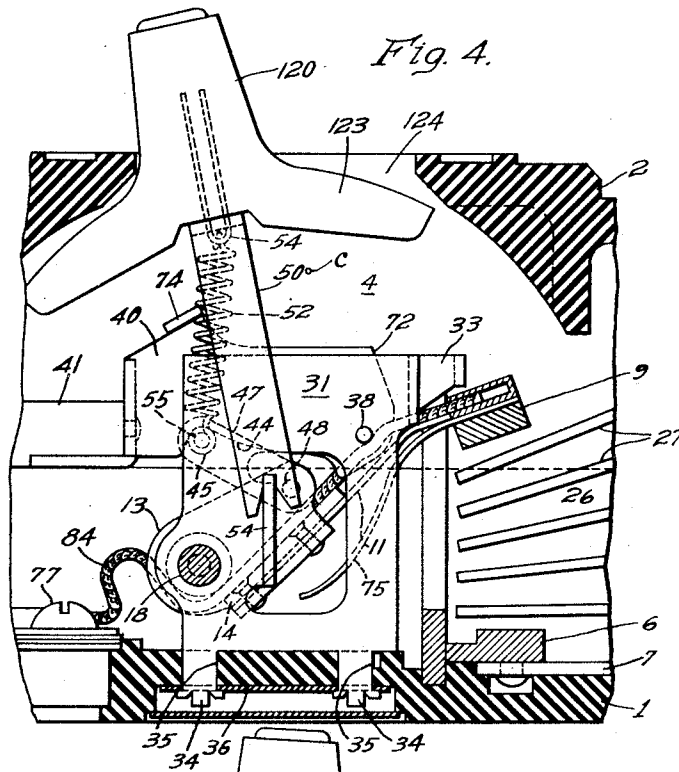
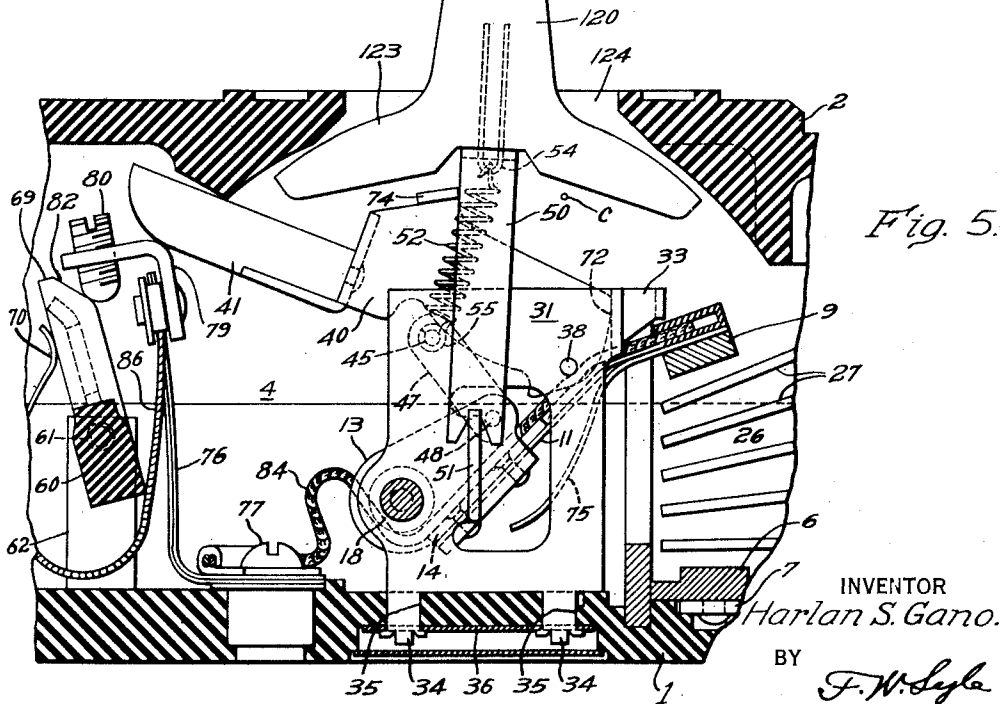
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CIRCUIT BREAKER

Filed Aug. 1, 1936

6 Sheets-Sheet 4



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2,204,409

CIRCUIT BREAKER

Filed Aug. 1, 1936

6 Sheets-Sheet 5

Fig. 6.

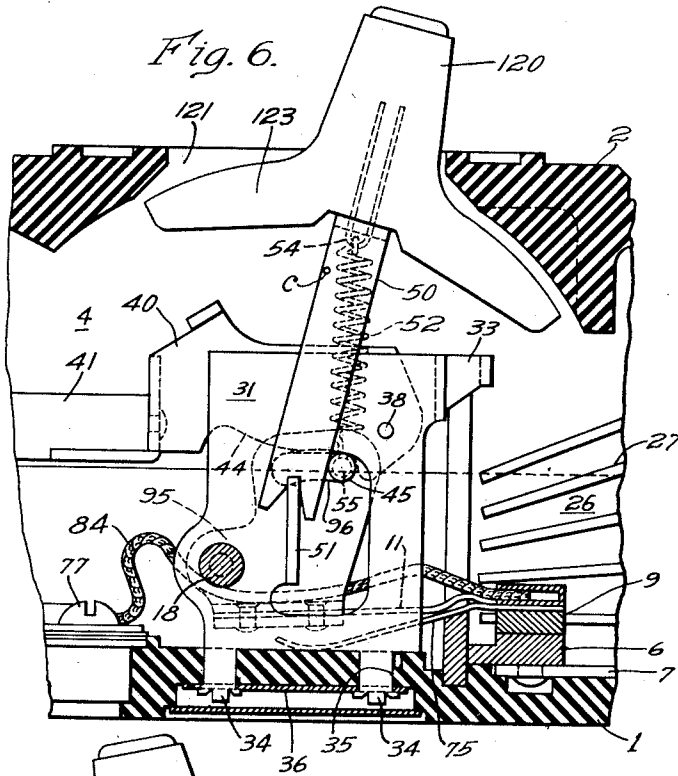
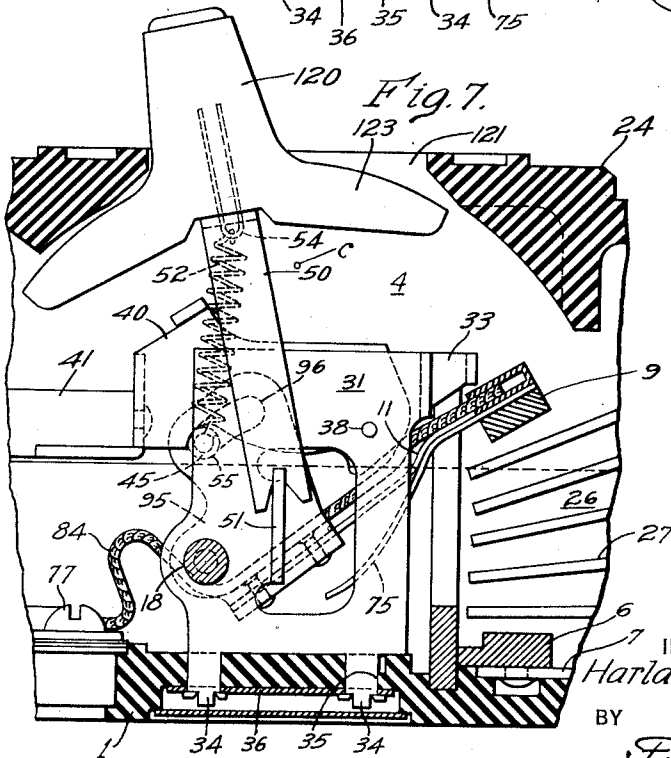


