

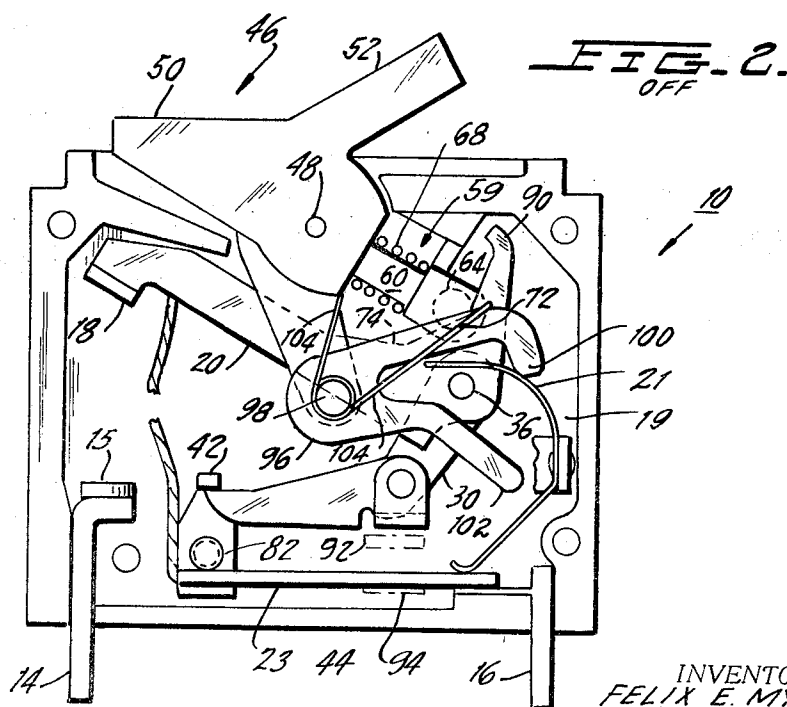
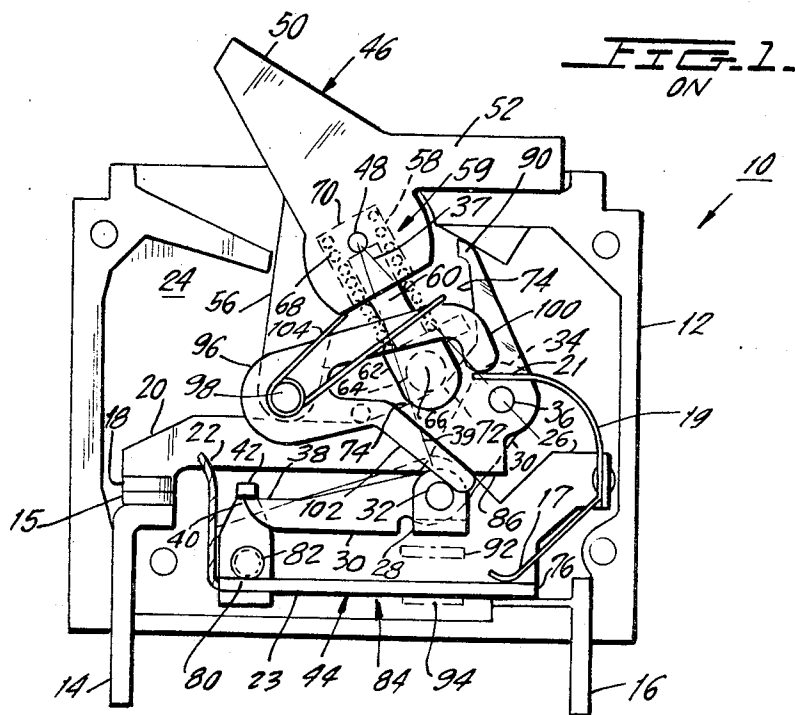
May 5, 1970

