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3,293,577

UNDervOLTAGE RELEASE FOR CIRCUIT BREAKER

Filed Sept. 21, 1965

2 Sheets-Sheet 1

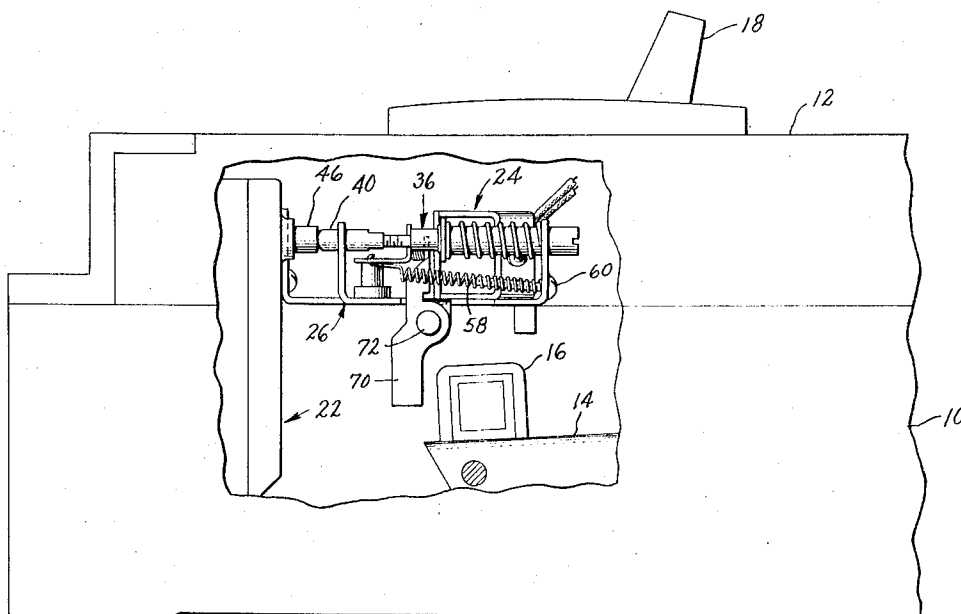


FIG. 1

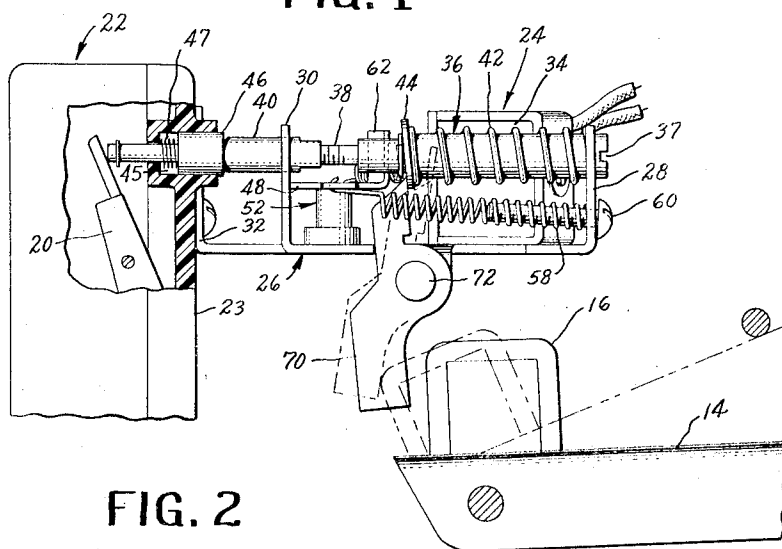


FIG. 2

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2 Sheets-Sheet 2

FIG. 3

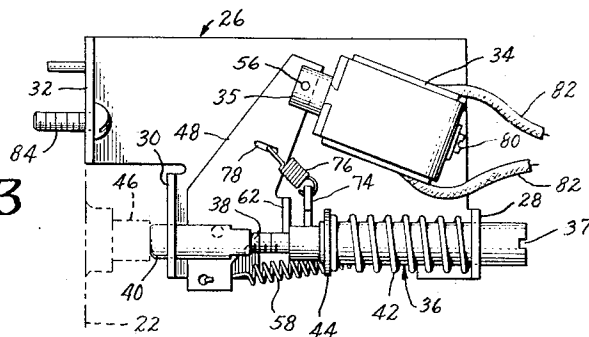


FIG. 4

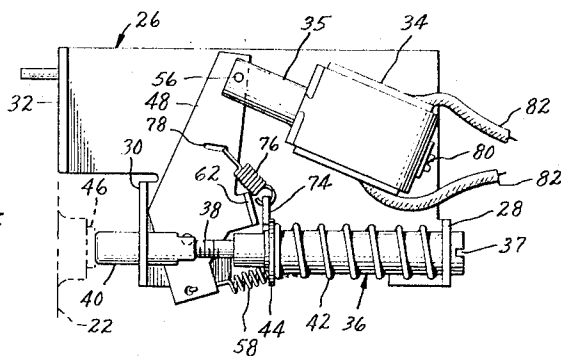
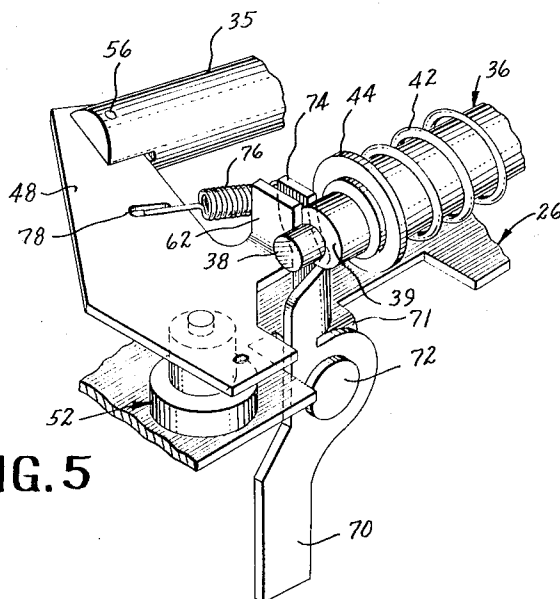


FIG. 5



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3,293,577
UNDervOLTAGE RELEASE FOR CIRCUIT
BREAKER

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20 Claims. (Cl. 335—20)

The present invention relates to electrical circuit breakers, and more particularly, to electrical circuit breaker assemblies of the type including means for causing automatic opening in response to predetermined conditions in the current passing therethrough and also means for causing opening in response to other electrical conditions such as a change in the condition of a remote control circuit or a decrease in line voltage.

Electrical circuit breakers commonly have a housing and include manually operable mechanisms for operating contacts thereof between open and closed circuit positions, and in addition, current responsive means for causing automatic opening of the contacts upon the occurrence of certain predetermined current conditions through the circuit breaker. In a certain number of uses, it is desirable that the circuit breaker include means for causing the opening of the breaker in response to a change in voltage conditions in the circuit, particularly in response to a predetermined drop in the voltage in the circuit. In certain other uses of such circuit breakers, it is also desirable that the circuit breaker include means permitting remote operation of the circuit breaker to the open circuit condition.

It is an object of the present invention to provide a novel, extremely compact and effective undervoltage tripping device for use in association with an electrical circuit breaker.

