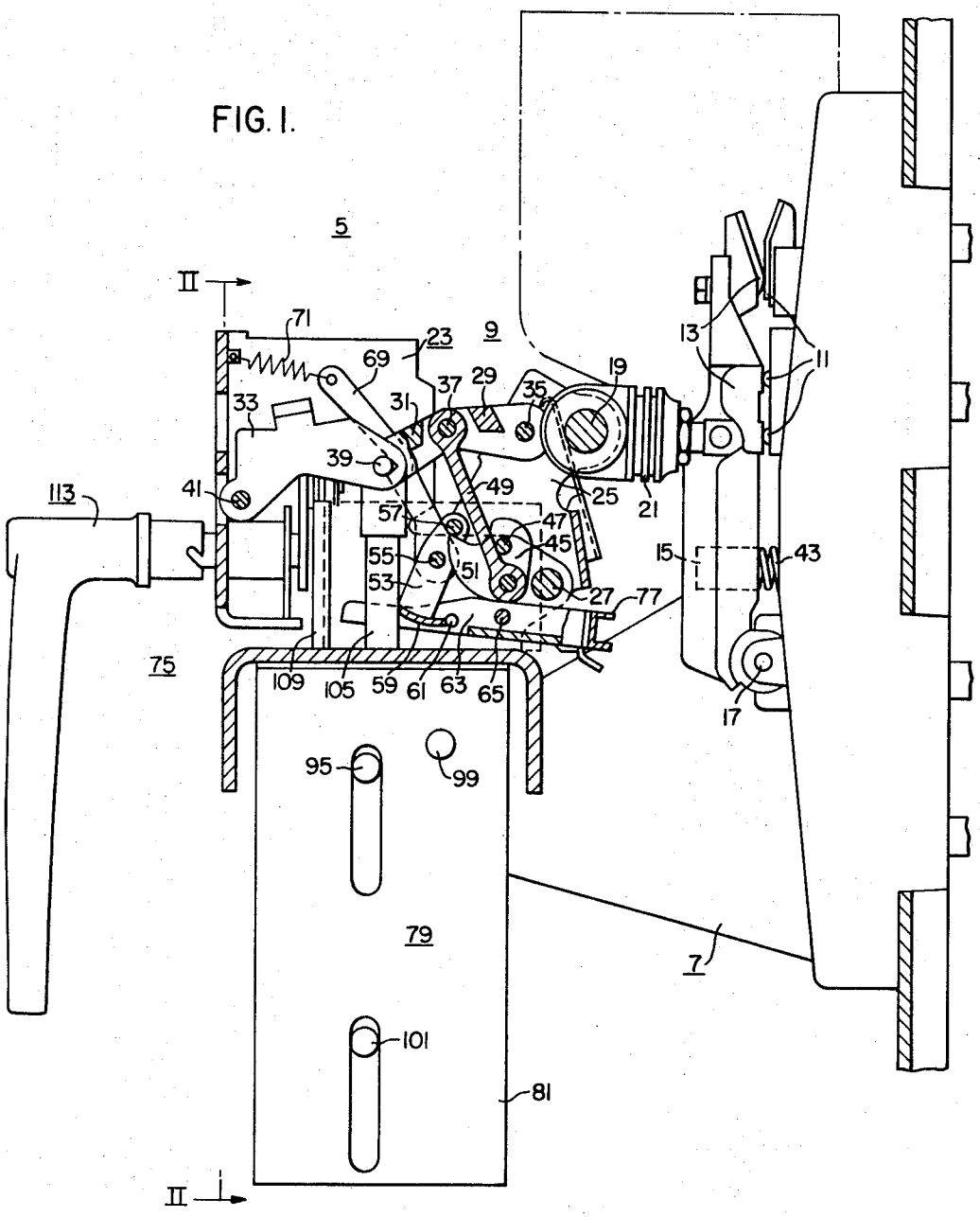
Dec. 1, 1970 E. W. KUHN 3,544,932

CIRCUIT BREAKER WITH IMPROVED TRIP MEANS

Filed Oct. 24, 1968 3 Sheets-Sheet 1

FIG. 1.



WITNESSES

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CIRCUIT BREAKER WITH IMPROVED TRIP MEANS

Filed Oct. 24, 1968 3 Sheets-Sheet 2

FIG. 3.

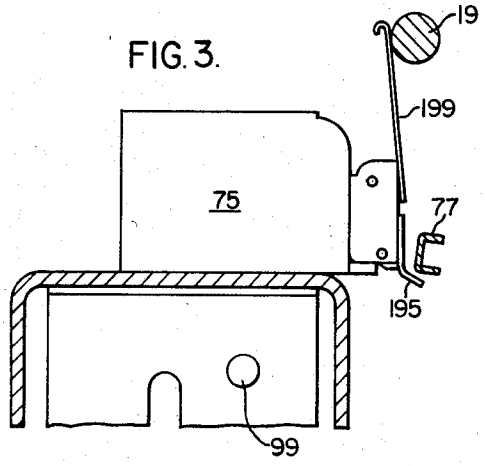
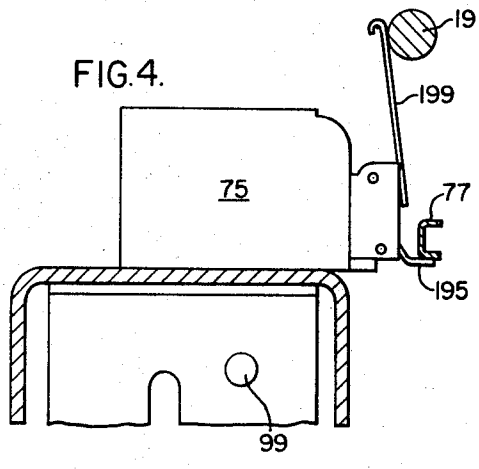


FIG. 4.