F. E. MYERS
AUTOMATIC CIRCUIT BREAKER WITH CAMMED
OVER-CENTER OPERATING MECHANISM

3,510,818

Filed June 24, 1968

2 Sheets-Sheet 1



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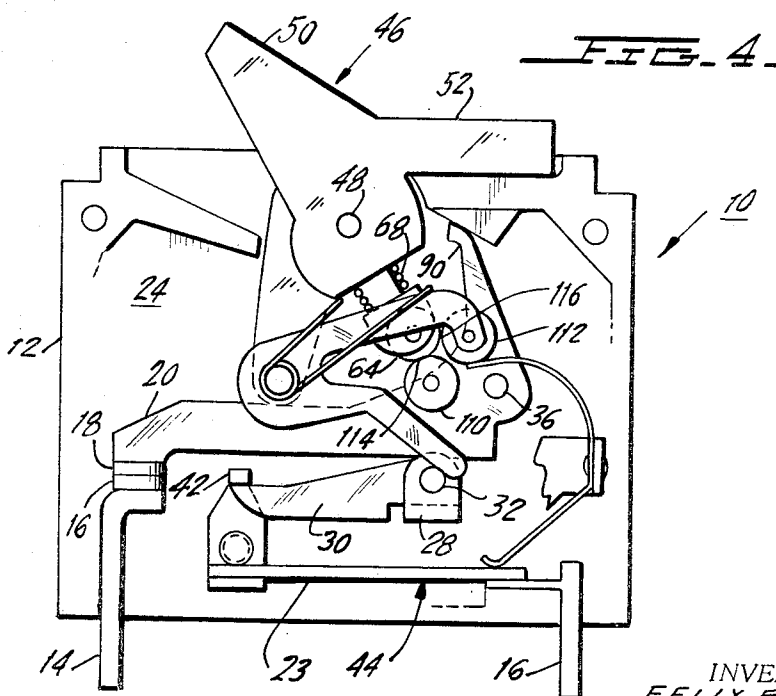
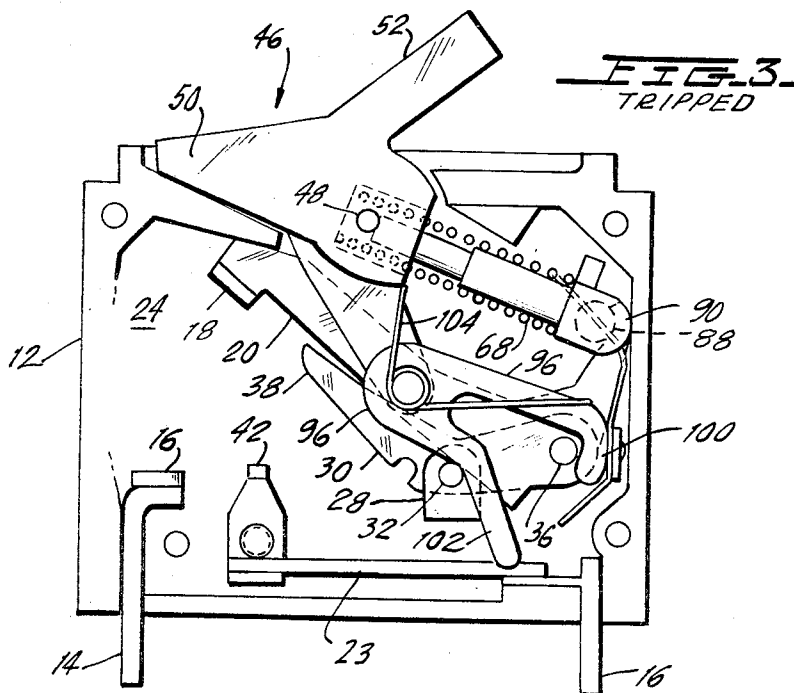
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AUTOMATIC CIRCUIT BREAKER WITH CAMMED OVER-CENTER OPERATING MECHANISM

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10 Claims

ABSTRACT OF THE DISCLOSURE

A circuit breaker including a cradle rotatable between a latched position and a released position upon the occurrence of predetermined fault conditions occurring within the circuit which the breaker is protecting. Piv-
otally mounted on the cradle is a contact arm which may be moved between an "on" and "off" position when the cradle is in its latched position, and furthermore is automatically rotated to a tripped position to interrupt the flow of current in response to rotation of the cradle between its latched and released position. The movable contact arm is so mounted on the cradle that there is a kicking action of the contact arm away from the stationary contact when the breaker is tripped, which action is desirable because of accidental contact welding. Smooth, reliable operation is achieved by the cooperation of a spring-biased plunger arrangement and the movable contact arm. Additionally, relatch means are provided to automatically reset and close the breaker with a single movement of the breaker handle.

This invention relates to circuit breakers, and more particularly relates to automatic circuit breakers of the type which interrupt current in response to occurrence of predetermined conditions within the line being protected by the breaker.

The circuit breaker industry is continually on the lookout for new circuit breakers capable of fulfilling the basic operating requirements of such units while at the same time are simple, reliable, and therefore economical to manufacture. Thus, with small circuit breakers of the so-called molded case type, such breakers must customarily be manually operable between an "on" and "off" position, while at the same time the breaker must be capable of automatically interrupting the flow of current therethrough in response to preset conditions.

