May 31, 1960 C. L. JENCKS 2,938,980

UNDERVOLTAGE TRIP DEVICE

Filed Dec. 22, 1958

Fig. 1.

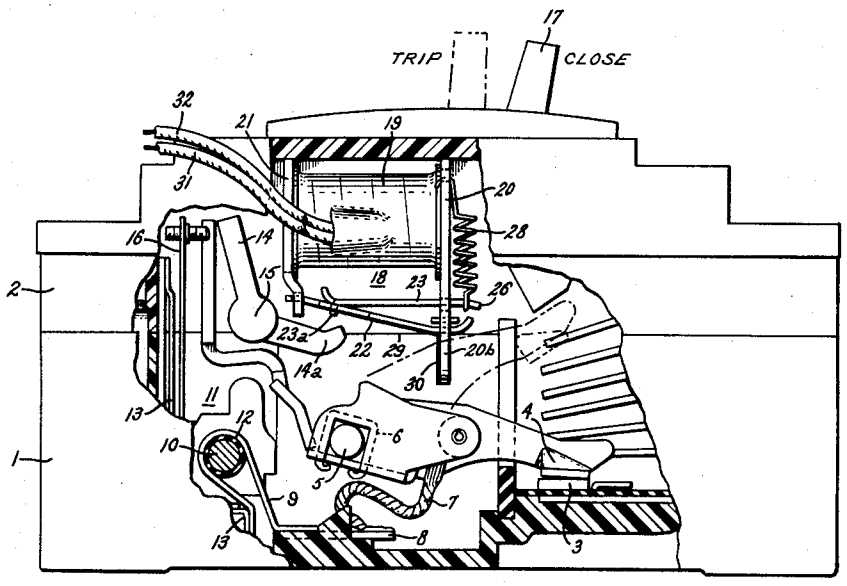
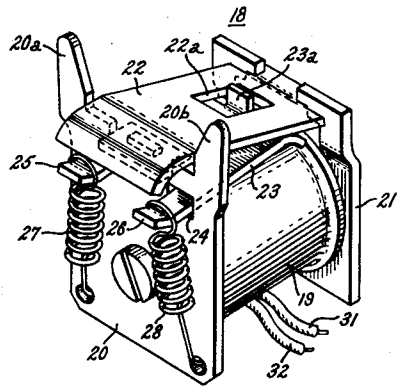


Fig. 2.



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UNDERVOLTAGE TRIP DEVICE

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5 Claims. (Cl. 200—106)

This invention relates to electric circuit breakers, and particularly to electric circuit breakers incorporating means for causing automatic opening upon the occurrence of low voltage or under voltage conditions.

Electric circuit breakers of the type which comprise a molded insulation casing usually incorporate means for causing the contacts of the circuit breaker to open automatically upon the occurrence of high or excessive current conditions in the circuit controlled by the breaker. In such circuit breakers operating mechanism including a latch and a trip member is provided which, when the circuit breaker contacts are in the closed position under normal operating conditions, restrains the latch member and is so constructed and arranged that upon movement of the trip member by a current responsive means, the latch member is released and the automatic circuit breaker mechanism opens the contacts. The trip member is ordinarily actuated by a current responsive member such as a bi-metallic strip or a magnetic operating means or both. In addition, it is frequently desirable to provide in such circuit breakers auxiliary tripping means to effect automatic opening, not only upon the occurrence of excessive current conditions in the controlled circuit but also upon the occurrence of certain other electrical operating conditions such as the occurrence of unusually low voltage conditions. In accordance with the prior art, magnetic solenoid type devices have been provided which are picked up when the circuit voltage is normal and which are dropped out or released upon the occurrence of undervoltage conditions to permit movement of a spring biased member to actuate the tripping device to cause tripping of the circuit breaker. Such devices have, however, been relatively large, bulky and expensive.

It is an object of the invention to provide an electric circuit breaker incorporating an undervoltage tripping device which is small, compact, inexpensive and which can be readily added to a conventional circuit breaker construction.

In carrying the invention into effect in one form thereof, an undervoltage release device is provided for use in combination with an electric circuit breaker having an insulating casing, a pair of relatively movable contacts operating means for operating the movable contacts between open and closed circuit positions and a trip member movable to cause automatic opening. The undervoltage release device comprises a solenoid having a magnetic core, an armature pivotally mounted adjacent one end of the core and disposed to be releasably held adjacent the other end of the core by magnetic attraction. A spring biased member for actuating the trip bar of the circuit breaker is pivotally mounted adjacent the releasable end of the armature and is held by the armature at a point near its pivoted end. As a result of this construction, the armature attracting force of the solenoid has a mechanical advantage over the biasing force of the spring and this makes possible the use of a smaller coil which in turn results in a smaller and less expensive overall assembly.

For a better and more complete understanding of the invention, reference should now be had to the following specification and to the accompanying drawing of which Fig. 1 is a view in side elevation of a portion of an electric circuit breaker incorporating the invention with a portion of the sidewall being broken away to reveal certain details of the tripping mechanism and also to reveal an assembly of stationary and movable contacts together with a pivoted carrying arm for the movable contact arm, and Fig. 2 is a view in perspective of the undervoltage release device of the invention.