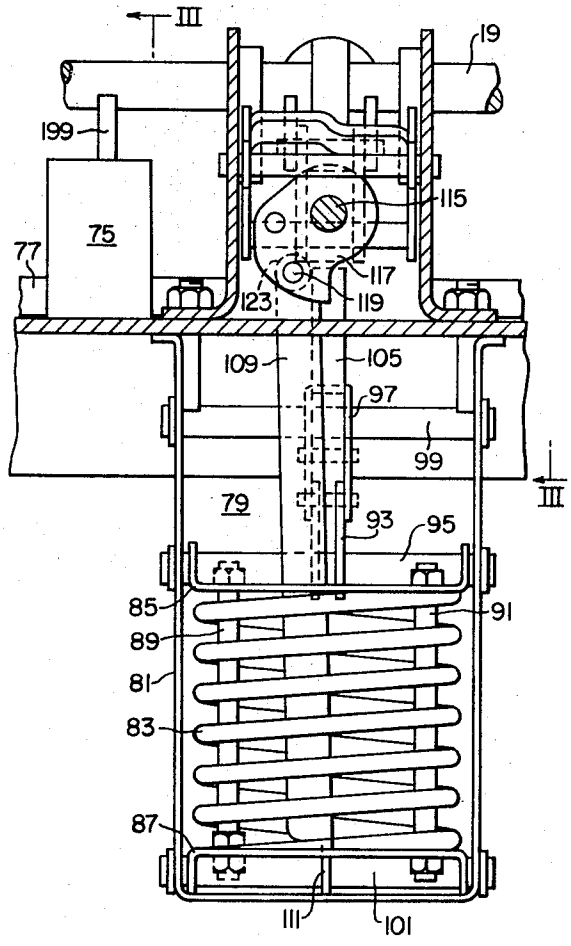


FIG. 2.

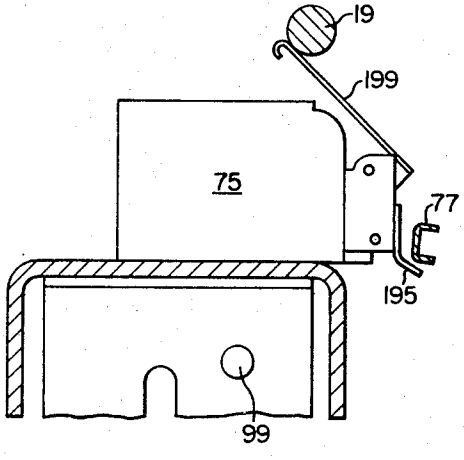


FIG. 5.

CIRCUIT BREAKER WITH IMPROVED TRIP MEANS

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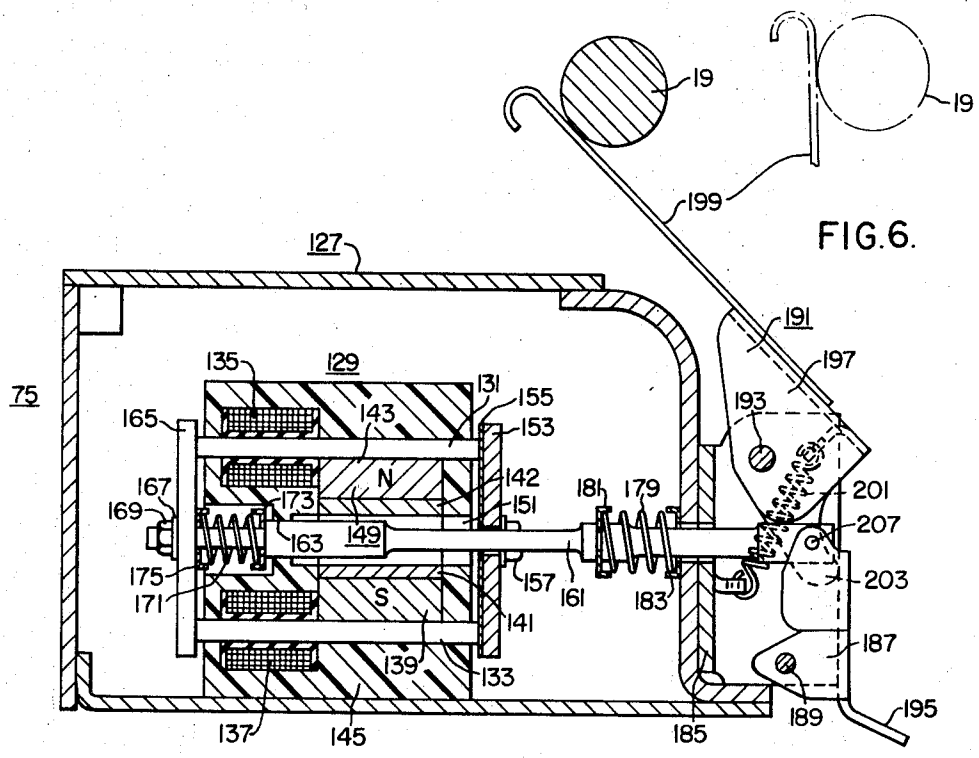


FIG. 6.