Generally, small circuit breakers capable of performing these functions include a cradle maintained in a latched position against the bias of an over-center spring mechanism. Upon the occurrence of the preset conditions, the cradle is unlatched and free to rotate to a tripped position whereby the over-center spring mechanism also rotates the movable contact arm of the breaker to an interrupting position. Furthermore, when the cradle is latched, the over-center spring mechanism and handle associated therewith may be manually operated to switch the circuit between a simple "on" and "off" position.

These over-center spring mechanisms generally include a main spring rigidly secured at one end to the operating handle and rigidly secured at the opposite end to a fixed point on the movable contact arm. This arrangement of rigidly securing both ends of the spring mechanism creates additional and costly steps in the manufacture and assembly of circuit breakers and furthermore does not permit the degree of leverage and consequent snap-action of the contact arm which is possible with the circuit breaker of the instant invention, to be described below.

Additionally, in most circuit breakers of the prior art, after the circuit breaker has tripped due to the oc-

currence of a fault within the circuit, it is customarily necessary to first move the circuit breaker handle in one direction to reset the cradle and then move the handle in the opposite direction to close the contacts. Various designers have attempted to eliminate this two-step operation but none have done so in the simplified manner made possible with the instant invention.

In one preferred embodiment of the instant invention, a cradle is pivotally rotatable between a latched position and a released position in response to the occurrence of predetermined fault conditions within the circuit. A rotatable contact arm is pivotally mounted on one end of the cradle and rotatable between its closed circuit position and a tripped position in response to movement of the cradle from the latched to its released position. The movement of both elements is effectuated by a novel spring-biased plunger arrangement one end of which is secured to the operating handle and the other end of which cooperates with a cammed surface provided on the movable contact arm. During an initial portion of the tripping sequence, the plunger causes the cradle and the contact arm to rotate together about the pivot point of the cradle in such a manner that the contact arm is kicked or pried away from the stationary contact. This is especially desirable in the event there has been some accidental contact welding. During a subsequent portion of the tripping sequence, the spring-biased plunger passes over-center with respect to the pivotal mounting of the contact arm whereby the contact arm is rapidly snapped to its fully tripped position.

In a further preferred embodiment of the instant invention the circuit breaker operating handle carries a relatch lever which effectuates resetting of the cradle and closing of the movable contact arm upon one single movement of the breaker handle. Furthermore, such relatch lever includes cooperating cam portions thereof which automatically disengage the relatch lever from that portion of the mechanism which it engages during the automatic relatching cycle, once the breaker has been reset and closed.

Accordingly it is an object of the instant invention to provide an automatic circuit breaker which is simple, reliable and inexpensive to manufacture.

Another object of the instant invention is to provide such an automatic circuit breaker which utilizes the novel interrelation and cooperation of a spring-biased plunger and cooperating cam surfaces to effectuate and fulfill the basic operating requirements.

Another object of the instant invention is to provide such a circuit breaker which accomplishes a kick-away or prying action of the movable contact arm thereof with respect to the stationary contact thereof so as to compensate for any accidental contact welding which may have taken place.

Another object of the instant invention is to provide such a circuit breaker which includes automatic relatching means for resetting and closing the circuit breaker in response to one single continuous motion of the circuit breaker handle.

Other objects and a fuller understanding of the instant invention may be had by referring to the following description and drawings, in which:

FIG. 1 shows a circuit breaker of the instant invention in the "on" position;

FIG. 2 shows the circuit breaker of FIG. 1 in the "off" position;

FIG. 3 shows the circuit breaker of FIG. 1 in the tripped position; and

FIG. 4 shows an alternative embodiment of the circuit breaker of the instant invention.

Turning to FIG. 1, there is illustrated a circuit breaker 10 constructed in accordance with the instant invention.

The breaker includes a molded case 12, generally of plastic or other insulating material, and would normally include a cover (which is not shown in FIG. 1 in order that the internal mechanism of the breaker may be seen). A pair of conductors 14 and 16, commonly known as stabs, depend through suitable apertures in the side wall of the casing such that the circuit breaker may be connected in the circuit which it is to protect. Secured to the stabs 14 is a stationary contact pad 15 which cooperates with the movable contact pad 18 secured on the movable contact arm 20. With the breaker contacts in closed circuit position illustrated in FIG. 1 (the "on" position) a circuit is completed through the stab 14, the cooperating contact pads 15, 18, the movable contact arm 20, a conductive braid 22 and a bimetal element 23 which is maintained in electrical contact with stab 16 by one end 17 of a torsion spring 19, the purpose of which will be further explained.

