# United States Patent

**Pflanz**

[15] **3,676,621**

[45] **July 11, 1972**


## [54] HIGH VOLTAGE ELECTRICAL CIRCUIT BREAKER WITH PREINSERTION RESISTOR DURING CLOSING


[72] Inventor: **Herbert M. Pflanz,** Westwood, Mass.

[73] Assignee: **Allis-Chalmers Manufacturing Company,** Milwaukee, Wis.



[22] Filed: **May 28, 1971**

[21] Appl. No.: **147,789**

[52] **U.S. Cl.** .....**200/144 AP,** 200/144 B, 200/145

[51] **Int. Cl.** .....**H01h 33/16**

[58] **Field of Search**.....200/144 B, 144 AP, 145 R, 146 R



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| 3,352,988 | 11/1967 | Wachta et al. | 200/144 B |
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|---|---|---|---|
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| 1,112,745 | 5/1968 | Great Britain | 200/144 B |



*Primary Examiner*—Robert S. Macon

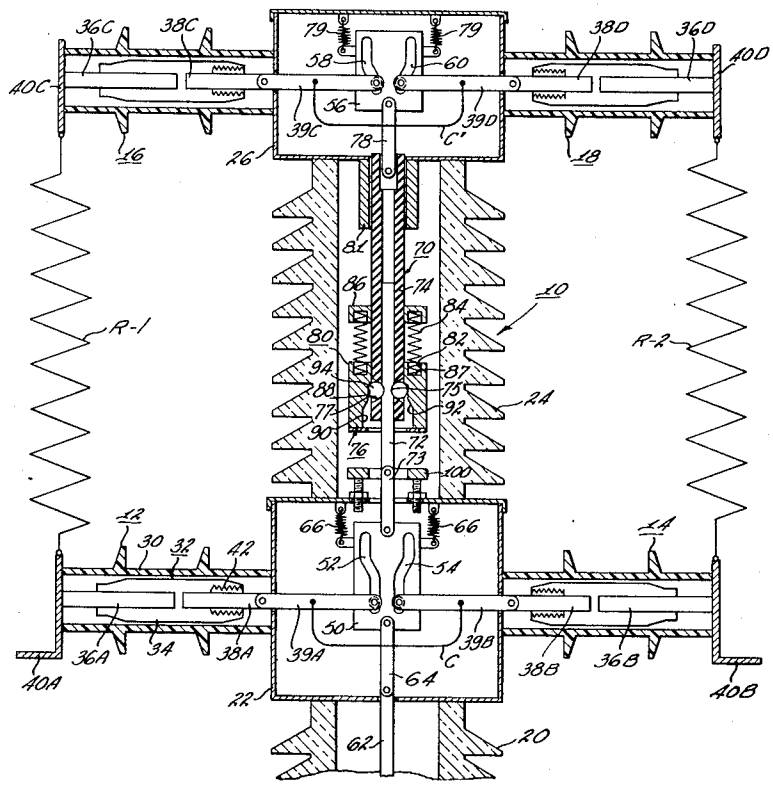
*Attorney*—Robert C. Sullivan, Lee H. Kaiser and Robert B. Benson



[57] **ABSTRACT**

A high voltage circuit breaker assembly adapted to reduce voltage surges which occur on prestriking of the switch during the closing stroke, such as when switching a capacitor bank onto a high voltage distribution line. The breaker assembly includes a first and a second breaker connected in parallel paths. Each breaker may be a vacuum interrupter. An operating mechanism causes the first breaker to close in series with a resistor during the closing stroke of the operating mechanism and during a later phase of the closing operation the operating mechanism causes closing of the second breaker to bypass the resistor. The operating mechanism includes means for maintaining the first breaker which is in series with the resistor open during the opening operation of the circuit breaker assembly, whereby to insure that the resistor is not in circuit during the opening operation so that the circuit is opened by the second breaker.


