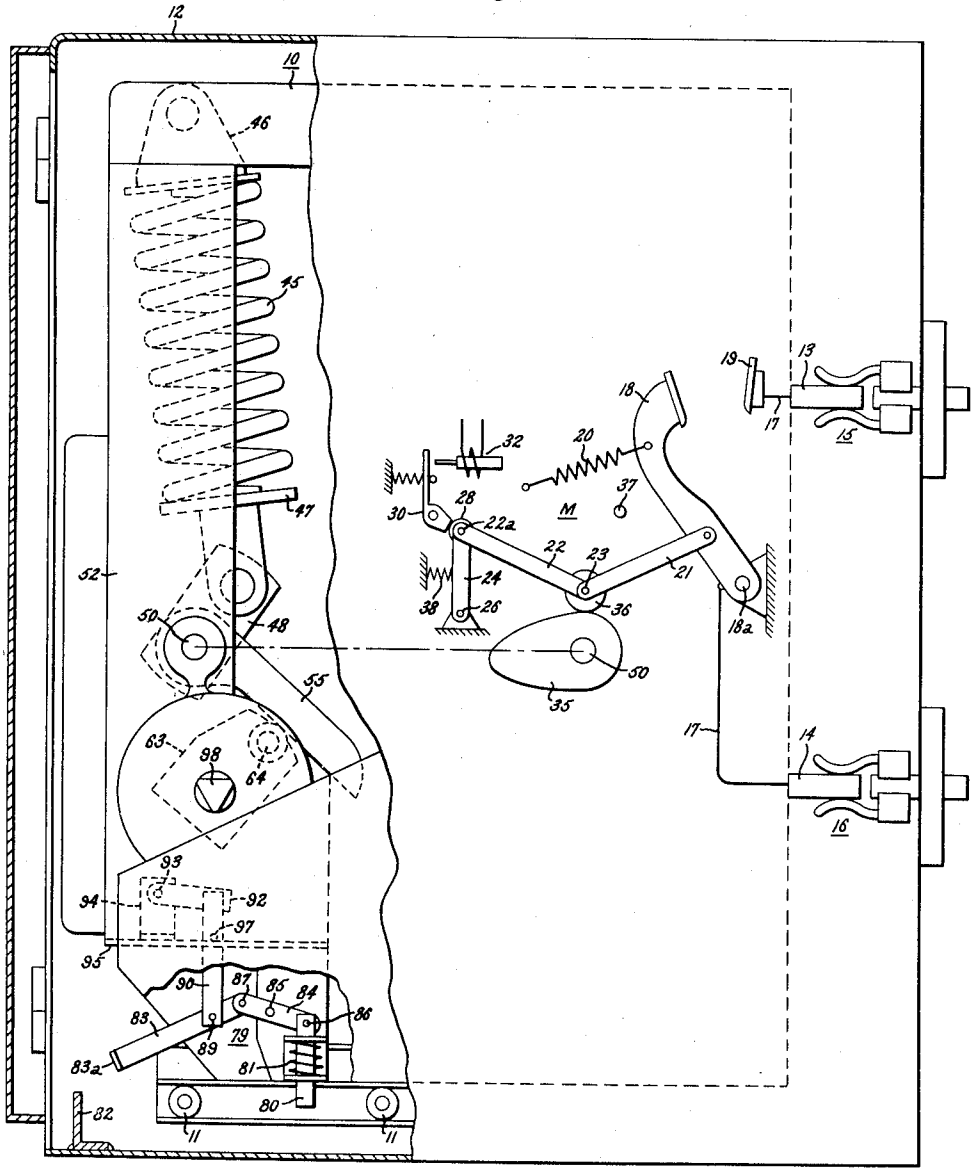
June 28, 1960 A. C. HAY 2,943,163

INTERLOCK ARRANGEMENT FOR A CIRCUIT BREAKER HAVING A STORED-ENERGY CLOSING DEVICE

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Fig. 1.



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Fig. 4.

