Jan. 19, 1960 H. H. MITCHELL 2,922,011

HYDRAULIC SPRING CLOSING MECHANISM FOR CIRCUIT BREAKERS-PREVENTION OF UNINTENTIONAL CLOSING

Filed July 1, 1957 2 Sheets-Sheet 1

FIG. 1.

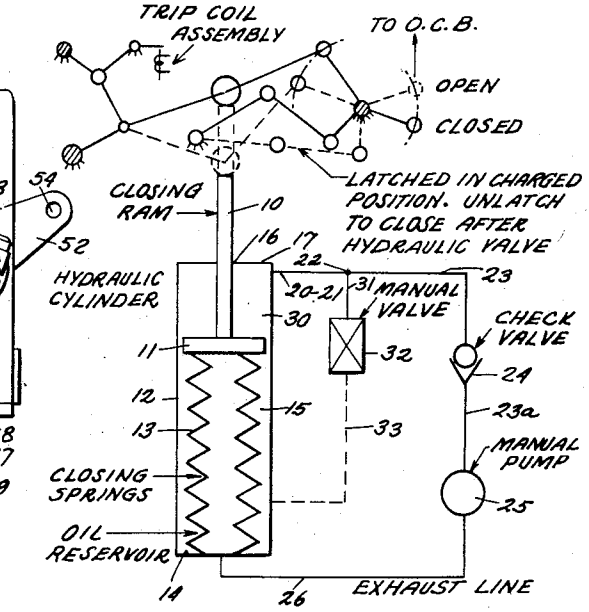


FIG. 2.

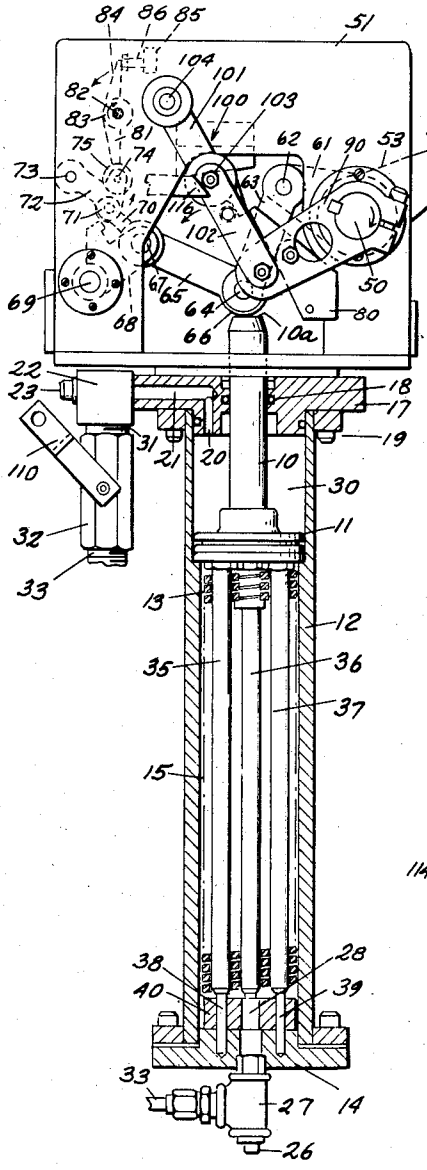
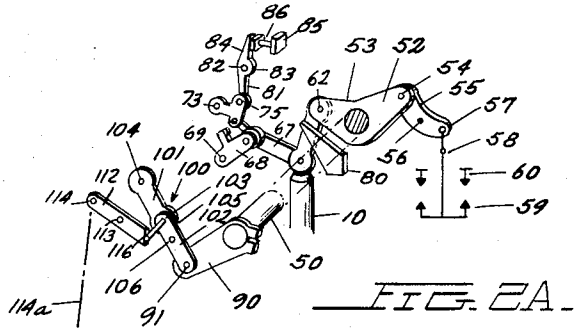


FIG. 2A.



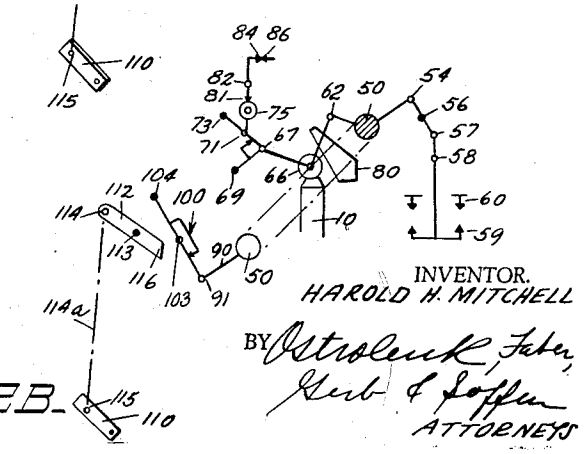


FIG. 2B.