**16 Claims, 2 Drawing Figures**



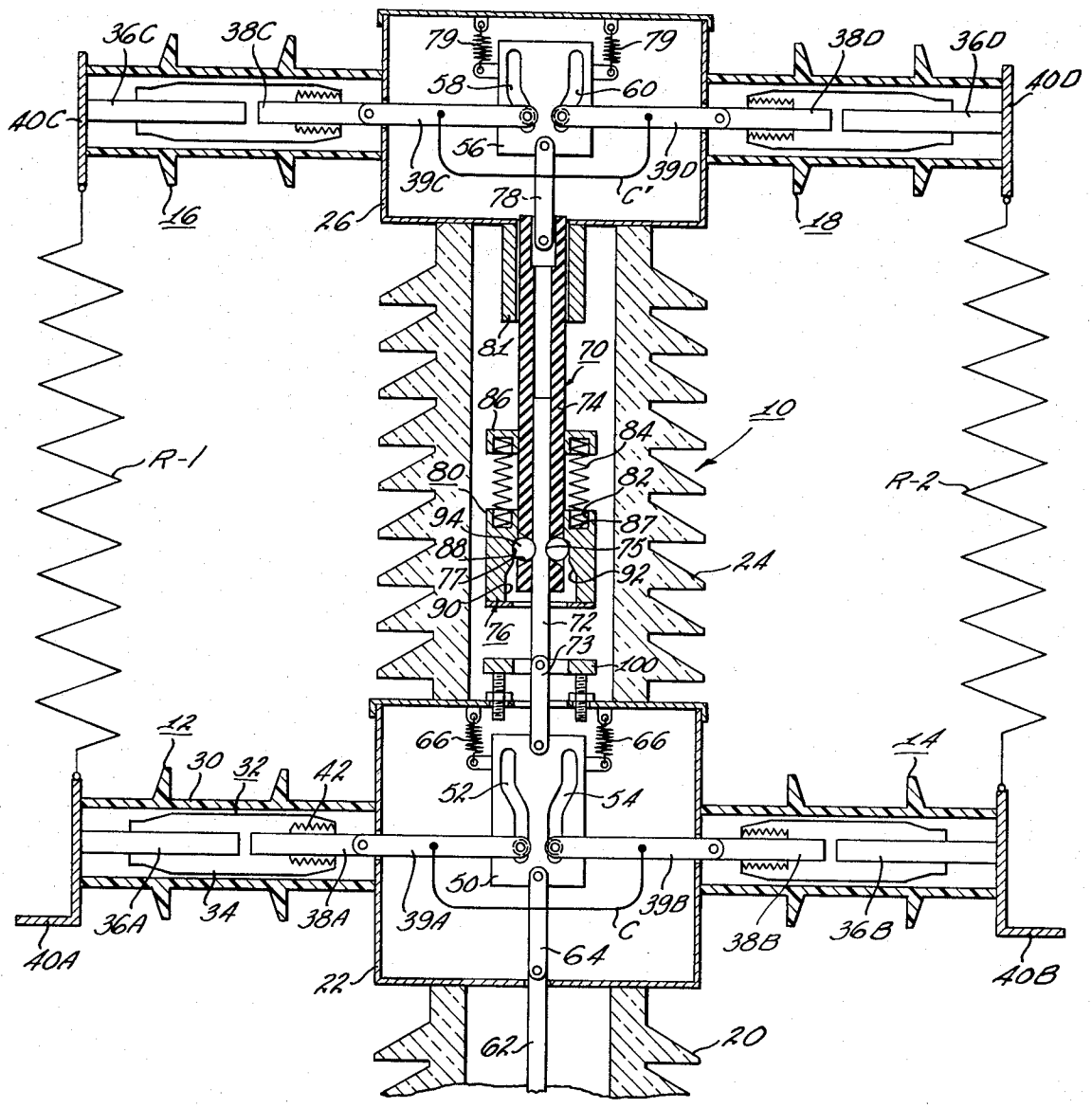



Fig. 1

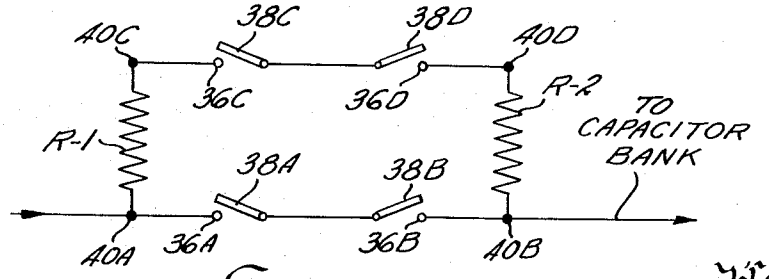



Fig. 2

Inventor
Herbert M. Pflanz
By Robert C. Sullivan
Attorney

# HIGH VOLTAGE ELECTRICAL CIRCUIT BREAKER WITH PREINSERTION RESISTOR DURING CLOSING

## BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to high voltage electrical circuit breakers and more particularly to a high voltage circuit breaker in which resistor means are preinserted into the circuit during closing of the breaker to reduce the severity of the switching surge produced by the breaker closing operation.

