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W. M. LEEDS

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COMPRESSED-GAS CIRCUIT INTERRUPTER

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2 Sheets-Sheet 1

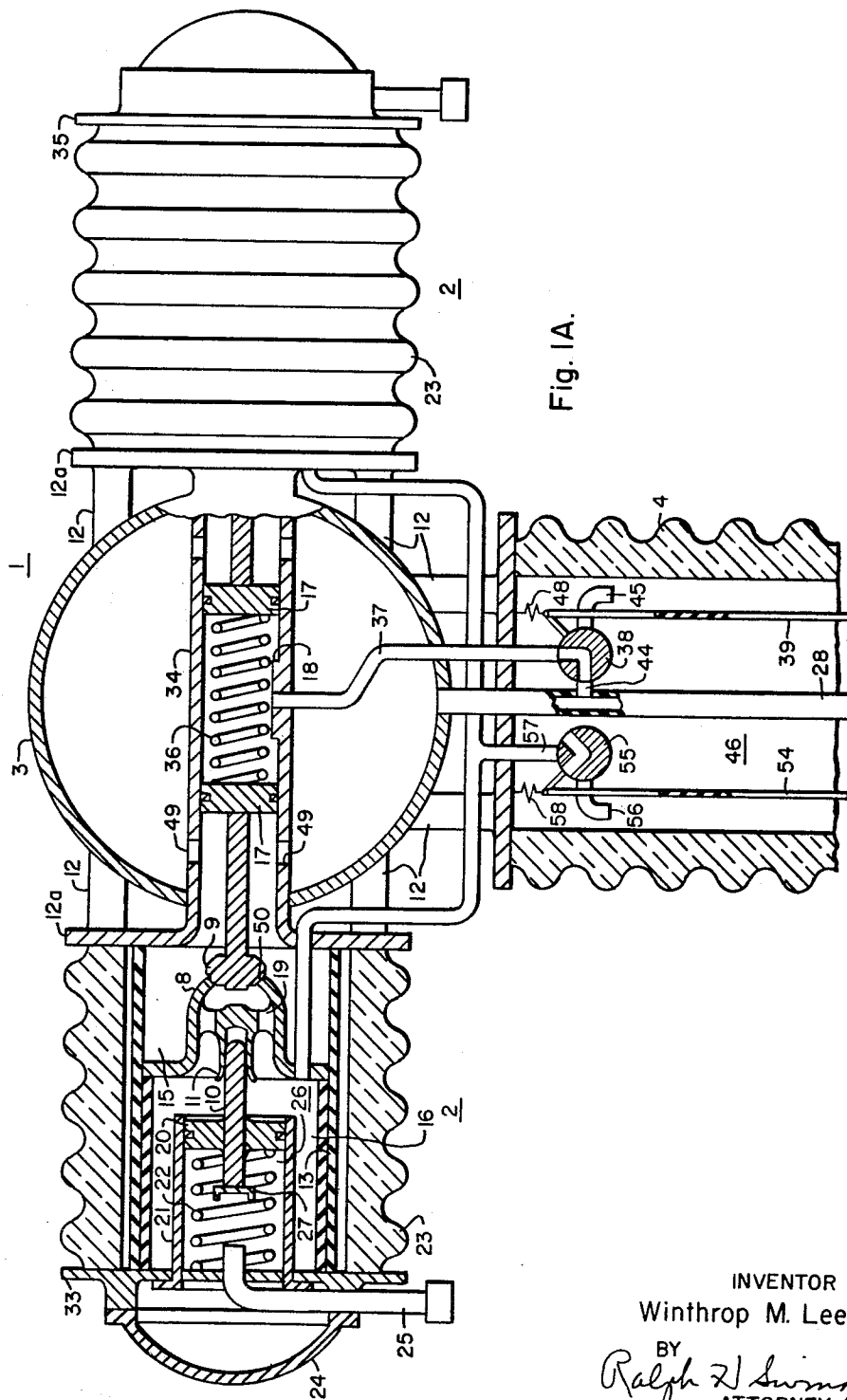


Fig. 1A.

