# United States Patent [19]

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[54] **QUICK CLOSING MECHANISM FOR CIRCUIT INTERRUPTER**


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[52] **U.S. Cl.** .....**200/153 SC**
[51] **Int. Cl.** .....**H01h 3/30**
[58] **Field of Search** .....200/153 SC, 153 G, 153 H; 335/21, 165, 167, 171, 188, 189



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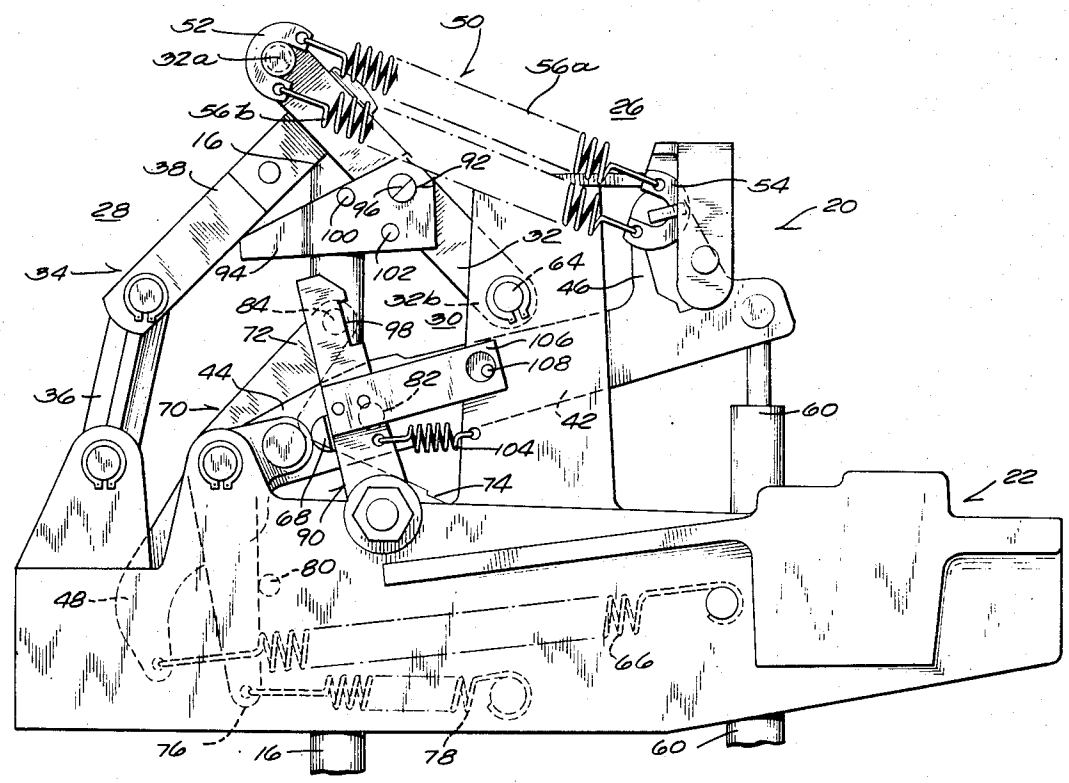
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[57] **ABSTRACT**

A circuit interrupter having an operating mechanism including means for providing and controlling a quick closing operation is disclosed. The mechanism includes a pivotable lever connected to a contact operating rod which is biased toward closing by a first spring means and a second spring means. When the pivotable lever is in a contact open position and a closing operation is occurring, a latch means holds the pivotable lever in an open position until the first spring means reaches its optimum closing force position. At the same time, the latch means and the pivotable arm hold the second spring means in a static, charged condition. When the first spring means reaches its optimum closing force position, an arm moved by the first spring means releases the latch means so that the pivotable lever is free to be snapped to a closed position by the simultaneous force of both the first and second spring means to thereby rapidly close the contacts.