Fig. 7.



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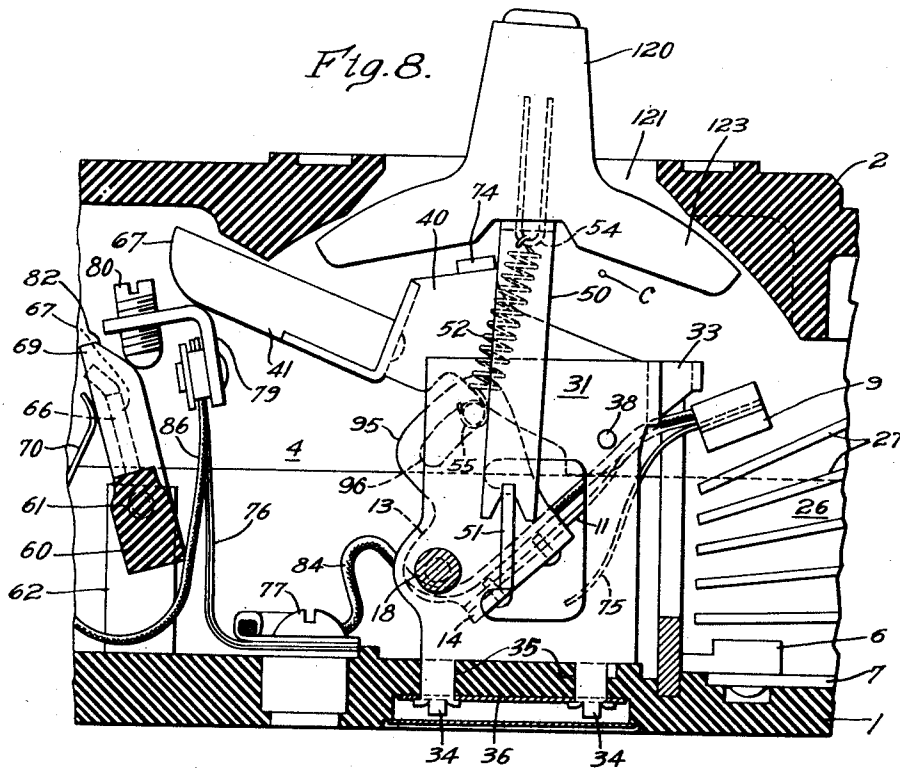
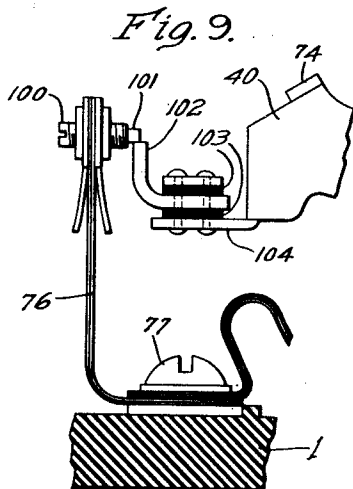
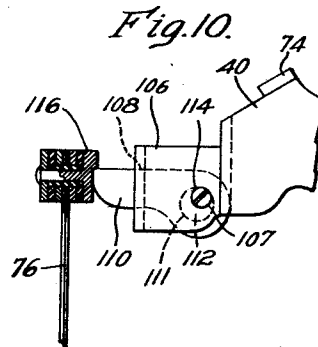
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CIRCUIT BREAKER

Filed Aug. 1, 1936

6 Sheets-Sheet 6



WITNESSES:

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2,204,409

CIRCUIT BREAKER

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Application August 1, 1936, Serial No. 93,807

41 Claims. (Cl. 200—116)

This invention relates to circuit breakers and more particularly to circuit breakers of the type employing an operating mechanism which opens and closes the contacts with a snap action and which is responsive to overload conditions for opening the breaker contacts. Heretofore, the circuit breakers of the type above mentioned have been relatively costly to manufacture and consequently their application has been limited to use in low voltage circuits of comparatively large current values, such as would be encountered in medium sized industrial motors and large commercial lighting installations.

In accordance with the present invention, an improved circuit breaker structure is provided which possesses the desirable features contained in breakers of greater cost but which readily adapts itself to low cost manufacturing methods, particularly quantity production thereby making it commercially possible to give low voltage low current circuits the same protection as was heretofore only available for circuits of greater power demand.

It is an object of this invention to provide an operating mechanism for circuit breakers of the type above described which is reliable in operation and which is inexpensive to manufacture.

A further and more specific object of my invention is to provide an operating mechanism for circuit breakers having a small number of parts and which is capable of actuating the breaker contacts to open and closed positions with a snap action.

Another object of my invention is to provide an operating mechanism for circuit breakers of simplified form which is responsive to overload current conditions for opening the breaker contacts.

A still further object of my invention is to provide an operating mechanism having auxiliary means for opening the breaker contacts on overload in the event of failure of the main contact actuating means.