2. Description of the Prior Art

When a circuit breaker is closed to energize or reclose a power line, voltage surges of relatively high magnitude may be produced. One well-known method of reducing the magnitude of such surges is to preinsert a resistance of suitable value into the circuit during the closing operation just prior to the moment at which the main contacts engage. This problem has been discussed in various United States patents including the following:

3,500,009 granted to Christy W. Bell on Mar. 10, 1970;
3,538,277 granted to Virgel E. Phillips on Nov. 3, 1970; and
3,538,278 granted to William H. Rathbun on Nov. 3, 1970.

The problem of the voltage surges during the closing operation is particularly acute in connection with the closing operation of vacuum interrupters used to connect capacitor banks to an electrical distribution system, in which it has been noted that traveling voltage and current waves of high magnitude occur as a result of prestriking of the switch during the closing stroke. Such traveling waves have been known to cause severe damage to system equipment. In this connection, reference is made to a paper entitled "Shunt Capacitor Energization with Vacuum Interrupters—A possible Source of Overvoltage" by Eugene W. Boehne and S.S. Low, printed in the IEEE Transactions on Power Apparatus and Systems, Vol. PAS–88, No. 9, September 1969.

## SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a circuit breaker assembly having an operating mechanism which is so constructed as to insert a resistor in series with the circuit breaker apparatus during the closing stroke of the breaker apparatus and which insures that the resistor is disconnected from the circuit during the entire opening operation of the breaker assembly.

It is another object of the invention to provide a circuit breaker assembly comprising a plurality of circuit breakers operated in cooperative relation with each other by a common operating mechanism in such manner that a resistor is automatically inserted in the circuit during the closing stroke of the breaker mechanism, said resistor being bypassed during a later phase of the closing stroke of the breaker mechanism by closure of the main contacts, together with means for maintaining the resistor removed from the circuit during the entire opening operation of the breaker mechanism.

It is another object of the invention to provide a circuit breaker assembly in which a resistor is preinserted in the circuit during the closing stroke of the breaker operating mechanism, the resistor being bypassed by the closure of the main contacts during a later phase of the closing stroke, the resistor being maintained out of the circuit during the entire opening operation of the breaker, all under the control of mechanical elements forming part of the breaker operating mechanism.

It is another object of the invention to provide a circuit breaker system which has particular utility in connection with the connection and disconnection of a capacitor bank with respect to a high voltage distribution system.

In achievement of these objectives there is provided in accordance with an embodiment of this invention a high voltage circuit breaker assembly adapted to reduce voltage surges which occur on prestriking of the switch during the closing stroke, such as when switching a capacitor bank onto a high voltage distribution line. The breaker assembly includes a first and a second breaker connected in parallel paths. Each breaker may be a vacuum interrupter. An operating mechanism causes the first breaker to close in series with a resistor during the closing stroke of the operating mechanism and during a later phase of the closing operation the operating mechanism causes closing of the second breaker to bypass the resistor. The operating mechanism includes means for maintaining the first breaker which is in series with the resistor open during the entire opening operation of the circuit breaker assembly, whereby to insure that the resistor is not in circuit during the opening operation so that the circuit is opened by the second breaker.

Further objects and advantages of the invention will become apparent with the following description taken in connection with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in vertical section, partially schematic, of a circuit breaker apparatus in accordance with the invention; and

FIG. 2 is a schematic diagram of the conduction path through the apparatus of FIG. 1.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is shown a circuit breaker assembly generally indicated at **10**, including four vacuum interrupter modules each generally respectively indicated at **12**, **14**, **16**, and **18** which cooperate in a manner which will be hereinafter described. The entire assembly **10** including the four vacuum interrupter modules **12**, **14**, **16**, and **18** together serve as one circuit breaker phase or pole, and therefore it will be understood that a three-phase connection of, for example, a capacitor bank to a three-phase transmission line would require the use of three of the assemblies indicated at **10** in the drawings.