**8 Claims, 4 Drawing Figures**



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SHEET 1 OF 2

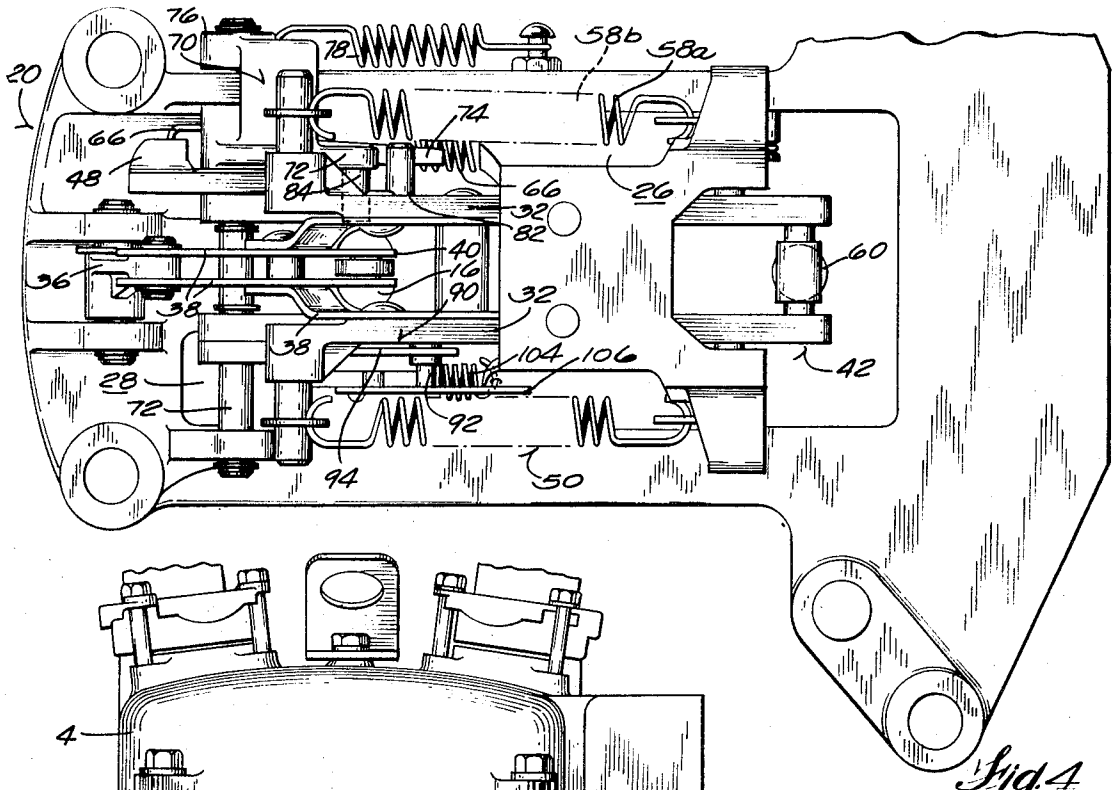



Fig. 4