These and other objects and advantages will appear more fully in the following description taken in connection with the accompanying drawings, in which

Figure 1 is a plan view showing the circuit breaker of my invention with the cover removed and some parts shown in section;

Fig. 2 is a vertical sectional view of the circuit breaker of my invention taken substantially along line II—II of Fig. 1, with the cover in mounted position;

Fig. 3 is a vertical cross sectional view taken along line III—III of Fig. 2;

Fig. 4 is a fragmentary sectional view of the operating mechanism of Fig. 2 shown in the open circuit position;

Fig. 5 is a fragmentary sectional view of the operating mechanism of Fig. 2 shown in the released or tripped position;

Fig. 6 is a fragmentary sectional view of a modified form of operating mechanism;

Fig. 7 shows the operating mechanism of Fig. 6 in the open circuit position;

Fig. 8 shows the operating mechanism of Fig. 6 in the released or tripped position;

Fig. 9 is a fragmentary view of the operating mechanism showing details of the current responsive trip device particularly arranged for single pole breakers; and

Figs. 10 and 11 are detailed fragmentary views of a modified form of trip device for single pole breakers.

In the drawings, the reference 1 designates a base preferably molded of insulating material which cooperates with a suitable cover 2, also of molded insulating material to form a housing for the breaker mechanism. A longitudinally extending partition wall 3 having its lower and upper portion respectively contained in the base 1 and cover 2 divides the space within the housing into two compartments 4 and 5.

Each of the compartments 4 and 5 has a stationary contact member 6 connected by a suitable conductor 7 to a terminal 8. The contacts 6 are adapted for cooperative engagement with movable contacts 9, each of which is secured to a resilient contact arm 11. The contact arms 11 are mounted for movement with a rotatable support member 12. The support members 12 are preferably of U-shape having opposed substantially parallel side walls 13 and a transverse section 14 to which the flexible contact arms 11 are secured.

A hub member 16 is disposed transversely between the side walls 13 of the member 12 and is rigidly secured to the side walls in any suitable manner, as for instance, by providing the hubs with reduced end portions of elongated cross section and the side walls with correspondingly shaped apertures through which the end portion extends. The protruding portions of the hubs may be spun over so as to firmly hold the hubs in position. To the outer ends of each member 16 is secured in coaxial relation therewith a bearing pin 17 about which the hubs 16 and the support members 12 are adapted to rotate. The inner ends of the hub members 16 are each provided with a coaxial coupling pin 18. The coupling pins 18 are fluted at their outer ends

other by means of a cylindrical coupling member 19 of insulating material. It will thus be seen that the coupling member 19 unites the movable contact supporting elements 12 securely to each other so as to form a unitary rotatable structure whereby the movement of the contact members 9 into and out of engagement with the fixed contact 6 will be simultaneous.

In order to accommodate the coupling member 19, an aperture 21 in the partition wall 3 is provided. Provision is also made to prevent flashover from one pole to the other at the joint between the aperture 21 and the coupling member 19 by providing an annular flange 22 upon the coupling member. The flange 22 is adapted to be disposed within a recess 23 surrounding the aperture 21 and in communication therewith.

The arc drawn by the separation of the contacts 6 and 9 is extinguished by means of an arc extinguishing device generally shown at 26 in Figures 1 and 2. In Fig. 1, however, the arc extinguisher is shown associated only with one pole, in order to more clearly illustrate the contact arrangement of the other pole. This device comprises a series of spaced plates 27 of magnetic material, each of which is provided with a U-shaped converging slot 28 (Fig. 1) so as to form an aligned groove in which the contacts 6 and 9 separate and cause the arc to play therein. The magnetic reaction produced by the slotted plates as the result of the arc current causes the arc to be moved into these plates during which movement rapid deionization takes place so as to cause the arc to be extinguished. Arc extinguishers of this type are well known in the art and are fully described in United States Patent No. 2,015,561, issued September 24, 1935, to O. S. Jennings, assigned to the assignee of this application, and need not be further illustrated or described.

Inasmuch as the two contact arms 11 are rigidly united for simultaneous operation, it will be apparent that by providing an operating mechanism for actuating one of the members 12, a corresponding actuation of the other member will result. As shown particularly in Figs. 1, 2 and 3, the operating mechanism generally indicated at 30 is associated with the contact members mounted in the compartment 4. The operating mechanism 30 comprises a frame 31 having two substantially parallel side plate members 32 joined at one end by a U-shaped member 33. The plates 32 are provided with projections 34 adapted to extend through suitable apertures 35 in the base 1. The protruding ends of the projections 34 also extend through a bearing plate 36 against which portions of the projections 34 are clinched over in rigid engagement therewith whereby the frame 31 is securely mounted to the base.

One of the pivotal pins 17 is journaled in one of the side frame members 32 whereas the other pivotal pin 17 is journaled in a suitable bearing member 37. The other frame member 32 also provides a bearing for the coupling pin 18. It is thus seen that the contact carrying arms 11 are pivotally mounted with respect to the frame 31.

Also mounted between the frame members 32 upon a pivotal pin 38 is a support or cradle 40. The support 40 is preferably of U-shape and is provided with a latching member 41 normally held by a trip mechanism 42 in the latched or set position. The trip mechanism 42 will be hereinafter more fully described.

The lower edges of the parallel side members

slightly inclined recesses 44 along which an actuating roller 45 is adapted to be moved. The actuating roller 45 is journaled in a connecting link 47 which in turn is pivotally connected to the side walls 13 of the contact arm supporting member 12 by means of a pin 48. It is thus seen that as the actuating roller 45 is moved along the recess 44 from the position shown in Fig. 2 to the position shown in Fig. 4, the support members 12 will be rotated about their pivotal axes 17 and as a result carry the contact arms 11 to an open circuit position.

