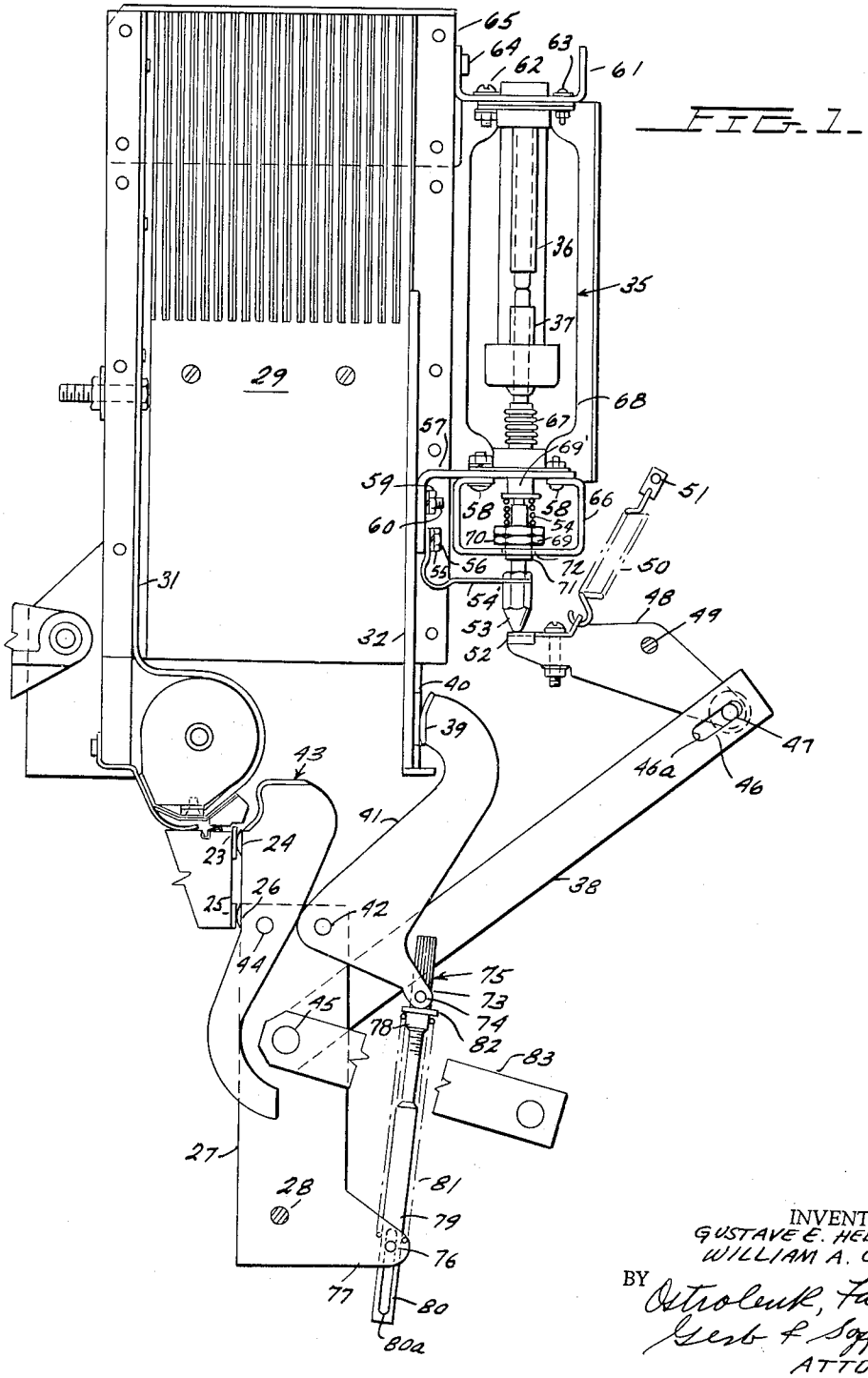
Aug. 15, 1961 G. E. HEBERLEIN ET AL 2,996,592

MULTI-BREAK RESISTANCE SHUNTED CIRCUIT BREAKER WITH A VACUUM SWITCH AS THE FINAL INTERRUPTER

Filed Dec. 30, 1958

3 Sheets-Sheet 1

FIG. 1



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Filed Dec. 30, 1958 3 Sheets-Sheet 2