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FIG. 3.

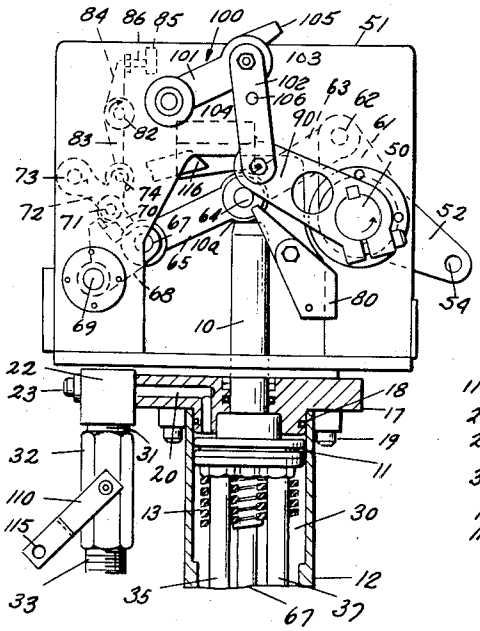
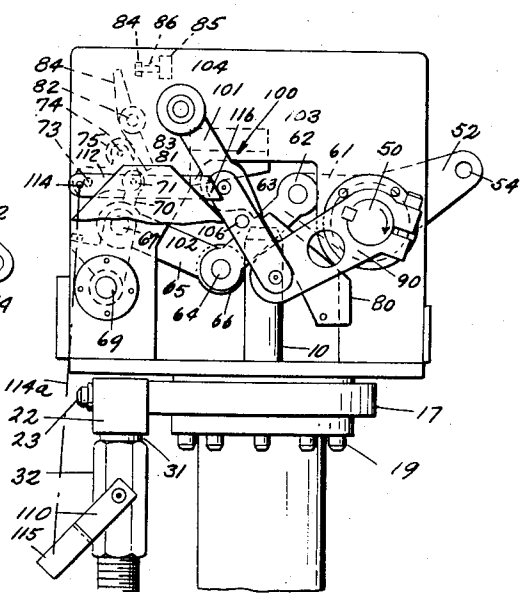


FIG. 4.



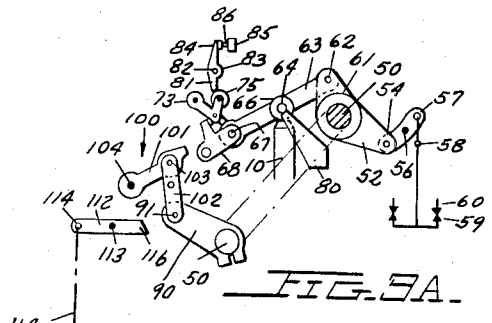


FIG. 3A.

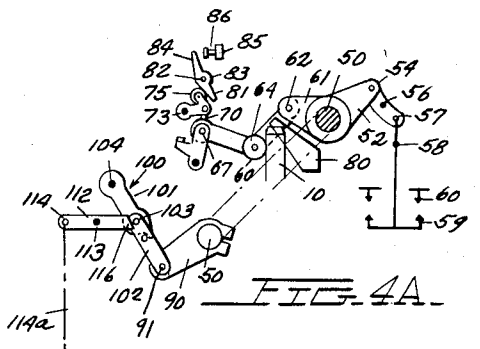


FIG. 4A.

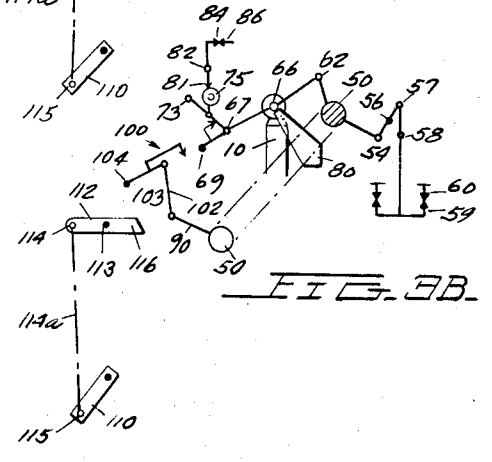


FIG. 3B.