Referring now to the drawing and particularly to Fig. 1, an electric circuit breaker is provided with an insulating casing having a base portion **1** and a cover plate **2**. Mounted on the base are a plurality of relatively stationary contact assemblies **3** of which only one is shown and a plurality of cooperating movable contact assemblies **4** of which is shown only that one which coacts with the stationary contact assembly **3**. The movable contact assembly **4** is pivotally mounted in the casing base **1** on a pivotal shaft **5**. All movable contact assemblies are ganged together for movement in unison on the shaft **5** to which each is attached by suitable means such as an inverted U-shaped bracket **6**. Each movable contact member is electrically connected by suitable means such as a flexible braid **7** to a terminal plate **8** to which is connected a conductor **9** which is looped around the core **10** of a magnetic trip device **11**. As shown, the conductor is insulated from the core by means of a tubular shaped member **12** which is made of a suitable insulating material. The other end of the looped conductor **9** is connected to one terminal of a heater element **13** whose other terminal is connected to a stationary terminal connecting lug (not shown) for connection to an incoming power line.

A movable trip bar **14** is pivotally supported by pivot means **15** within the casing. This trip bar is arranged to be moved on its pivot by suitable current responsive means such for example as the bi-metal unit **16** which is heated by the heater element **13** which may be included in the electrical circuit which is controlled by the main contact assemblies **3** and **4**. The trip bar **14** is arranged to effect release of the mechanism retaining latch (not shown) to cause automatic opening of the circuit breaker contact in a conventional and well understood manner. A showing of the retaining latch is omitted since an understanding of the details of this element and the elements with which it coacts is not necessary to an understanding of the present invention. A manually movable handle **17** is also provided for manually operating the mechanism to move the movable contacts between open and closed position.

The construction of the contact operating mechanism may be of any suitable type. For the purpose of causing actuation of the trip bar **14** in response to decrease in line voltage to a predetermined unacceptably low value, an undervoltage release assembly **18** is provided which may readily and easily be installed on the breaker. This assembly comprises a central magnetic core member (not shown) upon which is mounted an energizing coil **19**. This coil is trapped between pole faces **20** and **21** which are secured to the core by any suitable fastening means. The assembly is also provided with an armature **22** and a trip bar actuator **23**. The armature is made of a suitable magnetic material such as soft steel and the trip actuator is preferably made of a non-magnetic material such as brass. As shown, the armature is pivotally mounted near one of its ends on the pole face **21**. Its other end is attracted into and is held in engagement with the pole face member **20** when the coil **19** is energized.

The actuator is pivotally mounted on the opposite pole face **20**. As best shown in Fig. 2, the pole face **20** is provided with two spaced-apart holes **24** through which extend correspondingly spaced-apart legs **25** and **26** of the actuator plate. The actuator plate is biased for rotation in a counter clockwise direction (as viewed in Fig. 1), about its pivotal axis by suitable means such as tension springs **27** and **28** each of which has one of its ends anchored to the pole face **20** and its other end attached to a corresponding one of the legs **25** and **26**. The opposite end of the actuator is formed to provide a rounded surface which bears against the armature **22** at a point near its pivot. When the movable contact arm is in the open position as shown in dotted lines, it engages and holds the armature **22** close to its closed position, with only a relatively small air gap. Consequently when a voltage equal to or greater than a predetermined value is supplied to the terminals of the coil **19**, the armature is picked up to its closed gap position and holds the actuator against rotation in response to its spring bias. The central portion **23***a* of the curved end of the actuator plate is bent at approximately 90° to the plane of the plate and projects through an opening **22***a* in the armature member.

For the purpose of mounting the undervoltage assembly **18** in the breaker case, the pole face member **20** is provided with two mounting lugs **20***a* and **20***b*. A plurality of longitudinally disposed wall members **29** divide the base portion **1** of the casing into a number of chambers, one for each of the movable contact arm assemblies. In two of the walls which define one of the chambers are provided slots **30** for receiving the mounting lugs **20***a* and **20***b*. The undervoltage device assembly is mounted in the casing by setting the lugs **20***a* and **20***b* into the slots **30** and it is held in place by the cover **2** of the casing. A radially outwardly projecting extension **14***a* of the trip bar lies in the path of movement of the centrally disposed projection **23***a* of the actuator.

In operation, the circuit breaker contacts are closed in response to movement of the operating handle **17** to the "closed" position. In the closed position of the breaker, voltage is supplied from a source (not shown) to a load such for example, as one or more electric motors. In order to protect the load against dangerous operating conditions which result from unacceptably low values of line voltage, the coil **19** is energized from the line voltage by connecting its terminal leads **31** and **32** to appropriate points in the circuit.