FIG. 2

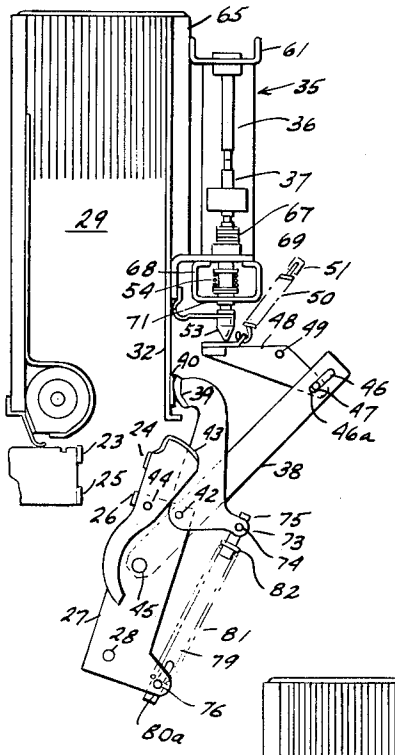


FIG. 3

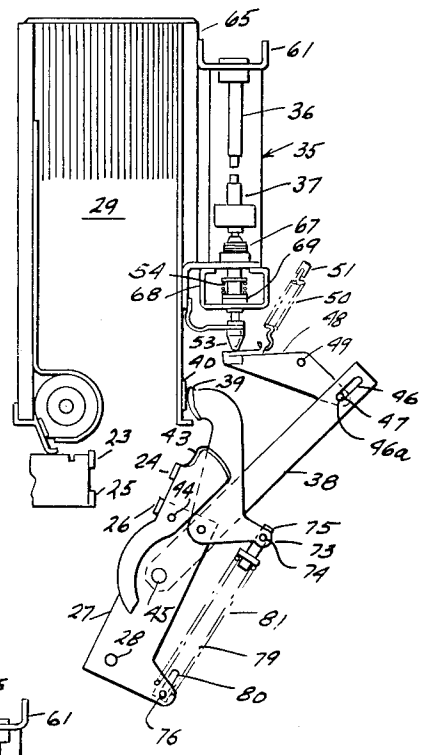
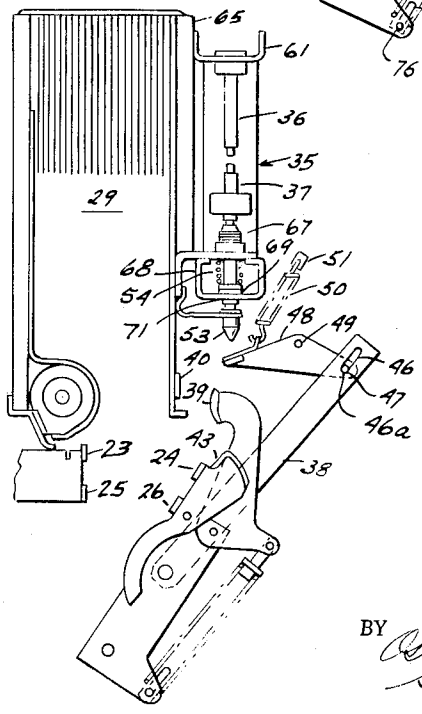


FIG. 4



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FIG. 5.