In describing the invention, it is assumed for convenience of description that the view of FIG. 1 is a view in vertical section, and the terms "upper" and "lower," etc., are used based on the assumption that the assembly **10** is vertically oriented.

The assembly **10** comprises a first hollow insulating column or bushing **20** on which is mounted a hollow housing or casing **22**. A second hollow insulating column **24** is mounted on the upper end wall of casing **22**. A second hollow housing or casing **26** is mounted on the upper end of insulating column **24**. The lower casing **22** supports on either side thereof the pair of vacuum interrupter modules **12** and **14** in axial alignment with each other; and the upper casing **26** similarly supports a pair of vacuum interrupter modules **16** and **18** which are axially aligned with each other. Vacuum interrupters are well known per se and are shown in many issued U.S. patents, such as, for example, U.S. Pat. No. 3,562,574 granted to Henry J. Wesoloski on Feb. 9, 1971.

The vacuum interrupter modules **16** and **18** lie on an axis which is parallel to but vertically spaced above the axis on which the vacuum interrupter modules **12** and **14** lie. The axes on which the modules **12** and **14** and **16** and **18** lie are respectively transverse, specifically, perpendicular, to the axis on which the insulating columns or bushings **20** and **24** lie.

The vacuum interrupter modules **12**, **14**, **16**, and **18** are understood to be identical and therefore only module **12** shown in cross section in FIG. 1 is hereinafter described in detail. Module **12** comprises a hollow tubular insulating housing **30**, preferably of transparent plastic material, which is rigidly mounted to casing **22**. A vacuum interrupter **32** is rigidly mounted within housing **30**, and interrupter **32** comprises an insulating envelope **34**, preferably transparent, within which a pair of cooperable separable contacts such as stationary contact **36A** and a movable contact **38A** are disposed. Stationary contact **36A** is electrically connected to a terminal **40A** mounted on insulating housing **30**. Movable contact **38A** enters envelope **34** through bellows means **42** which permit contact **38A** to be axially movable with respect to insulating en-

velope 34 while maintaining a proper seal. Similarly, vacuum interrupter module 14 includes a stationary contact 36B which is attached to a terminal 40B and a movable contact 38B. The contacts of modules 12 and 14 may be considered the "main contacts" in the sense that they carry the current after the circuit closing operation of the breaker assembly has been completed, as will be described hereinafter. Vacuum interrupter module 16 includes a fixed contact 36C which is attached to a terminal 40C and a movable contact 38C. Vacuum interrupter module 18 includes a fixed contact 36D which is attached to a terminal 40D and a movable contact 38D. It will be noted that the fixed contacts, the movable contacts, and the terminals of the respective vacuum interrupter modules 12, 14, 16 and 18 are all correspondingly numbered and differ only in the letter suffix appended to the respective reference numerals.

As seen in FIG. 1 and in the schematic wiring diagram of FIG. 2, movable contact 38A of vacuum interrupter module 12 is electrically connected to movable contact 38B of module 14 by a suitable flexible conductor means C located in housing 22, and movable contact 38C of module 16 is electrically connected to movable contact 38D of module 18 by a suitable flexible conductor means C' located in housing 26. Thus, the contacts of modules 12 and 14 are electrically connected in series with each other, and the contacts of modules 16 and 18 are electrically connected in series with each other.

A resistor R–1 is connected between the terminals 40A and 40C of the respective vacuum interrupter modules 12 and 16, and similarly, a resistor R–2 is connected between the terminals 40B and 40D of the vacuum interrupter modules 14 and 18.

Means are provided within lower housing 22 to effect axial movement of the two movable contacts 38A and 38B of modules 12 and 14 relative to their corresponding associated fixed contacts 36A and 36B.

For this purpose, there is positioned within lower housing 22 a vertically movable cam plate 50 having cam slots 52 and 54 therein which respectively engage the radially inner ends of drive rods 39A and 39B which are respectively mechanically connected to and control the position of the two movable contacts 38A and 38B of the vacuum interrupter modules 12 and 14.