The movement of the actuating roller 45 is produced by an operating lever 50 releasably pivoted to two outwardly extending brackets 51, in this instance formed integrally with the side members 32 of the frame. Connection between the operating lever 50 and the actuating roller 45 is had by means of a spring 52, the ends of which are respectively connected to the lever 50 at 54 and to the actuating roller 45 at 55. It will be noted that the recesses 44 extend to the right and left of the pivotal connection between the operating lever 50 and the brackets 51. The recesses 44 in the sides of the support 40 each form an inclined surface along which the actuating roller 45 is adapted to be moved. It will be noted that in the closed circuit position of the breaker shown in Fig. 2 the line of action of the overcenter spring 52 lies to the right of the line normal to the inclined surface at the point of contact of the roller 45 therewith, so that the actuating roller 45 is constrained at the right hand end of the recess 44 by the force exerted by the overcenter spring 52. The force exerted by spring 75 is also transmitted to the actuating roller 45. This force also acts to hold the roller 45 at right-hand end of the guide surface. When the operating lever 50 is moved from the position shown in Fig. 2 to the left to the position shown in Fig. 4, the line of action of the spring 52 is also moved to the left. At a certain point in this movement of the operating lever 50, the line of action of the spring 52 moves to the left of the normal line to the inclined surface at the point of contact of the actuating roller 45 therewith. The force exerted by the spring 52 then tends to move the actuating roller 45 toward the left hand end of the recess 44. When the component of force exerted by the spring 52 acting to move the roller 45 to the left overcomes the component of force of spring 75 acting to move roller 45 to the right, the roller begins to move and as it moves, the angle of link 47 changes so that spring 75 also tends to move the roller to the left thus causing the roller to move with a snap action and effect movement of the switch arms 11 and movable contacts 9 to their open circuit position with a snap action. At a certain point in the movement of the lever 50 toward the left the line of action of the spring 52 also crosses the line joining the connection 54 and the pivotal connection of the lever 50 to the brackets 51. The operating lever is then biased to move to the open circuit position shown in Fig. 4 by the force exerted by the spring 52.

The inclined surfaces formed by the recesses 44 may be of any suitable shape so long as they produce the desired snap action. In the preferred form of the invention shown in the drawings, the surfaces are curved so that they form a part of a circle, the center of curvature of which is indicated at C in Figs. 2, 4, 5, 6, 7 and 8. During the previously described movement of the

operating lever 50 from the position shown in Fig. 2 to that shown in Fig. 4, the line of action of the spring 52 moves to the left of the center of curvature C of the inclined surfaces so that during the movement of the operating lever the actuating roller 45 is moved with constantly increasing acceleration to the left hand end of the recesses to effect movement of the contacts 9 to their open circuit position with a snap action.

To close the breaker the operating lever 50 is moved from the position shown in Fig. 4 to the right to the closed circuit position shown in Fig. 2. When the lever 50 is thus moved the line of action of the overcenter spring 52 is moved from the left to the right side of the line normal to the inclined surface at the point of contact of the roller 45 therewith. This change of the line of action moves the roller 45 toward the right hand end of the recesses 44. At a certain point in the movement of the operating lever 50, the line of action of the spring 52 passes to the right of the center of curvature C of the inclined surfaces so that the roller 45 is moved to the right hand end of the recess during the movement of the operating lever 50 with constantly increasing acceleration, i. e., with a snap action. The movement of the roller 45 to the right hand end of the recess effects movement of the movable contacts 9 to their closed circuit position with a snap action.

The inclined curved surfaces of the recesses 44 thus take the place of an additional toggle link which was formerly used in this type of snap acting mechanism. Thus the extra toggle link has been eliminated and yet its function is retained.

It will be noted that when the breaker is in closed circuit position (Fig. 2) the line of action of the connecting link 47, i. e., the extension of the line passing through the center of the pin 48 and the actuating roller 45, passes to the right hand side of the normal line to the inclined surface of the recess at the point of contact of the actuating roller 45 therewith. Due to this fact the force exerted by the spring 75 which is transmitted to the actuating roller 45 through the link, or any force which tends to open the contacts such as magnetic reaction produced by the current on momentary overloads, maintains the actuating roller at the right hand end of the recesses 44. Thus the contacts are positively locked in their closed circuit position even though the spring 52 weakens or breaks.

It will be apparent that the provision of the recesses 44 in the support member 40 for the purpose of guiding the actuating roller 45 greatly simplifies the breaker operating mechanism. Thus, the active parts of the mechanism comprise the movable support 40, the actuating roller 45, the connecting link 47, the manually operable lever 50 and the overcenter spring 52. It will be noted that the spring 52 maintains the actuating roller 45 in engagement with the guide surfaces provided by the recesses 44 and also maintains the pivotal engagement of the operating lever 50 with the brackets 51.

It will also be apparent that the U-shaped end portion 33 of the frame 31 provides a stop for the movable contact 9 when it is moved from the closed to the open position.

The overload trip mechanism 42 which releasably retains the support member 40 in its normal or set position comprises a trip bar 60 preferably of insulating material and pivotally mounted at its ends on pins 61 secured to two upstanding brackets 62. The brackets 62 are

provided at their lower ends with projections 63 extending through the base 1 and having portions thereof clinched over for securing the same rigidly to the base in a manner similar to that previously described in connection with the mounting means for the frame 31.

The trip bar 60 is provided with a latch member 66 having an aperture 67 therein for the reception of the end of the latch element 41 secured to the support 40. The trip bar 60 is also provided with two integrally formed upstanding projections 69, the purpose of which will appear hereinafter. A leaf spring 70 having one end secured to the base 1 and the other in engagement with one of the projections 69 biases the trip bar 60 towards the latch element 41 to insure engagement of the element 41 with the co-operating latch member 66. It will be apparent that if the trip bar 60 is rotated in a counter-clockwise direction, as viewed in Fig. 2, the latch element 41 will be disengaged from the aperture 67 to cause the spring 52, actuating through the actuating roller 45, to rotate the support 40 clockwise about its pivotal pin 38. Upon the rotative movement of the support 40 in this direction, the actuating roller 45 carries with it the connecting link 47 and the movable contact supporting arm member 12 to thereby effect opening of the contact members 6 and 9.

The released or tripped position of the operating mechanism is shown in Fig. 5. As will be seen from Fig. 5, the limit of the clockwise rotation of the support member 40 is determined by the U-shaped end member 33 joining the side plates 32 of the frame 31. In this limiting position the inclined shoulders 72 of the support 40 are brought into engagement with the inner surface of the connecting member 33.

It will also be observed from Fig. 5 that in the tripped open circuit position the operating lever 50, due to the action of the spring 52, is moved from its closed circuit position to a position intermediate the open and closed position. Thus the operating lever serves as an indicator showing when the breaker has been tripped as a result of an overload current condition. The indicating position of the lever 50 is determined by stops 74 extending outwardly from the support member 40 and against which the lever 50 is adapted to rest. The stop members 74 also serve as means for resetting the support 40 to its normal or latched position. The resetting operation is accomplished by moving the operating lever 50 counter-clockwise (Fig. 5) to the open circuit position, whereupon the lever 50 engaging the stops 74 rotates the support 40 in a counter-clockwise direction until the end of the latch element 41 engages the aperture 67 in the latch member 66.