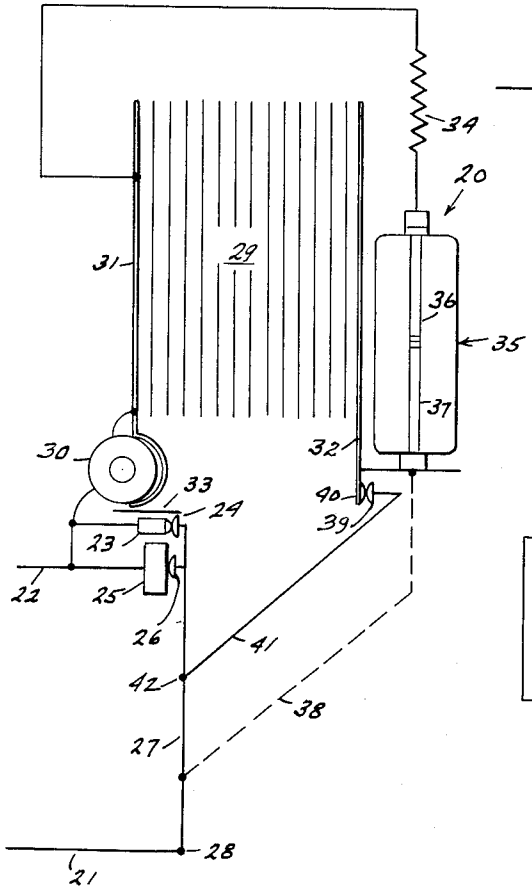
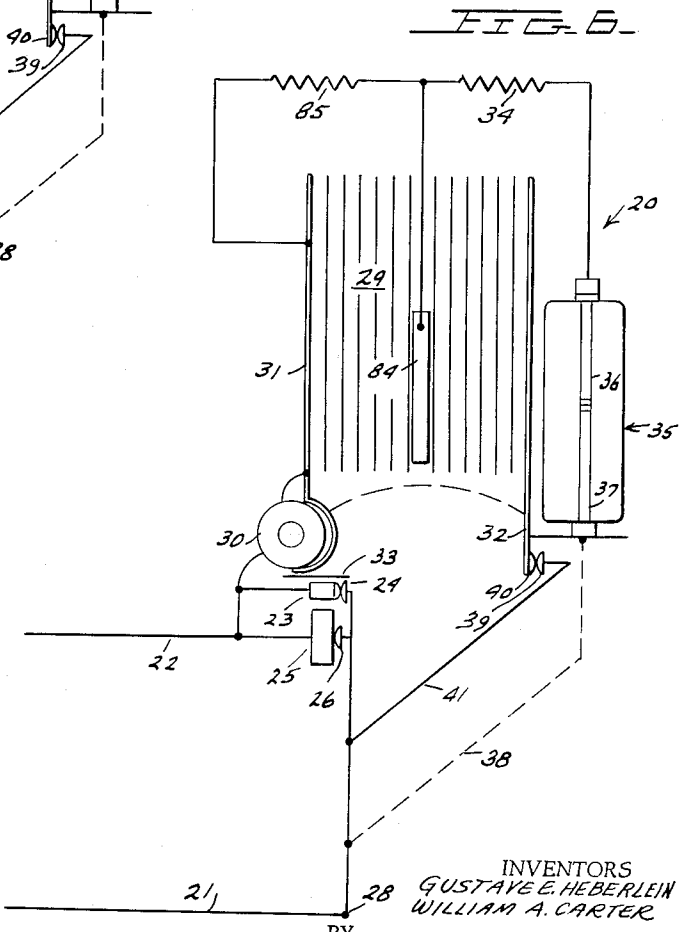


FIG. 6.



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2,996,592

MULTI-BREAK RESISTANCE SHUNTED CIRCUIT BREAKER WITH A VACUUM SWITCH AS THE FINAL INTERRUPTER

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5 Claims. (Cl. 200—145)

The instant invention relates to magnetic air circuit breakers and more particularly to a circuit breaker of this type wherein a resistor is inserted in shunt with the arc, in order to limit the arc current and to improve the power factor thereof, and including a vacuum switch as the final interrupter means.

As explained in the copending application Serial No. 731,769, filed April 29, 1958 entitled "Multiple Break Air Magnetic Breaker," with J. D. Wood as the inventor, and assigned to the assignee of the instant invention, a resistor may be inserted in series with each portion, except the initial portion, of the arc drawn in a multi-break magnetic air circuit breaker. The resistor serves to reduce the value of the arc current and also improve the power factor of the circuit prior to final interruption thereby preventing the occurrence of transient voltage surges which could cause restriking of the arc. Since each succeeding portion of the arc is of a reduced current magnitude, means are provided whereby the intensity of the magnetic field, covering the portion of the interrupter whose function it is to interrupt the arc of reduced current, must be increased as the arc current decreases.

The circuit breaker must be constructed to quickly and efficiently interrupt currents limited by shunt resistance during periods of fault as well as highly inductive currents of low magnitude which might be handled while switching an unloaded transformer. Previously, magnetically excited blow-out coils of many turns were suggested to clear these currents. Thus, the design of the interrupter was complicated by the special construction of the blow-out coils, and even with this special construction low values of current continued to present an appreciable problem.