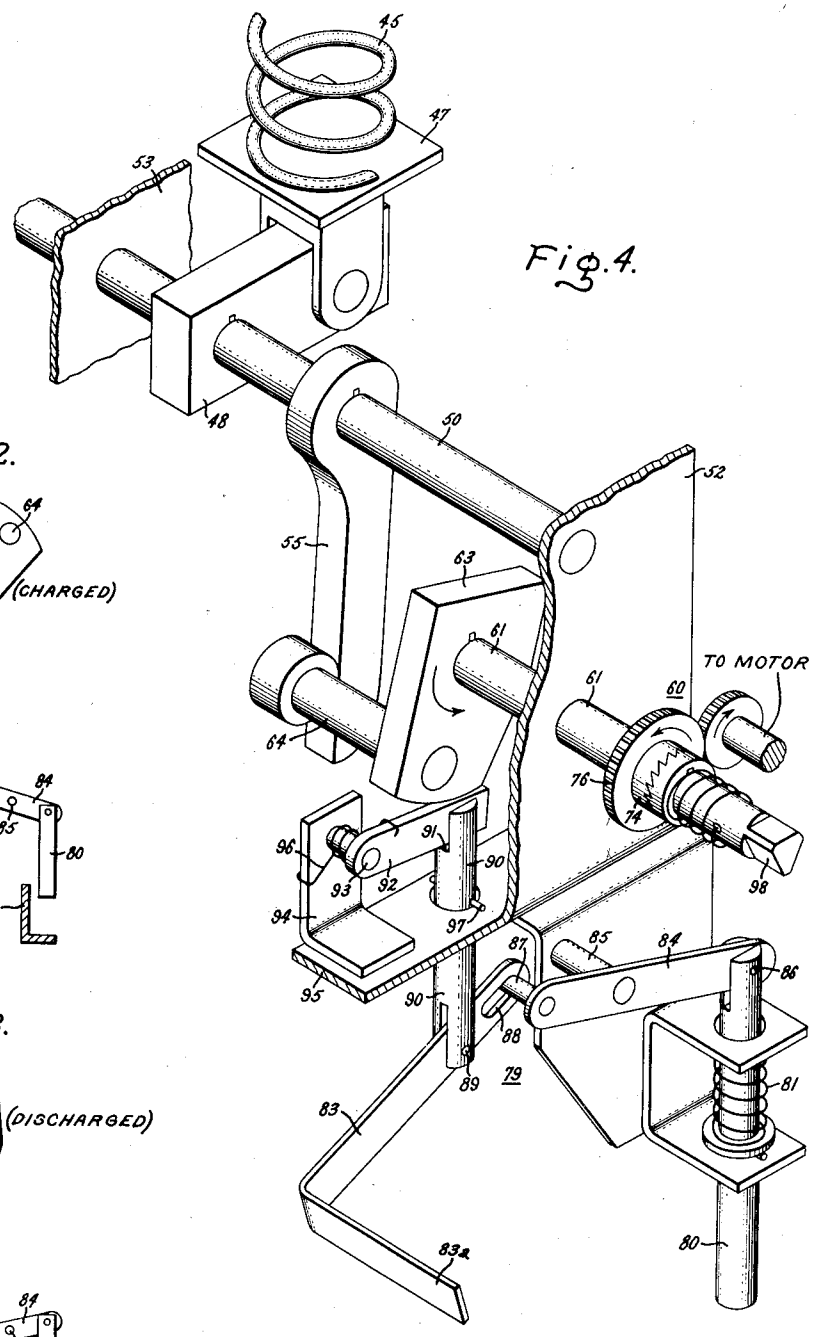


Fig. 2.

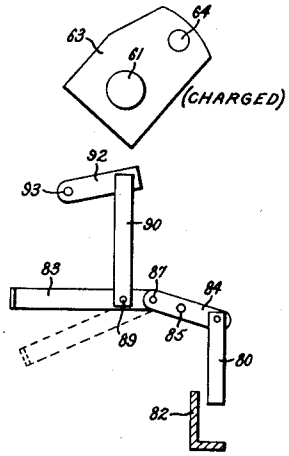
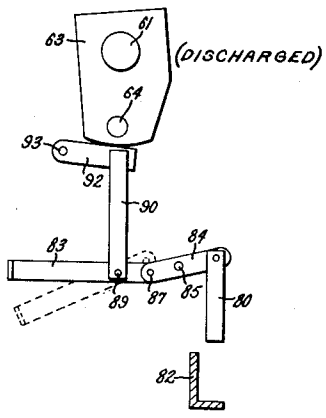


Fig. 3.