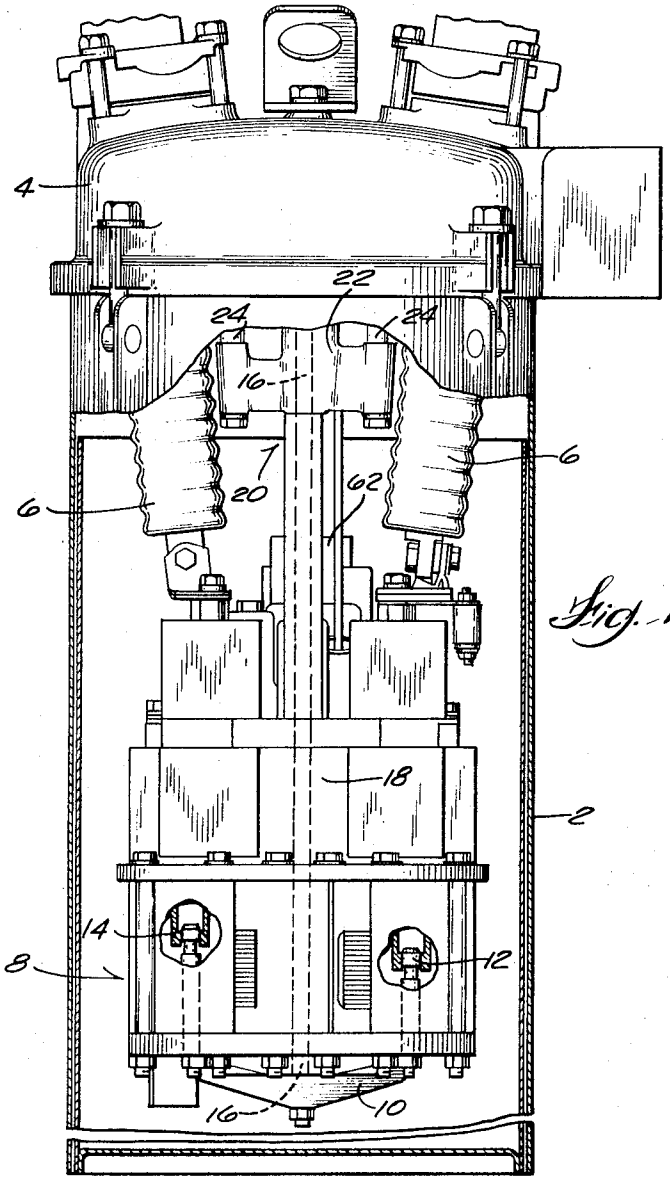



Fig. 1

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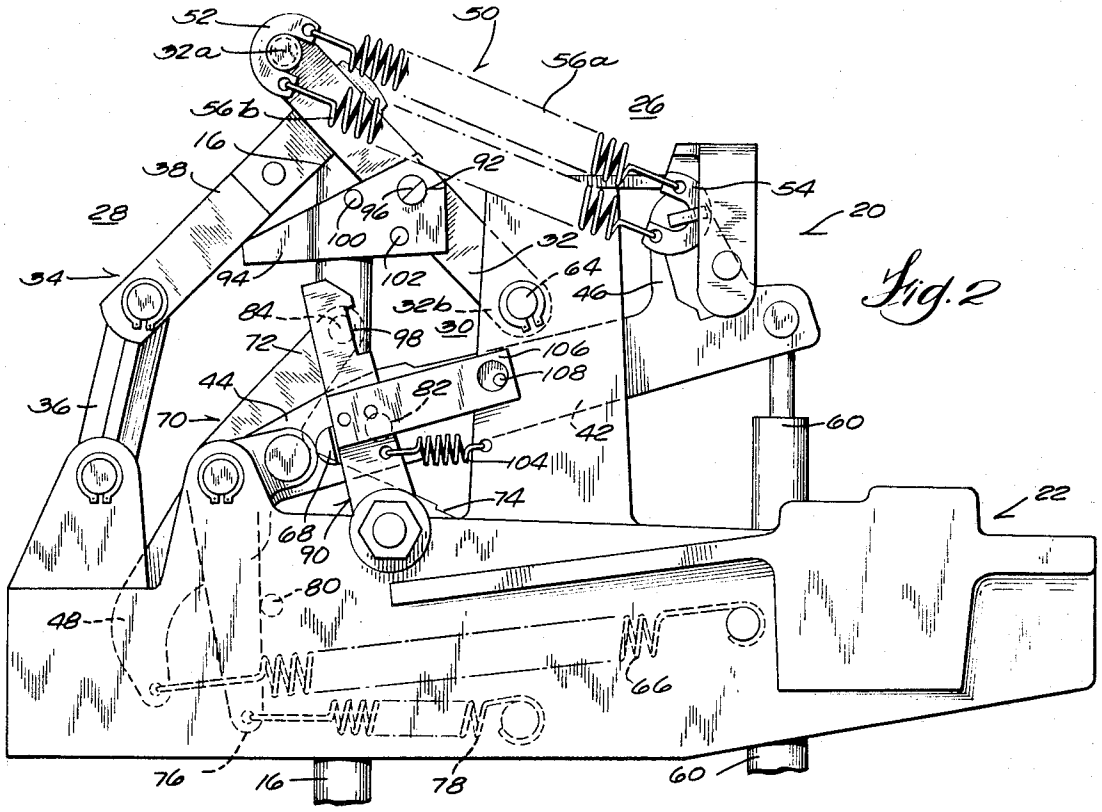



