Dec. 25, 1945. C. H. FLURSCHEIM 2,391,826

FLUID BLAST CIRCUIT BREAKER

Filed July 22, 1943

Fig. 1.

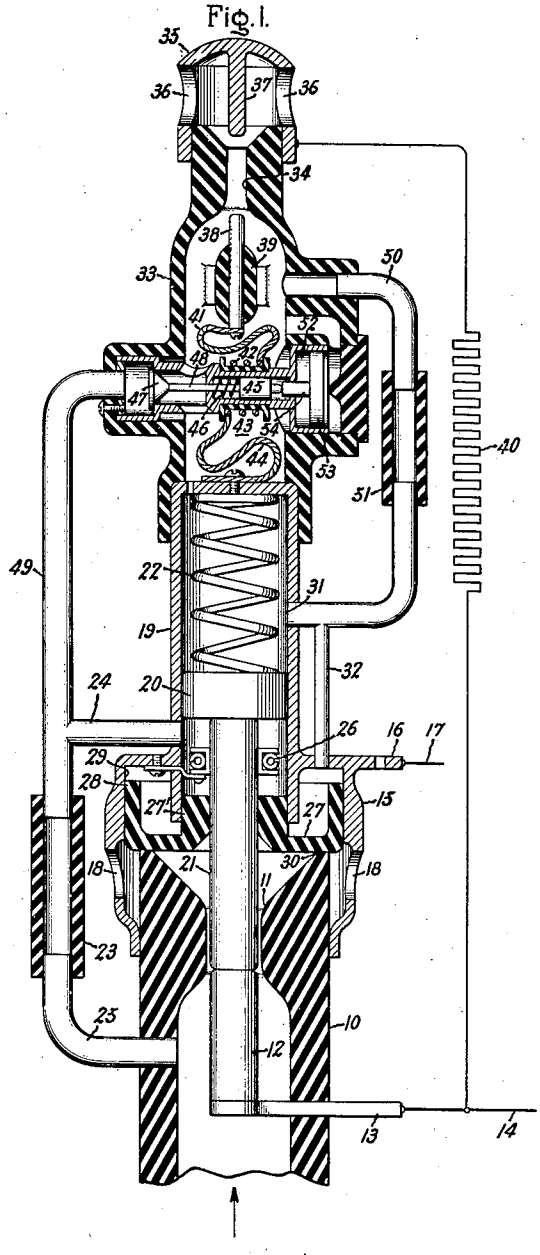


Fig. 2.

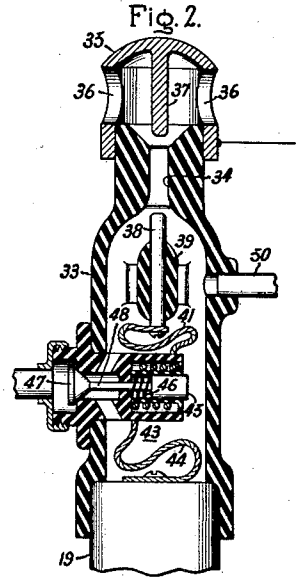
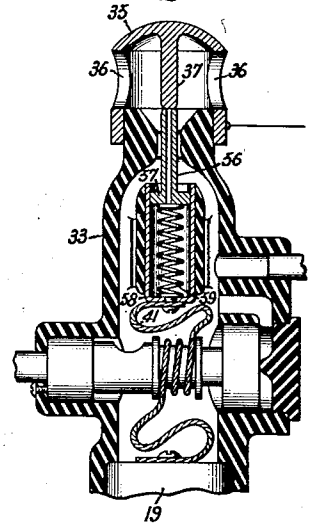


Fig. 3.



Inventor:
Cedric H. Flurscheim,
by Harry E. Dunham
His Attorney.