In accordance with the foregoing description it is seen that the contacts 6 and 9 are positively held in the closed position by virtue of the angular arrangement of the linkage 47 with respect to the member 12 and the recess 44. Inasmuch as the actuating spring 52 serves to move the support 40 in a clockwise direction when the support is released as a result of overload current conditions, a failure of the spring after the contacts have been closed would deprive the breaker of subsequent overload protection. In order to insure overload release even in the event of failure of the main actuating spring 52, I have provided an auxiliary actuating leaf spring 75, one end of which may be secured between the contact 9 and the contact arm 11. The other end of the

the base 1, thus in the event of failure of the spring 52 after the contacts 6 and 9 have been closed, the circuit will remain closed. However, in the event of overload, the support 40 will be released as usual and the spring 75 will urge the contact arms 11 in a counter-clockwise direction and cause the support 40 to be rotated clockwise to the released position.

In order to actuate the trip bar 60 in accordance with predetermined current conditions in the circuit in which the breaker is connected, there is provided a thermal responsive or bimetallic element 76 for each pole of the breaker. One end of each of the bimetallic elements 76 may be secured to the base 1 by means of a suitable screw 77. The upper end of each bimetallic element 76 is free to move and is provided with an angular bracket 79. The horizontal portions of the brackets 79 are each provided with an adjustable actuating screw 80, the lower end of which is adapted to engage the inclined surface 82 of the projection 69. Electrical connection is made by means of a flexible lead 84 from the movable contact 9 to each bimetal 76. Electrical contact between the bimetal 76 and its respective lead 84 is maintained by the screw 77. The electrical connection to the upper end of each bimetal 76 is obtained by flexible leads 86 secured to terminals 87 which, in turn, may be united with the brackets 79 and the bimetals 76 by means of brazing or any other suitable method. The other end of the flexible leads 86 are secured to angular connecting members 89 which serve as the two other terminals for the breaker. The lower end of each terminal 89 is preferably adapted to fit into a recess 91 formed in the base 1. The lower end of the leaf spring 70 is adapted to lie parallel with the lower end of one of the contact members 89 and is wedged into the recesses 91 by means of the contact member whereby it is operatively held in position.

From the foregoing description, it will be apparent that the circuit through each pole of the breaker includes the terminal 8, the connecting strip 7, contact 6, movable contact 9, flexible conductor 84, terminal 77, the bimetal 76, terminal 87, the flexible conductor 86 and the terminal 89. Current flowing through this circuit will heat the bimetals 76 which are adapted when heated, to deflect to the left or in a direction toward the projection 69 on the trip bar 60. This movement of the bimetals 76 to the left causes the lower ends of the adjustable screws 80 to engage the inclined surfaces 82 of projection 69 to thereby rotate the trip bar 60 in a counterclockwise direction as viewed in Fig. 2 and consequently release the latch element 41 to trip the breaker. The inclined surfaces 82 permit the use of adjusting screws 80 mounted with their axes perpendicular to the plane of the base 1, thereby greatly facilitating the ease of adjustment of the bimetals with respect to the trip bar 60. In calibrating the trip mechanism the adjusting screws 80 of each pole are rotated in either direction as the case may demand to move the lower ends thereof either toward or away from the engaging surfaces 82. It will be seen that by varying the spacing between the screws 80 and the projection 69, the several poles of the breaker may be adjusted to actuate the trip bar at the same predetermined current condition.

In the modified form of breaker operating mechanism shown in Figs. 6 to 8, the connecting link 47 has been eliminated for the purpose of

order to obtain substantially the same operating characteristics in the modified arrangement as shown in these figures, the movable contact arm supports 12, have been provided with side plates having a construction as shown at 95. The supports 95 are provided with an elongated curved aperture or slot 96, the aperture 96 is slightly inclined with respect to the recesses 44 and is adapted to receive the ends of the actuating roller 45. In all other respects the operating mechanism is the same as that shown in the preceding figures.

In operation if it is desired to open the contacts 6 and 9 of the breaker, the operating lever 50 is moved from the position shown in Fig. 6 to that shown in Fig. 7. The overcenter spring 52, as in the previous example, will move the actuating roller 45 to the left. In its movement to the left, the roller 45 will engage the upper inclined surface of the slot 96 and rotate the member 95 about its axis so as to move the contact arm 11 to the open position. The closing of the switch contacts is accomplished in the reverse order, that is, by moving the operating lever 50 to the right or to the position shown in Fig. 6. During this movement, the spring 52 actuates the roller 45 along the recesses 44 to the right with a snap action, and since in its movement toward the right the roller engages the lower surface of the slot 96, the member 95 will be rotated in the clockwise direction to effect closing of the breaker contacts.

The portions of the recesses 44 and the slots 96 engaged by the roller 45 when the contacts are in the closed position, are substantially parallel with respect to each other and thereby cooperate with the roller 45 to maintain the contact members 9 in positive engagement with the fixed contacts 6 independently of the action of the overcenter spring 52.

It will also be seen that in the event an overload occurs, the latch element 41 will be released and the support 40 will be permitted to rotate in a clockwise direction under the influence of the spring 52 which also moves the roller 45 to the left and upwardly along the recesses 44 and carries with it the movable contact arm support 95. It will, of course, be understood that resetting of movable support 40 is accomplished in the same manner as previously described.

The foregoing description has been particularly directed to the embodiments of a multi-pole breaker, more specifically a two-pole construction having been shown. It will, of course, be understood that the operating mechanism for operating the movable contact member 11 to open and closed positions may also be employed for actuating an additional movable contact arm for a third pole. In the latter arrangement, the actuating mechanism would be applied to the central pole of the breaker.

In the event that the operating mechanism above described is to be employed on a single pole construction, it is, of course, apparent that there is no necessity for a trip bar in the tripping mechanism for releasing the movable support 40 during overload conditions. Figure 9 discloses a preferred arrangement for a single pole construction showing the method of latching the movable support 40 to the current responsive element. In this instance, the bimetal 76 is provided at its free or movable end with an adjusting screw 100 which has a reduced end portion 101 adapted to overlie in latching engagement with a latch element 102 insulatingly mounted upon a projec-

tion 104 extending rearwardly of the movable support 40. Calibration of the bimetal is obtained by adjusting the screw 100 so as to vary the amount of overlap between the portion 101 and the latching element 102. The insulating connection 103 between the latch element 102 and the projection 104 is for the purpose of preventing the line current from flowing through the operating mechanism through the latch element 102 and to the bimetal 76 by way of the adjusting screw 100. It is readily seen that if current were permitted to take this path, the bimetal 76 would be shunted and would not respond properly to the current conditions flowing in the circuit.