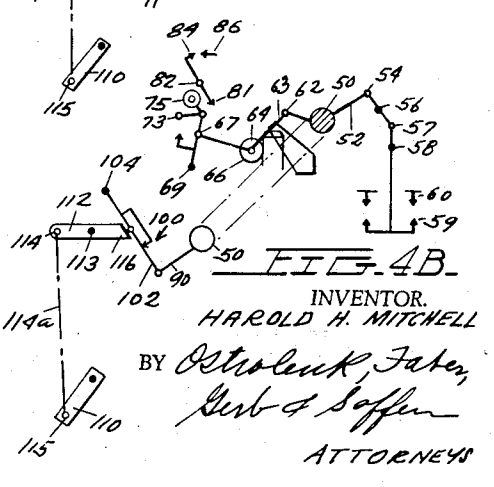


FIG. 4B.

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HYDRAULIC SPRING CLOSING MECHANISM FOR CIRCUIT BREAKERS—PREVENTION OF UNINTENTIONAL CLOSING

Harold H. Mitchell, La Canada, Calif., assignor, by mesne assignments, to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Application July 1, 1957, Serial No. 669,294

10 Claims. (Cl. 200—153)

My present invention relates to circuit breakers and more particularly to circuit breaker operating mechanisms which are particularly adapted to operate oil circuit breakers although they may readily be arranged to operate other types of circuit breakers.

Specifically, my invention relates to mechanisms for closing the circuit breaker, said mechanism being associated, however, with mechanisms for opening the circuit breaker and being so arranged that the selected operation of either closing or opening the breaker may be performed in accordance with the condition of the circuit breaker at any particular time, and without interference by the closing mechanism with the opening mechanism, or vice versa.

Heretofore, systems have been provided for closing circuit breakers, such closing mechanisms and the connection thereof to the circuit breaker being so arranged that the circuit breaker will at all times be trip free, both during the closing operation and after the closing operation is completed while the closing mechanism is still in the closing position.

In some circuit breakers, the closing mechanism is operated by a closing spring which is initially compressed preparatory to a closing operation by a hydraulic system operating in a cylinder in which the closing spring is compressed by a piston.

When the spring is permitted to expand, the piston is driven to operate a closing member to effect a closing of the circuit breaker.

Frequently, in mechanisms of this type, the freeing of the spring from compression, so that it may operate to move the piston to close the circuit breaker, is achieved by opening a valve, so that hydraulic fluid pressure may be equalized on both sides of the piston.

In other words, the spring is maintained in compressed condition by hydraulic pressure on the side of the piston opposite the spring. The equalization of pressure is then achieved by for instance, the opening of a valve which permits hydraulic fluid to flow and equalize pressure on both sides of the piston. When such equalized pressure is reached or approached, then the compressed spring is free to expand to operate the closing mechanism.

While the utilization of such hydraulic mechanism for initially compressing the powerful closing spring provides simplicity and convenience in operation, and the closing spring may thus be compressed manually by operation of a manual pump for forcing the hydraulic fluid against the piston to compress the spring, nevertheless, the possibility exists that in the event of a leak in the valve, the cylinder or the hydraulic line, pressure on both sides of the piston may either approach equalization or actually become equal, so that the spring may expand to close the circuit breaker.

My invention has for its primary object the provision of mechanism for positively locking the closing member and the piston in open position and maintaining the

spring in compressed position when the circuit breaker is intended to be and remains open.

Whether or not equalization or substantial equalization on both sides of the piston occurs, accidentally or otherwise, during the period when the circuit is to remain open, my invention has for a further object, the provision of means operable simultaneously and as a result of the operation of a closing handle to release said locking means when it is desired to close the circuit breaker.

In other words, the circuit breaker closing mechanism is locked in the open position and remains locked in an open position until a positive operation is performed intended to effect a closing of the circuit breaker.

A further object of the present invention is the arrangement of the locking means for the closing mechanism so that operation of a valve which is intended to equalize the hydraulic pressure to permit closing will simultaneously release the locking mechanism.

The foregoing and many other objects of my invention will become apparent in the following description and drawings in which:

Figure 1 is a schematic view showing generally the operation of my circuit breaker.

Figure 2 is a vertical view in cross-section showing my novel circuit breaker mechanism and the locking device in the open position.

Figures 2A and 2B are highly schematic views both showing the arrangement of the links and toggles of my novel circuit breaker in the open position thereof.

Figure 3 is a view corresponding to that of Figure 2 showing my novel circuit breaker operating mechanism in the closed position thereof.

Figures 3A and 3B are highly schematic views both showing the arrangement of the links and toggles of my novel circuit breaker in the closed position thereof.

Figure 4 is a view corresponding so that of Figures 2 and 3, showing my novel circuit breaker operating mechanism in the trip-free condition.

Figures 4A and 4B are highly schematic views both showing the arrangement of the links and toggles of my novel circuit breaker in the trip-free position thereof.

Referring first to Figures 1 and 2, I have shown schematically in Figure 1, the basic hydraulic operation of my circuit breaker operating mechanism and in Figure 2, the elements as they appear in actual commercial form with certain portions of the hydraulic connections omitted.