It is also an object of this invention to provide an undervoltage tripping device for an electrical circuit breaker that has buzzing or chatter control means for the solenoid used therewith.

It is another object of this invention to provide an undervoltage tripping device that allows for overtravel of a resetting lever.

It is a further object of this invention to provide an undervoltage tripping device for use with an electrical circuit breaker which can be readily converted to provide a remote control tripping device.

It is still another object of this invention to provide an undervoltage tripping device that is adjustable to operate at various percentages of desired voltage.

It has been found that the foregoing objects and other advantages can be readily attained in an undervoltage release device for circuit breakers which comprises a support for mounting on an associated circuit breaker and a solenoid mounted on the support. An actuating armature is reciprocally engaged by the solenoid and a tripping plunger is slidably mounted on the support. Compression spring means mounted on the support engages the tripping plunger for biasing the tripping plunger from a latched position to a tripped position to engage and operate the circuit breaker trip member of the associated circuit breaker. A latch member is pivotally mounted on the support and is engaged with the actuating armature, and the latch member includes a leg portion

releasably engaged with the tripping plunger in the latched position thereof. First tension spring means which is mounted between the support and the latch member biases the latch member in a direction to release the tripping plunger. A resetting lever is pivotally mounted on the support and has a portion engaged with the tripping plunger to effect sliding movement thereof to the latched position. Second tension spring means is operable by the resetting lever and connects to the latch member or to the actuating armature for returning the latch member and the tripping plunger to a latched position when the resetting lever is moved to a predetermined resetting direction and allows for overtravel of the resetting lever.