INVENTOR
Winthrop M. Leeds

BY
Ralph W. Swingle
ATTORNEY

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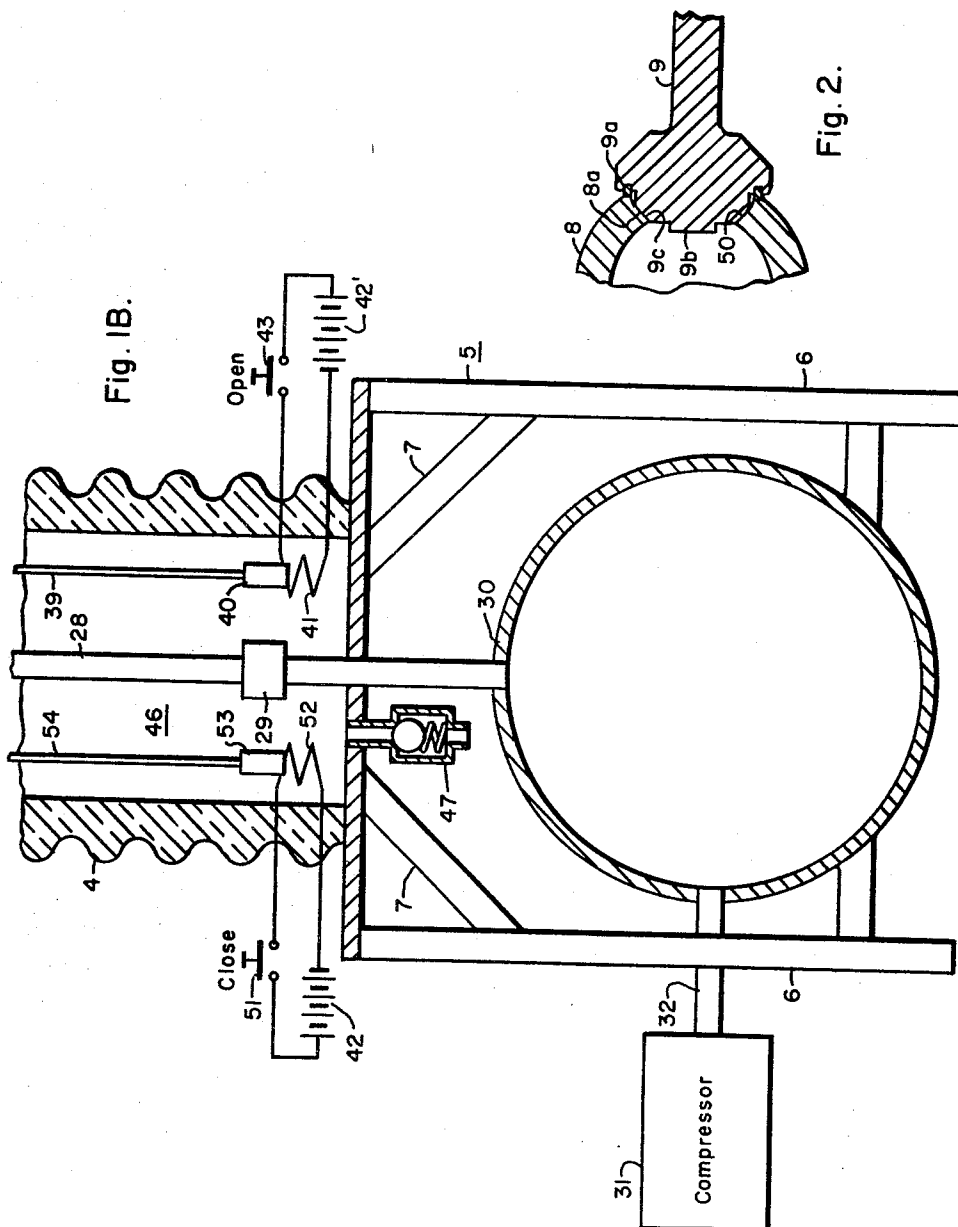
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COMPRESSED-GAS CIRCUIT INTERRUPTER

Winthrop M. Leeds, Forest Hills, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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This invention relates to circuit interrupters in general and, more particularly, to interrupting structures for compressed-gas circuit interrupters.

A general object of the invention is to provide an improved compressed-gas circuit interrupter, which will be more effective, and which will operate more rapidly than circuit interrupters of the compressed-gas type heretofore utilized in the industry.