Essentially, my novel circuit breaker closing mechanism comprises a closing ram **10**, which is connected to a piston **11** operating in cylinder **12**.

Closing springs **13** are compressed between the lower face of pistoon **11** and the lower interior surface **14** of the cylinder **12**, the said springs **13** being located in section **15** of the cylinder below the piston **11**.

The closing ram **10** extends upwardly through opening **16** in the head **17** of cylinder **12**, appropriate sealing means **18** being provided at the opening **16** to retain hydraulic pressure.

The cylinder head **17** is secured to the cylinder **12** in any appropriate manner, as for instance, by the securement means **19** and is provided with two connected intersecting passages **20**, **21**, which form part of the hydraulic line.

Passage **21** is connected through the T-member **22** to the hydraulic line **23** which, through the check valve **24** (not shown in Figure 2, but shown in Figure 1), is connected by line **23***a* to the pump **25** (also not shown in Figure 2).

Pump **25** is connected by exhaust line **26** to the T-connection **27**, which in turn, is connected to opening

28 in the lower end of the cylinder communicating with chamber 15 of the cylinder.

A bypass or parallel path is provided from the upper chamber 30 of cylinder 12 to the lower chamber 15 of cylinder 12, through the passage 20, 21, the T-connection 22, the passage 31, the operating valve 32 and the passage 33 to the T connection 27 and opening 28 leading to lower chamber 15 of the cylinder.

The chambers 15 and 30 of the cylinder are referred to as chambers for convenience only, it being understood that the axial length of each chamber varies as piston 11 is moved upwardly or downwardly in the cylinder 12.

In order to move the closing ram 10 from the up position of Figure 4 to the full open position of Figure 2, it is necesary to force the piston 11 down against the increasing bias of the closing spring 13.

In order to perform this operation, pump 25 is operated either manually or by any other appropriate means to draw fluid from the lower chamber 15 through line 26 and to pump the fluid through line 23*a*, check valve 24, lines 23 and 20, 21, into the upper chamber 30 of cylinder 15.

At this time, the operating valve 32 is closed. As the fluid is thus pumped into the upper chamber 30 of cylinder 15, the increase in pressure forces the piston 11 down from the position of Figures 3 and 4 to the position of Figure 2 to charge the closing spring 13.

While the closing spring 13 is here for convenience referred to as a single spring, the closing spring 13 may actually be a plurality of springs as shown in Figures 2, 3 and 4, each positioned about guide rods 35, 36, 37, secured to the undersurface of cylinder 11, and having extensions slidably received in recesses 38, 39 in the lower cylinder surface, or head 14 and in the bearing plate 40 for the springs.

When the operation of the pump 25 ceases, the check valve 24 serves to maintain the pressure in lines 23, 20, 21 and chamber 30, and thus maintain the piston 11 in the lower or compressed position of Figure 2 against the bias of springs 13.

In order to release this pressure and permit springs 13 to raise the piston 11 and closing ram 10 from the position of Figure 2 to the closed position of Figure 3, it is now necesary to permit hydraulic pressure in chamber 30 above the piston 11 to be released, and/or, to equalize the pressures in chamber 30 above the piston 11 and chamber 15 below the piston 11. This is achieved by the closing valve 32 which is normally closed when the circuit breaker is opened, but which, when opened establishes a connection from upper chamber 30 through passages 20, 21, 31 and valve 32 to passage 33 to the lower chamber 15.

Pressure is then equalized by this connection between chambers 30 and 15, and no resistance is then encountered to the expansion of the compressed springs 13 in the condition of Figure 2, other than that required to move the hydraulic fluid through said passages and valve 32.

The closing spring 13 may then expand driving piston 11 and closing ram 10 upwardly from the position of Figure 2 to the position of Figure 3 to close the circuit breaker.

The locking means which is the basic subject matter of the present invention, comprises the over-center toggle 100 which includes links 101 and 102 connected in toggle relation with each other by toggle pin 103.

The opertaion of this locking means, however, can be understood best after the basic circuit breaker operating toggle mechanism is described. Hence, the specific description of a locking toggle 100 will be deferred until the operation of the circuit breaker toggle per se can be made clear.

The operating mechanism of this invention is, of course, intended to move one or more moving contacts of a circuit breaker into and out of engagement with complementary contacts.

The movement of the movable contacts toward engagement is achieved by clockwise rotation of contact operating shaft 50, supported in any appropriate manner for rotation in appropriate bearings (not shown) between the walls of the operating mechanism housing 51.