In accordance with the general construction, the electrical circuit breaker used therewith desirably is a multipole molded case type having at least two elongated chambers therein each containing parts with relatively movable contacts providing one current path or "pole" of the circuit breaker, and current-responsive tripping means for causing automatic opening of all poles simultaneously. The tripping means includes a trip member which is movable to cause automatic opening of the contacts and which is engaged by the tripping plunger of the undervoltage release device to operate the circuit breaker.

The undervoltage tripping device is installed in a circuit breaker to provide automatic tripping when loss of power occurs or when there is a major voltage dip. More particularly, the undervoltage tripping device has a solenoid magnet with a moving armature affixed to a spring-loaded latch which restrains a spring-biased shaft and plunger. When released, the shaft and plunger move the breaker trip member or bar to trip the breaker. As long as the voltage connected to the solenoid is normal, the solenoid magnetic force overcomes the spring force and the plunger does not act on the trip bar. If the voltage is removed or dips to a predetermined percentage of rated voltage, the spring force overcomes the solenoid magnetic force, unlatches the shaft and plunger and trips the breaker. Unless the required voltage is restored to the solenoid coil, the breaker will trip if an attempt is made to close it. When normal voltage has been restored, resetting lever is used to move the plunger and lever so that the armature is again magnetically engaged by the solenoid magnet.

The invention will be more fully understood from the following detailed description and its scope will be pointed out in the appended claims.

In the drawings:

FIGURE 1 is a side elevational view of a circuit breaker assembly incorporating the undervoltage tripping device of this invention with the case partially broken away to reveal internal construction;

FIGURE 2 is an elevational view to an enlarged scale of a portion of the circuit breaker assembly of FIGURE 1 showing the undervoltage tripping device and a portion of the circuit breaker component partially in section for clarity of illustration;

FIGURE 3 is a top plan view of the undervoltage tripping device of FIGURE 1 to an enlarged scale showing the device in the "on" or latched position and parts of the circuit breaker in phantom line;

FIGURE 4 is a view similar to FIGURE 3 with the parts shown in the "tripped" position; and

FIGURE 5 is a perspective view to an enlarged scale of the undervoltage tripping device with parts broken away for clarity of illustration.

Referring now in detail to the attached drawings, the invention is shown in FIGURE 1 as an assembly of the overvoltage release device in an electric circuit breaker having a generally rectangular insulating casing with a base 10 and a cover 12. A pair of relatively movable contacts (not shown) are provided in the base 10 and function as a stationary contact connected to a line terminal (not shown) mounted on the base 10 and a movable contact connected to a load terminal (not shown) on the base 10. The movable contact is carried by a contact arm 14 which is pivotally supported in the base 10 by suitable means (not shown) and is rigidly engaged with the contact cross arm 16. In actuality, the circuit breaker illustrated is a three-pole circuit breaker with three elongated chambers or current paths or "poles," each of which contains current-carrying parts and contacts similar to those described hereinbefore.

An operating mechanism is also mounted in the base 10 for operating the contact cross arm 16 and the associated contact arms 14 of the other pole chambers between open and closed circuit positions by means of a manually operable handle member 18. The operating mechanism referred to includes a normally restrained but releasable member or cradle (not shown), which is adapted to be releasably held by a trip member 20 mounted in suitable latch means (not shown) carried by the trip unit generally designated by the numeral 22 and adapted to be released thereby upon the occurrence of predetermined current conditions. An electric circuit breaker mechanism of the type described is shown, for example, and more fully described in United States Patent No. 3,155,803, granted on November 3, 1964, to Kline and Powell, and assigned to the same assignee as the present invention. The trip unit 22 includes a separate box-like insulating enclosure and may be of any suitable type having a trip member 20 which is movable to cause the breaker to trip. A trip unit of the type described is shown in United States Patent No. 3,162,739 granted December 24, 1964, to Kline and Powell and assigned to the same assignee as the present invention.

For the purpose of initiating trip operation of the trip unit 22 upon the occurrence of a predetermined decrease in voltage in a selected circuit, for instance, as the circuit provides current through the stationary and moving contact described above, an undervoltage tripping device is provided as shown and designated generally by the numeral 24.