The device of the instant invention provides a means whereby the resistive fault currents as well as highly inductive currents of low magnitude are quickly and efficiently interrupted. This is achieved by utilizing a high vacuum switch connected in the circuit to act as a final interrupter. The vacuum switch is connected in series with a resistor so that the switch is then required to handle currents which range from the maximum value of current which the resistor will pass to very low values such as transformer magnetizing current. The circuit breaker of the instant invention is constructed in a manner such that the vacuum switch is automatically isolated from the circuit through the normal operation of the circuit breaker. This serves to improve the basic impulse level of the circuit breaker and insures complete circuit isolation. Isolating the vacuum switch is highly desirable since the switch is enclosed within a glass envelope which is susceptible to breakage. Further, the impulse level of the switch drops as a result of contaminants caused by repeated switch operation.

Accordingly, a primary object of the instant invention is to provide a novel multi-break resistance air magnetic shunt circuit breaker utilizing a high vacuum switch as the final interrupter.

Another object is to provide a multi-break magnetic air circuit breaker including a vacuum switch as well as an isolating switch which are both operated from the

main contact bridge of the circuit breaker to efficiently interrupt the circuit and to automatically isolate the vacuum switch and the remaining portions of the circuit breaker from the circuit.

These as well as other objects of the instant invention shall become readily apparent after reading the following description of the accompanying drawings in which:

FIGURE 1 is a side elevation of the circuit breaker in the closed position.

FIGURE 2 is a side elevation illustrating the contact structure of FIGURE 1 with the main contacts in the open position and the other contacts in the closed position.

FIGURE 3 is a side elevation showing the contact structure at the position wherein the main contacts and the vacuum switch are both opened while the isolation switch is still closed.

FIGURE 4 is a side elevation at the position wherein all of the contacts are opened.

FIGURE 5 is a schematic representation of the circuit breaker of FIGURES 1–4.

FIGURE 6 is a schematic illustrating a circuit breaker constructed in accordance with the instant invention in which the arc chute is divided into two sections with an individual current limiting resistor in parallel with each section.

Now referring more particularly to FIGURE 5, circuit breaker **20** comprises a lower current stud **21** and an upper current stud **22** suitably insulated from each other to which external circuit connections are made. Stationary arcing contact **23** and main contact **25** are mounted to the end of upper stud **22**. Movable main contact **26** and movable arcing contact **24**, which are engageable with stationary contacts **25**, **23** respectively, are mounted to one end of bridge **27** which is pivoted at its other end **28** to lower stud **21**.

Arc chute **29** is positioned above cooperating contacts **23**, **24** and **25**, **26** to receive an electric current arc drawn between these contacts upon parting thereof. Blowout coil **30**, connected between upper stud **22** and rear arc runner **31**, is operatively positioned to force the arc into arc chute **29** where the arc will be elongated and cooled by the spaced arc plates **29** which force the arc to travel a tortuous path from rear runner **31** to front arc runner **32**. An insulating means **33** usually in the form of a jump gap, is interposed between movable arcing contact **24** and rear runner **31** to extinguish the arc drawn between arcing contacts **23**, **24** by diverting the arc current through blowout coil **30**. The structure hereinbefore described may take any one of many forms well known to the circuit breaker art.

Arc chute **29** is paralleled by a series circuit, comprising a resistor **34** and a normally closed vacuum switch **35** connected between the front and rear arc runners **32** and **31** respectively. Vacuum switch **35** is of the type described in the U.S. Patent 2,740,867 to J. E. Jennings and comprises a pair of axially aligned contact studs **36**, **37**. Contact stud **37** is axially movable by means of an operative insulating connection, indicated by the dotted line **38** extending between switch **35** and bridge **27** as will hereinafter be fully explained.

When the arc current is transferred to blowout coil **30** the arc is forced into arc chute **29** and extends between rear runner **31** and movable arcing contact **24**. As the arc moves upward in chute **29** it transfers from movable arcing contact **24** to front runner **32**. With continued upward movement of the arc the series circuit **34**, **35** provides the lowest resistance path between the arc runners **31**, **32** so that the arc current is shunted to series circuit **34**, **35** and the arc is interrupted.

