Jan. 12, 1954 J. G. JACKSON 2,666,114

CIRCUIT BREAKER

Filed March 24, 1951 2 Sheets-Sheet 1

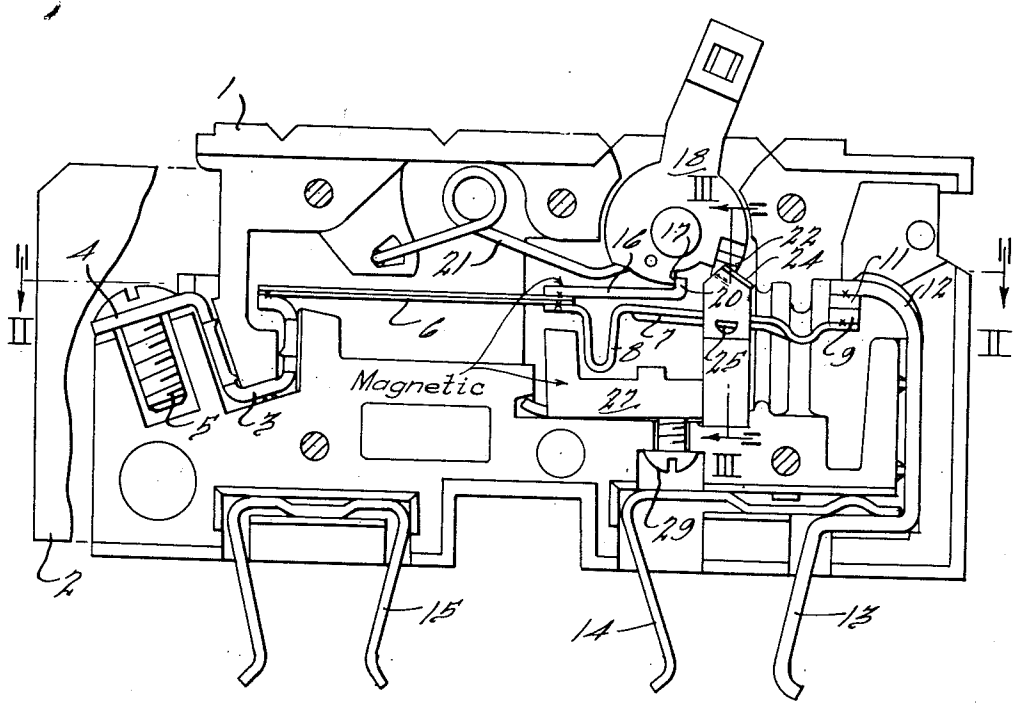


Fig. 1.

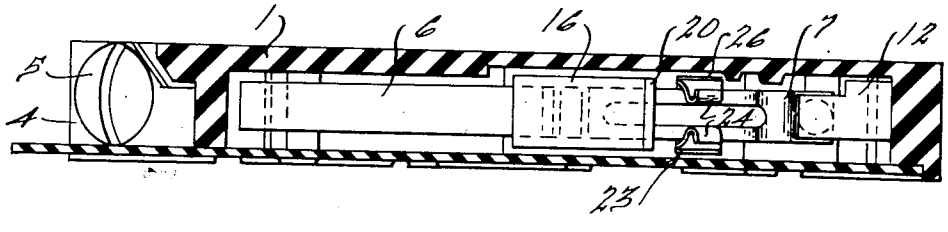


Fig. 2.

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2 Sheets-Sheet 2

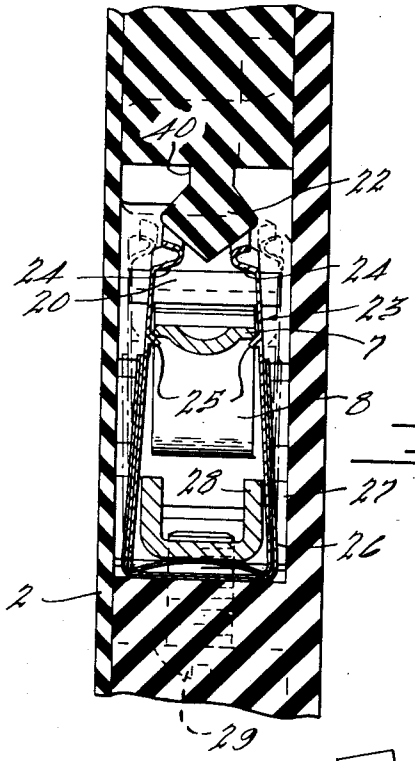


Fig. 3.