Fig. 2

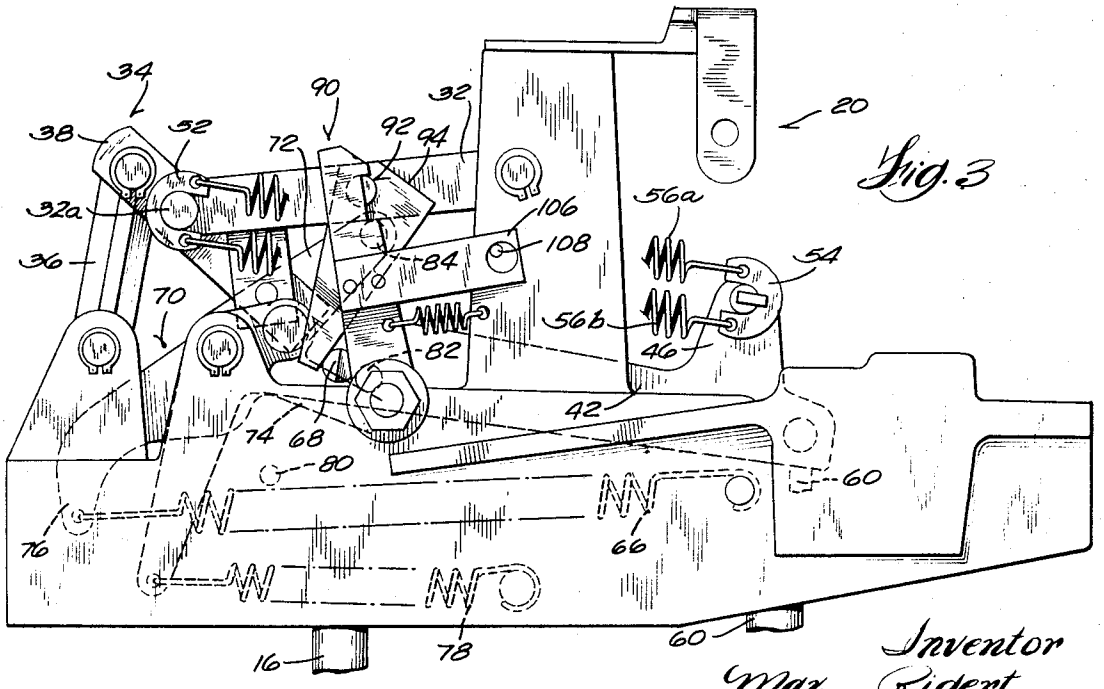



Fig. 3

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# QUICK CLOSING MECHANISM FOR CIRCUIT INTERRUPTER

## BACKGROUND OF THE INVENTION

This invention relates to circuit interrupters and in particular to a means for providing a snap contact closing action for a repeating circuit interrupter.

Repeating circuit interrupters are connected in the lines of electrical power systems where it is desired to prevent permanent interruption of the system due to a temporary fault anywhere on the system or due to a permanent fault on a section of the system. Thus, the recloser typically has at least one quick opening and reclosing operation during which a temporary fault is allowed to clear. The quick opening and reclosing operation is followed by a delayed opening and reclosing operation during which secondary protective devices are permitted to open any faulted sections. If the fault is on the main feeder, and is permanent, then it will continue to be sensed by the repeating circuit interrupter after the delayed reclosing operation and the interrupter will open and lock open. As in many circuit interrupting devices, it is desirable that the main current carrying contacts be rapidly opened and rapidly closed to minimize arcing during these operations. The invention disclosed herein may be suitable for use with various types of circuit interrupters, however, it is discussed herein in conjunction with a repeating circuit interrupter.

## SUMMARY OF THE INVENTION

It is a general object of the invention to provide in a circuit interrupter an operating mechanism having a plurality of closing force means for closing the interrupter contacts with a snap action and in which a part of the contact closing force is restrained and the contacts are held from closing until the total closing force is at an optimum.

The objects of the invention are accomplished by providing latching means for holding a first portion of the circuit interrupter contact operating mechanism in a first position corresponding to the disengaged position of the interrupter contacts while a second portion of the operating mechanism is developing and applying optimum closing force to the first portion. Simultaneously, the latch means acts to hold one closing force means in an optimum charged condition until another closing force means reaches its optimum closing condition. When the optimum closing force condition of the other closing force means is reached, the second portion of the contact operating mechanism releases the latch means so that the first portion of the operating mechanism is free to snap to a second position and rapidly engage the interrupter contacts.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows an elevational view, partly in cross section, of a repeating circuit interrupter having a quick closing operating mechanism according to the instant invention;

FIG. 2 shows an elevational view of the quick closing operating mechanism in a first or contact closed position;

FIG. 3 shows an elevational view of the operating mechanism of FIG. 2 in a contact open or second position; and