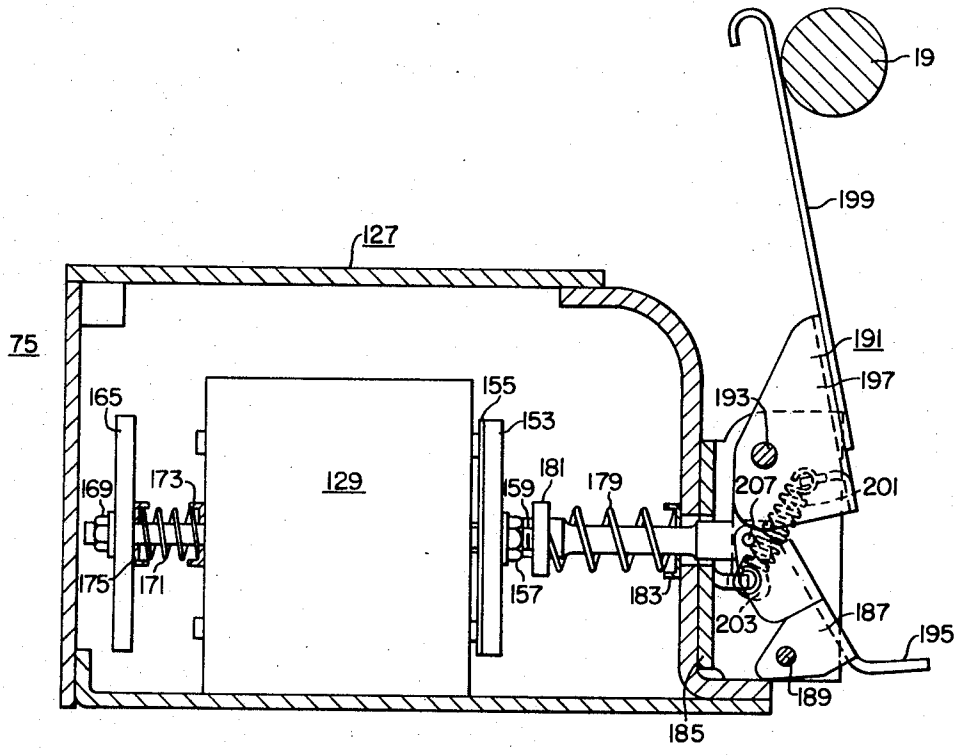


FIG. 7.

United States Patent Office

3,544,932
Patented Dec. 1, 1970

3,544,932

CIRCUIT BREAKER WITH IMPROVED TRIP MEANS

Edmund W. Kuhn, Pittsburgh, Pa., assignor to Westing-House Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Oct. 24, 1968, Ser. No. 770,305
Int. Cl. H01h 9/20
U.S. Cl. 335—174 9 Claims

ABSTRACT OF THE DISCLOSURE

A circuit breaker having improved trip means. The trips means is a magnetic trip device having magnetic pole-piece means, a magnetic fixed keeper, a moveable keeper having an actuator connected to the moveable keeper to trip the breaker upon the occurrence of abnormal or over load current conditions.

BACKGROUND AND OBJECTS OF THE INVENTION

For certain applications of circuit breakers, it is desirable to provide a flux-transfer trip device of the type comprising a plurality of magnetic circuits with means for transferring magnetic flux from a first circuit to a second circuit to effect release of a movable keeper in the first circuit to thereby effect a tripping operation of the circuit breaker. An object of this invention is to provide an improved circuit breaker comprising a flux-transfer trip device with a movable keeper positioned at one end of the trip device and an actuator operatively connected to the movable keeper and extending to the other end of the trip device to actuate the operating mechanism of the circuit breaker in order to effect an opening operation of the circuit breaker upon the occurrence of certain over load current conditions.

Another object of this invention is to provide an improved circuit breaker comprising a flux-transfer trip device having a movable keeper movable to a tripping position to effect a tripping operation of the circuit breaker and resilient reset means operated by a rigid part of the circuit breaker operating mechanism to reset the movable keeper without applying damaging forces to the parts of the trip device.

A further object of this invention is to provide a circuit breaker with an improved flux-transfer trip device comprising a movable keeper and an actautor connected to the movable keeper with shock-absorbing means for permitting movement of the actuator relative to the movable keeper under shock conditions.

A more general object of this invention is to provide a circuit breaker with an improved flux-transfer trip device that is reliable in operation and relatively easy to manufacture and to assemble into operating relationship with parts of the circuit breaker.