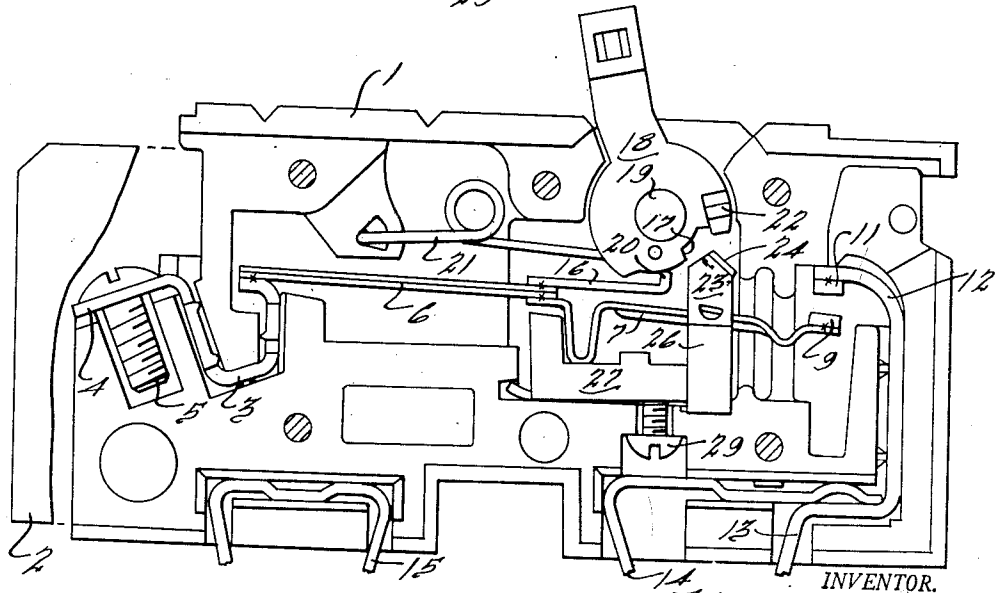


Fig. 4.

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UNITED STATES PATENT OFFICE

2,666,114

CIRCUIT BREAKER

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Application March 24, 1951, Serial No. 217,330

31 Claims. (Cl. 200—116)

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This invention relates to apparatus for making and breaking electric circuits and more particularly to an electric circuit breaker manually operable for switching operation and automatically operable to break the circuit in response to a current overload.

An object of the present invention is to provide an improved automatic electric circuit breaker which is of extreme simplicity of construction and assembly, which employs a minimum of parts, and which may be produced at low cost.

Another object of the present invention is a circuit breaker in accordance with the preceding object in which the electrical circuit through this breaker is both closed and opened with a snap action, the breaker, however, employing no over-center spring.

Another object of the present invention is the provision of a circuit breaker having novel calibration characteristics.

Another object of the present invention is the provision of an automatic electric circuit breaker having new and improved means for effecting ambient temperature compensation.

Another object is the provision of a circuit breaker having a bimetallic member having a fixed and a free end, a movable contact carrying arm being fixedly mounted to the free end of the bimetallic member, a resilient latch being provided for engaging the contact carrying arm and preventing its movement from one to the other of two operating positions, the latch being releasable upon the application of sufficient force to the contact arm.

Another object is the provision of a circuit breaker having a bimetallic member through which current flows having fixed and free ends, to the free end of which is fixedly mounted a contact carrying arm, a latch being provided which is biased to engage the contact carrying arm to normally prevent its movement, the latch, however, being releasable in at least one direction upon the application of sufficient force thereto by the contact arm by flexure of the bimetallic member or by manual operation.

Other objects and features of the invention will be readily apparent to those skilled in the art from the specification and appended drawing illustrating certain preferred embodiments in which:

Figure 1 is a side elevational view of a circuit breaker assembly with the side cover broken away to show the internal parts.

Figure 2 is a sectional view along the line II—II of Figure 1.

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Figure 3 is an enlarged partial sectional view along the line III—III of Figure 1.

Figure 4 is a view similar to that of Figure 1 showing the parts in the "off" position.

Figure 1 illustrates the device of the present invention with the parts in the normal "on" position. As shown therein, the device comprises a box-like base 1 of insulating material having an open side which is normally closed by a flat cover piece 2 also of insulating material, the cover piece 2 being attached to the base 1 by suitable means such as spun-over rivets, not shown. Integrally molded into the base 1 are a plurality of recesses of three sides, one of these sides being the back wall of the base 1. Into one of these recesses, at the left of Figure 1, there is pressed a terminal member 3 having an end 4 which projects beyond one end wall of the base 1 and receives there a terminal screw 5. To the other end of the terminal member 3 there is welded a main bimetal 6, the high expansion side of which forms the upper surface as viewed in Figure 1. To the other end of the main bimetal 6 there is welded a movable contact arm 7, having a return bent loop portion 8 near the bimetal 6, and carrying a movable contact 9 at its free end. The arm 7 is formed of a resilient spring strip and is strengthened by a stiffening rib over that portion between loop 8 and contact 9 to rigidify the same, while the loop portion 8 is not so stiffened so that it is readily deformed against its inherent resilience.

Disposed so as to cooperate with the movable contact 9 is a fixed contact 11 which is welded to a contact terminal 12, fitted into suitable recesses molded into the base 1. Terminal 12 has a projection 13 which protrudes through a recess in the bottom of base 1, the projection 13 and a jaw spring 14, which is also positioned within a base 1 recess, serving to provide for resiliently clamping the breaker to a bus bar. Spaced from the cooperating members 13 and 14 an amount equal to the spacing between adjacent bus bars employed with the circuit breaker is a non-current carrying bus jaw 15 which is fitted into a base 1 recess, and which has dependent resilient arms which, in the mounted position of the circuit breaker help hold it in position upon the bus bar structure, this bus jaw 15 being in no way connected to any of the current carrying parts of the circuit breaker.

To the free end of the main bimetal 6 there is welded at one end a magnetic armature plate 16 having an upturned flange 20 at its free end which cooperates with a first cam 17 of a manual

operating handle 18. The handle 18 also has formed integrally thereon a second cam 22 of a cross section particularly illustrated in Figure 3. The handle 18 is rotatably mounted upon a pivot pin 19 integral with, and projecting from, the side of base 1, the handle 18 being biased toward the position shown in Figure 4 by a handle spring 21.