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2,943,163

INTERLOCK ARRANGEMENT FOR A CIRCUIT BREAKER HAVING A STORED-ENERGY CLOSING DEVICE

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11 Claims. (Cl. 200—50)

This invention relates to electric switchgear, and more particularly it relates to an improved interlock arrangement for a cubicle-enclosed removable electric circuit breaker of the type having a stored energy device for effecting closing thereof.

In United States Patent 2,781,427 issued to George Rudolph on February 12, 1957, an interlock arrangement for a cubicle-enclosed circuit breaker having a stored-energy closing device is disclosed and claimed. As it is particularly described in that patent, the interlock arrangement includes a movable interference member controlled by a linkage which is operatively connected to the stored-energy closing device of the circuit breaker. Whenever the closing device is in a charged condition, the interference member is maintained in a blocking position whereby the circuit breaker is prevented from being withdrawn from its enclosing cubicle. Upon discharge of the closing device, the linkage responds by moving the interference member to a disabled position wherein it no longer prevents complete withdrawal of the circuit breaker.

The purpose of this interlock arrangement, as is clearly pointed out in the Rudolph patent, is to ensure that the circuit breaker is never removed from its enclosing cubicle with its closing device charged. This is particularly desirable since the stored-energy closing device in circuit breakers of this type usually is maintained in a charged condition even when the breaker contacts are open. Thus the above-described interlock arrangement automatically assures that the closing device is discharged before the breaker is withdrawn from the cubicle, and routine inspection and maintenance procedures can be safely carried out without the risk of accidental discharge of the closing device.

It is a general object of the present invention to provide an improved interlock arrangement of the type described generally above.

A specific object of this invention is the provision of such an arrangement wherein a separate and distinct manual operation is required to disable the interlock. In other words, the interlock is to be continually effective to prevent withdrawal of the circuit breaker until actuated by a definite manual operation. This eliminates undesirable wear and energy loss occasioned by an arrangement wherein the interlock is disabled automatically everytime the stored-energy closing device is discharged.

In carrying out my invention in one form, the circuit breaker is provided with a movable interference member normally disposed to block complete withdrawal of the circuit breaker from its enclosing cubicle, and manually operable actuating means is associated with the interference member for moving this member in a manner to unblock the circuit breaker. Disposed in cooperation with the actuating means and with the stored-energy closing device of the circuit breaker is means for rendering the actuating means ineffective to move the interference member as long as the closing device is charged, whereby the circuit breaker cannot be unblocked and withdrawn from the cubicle while the closing device is in a charged condition.

My invention will be better understood and its various objects and advantages will be more fully appreciated from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a side elevation, partly schematic, of a cubicle-enclosed circuit breaker embodying a preferred form of my invention;

Figs. 2 and 3 are partial side elevations showing the interlock linkages of my invention in two different positions, the interlock being disabled in Fig. 3; and

Fig. 4 is an enlarged perspective of the mechanism shown in Fig. 1 with the stored-energy closing device shown in a discharged condition.

Referring now to Fig. 1, there is shown a removable circuit breaker unit **10** which is mounted on suitable wheels **11** so that it is capable of horizontal reciprocating movement into and out of a relatively stationary enclosure or cubicle **12**. The removable circuit breaker unit **10** is provided with the usual disconnect contacts **13** and **14** which, in the fully inserted position shown in Fig. 1, are plugged into mating terminal structure **15** and **16** carried by the cubicle **12**. The removable unit **10** is adapted to contain an electric circuit breaker including a pair of relatively movable interrupting contacts **18** and **19** respectively connected to the disconnects **14** and **13** by the circuit **17**. One of the interrupting contacts **18** is pivotally mounted at **18***a* and is biased to the open circuit position shown by a suitable spring **20**.