The opening of the circuit breaker from the position of Figure 3 to that of either Figures 2 or 4, is achieved by rotation of the contact operating shaft 50 in a counterclockwise direction. The arrows on circular contact operating shaft 50 of Figures 2, 3 and 4, show the direction in which the shaft will next be rotated to perform the next operation, whether toward closing or opening.

The shaft 50 may be connected in any suitable manner to the movable contacts of the circuit breaker. One method shown in highly schematic form, is by means of an arm 52 which is part of bell crank lever 53 keyed to the contact operating shaft 50 and therefore rotatable with the shaft 50.

Lever 52 for operating one or more sets of movable contacts, may as shown in highly schematic form in Figures 2B, 3B and 4B, be connected to a bell crank lever 55 by pin 54, bell crank lever 55 being rotatable on a pin or shaft 56. The opposite end of the bell crank lever 55 is connected by pin 57 to a vertically movable contact arm 58 carrying, at its lower end, the movable contacts 59 for cooperation with the complementary contacts 60.

Consequently, rotation of contact carrying shaft from the position of Figure 3 to the position of Figures 2 or 4, will raise the lever 52 and will rotate bell crank lever 55 to drive the contact arm 58 and contacts 59 downwardly away from the complementary contacts 60 to open the circuit breaker.

Similarly, an opposite rotation of contact operating shaft from the position of Figure 2 to the position of Figure 3 will result in movement of the movable contacts 59 into engagement with complementary contacts 60 as shown in Figure 3B.

Lever arm 61 of bell crank lever 52 keyed to the contact operating shaft 50 is connected by pin 62 to lever 63, which through toggle pin 64 is in toggle relation with link 65.

Pins 62 and 64 are floating pins in the sense that they are not connected to any stationary bearing, but are moved to various positions by various forces exerted either on the pins or on the toggle links to which they are connected.

Pin 64 is provided with a roller 66 which serves as a bearing against which the end 10*a* of closing ram 10 may bear in moving the circuit breaker from the open position of Figure 2 to the closed position of Figure 3.

Link 65 is connected by floating pin 67 to link 68, the opposite end of which is connected to a stationary pin or shaft 69.

Link 68 is in toggle relation through pin 67 with link 70, the opposite end of which is connected by floating pin 71 to latch link 72.

Link 72 is rotatably mounted on stationary pin 73. Latch link 72 is provided with an extension 74 carrying the latch roller 75.

When the circuit breaker is closed as shown in Figure 3, the opening bias on the circuit breaker contacts is transmitted through bell crank lever 52 to the pin 62.

The toggle consisting of links 63 and 65 is undercenter and is supported, as the case may be, either on the end 10*a* of the closing ram 10 or on the support latch 80, which support latch engages pin 64.

The toggle comprising links 63, 65 is supported at its opposite end against the pin 67, which in turn, is supported by the under-center toggle comprising links 70 and 68. The bias, therefore, at toggle 70–68 is in a direction to cause it to further extend the toggle, and hence, move pin 71 upwardly. The latch link 72 owing

to the fact that its latch roller **75** is engaged by the latch **81**, locks this upward movement of pin **71** and link **72**, and thereby maintains all of the toggles in the position shown in Figure 3 when the circuit breaker is closed.

Latch **81** is rotatably mounted on shaft **82** and is biased in any suitable manner towards the position shown in Figures 2 and 3.

Preferably, latch **81** is connected to a latching bar **83** which is rotatably mounted as above pointed out, and the latching bar **83** is provided with a trip lever **84** which may be engaged by a tripping device (not shown). The trip lever bears against stop **85**.

The tripping device is so arranged that it may be selectively either manually operated or operated in response to current conditions on the line in which the circuit breaker is connected to rotate the latch lever **84** and the latch member **81** in a counterclockwise direction with respect to Figures 3 and 4. This removes the blocking support by latch **81** to latch roller **75** and pin **74**, and hence, removes the support from pin **71**.

Toggle **70–72** is thus allowed to extend from the position of Figure 3 to the position of Figure 4, and the subsequent movement of pin **67** to the left with respect to the figures pulls the roller **66** off the surface **10***a* of closing ram **10** and also pulls the toggle pin **64** or an extension thereof off the latch member **80**; the circuit breaker now opens in response to the bias on its movable contact even though the closing ram **10** is in the closing position as shown in Figure 4. This is the trip-free condition of the circuit breaker.

Either the toggle **63–65** or the toggle **70–72** may be provided with a relatively light resetting spring tending to rest the toggles toward the condition of Figure 2. This spring which is not shown, but which is well understood, is sufficiently light so that it will not interfere in any way with the closing springs **13** or with the opening bias springs of the circuit breaker, but is also sufficiently strong so that it will restore either one of the two toggles to which it is connected to the condition of Figure 2; so that the circuit breaker is reset for closing when the closing ram **10** is drawn down to the closed position and the latch member **81** is re-engaged with latch roller **75** in the position shown in Figure 2.