A more specific object of the present invention is to provide an improved compressed-gas circuit interrupter in which the gas reservoir chamber is disposed at high potential, in an elevated position, and the contact operating pistons are positioned immediately adjacent to said gas reservoir chamber, so that exceedingly rapid opening movement is obtained of the movable contacts during the circuit interrupter opening operation.

Another object of the invention is to provide an improved contact operating mechanism for a compressed-gas circuit interrupter in which the gas reservoir chamber is disposed at high potential in an elevated position, and the contact operating cylinder extends interiorly within said gas storage reservoir chamber, to thereby eliminate any delay during the contact opening movement.

Yet a further object of the invention is to provide an improved compressed-gas circuit interrupter utilizing one or more arc-extinguishing units, each of which includes two pairs of separable contacts, wherein one set of separable contacts is employed to effect arc extinction, whereas the other set of separable contacts performs an isolating function, and maintains the circuit open following reclosure of the first said pair of separable contacts.

Another object of the invention is to provide an improved compressed-gas circuit interrupter employing a pair of isolating contacts in series with a pair of separable arcing contacts, in which the isolating contacts maintain the circuit open following reclosure of the arcing contacts, and in which the isolating contacts remain separated in the open position within a pressurized isolating chamber.

Still a further object of the present invention is to provide an improved compressed-gas circuit interrupter of generally T-shaped construction, employing two laterally extending arc-extinguishing units supported at the upper end of an upstanding insulating pedestal, a gas reservoir chamber, or tank, being disposed at high potential on top of said supporting pedestal and having extending there-through an elongated operating cylinder, within which operate the two contact pistons for the pair of movable arcing contacts.

Still another object of the invention is to provide an improved compressed-gas circuit interrupter of the type specified in the immediate preceding paragraph, in which a pair of serially related isolating contacts is associated with each pair of arcing contacts, and separate, in the open-circuit position of the interrupter, within a pressurized isolating chamber.

An ancillary object of the invention is to provide an improved compressed-gas circuit interrupter in which a somewhat fragile, weatherproof casing, such as a porcelain casing, is protected from the explosive effect of the gas blast by a concentrically positioned interiorly disposed insulating tube of the requisite mechanical strength.

Further objects and advantages will readily become ap-

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parent upon reading the following specification, taken in conjunction with the drawings, in which:

FIGURES 1A and 1B collectively show a side elevational view, partially in vertical section, and certain structural parts being diagrammatically illustrated, of a compressed-gas circuit interrupter employing the principles of the present invention, and the contact structure being illustrated in the closed-circuit position; and

FIG. 2 is a fragmentary, enlarged, sectional view of the main movable contact structure, illustrating the same in the closed-circuit position.

Referring to the drawings, the reference numeral 1 generally designates a compressed-gas circuit interrupter of generally T-shaped configuration, including a pair of laterally extending arc-extinguishing units 2 jutting substantially horizontally outwardly from a centrally disposed metallic gas reservoir chamber 3. The gas reservoir chamber, or tank 3, is supported at the upper end of a hollow insulating pedestal 4, preferably formed from a suitable weatherproof material, such as porcelain.

The hollow upstanding supporting pedestal 4 is, in turn, supported upon an angle-iron framework 5, composed of suitable angle iron supports 6 interbraced by additional angle supports 7. Each arc-extinguishing unit 2 generally includes a pair of arcing contacts 8, 9 and a serially related pair of isolating contacts 10, 11. The construction is such, as more fully explained hereinafter, that the arcing contacts 8, 9 separate first, and extinguish the arc therebetween, and subsequently, the isolating contacts 10, 11 separate to provide an isolating gap in the circuit, maintaining the circuit open, despite a subsequent reclosure of the arcing contacts 8, 9.

As illustrated in FIG. 1A, it will be noted that the gas reservoir tank 3 has welded thereto cylindrical support members 12 having support plates 12a welded to the outer ends thereof. To each outer face of support plate 12a is suitably secured, by means of barrel nuts and bolts, a horizontally extending, insulating, support tube 13. The support tube 13 assists in defining an arcing chamber 15 and an isolating chamber 16. As shown, the two movable arcing contacts 9 have secured thereto, adjacent the inner ends thereof, a pair of contact operating pistons 17, which are biased apart by a compression closing spring 18.