For moving the contact **18** to its closed circuit position, I have shown a conventional trip free operating mechanism M which comprises a pair of toggle links **21** and **22** pivotally joined together at a knee **23**. One of the toggle links **21** is pivotally connected at its opposite end to the movable contact **18**, whereas the other of the toggle links **22** is connected by pivot pin **22***a* to the upper end of a guide link **24**. This guide link **24** is pivotally supported at its lower end on a fixed fulcrum **26**. The pivot pin **22***a* carries a latch roller **28** which cooperates with a suitable trip latch **30**.

So long as the trip latch **30** remains in the latched position shown, the toggle **21**, **22** is capable of transmitting thrust to the movable contact **18**. Thus, when the knee **23** is lifted from the position shown in Fig. 1, the toggle **21**, **22** is extended and drives the movable contact **18** toward the closed circuit position. This lifting of the knee **23** is accomplished by the action of a suitable rotatable cam **35** cooperating with a roller **36** which is mounted at the knee **23**. Preferably, the cam **35** is arranged to drive the toggle **21**, **22** slightly overcenter and against a stop **37** so that the movable contact will be held in closed circuit position even when the cam is returned to its original position shown in Fig. 1.

Should the latch **30** be tripped when the breaker is closed, or even during the closing stroke, the toggle **21**, **22** will be rendered inoperative to transmit thrust to the movable contact **18**. As a result, the opening spring will be free to drive the movable contact **18** to its open circuit position. As long as the latch **30** is held tripped, the toggle **21**, **22** will remain inoperative to transmit closing thrust to the movable contact **18**. A suitable resetting spring **38** cooperates with the guide link **24** to reset the mechanism to the latched position after it has been tripped.

For rotating the cam **35** so as to drive the contact **18** toward closed circuit position, I have provided in the illustrated embodiment a stored-energy closing device of the kind disclosed and claimed in U.S. Patent No. 2,667,076, issued to John A. Favre on January 26, 1954.

It is to be understood that the particular type of closing device illustrated has been selected simply because it readily lends itself to an understanding of the invention. The invention is equally applicable to other types of stored-energy closing devices.

As seen in Figs. 1 and 4, the disclosed closing device comprises a heavy compression spring 45, suitably supported at its upper end on a pivotally mounted bracket 46. At its lower end the spring 45 is coupled to an adapter 47 which is pivotally mounted on a crank arm 48. The crank arm 48 is keyed to a rotatable shaft 50 which is journaled in spaced side frames 52 and 53. As indicated in Fig. 1, the closing cam 35 is arranged to be driven by this rotatable shaft 50. Also keyed to the rotatable shaft 50 is a charging member 55 which is arranged to be driven by a suitable electric motor. As indicated in Fig. 4, power from the charging motor is transmitted to the charging member 55 through a gear train 60, a driving shaft 61, an orbital member 63 keyed to the shaft 61, and a driving pin 64 carried at the outer end of the orbital member 63.

When the driving shaft 61 is rotated counter-clockwise from the position shown in Fig. 4, the driving pin 64 acting through the charging member 55 and shaft 50 rotates the crank 48 counterclockwise to charge the spring 45. This counter-clockwise charging motion of crank 48 continues until the orbital member 63 moves into or just short of its dead center position with respect to the charging member 55. At this approximate dead center position, which is shown in Fig. 1, movement of the orbital member is stopped by a suitable limit switch (not shown) which opens the energizing circuit for the charging motor. The closing spring 45 is then fully charged and in a condition to drive the circuit breaker toward a closed position should the spring be subsequently discharged. As explained more fully in the above-mentioned Favre patent, this discharge action is normally effected by energizing the motor so as to drive the orbital member 63 over center. This motor energization is initiated by a suitable control switch (not shown), and as soon as the energized motor drives the orbital member 63 counterclockwise slightly beyond dead center, the closing spring 45 rapidly releases its energy and drives the shaft 50 clockwise at high speed, thereby closing the breaker.