The drive rods 39A and 39B extend through suitable passages in the opposite transverse end walls of housing 22 into cooperative engagement with the respective cam slots 52 and 54.

In a similar manner, a vertically movable cam plate 56 is positioned within upper housing 26 and includes cam slots 58 and 60 which engage the radially inner ends of drive rods 39C and 39D which are mechanically connected to and control the position of the respective movable contacts 38C and 38D respectively associated with the vacuum interrupter modules 16 and 18.

An operating rod 62 is connected by a link 64 to the lower end, with respect to the view shown in FIG. 1, of cam plate 50. The cam plate 50 is biased in an upward direction with respect to the view in FIG. 1 by springs 66 which are connected to cam plate 50 and also to the upper wall of housing 22. A pull rod assembly generally indicated at 70 is provided and includes an inner rod 72 and a hollow outer rod 74 in which inner rod 72 is telescopically received. Inner rod 72 and outer rod 74 are maintained in a fixed relation with respect to each other in the position shown in FIG. 1 during a portion of the operation by a clutch mechanism generally indicated at 76 which will be described hereinafter in more detail. The upper end of cam plate 50 is connected to the lower end of the inner rod 72 by a link 73. The upper end of outer rod 74 is connected by a link 78 to the lower end of cam plate 56. Springs 79 connected to the upper end of cam plate 56 and also to the upper wall of housing 26 bias cam plate 56 in an upward direction with respect to the view shown in FIG. 1. Guide means 81 attached to upper housing 26 serves to keep pull rod assembly 70 and its attachments axially aligned.

## DESCRIPTION OF THE CLUTCH MECHANISM

The clutch mechanism 76 which controls the engagement of the inner pull rod 72 and of the outer pull rod 74 with each other comprises a collar member generally indicated at 80 having a generally cylindrical cross section. Collar 80 includes an upwardly open (with respect to the view in FIG. 1) countersunk annular recess 82 which receives a biasing spring or springs 84. The upper end of biasing spring 84 bears against and is connected to a stop plate 86 which is rigidly secured to the outer periphery of outer rod member 74. The lower end of spring 84 bears against and is connected to the shoulder 87 which defines the bottom bounding surface of the countersunk annular recess 82. Collar 80 includes intermediate its axial length a reduced diameter passage 88 which is slightly greater in internal diameter than the outer diameter of outer rod 74.

Clutch collar 80 also includes at its lower end an enlarged passage 90 therethrough of larger diameter than reduced diameter portion 88. Larger diameter passage 90 is joined to the reduced diameter passage 88 by a tapered wall portion 92.

Inner pull rod 72 is provided adjacent the lower end thereof with a peripheral recess 75 which is adapted to cooperate with a peripheral recess 77 of outer pull rod 74 and with detent balls 94 whereby when the respective recessed regions 75 and 77 are in axial registry and with the reduced diameter passage 88 of collar 76 in the relative position shown in FIG. 1, then the inner and outer pull rods 72 and 74 are in interlocked engagement with each other and cannot move axially relative to each other, since detent balls 94 lie partially in the recess 75 of pull rod 72 and partially in the recess 77 of pull rod 74. The lower bounding surface of the peripheral recess 77 of outer pull rod 74 tapers downwardly toward its radially outer periphery. Also, the upper bounding surface of peripheral recess 77 of outer pull rod 74 tapers upwardly towards its radially outer periphery.

A vertically adjustable abutment 100 is mounted on the upper surface of housing 22 in the path of axial movement of clutch collar 80, and cooperates with clutch 76 to release inner pull rod 72 from outer pull rod 74 as will be explained hereinafter in more detail.