Patented Dec. 25, 1945 2,391,826

UNITED STATES PATENT OFFICE

2,391,826

FLUID BLAST CIRCUIT BREAKER

Cedric H. Flurscheim, Bowdon, England, assignor to Metropolitan-Vickers Electrical Company Limited, London W. C. 2, England, a company of Great Britain

Application July 22, 1943, Serial No. 495,745
In Great Britain July 30, 1942

8 Claims. (Cl. 200—148)

My invention relates to fluid blast electric circuit breakers or switches of the kind in which the circuit is adapted to be opened by the separation of contacts within an arcing chamber to which fluid, such as air or gas under pressure, is supplied during the opening operation. More specifically, my invention is an improvement on the arrangement disclosed and claimed in my copending application, Serial No. 495,746, filed concurrently with this application, now Patent 2,367,934, granted January 23, 1945.

In high voltage circuit breakers or switches a circuit including a resistance has been connected in parallel with the circuit through the main contacts of the circuit breaker during the circuit opening operation so that the current is transferred to the circuit including the resistance, after which the current through said resistance is interrupted thereby finally interrupting the current through the circuit breaker. Such an arrangement is disclosed and claimed in U. S. Reissue Patent No. 22,298, granted April 6, 1943. By using such a parallel resistance path in connection with fluid blast circuit breakers of high interrupting capacity an economical design is obtained since the parallel resistance path operates to reduce the severity of the transient voltage appearing across the circuit breaker main contacts subsequent to the extinction of the arc drawn across said contacts. As is well known, this transient voltage tends to cause restriking of the arc after it has once been extinguished.

Various means have been proposed for connecting a shunt resistance across the arc extinguishing contacts. In the copending application referred to above there is disclosed an arc gap connected in series with the resistance with this series arrangement connected in parallel to the main contacts of the circuit breaker. Upon interruption of the arc drawn across the main contacts the arc gap in the parallel circuit breaks down and the current which may flow through this parallel circuit is of course limited by the high resistance included in this circuit. The circuit across said arc gap may readily be extinguished by a blast of fluid such as air or other suitable gas. It is very essential that the arc strike across said arc gap rather than restrike across the main contacts and it is therefore important that no blast of fluid at said arc gap occurs until after the arc has actually formed thereacross, indicating that the arc has been extinguished across said main contacts. I have found that interruption of the current through the parallel resistance circuit should follow interruption of the arc between the main contacts at an interval of about a quarter of a cycle. Accordingly, it is desirable that there be a time delay in the operation of the means for interrupting the current through the resistance circuit so that arc resistance is not introduced into this circuit until after the interruption of the current in the main contacts. In my copending application I have shown an arrangement in which a blast of fluid is supplied to the arc gap connected in the parallel circuit including the resistance after the main contacts have separated a predetermined amount or in other words after a slight delay. Under very high current conditions, however, this slight delay may be objectionable since the current may have transferred to the parallel circuit including said resistance before the main contacts are separated the predetermined amount when the blast of fluid adjacent the arc gap in the parallel circuit is permitted to flow. In such a case it is desirable that a fluid blast be provided very promptly after an arc has formed across the gap in the resistance circuit to extinguish the same as soon as possible.

Accordingly, it is an object of my invention to provide means for controlling the arc occurring in the auxiliary circuit including the resistance connected across the main contacts of the fluid blast circuit breaker in response to the current flowing through said arc.

It is another object of my invention to provide a fluid blast circuit breaker having an auxiliary circuit including a resistance connected across the main contacts of the circuit breaker with means controlled by the current flowing through said auxiliary circuit for controlling the interruption of the current flowing in this auxiliary circuit.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the accompanying drawing, in which Fig. 1 is an elevational sectional view of a fluid blast circuit breaker embodying the present invention, and Figs. 2 and 3 are similar views of a portion of Fig. 1 to illustrate modifications of my invention.