The movable arcing contacts 9 engage relatively stationary, orifice-shaped contacts 8 of generally cup-shaped configuration. The stationary cup-shaped contacts 8 has integrally formed therewith a spider-support member 19, which supports the relatively stationary, isolating contact 11. The relatively stationary isolating contact 11 cooperates with the movable isolating contact 10, the latter being secured to a contact operating piston 20, separable within a stationary operating cylinder 21. A closing, compression spring 22 biases each of the movable isolating contacts 10 to its closed position in engagement with the stationary isolating contacts 11, as shown in FIG. 1A.

The supporting tube 13 maintains in compression a surrounding weatherproof casing 23 preferably composed of porcelain, and serves to protect the latter from the explosive effects of arcing. The insulating support tube 13 is in tension between the support plate 12a, the latter being secured to the cylindrical support member 12, and an outer cap closure member 24. A vent tube 25 extends through the closure cap 24 and leads into the space 26 in back of the contact operating piston 20. A movable valve 27, carried at the outer extremity of the movable isolating contact 10, cooperates with the vent tube 25, to close the latter at the extreme end of the opening movement of the movable isolating contact 10.

The gas reservoir tank 3 is preferably maintained at a

pressure of say 250 p.s.i. by means of a supply conduit 28, which passes downwardly through the pedestal 4 and is connected, through a reducing valve 29, with a high-pressure air storage reservoir 30 (FIG. 1B). The storage tank 30 is supported within the framework 5, and preferably contains gas at high pressure, say at 500 p.s.i. A compressor 31 is employed to compress air to the 500 p.s.i. pressure, and to feed it, by a conduit 32, into the base storage tank 30, maintaining the latter at its high-pressure condition. Naturally, the supply conduit 28 is formed of insulating material.

In the closed-circuit position of the interrupter, as illustrated in FIGS. 1A and 1B, the electrical circuit therethrough includes line terminal lug 33, conducting closure cap 24, conducting operating cylinder 21, piston 20, movable isolating contact 10, relatively stationary isolating contact 11, spider-support member 19, relatively stationary, orifice-shaped arcing contact 8, movable arcing contact 9, operating piston 17, conducting operating cylinder 34, and through the right-hand, arc-extinguishing unit 2, in a similar manner, to the right-hand terminal lug 35.

To effect a contact opening movement of the two movable arcing contacts 9, it is desired to dump the high-pressure air from the region 36 between the two contact pistons 17 by means of a control conduit 37, which leads to a two-way opening valve 38. The opening valve 38 is actuated by an operating rod 39 of insulating material, which extends downwardly interiorly within hollow support pedestal 4 and is secured to an armature 40. The armature 40 is moved, by an opening coil 41, which may be energized from a suitable battery source 42', by the closing of a normally open "open" button 43. Thus, closing the "open" or "trip" button 43 will effect an energization of opening solenoid 41. This will move armature 40 and hence insulating operating rod 39 downwardly, closing off the high-pressure connection 44 to the valve 38, and opening the low-pressure connection 45.

The low-pressure conduit 45, as shown, opens to the low pressure region 46 within hollow pedestal 4. A low-pressure, air-release valve 47 maintains the air pressure within region 46 at substantially atmospheric pressure, but prevents the entrance thereto of a moisture-laden air from the ambient air outside of the support pedestal 4.

From the foregoing it will be readily apparent that when it is desired to effect the opening operation of the interrupter 1, it is merely necessary to close the trip button 43. This will energize coil 41 and move armature 40 and operating rod 39 downwardly, against the biasing action exerted by tension spring 48, to dump the high-pressure air from within region 36 between the two contact operating pistons 17.

The two movable arcing contacts 9 will move toward each other, in the opening direction, as caused by high-pressure air within tank 3 acting through openings 49 of operating cylinder 34 upon the outer faces of the operating pistons 17. The movable arcing contacts 9 will hence move toward each other very rapidly, because of the immediate proximity of the storage reservoir 3 and the location of openings 49 in operating cylinder 34.

The opening motion of the movable arcing contacts 9 away from their cooperable stationary contacts 8 will establish a pair of serially related arcs within the two arc-extinguishing units 2 simultaneously. The high-pressure air, or gas, will also pass through the openings 49, provided in operating cylinder 34, and pass through the orifice opening 50 provided by orifice-shaped, stationary contact 8. This high-pressure air, passing through orifice 50, will extinguish the arc established between separated contacts 8, 9, and will pass around the spider support member 19 to raise the pressure within the isolating chamber 16.