## DESCRIPTION OF THE OPERATION

The operation of the apparatus of the invention will now be described:

With the breakers and operating mechanism in the position shown in FIG. 1, assume that a closing signal is given which causes downward movement of operating rod 62. The downward movement of rod 62 causes a downward movement of cam plate 50, of link 73, of the coupled pull rod assembly including the rods 72–74, of the link 78, and of upper cam plate 56. Cam slots 58 and 60 of upper cam plate 56 are so shaped that shortly after the beginning of the downward closing stroke of rod 62, the movable contacts 38C and 38D associated with the respective vacuum interrupter modules 16 and 18 are moved into closed engagement relative to their respective associated fixed contacts 36C and 36D. This, therefore, completes a current path from terminal 40A through resistor R–1 to terminal 40C, through fixed contact 36C and movable contact 38C, through movable contact 38D and fixed contact 36D to terminal 40D, through resistor R–2 to terminal 40B. Shortly afterwards, while operating rod 62 continues to move downwardly in its closing operation, lower cam plate 50 moves to a position in which cam slots 52 and 54 cause closing movement of the respective movable contacts 38A and 38B associated with vacuum interrupter modules 12 and 14, into closed contacting engagement with the respective fixed contacts 36A and 36B. When this happens, a current path is completed from terminal 40A through the fixed contact 36A and movable contact 38A of vacuum interrupter module 12, to movable contact 38B of vacuum interrupter module 12, to movable contact 38B of vacuum interrupter module 14 to terminal 40B. Thus, the completion of the closing movement of the contacts 38A and 38B into engagement with their cor-

responding associated fixed contacts 36A and 36B of the respective modules 12 and 14 causes the current path through resistors R–1 and R–2 to be bypassed.

As operating rod 62 continues to move downwardly to complete its closing stroke, the clutch collar 76 which is moving with the downwardly moving rod assembly 70 strikes against adjustable abutment 100 and as the rod assembly 70 continues to move downwardly with operating rod 62, the detent balls 94 which are moving downwardly with the interengaged rods 72–72 of rod assembly 70 move downwardly and radially outwardly along the downwardly tapered lower bounding surface of recess 77 of outer pull rod 74 and into the large diameter passage 90 of collar 76 and are thereby released from their interlocking engagement with respect to inner rod 72. Since rods 72 and 74 of the rod assembly 70 are now disengaged from each other, springs 79 pull upwardly on upper cam plate 56 which is connected by link 78 to outer rod 74, causing cam slots 58 and 60 of cam plate 56 to move to a position such as that shown in FIG. 1 which causes movable contacts 38C and 38D of modules 16 and 18 to move to an open position relative to their respective associated fixed contacts 36C and 36D. This opening movement of movable contacts 38C and 38D causes an opening of the circuit of the resistors R–1 and R–2, removing the already bypassed resistors R–1 and R–2 completely from the interrupting circuit by the end of the downward or closing stroke of operating rod 62. Upper cam plate 56 remains in contact the position just described in which contacts 38C and 38D are open, throughout the opening operation to be described and until the beginning of the next closing operation. Thus, the circuit of resistors R–1 and R–2 is open during the circuit breaker opening operation to be described.

On the opening operation, the restraining force on operating rod 62 is released. This allows cam plate 50 to move upwardly under the action of springs 66, thereby moving cam slots 52 and 54 on cam plate 50 to a position in which movable contacts 38A and 38B of modules 12 and 14 are moved to open position. Inner rod 72 also moves upwardly at this time due to its connection with cam plate 50 by link 73.

During the opening stroke of operating rod 62, the inner pull rod 72 moves upwardly independently of outer pull rod 74 (that is, rods 72 and 74 are not now interlocked) since the outer pull rod 74 has been released from interlocking engagement with inner rod 72 toward the end of the closing operation, as previously described, and has moved upwardly under the influence of springs 79. Collar 80 may be provided with suitable restraining and positioning means (not shown) for detent balls 94 to prevent the balls 94 from dropping out of collar 80 and also to properly orient and position balls 94 relative to collar 80. As the opening stroke of the operating mechanism is completed by the further upward movement of operating rod 62, the detent balls 94 carried by collar 80 again snap into engagement with the notched or recessed portion 75 of inner rod 72, causing rods 72 and 74 to again become interlocked with each other as shown in the position of view of FIG. 1. The clutch assembly and the rest of the operating mechanism is then ready for another cycle of operation similar to that just described.