Referring particularly to FIGURES 2 through 5, the undervoltage tripping device 24 comprises a generally flat sheet metal support frame or support generally designated by the numeral 26 and having bentover end or side wall portions 28, 30 and 32. The side wall portion 32 abuts against a wall portion 23 of the trip unit 22. A solenoid 34 is rigidly mounted on the frame 26 by suitable means and has an actuating armature 35 reciprocally disposed in the core thereof.

A tripping plunger, generally designated by the numeral 36, is slidably supported in suitable apertures (not shown) of the sidewall portions 28 and 30 and is adjustable in length by means of a threaded portion 38 of reduced cross section which is threadably received within the trip engaging portion 40. The reduced cross-section of the threaded portion 38 provides a notch with a shoulder portion 39 on the tripping plunger 36 for a purpose to be described hereinafter. To permit facile adjustment with a screwdriver, a slot 37 is provided in one end of the tripping plunger 36. Thus, the tripping plunger 36 is adjustable in length to obtain proper and effective engagement with the trip unit 22.

The tripping plunger 36 is disposed within a helical compression spring 42 which is mounted between the side wall portion 28 and a washer 44 providing a radially outwardly

extending shoulder on the tripping plunger 36 and biases the tripping plunger 36 toward the trip unit 22. The trip engaging portion 40 extends through side wall 30 and engages a spring biased tripping rod 46 slidably supported in an aperture 45 in the wall 23 of the trip unit 22 and biased toward the trip engaging portion 40 by spring 47. The piston 46 extends through the wall 23 of the trip unit 22 and engages the trip member 20. Thus, the tripping plunger 36 is biased by compression spring 42 toward engagement with tripping rod 46 which is slidable to engage and move trip member 20 to trip the circuit breaker.

For the purpose of releasably holding the tripping plunger 36 against movement to the left due to the biasing pressure of the compression spring 42, a latch member 48 is pivotally supported on a reduced end portion 50 of the post 52. One end of the latch member 48 is slidably connected to the actuating armature 35 of the solenoid 34 by means of a pin 56 which is disposed in an elongated aperture (not shown) in the latch member 48 to permit relative sliding movement therebetween. The latch member 48 is constantly biased for rotation in a counterclockwise direction as illustrated in FIGURE 3 so that the armature 54 is constantly subjected to a force tending to move it away from magnetic engagement with solenoid 34, by means of the tension spring 58 which is mounted between the other end of the latch member 48 and the side wall portion 28. A screw 60 having the same pitch as the spring 58 passes through an aperture (not shown) in the side wall portion 28 and threads internally into the spring 58. The tension or biasing force on the latch member 48 may be adjusted by turning the screw 60 whereby a portion of the spring 58 may be released or taken up by the threaded shank of the screw 60. Thus, the force biasing the armature 35 away from the solenoid 34 may be adjusted by means of screw 60 so that the armature 35 is moved from magnetic engagement with the solenoid 34 at the predetermined percentage of rated voltage. Also, adjusting the force of spring 58 does not affect the spring force biasing the tripping plunger 36. By reason of the latch construction as described, the force required by the solenoid 34 to hold the armature 35 against the force of spring 58 is substantially less than the force that would be required by a solenoid to hold an armature against the force of the spring 42.

The tripping plunger 36 is held in the latched position by a leg portion 62 extending normally to the latch member 48 for engagement with the shoulder portion 39 formed by the reduced cross section of the threaded portion 38 on the tripping plunger 36 when the latch member 48 is held in the latched position by the engagement of the armature 35 by the solenoid 34. Thus, when the solenoid 34 magnetically engages the armature 54 and holds the latch member 48 in the latched position, as illustrated in FIGURE 3, the leg 62 engages the shoulder portion 39 of the tripping plunger 36 so that the trip engaging portion 40 is restrained from engagement with the tripping rod 46 of the trip unit 22. When the voltage energizing the solenoid 34 falls below the predetermined percentage of rated voltage, the armature 35 is released and the latch 48 is rotated by the force of the tension spring 58 so that the leg portion 62 is moved from engagement with shoulder 39 and tripping plunger 36 is moved into engagement with tripping rod 46 which in turn engages trip member 20, thereby tripping the circuit breaker.

