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GAS BLAST CIRCUIT BREAKER

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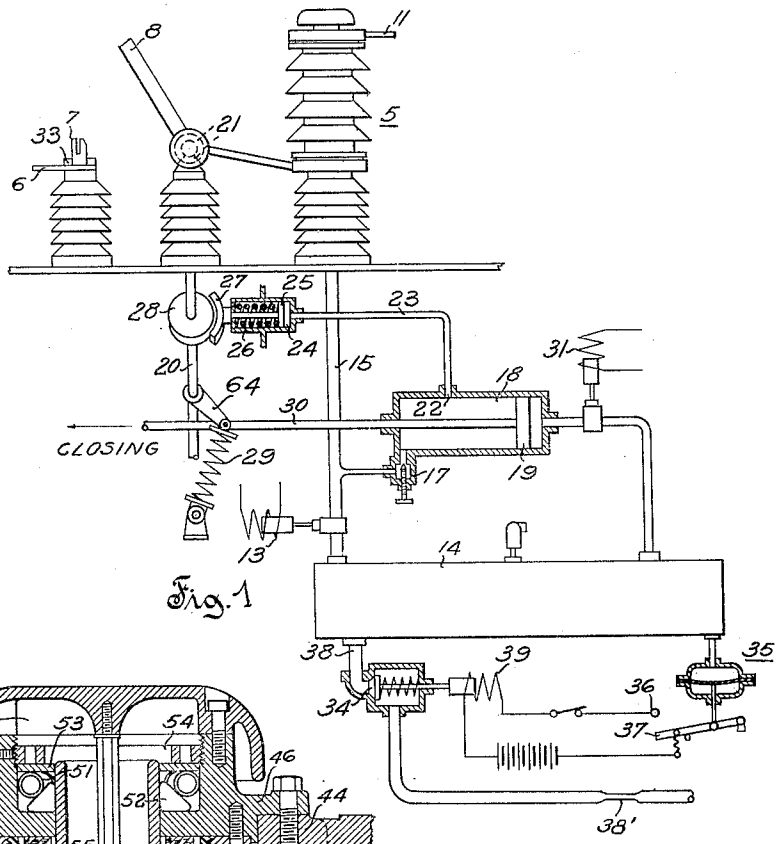

Fig. 1

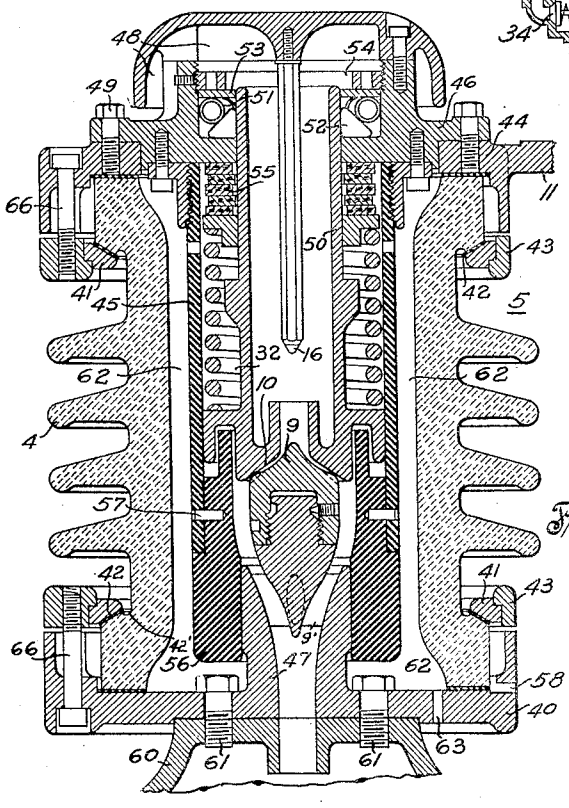

Fig. 2

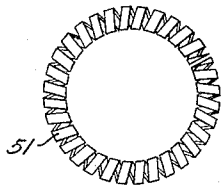

Fig. 3

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GAS BLAST CIRCUIT BREAKER

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This invention relates in general to circuit breakers and controls therefor and relates in particular to an improved gas blast circuit breaker that is structurally rugged and functionally efficient and that is controlled in an improved manner.

In the gas blast circuit breakers of the prior art hollow ceramic insulators are used as part of a conduit for conveying gas under pressure from a gas reservoir to the circuit interrupting contacts of the breaker. Since the ceramic insulators are exposed directly to the pressure of the blast gases they must be made sufficiently strong to withstand the stresses imposed upon them. If the blast gas is supplied to a pair of contacts through a pipe positioned inside an insulator and fixed relative thereto, the insulator may still be subject to stress because of the difference between the coefficients of expansion of the pipe material and the ceramic.