SUMMARY OF THE INVENTION

An improved circuit breaker comprises a flux-transfer type trip device that may be pulsed by a low energy electrical signal supplied under abnormal or overload conditions in order to effect a tripping operation of the circuit breaker. The trip device comprises a pair of spaced pole pieces with a movable keeper positioned at one end of the pole pieces and a fixed keeper positioned at the other end of the pole pieces. A permanent magnet structure is positioned between the pole pieces and between the fixed and movable keepers in order to supply magnetic flux. The magnetic device is constructed with a gap between the fixed keeper and the pole pieces. The movable keeper, in the set position thereof, engages the pole pieces. With the

movable keeper in the set position, most of the magnetic flux from the permanent magnet structure operates through a magnetic circuit, that comprises the movable keeper, to work to maintain the movable keeper in the set position. The remainder of the magnetic flux passes through another magnetic circuit that includes the fixed keeper. An actuator, that is operatively connected to the movable keeper at one end thereof, extends through opening means in he trip device and is operatively connected, at the other end thereof, to a trip member. Spring means biases the movable keeper and actuator toward a tripping position. A pair of coils are conneced in series and to the magnetic device in order to buck the magnetic flux through the one magnetic circuit to raise the reluctance of the one magnetic circuit when the coils are pulsed to thereby effect a transfer of magnetic flux from the one magnetic circuit to the other magnetic circuit in order to effect release of the movable keeper. Upon release of the movable keeper, the spring means biases the movable keeper and actautor to a tripping position to operate the trip member to effect a tripping operation of the circuit breaker. The movable keeper is operatively connected to the actuator through a shock-absorbing spring so that under shock conditions the actuator can move slightly relative to the movable keeper without the full force of the shock of the actautor being transmitted to the movable keeper. Resilient reset means, which is operatively connected to the actuator, is engaged by a rigid part of the circuit breaker operating mechanism in order to reset the movable keeper and actuator during an opening operation of the circuit breaker. With the provision of resilient reset means the construction and positioning of parts is less critical and a rigid part of the operating mechanism can operate to reset the actuator and movable keeper without applying damaging forces to the parts of the trip device. The magnetic device is mounted within an enclosure, and the actuator extends out through an opening in the enclosure where the trip member and resilient reset means are operatively connected to the trip device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view, partly in section and with parts broken away, of a three-pole circuit breaker embodying principles of this invention;

FIG. 2 is a sectional view, with parts broken away, taken generally along the line II—II of FIG. 1;

FIG. 3 is a sectional view taken generally along the line III—III of FIG. 2;

FIG. 4 is a view similar to FIG. 3 with the trip device operated to the tripping position and with the circuit breaker tie bar still in the closed position;

FIG. 5 is a view similar to FIG. 4 with the circuit breaker tie bar in the open position and the trip device operated to the reset position;

FIG. 6 is a side sectional view of the trip device seen in FIGS. 3–5 with the reset member and trip member shown in full lines in the position illustrated in FIG. 5 and with the reset member shown in broken lines in the position illustrated in FIG. 3;

FIG. 7 is a view similar to FIG. 6 with the trip device shown in the tripping position illustrated in FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, there is shown, in FIG. 1, a circuit breaker 5 comprising a metallic supporting frame structure indicated generally at 7 and a circuit-breaker structure indicated generally at 9 supported on the supporting frame structure 7. Except for the trip device that will be hereinafter more specifically described the circuit breaker 5 is identical to the circuit breaker described in

the patent to G. D. Gamel et al. Pat. No. 3,045,083, issued July 17, 1962. Thus, only a brief description of the circuit breaker will be provided herein.

The circuit breaker **5** is a three-pole circuit breaker with each pole comprising a stationary contact structure **11** and a movable contact structure **13**. Each of the movable contact structures **13** is supported on a contact arm **15** that is supported for movement about a fixed pivot **17**. A common elongated rigid tie bar **19** extends across the three-pole units. In each pole unit a separate insulating connector **21** is connected to the tie bar **19** and to the associated contact arm **15** to connect the three contact arms **15** for simultaneous movement upon movement of the tie bar **19**. The tie bar **19** is operated between open and closed positions by operation of an operating mechanism indicated generally at **23**.

The operating mechanism **23** comprises an operating lever **25** supported on a pivot pin **27** that is supported on the supporting structure **7**. The lever **25** is pivotally connected to the tie bar **19** to operate the tie bar **19**. An operating linkage, comprising toggle links **29, 31** and **33**, is provided to hold the lever **25** in the closed position and to operate the lever **25** between the open and closed positions. The toggle link **29** is pivotally connected to the lever **25** by means of a pivot pin **35**. The link **31** is connected to the link **29** by means of a knee pivot pin **37** and pivotally connected to the link **33** by means of a knee pivot pin **39**. The link **33** is supported for pivotal movement on a fixed pivot pin **41** that is mounted on the supporting structure **17**.

The linkage **29, 31, 33** comprises two toggles one of which **29, 31** functions as a tripping toggle and the other of which **31, 33** functions as a closing toggle. The tripping toggle **29, 31** is normally slightly underset above a line drawn through the pivot pins **39, 35**, and the closing toggle **31, 33** is normally slightly underset below a line drawn through the pivots **37, 41**.

The tripping toggle **29, 31** is normally biased in a direction to cause its collapse by springs **43**, that are positioned in each pole unit between the support structure **17** and movable contact arm **15**, which bias the contact arms **15** in an opening direction and bias the connecting members **21** toward the left. The tripping toggle **29, 31** is normally prevented from collapsing by means of a main latch member **45** that is pivoted on a pin **47** and connected by a link **49** to the knee pivot **37** of the toggle **29, 31**. The link **49** is pivotally connected to the latch **45** by means of a pivot pin **51**.