When the isolating chamber 16 has become pressurized to an extent sufficient to cause outward opening movement of the operating piston 20, against the biasing ac-

tion exerted by closing spring 22, the movable isolating contact 10 will move outwardly away from stationary isolating contact 11 maintaining the circuit open. The contact operating piston 20 will move outwardly until the valve 27 closes over the inner end of the vent tube 25. This will prevent any leakage whatsoever of gas out of the pressurized isolating chamber 16, and because of the high-pressure conditions within pressurized isolating chamber 16, the isolating gap between isolating contacts 10, 11 can easily hold the line voltage. As well understood by those skilled in the art, the dielectric strength of a gas, such as air, increases as its pressure increases.

Since the opening trip button 43 is momentarily closed (the foregoing contact opening movements taking place exceedingly rapidly), the tension spring 48 will effect upward movement of the operating rod 39, following de-energization of opening solenoid 41, and consequently, the two-way valve 38 will return to its original condition, wherein it connects high-pressure conduit 44 with control conduit 37. This will raise the pressure within region 36 between contact pistons 17 to the pressure of tank 3, and consequently, the compression spring 18 will effect rapid closing of both serially related pairs of arcing contacts 8, 9, the two pairs of isolating contacts 10, 11 remaining open.

From the foregoing description it will be apparent that in the fully open-circuit position of the interrupter 1, the arcing contacts 8, 9 have reclosed, but the circuit through the interrupter 1 is maintained open by the separation between the isolating contacts 10, 11 because of the pressurized condition of isolating chambers 16.

When it is desired to effect the closing of the circuit through the interrupter 1, the closing button 51 is depressed, thereby energizing, through the battery 42, the closing solenoid 52. This will attract closing armature 53 and hence pull operating rod 54 downwardly. Such action will rotate the two-way closing valve 55 connecting the low-pressure conduit 56 with the control conduit 57, the latter leading through the support cylinder 12 to the regions 16 within the isolating chambers. This will dump the high pressure out of isolating chambers 16 and permit the closing compression springs 22 to move the isolating pistons 20, and movable isolating contacts 10 into engagement with the stationary isolating contacts 11. Since the arcing contacts 8, 9 have previously closed, this action will effect closing of the circuit through the interrupter 1.

The closing button 51 is only momentarily actuated, so that following its release, the tension spring 58 will move closing rod 54 upwardly, thereby returning closing valve 55 to its original condition, as shown in FIG. 1A, wherein control conduit 57 is closed off. The interrupter 1 is now in readiness for a subsequent opening operation.

From the foregoing description of the invention it will be apparent that there is provided an improved compressed-gas circuit interrupter, in which the storage tank 3 is maintained at high potential and immediately adjacent the contact pistons 17, to thereby eliminate any delay in the opening operation of the arcing contacts 8, 9. High-speed interruption is, therefore, obtained since high-pressure air, or gas, is available in close proximity to the contacts 8, 9.

It will be noted that the internal isolating gaps between isolating contacts 10, 11 are in high-pressure air within pressurized isolating chambers 16, thereby maintaining a high insulation value. Moreover, the porcelain casings 23 are not subjected to high-pressure air, since they are protected by the insulating support tubes 13.

The structure of the invention has an additional advantage, inasmuch as the contact pistons 17 are not required to hold a large pressure differential for a long time, it being noted that the movable arcing contacts 9 and the contact piston 17 operating the same, are maintained in the open position only for a short period of time just sufficient to effect arc extinction, and to enable the

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movable isolating contact 10 to move to its open position.

The gas reservoir tank 3, at high potential, not only contains a sufficient supply of high-pressure air immediately adjacent the contact structures for several operations of the interrupter, but as noted in FIG. 1, the tank 3, in addition, provides a structurally strong support for the laterally extending, arc-extinguishing units 2 including their casings 23 and other component parts. The controls for operating the valves 38, 55 are at ground potential, and insulated from all high-voltage parts by the insulating operating rods 39, 54. The lower storage tank 30 provides for replenishing the compressed gas in the upper tank 3 through the feed conduit 28 for a number of additional operations, even though the compressor 31 may fail to function. Thus, the interrupter 1 is so constructed as to function for a large number of operations if, for some reason, the compressor 31 becomes inoperable.