The above described discharge of the closing spring 45 also drives the orbital member 63 counterclockwise from the position of Fig. 1 to the position of Fig. 4. A suitable overrunning clutch indicated schematically at 74 is provided to permit shaft 50, during spring discharge, to move at high speed free from the restraining influence of the gear train 60. During this period, the shaft 61 overruns the gear 76 which is mounted for rotation thereon. When the parts have assumed the position of Fig. 4, a limit switch closes thereby automatically energizing the motor and causing it to recharge the closing spring 45. As previously explained, this recharging operation continues until the parts approach the dead center position of Fig. 1, at which time the limit switch opens the motor energizing circuit.

If an attendant wishes to remove the cubicle-enclosed circuit breaker unit 10 from its cubicle 12 so as to permit inspection or repair of its internal parts, he must first trip the breaker to open circuit position. Interlocks which ensure such tripping are well known, and any suitable conventional form of such an interlock can be used with my breaker. An example of such an interlock is shown in U.S. Patent No. 2,776,346 issued to V. N. Stewart and M. B. Fornwalt on January 1, 1957. Interlocks such as those shown in that patent operate by maintaining the breaker trip latch, such as my latch 30, in a tripped position during the withdrawal operation.

For most types of breakers, once the breaker has been tripped open, the attendant is then free to remove it from its enclosing cubicle and safely perform whatever repair or inspection operations are desired. However, if the circuit breaker is of a type which has a stored-energy closing device, as described above, it is likely that the closing device will be charged at the time the breaker is removed from its cubicle even though the breaker is tripped open. To safeguard against the possibility that the stored-energy closing device may accidentally be discharged during subsequent repair or inspection operations, it is desirable to provide an additional interlock arrangement which prevents removing the breaker unit 10 from its cubicle 12 unless the closing device 45 is first discharged. Toward this end I provide the improved interlock linkages and arrangement 79 which will now be described in detail.

As is best illustrated in Fig. 4, the interlock arrangement 79 comprises an interference member 80 supported by the side frame 52 for vertically sliding movement relative to the circuit breaker. The member 80 is normally disposed in its lower or blocking position shown, where it is maintained by suitable spring means 81. If withdrawal of the breaker from the enclosure is attempted with the interference member 80 in this blocking position the interference member will engage a fixed stop 82 projecting upwardly from the bottom of cubicle 12, as is shown in Fig. 1, and further withdrawal of the breaker will be blocked. Thus, so long as the interference member is in its normal disposition, complete withdrawal of the circuit breaker unit 10 from the cubicle is effectively prevented.

In order to lift the interference member 80 against the force of the bias spring 81 to a disabled position where it will clear the stop 82 and hence permit complete withdrawal of the circuit breaker unit 10, a pivotally mounted actuating member 83 is provided. The actuation member 83 preferably is an L-shaped lever extending frontwardly at one side of the circuit breaker unit 10, as can be seen in Fig. 4, for convenient manual operation. In order that the interference member 80 may be raised from its normal position, thereby disabling the interlock, by lifting the forward end 83*a* of the actuating member 83 a relatively short distance, these two members are interconnected by means of a pivotally movable intermediate link 84.

The link 84 is pinned intermediate its ends at 85 to the side frame 52 of the circuit breaker. The rear end of link 84 is pivotally connected at 86 to the upper end of the interference member 80. The forward end of link 84 is provided with a laterally protruding stud 87 which rides in an elongated slot 88 located near the rear of the actuating member 83. Thus, as is evident from Fig. 4, when the actuating member 83 is moved in a clockwise direction about its pivotal support 89 by manually lifting 83*a*, the intermediate link 84 will be tilted in a counterclockwise direction about its pivot 85 thereby operating the interference member 80 to its disabled disposition. This unblocks the unit 10 which can now be removed from the enclosing cubicle 12.

The pivot 89 on which the actuating member 83 is mounted is a floating pivot. It is operatively connected to the orbital member 63 of the stored-energy closing device by means of a movable supporting member 90 which is suitably guided for generally vertical movement. The upper end of the supporting member 90 is slotted at 91 in order to receive a cam member 92 which is disposed to engage the orbital member 63. The cam member 92 is pivotally anchored at one point to a shaft 93 supported by a bracket 94 which is affixed to a shelf 95 integrally extending from the side frame 52 of the circuit breaker. See Fig. 4. A relatively weak bias spring 96 is provided to urge the cam member 92 in a clockwise direction about the axis of shaft 93, thereby augmenting the force of gravity in biasing the supporting member 90 to its lowest position. Suitable stop means, such as the illustrated pin 97 in the supporting member 90, determines the limit to which the interengaging support-

ing and cam members **90** and **92** can move in accordance with this bias.

The supporting member **90** and hence the pivotal mounting **89** can move upwardly from their positions shown in Figs. 1 and 4 until the cam member **92** engages the orbital member **63**. Thus, the angular position of the orbital member **63** determines the upper limit to which the floating pivot **89** can be moved. Since the angular position of the orbital member changes in accordance with the charged or discharged condition of the breaker closing device, as has been explained in detail hereinbefore, it is evident that the degree of freedom with which the floating pivot **89** can move is responsive to charging and discharging of the closing spring **45**.

When the spring **45** discharges, the orbital member **63** of the closing device moves to the position in which it is shown in Figs. 3 and 4. In this position, it blocks the cam member **92** of the interlock arrangement **79** in the position to which it is biased thereby preventing appreciable upward movement of the supporting member **90**. Consequently, the floating pivot **89** is maintained in the position shown in Figs. 3 and 4, and manual operation of the actuating member **83** will be effective to disable the interference member **80**. This is best illustrated in Fig. 3 where the actuating member **83** has been moved from its original position (broken lines) in a clockwise direction with respect to the pivot **89** thereby tilting the link **84** counterclockwise and lifting the interference member **80** free of the fixed stop **82**. The actuating member is able to move the member **80** in this manner only when its floating pivot **89** is confined within predetermined relatively narrow limits.

Whenever the orbital member **63** is moved counterclockwise beyond the position of Figs. 3 and 4 so as to recharge the breaker closing spring **45**, the cam member **92** of the interlock is unblocked and can be moved in a counterclockwise direction without interference from **63**. The floating pivot **89** is no longer confined within the limits necessary to render the actuating member **83** effective for disabling the interference member **80**, and the actuating member will now be unable to change the normal disposition of member **80**.

Should manual operation of the actuating member **83** be attempted with the closing device charged, as illustrated in Figs. 1 and 2, this member will move from its original position (broken lines in Fig. 2) in a clockwise direction with respect to the stud **87**, the pivotal mounting **89** shifting upwardly without restriction by the closing device. The relative strengths of the bias springs **81** and **96** are selected so that the amount of force which will move the supporting member **90** and hence the floating pivot **89** in opposition to the bias provided by the relatively weak spring **96** and gravity is less than the force required to lift the interference member **80** from its normal disposition in opposition to the bias of spring **81**. Thus, the slotted end of the actuating member **83** remains relatively stationary under these conditions, and the actuating member is rendered ineffective to move the interference member **80** to its disabled position.

From the foregoing it should now be apparent that the interference member **80** can be disabled, thereby permitting the removable circuit breaker unit **10** to be completely withdrawn from its enclosing cubicle **12**, only by operating the actuating member **83** while the breaker closing spring **45** is discharged. Only then will the floating pivot **89** be maintained in a position rendering the actuating member effective to perform its disabling function. In order to remove the circuit breaker from the cubicle, the actuating member **83** must be held in its operative condition while the raised interference member **80** moves past the stop **82**. The linkages **90** and **92** are operable in response to recharging of the closing device at any time during operation of the actuating member **83** to shift the floating pivot **89** in a manner immediately

rendering the actuating member ineffective to perform its disabling function.

Discharge of the breaker closing device may be effected manually by means of a suitable tool (not shown) applied to the triangular end **98** of the driving shaft **61**. By utilizing such a tool, the attendant may manually move the orbital member **63** over center and permit the closing spring **45** to discharge as desired. The conventional interlock (not shown) which holds the latch **30** in a tripped position assures that such discharge of the closing springs will not close the breaker contacts **18** and **19**.

As previously described, under normal conditions the charging motor is arranged to automatically recharge the closing spring **45** as soon as it is discharged. The above-cited Rudolph patent discloses means effective in response to partial withdrawal of the breaker from its cubicle **12** for rendering the charging motor inoperative to recharge the spring. Thus, once the attendant moves the circuit breaker to the position in which interference member **80** engages the fixed stop **82** projecting from the bottom of the cubicle **12** and manually discharges the breaker closing spring **45**, the closing spring will remain safely discharged and unaffected by the charging motor.

In accordance with my invention, the interlock arrangement **79** is so constructed that none of the linkages comprising this interlock is engaged by the stored-energy closing device during regular closing operations of the circuit breaker. More particularly, the camming member **92** of the interlock is normally disposed in a position of non-engagement with respect to the orbital member **63** of the circuit breaker closing mechanism. Thus, these cooperating elements are not subject to repeated wear and frictional losses everytime the circuit breaker is closed.

While I have shown and described a preferred form of my invention by way of illustration, many modifications will occur to those skilled in the art. I, therefore, contemplate by the claims which conclude this specification to cover all such modifications as fall within the true spirit and scope of my invention.

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

1. In a switchgear unit: a cubicle; a circuit breaker movable into and out of said cubicle and comprising a stored-energy closing device which is dischargeable to close the circuit breaker; interlock means normally disposed to prevent withdrawal of said breaker from said cubicle, said interlock means being manually operable from its normal disposition to a disabled disposition in order to permit withdrawal of said breaker; and means associated with said interlock means and with said closing device for rendering said interlock means ineffective to change dispositions upon attempting a manual operation thereof while said closing device is charged, whereby said breaker cannot be withdrawn from said cubicle as long as said closing device is charged.

2. In combination: a relatively stationary enclosure; a removable circuit breaker unit adapted to contain an electric circuit breaker having a stored-energy closing device which is dischargeable to close the circuit breaker, said removable unit being disposed for reciprocating movement into and out of said enclosure; interlock means normally disposed to prevent removal of said removable unit from said enclosure, said interlock means being operable from its normal disposition to a disabled disposition in which it is no longer effective to prevent removal of said removable unit; and means associated with said interlock means and with said closing device for preventing operation of said interlock means from its normal to its disabled dispositions whenever said closing device is charged and for permitting said operation upon discharge of said closing device, whereby said closing device must

be discharged before said removable unit can be removed from said enclosure.

3. In combination: a relatively stationary enclosure; a removable circuit breaker unit adapted to contain an electric circuit breaker having a stored-energy closing device which is dischargeable to close the circuit breaker, said removable unit being disposed for reciprocating movement into and out of said enclosure; means for imparting said reciprocating movement to the removable unit; and interlock means comprising a movable member normally disposed to block movement of said removable unit completely out of said enclosure, manually operable actuating means for effecting movement of said member in a manner to unblock said removable unit, and means associated with said actuating means and with said closing device for preventing effective operation of said actuating means whenever said closing device is charged.

4. In a switchgear unit: a cubicle; a circuit breaker movable into and out of said cubicle and comprising a stored-energy closing device which is dischargeable to close the circuit breaker; and interlock means for preventing withdrawal of said breaker from said cubicle while said closing device is charged, said interlock means comprising a movable interference member normally disposed to prevent withdrawal of said breaker, a manually operable actuating member for said interference member, and means for rendering said actuating member effective when manually operated to disable said interference member and thereby permit withdrawal of said breaker only in response to discharge of said closing device.

5. In a switchgear unit: a cubicle; a circuit breaker movable into and out of said cubicle and comprising a stored-energy closing device which is dischargeable to close the circuit breaker; and interlock means for ensuring discharge of said closing device before said breaker is completely withdrawn from said cubicle comprising an interlock member movable relative to said breaker and normally disposed in a first position to prevent withdrawal of said breaker from said cubicle, actuating means for moving said interlock member to a second position thereby enabling said breaker to be completely withdrawn, and means associated with said actuating means and said closing device for enabling said actuataing means to move said interlock member from said first to said second positions only after said closing device has first been discharged.