The main latch **45** is held in latching position by an intermediate latch lever **53** that is pivoted on a pin **55** that is supported on the supporting structure **17**. The latch **53** carries a latch roller **57** which normally engages the main latch **45** to releasably hold the main latch in the latching position seen in FIG. 1. The latch lever **53**, at its lower end, carries a latch portion **59** that normally engages a latch roller **61** on a latch member **63** that is supported for pivotal movement on a pin **65** that is supported on the support structure **7**. The latches **53** and **63** are biased by spring means (not shown) to the latching positions seen in FIG. 1.

As long as the main latch **45** is held in latching position by the latching mechanism just described, the tripping toggle **29, 31** will, through the link **49**, be held in the closed position. The closing toggle **31, 33** is normally prevented from collapsing by a shouldered support member **69** pivoted on the pin **55** and biased by a spring **71** into supporting engagement with the knee pin **39** of the toggle **31, 33**.

The circuit breaker is shown in FIG. 1 in the closed and latched position with the support member **69** supporting the closing toggle **31, 33** in its extended thrust transmitting position. The circuit breaker is automatically tripped open by operation of a trip device **75** indicated by broken lines in FIG. 1 and shown in FIGS. 2–7. The trip device **75**, which operates against a part **77**, that is fixedly secured to the latch **63**, will be hereinafter more specifically described.

Upon the occurrence of an abnormal or overload condition above a predetermined value in any of the pole units, the trip device **75** is operated to operate against the part **77** of the latch **63** to pivot the latch **63** counterclockwise (FIG. 1) to thereby disengage the latch roller **61** from the latch portion **59** of the latch lever **53**. The latching engagement of the main latch **45** with the latch roller **57** is of the slip-off type, and as soon as the latch lever **53** is released it is moved to an unlatching position by the upward force applied to the main latch **45** through the link **49**. The tripping toggle **29, 31** immediately collapses permitting counterclockwise movement of the operating lever **25** and opening movement of the tie rod **19** with the tie rod **19** moving from the position seen in FIG. 1 to the position seen in FIG. 5 during which movement the contact arms **15**, which are operatively connected to the tie bar **19** by means of the connectors **21**, pivot about the pivots **17** from the closed position seen in FIG. 1 to an open position wherein the movable contacts **13** are disengaged from the stationary contacts **11**. During the collapse of the tripping toggle **29, 31**, a portion of the toggle link **31** engages and actuates the support member **69** against the bias of the spring **71** to a non-suporting position thereby freeing the closing toggle **31, 33**. The closing toggle thereupon collapses downwardly to reset and relatch the tripping toggle **29, 31**.

The linkages **29, 31** and **31, 33** are trip free. During an opening operation, the contacts cannot be closed until the closing toggle collapses resetting the linkages for a closing operation.

The opening operation can also be initiated manually by a trip lever (not shown) that also rotates the latch **63** to the unlatching position.

A spring closing mechanism indicated generally at **79** is provided for manually closing the breaker. The spring closing mechanism **79** is partially enclosed within a U-shaped housing **81** that is fixedly secured to the support structure **7**. The spring closing mechanism **79** comprises a closing spring **83** that is supported between a top spring support **85** and a bottom spring support **87**, which spring supports are supported for rectilinear movement within the housing **81**. A guide bolt **89** is connected to the bottom spring support **87** to move with the bottom spring support **87**, and a guide bolt **91** is connected to the top spring support **85** to move with the top spring support **85**. A toggle link **93** is pivotally connected to a cross bolt **95** that is connected to the top spring support, and a toggle link **97**, that is pivotally connected to a stationary cross bolt **99**, is pivotally connected to the toggle link **93**. The bottom spring support **87** is connected to a cross bolt **101** that moves with the bottom spring support **87**. The toggle link **97** is also pivotally connected to a vertically movable thrust rod **105**. The thrust rod **105** has an opening in its upper end for receiving the pin **39**.

A lift link **109** is provided for lifting the bottom spring support **87**. The lift link **109** is a flat member that passes through an opening in the top spring support **85** and has an angle shaped lower portion **111** projecting through an opening in the bottom spring support **87**. The cross bolt **101** passes through an opening in the portion **111** of the lift link **109** so that upward movement of the lift link **109** will lift the bottom spring support **87**.

A handle structure indicated generally at **113** is provided to operate an operating shaft **115** (FIG. 2). The handle structure **113** is more specifically described in the above-mentioned application of G. D. Gamel et al. U.S. Pat. No. 3,045,083. The shaft **115** (FIG. 2) is supported for movement about a fixed axis. A plate **117**, which is fixedly secured to the shaft **115**, is pivotally connected to the upper end of the lift link **109** by means of a pin **119**.