In order to reset the undervoltage tripping device 24, a resetting lever 70 is mounted on a bracket 71 of the frame 26 by means of a pivot pin 72, and extends generally normally to the tripping plunger 36. A leg portion 74 of the tripping lever 70 engages the shoulder portion 44 on the tripping plunger 36, and the undervoltage tripping device 24 may be reset from the tripped position shown in FIGURE 4 to the latched position shown in FIGURE 3 by rotating the resetting lever 70 in a clockwise direction as viewed in FIGURE 2 so that the leg portion 74 engages the shoulder 44 and moves the tripping plunger 36 to the

latched position. A second tension spring 76 in the form of a helical coil is connected between the leg portion 74 and an aperture 78 in the latch 48 so that, as the resetting lever 70 is rotated, the spring 76 biases the latch member 48 and the armature 54 into the latch position. The spring 76 also allows for overtravel of the resetting lever 70 after the armature 35 has been engaged by solenoid 34. If normal voltage has been restored to the solenoid 34, the armature 35 will be held by the solenoid and the latch member 48 will be retained in the latched position by engagement of the leg portion 62 thereof with the shoulder portion 39 so that the tripping plunger 36 is restrained from moving to the tripped position.

The solenoid 34 is provided with buzz or chatter reducing means similar to that described in Patent No. 3,117,257 issued to Richard S. Stone on January 7, 1964. The drop-out voltage of the solenoid may be set to the desired percentage of rated voltage by the adjusting screw 60 and buzzing or chattering in the solenoid 34 at the selected voltage may be reduced by rotating the buzz control member 80. Thus, an undervoltage tripping device is provided that may be set to operate at a high percentage of rated voltage where buzzing and chattering frequently occur, and which may be easily and conveniently removed by adjusting the buzz control member 80. The reference voltage is supplied to the solenoid 34 by means of the wires 82.

In FIGURES 1, 3 and 5 the parts are shown in the position which they occupy during normal operation of the circuit breaker. In this position, the tripping plunger 36 is held in retracted position when the solenoid 34 is energized by a reference voltage, thereby holding the latch member 48 in the latched position against the bias of the spring 58. In this position, the leg portion 62 engages the shoulder 39 of the tripping plunger 36, thereby restraining the tripping plunger 36 from movement inwardly toward the trip unit 22. If the voltage applied to the solenoid 34 decreases a predetermined amount, the field acting upon the armature 35 will be reduced sufficiently so that it will be moved outwardly of the solenoid 34 by the action of the spring 58. As this occurs, the latch member 48 rotates and the leg portion 62 becomes disengaged from the shoulder 39, permitting the tripping plunger 36 to be moved inwardly by the compression spring 42 and to engage the tripping rod 46 which moves inwardly against the bias of spring 47 and actuates the trip member 20, thereby initiating tripping action of the circuit breaker.

After the breaker has been tripped due to actuation of the undervoltage tripping device 24, the circuit breaker may be reset by movement of the contact arm 14 by the action of the operating mechanism actuated by handle 18 being moved to the off position. The contact arm 14 rotates in a counterclockwise direction when moving to the off position as illustrated in phantom line in FIGURE 2, and as the contact arm 14 is rotated, the contact cross arm 16 engages the resetting lever 70 and rotates it in a clockwise direction to the position illustrated in phantom line in FIGURE 2. As the resetting lever 70 is rotated, the tension spring 76 rotates the latch member 48, and the armature 35 is moved into engagement with the solenoid 34. If the reference voltage applied to solenoid 34 is of proper value, the armature 35 will then be held within the solenoid 35 and the latch member 48 will retain the tripping plunger 36 in the latched position ready for subsequent operation, and the handle 18 of the breaker may be turned to the "on" position.

If the handle 18 is moved to the "on" position before the voltage applied to solenoid 34 has returned to the preset value, the tripping plunger 36 will trip the breaker in the manner described above when the contact cross arm 16 and resetting lever 70 move to the "on" position illustrated in solid line in FIGURE 2. This occurs because neither the latch member 48 nor the resetting lever

70 will restrain the tripping plunger 36 in the latched position.

In accordance with this invention, the circuit breaker and undervoltage trip device 24 are both designed to cooperate in such a way that the trip device can be securely mounted within the insulating casing of the circuit breaker with a minimum of fastening elements.

In accordance with another aspect of this invention, the parts may be readily adapted to operate as a "remote trip" device, rather than as an "undervoltage trip" device. In the undervoltage trip device, the parts are normally biased toward tripping condition but are restrained from causing tripping by the solenoid which is normally energized, and a failure in voltage in the solenoid therefore permits tripping to occur by spring action. In the remote trip device, the parts are normally in a latched condition and are moved temporarily to a tripped condition by means of the solenoid armature or plunger action.