In Figs. 10 and 11 a modified latching arrangement is shown for a single pole breaker construction. In this instance the movable support 40 is provided with a narrow U-shaped extension 106. This extension has a transverse aperture 107 for the reception of the axis of a cam adjusting member. The end portion of the projection 106 also has a rectangular opening 108 for the reception of a movable latch element 110 adapted to releasably engage the latch member 116 mounted on the movable end of the bimetal 76. The latch element 110 has a circular aperture 111 therethrough for the reception of the cam surface 112 of the cam adjusting means 114 journaled in the aperture 107. Thus, as the cam adjusting means 114 is rotated either clockwise or counter-clockwise, reciprocating movement will be imparted to the latch element 110 and the distance between the latch element 110 and the latch member 116 secured to the movable end of the bimetal 76 may be adjusted. After this adjustment, a lump of solder may be placed on the end of the adjusting means 114 to seal the calibration of the breaker.

The latch member 116 is insulatingly mounted upon the end of the bimetal 76, as shown, so as to prevent the line current from flowing through the operating mechanism and entering the bimetal by way of the latch element 110.

In each of the operating mechanisms above described the operating lever 50 is provided with a manually engageable portion or handle 120 of insulating material and which projects exteriorly of the cover 2 through an elongated aperture 121. In order to protect the operator from accidental contact with the energized metallic portions of the operating mechanism, the handle 120 is provided with an arcuate shield portion 123. The shield portion 123 is preferably molded integrally with the handle 120 and is adapted to underlie the aperture 121 and extends in both longitudinal and lateral directions beyond the confines of the aperture so as to completely enclose the same regardless of the position of the operating handle.

From the foregoing description it will be apparent that I have provided a simple operating mechanism for circuit breakers having a small number of parts which may be manufactured at a low cost. The simple design embodies a snap action mechanism for operating the breaker contacts and possesses the usual advantages of such mechanism. In addition, the actuating mechanism is provided with overload protection of a simple yet reliable design. The invention also makes provision for effectively insulating the several poles from each other thereby lessening the likelihood of failure due to flashover between the poles.

In short, the present invention has made possible the protection of low voltage low current circuits to a degree commensurate with that

heretofore provided only for circuits of higher voltage and higher current demand.

Although I have shown and described a circuit breaker embodying a specific structure, it is to be understood that the same is for the purpose of illustration and that changes and modifications may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a circuit breaker, a movable contact member having opposed inclined surfaces, an actuating member cooperatively engaging said inclined surfaces, a support member also having an inclined surface, and yielding means for maintaining said actuating member in engagement with said inclined surface on said support, said yielding means being operable between predetermined positions to operate said contact member to open and closed positions.

2. In a circuit breaker, an actuating member, guide means along which said actuating member is adapted to be moved, a movable contact member, a coupling member movable with said contact member and having a guide slot therein along which said actuating member is also adapted to be moved, said guide slot being disposed with respect to said guide means so that movement of said actuating member back and forth along said guide means moves said contact member to open and closed positions, and means for moving said actuating member.

3. In a circuit breaker, an actuating member, guide means along which said actuating member is adapted to be moved, a movable contact member, a coupling member movable with said contact member and having a guide slot therein along which said actuating member is also adapted to be moved, said guide slot being disposed with respect to said guide means so that movement of said actuating member back and forth along said guide means moves said contact member to open and closed positions, and means for moving said actuating member, the portions of said guide slot and said guide means engaged by said actuating member when said contact member is in the closed position being disposed in such manner with respect to each other to positively maintain said contact member in the closed position independently of said means for moving said actuating member.

4. In a circuit breaker, an actuating member, guide means along which said actuating member is adapted to be moved, a movable contact member, a coupling member movable with said contact member and having a guide slot therein along which said actuating member is also adapted to be moved, said guide slot being disposed with respect to said guide means so that movement of said actuating member back and forth along said guide means moves said contact member to open and closed position, a pivotally mounted operating member, and yielding means operatively connecting the operating member to the actuating member for moving the latter.

5. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said movable contact member, a movable support, current responsive means for releasably holding said support in operative position, said support having a guide along which said actuating member is adapted to be moved, means for moving said actuating member back and forth along said guide to operate said contact member to open and closed

movable contact to closed position as said actuating member is moved along the guide in one direction.

5 6. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said movable contact member, a movable support, current responsive means for releasably holding said support in operative position, said support having a guide along which said actuating member is adapted to be moved, and yielding means for maintaining said actuating member in engagement with said guide, said yielding means being operable between predetermined positions with a snap action to operate said contact member to open and closed position with a snap action.

7. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said movable contact member, a movable support, current responsive means for releasably holding said support in operative position, said support having a guide along which said actuating member is adapted to be moved, and yielding means for moving said actuating member along said guide means to open or to closed circuit position with a snap action to operate said contact member to open or to closed circuit position with a snap action, said yielding means serving to maintain said actuating member in engagement with said guide means and to move said support when released to operate said contact member from the closed to the open circuit position.

8. In a circuit breaker, a frame, a contact member hingedly mounted within said frame, an actuating member operably connected to said contact member, a support within said frame having a guide surface thereon along which said actuating member is adapted to be moved, manually operable means having releasable pivotal engagement with said frame, and yielding means connecting said manually operable means and said actuating member for maintaining the actuating member in engagement with said guide surface and the manually operable means in pivotal engagement with said frame, said yielding means under the influence of said manually operable means being operable to move said actuating member between predetermined positions to operate said contact member to open and closed positions with snap action.

9. In a circuit breaker, a frame, a contact member hingedly mounted within said frame, an actuating member operably connected to said contact member, a movable support within said frame, current responsive means for releasably holding said support in operative position, said support having a guide surface thereon along which said actuating member is adapted to be moved, manually operable means having releasable pivotal engagement with said frame, and yielding means connecting said manually operable means and said actuating member for maintaining the actuating member in engagement with said surface and the manually operable means in pivotal engagement with said frame, and for moving said support when released to operate said contact member from the closed to the open position.