Mounted on base 1 with its legs embracing contact arm 7 is a resilient latch member 23 of generally U-shape, as illustrated in Figure 3. The ends of the legs of the latch member 23 are formed into inwardly directed loops 24 of generally U-shape, while projecting inwardly from each of the legs of latch 23 is a latch ear 25 engageable with contact arm 7. As may be seen in Figure 3, the bight of the latch member 23 is concave in cross section. An ambient temperature compensating bimetal 26, which is also of U-shape, is disposed about the lower portion of the latch member 23, the high expansion side of bimetal 26 comprising the outer surface.

Mounted within a suitable recess in the base 1 is a yoke 27 of magnetic material which is of cross sectional U-shape, the yoke 27 having an end extension 28 of reduced width which projects between the legs of the latch 23 and rests upon the concave bottom surface thereof. Threaded into a suitable aperture in the bottom surface of the yoke 27 is an adjusting screw 29 which is fitted into a recess in base 1 and which is accessible when jaw spring 14 is removed. As will be seen from an inspection of Figure 3, rotation of the adjusting screw 29 will vary the position of the extension 28 and hence the concavity of the bight of the latch 23. As the concavity of the bight varies, the inherent bias of the latching legs will vary inversely therewith to vary the force required to be exerted on ears 25 by contact arm 7 to effect movement of contact 9 to "off" position.

It will be readily seen that the assembly of the parts into the base is an extremely simple operation which comprises merely fitting the parts into their allotted positions in base 1 and affixing the cover 2 to the base to close the open side of the base. After assembly, the bimetal 6 and contact arm 7 are given an initial set so that they will move the contact 9 to engaged position when the legs of latch 23 are separated. This is the "on" position with the contact arm 7 above the ears 25 as shown in Figures 1 and 3. For any given design of breaker as to size and material, it will be determined what force it is necessary to exert at the free end of bimetal 6 to effect unlatching movement of the contact arm 7 at the desired current rating. In calibrating the breaker, this force is applied to the free end of the bimetal 6 and the screw 29 is adjusted to vary the position of the projection 28 and, hence, the cavity of the latch 23 until the proper bias is placed on the latch legs to release the contact arm 7 at the predetermined pressure and, hence, at the desired current rating. After this adjustment has been effected, changes in ambient temperature will cause the compensating bimetal 26 to vary the bias on the legs of latch 23, thus tending to maintain relatively constant the current-time tripping characteristic of the breaker. For example, upon an increase in ambient temperature, the bimetal 26 urges the legs of latch 23 inwardly, increasing the force which contact arm 7 must exert on ears 25 to move to "off" position.

The initial bias to bimetal 6 and contact arm 7 causes contacts 9 and 11 to engage. The operating contact pressure between the contacts is supplied through the bias of the legs of latch 23 operating through the upper inclined surfaces of ears 25 on the under edges of contact arm 7. This pressure is increased as energy is stored in loop 8 prior to both manual and automatic tripping as hereinafter described.

The operation of the circuit breaker will now be described:

The parts are shown in Figure 1 in closed circuit or "on" position. To open the circuit, handle 18 is rotated in a counterclockwise direction. The initial force exerted on handle 18 in this direction is transformed into a downward force on plate 16, through the engagement of cam 17 and flange 20. This initial downward force on plate 16 is transmitted to the free end of bimetal 6 which moves the attached end of contact arm 7 downwardly. Inasmuch as the loop portion 8 of the movable contact arm 7 is relatively resilient, and the remainder of the contact arm 7 is relatively stiff, the initial effect of this movement is a stressing of the portion 8 and a partial rotation of the movable contact arm 7 about the ears 25 of latch member 23 as a fulcrum. Movable contact 9 is urged more tightly against the fixed contact 11 as this partial rotation occurs. The pressure applied to the movable contact arm 7 will be increased upon further rotation of handle 18 until such time as the legs of latch 23 will no longer be able to hold the movable contact arm 7. When this condition is reached, the legs of latch 23 are forced apart and the contact arm 7 will be moved with a snap action resulting from the rapid release of the energy stored in portion 8 past the ears 25 to a position below them, the movable contact 9 being thus quickly separated from the fixed contact 11. The legs of resilient latch 23 will snap back into the position illustrated in full lines in Figure 3 as the arm 7 passes ears 25, and these protruding ears will prevent the arm 7 from moving to the closed circuit position until the legs of latch 23 are again separated by the cam 22 of handle 18. The position of the parts in the "off" position is shown in Figure 4.

With the parts in the "on" position, should a sustained overload occur which is of a magnitude to cause the main bimetal 6 to be sufficiently deflected, the end of the bimetal 6 connected to the movable contact arm 7 will cause, initially, a rotation of the contact arm 7 about the ears 25 and a stressing of the resilient portion 8, in exactly the same manner as was previously described for the manual opening of the contacts. When sufficient pressure is exerted by the bimetal 6, contact arm 7 will snap past ears 25 into the "off" position. Flange 20 will disengage cam 17 and handle 18 will be moved counterclockwise under the bias of spring 21. The parts in this automatically tripped position are again as shown in Figure 4.