To summarize, the operation of the toggle mechanisms, the moving of closing ram **10** from the position of Figure 2 to the position of Figure 3, extends the toggle **65–63** to a substantially extended but under-center position, rotating the shaft **50** and extension **52** of bell crank lever **53** in a direction to close the circuit breaker. The extended toggle **63–65** is supported by the toggle **70–68** at pin **67**, this latter toggle being in turn supported at pin **71** by the latch lever **72**, the latch roller **75** and the latch **81**.

Trip-free operation is, of course, a result of the closing of the circuit breaker on an over current or fault condition which operates the trip member or the result of any other tripping operation which occurs while the closing ram **10** is in the elevated position of Figure 3.

In this case, the toggles operate as previously pointed out to open the circuit breaker, the toggles assuming the position of Figure 4 with the roller **66** bearing against the side of ram **10**. While the circuit breaker is open in this instance, since the closing ram **10** is extended the toggles cannot fully collapse in response to the light toggle restoring spring referred to. When the closing ram is withdrawn to the position of Figure 2, then the toggles may collapse and the latch reset as shown in Figure 2.

When the circuit breaker is closed and the pin **64** of toggle **63–65** is supported on member **80**, the closing ram may be withdrawn and the circuit breaker will remain closed.

It will be obvious, that when the circuit breaker is open in the position of Figure 2, any operation of the hyrdaulic mechanism which will release the pressure

in chamber **30** or permit equalization of pressure in chambers **30** and **15** of the cylinder **12** will result in the expansion of the closing spring **13** and a movement of the parts from the open position of Figure 2 to the closed position of Figure 3.

This invention has for its special object another lock device so arranged that as long as the valve **32** is intended to stay closed and thereby hold the piston **11** in its lowered position and compress spring **13**, the entire toggle mechanism remains locked in the position of Figure. 2.

My invention has for its further object the arrangement of the operating mechanism of the valve **32** in such a manner that opening the valve to permit equalization of pressure and the expansion of springs **13** will automatically release the interlock. In order to provide this interlock and means which will prevent the operation of the closing springs **13** to lift the ram **10** until an actual operation of that type is desired, I provide on the contact operating shaft **50** an additional crank **90** keyed thereto. Crank **90** is connected by pin **91** to the toggle **100** consisting of link **102**, **101** and toggle pin **103**. Link **101** of toggle **100** is connected to the stationary pivot **104**.

When all of the toggle elements of the circuit breaker have moved to the open position of Figure 2, toggle **100** moves over-center around its knee pin **103** tending actually to break in the other direction, that is, in a direction to move pin **103** to the left of the line connection pins **104** and **91**.

Extension **105** of link **101** bearing against stop pin **106** (Figure 3) of link **102** prevents this break of the toggle in the opposite direction from occurring while, nevertheless, permitting the toggle **100** to move just beyond center. With the toggle **100** broken just beyond center, any attempt to rotate the contact operating shaft **50** in a clockwise direction with respect to Figure 2 will be defeated since the extended toggle **100** prevents rotation of crank arm **90** which is keyed to the shaft **50**.

Hence, any force tending to raise the closing ram **10** would be blocked by reason of the fact that, with contact operating shaft **50** held against rotation, lever **61** cannot rotate clockwise and link **63** cannot rise.

Since all of the links are so arranged that they assume the position shown in Figure 2, when the circuit breaker is open, the locking toggle **100** extends into locking position automatically on opening of the circuit breaker mechanism. The locking extension of toggle **100** even takes place when the opening occurs in response to trip-free operation, as shown in Figure 4, since the condition of toggle **100** depends only on the angular position of lever **90** keyed to the contact operating shaft **50**.

When now it is desired to close the circuit breaker, not only must the pressure in chamber **30** of cylinder **12** be released or equalized to permit the springs **13** to expand, but also the lock achieved by toggle **100** must be broken. For this purpose, toggle **100** must be moved back over-center, that is, with the knee pin **103** moving toward the right with respect to Figure 2; when this toggle breaks over-center to the right, it offers no further resistance to the clockwise movement of crank arm **90** and contact operating shaft **50**. Any appropriate means may be provided to move the knee pin **103** of toggle **100** to the right, including a push rod engaging an extension of the knee pin **103**.

Preferably, since the closing operation should result from operation of handle **110** of the control valve **32**, that is, the operation of the handle **110** to open the control valve **32**, the said handle **110** may be interlocked with means automatically operable on movement of the handle **110** to push the knee pin **103** of toggle **100** through center, so that it may break to permit rotation upwardly of the end of crank arm **90**. Handle **110** is so arranged that the valve **32** is closed when the handle **110** is in the up position of Figure 2, and so that valve **32** is open

when the handle 110 is in the down position of Figures 3 and 4.