10. A circuit breaker comprising a base of insulating material, said base having a plurality of apertures therethrough, a plate on one side of said base of a material different from said base, said plate having apertures therethrough aligned

opposite side of said base having opposed substantially parallel side portions and a U-shaped end portion joining the side portions, said side portions having projections thereon extending through the apertures in said base and plate, at least a portion of said projections being clinched over against said plate to secure said frame to said base, a movable contact moving member hingedly mounted between the side portions of said frame, and an operating mechanism for said contact moving member mounted on said frame, said operating mechanism including means operable between predetermined positions for operating said contact moving member to open and closed positions with a snap action, the end portion of said frame serving as a stop for said contact moving member when in the open position.

11. A circuit breaker comprising a base of insulating material, said base having a plurality of apertures therethrough, a frame having opposed substantially parallel side portions and a U-shaped end portion joining the side portions, said side portions having projections thereon adapted to extend through the apertures in said base, at least a portion of said projections being clinched over to secure said frame to said base, a movable contact carrying member hingedly mounted between the side portions of said frame, a support pivotally mounted between the side portions of said frame, current responsive means for releasably holding said support in operative position, and an operating mechanism associated with said support including means operable between predetermined positions to operate said contact carrying member to open and closed positions and for moving said support when released to operate said contact carrying member from the closed to the open position, the end portion of said frame serving as a stop for limiting the movement of said support when in the released position.

12. In a circuit breaker, a movable contact member, an operating mechanism including yielding means operable between predetermined positions to move said contact member to open and closed positions with a snap action, said operating mechanism being adapted to retain said contact member in the closed position independently of said yielding means, current responsive means associated with said operating mechanism operative to cause said yielding means to operate said contact member from the closed to the open position, and auxiliary yielding means operable at least in the event of failure of said first named yielding means and independently thereof to move said contact member from the closed to the open position in response to the actuation of said current responsive means.

13. In a circuit breaker, a movable contact member, a movable support, current responsive means for releasably retaining said support in operative position, an operating mechanism associated with said support and including an overcenter spring operable to move said contact member to open and closed position with a snap action and to move said support when released to operate said contact member from the closed to the open position, said operating mechanism retaining said contact member in the closed position independently of said overcenter spring, and an auxiliary spring associated with said contact member operable at least in the event of failure of said overcenter spring and in-

dependently thereof to move said support when released to operate said contact member from the closed to the open position.

14. In a circuit breaker, a movable contact member, means including a support member movable from a normal to a tripped position to operate said contact member from the closed to the open position, a latch element adjustably mounted on said movable member, an electro-responsive means normally having overlapping engagement with the latch element of said movable support member to retain said movable member in its normal position, and a rotatable cam member operable to adjust said latch element with respect to said support for varying the amount of overlap between said latch element and said electro-responsive means.

15. In a circuit breaker, a movable contact member, actuating means for moving said contact member to open and to closed circuit position, said actuating means including a member movable from a normal position to a tripped position to cause said contact member to move from the closed to the open circuit position, means for biasing said movable member to move to its tripped position, said movable member having a latch portion, an electroresponsive means, a latch member mounted on said electroresponsive means normally in overlapping engagement with said latch portion and through which said movable member is maintained in its normal position against its bias, said latch member being adjustably mounted on said electro-responsive means for varying the amount of overlap with said latch portion.

16. In a multi-pole circuit breaker, a plurality of movable contact members, a rotatable member secured to each of said contact members, means of insulating material for rigidly coupling said rotatable members to form a rotatable structure, the axis of rotation of said insulating coupling means being aligned with the axes of said rotatable members, and means operably connected to said rotatable structure for moving said contact members to open and to closed positions.

17. In a multi-pole circuit breaker, a casing of insulating material having a partition wall to form separate compartments therein, a movable contact member in each compartment, a rotatable member rigidly secured to each of said contact members, means of insulating material for rigidly coupling said rotatable members to form a unitary rotatable structure, said partition wall having an aperture therein through which said coupling means is adapted to extend, and means associated with said coupling means adapted to cooperate with the walls of said aperture to provide a flash proof joint between adjacent poles.

18. In a multi-pole circuit breaker, a casing of insulating material having a partition wall to form separate compartments therein, a movable contact member in each compartment, a rotatable member rigidly secured to each of said contact members, means of insulating material for rigidly coupling said rotatable members to form a unitary rotatable structure, said partition wall having an aperture therein through which said coupling means is adapted to extend, said partition wall having a continuous recess surrounding said aperture and in communication therewith, and an outwardly extending flange upon said coupling means adapted to operatively register with said recess to provide a flash-proof joint between adjacent poles.

19. In a circuit breaker, a movable contact

member, an actuating member, means connecting said actuating member and said movable contact member, guide means along which said actuating member is adapted to be moved, and means for moving said actuating member along said guide means to open or to closed circuit position with a snap action to operate said contact member to open or to closed circuit position with a snap action, said guide means serving to positively lock said contact member in closed circuit position against any opening force applied to said member when said actuating member is in the closed circuit position.

20. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said movable contact member, guide means along which said actuating member is adapted to be moved, and yielding means for moving said actuating member along said guide means to open or to closed circuit position with a snap action to operate said contact member to open or to closed circuit position with a snap action, said guide means serving to positively lock said contact member in closed circuit position against any opening force applied to said member when said actuating member is in the closed circuit position.

21. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said movable contact member, means including a curved guide surface over which said actuating member is adapted to ride and means for moving said actuating member over said surface to open or closed position with a snap action to operate said contact member to open or to closed circuit position with a snap action, the curvature of said surface at the closed position of said actuating member being so disposed relative to the line of action of said connecting means that said contact member is positively locked in the closed circuit position against any force acting thereon tending to open the same.

22. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said movable contact member, means including a curved guide surface over which said actuating member is adapted to ride and yielding means for moving said actuating member over said surface to open or closed position with a snap action to operate said contact member to open or to closed circuit position with a snap action, the curvature of said surface at the closed position of said actuating member being so disposed relative to the line of action of said connecting means that said contact member is positively locked in the closed circuit position against any force acting thereon tending to open the same.

23. In a circuit breaker, a movable contact member, an actuating member, a link pivotally connecting said actuating member and said contact member, guide means along which said actuating member is adapted to be moved, a pivotally mounted operating member and a spring means operatively connecting said operating member and said actuating member for moving said actuating member along said guide means to open or to closed circuit position with a snap action to operate said contact member to open or to closed circuit position with a snap action, the configuration of said guide means adjacent the closed circuit position of said actuating member being so disposed relative to the line

or action of said connecting link between said actuating member and the contact member that said contact member is positively locked in closed circuit position against any force applied to the contact member tending to open the same.