At this time the current is limited by the value of

resistor 34 which is preferably, though not necessarily, of a value which will limit the current to a value within the continuous current rating of vacuum switch 35. Continued clockwise movement of bridge 27 about pivot 28 then causes the operative connection 38 to bring about the opening of vacuum switch 35 thereby interrupting the current flowing through resistor 34 which is the current of the external circuit.

Continued clockwise movement of bridge 27 causes movable isolating contact 39 to separate from stationary isolating contact 40 which is mounted to the lower end of front arc runner 32. Movable isolating contact 39 is mounted to one end of conducting contact arm 41 which is pivotally mounted at 42 to bridge 27. The separation of isolating contacts 39, 40 effectively isolates the remaining portions of circuit breaker 20 from the external circuit. Thus, there is a sequential operation of cooperating contacts 23, 24, vacuum switch 35 and isolating contacts 39, 40 which is brought about by the mechanical connections between bridge 27, contact arm 41 and insulating connection 38 which will be fully explained in the following description.

Now referring more particularly to FIGURES 1–4, the structure found therein will be tied into the schematic of FIGURE 5 wherever possible by the utilization of common reference numbers between all of these figures. Movable contacts 24, 26 are secured to contact member 43 which is pivotally mounted at 44 to bridge 27. A biasing means (not shown) urges contact member 43 counterclockwise about pivot 44 so that upon a clockwise movement of bridge 27 from the position of FIGURE 1 to the position of FIGURE 2, main contacts 25, 26 will separate before arcing contacts 23, 24. Similarly, upon movement of bridge 27 in a counterclockwise direction, arcing contacts 23, 24 will be brought into engagement before main contacts 25, 26.

One end of insulating connection 38 is pivotally connected at 45 to bridge 27. An elongated slot 46 is formed in connection 38 near the other end thereof. Pin 47 positioned at the end of one arm of crank 48 is disposed within slot 46. Crank 48 is pivotally mounted to stationary pivot 49 and the other end of crank 48 is secured to one end of tension spring 50 whose other end is secured to stationary point 51 thereby biasing crank 48 clockwise about pivot 49. Thus, crank tip 52 is biased toward engagement with extension 53 which is secured to the free end of L-shaped yieldable member 54', secured at its other end to front arc runner 32 by means of fasteners 55, 56.

Vacuum switch 35 is mounted at its lower end to conducting bracket 57 by means of fasteners 58 while bracket 57 is secured to front arc runner 32 by means of fasteners 55, 56 and 59, 60. The upper end of vacuum switch 35 is secured to conducting bracket 61 by means of fasteners 62, 63 while bracket 61 is secured by fasteners 64 to the insulating shell 65 of arc chute 29. A U-shaped member 66 having inwardly turned ends is secured to bracket 57 below vacuum switch 35 by fastening means 58.

Movable contact stud 37 extends through bellows 67 to a point outside of evacuated envelope 68 and is operatively engaged by lock nuts 69, 70. Threaded stud 71, extending upwardly from extension 53, passes through opening 72 in the bottom of U-shaped member 66 and is received by lock nut 70. Coil spring 54 is interposed between lock nut 69 and a sleeve 69' projecting downward from bracket 57 with the lower end of stud 37 extending therethrough. Spring 50 biases crank tip 52 into engagement with extension 53 with a force sufficient to overcome the force of spring 54 thereby enabling contact stud 37 to engage contact stud 36.

When bridge 27 is moved from the position of FIGURE 1 to that of FIGURE 2, elongated slot 46 moves relative to pin 47 so as not to cause rotation of crank 48. However, continued clockwise movement of bridge 27 from the position of FIGURE 2 to that of FIGURE 3 causes the bottom surface 46*a* of slot 46 to engage pin 47 thereby rotating crank 48 counterclockwise about pivot 49. This permits spring 54 to move threaded stud 71 downward carrying contact stud 37 with it thereby opening vacuum switch 35. The separation between contact studs 36, 37 is limited by the engagement of lock nut 70 with U-shaped member 66.