Referring now to Fig. 1 of the drawing, I have illustrated an electric circuit interrupting device comprising a main arcing chamber 10 formed of a cylindrical insulating member having integrally

formed at the upper end thereof a nozzle 11. Mounted within the arcing chamber 10 is a stationary contact 12 with the contacting portion thereof extending adjacent the lower end of nozzle 11. Stationary contact 12 is connected to a suitable line terminal 13 which in turn is connected to a power line, or the like, 14, the circuit of which is to be controlled by the circuit breaker described hereinafter. Suitably supported from the upper end of arcing chamber 10 is a hood 15 provided with a line terminal 16 to which the line 17, which together with line 14 forms the power circuit to be controlled, is connected. The hood 15 is provided with lateral openings 18 through which air or gas from the gas blast may escape to atmosphere after passing through nozzle 11. The upper portion of hood 15 terminates in a cylinder 19 in which is reciprocally mounted a piston 20 connected to a movable rod contact 21 adapted to extend through nozzle 11 and engage with stationary contact 12. A spring 22 in cylinder 19 normally biases contact 21 into engagement with contact 12. Arcing chamber 10 is connected, by means of a suitable conduit including a portion 23 of insulating material and portions 24 and 25, with cylinder 19 below piston 20 so that when fluid under pressure such as air or any other suitable gas enters arcing chamber 10 from a source not shown, as indicated by the arrow in Fig. 1, this fluid causes piston 20 to move upwardly to separate relatively movable contacts 12 and 21 to draw an arc therebetween. At the same time a blast of fluid passes through nozzle 11 and to atmosphere through lateral openings 18 to cause rapid extinguishment of the arc drawn. Movable contact 21 is electrically connected to cylinder 22 by means of any suitable sliding contact such as 26.

In my copending application referred to above, I have provided valve means for controlling the flow of gas on the discharge side of the nozzle 11 so as to surround the contacts by a good dielectric such as air under high pressure thereby decreasing the tendency of the arc to restrike. In Fig. 1, I have shown a similar arrangement in which a valve means 27 is provided having an upwardly extending piston portion 27' of relatively small cross section reciprocatingly mounted in cylinder 19. Valve means 27 is also provided with an upturned flange 28 of large diameter constructed so as to form a piston which is reciprocatingly mounted in a large cylinder 29 formed in hood 15. The valve means 27 is adapted to seat on a circumferential lip 30 formed on the upper end of arcing chamber 10 above nozzle 11. Valve means 27 is biased upwardly in response to the fluid pressure existing on the discharge side of nozzle 11 and is biased downwardly by the fluid pressure in arcing chamber 10 which acts on the piston portion 27' thereof in cylinder 19 by virtue of conduit portions 23, 24 and 25.

In order that valve means 27 may close completely after a predetermined separation of relatively movable contacts 21 to maintain a high pressure air dielectric around the separated contacts, I connect a predetermined point of cylinder 19, such as the opening 31 in cylinder 19 with cylinder 29 in hood 15 by means of a conduit 32. With this arrangement, as soon as contacts 12 and 21 have separated sufficiently so that piston 20 moves above the point of opening 31 in cylinder 19, fluid under pressure from arcing chamber 10 is permitted to enter cylinder 29 thereby forcing down valve means 27 to engage circumferential lip 30. With this arrangement, the pressure maintained on the outlet side of nozzle 11 bears a predetermined relationship to the pressure below the nozzle 11, and when the contacts have separated a predetermined amount the flow of fluid through nozzle 11 is stopped completely and the high pressure fluid is permitted to surround the separated contacts so as to provide a good insulating dielectric surrounding these contacts.

In order to provide the arcing means of the auxiliary circuit connected in parallel with main contacts 12 and 21, I have provided a second or auxiliary arcing chamber 33 which is supported on the upper end of cylinder 19. Arcing chamber 33 terminates in a nozzle 34 and the upper end of arcing chamber 33 is closed by a hood 35 which includes lateral openings 36 therein through which fluid from arcing chamber 33 may escape to atmosphere. Depending from the center of hood 35 and extending closely adjacent to the upper end of nozzle 34 is a stationary electrode 37. Another cooperating electrode 38 comprising a stationary rod-like member is disposed vertically and axially within auxiliary arcing chamber 33 being suitably supported therein as indicated at 39. This electrode extends upwardly toward electrode 37 so that the upper end thereof is closely adjacent the nozzle 34. The space between electrodes 37 and 38 forms the auxiliary arc gap which is serially arranged in a circuit including high resistance 40. One terminal of high resistance 40 is electrically connected with line terminal 13 while the other end thereof is connected with hood 35 and consequently with one side of the arc gap between electrodes 37 and 38. The other side of the arc gap is electrically connected through conductor 41, the winding 42 of a solenoid generally indicated at 43, and conductor 44, with cylinder 19 and consequently with line terminal 16 so that the auxiliary circuit including resistance 40 is connected in parallel with main contacts 12 and 21.