6. In combination: a relatively stationary enclosure; a removable circuit breaker unit adapted to contain an electric circuit breaker having a stored-energy closing device which is dischargeable to close the circuit breaker, said removable unit being disposed for insertion into and withdrawal from said enclosure; and interlock means for ensuring that said closing device is discharged before said removable unit is completely withdrawn from said enclosure comprising a movable member normally disposed in a first position to prevent complete withdrawal of said removable unit from said enclosure, actuating means for moving said member from said first position to a second position in order to permit withdrawal of said removable unit, and means associated with said actuating means and with said closing device for rendering said actuating means ineffective to move said member out of said first position unless said closing device is first discharged.

7. In a switchgear unit: a cubicle; a circuit breaker movable into and out of said cubicle and comprising a stored-energy closing device which is dischargeable to close the circuit breaker; and interlock means for ensuring discharge of said closing device before said breaker is completely withdrawn from said cubicle comprising an interference member movable relative to said breaker and normally disposed in position to engage a portion of said cubicle when said breaker is partially withdrawn therefrom, manually operable actuating means effective to move said interference member from its normal position thereby disabling said interference member in order to permit complete withdrawal of said breaker, and means operatively connecting said actuating means to said closing device for rendering said actuating means ineffective to move said interference member whenever said closing device is charged.

8. In a switchgear unit: a cubicle; a circuit breaker movable into and out of said cubicle and comprising a stored-energy closing device which is dischargeable to close the circuit breaker; and interlock means for ensuring discharge of said closing device before said breaker is completely withdrawn from said cubicle, said interlock means comprising a movable interference member normally disposed to block complete withdrawal of said breaker from said cubicle, an actuating member mounted on a floating pivot and effective to disable said interference member and thereby permit complete withdrawal of said breaker only when said pivot is maintained in a predetermined position, and means responsive to discharge of said closing device for maintaining said pivot in said predetermined position.

9. In a switchgear unit: a cubicle; a circuit breaker movable into and out of said cubicle and comprising a stored-energy closing device which is dischargeable to close the circuit breaker; and interlock means for ensuring discharge of said closing device before said breaker is completely withdrawn from said cubicle comprising a movable interference member normally disposed to block complete withdrawal of said breaker from said cubicle, a pivotally mounted actuating member for disabling said interference member thereby to permit complete withdrawal of said breaker, and means operatively connecting the pivotal mounting of said actuating member to said closing device for enabling said pivotal mounting to shift in a manner rendering said actuating member ineffective to disable said interference member whenever said closing device is charged.

10. In combination: a relatively stationary enclosure; a removable circuit breaker unit adapted to contain an electric circuit breaker having a stored-energy closing device which is dischargeable to close the circuit breaker, said removable unit being disposed for insertion into and withdrawal from said enclosure; and interlock means for ensuring that said closing device is discharged before said removable unit is completely withdrawn from said enclosure comprising a movable interference member normally disposed to prevent complete withdrawal of said removable unit from said enclosure, an actuating member mounted on a floating pivot and connected to said interference member, said actuating member being manually operable to disable said interference member and thereby permit complete withdrawal of said removable unit only if said floating pivot is confined within predetermined limits, and means connected to said floating pivot and responsive to discharge of said closing device for confining said pivot within said predetermined limits.

11. In combination: a relatively stationary enclosure; a removable circuit breaker unit adapted to contain an electric circuit breaker having a stored-energy closing device which is dischargeable to close the circuit breaker, said removable unit being disposed for insertion into and withdrawal from said enclosure; and an interlock linkage mounted on said removable unit for preventing the complete withdrawal of said removable unit from said enclosure unless said closing device is discharged, said linkage comprising a movable supporting member operatively associated with said closing device, a movable interference member normally disposed to engage a por-

tion of said enclosure when said removable unit is partially withdrawn therefrom, spring means for maintaining said interference member in its normal disposition, and a manually operable actuating member coupled to said interference member for moving said interference member in opposition to said spring means thereby to from said enclosure, said actuating member being pivot-

ally supported by said supporting member which is movable during manual operation of said actuating member for rendering said actuating member ineffective to move said interference member whenever said closing device is charged.

No references cited.