As long as the line voltage remains greater than a predetermined value the armature member **22** is held in the closed gap position in which it is illustrated in Fig. 1 in which it holds the actuator member **23** in the illustrated horizontal position, out of engagement with the extension **14***a* of the trip bar. However, when the coil circuit is opened, or when the voltage drops below the previously mentioned predetermined value, the armature member **22** is released and this in turn permits the springs **27** and **28** to rotate the actuator plate **23** in a clockwise direction to cause the central projecting portion **23***a* to engage the extension **14***a* of the trip bar. This causes the trip bar **14** to rotate in a clockwise direction to a position in which it trips the latch of the operating mechanism and thereby permits the operating mechanism to rotate the movable contact arm assemblies **4** in a counterclockwise direction to the dotted line position which is illustrated in Fig. 1. In the open position of the contacts, the protected load is disconnected from the source and the movable contact arm engages the armature **22** of the undervoltage release assembly and moves it upwardly in a counterclockwise direction to a position in which the magnetic attraction at pole face **20** will be sufficient to hold it when the voltage supplied to the coil **19** is again restored to the predetermined pickup value.

An advantage of the construction of the undervoltage release device assembly **18** is that the coil holding force does not have to be as great as the bias force of the springs **27** and **28** because of the mechanical advantage which results from the actuator plates **23** bearing on the armature at a point near its pivot. The practical result is that a smaller coil can be used than would otherwise be possible and this in turn results in a smaller, less expensive and more compact overall assembly.

Although in accordance with the provisions of the patent statutes this invention is described as embodied in concrete form and the principle of its operation has been explained together with the best mode in which it is now contemplated applying that principle it will be understood that the specific structure shown and described is merely illustrative and that the invention is not limited thereto since alterations and modifications will readily suggest themselves to persons skilled in the art without departing from the true spirit of this invention or from the scope of the annexed claims.

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

1. For use with a circuit breaker having a casing, a stationary contact mounted in said casing, a relatively movable contact, operating mechanism for operating said movable contact between open and closed positions and a trip member; an undervoltage trip device comprising a solenoid having a core member provided with two pole face members, one at each end, an armature member pivotally mounted on a first of said pole face members and disposed to be attracted by the second of said pole face members in response to energization of the solenoid; a trip actuating member pivotally mounted on said second pole face member disposed between said armature and said solenoid with its free end bearing against said armature at a point near its pivot and spring means biasing said trip actuating member against said armature to provide for pivotal movement of said actuating member in a direction to engage said trip member in response to less than a predetermined value of energization of said solenoid.

2. For use with a circuit breaker having a casing, a stationary contact mounted in said casing, a relatively movable contact, operating mechanism for operating said movable contact between open and closed positions and a trip member; an undervoltage trip device comprising a solenoid having a core member provided with two pole face members, one at each end, an armature member pivotally mounted near one of its ends on a first of said pole face members and disposed in spaced apart relationship with respect to said solenoid to provide for attraction of its unpivoted end by the second of said pole face members in response to energization of said solenoid, a trip actuating member pivotally mounted on said second pole face member and disposed in the space between said armature member and said solenoid in a direction generally parallel to the axis of said core and means biasing said trip actuating member to cause its unpivoted end to bear against said armature member at an intermediate point thereof to provide a mechanical advantage of the magnetic force of attraction of said armature with respect to the force of said biasing means.

3. An undervoltage release device comprising a solenoid having a magnetic core, an armature member pivotally mounted adjacent one end of said core and disposed to have its free end held adjacent the other end of the core by magnetic attraction and released therefrom in response to deenergization of said solenoid, a biasing spring, and a non-magnetic tripping member biased by said spring for motion in a tripping direction and pivotally mounted adjacent the releasable end of said armature and held against the bias of said spring by said armature at an intermediate point adjacent its pivoted end to provide a mechanical advantage of the magnetic force at-

tracting said armature with respect to the force of said spring bias.

4. In a circuit breaker having a casing, a stationary contact mounted in said casing, a movable contact arm carrying a relatively movable contact, operating mechanism for operating said movable contact between open and closed positions and a trip member, an undervoltage release device comprising a solenoid having a magnetic core, an armature member pivotally mounted adjacent one end of the core and disposed to be releasably held adjacent the other end of the core by magnetic attraction, and a spring biased trip actuating member pivotally mounted adjacent the releasable end of said armature and held thereby at a point adjacent its pivoted end, and means mounting said undervoltage release device in said casing with said trip actuating member disposed to engage said trip member in response to drop out of said armature and with said armature disposed in the path of the opening movement of said movable contact carrying arm to effect reset of said armature by said arm.

5. In a circuit breaker having a casing, a stationary contact mounted in said casing, a movable contact arm carrying a relatively movable contact, operating mechanism for operating said movable contact arm between

open and closed position and a trip member, an undervoltage release device comprising a solenoid having a magnetic core provided with two pole face members; one at each end and one provided with extending mounting legs, an armature member pivotally mounted adjacent one end of said core and disposed to be releasably held adjacent the other end thereof by magnetic attraction and a spring biased trip actuating member pivotally mounted adjacent the releasable end of said armature and held by the armature at a point adjacent its pivoted end, walls in said casing defining a chamber for said movable arm and contacts and provided with mounting slots for receiving said mounting legs to mount said undervoltage release device with said trip actuating member disposed to engage said trip member in response to dropout of said armature and with said armature disposed in the path of the opening movement of said movable contact carrying member to effect reset of said armature by said arm.

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