From the foregoing detailed description of the present invention, it has been shown how the objects of the invention have been obtained in a preferred manner. However, modifications and equivalents of the disclosed concepts such as readily occur to those skilled in the art are intended to be included within the scope of this invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An electrical circuit breaker assembly comprising a first breaker, a resistor means connected in series with said first breaker whereby when said first breaker is closed said resistor means is connected in circuit, a second breaker connected in shunt relation to said first breaker and said resistor means, an operating means responsive to opening and closing signals for said breaker assembly, first and second control means respectively associated with said first and second breaker for controlling the closing and opening of the respective breakers, means connecting said operating means to said first and said second control means during the closing operation of the breaker assembly to cause the closing of said first breaker before the closing of said second breaker to thereby connect said resistor means in circuit before said second breaker is closed, closing of said second breaker being effective to complete an electrical path in shunt relation to said first breaker and to said resistor means, clutch means effective substantially at the end of said closing operation of the breaker assembly for disconnecting said operating means from said first control means, and means acting on said first control means and effective upon the disconnection of said operating means from said first control means for moving said first control means to a position in which said first breaker is opened and is maintained open throughout the subsequent circuit opening operation of said second breaker whereby said resistor is not in circuit during said circuit opening operation of said second breaker.

2. An electrical circuit breaker assembly as defined in claim 1 in which said first and second breakers are vacuum interrupters.

3. An electrical circuit breaker assembly as defined in claim 1 in which said first and second control means respectively comprise separate cam means cooperatively engaging the respective said first and second breaker for controlling the closing and opening of the respective breakers.

4. An electrical circuit breaker assembly as defined in claim 1 including a first and a second cam plate respectively associated with said first and second breakers, means connecting a movable contact of each of said breakers to its corresponding cam plate whereby movement of each respective cam plate is effective to change the position of the corresponding movable contact relative to an associated fixed contact to close or to open the respective breaker, means connecting said operating means to both said cam plates during the circuit closing operation of said breaker assembly and effective to cause the closing movement of said first and said second breaker, said clutch means disconnecting said operating means from said first cam plate after said second breaker has moved to closed position, and means for moving said first cam plate independently of said operating means after said operating means has been disconnected from said first cam plate, whereby to move said first cam plate to a position in which it causes opening of said first breaker and in which it maintains said first breaker open during the subsequent circuit breaker assembly opening operation.

5. An electrical circuit breaker assembly as defined in claim 1 in which said means acting on said first control means effective upon the disconnection of said operating means is a spring means.

6. An electrical circuit breaker assembly as defined in claim 1 including means tending to bias said second control means to a position in which it would move said second breaker to an open position, whereby when restraining force is released from said operating means, said second control means moves to a position in which it opens said second breaker.

7. An electrical circuit breaker assembly as defined in claim 1 comprising an inner pull rod and outer pull rod mounted for telescopic movement relative to each other, means collecting one of said pull rods to said second control means, means connecting the other of pull rods to said first control means, said operating means comprising an operating rod which is moved in response to a closing signal to initiate the closing operation of said breaker assembly, means connecting said operating rod to said second control means, clutch means effective when in engaged position to hold said inner and outer pull rods in a fixed position relative to each other whereby said inner and said outer pull rods move together when said operating rod is moved to thereby sequentially move said first breaker and said second breaker to closed position during the closing operation of said breaker assembly, means for disengaging said clutch means substantially at the end of said closing operation to per-

mit said inner and said outer pull rods to move relative to each other, and means effective upon the disengagement of said clutch means for moving said first control means and the other of said pull rods to a position in which said first breaker is opened and remains open during the subsequent opening operation of said circuit breaker assembly.

8. An electrical circuit breaker assembly as defined in claim 7 in which said inner and said outer pull rods are provided with cooperating recesses adapted to be in registry during the closing of said first and second breaker, detent balls received in said cooperating recesses to hold said pull rods in interlocked engagement with each other, a clutch collar coaxially positioned about said pull rods to hold said detent balls in said cooperating recesses, and means effective near the end of the closing operation of said breaker assembly to move said clutch collar to permit said detent balls to move to a position in which said pull rods are released from interlocking engagement with each other.

9. An electrical circuit breaker assembly as defined in claim 1 comprising a pair of said first breakers connected in series with each other, said resistor means being connected in series with said pair of said first breakers, a pair of said second breakers connected in series with each other, said pair of said second breakers connected in series with each other, said pair of second breakers being connected in shunt relation to the series connection of said pair of said first breakers and said resistor means.