A cam member 112 is provided pivotally mounted on the stationary pivot 113 on the housing 51 of the operating mechanism. The left-hand extension of the lever 112 being pivotally connected at 114 to the pull rod 114a the lower end of which is pivotally connected at 115 to the valve control handle 110.

Lever 112 at its right-hand end with respect to the figures, is provided with the cam surface 116, the cam surface registering with an extension of pin 103.

When now the handle 110 is moved downwardly, pull rod 114a is also moved downwardly, the left-hand end of lever 112 is moved downwardly and the cam surface 116 of the lever 112 rises up. The raising of the cam surface 116 of lever 112 pushes the knee pin extension 103 to the right with respect to Figure 2, breaking the toggle 100 back through center toward the right, so that the toggle may now collapse on further movement of handle 110 and permit, as shown in Figure 3, the crank arm 90 to rotate clockwise in response to the operation of the closing members and thereby permit the contact operating shaft 50 to rotate in a direction to close the circuit breaker.

As previously pointed out, after the circuit breaker is closed in the condition of Figure 3, hydraulic mechanism may be operated to draw down the closing ram 10 while the member 80 maintains the toggle mechanism in the position of Figure 3. In this case, the handle 110 may be raised back to the position of Figure 2 and the cam lever 112 restored to the position of Figure 2 without interfering with the closed condition of the circuit breaker. When the circuit breaker is, therefore, tripped, all of the parts return to the position of Figure 2 and the automatic lock takes place.

If while the circuit breaker is closed and remains closed with the closing ram withdrawn, a leak should occur causing the closing ram to rise accidentally, then, as shown in Figure 4, this condition will not interfere with the tripping of the circuit breaker.

Thereafter, in order to reclose the circuit breaker, the chamber 30 of cylinder 12 must be recharged meaning, of course, that handle 110 must be raised to the position of Figure 2, and on withdrawal of the closing ram 10, all elements will be restored to the open and interlocked position of Figure 2.

In the foregoing I have described my invention solely in connection with specific illustrative embodiments thereof. Since many variations and modifications of the invention will now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein contained but only by the appended claims.

I claim:

1. In switchgear having a movable contact and a complementary contact, a movable contact operating member comprising a shaft rotatable in a first direction to effect a closure of said contacts and in a second direction to effect an opening of said contacts; closing means operable to rotate said shaft in said first direction; and locking means for defeating the operation of said closing means and maintaining said shaft in the open position for said contacts; said locking means comprising a crank on said shaft; a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said shaft is in the open position for said contacts; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said shaft in the open position of said contacts and preventing rotation of the shaft in the said first direction by said closing means.

2. In switchgear having a movable contact and a complementary contact, a movable contact operating member comprising a shaft rotatable in a first direction to effect a closure of said contacts and in a second direction to effect an opening of said contacts; closing means operable to rotate said shaft in said first direction; and locking means for defeating the operation of said closing means and maintaining said shaft in the open position for said contacts; said locking means comprising a crank on said shaft; a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said shaft is in the open position for said contacts; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said shaft in the open position of said contacts and preventing rotation of the shaft in the said first direction by said closing means and additional means operable on said toggle for moving said toggle from the blocked position through center to a position where it is free to collapse to permit rotation of said shaft in said first direction in response to operation of said closing means.

3. In switchgear having a movable contact and a complementary contact, a movable contact operating member comprising a shaft rotatable in a first direction to effect a closure of said contacts and in a second direction to effect an opening of said contacts; closing means operable to rotate said shaft in said first direction; and locking means for defeating the operation of said closing means and maintaining said shaft in the open position for said contacts; said locking means comprising a crank on said shaft; a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said shaft is in the open position for said contacts; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said shaft in the open position of said contacts and preventing rotation of the shaft in the said first direction by said closing means and additional means operable on said toggle for moving said toggle from the blocked position through center to a position where it is free to collapse to permit rotation of said shaft in said first direction in response to operation of said closing means; said additional means being operable in response to operation of said closing means.

4. In switchgear having a movable contact and a complementary contact, a movable contact operating member comprising a shaft rotatable in a first direction to effect a closure of said contacts and in a second direction to effect an opening of said contacts; closing means operable to rotate said shaft in said first direction; and locking means for defeating the operation of said closing means and maintaining said shaft in the open position for said contacts; said locking means comprising a crank on said shaft; a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said shaft is in the open position for said contacts; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said shaft in the open position of said contacts and preventing rotation of the shaft in the said first direction by said closing

means and additional means operable on said toggle for moving said toggle from the blocked position through center to a position where it is free to collapse to permit rotation of said shaft in said first direction in response to operation of said closing means; a handle for initiating the operation of said closing means; said handle being also connected to operate said additional means.