FIG. 4 shows a plan view of the operating mechanism as shown in FIG. 2.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawings, a circuit interrupter of the reclosing type is shown supported within a tank 2 having a cover 4. Insulating bushings 6 extend through the cover 4 and electrically connect the lines (not shown) of an electrical distribution system with the contact assembly 8 within the tank 2. The contact assembly 8 includes a conducting cross head 10 carrying movable contacts 12 and stationary contacts 14 electrically connected to the distribution lines through bushings 6. The movable contacts 12 are movable into and out of engagement with the stationary contacts 14 and are shown in their engaged position with the stationary contacts 14 in FIG. 1. An operating mechanism assembly 20 is supported from the cover 4 within the tank 2 and has a contact rod 16 extending from it down to the cross head 10 and affixed to the cross head 10 so that vertical movement of the contact rod 16 moves the contacts 12 in to and out of engagement with contacts 14. The operating mechanism assembly 20 also includes a solenoid 18 electrically connected to the distribution lines through bushings 6.

The operating mechanism assembly 20 further includes a frame 22 supported by spacers 24 from cover 4, contact operating means 26, contact means 28 and latch means 30. The contact means 28 includes the contact operating arm 32, a collapsible linkage 34, the contact rod 16, the cross head 10 and contacts 12 and 14. Relative to the view of FIG. 2, the contact operating arm 32 has an upper end 32*a*, and a lower end 32*b* pivotally supported on the frame 22. The collapsible linkage 34 includes links 36 and 38 pivotally connected together with the link 38 being pivotally connected to the arm 32 and the link 36 being pivotally connected to the frame 22. The link 38 has an end 40 pivotally connected to the contact rod 16 so that all pivotal movement of the collapsible linkage 34 and contact operating arm 32 is applied to the contact rod 16 to move it vertically. It should be understood that in some cases the various links, levers and arms of the operating mechanism assembly 20 comprise double members as in the case of link 38. However, for the purpose of simplicity, double member items will nevertheless be referred to in the singular with a single identifying numeral.

The contact operating means 26 also includes the contact operating arm 32 and further comprises a plunger arm 42 having an end 44 pivoted on the frame 22 and a free end 46. The end 46 of plunger arm 42 and the end 32*a* of contact operating arm 32 respectively carry washers 54 and 52 and overcenter spring means 50 is connected between the plunger arm 42 and contact operating arm 32 and affixed to the washers 52 and 54. The free end 46 of plunger arm 42 is also pivotally connected to a plunger rod 60 which extends down to and is affixed to the moving rod 60 which extends down to and is affixed to the moving plunger 62 of solenoid 18. A counterbalancing spring 66 is also connected between the frame 22 and the end 48 of plunger arm 42. The counterbalancing spring 66 balances the weight of the solenoid plunger to eliminate any effect from these items on the operation of the operating mechanism assembly 20.

A spring lever **70** is also pivotally mounted on the frame **22** and includes an upper arm **72**, a middle arm **74** and a lower arm **76**. A closing spring **78** is connected between the lower arm **76** and the frame **22** and biases the lever **70** in a counter-clockwise direction relative to the view of FIG. **2**. A pin **80** affixed to frame **22** holds the lever **70** against the bias of spring **78** in a position permitting cooperation of the lever **70** with the contact operating means **26** and contact means **28**. The plunger arm **42** includes a pin **82** which engages the middle arm **74** and pivots the lever **70** to charge the spring **78** when the arm **42** pivots downwardly. The upper arm **72** of lever **70** has a pin **84** affixed thereto which is engaged by the contact operating arm **32** when the latter pivots downwardly.

The latch means **30** includes a latch lever **90** pivotally mounted on the frame **22**, a half cylindrical latch pin **92** rotatably mounted on the contact operating arm **32** and a latch release lever **94** rigidly affixed to the pin **92**. The latch pin **92** and latch lever **90** have an unlatched position as shown in FIG. **2**. When the contact operating arm **32** pivots downwardly the latch pin **92** moves into a latched position with latch lever **90** in which the latch face **96** engages the notch **98** in the lever **90** as shown in FIG. **3**. The weight of the latch release lever **94** serves to maintain the release lever **94** in a relatively low position in which the latch pin **92** is in its most counterclockwise position relative to the view of FIG. **2** and in which latch pin **92** is also in a latched position with latch lever **90** when the contact operating arm **32** is pivoted downward. The projections **100** and **102**, which may comprise screws threaded into the lever **94**, are engageable with the contact operating arm **32** to limit the rotational travel of release lever **94** and latch pin **92**. The latch lever **90** is biased toward engagement with the latch pin **92** by the latch spring **104** when the pin **92** is in a downward position. A pin **108** projects from the frame **22** through an arm **106** affixed to the latch lever **90** to limit the degree of travel of the latch lever **90**.