This remote trip form of the invention has parts corresponding to the parts previously described with the exception that the solenoid 34 has an armature plunger which is normally positioned in an unattracted or outer position and operates a rod connected to a latch member similar to the latch member 48. A tension spring similar to tension spring 58 is engaged with the latch, in this case between the pivot of the latch member and the rod. The tension spring in this form therefore tends to hold the latch member in its latched condition. When the solenoid is energized, however, the armature is pulled into the coil moving the push rod and rotating the latch member against the pull of the tension spring. This releases the tripping plunger to the tripped position in the same manner as previously described. As the contact arm moves toward the open position, the contact cross arm engages the resetting lever and causes resetting of the latch member 48, and movement of the tripping plunger to the original position in the manner similar to that described for the undervoltage tripping device.

Accordingly, there is provided by this invention an undervoltage trip device which is compact and effective, has adjustable parts, and which can be readily mounted in a circuit breaker. The tripping plunger may be adjusted to be engaged properly with the tripping unit and the drop-out voltage may be set at the desired percentage of rated voltage and the solenoid adjusted to reduce buzzing and chattering. A coil spring between the latch and resetting lever provides for overtravel of the lever. Moreover, the specifically described undervoltage trip device can be readily converted to a shunt-trip device with similar operation and advantages.

While we have disclosed only certain embodiments of the invention, it will be readily appreciated that many modifications thereof may be made. We, therefore, intend by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

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

1. An automatic tripping device for circuit breakers comprising:

- (a) a support for mounting on an associated circuit breaker;
- (b) a solenoid mounted on said support;
- (c) an actuating armature reciprocally engaged by said solenoid;
- (d) a tripping plunger slidably mounted on said support;
- (e) a compression spring means mounted on said support and engaging said tripping plunger for biasing said tripping plunger from a latched position to a tripped position to engage and operate a circuit breaker trip member of the associated circuit breaker;
- (f) a latch member pivotally mounted on said support and engaged with said actuating armature, said

latch member including a leg portion releasably engageable with said tripping plunger in the latched position thereof;

- (g) first tension spring means mounted between said support and said latch member for biasing said latch member in a direction to release said tripping plunger;
- (h) a resetting lever pivotally mounted on said support and having a portion engaged with said tripping plunger to effect sliding movement thereof to the latched position; and
- (i) second tension spring means operable by said resetting lever and connected to one of said latch member and actuating armature for returning said latch member and said tripping plunger to a latched position when said resetting lever is moved to a predetermined resetting direction and allowing for over-travel of said resetting lever.

2. The automatic tripping device of claim 1 wherein said solenoid includes means to reduce buzzing and chattering when actuated by alternating current.

3. The automatic tripping device of claim 1 wherein said first tension spring means is adjustable for changing the force applied to said latch.

4. The automatic tripping device of claim 1 wherein said tripping plunger has a shoulder portion engaged with said compression spring and said resetting lever.

5. The automatic tripping device of claim 1 wherein said tripping plunger is adjustable in length to increase and decrease its length for engagement with the trip member of the associated circuit breaker.

6. The automatic tripping device of claim 1 wherein said second tension spring means is connected between said resetting lever and said latch member.

7. The automatic tripping device of claim 1 wherein said second tension spring means is a helical spring.

8. For use with an associated electric circuit breaker including at least one pair of relatively movable contacts, operating mechanism for operating said movable contacts between said open and closed circuit positions and trip means including a trip member movable to cause automatic opening of said contacts, an automatic tripping device comprising:

- (a) a support for mounting on the associated circuit breaker;
- (b) a solenoid mounted on said support;
- (c) an actuating armature reciprocally engaged by said solenoid;
- (d) a tripping plunger slidably mounted on said support;
- (e) compression spring means around said tripping plunger and mounted between said support and a shoulder portion of said tripping plunger for biasing said tripping plunger from a latched position to a tripped position to engage and operate the circuit breaker trip member of the associated circuit breaker;
- (f) a latch member pivotally mounted on said support and slidably engaged with said actuating armature, said latch member including a leg portion releasably engageable with said tripping plunger in the latched position thereof;
- (g) first tension spring means mounted between said support and said latch member for biasing said latch member in a releasing direction to release said tripping plunger, said solenoid when energized by current passing therethrough serving to hold said actuating armature in retracted position to retain said latch member in latching position against the biasing force of said first tension spring means;
- (h) a resetting lever pivotally mounted on said support and having a portion engaged with said shoulder portion of said tripping plunger to effect sliding movement thereof to the latched position; and

- (i) second tension spring means between said resetting lever and said latch member for returning said tripping plunger and said latch member to latched position when said resetting lever is moved to a predetermined resetting direction and allowing for over-travel of said resetting lever.