5. In switchgear having a movable contact and a complementary contact, a movable contact operating member comprising a shaft rotatable in a first direction to effect a closure of said contacts and in a second direction to effect an opening of said contacts; closing means operable to rotate said shaft in said first direction; and locking means for defeating the operation of said closing means and maintaining said shaft in the open position for said contacts; said locking means comprising a crank on said shaft; a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said shaft is in the open position for said contacts; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said shaft in the open position of said contacts and preventing rotation of the shaft in the said first direction by said closing means and additional means operable on said toggle for moving said toggle from the blocked position through center to a position where it is free to collapse to permit rotation of said shaft in said first direction in response to operation of said closing means; said additional means comprising a cam member pivotally mounted adjacent said toggle pin, rotation of said cam member in one direction causing the cam to engage said toggle pin and move the same through center to permit collapse of said toggle; a member for initiating the operation of said closing means; said last mentioned member being also connected to rotate said cam member in said one direction.

6. In switchgear having a movable contact and a complementary contact, movable contact operating apparatus including a crank; said crank being rotatable in a first direction upon a closure of said contacts and in a second direction upon an opening of said contacts; closing means engageable with said movable contact operating apparatus to effect a closure of said contacts; and locking means for defeating the operation of said closing means and maintaining said contacts in open position; said locking means being connected to said crank and consisting of a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said contacts are in the open position; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said crank in the open position and preventing closure thereof.

7. In switchgear having a movable contact and a complementary contact; movable contact operating means; a closing ram engageable with said movable contact operating means to effect a closure of said contacts; spring means for biasing said closing ram for operation thereof in the closing direction; means for charging said spring means and for restraining the same against operation of said ram in the closing direction; and means for locking said movable contact against unintended closure; said means including a crank associated with said movable contact operating means; said crank being rotatable in a first direction upon a closure of said contacts and in a second direction upon an opening of said contacts;

and a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said contacts are in the open position; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said contacts in the open position.

8. In switchgear having a movable contact and a complementary contact; movable contact operating means; a closing ram engageable with said movable contact operating means to effect a closure of said contacts; spring means for biasing said closing ram for operation thereof in the closing direction; means for charging said spring means and for restraining the same against operation of said ram in the closing direction; and means for locking said movable contact against unintended closure; said means including a crank associated with said movable contact operating means; said crank being rotatable in a first directoin upon a closure of said contacts and in a second direction upon an opening of said contacts; and a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said contacts are in the open position; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said contacts in the open position and additional means operable in response to release of said spring restraining means for moving said toggle from a blocked position through center to a position where it is free to collapse to permit movement of said crank in said first direction to close said contacts.

9. In switchgear having a movable contact and a complementary contact; movable contact operating means; a closing ram engageable with said movable contact operating means; a closing ram engageable with said movable contact operating means to effect a closure of said contacts; spring means for biasing said closing ram for operation thereof in the closing direction; hydraulic means for charging said spring means and a valve for maintaining the hydraulic means in condition to restrain said spring means in charged position and means for locking said movable contact against unintended closure; said means including a crank associated with said movable contact operating means; said crank being rotatable in a first direction upon a closure of said contacts and in a second direction upon an opening of said contacts; and a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said contacts are in the open position; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said contacts in the open position.

10. In switchgear having a movable contact and a complementary contact; movable contact operating means; a closing ram engageable with said movable contact operating means; a closing ram engageable with said movable contact operating means to effect a closure of said contacts; spring means for biasing said closing ram for operation thereof in the closing direction; hydraulic means for charging said spring means and a valve for maintaining the hydraulic means in condition to restrain said spring means in charged position and means for locking said movable contact against unintended closure; said means including a crank associated with said mov-

able contact operating means; said crank being rotatable in a first direction upon a closure of said contacts and in a second direction upon an opening of said contacts; and a toggle comprising one link connected at one end thereof to said crank, a toggle pin at the other end of said link; a second link connected at one end thereof to said toggle pin, the other end of the said second link being stationarily pivoted; said toggle pin moving over center when said contacts are in the open position; means associated with said toggle for blocking breaking and collapse of said toggle in the over center position; said blocking means and over center position of said toggle locking said contacts in the open position and a first member for operating said valve to release

the restraint on said charged spring; and a second member moving said toggle from a blocked position through center to a position where it is free to collapse to permit movement of said crank in said first direction to close said contacts and means interconnecting said first and second members for simultaneous operation.

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