The operation of the operating mechanism assembly **20** is as follows: The contact operating means **26** and contact means **28** have a closed position shown in FIG. **2** in which the movable contacts **12** and stationary contacts **14** are in engagement. Upon the occurrence of an overcurrent condition in the line in which the circuit interrupter is connected, the solenoid **18** will be sufficiently energized to draw the plunger rod **60** downwardly to thereby pivot the plunger arm **42** downwardly and charge the overcenter spring means **50**. Since the actuating force of the spring means **50** is along a line above the pivot point **64** of the contact operating lever **32** as shown in FIG. **2**, the arm **32** will be urged clockwise but will not move due to the holding force of the collapsible linkage **34** and the bearing of the movable contacts **12** against the stationary contacts. As the plunger arm **42** continues downwardly, the line of force of the spring means **50** will move below the pivot point **64** so that the contact operating arm **32** will be urged in a counterclockwise or downward direction. Since counterclockwise rotation of arm **32** is not restrained, the linkage **34** will collapse and the arm **32** will pivot downwardly with a snap action as the spring means **50** moves past pivot point **64** and the contact rod **16** will move downwardly rapidly to snap the movable contacts **12** out of engagement with the stationary contacts **14**. As the contact operating arm **32** moves downwardly, the latch pin **92** also moves downwardly and the weight of the latch release lever **94** maintains the latch pin **92** rotated in its maximum counterclockwise position. Thus, when the pin **92** is sufficiently downward it will move into notch **98** and latch face **96** will be maintained in engagement with notch **98** by spring **104**.

Also, as the plunger arm **42** moves downwardly, the pin **82** engages the middle arm **74** of lever **70** and rotates the spring lever **70** clockwise relative to the view of FIG. **2** to charge the closing spring **78**. As the contact operating arm **32** nears its most downward position it will engage the pin **84** on the upper arm **72** of the spring lever **70** to thereby hold the closing spring **78** in a charged condition as long as the contact operating arm **32** is latched in its downward position by the latch means **30**.

When the contacts **12** and **14** open, the line in which the circuit interrupter is connected is de-energized. A time delay means may then be provided by a time delay means (not shown) which is well known in the art and which delays the reclosing operation of the contacts **12** and **14** a predetermined time. The delay means typically retards the upward movement of the plunger rod **60**. However, at the end of the delay effect, the plunger rod **60** is free to move rapidly upwardly and arm **42** pivots counterclockwise due to force of overcenter spring means **50** as it contracts. Since the contact operating arm **32** is latched in an open, downward position the contacts **12** and **14** will remain out of engagement until the latch means **30** is released. When the actuating line of force of the overcenter spring means **50** moves above the pivot point **64**, the spring means **50** is in an optimum position for applying closing force to the contact means **28**. When the spring means **50** approaches this position, a pin **68** extending from plunger arm **42** engages the latch release lever **94** to rotate the lever **94** and the latch pin **92** and release the pin **92** from the latch lever **90**. Release of the contact operating arms **32** by the latch means **30** permits the spring means **50** to snap the arm **32** upward and also, by releasing the arm **32** the spring lever **70** and closing spring **78** are released so that the closing spring **78** will contract and discharge to provide a snap, upward force to the arm **32**. The combined force of spring means **50** and closing spring **78** rapidly moves the contact operating means **26** and contact means **28** back upward to their first position shown in FIG. **2** and rapidly moves the contacts **12** and **14** into engagement.

It may be readily seen that a circuit interrupter contact operating mechanism has been provided in which closing of the contacts is controlled by latch means which may be released by the contact operating mechanism itself at a time during the closing sequence permitting optimum closing force to be applied to the mechanism. Moreover, the latch means cooperates with a closing spring mechanism so that the closing spring mechanism is also restrained by the latch means until the release of the latter.

While only a preferred embodiment of the invention has been shown herein, it will be realized that many modifications thereof are feasible without departing from the spirit and scope of the invention. It is accordingly intended that the scope of the invention is not to be limited to the specific embodiment disclosed.