9. The automatic tripping device of claim 8 wherein said first tension spring means is adjustable for changing the force applied to said latch.

10. The automatic tripping device of claim 8 wherein said tripping plunger is adjustable in length to increase and decrease its length for engagement with the trip member of the associated circuit breaker.

11. The automatic tripping device of claim 8 wherein said solenoid includes means to reduce buzzing and chattering when actuated by alternating current.

12. An undervoltage release device for circuit breakers comprising:

- (a) a support mounted on an associated circuit breaker;
- (b) a solenoid mounted on said support;
- (c) an actuating armature reciprocally engaged by said solenoid;
- (d) a tripping plunger slidably mounted on said side wall portion of said support, said tripping plunger being adjustable in length for engagement with and to operate a trip member of the associated circuit breaker;
- (e) compression spring means around said tripping plunger and mounted between said support and a shoulder portion of said tripping plunger for biasing said tripping plunger from a latched position to a tripped position to engage and operate the trip member of the associated circuit breaker;
- (f) a latch member pivotally mounted on said support and slidably engaged with said actuating armature, said latch member including a leg portion releasably engageable with said tripping plunger in the latched position thereof;
- (g) first tension spring means mounted between said support and said latch member for biasing said latch member in releasing direction to release said tripping plunger, said first tension spring means being adjustable for changing the force applied to said latch, said solenoid when energized by current passing therethrough serving to hold said actuating armature in retracted position to retain said latch member in latching position against the biasing force of said first tension spring means;
- (h) a resetting lever pivotally mounted on said support and having a portion engaged with said shoulder of said tripping plunger to effect sliding movement thereof to the latched position; and
- (i) second tension spring means between said resetting lever and said latch member for returning said lever and said tripping plunger to a latch position when said resetting lever is moved to a predetermined resetting direction and allowing for overtravel of said resetting lever.

13. The undervoltage release device of claim 12 wherein said solenoid includes means to reduce buzzing and chattering when actuated by alternating current.

14. An undervoltage release device for circuit breakers comprising:

- (a) a support having bottom and side wall portions mounted on an associated circuit breaker;
- (b) a solenoid mounted on said support having means to reduce buzzing and chattering when actuated with alternating current;
- (c) an actuating armature reciprocally engaged in said solenoid;
- (d) a tripping plunger slidably mounted on said side wall portions of said support having a first and second shoulder portion, said tripping plunger being ad-

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- justable in length for engagement with and to operate a trip member of the associated circuit breaker;
- (e) compression spring means around said tripping plunger and mounted between one of said side wall portions of said support and said first shoulder portion of tripping plunger for biasing said tripping plunger into a tripping direction to engage and operate the trip member of the associated circuit breaker;
- (f) a latch member pivotally mounted on said support and slidably engaged with said actuating armature, said latch member including a leg portion releasably engageable with said second shoulder portion of said tripping plunger in the latched position thereof;
- (g) first tension spring means mounted between one of said side wall portions of said support and one end of said latch member for biasing said latch member in releasing direction to release said tripping plunger, said first tension spring means being adjustable for changing the force applied to said latch, said solenoid when energized by current passing therethrough serving to hold said actuating armature in retracted position to retain said latch member in latching position against the biasing force of said first tension spring means;
- (h) a resetting lever pivotally mounted on said support and having a leg portion engaging said first shoulder portion on said tripping plunger to effect sliding movement thereof to the latched position, said lever extending generally normal to said tripping plunger; and
- (i) second tension spring means between said latch member and said resetting lever for returning said lever and said tripping plunger to latched position when said resetting lever is moved to a predetermined resetting direction and allowing for overtravel of said resetting lever.
- 15.** An electrical circuit breaker assembly comprising:
- (A) an electrical circuit breaker including:
- (1) a housing,
 - (2) at least one pair of relatively movable contacts in said housing,
 - (3) operating means for operating said contacts between open and closed circuit position, and
 - (4) trip means including a trip member movable to cause automatic opening of said contacts; and
- (B) an undervoltage release device for said circuit breaker comprising:
- (1) a support mounted on said circuit breaker housing,
 - (2) a solenoid mounted on said support,
 - (3) an actuating armature reciprocally engaged by said solenoid,
 - (4) a tripping plunger slidably mounted on said support,
 - (5) compression spring means mounted on said support and engaging said tripping plunger for biasing said tripping plunger from a latched position to a tripped position to engage and operate said circuit breaker trip member of said circuit breaker,
 - (6) a latch member pivotally mounted on said support and engaged with said actuating armature, said latch member including a leg portion releasably engageable with said tripping plunger in the latched position thereof,
 - (7) first tension spring means mounted between said support and said latch member for biasing said latch member in a direction to release said tripping plunger,
 - (8) a resetting lever pivotally mounted on said support and having a portion engaged with said tripping plunger to effect sliding movement thereof to the latched position, and
 - (9) second tension spring means operable by said resetting lever and connected to one of said latch member and actuating armature for returning said