Secured to the inner wall 24 of the breaker, is a plate 26 having an outstanding tab portion 28 by which a cradle 30 is pivotally mounted at the pivot point 32, which pivot point 32 is stationary with respect to the casing 12 and the stationary contact pad 15.

One end 34 of the cradle carries a second pivot pin 36 by which the movable contact arm 20 is rotatably mounted on the cradle 30. The opposite end 38 of the cradle includes a latch tip 40 normally retained under the latch 42 associated with automatic tripping mechanism generally designated 44.

The breaker includes an operating handle 46 rotatably mounted on the casing 12 at the pivot point 48. The handle includes two depressible operating surfaces 50 and 52, a depending leg 56, and an internal cavity 58.

Associated with the handle 46 is a spring-biased plunger arrangement 59 which includes a shank portion 60 to which is secured a pair of plates 62 (only one of which is shown in FIG. 1) spaced apart to support a roller 64 carried on an axle 66 supported within the plates 62. The shank 60 is housed within a compression spring 68, one end of which bottoms on the internal surface 70 of the cavity 58 and the other end bottoms on the plates 62. Since the plates 62 are positioned on opposite sides of the movable contact arm 20, the compression spring normally biases the roller 64 outwardly into engagement with a point of contact 72 on a cammed inner surface 74 of the contact arm. As will be further explained, this point of contact 72 is a variable point of contact dependent upon the condition of the circuit breaker.

In the "on" position of FIG. 1, the bias of compression spring 68 is to the left of center with respect to the second pivot point 36 (left of line 37) such that the movable contact arm 20 is biased counterclockwise in FIG. 1 about point 36 to maintain the contact pads 15 and 18 in firm electrical contact. Simultaneously the bias of compression spring 68 is to the right of center with respect to the first pivot point 32 (right of line 39) such that the cradle 30 is maintained biased in a clockwise position in FIG. 1 retained only in its latched position by the cooperation of latch tip 40 and latch 42. In summary, it may be said that the point of contact 72 between the roller 64 and the cammed surface 74 of the movable contact arm is at a point intermediate the pivot points 32 and 36.

Assuming it is desirable to change the breaker from the "on" position of FIG. 1 to the "off" position of FIG. 2, the operator merely depresses the surface 50 of operating handle 46 to rotate the handle counterclockwise about pivot point 48. In so doing, the point of contact 72 passes overcenter with respect to the second pivot point 36 whereby the contact arm 20 will be rapidly snapped clockwise from the position of FIG. 1 to the "off" position of FIG. 2 whereby the cooperating contact pads 15 and 18 are separated to interrupt the flow of current between stabs 14 and 16. During this entire sequence, the cradle remains in its latched position. Also, the point of contact 72 between the roller 64 and the cammed surface 74 has

shifted to a point outside or overcenter with respect to the pivot point 36.

Turning now to automatic tripping, the automatic tripping mechanism 44 includes the bimetal 23 maintained at one end 76 against stab 16 by torsion spring 19. The opposite end 80 is secured to the latch 42 which is rotatably mounted on the plate 26 by the pivot bar 82. The bimetal is designed to deflect in a clockwise direction with respect to the pivot bar 82; but because the end 76 thereof is restricted from clockwise movement, heating of the bimetal causes a bowing effect at the center in the direction of arrow 84 of FIG. 1. Thus upon the occurrence of a predetermined overload current flowing in the circuit, the bimetal 23 bows sufficiently in the direction of arrow 84 to rotate the latch 42 counterclockwise about the pivot bar 82 to free the end or latch tip 40 of the cradle 30 such that the cradle begins to rotate clockwise (under the bias of spring 68 about pivot 32).