The parts of the circuit breaker are shown in FIG. 2 in the open position. In order to close the breaker, the handle structure **113** (FIG. 1) is rotated to rotate the

shaft **115** (FIG. 2) clockwise. As the plate **117** (FIG. 2) rotates clockwise, the link **109** is lifted to lift the bottom spring support **87**. Upward movement of the top spring support **85** is prevented because the links **93, 97** are on dead center. The upward movement of the link **109**, therefore, lifts the bottom spring support **87** to compress the spring **83** between the spring supports **87, 85**. As the link **109** moves upward (FIG. 2) a roller **123**, that is connected to the pin **119**, operates against the toggle link **33** (FIG. 1), which toggle link **33** is collapsed when the breaker is in the open position of FIG. 2, to pivot the toggle link **33** counterclockwise about the pivot **41** raising the thrust rod **105** which rotates the toggle link **97** to move the toggle **93, 97** off of dead center permitting the toggle **93, 97** to collapse to thereby permit upward movement of the top spring support **85** under the force of the charged spring **83** which has been charged by the upward movement of the lower spring support **87**. The spring **83** then expands rapidly moving the top spring support **85** upwardly to force the thrust rod **105** upward. Upward movement of the thrust rod **105** from the open position to the closed position operates, with the tripping toggle **29, 31** in the thrust-transmitting position, to move the closing toggle **31, 33** to the closed position seen in FIG. 1 during which movement the lever **25** is pivoted clockwise about the pivot **27** to move the tie bar **19** from the open position seen in FIG. 5 to the closed position seen in FIG. 1. Movement of the tie bar **19** to the closed position operates through the connectors **21** to pivot the three contact arms **115**, about the pivots **17**, to the contact-closed position seen in FIG. 1.

The trip device **75** (FIGS. 6 and 7) comprises a trip housing structure **127** and a magnetic device **129** supported within the housing **127**. The magnetic device **129** comprises a pair of magnetic steel pole pieces **131, 133**, a conducting coil **135** around the pole piece **131**, a conducting coil **137** around the pole piece **133** and four permanent magnet members **139, 141, 142, 143**, which members **139, 131, 135, 137, 139, 141, 142** and **143** are all potted in an insulating epoxy resin **145** which encapsulates these members and supports them as a unitary structure. The permanent magnet members **139, 141, 142, 143** form a permanent magnet structure indicated generally at **149** which is formed of the four members merely to facilitate assembly using readily available magnet members. The permanent magnet structure **149** is a rubber bonded barium ferrite permanent magnet material that is available under the trade name "Plastiform." As can be understood with reference to FIG. 6, an opening **151** is drilled through the permanent magnet structure **149** and insulating casing **145**. A magnetic steel fixed keeper **153** is fixedly secured to one end of the pole pieces **131, 133** with an insulating sheet **155** sandwiched between the fixed keeper **153** and pole pieces **131, 133** to provide a gap between the fixed keeper **153** and the pole pieces **131, 133**. As can be understood with reference to FIG. 6, the opening **151** extends through the insulating plate **155** and the fixed keeper **153**. The fixed keeper **153** is secured to the pole pieces **131** by a pair of nuts **157** that are threaded onto bolts **159** that are embedded in the epoxy **145** when the epoxy **145** is potted. An actuating rod **161** extends through the opening **151**. As can be understood with reference to FIG. 6, the opening **151** is drilled such that there is a small-diameter portion **163** of the epoxy resin which receives the rod **161** to guide the rod for rectilinear back-and-fourth movement in the opening **151**. The actuating rod **151** extends through an opening in a magnetic steel movable keeper **165**. A washer **167** is provided on the outer end of the rod **161**, and a nut **169** is threaded on the rod **161** against the washer **167** so that as the rod **161** is moved to the right (FIG. 6) this movement will pull the movable keeper **165** to the right to the set position seen in FIG. 6 wherein the movable keeper **165** engages the pole pieces **131, 133**. A shock-absorbing coil spring **171** is supported between a spring support **173** that engages a shoulder portion of the rod **161** and a spring support **175** that engages the movable keeper **165**. A coil spring **179** is supported between a spring support **181** that engages a shoulder of the actuating rod **161** and a spring support **183** that engages the housing **127** to actuate the actuating rod **161** to the left (FIG. 6) upon release of the movable keeper **165**.

The trip device **75** also comprises a supporting bracket **185** that is fixed to the one end of the housing **127**, a trip member **187** that is pivotally supported on a pin **189** that is supported on the bracket **185** and a reset member **191** that is pivotally supported on a pin **193** that is supported on the bracket **185**. The trip member **187** is a generally U-shaped member with the pin **189** passing through the opposite legs thereof. The bight portion of the trip member **187** is extended outward to provide an actuating extension **195**. The reset member **191** is a resilient reset member comprising a rigid generally U-shaped member **197** and a resilient leaf-spring **199** secured to the member **197**. The pin **193** extends through the legs of the U-shaped member **197**. A tension spring **201** is connected to a bent-over portion of the member **197** at one end thereof and to a bent-over portion of the supporting bracket **185** at the other end thereof to bias the reset member **191** in a clockwise (FIG. 6) direction. The member **197** is provided with an extension **203** that engages the bight portion of the trip member **187** between the legs of the trip member **187** in a manner to be hereinafter described. The trip member **187** is pivotally connected to the actuating rod **161** by means of a loose-fitting pin **207**.

The trip device **75** is shown in FIG. 6 in the set position with the leaf-spring member **199** shown in broken lines in the position that the member **199** would assume under the bias of the spring **201** when the tie bar **19** is in the contact-closed position shown in broken lines. The trip device **75** and parts **19, 77** are shown in FIG. 3 in the set position with the tie bar **19** shown in the contact-closed position and the part **77** of the latch **63** shown in the latching position. As can be understood with reference to FIG. 6, the permanent magnet structure **149** generates magnetic flux which passes through the magnet structure **149**, the pole piece **133**, the movable keeper **165**, the pole piece **131** and back through the magnet structure **149**. Part of the flux generated in the magnet structure **149** passes through the magnet structure **149**, the pole piece **133**, the gap **155**, the fixed keeper **153**, the gap **155**, the pole piece **131** back through the magnet structure **149**. Thus, there are two magnetic circuits in the magnetic device **129** with the greater portion of the magnetic flux from the magnet structure **149** passing through the one magnetic circuit which includes the movable keeper **165** and with the remainder of magnetic flux passing through the higher-reluctance other magnetic circuit which includes the gap **155** and the fixed keeper **153**.