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- latch member and said tripping plunger to a latched position when said resetting lever is moved to a predetermined resetting direction and allowing for overtravel of said resetting lever.
- 16.** The circuit breaker assembly of claim **15** wherein said solenoid includes means to reduce buzzing and chattering when actuated by alternating current.
- 17.** The circuit breaker assembly of claim **15** wherein said first tension spring means is adjustable for changing the force applied to said latch.
- 18.** The circuit breaker assembly of claim **15** wherein said tripping plunger has a shoulder portion engaged with said compression spring and said resetting lever.
- 19.** An electrical circuit breaker assembly comprising:
- (A) an electrical circuit breaker including:
- (1) a housing,
 - (2) at least one pair of relatively movable contacts in said housing,
 - (3) operating means for operating said contacts between open and closed circuit position, and
 - (4) trip means including a trip member movable to cause automatic opening of said contacts; and
- (B) an undervoltage release device for said circuit breaker comprising:
- (1) a support mounted on said circuit breaker housing,
 - (2) a solenoid mounted on said support,
 - (3) An actuating armature reciprocally engaged by said solenoid,
 - (4) a tripping plunger slidably mounted on said support,
 - (5) compression spring means around said tripping plunger and mounted between said support and a shoulder portion of said tripping plunger for biasing said tripping plunger from a latched position to a tripped position to engage and operate said circuit breaker trip member of said circuit breaker,
 - (6) a latch member pivotally mounted on said support and slidably engaged with said actuating armature, said latch member including a leg portion releasably engageable with said tripping plunger in the latched position thereof,
 - (7) first tension spring means mounted between said support and said latch member for biasing said latch member in a releasing direction to release said tripping plunger, said solenoid when energized by current passing therethrough serving to hold said actuating armature in retracted position to retain said latch member in latching position against the biasing force of said first tension spring means,
 - (8) a resetting lever pivotally mounted on said support and having a portion engaged with said shoulder portion of said tripping plunger to effect sliding movement thereof to the latched position, and
 - (9) second tension spring means between said resetting lever and said latch member for returning said tripping plunger and said latch member to latched position when said resetting lever is moved to a predetermined resetting direction and allowing for overtravel of said resetting lever.
- 20.** An automatic tripping device for circuit breakers comprising:
- (a) a support for mounting on an associated circuit breaker;
 - (b) a solenoid mounted on said support;
 - (c) an actuating armature reciprocally engaged by said solenoid;
 - (d) a tripping plunger slidably mounted on said support, said tripping plunger being adjustable in length for engagement with and to operate a trip member of the associated circuit breaker;
 - (e) a compression spring means mounted on said support and engaging said tripping plunger for biasing said tripping plunger from a latched position to a tripped position to engage and operate a circuit

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- breaker trip member of the associated circuit breaker;
- (f) a latch member pivotally mounted on said support and engaged with said actuating armature, said latch member including a leg portion releasably engageable with said tripping plunger in the latched position thereof;
- (g) adjustable tension spring means mounted between said support and said latch member for biasing said latch; and

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- (h) a resetting lever pivotally mounted on said support and having a portion engaged with said tripping plunger to effect sliding movement thereof to the latched position.

No references cited.

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