To move the parts from the "off" position of Figure 4 to the "on" position of Figure 1, handle 18 is rotated in the clockwise direction. In this movement, flange 20 rides along the undersurface of handle 18 until it has passed the cam 17 of the handle. Contact arm 7 will then rise until it engages the undersurfaces of ears 25. As the handle rotation is continued, the end loops 24 of the latch member 23 are engaged by the cam 22 of handle 18 to spread apart the legs of the latch member 23 until they are sufficiently spaced to permit the contact arm 7 to clear the under edges of ears 25. When this oc-

curs, the contact arm 7 will snap the movable contact 9 into engagement with the fixed contact 11, the snap action resulting from the inherent bias of the main bimetal 6 and arm 7 toward the closed circuit position. The maximum deflection of the legs of the latch member 23 is indicated in dotted lines in Figure 3. Release of handle 18 will then permit spring 21 to rotate the handle to the position shown in Figure 1 in which cam 17 is engaged by the flange 20 of plate 16 to index the handle position. The legs of latch 23 will then spring back to the full line position of Figure 3, and the upper surface of ears 25 will engage the under edges of arm 7 to strongly bias it upwardly thereby increasing the contact pressure. As will be seen from Figure 3, the configuration of the cam 22 is such that when the handle 18 is rottaed to its maximum clockwise position, the legs of latch 23 will once again be permitted to move inwardly to the position illustrated in full lines in Figure 3, loops 24 being received in recesses 40. This position is unstable and the parts will return to the position of Figure 1 when handle 18 is released. It should be noted that the circuit breaker will open under overload regardless of the handle position, and should the handle 18 be held in the fully rotated clockwise position, upon the occurrence of an overload, the snap-open action described will also occur due to the fact that the legs of the latch 23 will be in the full line position of Figure 3, having been permitted to move to this position by the configuration of cam 22.

With the circuit breaker in the "on" position, should a heavy current overload through the circuit breaker occur, the flux emanating from such overload current will cause the magnetic armature plate 16 to be attracted to the core 27, the resulting force upon the contact arm 7 being sufficient to effect a snap opening of the movable contact 9 away from the fixed contact 11 in a manner similar to the opening on manual operation and on bimetal flexure.

It will, therefore, readily appear that the circuit breaker of the present invention is one which accomplishes a quick-make and quick-break trip-free action, and which provides for the achievement of these desirable effects at a very minimum of cost with a minimum of parts and without the use of an over-center spring. Furthermore, it will be seen that the calibration of the circuit breaker of the present invention is effected in an extremely simple and reliable manner which was unknown in prior mechanisms, and that the device has been so constructed and arranged that the value of current which causes automatic opening of the contacts for the circuit breaker will not change substantially upon variations in ambient temperature.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. In a circuit breaker, a fixed contact, movable contact means disposed to cooperate with said fixed contact whereby an electrical circuit may be completed through said circuit breaker, means for electrically connecting said circuit breaker to exterior electrical circuits, current responsive means normally biasing said movable contact means toward closed circuit position, means for holding said movable contact away from said fixed contact, and manual means for moving said movable contact means into engagement with said holding means and for effecting the release of said movable contact means from said holding means whereby said movable contact means will engage said fixed contact to close the electrical circuit through the circuit breaker.

2. In a circuit breaker, a fixed contact, movable contact means disposed to cooperate with said fixed contact whereby an electrical circuit may be completed through said circuit breaker, means for electrically connecting said circuit breaker to exterior electrical circuits, current responsive means normally biasing said movable contact means toward closed circuit position and biasing said movable contact means toward open circuit position upon the occurrence of abnormal current conditions within said circuit breaker, means opposing the movement of said movable contact means from open circuit position to closed circuit position and vice versa, said current responsive means having sufficient strength to overcome said opposing means upon the occurrence of abnormal current conditions whereby to effect an opening movement of said movable contact arm to break the electrical circuit through the circuit breaker, and manual means for overcoming said opposing means to move said movable contact to open and closed circuit positions at will.

3. In a circuit breaker, a fixed contact, a movable contact having a supporting arm therefor movable to open and closed circuit positions, means for connecting said circuit breaker to exterior electrical circuits, current responsive means for biasing said arm toward closed circuit position, a latch opposing movement of said arm from closed to open circuit position, and a manually operable handle for applying pressure to said arm to effect movement thereof past said latch to open circuit position, said current responsive means effecting movement of said arm past said latch upon the occurrence of abnormal current conditions for automatically moving said supporting arm to open circuit position.

4. In a circuit breaker, a fixed contact, a movable contact having a supporting arm therefor movable to open and closed circuit positions, means for connecting said circuit breaker to exterior electrical circuits, current responsive means for biasing said arm toward closed circuit position, a movable latch normally opposing movement of said arm from closed to open circuit positions, and a manual handle operable to force said arm past said latch to move the arm and movable contact to open circuit position.

5. In a circuit breaker, a fixed contact, a movable contact having a supporting arm therefor movable to open and closed circuit positions, means for connecting said circuit breaker to exterior electrical circuits, current responsive means normally biasing said arm toward closed circuit position, a movable latch having projections normally opposing movement of said arm from either one to the other of said circuit positions, and a manual handle operable to overcome the effect of said latch to move said arm from either one to the other of said circuit positions at will, said current responsive means reversing the bias applied to said arm upon the occurrence of abnormal current conditions to effect move-

ment of said arm from closed to open circuit position.