Continued clockwise movement of bridge 27 between the positions of FIGURES 3 and 4 will bring about additional counterclockwise movement of crank 48. However, the engagement between lock nut 70 and U-shaped member 66 prevents further separation of movable contact stud 37 from stationary contact 36.

Extension 73 of contact arm 41 is connected by means of pin 74 to rod assembly 75 near one end thereof. The other end of rod assembly 75 is connected by means of pin 76 to an extending portion 77 of bridge 27. Rod assembly 75 comprises a stud member 78 which is in threaded engagement with elongated member 79. An elongated slot 80 in member 79 is provided to receive pin 76. Compression spring 81 bears against pin 76 and flange 82 of stud member 78 thereby biasing contact arm 41 counterclockwise about pivot 42.

Movement of bridge 27 between its positions of FIGURES 2 and 3 will permit an expansion of spring 81 causing a counterclockwise rotation of contact arm 41 about pivot 42 which maintains movable contact 39 in engagement with stationary isolating contact 40. As bridge 27 is pivoted clockwise about pivot 28 from position 3 to position 4 the bottom surface 80*a* of elongated slot 80 engages pin 76 thereby preventing further counterclockwise movement of contact arm 41. This enables isolating contacts 39, 40 to be disengaged. The setting of the distances between pins 74 and 76 determines the point in the opening stroke of bridge 27 when isolated contacts 39, 40 will separate.

It is to be understood that bridge 27 may be moved by any suitable circuit operating mechanism acting through link 83.

In FIGURE 6 there is illustrated a modification of the circuit breaker hereinbefore described. This modification comprises a connection of the series circuit 34, 35 between the front arc runner 32 and a mid-runner 84 which is positioned between the front 32 and rear 33 arc runners. A second current limiting resistor 85 is connected between mid-runner 84 and rear arc runner 31.

With this latter construction the separation of arcing contacts 23, 24 will first cause an arc to be drawn in the near portion of arc chute 29 between mid-runner 84 and rear arc runner 31. As this arc is elongated and deionized in the rear portion of chute 29 the arc current will be transferred to resistor 85 and the current through resistor 85 will appear as an arc in the front portion of chute 29 between mid-runner 84 and front runner 32.

When this arc has been driven sufficiently toward the top of chute 29, the current thereof will transfer to the series circuit of resistor 34 and vacuum switch 35. This current will be interrupted by the opening of vacuum switch 35 and thereafter contacts 39, 40 will separate to isolate the other portions of the circuit breaker.

Thus, we have provided a novel circuit breaker utilizing a multi-break principle having resistance means to limit the arc current and improve the power factor thereof prior to final interruption by a vacuum switch.

Although we have here described preferred embodiment of our novel invention, many variations and modifications will now be apparent to those skilled in the art, and we therefore prefer to be limited, not by the specific disclosure herein, but only by the appending claims.

We claim:

1. A circuit breaker comprising a bridge movable from a first to a second position and from a second to a third position, a pair of cooperating contacts one of which is stationary and the other of which is carried by said

bridge, a vacuum switch and an insulating connection extending from said bridge into operative engagement with said switch, an arc extinguishing means including an arc chute and a magnetic means operatively positioned to force an electric current arc formed by the parting of said contacts into said arc chute; said arc chute comprising a first runner, a second runner, and a plurality of spaced arc plates stacked between said runners; a series circuit, comprising a resistor and said switch, connected across at least a portion of said chute; said contacts being engaged and said switch being closed when said bridge is in said first position; said contacts being disengaged and said switch being closed when said bridge is in said second position; said contacts being disengaged and said switch being open when said bridge is in said third position.

2. A circuit breaker comprising a bridge movable from a first to a second position and from a second to a third position, a first pair of cooperating contacts one of which is stationary and the other of which is carried by said bridge, a vacuum switch and an insulating connection extending from said bridge into operative engagement with said switch, an arc extinguishing means including an arc chute and a magnetic means operatively positioned to force an electric current arc formed by the parting of said contacts into said arc chute; said arc chute comprising a first runner, a second runner, and a plurality of spaced arc plates stacked between said runners; said magnetic means being connected to said first runner; a series circuit, comprising a resistor and said switch, connected across at least a portion of said chute; said contacts being engaged and said switch being closed when said bridge is in said first position; said contacts being disengaged and said switch being closed when said bridge is in said second position; said contacts being disengaged and said switch being open when said bridge is in said third position; an arm mounted to said bridge; a second pair of cooperating contacts one of which is mounted to said second runner and the other of which is mounted to said arm; said bridge also being movable from said third position to a fourth position; said second pair of contacts being closed while said bridge is in said first, said second, and said third positions; said second pair of contacts being opened by the movement of said bridge from said third position to said fourth position.