It is therefore an object of the present invention to provide an improved gas blast circuit breaker which avoids the above disadvantages of prior art circuit breakers.

It is also an object of the present invention to improved a gas blast circuit breaker of the type utilizing a hollow insulator of ceramic material for conveying gas under pressure, by removing or reducing the radial stresses due to gas pressure on the insulator.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawing, in which:

Fig. 1 is a schematic diagram showing the control for a gas blast circuit breaker of the type shown in Fig. 2;

Fig. 2 is a section view through an interrupting chamber of a gas blast circuit breaker involving the present invention; and

Fig. 3 is a detailed top view of a contact pressure member utilized in the switch in Fig. 1.

Fig. 1 shows generally a circuit breaker and control in which 5 denotes generally the interrupting head of a gas blast circuit breaker for connecting and disconnecting a line conductor 6 through disconnect contacts 7 and 8 and arcing contacts 9 and 10 (not shown in Fig 1) to a load conductor 11. In general, the circuit is opened by energization of a solenoid operated

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valve 13 responsive to overload in the circuit 6—11 or otherwise controlled. Operation of the valve 13 permits air from the reservoir 14 to be supplied through pipe 15 to the interrupting head 5, where such pressure acts on movable contact 10 (not shown in Fig. 1) as a piston. As the arcing contacts 9 and 10 separate, an arc is drawn one end of which is transferred by the gas blast from the movable arcing contact 10 to an auxiliary electrode 16. The arc is deionized and cooled and is thereby quickly extinguished.

At the same time air is admitted by valve 13 to the blast tube 15, air is admitted at a predetermined rate from the blast tube 15 through needle valve 17 to the disconnect operating cylinder 18. As the pressure builds up on piston 19, after a predetermined time depending upon the adjustment of needle valve 17, the piston 19 and rod 30 are moved to the right as viewed in the drawing. It will be noted that shaft 20 is operably connected to contact 8 through meshed gears 21, and that rod 30 is operably connected to arm 64 of shaft 20. Consequently, movement of rod 30 to the right causes arm 64 to rotate shaft 20 in a counterclockwise direction, as viewed from above, which in turn moves contact 8 clockwise to the open position. As the piston 19 moves past a port 22 in the cylinder 18, pressure from the cylinder 18 is supplied through a pipe 23 to a cylinder 24. This pressure acts on a piston 25 against the spring 26 to press a brake shoe 27 against a drum 28 on the shaft 20, thereby braking the movement of the movable disconnect contact 8. In order to provide desired isolation, the movable contact 8 is further moved to the full open position shown, by means of a compression spring 29 acting on the crank 64 when the air pressure in cylinder 24 subsides and brake shoe 27 is released from drum 28.

The circuit breaker is closed by operation of the solenoid operated valve 31 to permit gas under pressure to flow into the cylinder 18 forcing the piston 19 in the arrow direction to move the contact 8 to closed position. The arcing contacts 9 and 10 have previously reclosed by means of the spring 32 after pressure was removed from the movable contact 10. The full force of the gas pressure in cylinder 18 is maintained on the piston 19 until the contact 8 has made with the contact 7. As contact 8 moves

to the full closed position so that it contacts with and tends to rebound from a resilient pad 33 of suitable material such as cork or a rubber cork mixture, the piston 19 has passed the port 22 and again gas under pressure is supplied to the braking piston 25 and the shaft 20 is stopped. Application of the brake 27 to the drum 28 prevents shaft 20 from reversing its direction of rotation and consequently forestalls rebound of contact 8 from pad 33 toward the open position.

The above improved braking structure and control permits the full available closing force to be utilized for closing the contacts 7, 8. This avoids the disadvantages of prior art braking devices where, because of the high inertia of the moving contact, the braking force was applied before the contacts closed and, therefore, detracted from the closing force. Such lack of full closing force at times caused improper closing especially if closing in on a short circuit. By stopping the switch blade only after it has reached full closed position, proper closing is assured.

Pressure in the reservoir 14 is maintained at a substantially constant relative low pressure by means of a solenoid operated valve 34 that is controlled by a pressure operated switch generally designated as 35. If the pressure in the reservoir 14 drops below a predetermined value, contacts 36 and 37 are closed to energize solenoid operated valve 34 to open the supply pipe 38 from a relatively high pressure supply vessel (not shown), where relative large pressure variations may be permitted. By utilizing a solenoid valve rather than a pressure operated valve, such valve is either fully open or fully closed. There is no excessive wear on the valve seat due to "wire drawing" of the supply gas. This also permits the smallest cross section or constriction 38' of the supply line to the reservoir 14 to be located at a point away from the valve 34 so that the valve is not subjected to excessive low temperature due to expansive cooling.