During an initial period of the tripping operation both the cradle 30 and the contact arm 20 rotate together clockwise about the pivot point 32. During that initial rotation, the under surface 86 of the contact arm 20 comes down and strikes the pivot pin 32. This leverage pries the contact pad 18 away from the stationary contact pad 15 and is desirable in the event there has been some contact welding taking place at the cooperating contacts. It will be appreciated that the time period during which the contact arm 20 and the cradle 30 rotate simultaneously as a single unit, will correspond to the period within which the point of contact 72 remains intermediate with respect to the pivot pins 32 and 36. Once the point of contact 72 shifts over-center with respect to the pivot point 36, the contact arm 20 and the cradle 30 will rotate independently at different speeds. Thus there will be rotation of the cradle 30 from the position of FIG. 1 to the position of FIG. 3 while at the same time the contact arm 20 will spin or rotate independently about the pivot point 36 from the position of FIG. 1 to the tripped position of FIG. 3. Finally the point of contact of the roller 64 slides along the cammed surface 74 of the contact arm 20 to its final resting point 88, illustrated in FIG. 3, where it is retained by a hook portion 90 of the contact arm 20.

It will be appreciated that during the tripping sequence during which the cradle 30 and contact arm 20 move from their latched and closed positions to their released and tripped positions, respectively (FIG. 3) under the influence of the biasing plunger arrangement; the handle 46 simultaneously rotates between "on" position in FIG. 1 to the tripped position of FIG. 3. Similarly it will be appreciated that once the circuit has been interrupted, the bimetal 23 will return to its initial straight line position illustrated in the figures whereby the latch 42 will also revert to its initial position, illustrated in all the figures.

As is customary in the art, instantaneous tripping capabilities are added by providing an electromagnet defined by the core 92 and movable armature 94 associated therewith with a winding being provided by means of the current-carrying bimetal 23 passing therebetween such as to define one loop. Upon the occurrence of a fault of a predetermined current magnitude, the armature 94 and the bimetal 23 secured thereto are drawn toward the core 92 so as to rotate the latch 42 and initiate a tripping operation in a manner previously described.

As disclosed earlier, the instant invention further includes means by which the circuit breaker of the instant invention may be automatically reset and its contacts reengaged with one single continuous motion of the operating handle. To this end, circuit breaker includes a relatch lever 96 which is pivotally mounted at 98 on the depending leg 56 of the operating handle 46. The relatch lever includes a hook-like portion 100 on one leg and a cam surface portion 102 on another leg thereof. A torsion spring 104 normally maintains the relatch lever 96 biased clockwise about the pivot point 98, but as illustrated in FIG. 1, when the breaker is in the "on" position, the cam

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surface 102 engages the pivot point 32 to maintain the hook portion 100 of the relatch lever out of engagement with any parts of the breaker mechanism. Whenever the breaker is in the "off" position of FIG. 2, the opposite end 21 of torsion spring 19 maintains the relatch lever out of engagement with any portions of the mechanism.

However, when the breaker has been tripped and the operating handle 46 rotated from the position in FIG. 1 to the position of FIG. 3, the cam surface 102 no longer prevents the torsion spring 104 from rotating the latch lever 96 clockwise such that the hook-like portion 100 rotates clockwise to the position illustrated in FIG. 3. Thus when the operator depresses the operating surface 52 of the handle 46, and thereby begins the rotation clockwise of the operating handle 46, hook-like portion 100 of the relatch lever catches the pivot pin 36 by which the contact arm 20 is pivotally mounted on the cradle 30 and both the cradle and the contact arm begin rotating in the counterclockwise direction about the pivot point 32.

Continued depression of the surface 52 causes sufficient rotation of the cradle 30 that the latch tip 38 passes under and is relatched by the latch 42 while subsequently the point of contact of the roller 64 passes over-center with respect to the pivot point 36 whereby the contact arm 20 will be rapidly snapped to the closed circuit position of FIG. 1.

Finally, it will be appreciated that as the operating handle rotates clockwise about the pivot point 48 from the position of FIG. 3 back to the "on" position of FIG. 1, the cam surface 102 of the relatch lever 96 once again comes into contact with the pivot point 32 to rotate the hook portion 100 free of pivot 36.

Turning to FIG. 4, there is illustrated an alternative embodiment of the circuit breaker of the instant invention wherein like numerals have been used to indicate like parts. The breaker is illustrated in the "on" position similar to FIG. 1. The primary difference between the breakers is with the embodiment of FIG. 4, a pair of rollers 110 and 112 are rotatably secured to the contact arm 20. Thus with the breaker in the "on" position, the roller 64 of the spring-biased plunger arrangement contacts both rollers 110 and 112 at 114 and 116, respectively. However, it will be appreciated that the main thrust of the compression spring 68 lies on a line intermediate the pivot points 32 and 36, as was the case with FIG. 1. Thus the contact arm 20 remains biased counterclockwise such that the cooperating contacts 15 and 18 are in firm electrical contact while at the same time the cradle is biased clockwise about the pivot point 32 against the latch 42.