6. In a circuit breaker, a fixed contact, a movable contact having a supporting arm therefor movable to open and closed circuit positions, means for connecting said circuit breaker to exterior electrical circuits, bimetallic means normally biasing said arm toward closed circuit position but reversing this bias upon the occurrence of abnormal current conditions, a resilient generally U-shaped latch having the legs thereof disposed at opposite sides of said arm, projections extending inwardly from said legs into the path said arm traverses during changes in circuit positions to prevent such changes, and manual means operable to effect the withdrawal of said projections from said path whereby said arm may move to closed circuit position, said bimetallic means having sufficient strength upon the occurrence of abnormal current conditions to effect the movement of said arm past said projections to the open circuit condition.

7. In a circuit breaker, a fixed contact, a movable contact having a supporting arm therefor movable to open and closed circuit positions, means for connecting said circuit breaker to exterior electrical circuits, bimetallic means normally biasing said arm toward closed circuit position but reversing this bias upon the occurrence of abnormal current conditions, a resilient, generally U-shaped latch having the legs thereof disposed at opposite sides of said arm, projections extending inwardly from said legs into the path said arm traverses during changes in circuit positions to oppose such changes, adjustable means to vary the relationship between said projections and said arm to vary the calibration of said circuit breaker, and manual means operable to effect the withdrawal of said projections from said path whereby said arm may move to closed circuit position, said bimetallic means having sufficient strength upon the occurrence of abnormal current conditions to effect the movement of said arm past said projections to the open circuit condition.

8. In a circuit breaker, fixed and movable contacts, a supporting arm for said movable contact, means for electrically connecting said circuit breaker to external electrical circuits, a resilient U-shaped latch, means mounting said latch so that the legs thereof are adjacent opposite sides of said arm and extend substantially in the direction of movement of said arm, projections extending inwardly from the legs of said latch and into the path said arm traverses as said movable contact is moved from open to closed circuit positions and vice versa, said latch and projections having sufficient rigidity to normally prevent movement of said arm past said projections, means for applying force to said arm to tend to move it from one circuit position to the other, and adjustable means for varying the relationship between said projections and said arm to effect the calibration of said circuit breaker, at least a portion of said force applying means being current responsive and having sufficient strength to move said arm past said projections upon the occurrence of abnormal current conditions to effect an opening of the electrical circuit through the circuit breaker.

9. In a circuit breaker, fixed and movable contacts, a supporting arm for said movable contact, means for electrically connecting said circuit breaker to external electrical circuits, a resilient U-shaped latch, means mounting said latch so that the legs thereof are adjacent opposite sides of said arm and extend substantially in the direction of movement of said arm, projections extending inwardly from the legs of said latch and into the path said arm traverses as said movable contact is moved from open to closed circuit positions and vice versa, said latch and projections having sufficient rigidity to normally prevent movement of said arm past said projections, means for applying force to said arm to tend to move it from one circuit position to the other, adjustable means for varying the relationship between said projections and said arm to effect calibration of said circuit breaker, and thermally responsive means for further varying the relationship between the projections and arm upon changes in ambient temperature, at least a portion of said force applying means being current responsive and having sufficient strength to move said arm past said projections upon the occurrence of abnormal current conditions to effect an opening of the electrical circuit through the circuit breaker.

10. In a circuit breaker, fixed and movable contacts, a supporting arm for said movable contact, means for electrically connecting said circuit breaker to external electrical circuits, a resilient U-shaped latch, means mounting said latch so that the legs thereof are adjacent opposite sides of said arm and extend substantially in the direction of movement of said arm, projections extending inwardly from the legs of said latch and into the path said arm traverses as said movable contact is moved from open to closed circuit positions and vice versa, said latch and projections having sufficient rigidity to normally prevent movement of said arm past said projections, means for applying force to said arm to tend to move it from one circuit position to the other, adjustable means for varying the relationship between said projections and said arm to effect calibration of said circuit breaker, a generally U-shaped bimetal embracing said latch for varying the relationship between said projections and said arm upon changes in ambient temperature to maintain relatively constant the value of current required to trip the circuit breaker, at least a portion of said force applying means being current responsive and having sufficient strength to move said arm past said projection upon the occurrence of abnormal current conditions to effect an opening of the electrical circuit through the circuit breaker.

11. In a circuit breaker, a fixed contact, a movable contact movable between open and closed circuit positions, a supporting arm for said movable contact, a terminal member, a bimetal mounted on said terminal member at one end having its other end mounting said supporting arm and normally biasing said movable contact toward closed circuit position, said bimetal tending to effect an opening movement of said arm upon the occurrence of abnormal currents, means for electrically connecting said fixed contact to an external electrical circuit, a latch of generally U-shape having said arm extending through the legs thereof, an ear extending inwardly from each of the legs of said latch to engage said arm and normally prevent its movement from one circuit position to the other, and manual means rotatable for effecting divergence of the legs of said latch and consequent withdrawal of said ears from the path of said arm whereby said arm may move under the influence of the bias applied thereto, said bimetal apply-

ing a bias to said arm upon the occurrence of abnormal current conditions which is of sufficient force to effect divergence of the legs of said latch whereby said arm may carry the movable contact to the open circuit position.

12. In a circuit breaker, a fixed contact, a movable contact movable between open and closed circuit positions, a supporting arm for said movable contact, a terminal member, a bimetal mounted on said terminal member at one end and having its other end mounting said supporting arm and normally biasing said movable contact toward closed circuit position, said bimetal tending to effect an opening movement of said arm upon the occurrence of abnormal currents, means for electrically connecting said fixed contact to an external electrical circuit, a latch of generally U-shape having said arm extending through the legs thereof, an ear extending inwardly from each of the legs of said latch to engage said arm and normally prevent its movement from one circuit position to the other, each of said ears having a sloped surface which engages said contact arm in the closed circuit position and urges said arm toward closed circuit position, adjustable means for varying the relationship between said ears and said arm to effect calibration of said circuit breaker, and manual means rotatable for effecting divergence of the legs of said latch and consequent withdrawal of said ears from the path of said arm whereby said arm may move under the influence of the bias applied thereto, said bimetal applying a bias to said arm upon the occurrence of abnormal current conditions which is of sufficient force to effect divergence of the legs of said latch whereby said arm may carry the movable contact to the open circuit position.