The solenoid 43 includes a plunger 45 which is biased to the position indicated in Fig. 1 by means of a spring 46. Plunger 45 is connected to a valve member 47 by means of a suitable valve stem 48. Valve member 47 is adapted to control the flow of fluid from arcing chamber 10 through conduits 25, 23 and 49 into auxiliary arcing chamber 33. Sufficient energization of winding 42 of solenoid 43 will cause solenoid plunger 45 to move to the left with the consequent movement of valve member 47 to permit fluid from arcing chamber 10 to enter auxiliary arcing chamber 33. Arcing chamber 33, as disclosed in my copending application referred to above, is also connected to a predetermined point in cylinder 19 such as opening 31 by means of a conduit 50 including an insulating portion 51 so as to supply fluid under pressure to arcing chamber 33 with a predetermined time delay after the main contacts have been fully separated, such time delay being determined either by the length of the conduit 50 and the corresponding time taken for the pressure wave to travel from cylinder 19 to arcing chamber 33, or by means of a suitable constriction (not shown) which may be provided in conduit 50.

In order that valve member 47 may be maintained in the open position once it has been opened until the pressure in arcing chamber 10 is substantially reduced as by closing the valve (not shown) between the source of fluid under pressure and arcing chamber 10, I provide within auxiliary arcing chamber 33 a cylinder 52 within which is mounted a piston 53 having a piston rod

54 adapted to engage valve stem 48 which extends through armature 45 of solenoid 43. Whenever fluid under sufficient pressure exists in auxiliary arcing chamber 33 piston 53 is moved to the left so as to hold open valve member 47.

The circuit interrupting operation of the arrangement described above is initiated by opening the main control valve (not shown) to permit fluid, such as air or other gas under pressure, to enter main arcing chamber 10 whereupon fluid under pressure will cause piston 20 to move upwardly separating contacts 12 and 21. A blast of fluid through nozzle 11 will extinguish the arc drawn and due to the relatively short gap between electrodes 37 and 38 and the low air pressure still there an arc will be produced across electrodes 37 and 38 by virtue of the high transient voltage, thereby causing current to flow through high resistance 40. If the current to be interrupted by the circuit breaker is relatively small, the current through the winding 42 of solenoid 43 will be insufficient to open valve 47. However, after a predetermined time delay fluid under pressure will enter auxiliary arcing chamber 33 through conduit 50 and a blast of fluid will be produced through nozzle 34 to interrupt the current flowing through resistance 40. This can be accomplished without much difficulty since by virtue of resistance 40 the current flowing through resistance 40 to be interrupted is much smaller than the current that was interrupted upon separation of contacts 12 and 21. Under higher current conditions, however, it is desired to have a blast of fluid through nozzle 34 as soon as an arc is produced between electrodes 37 and 38 which indicates that the arc has been extinguished between main contacts 12 and 21. This is accomplished with my invention by means of solenoid 43 which opens valve 47 as soon as current flows through resistance 40 under high short circuit conditions and consequently the time delay referred to above is eliminated. This time delay, of course, is provided only to be sure that no fluid under pressure is permitted in auxiliary arcing chamber 33 until current flows in resistance 40.

It should be understood that instead of providing a separate piston such as 53 in Fig. 1, the solenoid plunger 45 might be exposed to the fluid under pressure so as to, in effect, provide a piston for opening valve member 47. Such an arrangement is disclosed in Fig. 2 in which the corresponding parts thereof are designated by the same reference numerals as in Fig. 1. Cylinder 52 and piston 53 have been eliminated and one end of solenoid armature 45 is exposed to the pressure within arcing chamber 33 so that when valve 47 is opened the air pressure acts on solenoid armature 45 to maintain valve 47 open as long as pressure is maintained within arcing chamber 33 even though the circuit has been interrupted through resistance 40.