If it is desired to manually operate the breaker from the "on" position of FIG. 4 to the "off" position which would be similar to FIG. 2, the operating surface 50 of the handle 46 would be depressed to rotate the handle counterclockwise about the pivot point 48. In so doing, the spring 68 would be initially compressed even further as the roller 64 passes over the high point of roller 112. After such over-center position was reached the arm 20 would be snapped to the open position of FIG. 2 with the roller ending up in the position similar to that illustrated in FIG. 2. Similarly the tripping operation of the circuit breaker in response to the occurrence of predetermined conditions follows the description previously presented.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now be apparent to those skilled in the art.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. A circuit breaker for interrupting a circuit, said circuit breaker comprising:

stationary contact means;

pivotally mounted cradle means rotatable between a latched position and a released position in response

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to the occurrence of predetermined conditions in said circuit;

movable contact means pivotally mounted on said cradle means and rotatable between closed and tripped positions with respect to said stationary contact means in response to rotation of said cradle means between its latched and released position;

pivotally mounted handle means rotatable between first and second handle positions;

latch means for maintaining said cradle means in latched position when said handle means is in its first handle position;

trip means for freeing said cradle means from its latched position in response to said predetermined conditions;

spring biased plunger means secured at one end to said handle operating means and at its other end engaging said movable contact means for maintaining said movable contact means in its closed position when said cradle is in its latched position, and for rotating said cradle, said movable contact means, and said handle means to their released, tripped and second handle positions, respectively, upon the freeing of said cradle means from its latched position; and

relatching means cooperating with said handle means and said movable contact means for returning said cradle and movable contact means to their latched and closed positions, respectively, upon the movement of said handle means between its second and first position; and

wherein said cradle means is pivotally mounted at a first point relatively stationary with respect to said stationary contact means; said movable contact means is pivotally mounted at a second pivot disposed on one end of said cradle means, and said other end of said spring-biased plunger means engages said movable contact means at a point of contact intermediate said first and second pivot points when said cradle is in its latched position.

2. The circuit breaker of claim 1, wherein said movable contact means includes a camming surface upon which said other end of said spring-biased plunger means rides when said cradle, said movable contact means, and said handle means are rotated between their latched, closed, and first positions and their released, tripped and second positions, respectively.

3. The circuit breaker of claim 2, wherein said other end of said spring-biased plunger means carries roller means which cooperates with said camming surface.

4. The circuit breaker of claim 1, wherein said cradle and said movable contact means rotate together for a predetermined length of time after said cradle begins moving from its latched toward its released position; said predetermined length of time coinciding to the period within which said point of contact of said other end of said plunger means and said movable contact means remains intermediate with respect to said first and second pivot points.

5. The circuit breaker of claim 4, wherein said second pivot point becomes a temporary pivot for said movable contact means while said movable contact means and said cradle rotate together, whereby the end of said movable contact means which is normally in engagement with said stationary contact means will be kicked away therefrom when said cradle and movable contact means begin movement toward their released and tripped positions, respectively.

6. The circuit breaker of claim 4, wherein said point of contact passes over-center with respect to said second pivot point after said predetermined length of time; whereby said contact arm will be rapidly snapped to its tripped position.

7. The circuit breaker of claim 1, wherein said movable contact means is rotatable between said closed posi-

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tion and said off position when said cradle means is in its latched position; and said handle means is rotatable between its first position and an intermediate third position when said cradle means is in its latched position; movement of said handle means from its first to its third position causing said point of contact of said plunger means to shift between its intermediate location and a location over-center with respect to said second pivot point; whereby said movable contact means will be rotated to its off position.

8. The circuit breaker of claim 1, wherein said relatching means includes relatch lever means pivotally secured on said handle means; said relatch lever means including a hook portion which catches said second pivot point to rotate said cradle means and movable contact means to their latched and closed position, respectively, upon rotation of said handle means between its second and first positions.

9. The circuit breaker of claim 8, wherein said relatch lever means further includes a cam portion which engages said first pivot point to rotate said relatch lever means and disengage said hook portion from said second pivot point when said handle reaches said first position from said second position.

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10. The circuit breaker of claim 8, wherein said trip means is automatic and includes a rotatable latch means which retains the opposite end of said cradle means to maintain said cradle means in its latched position, said latch means rotating to free said opposite end to allow said cradle means to rotate toward its tripped position in response to the occurrence of said conditions, said opposite end of said cradle being recaught by said latch means when said cradle means is rotated back toward its latch position by said relatch lever.

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