The coils **135, 137** are connected in electrical series and pulsed by a DC current, in response to an abnormal or overload condition in any of the three pole units of the circuit breaker, by means of an overcurrent protective device of the type specifically described in the patent application of John David Watson et al., Ser. No. 765,584, filed Oct. 7, 1968. The polarity of the coils **135, 137** is such that when the coils are pulsed the curent in the coils bucks the magnetic flux in the magnetic circuit that includes the movable keeper **165** to raise the reluctance of the magnetic circuit that includes the movable keeper **165** whereupon magnetic flux transfers to the magnetic circuit that includes the fixed keeper **153**. Thus, when the coils **135, 137** are pulsed the movable keeper **165** is released and the charged kickout spring **179** moves the actuating rod **161** to the left to operate through the shock-absorbing spring **171** to move the movable keeper **165** from the set position seen in FIG. 6 to the tripping position seen in FIG. 7. Upon movement of the movable keeper **165** and actuating rod **161** from the set position to the tripping position seen in FIG. 7, the actuating rod **161** pivots the trip member **187** counterclockwise to the tripping position

seen in FIGS. 7 and 4. As can be understood with reference to FIGS. 7, 4 and 1, when the trip member **187** moves to the tripping position the part **195** of the trip member **187** engages the part **77**, that is connected to the latch **63** (FIG. 1) to pivot the latch **63** in a counterclockwise (FIG. 1) direction about the pivot **65**. This unlatching movement of the latch **63** (FIG. 1) serves to release the latch **53** to effect an opening operation of the circuit breaker in the same manner as was hereinbefore described. The parts are shown in FIGS. 4 and 7 at the instant when the trip member **187** is moved to the tripping position with the tie bar **19** still shown in the closed position about to be operated to the open position as the latches are released. When the circuit breaker is operated to the open position the rod **19** moves from the position seen in FIGS. 4 and 7 (seen in broken lines in FIG. 6) to the open position seen in FIGS. 5 and 6. As the tie bar **19** moves to the open position seen in FIGS. 5 and 6, the tie bar engages the resilient leaf spring **199** of the resilient reset member **191** to pivot the reset member **191** in a counterclockwise direction about the pivot **193**. During this movement, the projecting portion **203** of the reset member **191** engages the trip member **187** to pivot the trip member **187** in a clockwise direction about the pivot **189** moving the actuating rod **161** from the released or tripping position seen in FIG. 7 back to the set or reset position seen in FIG. 6. As the actuating rod **161** moves to the position seen in FIG. 6, the rod **161** operates through the washer **167** to pull the movable keeper **165** back into the set position in engagement with the pole pieces **131, 133**. The coils **135, 137**, which were only momentarily pulsed to effect the tripping operation, are not energized when the circuit breaker is tripped and they will not be energized when the circuit breaker is reclosed unless there is a condition in one of the pole units that would operate the protective relay to again energize the coils **135, 137**. Thus, when the movable keeper **165** is re-engaged in the set position engaging the pole pieces **131, 133** the magnetic flux will automatically transfer from the higher reluctance magnetic circuit that includes the fixed keeper **153** back through the lower reluctance magnetic circuit that includes the movable keeper **165** so that the magnetic flux in the circuit through the movable keeper **165** will again work to hold the movable keeper **165** in the set position seen in FIG. 6 until the coils **135, 137** are again pulsed.

As can be understood with reference to the drawings, with the rigid tie bar **19** operating against a resilient leaf-spring member **199** the manufacturing tolerances and positioning of parts in the breaker is less critical in that when the tie bar **19** moves past the point where the movable keeper **165** engages the pole pieces the tie bar **19** will merely flex the leaf-spring **199** without applying damaging forces to the parts of the trip device.

Following an opening operation of the circuit breaker, the circuit breaker is manually closed by operation of the handle operating structure **113** (FIG. 1) in the same manner as was hereinbefore described. During the closing operation, the tie bar **19** moves from the full line position seen in FIG. 6 to the broken line position seen in FIG. 6 (from the position seen in FIG. 5 to the position seen in FIG. 3) whereupon the spring **201** biases the reset member **191** clockwise about the pivot **193** from the position seen in FIG. 6 to the position seen in FIG. 3.

With the trip device in the reset position, if the actuating rod **161** is moved slightly to the left under shock conditions, some of the shock force will be absorbed by the shock-absorbing spring **171** without being directly applied to the movable keeper **165**. The actuating rod **161** extends through an opening, in the movable keeper **165**, that is large enough to permit relative movement of the rod to the left (FIG. 6) without moving the movable keeper **165**. The spring **171**, however, must be sufficiently stiff so that when the movable keeper **165** is released the movable keeper will be immediately biased to the left under the biasing force of the spring **179** operating through the rod **161** and spring **171**.