10. An electrical circuit breaker assembly comprising a first breaker, a resistor means connected in series with said first breaker whereby when said first breaker is closed said resistor means is connected in circuit, a second breaker connected in shunt relation to said first breaker and said resistor means, a first and a second cam means respectively associated with said first and second breakers for controlling the closing and opening of the respective breakers, operating means controlling the position of said respective cam means during the closing operation of the breaker assembly whereby to cause the closing of said first breaker before the closing of said second breaker to thereby connect said resistor means in circuit before said second breaker is closed, closing of said second breaker under the control of said second cam means being effective to complete an electrical path in shunt relation to said first breaker and to said resistor means, means for disconnecting said operating means from said first cam means after the closing of said second breaker, and means acting on said first cam means after said operating means is disconnected from said first cam means for maintaining said first breaker open during the entire opening operation of said second breaker, whereby said resistor means is not in circuit during said opening operation of said second breaker and whereby said circuit is opened only by said second breaker.

11. An electrical circuit breaker assembly as defined in claim 10 in which said means for disconnecting said operating means from said first cam means is a clutch.

12. An electrical circuit breaker assembly as defined in claim 10 in which said means acting on said first cam means is a spring.

13. An electrical circuit breaker assembly as defined in claim 10 in which said first and second breakers are vacuum interrupters.

14. An electrical circuit breaker assembly as defined in claim 10 including means tending to bias said second cam means to a position in which it would move said second breaker to an open position, whereby when restraining force is released from said operating means said second cam means moves to a position in which it opens said second breaker.

15. An electrical circuit breaker assembly comprising a first hollow insulating column, a hollow housing mounted on an upper end of said first insulating column, a first circuit interrupting device supported by said first housing and extending from said first housing along a first axis substantially perpendicular to the axis of said first insulating column, a second insulating column mounted on the upper end of said first housing in substantial axial alignment with said first insulating column, a second hollow housing mounted on an upper end of said second insulating column, a second circuit interrupting device supported by said second housing and extending from said second housing along a second axis substantially perpendicular to the axis of said first and second insulating columns, first and second cam means respectively positioned in said first and second housings, means connecting the respective first and second cam means to a movable contact of the respective said first and second circuit interrupting devices whereby movement of each respective cam means is effective to change the position of the corresponding movable contact relative to an associated fixed contact to close or to open the respective circuit interrupting device, a resistor means connected in series with said second circuit interrupting device, said first circuit interrupting device being connected in shunt relation to said second circuit interrupting device and said resistor means, an operating means positioned in said first insulating column and responsive to opening and closing signals for said breaker assembly, means connecting said operating means to said first and to said second cam means during the closing operation of said breaker assembly to cause the closing of said second circuit interrupting device before the closing of said first circuit interrupting device to thereby connect said resistor means in circuit before said first circuit interrupting device is closed, clutch means effective substantially at the end of said closing operation of the breaker assembly for disconnecting said operating means from said second cam means, and means acting on said second cam means and effective upon the disconnection of said operating means from said second cam means for moving said second cam means to a position in which said second circuit interrupting device is opened and is maintained open throughout the subsequent circuit opening operation of said first circuit interrupting device whereby said resistor means is not in circuit during said circuit opening operation of said first circuit interrupting device.

16. An electrical circuit breaker assembly as defined in claim 15 comprising a pair of said first circuit interrupting devices electrically connected in series with each other and supported by said first housing along said first axis and on opposite sides of said first housing, a pair of said second circuit interrupting devices electrically connected in series with each other and supported by said second housing along said second axis and on opposite sides of said second housing, said first cam means controlling the opening and closing of said pair of said first circuit interrupting devices, said second cam means controlling the opening and closing of said pair of said second circuit interrupting devices.

* * * * *

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# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,676,621 Dated July 11, 1972

Inventor(s) Herbert M. Pflanz

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

Column 6, in each of lines 1 and 30, --- said --- should be inserted after "and"; line 60, "collecting" should read --- connecting ---. Column 7, lines 23 and 24, "said pair of said second breakers connected in series with each other," should be deleted; line 25, --- said --- should be inserted after "of"; line 34, --- said --- should be inserted after "and" (first occurrence).

Signed and sealed this 2nd day of January 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

PO-1050
(5/69)

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Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents