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ELECTRIC CIRCUIT BREAKER

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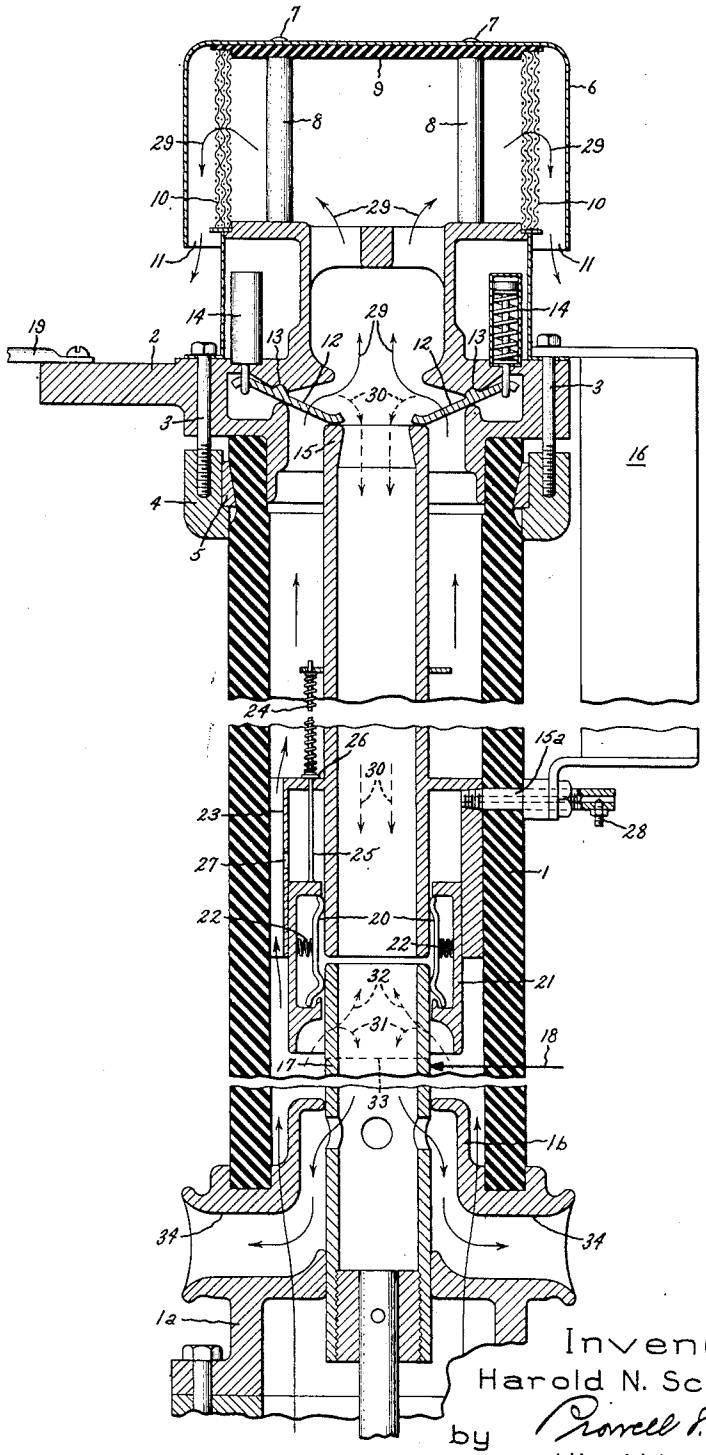

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ELECTRIC CIRCUIT BREAKER

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8 Claims. (Cl. 200—148)

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This invention relates to electric circuit breakers and more particularly to circuit breakers of the fluid-blast type wherein current-interrupting contacts are arranged in series relation to circuit-isolating contacts which are opened subsequent to the opening of the interrupting contacts. In circuit breakers of this type, a resistor is frequently connected in parallel with the interrupting contacts so that the resistor current which flows after opening of the interrupting contacts must be interrupted by the isolating contacts.

Application Serial No. 201,961, of Albert Roxburgh et al., filed December 21, 1950, and application Serial No. 202,100, of John W. Beatty, filed December 21, 1950, which are assigned to the assignee of this invention, both disclose and claim interrupters wherein interrupting contacts are connected in series with isolating contacts and wherein a resistor is connected in parallel with the interrupting contacts. Both the Roxburgh et al. and the Beatty applications are of the air-blast type. Furthermore, both these applications disclose arrangements wherein three exhaust passages are provided for the removal of pressure gas supplied to the interrupter.

A principal object of this invention is to provide an improved fluid blast circuit breaker which is simple, compact and rugged in construction.

Another object of this invention is the provision of an improved gas blast circuit breaker which is arranged with a minimum of exhaust passages for the discharge of gas to atmosphere so as to obtain optimum use of the pressure gas without causing wastage thereof.

Still another object of this invention is to provide a gas blast circuit breaker wherein a blast of gas supplied to the breaker may readily exhaust to atmosphere during a circuit-interrupting operation through a plurality of exhaust passages, and through at least one less exhaust passage after interruption of the circuit, thereby to enhance the conservation of pressure gas.

A further object of this invention is the provision of a gas blast circuit breaker wherein all parts are arranged in line and with all the contact members contained within a single compact enclosing structure.

The invention in one form as applied to a gas blast circuit breaker comprises an enclosing structure in which is disposed a tubular conducting member having an interrupting contact normally in engagement with one end thereof and having a tubular isolating contact disposed in substantially coaxial relation thereto at the other

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end thereof. Bridging contact means may be arranged normally to interconnect the conducting member electrically and also pneumatically with the tubular isolating contact so that these parts form an exhaust path for pressure gas supplied to the end of the conducting member remote from the isolating contact during the operation of the interrupting contact. In addition, fluid pressure responsive means may be used to cause the bridging contact means to operate after operation of the interrupting contact means so as to isolate the circuit and to prevent the exhaust of fluid through the tubular conducting member thereby to conserve the supply of pressure gas.

The invention both as to its organization and method of operation will be better understood from the following description taken in connection with the accompanying drawing in which the single figure thereof is a cross-sectional view showing a circuit breaker embodying the principles of the invention.

In the drawing, the numeral 1 represents a tubular insulating casing forming a portion of the enclosing structure for the circuit breaker. The tubular member 1 is mounted on suitable base structure 1*a* comparable to that shown and described in the above-mentioned Beatty application Serial No. 202,100. The base structure 1*a* is provided with a chamber 1*b* which permits upward incoming blasts of gas outside the chamber 1*b* and which forms a downward exhaust path inside the chamber, both being indicated by arrows in the drawing. Secured to the upper end of tubular enclosing structure 1 is a metallic support member 2. Member 2 is affixed to tubular insulating member 1 by means of bolts 3 which engage clamping ring 4 which in turn forces the wedge-shaped segments 5 into gripping relation with the upper end of insulating enclosing tubular member 1. Mounted on the support member 2 is a closure cap member 6 which is secured to member 2 by bolts 7 which extend through sleeves 8. Secured to the top surface of the cover 6 is an insulating plate 9 and mounted within the member 6 is a foraminated wall 10 which acts in known maner to cool the products of an interrupting operation before the exhaust thereof in the direction of the arrows to atmosphere through the passage generally designated by the numeral 11.

Disposed within the support structure 2 are a plurality of finger contacts 12 which are fulcrumed at 13 to the base member 2 and which are biased by means of compressional springs 14 toward engagement with the upper end of a fixed

tubular conducting member 15 which is mounted within the insulating enclosing structure 1 by means of devices such as are indicated at 15a. A more detailed disclosure of the particular arrangement of the petal-type contacts 12 and parts associated therewith is set forth in application Serial No. 233,637, of John W. Beatty, filed June 26, 1951. The contacts 12 are moved out of engagement with the fixed tubular conducting member 15 by means of a blast of gas, such as air under pressure, which is supplied to the base structure 1a by any suitable valve means such as is disclosed in application Serial No. 233,542, of Ronald B. Shores, filed June 26, 1951, and assigned to the assignee of this application.

Connected between the support structure 2 and the member 15a, which is in electrical contact with the fixed tubular conducting member 15, is a shunt resistor 16. Thus it will be seen that once the finger contacts 12 are separated from the fixed conducting member 15, a portion of the current through the circuit breaker flows through the resistor 16. After interruption of the arc, the current through the resistor must be interrupted by other means. As in the above-mentioned Roxburgh et al. application, this resistor current is interrupted by means of a so-called isolating contact.

In the drawing, a suitable isolating contact is indicated by the numeral 17. Disposed for cooperation with the isolating contact 17 is a sliding contact or other suitable connecting means such as indicated schematically at 18 while a terminal 19 is provided on the support structure 2. Electrical contact between isolating contact 17 and structure 15 is normally maintained by the bridging contacts 20. Thus the circuit through the interrupter comprises the terminal 19, member 2, finger contacts 12, fixed tubular conducting member 15, the bridging contacts 20 and the isolating contact 17 and the terminal 18. The current through resistor 16 is interrupted by the action of the isolating contact 17 separating from the bridging contacts 20 after the interruption of the arc drawn by the contacts 12. To this end the contacts 20 are disposed within a cradle-like piston member 21 and are biased toward engagement with the conducting member 15 and the isolating contact 17 by individual compressional springs 22. The cradle-like piston member 21 is operable within the cylindrical structure 23 and suitable bias for the piston 21 is provided in the form of a plurality of compressional springs 24 which are disposed about a plurality of guide rods 25 and which effectively bias the piston member 21 downwardly, the springs 24 being in engagement at their lower ends with a projecting shoulder 26 secured to the guide rods 25.

In order to control the upward movement of the piston member 21 and parts associated therewith in such a way as to insure the separation of bridging contacts 20 from isolating contact 17 after interruption of the arc by the interrupting contacts 12, a suitable port 27 is provided in the cylinder wall 23 and a needle valve 28 is provided in the terminal member 15a. Thus when a blast of pressure fluid is supplied to the space between the insulating sleeve 1 and the isolating contact 17, the upward movement of piston member 21 is delayed sufficiently so that contacts 20 separate from isolating contact 17 after separation of interrupting contacts 12 from the tubular conducting member 15. The effect of port 27 is to precharge with pressure fluid the space above the piston 21, which fluid opposes the immediate formation of the isolating gap while the operation of needle valve 28 is such as to regulate the exhaust of pressure fluid from the space above piston 21 at a controlled rate for determining the time delay between interrupting and isolating. After, or coincident with, interruption of the resistor current by means of the contacts 20, the isolating contact 17 is moved downwardly. The particular apparatus for causing downward movement of contact is not shown in the drawing since such apparatus forms no part of the present invention. Suitable apparatus for this purpose is disclosed in the above-mentioned application of Ronald B. Shores.

In view of the above description, it will be understood that, when pressure gas is supplied to the lower portion of tubular insulating member 1 in the space between that insulator and the isolating contact 17, such pressure gas flows upwardly first to separate the interrupting contacts 12 from the fixed tubular contact 15 before the isolating contact 17 is drawn downwardly. Such pressure gas is exhausted upwardly through the cover member 6 and the opening 11 in the direction of the arrows 29 and also flows downwardly through the tubular conducting member 15 in the direction of the dotted-line arrows 30. The downwardly flowing exhaust gas in tubular conducting member 15 flows on through the space between the conducting member 15 and the isolating contact 17, thereafter through the isolating contact 17 and to atmosphere through the ports 34 in base member 1a. Thus during this interrupting process, the pressure fluid flows both upwardly and downwardly from the region surrounding the interrupting contacts 12. After the cradle-like piston 21 is moved upwardly so as to separate the contacts 20 from the isolating contacts 17, the pressure from the source can flow into the space between the lower end of conducting member 15 and the upper end of isolating contact 17 so as to oppose the flow of fluid downwardly through the conducting member 15 from the interrupting contacts 12.

Accordingly, this new influx of blast pressure through the insolating gap will oppose or neutralize the downward exhaust flow through the fixed tube 15 from the main contact arc gap. More specifically, the downward exhaust flow represented by arrows 30 will be effectively opposed by the upward component of the isolating gap blast indicated by arrows 32 while the downward component of the gap blast represented by the arrows 31 follows the original exhaust path to atmosphere through the presently downwardly moving isolating tubular contact 17, which, in the next instant, may be assumed to be passing through a point in its opening movement represented by the dotted transient position 33.

Thus it will be seen from the above description that by the invention a substantial blast of gas is supplied to the interrupting contacts 12 during the interrupting operation due to the fact that two exhaust paths are provided; i. e., upwardly in the direction of the solid line arrows 29 and downwardly in the direction of the dotted line arrows 30. After the main arc is extinguished, the blast to the interrupting contacts 12 need no longer be high in magnitude. Thus this blast is reduced due to the fact that incoming pressure gas indicated by the arrows 32 flows through the space between the isolating contact 17 and the fixed conducting member 15 to encounter the fluid tending to flow downwardly

in conducting member 15 in the direction of the dotted line arrows 30. Thus the pressure across the ends of the fixed conducting member 15 becomes substantially equalized to render ineffective one exhaust path and to reduce the total blast to the interrupting contacts. In this way, a substantial amount of pressure gas is conserved.

It will also be understood that by the invention, a compact and rugged arrangement is possible and that all the parts may be mounted in line in a single columnar structure which occupies a minimum of space.

Although the chosen embodiment described herein has featured a "retracting" isolating contact with pneumatic timing as constituted by the piston-carried contacts 20; it will be understood that the movable isolating contact could abut, or telescope with, or engage tulip-type contacts mounted upon, the lower end of the fixed tubular conducting member 15. In such a case, the opening instant of the isolating gap would be accomplished by mechanically timing the downward opening movement of the moving tubular contact 17.

From the above detailed explanation it will be appreciated that the invention essentially provides a continuous substantially open-ended, tubular, current-carrying structure which is made disjointable at two spaced points along its length to constitute a pair of series breaks. By enclosing these breaks in a common pressure-confining casing, and by arranging for the sequential opening of the breaks, the gas blast introduced to the casing produces a double-exhaust arc-extinguishing blast at the break toward one end of the structure which, coincident with the opening of the other break, becomes limited to a single-exhaust scavenging blast.

While I have shown and described a particular embodiment of the invention, I do not wish to be limited thereto and intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. An electric circuit breaker of the fluid-blast type comprising an enclosing structure, a plurality of hollow tubular conducting elements normally arranged in series conducting relation with each other and defining a continuous hollow passage the extremities of which form fluid exhaust passages, said elements being relatively movable during a circuit-opening operation so as to establish two gaps in sequence, said enclosing structure being arranged with respect to said conducting elements so as to enclose said gaps, and means for supplying a blast of fluid pressure to said structure, said fluid being exhausted in both directions through said hollow passage from the first of said gaps to be established during a circuit-opening operation prior to the establishment of the second of said gaps, fluid pressure supplied to said second gap being in opposition to the flow of fluid through said hollow passage from the first of said gaps to be formed to the second of said gaps to be formed.

2. An electric circuit breaker of the fluid-blast type comprising an enclosing structure, a plurality of hollow tubular conducting elements normally arranged in series conducting relation with each other and defining a continuous hollow passage the extremities of which form fluid exhaust passages, said elements being relatively movable during a circuit-opening operation so as to establish two gaps in sequence, said enclosing structure being arranged with respect to said conducting elements so as to enclose said gaps, and means for supplying a blast of fluid pressure to said structure, the fluid pressure supplied to the second of said gaps to be formed being in opposition to the flow of fluid from the first of said gaps to be formed through said hollow passage toward the said second of said gaps.

3. An electric circuit breaker of the fluid-blast type comprising an enclosing structure, a fixed tubular conducting member disposed within said structure, a movable tubular isolating contact disposed in said enclosing structure at one end of said fixed conducting member and normally in conducting relation to said fixed conducting member, said isolating contact and said fixed conducting member forming an exhaust path for fluid supplied to the end of said conducting member remote from said isolating contact, and fluid-actuated means operable in response to a blast of fluid supplied to said enclosing structure electrically to separate said fixed conducting member and said isolating contact and to establish communication between the incoming fluid blast and the space within said tubular conducting member at the end thereof adjacent said isolating contact thereby to oppose the exhaust of fluid through said tubular conducting member.

4. An electric circuit breaker of the fluid-blast type comprising a tubular enclosing structure, a fixed tubular conducting member disposed within said structure, a movable tubular isolating contact disposed in spaced substantially coaxial relation to said fixed conducting member, fluid-actuated bridging means normally forming an electrical connection between said fixed conducting member and said isolating contact, said isolating contact and said fixed conducting member forming an exhaust path for pressure fluid supplied to said enclosing structure and to the end of said fixed conducting member remote from said isolating contact, said fluid-actuated bridging means being operable in response to said fluid to break the electrical connection between said fixed conducting member and said isolating contact and to establish communication between the incoming fluid blast and the space within said tubular conducting member at the end thereof adjacent said isolating contact thereby to oppose the exhaust of fluid through said tubular conducting member, and means for preventing the completion of an operation of said fluid-actuated means until after opening of said interrupting contact means.

5. An electric circuit breaker of the fluid-blast type comprising a tubular enclosing structure, a fixed tubular conducting member disposed within said structure, interrupting contact means biased toward engagement with one end of said fixed conducting member, a movable tubular isolating contact disposed at the other end of said fixed conducting member in spaced substantially coaxial relation thereto, fluid-actuated bridging means normally forming an electrical connection between said fixed conducting member and said isolating contact, said isolating contact and said fixed conducting member forming an exhaust path for fluid supplied to said interrupting contact means after operation thereof, said fluid-actuated bridging means being operable in response to a blast of fluid supplied to said enclosing structure to break the electrical connection between said fixed conducting member and said isolating con-

tact and to establish communication between the incoming fluid blast and the space within said tubular conducting member at the end thereof adjacent said isolating contact thereby to prevent the exhaust of fluid through said tubular conducting member, and means for preventing the completion of an operation of said fluid-actuated means until after opening of said interrupting contact means.

6. An electric circuit breaker of the fluid-blast type comprising a tubular enclosing structure, a fixed tubular conducting member disposed within said structure, interrupting contact means biased toward engagement with one end of said fixed conducting member, a movable tubular isolating contact disposed in said enclosing structure at the other end of said fixed conducting member in spaced substantially coaxial relation thereto, bridging means normally forming an electrical connection between said fixed conducting member and said isolating contact, said isolating contact and said fixed conducting member forming an exhaust path for fluid supplied to said interrupting contact means after operation thereof, means including a piston and a cylinder operable in response to a blast of fluid supplied to said enclosing structure to break the electrical connection between said fixed conducting member and said isolating contact and to establish communication between the incoming fluid blast and the space within said tubular conducting member at the end thereof adjacent said isolating contact thereby to oppose the exhaust of fluid through said tubular conducting member, and means including regulating valve means affording communication between atmosphere and the surface of said piston means opposite to the working face thereof and a port in a wall of said cylinder for admitting a portion of said blast to the surface of said piston opposite to the working face thereof for preventing the completion of an operation of said fluid-actuated means until after opening of said interrupting contact means.

7. A fluid blast electric circuit breaker comprising an enclosing structure, a fixed tubular conducting member disposed within said structure, interrupting contact means disposed in said enclosing structure and biased into engagement with said tubular conducting member at one extremity thereof, a tubular isolating contact disposed within said enclosing structure in coaxial relation to said tubular contact member at another extremity thereof and in spaced relation thereto, a fluid-responsive bridging contact means normally interconnecting said tubular conducting member and said isolating contact, said tubular conducting member and said tubular isolating contact forming a path for the exhaust of fluid supplied to said interrupting contact after the initiation thereby of opening movement of said interrupting contact and before disconnection of said isolating contact from said tubular conducting member by said fluid-responsive bridging contact means in response to fluid supplied to said enclosing structure.

8. A fluid blast electric circuit breaker comprising an enclosing structure, a fixed tubular conducting member disposed within said structure, interrupting contact means disposed in said enclosing structure and biased into engagement with said tubular conducting member at one extremity thereof, a tubular isolating contact disposed within said enclosing structure in coaxial relation to said tubular contact member at another extremity thereof and in spaced relation thereto, and fluid-responsive bridging contact means normally interconnecting said tubular conducting member and said isolating contact, said tubular conducting member and said tubular isolating contact forming a path for the exhaust of fluid supplied to said interrupting contact after the initiation thereby of opening movement of said interrupting contact and before disconnection of said isolating contact from said tubular conducting member by said fluid-responsive bridging contact means in response to fluid supplied to said enclosing structure, fluid pressure in said tubular conducting member being substantially equalized after operation of said fluid-responsive bridging contact means so as to oppose the exhaust of fluid from said interrupting contact through said tubular contact member.

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