13. In a circuit breaker, a fixed contact, movable contact means disposed to cooperate with said fixed contact whereby an electrical circuit may be completed through said circuit breaker, means for electrically connecting said circuit breaker to exterior electrical circuits, current responsive means normally biasing said movable contact means toward closed circuit position and biasing said movable contact means toward open circuit position upon the occurrence of abnormal current conditions within said circuit breaker, means opposing the movement of said movable contact means from open circuit position to closed circuit position and vice versa, said current responsive means having sufficient strength to overcome said opposing means upon the occurrence of abnormal current conditions whereby to effect an opening movement of said movable contact arm to break the electrical circuit through the circuit breaker, and manual means for applying force to said movable contact means to move said movable contact to open circuit position at will.

14. In a circuit breaker, a fixed contact, movable contact means disposed to cooperate with said fixed contact whereby an electrical circuit may be completed through said circuit breaker, means for electrically connecting said circuit breaker to exterior electrical circuits, current responsive means normally biasing said movable contact means toward closed circuit position, means holding said movable contact means against its normal bias in the open circuit position of said movable contact means and aiding said normal bias in the closed circuit position of said movable contact means, and manual means for applying force to said movable contact means to move said movable contact to open circuit position at will.

15. In a circuit breaker, a fixed contact, current responsive means having fixed and free ends, a movable contact having a supporting arm therefor, resilient means joining a portion of said arm spaced from said movable contact to said free end, a latch positioned intermediate said movable contact and said resilient means for opposing movement of said arm from closed to open circuit position, and means including said current responsive means operable to stress said resilient means and to effect partial rotation of said supporting arm about said latch as a fulcrum, said resilent means when sufficiently stressed effecting snapping said supporting arm past said latch to open circuit position.

16. In a circuit breaker, a fixed contact, current responsive means having fixed and free ends, a movable contact cooperating with said fixed contact, a supporting arm for said movable contact having a resilient portion spaced from said movable contact joined to said free end, a resilient latch having means for engaging said supporting arm intermediate said movable contact and said resilient portion and opposing movement of said arm from closed to open circuit position, a manually operable handle for stressing said resilient portion to effect movement of said arm past said latch to open circuit position, said current responsive means stressing said resilient portion upon the occurrence of abnormal current conditions for automatically moving said supporting arm to open circuit position, the initial stressing of said resilient portion being accompanied by a rotation of said supporting arm about said latch as a fulcrum to increase the contact pressure.

17. In a circuit breaker, a fixed contact, a movable contact, a resilient supporting arm, means mounting said movable contact to one portion of said arm, current responsive means having fixed and free ends, means joining said free end to said arm at a position spaced from said movable contact, said current responsive means normally biasing said movable contact toward said fixed contact, a resilient latch having means for engaging said supporting arm at a position spaced from said movable contact for opposing movement of said arm from closed to open circuit position, a manually operable handle for applying pressure to said arm to effect movement of said arm past said latch to open circuit position, said current responsive means applying pressure to said arm upon the occurrence of abnormal current conditions to effect movement of said arm past said latch to open circuit position automatically, said resilient arm initially rotating about said latch as a fulcrum and when sufficiently stressed snapping past the latch to effect rapid separation of said movable contact from said fixed contact.

18. In a circuit breaker, a fixed contact, a movable contact having a supporting arm therefor movable to open and closed circuit positions, current responsive means normally biasing said supporting arm to closed circuit position but reversing the bias applied thereto upon the occurrence of abnormal circuit conditions for automatically moving said supporting arm to open circuit position, a latch engaging said arm for opposing its movement from open to closed circuit position and vice versa, manual means for applying force to said arm to move said arm past the latch to open circuit position and for releasing

said latch to permit said arm to move to closed circuit position, and resilient means for effecting rapid and substantial separation of said movable contact from said fixed contact as said arm is moved past said latch toward open circuit position.

19. In a circuit breaker, a fixed contact, a bimetal having fixed and free ends, an arm, a movable contact, means mounting said movable contact to one end of said arm, resilient means joining the free end of said bimetal to a portion of said arm spaced from said movable contact, said bimetal normally biasing said movable contact toward said fixed contact but reversing the bias upon the occurrence of abnormal circuit conditions for automatically moving said arm to open circuit position, a latch engaging said arm intermediate said movable contact and said resilient means and opposing movement of said arm from closed to open position and vice versa, a manually operable handle for applying force to said arm to move it past said latch to open circuit position and for engaging and withdrawing said latch to permit said arm to move to closed circuit position, said resilient means being stressed by both said bimetal and handle actions before movement of the arm to open circuit position and effecting such opening movement with a snap action.

20. In a circuit breaker, a fixed contact, a bimetallic member having fixed and free ends, a movable contact cooperating with said fixed contact, a supporting arm for said movable contact mounted on the free end of said bimetallic member and having a resilient loop portion adjacent to its mounting end, said bimetallic member and arm normally biasing said movable contact toward closed circuit position, a resilient latch engaging said supporting arm intermediate said movable contact and said resilient portion and opposing movement of said arm from closed to open circuit position and vice versa, a manually operable handle for stressing said resilient portion to effect movement of said arm past said latch to open circuit position at will and for engaging and withdrawing said latch to permit said arm to move to closed circuit position under its normal bias, said bimetallic member stressing said resilient portion upon the occurrence of abnormal current conditions to automatically move said supporting arm to open circuit position, said resilient portion when sufficiently stressed effecting snap movement of said supporting arm past said latch to open circuit position.

21. In a circuit breaker, a fixed contact, a bimetallic member having fixed and free ends, a movable contact cooperating with said fixed contact, a supporting arm for said movable contact mounted on the free end of said bimetallic member and having a resilient loop portion adjacent to its mounting end, said bimetallic member and arm normally biasing said movable contact toward closed circuit position, a resilient latch engaging said supporting arm intermediate said movable contact and said resilient portion and opposing movement of said arm from closed to open circuit position and vice versa, a manually operable handle for stressing said resilient portion to effect movement of said arm past said latch to open circuit position at will and for engaging and withdrawing said latch to permit said arm to move to closed circuit position under its normal bias, said bimetallic member stressing said resilient portion upon the occurrence of abnormal current conditions to automatically move said supporting arm to open circuit position, the initial stressing of said resilient portion tending to rotate said supporting arm about said latch as a fulcrum to increase the contact pressure.

22. In a circuit breaker, a fixed contact, a movable contact, a supporting arm for said movable contact movable to open and closed circuit positions, means for connecting said circuit breaker to exterior electrical circuits, bimetallic means normally biasing said arm toward closed circuit position but reversing this bias upon the occurrence of abnormal current conditions, a resilient generally U-shaped latch having the legs thereof disposed at opposite sides of said arm, projections extending inwardly from said legs into the path said arm traverses during changes in circuit positions to oppose such changes, said projections having surfaces thereon which hold said arm in open circuit position and other surfaces which urge said arm toward closed circuit position, and manual means operable to effect the withdrawal of said projections from said path whereby said arm may move to closed circuit position, said bimetallic means flexing sufficiently upon the occurrence of abnormal current conditions to effect the movement of said arm past said projections to the open circuit condition.

23. In a circuit breaker, a fixed contact, a movable contact, a supporting arm for said movable contact movable to open and closed circuit positions, means for connecting said circuit breaker to exterior electrical circuits, bimetallic means normally biasing said arm toward closed circuit position but reversing this bias upon the occurrence of abnormal current conditions, a resilient generally U-shaped latch having the legs thereof disposed at opposite sides of said arm, projections extending inwardly from said legs into the path said arm traverses during changes in circuit positions to oppose such changes, said projections having surfaces which engage the upper edges of said arm when said arm is in open circuit position to prevent its movement under its normal bias and other, inclined surfaces which engage the under edges of said arm when said arm is in closed circuit position to increase the contact pressure, and manual means operable to effect the withdrawal of said projections from said path whereby said arm may move to closed circuit position, said bimetallic means flexing sufficiently upon the occurrence of abnormal current conditions to effect movement of said arm past said projections to the open circuit condition.

24. In a circuit breaker, a fixed contact, a movable contact, a supporting arm for said movable contact movable to open and closed circuit positions, means for connecting said circuit breaker to exterior electrical circuits, bimetallic means normally biasing said arm toward closed circuit position but reversing this bias upon the occurrence of abnormal current conditions, a resilient, generally U-shaped latch having the legs thereof disposed at opposite sides of said arm, projections extending inwardly from said legs into the path said arm traverses during changes in circuit positions to oppose such changes, said projections having surfaces which engage the upper edges of said arm when said arm is in open circuit position to prevent its movement under its normal bias and other, inclined surfaces which engage the under edges of said arm when said arm is in closed circuit po-

sition to increase the contact pressure, and manual means operable to effect the withdrawal of said projections from said path whereby said arm may move to closed circuit position and to effect the application of force to said arm to move said arm to open circuit position, said bimetallic means flexing sufficiently upon the occurrence of abnormal current conditions to effect movement of said arm past said projections to the open circuit position.

25. In a circuit breaker, a fixed contact, current responsive means having fixed and free ends, a movable contact cooperating with said fixed contact, a supporting arm for said movable contact having a resilient portion spaced from said movable contact joined to said free end, a resilient, generally U-shaped latch having the legs thereof disposed at opposite sides of said arm, projections extending inwardly from said legs in the path said arm traverses during changes in circuit positions, said projections having surfaces which engage the upper edges of said arm when said arm is in open circuit position to prevent its movement toward closed circuit position and other, inclined surfaces which engage the under edges of said arm when said arm is in closed circuit position to increase the contact pressure, a manually operable handle for stressing said resilient portion to effect movement of said arm past said latch to open circuit position, said current responsive means stressing said resilient portion upon the occurrence of abnormal current conditions for automatically moving said supporting arm to open circuit position, the initial stressing of said resilient portion tending to rotate said supporting arm about said latch as a fulcrum to increase the contact pressure.