It is well known that the expansion of gas through a constriction is a process in which heat is absorbed and that the cooling resulting therefrom may be sufficient to cause water vapor normally present in the gas to condense and freeze as ice. If gas were allowed to exand in the supply line of the system shown in Fig. 1, in or near the valve 34, ice formed by such expansion could well prevent opening and closing of the valve. To obviate such difficulty, the gas is allowed to expand at a point remote from the valve, e. g., constriction 38', so that any ice formed thereat cannot reach and clog the valve mechanism. Although the constriction 38' in the supply line, as shown in Fig. 1, is placed ahead of the valve 34, such constriction may also be placed in the supply pipe 38 at a point between the valve 34 and reservoir 14 but remote from the valve. The replenishing of the reservoir 14 with pressure gas can be rapidly effected because the valve 34 is fully opened throughout the entire replenishing period.

The interrupting head of the circuit breaker is shown in detail in Fig. 2. The supporting base 40 is clamped on the cap 60 by means of cap screws 61 and has clamped thereon in an improved manner an insulator 4 of ceramic material of which porcelain is an example. A force is applied to a continuous clamping ring 43 by a series of threaded members 66 and such force is transmitted through a split ring 41 onto the porcelain 4 in a direction substantially perpendicular to the surface 42. This clamping structure minimizes bending moments and shear stresses in the porcelain.

By cutting away the inside corner of the porcelain 4 immediately adjacent the surface 42 at 42', the glaze of the porcelain meets the ground surface 42 in a long curve so that the mechanical stresses are not concentrated. The ends of the insulator 4 are formed as shown in Fig. 2 so that the cross-section of porcelain is maintained substantially uniform but at the same time the reaction of the supporting member 40 is directly under, and that of conducting member 44 is directly over, the corresponding surface 42. By cutting away the interior top and bottom edges of the procelain as shown, the force applied at 42 by the clamping ring 43, produces no bending moment in the ends of the porcelain. By maintaining a substantially uniform cross-section, the process of firing and drying the porcelain is considerably less costly and time consuming. An opening 58 in the supporting member 40 is provided to drain any accumulated moisture. A similar clamping structure is utilized at the top of the insulator 4 for clamping the contact supporting and current conducting member 44 on the insulator.

An insulating tube 45 is rigidly supported from a cap 46 and has a close sliding fit with an upward-extending portion 47 of the base 40 forming a portion of the air supply conduit. The fixed contact 9 is partially enclosed by the upward-extending walls of portion 47 and supported thereon by means of transversely extending members 9'. An extension 56 of insulating material is supported on the tube 45 as by gluing and by dowels 57 and this extension forms the passage wall for carrying the arc extinguishing gas from the member 47 to the movable contact 10. There is, therefore, a cylindrically delimited space 62 at atmospheric pressure, by reason of opening 63, extending the entire length of the inside surface of insulator 4. The stresses due to the compressed gases are therefore prevented from affecting the insulator 4 in radial direction and no stresses due to differences in coefficients of expansion of the insulator 4 and the insulating tube 45 are present because of the sliding fit between tube 45 and base portion 47. The only stresses on the porcelain 4 are plain axial stresses due to the force exerted by the pressure gas acting on base portion 47, as a piston, in the extension 56, as a cylinder, and this force can be kept small by keeping the diameter of portion 47 small.

The cap 46 may be bolted, as by bolts 49, to the conducting member 44 and by reason of the sliding fit between extension 56 and base portion 47, removal of the cap 46 removes the entire movable contact structure and permits easy inspection of the fixed contact 9. The movable contact 10 has a long upward-rising extension 50 forming a tube for removal of the exhaust gases and the products of arcing. By reason of the fact that this combination of movable contact, piston and exhaust passage is in one piece, a simple, rugged and efficient structure is obtained.

Current is transmitted from the conducting member 44 through the cap 46 and thence to the extension 50 in an improved manner. A toroidal spiral spring 51, shown more clearly in Fig. 3, wound of flat wire of a width at least several times its thickness, is positioned between a ring formed of a plurality of contact segments 52 of triangular cross-section and a flat ring 53. Pressure supplied to the ring 53, by turning down the threaded retaining ring 54, is efficiently transmitted by the

spring 51 to the segments 52 pressing against the cap 46 and the conducting extension 50. Although this spring by reason of substantial width of the spring wire relative to its thickness, resists tilting, it is soft in the direction in which the force is applied and, consequently, provides a floating contact with good pressure between the contacts 52 and the current conducting members 46 and 50. Easy slidability of the member 50 is maintained and no pigtails are necessary to obtain the good conductive connection.