Although in Figs. 1 and 2 I have disclosed the electrodes 37 and 38 as fixedly mounted so as to provide a permanent arc gap, it should be understood that electrodes 37 and 38 might be arranged as relatively movable contacts which are normally in engagement and which are separated to draw an arc after the main contacts 12 and 21 have been separated. Such an arrangement is disclosed in Fig. 3 wherein the corresponding parts thereof are designated by the same reference numerals as in Fig. 1. In Fig. 3 the electrode 38 is replaced by a movable contact 56 connected to a piston 57 reciprocally mounted in a cylinder 58 fixedly supported in auxiliary arcing chamber 33 in the same manner as was electrode 38 in Fig. 1. Piston 57 is biased upwardly by spring means 59 so that contact 56 is moved into engagement with electrode 37. Cylinder 58 is electrically connected with conductor 41. With this arrangement contact 56 is moved downwardly as soon as fluid under pressure enters auxiliary arcing chamber 33 to draw an arc between electrode 37 and contact 56, and thereafter the arrangement operates in exactly the same manner as the circuit disclosed in Fig. 1.

While I have illustrated specific embodiments of my invention it should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit and scope of my invention.

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

1. A fluid blast circuit breaker for high voltage power circuits comprising relatively movable contacts separable to form an arc gap therebetween, means for directing an interrupting blast of fluid adjacent said arc gap for extinguishment of an arc drawn between said contacts, a circuit including a resistance arranged to be connected in shunt with said arc gap, means for providing an auxiliary arc gap connected in said circuit including said resistance, and means for supplying and controlling a blast of fluid adjacent said auxiliary arc gap in response to the current flowing in said circuit including said resistance.

2. A fluid blast circuit breaker for high voltage power circuits comprising relatively movable contacts separable to form an arc gap therebetween, means for directing an interrupting blast of fluid adjacent said arc gap for extinguishment of an arc drawn between said contacts, a circuit including a resistance arranged to be connected in shunt with said arc gap, means for providing an auxiliary arc gap serially arranged with the resistance in said circuit, means including a valve for producing a blast of fluid adjacent said auxiliary arc gap to interrupt the current flowing through said circuit including said resistance, and means responsive to the current flowing through said resistance for controlling said valve.

3. A fluid blast circuit breaker for high voltage power circuits comprising relatively movable contacts separable to form an arc gap therebetween, means for directing an interrupting blast of fluid adjacent said arc gap for extinguishing the arc drawn between said contacts, a circuit including a resistance arranged to be connected in shunt with said arc gap, means for providing an auxiliary arc gap serially arranged in said circuit with said resistance, means including a valve for producing a blast of fluid adjacent said auxiliary arc gap to interrupt the current flowing through said circuit including said resistance, and means including a solenoid operatively connected to said valve and responsive to the current flowing through said resistance for controlling the opening of said valve so that a blast of fluid is provided adjacent said auxiliary gap only after the arc is extinguished across said arc gap between said relatively movable contacts and an arc is established across said auxiliary gap.

4. A fluid blast circuit breaker for high voltage power circuits comprising relatively movable contacts separable to form an arc gap therebetween, means for directing an interrupting blast of fluid adjacent said arc gap for extinguishing the arc

drawn between said contacts, a circuit including a resistance arranged to be connected in shunt with said arc gap, means for providing an auxiliary arc gap serially arranged in said circuit with said resistance and arranged so that the high transient voltage following extinguishment of the arc drawn between said relatively movable contacts will produce an arc across said auxiliary gap and cause current to flow through said resistance, means including a valve for producing a blast of fluid adjacent said auxiliary arc gap to interrupt the current flowing through said circuit including said resistance, and means including a solenoid operatively connected to said valve and responsive to the current flowing through said resistance for controlling the opening of said valve so that a blast of fluid is provided adjacent said auxiliary gap only after an arc is established across said auxiliary gap indicating that the arc across said arc gap between said relatively movable contacts is extinguished.