3. A circuit breaker comprising a bridge movable from a first to a second position and from a second to a third position, a first pair of cooperating contacts one of which is stationary and the other of which is carried by said bridge, a vacuum switch and an insulating connection extending from said bridge into operative engagement with said switch, an arc extinguishing means including an arc chute and a magnetic means operatively positioned to force an electric current arc formed by the parting of said contacts into said arc chute; said arc chute comprising a first runner, a second runner, and a plurality of spaced arc plates stacked between said runners; said magnetic means being connected to said first runner; a series circuit, comprising a resistor and said switch, connected across a portion of said chute; said contacts being engaged and said switch being closed when said bridge is in said first position; said contacts being disengaged and said switch being closed when said bridge is in said second position; said contacts being disengaged and said switch being open when said bridge is in said third position; said arc chute portion extending to said second runner; and a resistance means shunting the remaining portion of said arc chute.

4. A circuit breaker comprising a bridge movable from a first to a second position and from a second to a third position, a first pair of cooperating contacts one of which is stationary and the other of which is carried by said

bridge, a vacuum switch and an insulating connection extending from said bridge into operative engagement with said switch, an arc extinguishing means including an arc chute and a magnetic means operatively positioned to force an electric current arc formed by the parting of said contacts into said arc chute; said arc chute comprising a first runner, a second runner, and a plurality of spaced arc plates stacked between said runners; said magnetic means being connected to said first runner; a series circuit, comprising a resistor and said switch, connected across a portion of said chute; said contacts being engaged and said switch being closed when said bridge is in said first position; said contacts being disengaged and said switch being closed when said bridge is in said second position; said contacts being disengaged and said switch being open when said bridge is in said third position; said arc chute portion extending to said second runner; and a resistance means shunting the remaining portion of said arc chute; an arm mounted to said bridge; a second pair of cooperating contacts one of which is mounted to said second runner and the other of which is mounted to said arm; said bridge also being movable from said third position to a fourth position; said second pair of contacts being closed while said bridge is in said first, said second, and said third postions; said second pair of contacts being opened by the movement of said bridge from said third position to said fourth position.

5. In a magnetic circuit breaker; said magnetic circuit breaker comprising a stationary contact, a movable contact movable between an engaged and disengaged position with respect to said stationary contact, a blowout coil, a jump gap, a disconnect switch having first and second relatively movable contacts and an arc chute; said arc chute extending between a first arc runner and a second arc runner; said magnetic circuit breaker having a first and second terminal; said first terminal being connected to a first end of said blowout coil and said stationary contact; the opposite end of said blowout coil being connected to said first arc runner; said jump gap being interposed between said stationary contact and said first arc runner; said second arc runner being connected to said first contact of said disconnect switch; said second disconnect contact being connected to said second terminal of said circuit breaker; a shunt circuit comprising a resistor connected in series with a vacuum switch; one end of said shunt circuit being directly connected to said first arc runner; the opposite end of said shunt circuit being directly connected to said second arc runner; and coordinating means; said coordinating means being connected to said circuit breaker movable contact, said disconnect switch, and said vacuum switch; said coordinating means being operable for causing a predetermined sequential operation whereby said movable contact first moves toward its said disengaged position, said vacuum switch thereafter operates to an open circuit condition, and said disconnect switch thereafter opens.

References Cited in the file of this patent

UNITED STATES PATENTS

1,783,279	Burham	Dec. 2, 1930
2,345,724	Baker et al.	Apr. 4, 1944
2,480,622	Warnock	Aug. 30, 1949
2,748,226	MacNeill et al.	May 29, 1956
2,815,418	Latour	Dec. 3, 1957

FOREIGN PATENTS

344,867	Great Britain	Mar. 10, 1931
547,270	Germany	Mar. 22, 1932
392,898	Great Britain	1933
579,464	Germany	June 27, 1933