I claim:

1. In a circuit interrupter including a pair of relatively movable contacts operable into and out of engagement with each other, the combination comprising:

contact operating means having a first position in which said contacts are in engagement and a second position in which said contacts are out of engagement, said operating means between said positions and moving the contacts into out of engagement;

second spring means for assisting actuation of the contact operating means to the first position, said second spring means having a relatively discharged position when the contact operating means is in said second position, said second spring means being movable from the discharged to the charged position in response to movement of the contact operating means from the first to the second position;

latch means mounted on the contact operating means and comprising a latch lever and a latch pin, said latch means having a latched position when said contacts are disengaged for holding the operating means in its second position and maintaining the second spring means in the charged position and being rotatable out of the latched position; and

latch release means responsive to the first spring means after the latter initiates actuation of the operating means from the second to the first position for releasing said latch means from its latched position whereby the operating means and the second spring means are freed to move to their respective first and discharged positions.

2. The combination according to claim 1 wherein said contact operating means has a third position intermediate said second and first positions, said contact operating means being sequentially movable from the second position to the third position and thence to the first position, said latch release means being operative when the contact operating means is in the third position whereby the second spring means is freed to discharge and assist actuation of the operating means from the third to the first position.

3. The combination according to claim 2 wherein said contact operating means includes first and second arms, said first arm being in charging engagement with the second spring means during movement of the contact operating means from the first to the second position, said second spring means being in biasing engagement with the second arm during movement of the contact operating means from the second to the third position and during the initial portion of movement from the third to the first position.

4. The combination according to claim 1 wherein said latch means includes a release lever rigidly affixed to said latch pin and extending transversely from said pin, said latch release means engaging the release lever during movement to rotate the latch pin.

5. The combination according to claim 3 wherein:

said latch means comprises a latch lever, a latch pin having a latched position with the latch lever and being rotatable out of the latched position and a release lever rigidly affixed to the latch pin; and

the latch release means includes said first arm and said first arm engages the release lever when the contact operating means is in the third position to rotate and release the latch pin from said latched position.

6. In a circuit interrupter having a pair of relatively movable contacts, the combination comprising:

contact operating means having a first position in which said contacts are out of engagement, and a third position, said contact operating means being movable between said positions for moving the contacts into and out of engagement;

said contact operating means including an actuating arm engaging the second actuating means to charge the latter during movement of the contact operating means to the second position, said actuating arm being out of engagement with the second actuating means during movement of the contact operating means from the second to third position;

latch means for holding the contact operating means when the contact operating means is in said second position subsequent to movement of the contact operating means from the first position, said latch means being releasable in response to the contact operating means when the latter is in said third position; and

second actuating means for assisting movement of the contacts into engagement, said second actuating means having a discharged condition and a charged condition and assuming said charged condition in response to the first actuating means during movement of the contacts out of engagement by the contact operating means, said second actuating means assuming said discharged condition in response to latch means upon release of the latter whereby the discharge of the second actuating means provides force for moving the contacts into engagement.

7. The combination according to claim 6 wherein said actuating arm engages the latch means to release the latter when the contact operating means is in said third position.

8. In a circuit interrupter the combination comprising:

contact means including a pair of relatively movable contacts and being operable between a first position in which said contacts are engaged and a second position in which said contacts are out of engagement;

contact operating means including actuating means for moving the contact means between said positions whereby the contacts are moved into and out of engagement, said actuating means comprising first spring means for applying moving force to said contact means, said first spring means being continually operative during movement of the contact means from the first to the second position and back to the first position, said actuating means also comprising second spring means for applying additional moving force to said contact means, said second spring means being operative only during the latter portion of movement of the contact means from the second to the first position;

latch means including a latch lever and also including a rotatable latch pin mounted on the contact operating means and having a latched position

with the latch lever when said contacts are disengaged for latching said contact means in its second position whereby said contacts are held out of engagement; and

said contact operating means includes latch release means for rotating said latch pin to effect release of the latch pin and latch lever from their latched position whereby said contact means and contacts are free to be moved respectively to their first position and into engagement.

* * * * *

# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 3,723,686 Dated March 27,1974

Inventor(s) Max Rigert

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 8, after "means" insert -- including first spring means for actuating the operating means --, line 9, after "into" insert -- and --, line 15, after the 1st occurrence of "said" cancel"second" and insert -- first --, line 15, after "position" insert -- and a charged position when the contact operating means is in said second position,--. Column 6, line 7, after "are" cancel "out of engagement" and insert -- engaged, a second position in which said contacts are out of engagement, --, line 35, after "to" insert -- said --.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

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Attesting Officer

C. MARSHALL DANN
Commissioner of Patents



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