24. In a circuit breaker, a movable contact member, an actuating member, a link pivotally connecting said actuating member and said contact member, guide means along which said actuating member is adapted to be moved, a pivotally mounted operating member and a spring means operatively connecting said operating member and said actuating member for moving said actuating member along said guide means to open or to closed circuit position with a snap action to operate said contact member to open or to closed circuit position with a snap action, said guide means being so shaped that it serves to lock said contact member in closed circuit position against any force applied to the contact member tending to open the same.

25. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said movable contact member, guide means along which said actuating member is adapted to be moved, and means for moving said actuating member along said guide means to open or to closed circuit position with a snap action to operate said contact member to open or to closed circuit position with a snap action, said guide means serving to positively lock said contact member in closed circuit position against any opening force applied to said member when said actuating member is in the closed circuit position, and current responsive means associated with said guide means for operating said contact member from the closed to the open circuit position in response to predetermined conditions.

26. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said contact member, means including a guide surface over which said actuating member is adapted to be moved, means for moving said actuating member back and forth over said guide surface to operate said contact member to open and to closed circuit position, said surface acting in the manner of a cam to move said contact member through said connecting means to closed position when said actuating member is moved in one direction over said surface.

27. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said contact member, a support having a guide surface over which said actuating member is adapted to be moved, means for moving said actuating member back and forth over said surface with a snap action to operate said contact member to open and to closed circuit position with a snap action, said surface acting in the manner of a cam to move said contact member through said connecting means to closed circuit position when said actuating member is moved in one direction over said surface.

28. In a circuit breaker, a movable contact member, an actuating member, means connecting said actuating member and said movable contact member, a movable support, current responsive means for releasably holding said support in operative position, said support having a guide along which said actuating member is adapted to be moved, means for moving said ac-

tuating member to open and to closed position, said guide being shaped to cause said movable contact member to be moved to closed position as said actuating member is moved in one direction along the guide, and to positively lock said contact member in closed position against any force tending to move the same to open circuit position applied to the contact member.

29. In a circuit breaker, relatively movable contact means for opening and closing the circuit, a movable contact operating member, a guide surface on said contact operating member, actuating means having a portion by which it may be actuated and a portion movable along said guide surface for moving said contact means with a snap action to open or to close the circuit, said contact operating member remaining stationary during normal opening and closing operations of said contact means by said actuating means, and current responsive means operable to cause movement of said contact operating member to open the circuit independently of the position in which the said portion of the actuating means by which the actuating means may be moved is held.

30. In a circuit breaker, relatively movable contact means, a pivoted contact operating member having a guide surface, actuating means comprising an actuating member movable along said guide surface for actuating said contact means to open or to closed position, a movable operating handle and an overcenter spring for moving said actuating member along said guide surface, said contact operating member remaining stationary during normal opening and closing operations of said contact means by said actuating means, and current responsive means operable to cause movement of said contact operating member to open said contact means irrespective of the position in which said operating handle is held.

31. In a multipole circuit breaker, a plurality of movable contact members, a rotatable member secured to each of said contact members, bearing means rotatably mounting said rotatable members in axial alignment, and means of insulating material coupling said rotatable members together to form a unitary rotatable structure.

32. In a multipole circuit breaker, a plurality of rotatable shafts mounted in axial alignment, a movable contact connected to each of said shafts by a resilient arm, and means of insulating material coupling said shafts together to form a unitary rotatable structure.

33. In a multipole circuit breaker, a plurality of movable contact members, a rotatable member of conducting material connected to each of said contact members, bearing means rotatably mounting said rotatable members in axial alignment, and means of insulating material coupling said rotatable members together to form a common rotatable structure, said insulating means serving to electrically insulate said contact members from each other.

34. In a multipole circuit breaker, a casing of insulating material having a partition wall forming separate compartments therein, a movable contact member in each compartment, a rotatable member secured to each of said contact members, means of insulating material rigidly coupling said rotatable members to form a unitary rotatable structure, said partition wall having an aperture therein through which said insulating coupling means extends.

35. In a circuit interrupter, relatively movable

contacts, a contact actuating member movable to open and to close said contacts, a movable support having a guide surface along which said actuating member is movable, means releasably retaining said support in a normal position, and means including an overcenter spring for moving said contact actuating member along said guide surface to open and to close said contacts, said support when released causing opening of said contacts.

36. In a circuit interrupter, relatively movable contacts, a contact actuating member movable to open and to close said contacts, a movable support having a guide surface along which said actuating member is movable, means releasably retaining said support in a normal position, and means including a spring for moving said contact actuating member back and forth along said guide surface to open and to close said contacts, said spring moving said support when the support is released to cause opening of said contacts.

37. In a circuit interrupter, relatively movable contacts, a contact actuating member movable to open and to close said contacts, a movable support having guide means along which said actuating member is movable, trip means releasably retaining said support in a normal position, and means including an operating handle movable to open and to closed positions and a spring moved by said handle for moving said contact actuating member along said guide means to open and to close said contacts, said support when released by operation of said trip means causing automatic opening of said contacts, and also causing movement of said operating handle to an indicating position different from the manual open and closed positions.

38. In a circuit interrupter, relatively movable contacts, a member releasable to cause automatic opening of said contacts, said member having a guide means, trip means releasably retaining said

releasable member in a normal position, and an element movable back and forth along said guide means for actuating said contacts to open or to close the same.

39. In a circuit interrupter, relatively movable contacts, a member movable when released to cause automatic opening of said contacts, said member having a guide surface, means releasably retaining said member in a normal position, actuating means including an element movable along said guide surface for actuating said contacts to open or to close the same, and an actuating spring for moving said element along said guide surface and for moving said releasable member when said releasable member is released.

40. In a circuit interrupter, relatively movable contacts, a movable support having a guide surface, means for releasably retaining said support in a normal position, a contact actuating member movable along said guide surface to open or close said contacts, and means including an overcenter spring for moving said actuating member along said guide surface, said spring acting to move the support when the support is released to cause automatic opening of said contacts.

41. In a multipole circuit breaker, a casing of insulating material having a partition wall forming divided chambers therein, a movable contact member in each chamber, a rotatable member secured to each of said contact members, means of insulating material rigidly coupling said rotatable members to form a unitary rotatable structure, said partition wall having an aperture therein through which said insulating coupling means extends, and said insulating coupling means having a flange portion of greater size than said aperture which cooperates with the partition wall at said aperture for preventing flashover between adjacent poles of the breaker.

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