When the contacts 9 and 10 are opened, the impact of the moving contact 10 is absorbed by a cushioning means for absorbing impact shown as made up of rings 55 of material such as cork, or a rubber-cork mixture. One end of the arc drawn is maintained on the uppermost tip of the fixed contact 9 and the other end of such arc is transferred to the auxiliary contact 16. This centralizes the arc in the orifice of contact 10. The arc is therefore maintained at the desired minimum length in the region of greatest air flow. By reason of the centralization of the arc, all surfaces thereof are available for action thereagainst by the gas stream. The gas stream is directed along the arc, toward a point of the auxiliary contact 16 whereby any vapor from the arc root on the auxiliary contact is immediately blasted to a portion of the exhaust passage away from the arc. The above features combine to provide improved and efficient extinguishing of the arc thereby causing circuit interruption.

Although but one embodiment of the present invention has been illustrated and described it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. In a gas blast circuit breaker, a hollow insulator of ceramic material, relatively movable contacts separable within said insulator, one of said contacts provided with an orifice therein, a plurality of openings in said insulator, one of said openings providing for entry of gas under pressure for passage through said orifice, the other of said openings providing for exhausting said gas from said orifice, a flange member for said insulator at one end thereof, and means providing a space at substantially atmospheric pressure on substantially the entire inside walls of said insulator between said openings, said means comprising a tube of insulating material having a sliding fit at one end thereof with said flange member and rigidly connected to said insulator at the other end thereof, said tube comprising a cylinder in which said movable contact slides as a piston.

2. In a gas blast circuit breaker, a hollow insulator of ceramic material, a closure member for closing one end of said insulator except for a passageway for entry of gas under pressure, a tube of insulating material slidably joining said closure member and providing continuation of said passageway, a piston member slidably supported in said tube and comprising an orifice type movable contact, said movable contact comprising an exhaust passageway, a second closure member for closing the other end of said insulator except for an exhaust opening from said exhaust passageway, and means for supporting said piston member and said tube on said second closure member.

3. A gas blast circuit breaker comprising: a first hollow insulator; fixed and movable contacts disposed within said first insulator for drawing an arc therein, said movable contact having a tubular portion defining an entry orifice and an exit conduit extending coaxially within said first insulator; a second hollow insulator disposed about said first insulator and having a wall defining two openings therein, one of said openings providing for entry of gas under pressure to said orifice for moving said arc into said tubular portion whereby said first insulator is protected from the thermal effects of said arc, the other of said openings providing for the exit of gas from said tubular portion; and means for supporting said first insulator within said second insulator including flange means mounted on one end of said second insulator for slidably guiding one end of said first insulator, said supporting means cooperating with said insulators to provide a space therebetween containing gas at substantially atmospheric pressure for relieving said second insulator of stresses induced by the radial application of gas pressures to said first insulator and for relieving said first insulator of stresses induced by the axial application of gas pressures to said supporting means upon the passage of gas through said breaker to interrupt said arc.

4. In a gas blast circuit breaker, a hollow cylindrical insulator of ceramic material, a closure member for closing one end of said insulator except for a passageway for entry of gas under pressure, a tube of insulating material supported on the other end of said insulator slidably joining said closure member and forming an exhaust passageway providing continuation of said entry passageway, a pair of cooperating contacts in said tube and means for separating said contacts to draw therebetween an arc to be blown by said gas into said exhaust passageway, said insulator and said tube jointly defining a space filled with gas at substantially atmospheric pressure to prevent transmission of radial pressure from the space within said tube to the inner wall of said insulator.

5. In a gas blast circuit breaker, a fixed arcing contact, a movable arcing contact, gas actuated means for moving said movable arcing contact from an initial position in which said movable arcing contact is engaged with said fixed arcing contact to a final position in which said movable arcing contact is disengaged from said fixed arcing contact, said movable arcing contact comprising an entry orifice and an exhaust passageway, a fixed auxiliary contact electrically connected to said movable contact and having substantially its entire length disposed within said exhaust passageway for said initial and final positions of said movable contact, and means for causing a gas blast through said orifice and said passageway to cause contact separating operation of said gas actuated means and to transfer an arc drawn between said fixed and said movable arcing contacts to said fixed arcing and said fixed auxiliary contacts.

6. In a gas blast circuit breaker, a tubular insulator of ceramic material, a closure member for closing one end of said insulator except for an opening for entry of gas under pressure, a tube of insulating material supported on the other end of said insulator and slidably joining said closure member and providing a continuation of said opening, a fixed contact disposed in said tube and supported by said closure member, and a piston member comprising an orifice type movable contact slidably supported in said tube, said mov-

able contact defining an exhaust passageway having a substantially constant diameter and extending beyond the said other end of said ceramic insulator whereby gas introduced through said opening acts on said piston member to separate said contacts and is discharged through said exhaust passageway.

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