I claim:

1. A circuit breaker comprising a stationary contact, a movable contact cooperable with said stationary contact, an operating mechanism releasable to effect automatic opening of said contacts, trip means comprising a magnetic device, said magnetic device comprising magnetic pole-piece means, a magnetic fixed keeper supported at a first end of said pole-piece means, a magnetic movable keeper at a second end of said pole-piece means opposite said first end, an elongated actuator operatively connected at one end thereof to said movable keeper and extending at the other end thereof past said fixed keeper, permanent magnet flux supplying means positioned between said fixed keeper and movable keeper and providing magnetic flux that operates in a first magnetic circuit through said pole-piece means and said movable keeper to maintain said movable keeper and said actuator in a set position in which set position said movable keeper is positioned against said pole-piece means, biasing means biasing said actuator and movable keeper away from said pole-piece means, means for effecting a transfer of magnetic flux from said first magnetic circuit to a second magnetic circuit which is through said pole-piece means and said fixed keeper whereupon said movable keeper is released, upon release of said movable keeper said biasing means biasing said movable keeper and said actuator away from said pole-piece means to bias said movable keeper and said actuator to a tripping position in which tripping position said movable keeper is spaced from said pole-piece means, upon movement of said movable keeper and said actuator to said tripping position said actuator at said other end thereof operating to effect release of said operating mechanism to thereby effect opening of said contacts, and means automatically moving said actuator and said movable keeper back to said set position upon opening of said contacts.

2. A circuit breaker according to claim **1**, said magnetic device being constructed and arranged such that the magnetic reluctance in said second magnetic circuit is higher than the magnetic reluctance in said first magnetic circuit, said means for transferring magnetic flux from said first magnetic circuit to said second magnetic circuit comprising coil means energized upon the occurrence of overload current conditions to effect said transfer of magnetic flux, and upon movement of said movable keeper and said actuator back to said set position with said coil means deenergized magnetic flux automatically transferring from said second magnetic circuit to said first magnetic circuit to work to maintain said movable keeper and said actuator in said set position.

3. A circuit breaker according to claim **2**, said means for moving said movable keeper and said actuator back to said set position comprising resilient reset means operatively connected to said actuator, said operating mechanism comprising a movable member movable to an open position upon opening of said contacts and to a closed position upon closing of said contacts, and upon movement of said movable member to the open position said movable member engaging said resilient reset means and operating said resilient reset means to operate said actuator and said movable keeper back to said set position.

4. A circuit breaker according to claim **3**, said circuit breaker comprising a multi-pole circuit breaker, a stationary contact and a movable contact for each pole unit, a separate movable contact arm carrying each of said movable contacts, a rigid tie bar common to all of said pole units and operatively connected to simultaneously move all of said movable contact arms, and said movable member that engages said resilient reset means being said tie bar.

5. A circuit breaker according to claim **3**, said operating mechanism comprising latch means movable to a releasing position to release said operating mechanism, said

trip device comprising a trip member operatively connected to said actuator and movable upon movement of said movable keeper and said actuator to the tripping position to engage said latch means and to move said latch means to the releasing position, and said resilient reset means comprising a reset member separate from said trip member and supported to actuate said trip member said movable keeper and said actuator back to the set position upon opening of said contacts.

6. A circuit breaker according to claim 5, said trip means comprising a trip housing structure, said magnetic device being supported within said trip housing structure, said trip housing structure having opening means therein, said actuator extending out through said opening means, and said trip member and said resilient reset means being supported on said trip housing structure external of said trip housing structure.

7. A circuit breaker according to claim 4, means supporting said trip member on a first fixed pivot, means supporting said resilient reset means on a second fixed pivot separate from said first fixed pivot, means connecting said trip member with said actuator, spring means biasing said resilient reset means toward an initial position, upon release of said movable keeper said movable keeper said actuator and said trip member operatively moving to release said latch means with said resilient reset means remaining in said initial position, upon opening of said contacts said movable member engaging said resilient reset means and moving said resilient reset means to the set position during which movement said resilient reset means operates to move said movable keeper said trip member and said actuator back to the set position, and upon the occurrence of a subsequent closing operation said spring means biasing said resilient reset means back to said initial position during which movement of said resilient reset means said movable keeper said trip member and said actuator remain in said set position.

8. A circuit breaker according to claim 3, said magnetic device having opening means therein, said actuator comprising an elongated actuating rod operatively connected to said movable keeper at one end thereof and extending through said opening means past said fixed keeper, a trip member operatively connected to said other end of said actuating rod and movable upon movement of said actuating rod to effect release of said operating mechanism, and said resilient reset means being supported in proximity to said other end of said actuating rod and being operable to said reset position to move said actuating rod said movable keeper and said trip member back to the set position.

9. A circuit breaker according to claim 8, a first spring means biasing said actuating rod toward the tripping position, said movable keeper having an opening therein, said actuating rod at said one end thereof extending through said opening and being connected to said movable keeper to move said movable keeper with said actuating rod back to said set position, and a shock-absorbing spring connected between said actuating rod and said movable keeper to permit said actuating rod to move toward the tripping position under shock conditions with said movable keeper in the set position during which movement said actuating rod compresses said shock-absorbing spring and moves relative to said set movable keeper, upon release of said movable keeper said tripping spring operating said actuating rod to operate through said shock-absorbing spring to move said movable keeper and said actuating rod to the tripping position.

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