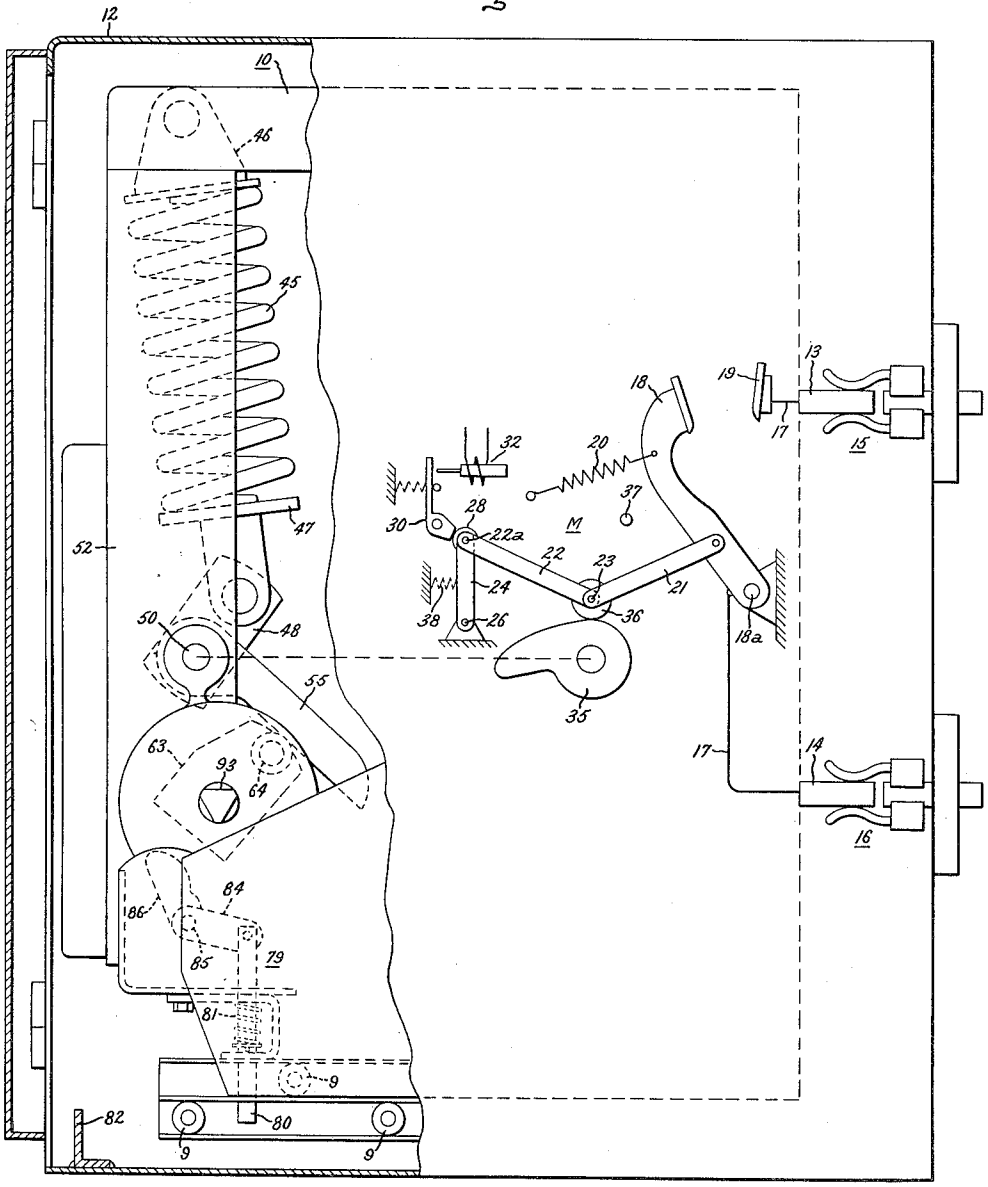
Feb. 12, 1957 G. RUDOLPH 2,781,427

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

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Fig. 1.



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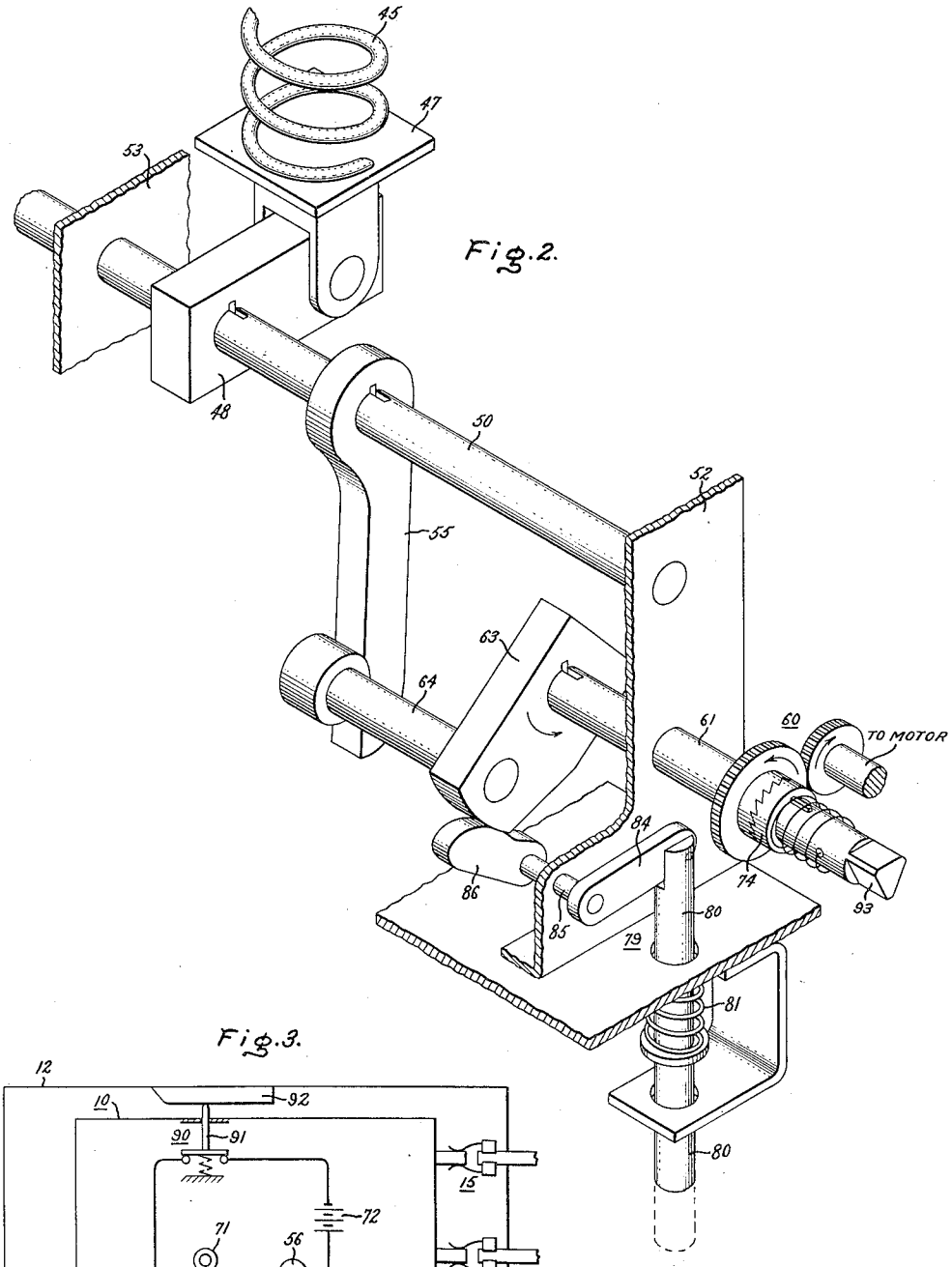


Fig. 2.

Fig. 3.

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United States Patent Office 2,781,427
Patented Feb. 12, 1957

2,781,427

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

George Rudolph, Broomall, Pa., assignor to General Electric Company, a corporation of New York

Application February 3, 1955, Serial No. 485,997

12 Claims. (Cl. 200—50)

This invention relates to an interlock arrangement for a cubicle-enclosed, electric circuit breaker of the type having a stored energy device for effecting closing thereof.

If an attendant wishes to remove a cubicle-enclosed circuit breaker from its cubicle so as to permit inspection or repair of its internal parts, he first trips the breaker to its open circuit position. Interlocks which insure such tripping are well known. For most types of breakers, once the breaker has been tripped open, the attendant is then free to safely remove it from its cubicle and to safely perform whatever repairs or inspection operations are desired. However, if the breaker is of the type which has a stored energy closing device, 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 accidental discharge of such a stored energy closing device during subsequent repair or inspection operations, it has been customary to manually block the closing device in its charged position before the breaker is withdrawn from its cubicle. This procedure is disadvantageous because it depends for its reliability upon the skill and memory of the attendant.

Thus, an object of my invention is to provide, in a circuit breaker having a stored-energy closing device, means which acts automatically to insure against accidental discharge of the closing device during the time the breaker is being inspected or repaired.

A further object is to provide a simple, inexpensive and reliable interlock which prevents removal of the circuit breaker from its enclosing cubicle while the stored-energy closing device is charged.

In accordance with one form of my invention, the circuit breaker is provided with a movable interference member which is operable in a blocking position to prevent withdrawal of the breaker from its enclosing cubicle and is operable in a disabled position to permit said withdrawal. This interference member is controlled by a linkage which is operably connected to the stored-energy closing device of the circuit breaker. So long as the closing device is charged, the interference member remains in its blocking position, but when the closing device is discharged, the linkage responds by removing the interference member into its disabled position, thereby permitting withdrawl of the breaker but only when the closing device is discharged.

Where a stored-energy closing device is utilized, it is conventional to provide a charging motor which automatically recharges the closing device as soon as it is discharged. In accordance with another aspect of my invention, this charging motor is rendered inoperative in response to partial withdrawal of the breaker from its cubicle, whereas the interference member is arranged to block circuit breaker movement only after additional withdrawal movement has taken place. Thus, when the circuit breaker is withdrawn into its blocked position, the charging motor has already been rendered inoperative. As a result, when the closing device is then discharged to disable the interference member, the closing device remains safely discharged and unaffected by the charging motor.

For a better understanding of my invention, reference may be had to the following specification taken in connection with the accompanying drawing wherein Fig. 1 shows a cubicle-enclosed circuit breaker partly in section and embodying my invention. A portion of the circuit breaker is shown in schematic form. Fig. 2 is an enlarged perspective view of a portion of the mechanism shown in Fig. 1, and Fig. 3 is a schematic diagram illustrating the manner in which I control the motor for charging the circuit breaker closing device.

Referring now to Fig. 1, there is shown a circuit breaker **10** which is mounted on suitable wheels **9** so that it is capable of horizontal movement into and out of a connected position within an enclosing cubicle **12**. The breaker **10** is provided with the usual disconnect contacts **13** and **14** which, in the connected position shown in Fig. 1, are plugged into mating terminal structures **15** and **16** carried by the cubicle **12**. In this connected position, the breaker is adapted to control a power circuit **17** which extends between the terminal structures. This circuit control is effected by means of a pair of relatively-movable interrupting contacts **18** and **19**. One of these 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 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 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 the usual 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 **20** 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 and assigned to the assignee of the present invention. 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 2, the disclosed closing device comprises a heavy compression spring **45**, suitably sup-

ported 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. This 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. This motor is not shown in Figs. 1 or 2 but is schematically shown at 56 in Fig. 3. As shown in Fig. 2, 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. 2, the driving pin 64 acting through the charging member 55 and shaft 50 rotates the crank 48 counter-clockwise 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 which opens the energizing circuit for the charging motor 56. This is shown most clearly in Fig. 3 wherein the motor 56 is shown connected in circuit with a suitable power source such as a battery 72. The limit switch, which is shown at 70 is controlled by a cam 71 which is operatively connected in a suitable manner to the driving shaft 61 and is shaped to open the switch 70 as the above-mentioned dead center position is approached. 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 effected by a suitable switch such as the push button 73 of Fig. 3. As soon as the energized motor drives the crank 63 counter-clockwise slightly beyond dead center, the closing spring 45 rapidly releases its energy and drives the shaft 50 clockwise at high speed, thereby driving the breaker toward closed position.

The above described discharge of the closing spring 45 also drives the orbital member 63 counter-clockwise from the position of Fig. 1 to the position of Fig. 2. 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. 2 the limit switch cam 71 is arranged to permit the limit switch to close 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 70 opens the motor energizing circuit.

If an attendant wishes to remove a cubicle-enclosed circuit breaker from its cubicle so as to permit inspection or repair of its internal parts, he first trips the breaker to open circuit position. Interlocks which insure 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 Fig. 2 of U. S. Patent No. 2,702,324, issued to W. J. Donaldson and assigned to take assignee of the present invention. Interlocks such as those shown in the Donaldson 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 safely removed it from its cubicle and to 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 accidental discharge of such a stored energy closing device during subsequent repair or inspection operations, it has been customary to manually block the closing device in its charged position before the breaker is withdrawn from its cubicle. This procedure is disadvantageous because it depends for its reliability upon the skill and memory of the attendant.

To overcome the above-noted disadvantages, I have provided, in the disclosed circuit breaker 10, an interlock arrangement 79 which is automatic in operation and does not depend for its reliability upon the skill or memory of the attendant. To this end, the interlock arrangement 79 prevents removal of the breaker from its cubicle 12 while the closing device 45 is in a charged condition, and only after the closing device has been discharged, may the breaker be removed. More particularly, this interlock arrangement 79 comprises a vertically slidable interference member 80 which is suitably biased into a blocking position such as shown in Fig. 1, as by a spring 81. This interference member is arranged to remain in its blocking position so long as the circuit breaker closing spring 45 is charged. If withdrawal of the breaker is attempted with this interference member 80 in its blocking position, the interference member will engage a fixed stop 82 projecting from the bottom of the cubicle 12, and further withdrawal will be prevented. Thus, so long as the closing spring 45 is charged, complete withdrawal of the breaker from the cubicle will be effectively prevented.

As best illustrated in Fig. 2, the interference member 80 is controlled by a linkage 84, 85, 86 which responds to discharge of the breaker closing spring 45 to lift the interference member into a disabled position where it clears the stop 82. With the interference member so disabled, complete withdrawal is then permitted. The controlling linkage for the interference member comprises a shaft 85 rotatably journaled in the side frame 52, a control link 84 pinned to one end of shaft 85 and a cam member 86 pinned to the other end of the shaft 85. The link 84 is pivotally joined to the interference member 80. The cam 86 is arranged to be engaged and controlled by the orbital member 63. More particularly, when the orbital member 63 moves into the position of Fig. 2 in response to discharge of the closing spring 45, cam 86 is rotated to lift the interference member to its disabled position. When the orbital member 63 is moved counter-clockwise beyond the position of Fig. 2 so as to recharge the closing spring 45, the interference member is permitted to return to its blocking position under the influence of the biasing spring 81. Thus, only when the closing spring 45 is discharged, is removal of the breaker permitted.

As previously described, under normal conditions, the charging motor is arranged to automatically recharge the closing spring 45 as soon as it is discharged. In accordance with the present invention, this charging motor is rendered inoperative in response to a partial withdrawal of the breaker from its cubicle 12, whereas the interference member 80 is arranged to block circuit breaker movement only after additional withdrawal movement has taken place. For example, referring to Fig. 3, when the circuit breaker is withdrawn to an intermediate position A, the motor energizing circuit is rendered inoperative by the opening of a suitable position-responsive disabling swith 90. In the illustrated embodiment, this disabling switch 90 is spring-biased toward open position but is prevented from opening until its projecting portion 91 is moved past the outer edge of a suitable stationary cam 92. Thus, when the breaker is further withdrawn into its

blocked position indicated by B in Fig. 3, the motor is no longer operative to automatically recharge the closing spring after its discharge. Thus, once the attendant moves the circuit breaker into the blocked position B and discharges the closing spring, the closing spring remains safely discharged and unaffected by the charging motor.

Since the motor is disabled when the breaker occupies the blocked position B, discharge of the closing spring **45** is manually effected by means of a suitable tool (not shown) applied to the triangular end **93** 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 springs to discharge as desired. The conventional interlock (not shown) which holds the latch **30** in tripped position assures that such discharge of the closing springs will not close the breaker.

It is to be understood that the illustrated closing device is simply one example of closing devices to which my invention is applicable. For another example, reference may be had to Favre Patent No. 2,674,345, wherein a latch is utilized to hold the closing device in charged position. The particular type of closing device shown has been selected simply because it readily lends itself to an understanding of the invention and not because it has any particular tendency to become accidentally discharged. As a matter of fact, even without my interlock arrangement, the possibilities that the illustrated closing device will be accidentally discharged are quite remote because of the relatively involved series of steps required to discharge the closing device when the breaker is removed from the cubicle.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention in its broader aspects and I, therefore, aim in the appended claims to cover all such changes and 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 closing spring which is dischargeable to close the circuit breaker, the circuit breaker being of the type which can be tripped free of its closing spring and in which means are provided for insuring tripping before withdrawal of the breaker from said cubicle, an interference member operable in a blocking position to prevent withdrawal of said breaker from said cubicle and movable into a disabled position to permit said withdrawal, means for maintaining said interference member in its blocking position while said closing spring is charged and means responsive to discharge of said closing spring for moving said interference member into its disabled position whereby to permit withdrawal of said breaker when said spring is discharged.

2. In a switchgear unit, a cubicle, a circuit breaker movable into and out of said cubicle and comprising a closing spring which is dischargeable to close the circuit breaker, a movable interference member biased toward a blocking position wherein said member is operable to prevent withdrawal of said breaker from said cubicle while said spring is charged and movable to a disabled position to permit withdrawal of said breaker, and means responsive to discharge of said spring for moving said interference member into its disabled position whereby to permit withdrawal of said breaker from said cubicle.

3. 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 for preventing withdrawal of said breaker from said cubicle while said closing device is charged, and means responsive to discharge of said closing device for disabling said interlock means whereby to permit said breaker to be withdrawn from said cubicle while said closing device is discharged.

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, interlock means for insuring discharge of said closing device before said breaker is completely withdrawn from said cubicle comprising a linkage carried by said breaker and having one end thereof operatively connected to said closing device, the other end of said linkage being provided with a member movable relative to said breaker and located to engage a portion of said cubicle when said breaker is partially withdrawn from said cubicle with its closing device charged.

5. In a switchgear unit, a cubicle, a circuit breaker movable into and out of said cubicle and comprising a closing spring which is dischargeable to close the circuit breaker; a spring controlling member which is movable into a predetermined first position to charge said spring, is movable out of said first position to permit said spring to discharge, and is movable into a predetermined second position in response to discharge of said spring; an interference member operable in a blocking position to prevent withdrawal of said breaker from said cubicle and movable to a disabled position to permit said withdrawal, and means operable in response to movement of said spring controlling member into said second position for moving said interference member into its disabled position whereby to permit withdrawal of said breaker when said spring is discharged.

6. In a switchgear unit, a cubicle, a circuit breaker movable into and out of said cubicle and comprising a closing spring which is dischargeable to close the circuit breaker, an interference member operable in a blocking position to prevent withdrawal of said breaker from said cubicle and movable into a disabled position to permit said withdrawal, a spring controlling member which is movable from a first to a second position in response to discharge of said closing spring, means for maintaining said interference member in its blocking position while said spring is charged, and actuating means operable in response to movement of said spring controlling member into said second position for moving said interference member into its disabled position whereby to permit withdrawal of said breaker but only when said spring is discharged.

7. The combination of claim 6 in which said actuating means comprises a cam member which is operable by said spring controlling member during movement thereof into said second position and means responsive to operation of said cam member for moving said interference member into its disabled position.

8. In a switchgear unit, a cubicle, a circuit breaker movable into and out of said cubicle and comprising a closing spring which is dischargeable to close the circuit breaker, an interference member operable in a blocking position to prevent withdrawal of said breaker from said cubicle and movable into a disabled position to permit said withdrawal, motor means which is operable both to charge said spring and to effect discharge thereof, means for rendering said motor inoperable in response to partial withdrawal of said breaker from said cubicle, manually actuable means for discharging said spring when said motor is inoperable, and means responsive to discharge of said spring from moving said interference member to its disabled position.

9. In a switchgear unit, a cubicle, a circuit breaker movable into and out of said cubicle and comprising a closing spring which is dischargeable to close the circuit breaker, an interference member operable in a blocking position to prevent withdrawal of said breaker from said cubicle and movable into a disabled position to permit said withdrawal, a spring controlling member, motor means which is operable to move said spring controlling member into a predetermined position to charge said

spring and is operable to move said member out of said predetermined position to permit discharge of said spring, means for rendering said motor means inoperable in response to partial withdrawal of said breaker from said cubicle, manually actuable means for discharging said spring when said motor is inoperable, means for maintaining said interference member in its blocking position while said spring is charged, and means operable in response to discharge of said spring for moving said interference member to its disabled position whereby to permit complete withdrawal of said switchgear unit from said cubicle.

10. 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 breaker, motor means which is normally operable to automatically recharge said closing device in response to its discharge, means responsive to partial withdrawal of said breaker from said cubicle to render said motor means inoperative, interference means operable after further withdrawal of the breaker to block complete withdrawal of the breaker while said closing device is charged, and means responsive to discharge of said closing device for disabling said interference means thereby to permit complete withdrawal of the breaker when said closing device is discharged.

11. In a switchgear unit, a cubicle, a circuit breaker movable into and out of a connected position within said cubicle, a stored-energy closing device which is dischargeable to close the breaker, motor means which is normally operable to automatically recharge said closing device in response to its discharge, an interference member operable in a blocking position to prevent withdrawal of said breaker more than a predetermined distance from its connected position and movable to a disabled position to permit additional withdrawal, means responsive to withdrawal of said breaker a distance less than said predetermined distance for rendering said motor means inoperative, and means responsive to discharge of said closing device for moving said interference member to its disabled position whereby to permit said additional withdrawal of said breaker when said closing device is discharged.

12. The apparatus of claim 4 in combination with motor means normally operative to automatically recharge said stored-energy closing device in response to discharge thereof, switch means for rendering said motor means inoperable in response to withdrawal of the breaker from said cubicle to an extent less than that required to render said interlock means effective.

No references cited.