26. In a circuit breaker, a fixed contact, current responsive means having fixed and free ends, a movable contact cooperating with said fixed contact, a supporting arm for said movable contact having a resilient portion spaced from said movable contact joined to said free end, a resilient, generally U-shaped latch having a curved bight and having the legs thereof disposed at opposite sides of said arm, a projection extending inwardly from each of said legs, said projections having surfaces which engage the upper edges of said arm when said arm is in open circuit position to prevent its movement toward closed circuit position and other, inclined surfaces which engage the under edges of said arm when said arm is in closed circuit position to increase the contact pressure, means for varying the curve of said bight to change the resilient bias of said legs, a manually operable handle for stressing said resilient portion to effect movement of said arm past said latch to open circuit position at will, said current responsive means stressing said resilient portion upon the occurrence of abnormal current conditions for automatically moving said supporting arm to open circuit position, the initial stressing of said resilient portion tending to rotate said supporting arm about said latch as a fulcrum to increase the contact pressure, said resilient portion when sufficiently stressed snapping said arm past said latch to effect rapid separation of said movable contact from said fixed contact.

27. In a circuit breaker, a fixed contact, current responsive means having fixed and free ends, a movable contact cooperating with said fixed contact, a supporting arm for said movable contact having a resilient portion spaced from said movable contact joined to said free end, a resilient, generally U-shaped latch, said latch having a cam surface at the end of each leg and having the legs thereof disposed at opposite sides of said arm, a projection extending inwardly from each of said legs at a position spaced from said cam surface, said projections having surfaces which engage the upper edges of said arm when said arm is in open circuit position to prevent its movement toward closed circuit position and other, inclined surfaces which engage the under edges of said arm when said arm is in closed circuit position to increase the contact pressure, a manually operable handle for stressing said resilient portion to effect movement of said arm from closed to open circuit position past said latch, said handle having a cam surface engageable with the cam surfaces of said latch to effect a spreading movement of the legs of said latch whereby said projections are moved out of engagement with said arm which then may move to closed circuit position, said current responsive means normally biasing said arm to closed circuit position but reversing the bias applied thereto upon the occurrence of abnormal current flow for automatically moving said supporting arm to open circuit position, said resilient portion when sufficiently stressed snapping said arm past said latch to effect rapid separation of said movable contact from said fixed contact.

28. In a circuit breaker, a fixed contact, current responsive means having fixed and free ends, a movable contact cooperating with said fixed contact, a supporting arm for said movable contact having a resilient portion spaced from said movable contact joined to said free end, a resilient generally U-shaped latch, said latch having a cam surface at the end of each leg and a curved bight and having the legs thereof disposed at opposite sides of said arm, a projection extending inwardly from each of said legs at a position spaced from said cam surface, said projections having surfaces which engage the upper edges of said arm when said arm is in open circuit position to prevent its movement toward closed circuit position and other, inclined surfaces which engage the under edges of said arm when said arm is in closed circuit position to increase the contact pressure, adjustable means for changing the curvature of said bight to change the spacing between the legs of said latch to thereby vary the relationship between said projections and said arm, a manually operable handle for stressing said resilient portion to effect movement of said arm from closed to open circuit position past said latch, said handle having a cam surface engageable with the cam surfaces of said latch to effect a spreading movement of the legs of said latch whereby said projections are moved out of engagement with said arm which then may move to closed circuit position, said current responsive means normally biasing said arm to closed circuit position but reversing the bias applied thereto upon the occurrence of abnormal current flow for automatically moving said supporting arm to open circuit position, said resilient portion when sufficiently stressed snapping said arm past said latch to effect rapid separation of said movable contact from said fixed contact.

29. In a circuit breaker, a fixed contact, current responsive means having fixed and free ends, a movable contact cooperating with said fixed contact, a supporting arm for said movable contact having a resilient portion spaced from

said movable contact joined to said free end, a resilient generally U-shaped latch, said latch having a cam surface at the end of each leg and a curved bight and having the legs thereof disposed at opposite sides of said arm, a projection extending inwardly from each of said legs at a position spaced from said cam surface, said projections having surfaces which engage the upper edges of said arm when said arm is in open circuit position to prevent its movement toward closed circuit position and other, inclined surfaces which engage the under edges of said arm when said arm is in closed circuit position to increase the contact pressure, adjustable means for varying the curvature of said bight to change the spacing between the legs of said latch to thereby vary the relationship between said projections and said arm, a generally U-shaped bimetal embracing said latch for varying the bias on said legs upon changes in ambient temperature to maintain relatively constant the value of current required to trip the circuit breaker, a manually operable handle for stressing said resilient portion to effect movement of said arm from closed to open circuit position past said latch, said handle having a cam surface engageable with the cam surfaces of said latch to effect a spreading movement of the legs of said latch whereby said projections are moved out of engagement with said arm which then may move to closed circuit position, said current responsive means normally biasing said arm to closed circuit position but reversing the bias applied thereto upon the occurrence of abnormal current flow for automatically moving said supporting arm to open circuit position, said resilient portion when sufficiently stressed snapping said arm past said latch to effect rapid separation of said movable contact from said fixed contact.

30. The circuit breaker defined in claim 3 in which means are provided biasing said handle toward its open circuit position, and in which means are provided on said arm which engage said handle when said arm and handle are in closed circuit position to hold said handle in its closed circuit position against its bias, said handle applying force to said last mentioned means to effect manual opening of the circuit breaker.

31. The circuit breaker defined in claim 6 in which said manual means are provided with portions permitting return of said projections into the path said arm traverses when said manual means is held in its extreme closed circuit position whereby said circuit breaker opens with a snap action upon the occurrence of overload current flow therethrough when the handle is held in its extreme closed circuit position.

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