5. A fluid blast circuit breaker for high voltage power circuits comprising relatively movable contacts separable to form an arc gap therebetween, means for directing an interrupting blast of fluid adjacent said arc gap for extinguishing the arc drawn between said contacts, a circuit including a resistance arranged to be connected in shunt with said arc gap, means for providing an auxiliary arc gap serially arranged in said circuit with said resistance and arranged so that the high transient voltage following extinguishment of the arc drawn between said relatively movable contacts will break down said auxiliary gap and cause current to flow through said resistance, means including a valve for producing a blast of fluid adjacent said auxiliary arc gap to interrupt the current flowing through said circuit including said resistance, means including a solenoid operatively connected to said valve and responsive to the current flowing through said resistance for controlling the opening of said valve so that a blast of fluid is provided adjacent said auxiliary gap only after an arc is established across said auxiliary gap indicating that the arc across said arc gap between said relatively movable contacts is extinguished, and fluid operated means for holding said valve in the open position.

6. A fluid blast circuit breaker for high voltage power circuits comprising relatively movable contacts separable to form an arc gap therebetween, means for directing an interrupting blast of fluid adjacent said arc gap for extinguishing the arc drawn between said contacts, a circuit including a resistance arranged to be connected in shunt with said arc gap, means including relatively separable electrodes adapted to provide an auxiliary arc gap serially connected in said circuit with said resistance and arranged so that the high transient voltage following extinguishment of the arc drawn between said relatively movable contacts will produce an arc across said auxiliary gap and cause current to flow through said resistance, means including a valve for producing a blast of fluid adjacent said auxiliary arc gap to interrupt the current flowing through said circuit including said resistance, and means including a solenoid operatively connected to said valve and responsive to the current flowing through said resistance for controlling the opening of said valve so that a blast of fluid is provided adjacent said auxiliary gap only after an arc is established across said auxiliary gap indicating that the arc across said arc gap between said relatively movable contacts is extinguished.

7. A fluid blast circuit breaker for high voltage power circuits comprising relatively movable contacts separable to form an arc gap therebetween, means for directing an interrupting blast of fluid adjacent said arc gap for extinguishing the arc drawn between said contacts, a circuit including a resistance arranged to be connected in shunt with said arc gap, means adapted to provide an auxiliary arc gap serially connected in said circuit with said resistance and arranged so that the high transient voltage following extinguishment of the arc drawn between said relatively movable contacts will produce an arc across said auxiliary gap and cause current to flow through said resistance to interrupt the current flowing through said circuit including said resistance, means operative upon a predetermined separation of said contacts for producing a blast of fluid adjacent said auxiliary arc gap under all operating conditions, and means including a solenoid operated valve responsive to the current flowing through said resistance for producing a blast of fluid adjacent said auxiliary gap under high current conditions, said fluid blasts adjacent said auxiliary arc gap being produced after the arc across said arc gap between said relatively movable contacts is extinguished.

8. A fluid blast circuit breaker for high voltage power circuit comprising a first set of relatively movable contacts separable to form an arc gap therebetween, means for directing an interrupting blast of fluid adjacent said arc gap for extinguishing the arc drawn between said contacts, a circuit including a resistance arranged to be connected in shunt with said arc gap, a second set of relatively movable contacts adapted to provide an auxiliary arc gap serially connected in said circuit with said resistance and arranged so that when the arc drawn between said first set of relatively movable contacts is extinguished the current will be transferred to said resistance, means operative upon a predetermined separation of said first set of contacts for producing a blast of fluid adjacent said second set of contacts to cause separation thereof to provide said auxiliary arc gap, and means including a solenoid operated valve responsive to the current flowing through said resistance for producing a blast of fluid adjacent said auxiliary arc gap under high current conditions, said fluid blasts adjacent said auxiliary arc gap being produced after the arc across said arc gap between said first set of relatively movable contacts is extinguished.

CEDRIC H. FLURSCHEIM.