It will moreover be apparent that the space within the upstanding, hollow, porcelain pedestal 4 is maintained full of dry air, since it serves as an exhaust chamber for the pressurized, isolating chamber 16 following opening of the valve 55. The check valve 47 assists in this action so that there is no chance of condensation on the inner walls of the porcelain pedestal 4 due to moisture-laden air being present within the pedestal 4.

A distinct advantage of the invention is the particular location of the operating cylinder 34 for the two movable contact pistons 17. Not only does the operating cylinder 34 accommodate movement of both contact pistons 17, but also, extending diametrically across the air reservoir tank 3, it provides additional structural support, and insures that the openings 49 therein provide an immediate supply of high-pressure gas at the right location during the initial portion of the opening operation of the interrupter 1.

As shown in FIG. 2, the movable main arcing contact 9 is provided with a movable valve ring 9a of suitable flexible material on the upstream side of the region of arcing to assist in maintaining a proper high-pressure air seal in the closed-circuit position of the interrupter. The arc-resisting tip portion 9b of the contact 9 resists arc erosion, and the contact surfaces 9c and 8a engage to provide a good path for current flow in the closed-circuit position, as shown in FIG. 2.

It is to be understood that in practice current-collecting fingers would be used on the movable contacts, so that the operating pistons would not carry current, as shown in the drawing.

Although there has been illustrated and described a circuit interrupter embodying the principles of the present invention, it is to be understood that the same was merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art without departing from the spirit and scope of the invention.

I claim as my invention:

1. A compressed-gas circuit interrupter including an arc-extinguishing unit, said unit including a pair of separable arcing contacts and a serially related pair of isolating contacts, said pair of isolating contacts remaining open in the open-circuit position of the interrupter, an operating piston for effecting opening motion of one of said isolating contacts, means defining an isolating chamber, means for sending a blast of compressed gas adjacent the pair of separable arcing contacts, said blast of gas exhausting into said isolating chamber to raise the pressure within said isolating chamber, said operating piston responding to a rise of pressure within said isolating chamber by moving and so effecting opening movement of said one isolating contact, and said serially related pair of isolating contacts separating only following interruption of the arc between said pair of separable arcing contacts.

2. The combination in a compressed-gas circuit interrupter of a movable arcing contact and an orifice-shaped

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relatively stationary contact separable to establish an arc, means for forcing a blast of high-pressure gas through said orifice-shaped stationary contact to extinguish said arc, means defining an isolating chamber, a pair of separable isolating contacts separable within said isolating chamber to establish an isolating gap in the circuit following arc extinction, said pair of isolating contacts remaining open in the open-circuit position of the interrupter, said blast of high-pressure gas exhausting into said isolating chamber to raise the pressure therein, and means responsive to a rise of pressure within said isolating chamber to effect opening isolating movement of one of said isolating contacts.

3. The combination in a compressed-gas circuit interrupter of a movable arcing contact and an orifice-shaped relatively stationary contact separable to establish an arc, means for forcing a blast of high-pressure gas through said orifice-shaped stationary contact to extinguish said arc, means defining an isolating chamber, a pair of separable isolating contacts separable within said isolating chamber to establish an isolating gap in the circuit following arc extinction, said pair of isolating contacts remaining open in the open-circuit position of the interrupter, said blast of high-pressure gas exhausting into said isolating chamber to raise the pressure therein, and means responsive to a rise of pressure within said isolating chamber to effect opening, isolating movement of one of said isolating contacts, and means biasing said movable arcing contact closed against the orifice-shaped relatively stationary contact.

4. The combination in a compressed-gas circuit interrupter of a movable arcing contact and an orifice-shaped relatively stationary contact separable to establish an arc, means for forcing a blast of high-pressure gas through said orifice-shaped stationary contact to extinguish said arc, means defining an isolating chamber, a pair of separable isolating contacts separable within said isolating chamber to establish an isolating gap in the circuit following arc extinction, said pair of isolating contacts remaining open in the open-circuit position of the interrupter, said blast of high-pressure gas exhausting into said isolating chamber to raise the pressure therein, means responsive to a rise of pressure within said isolating chamber to effect opening isolating movement of one of said isolating contacts, means biasing said movable arcing contact closed against the orifice-shaped relatively stationary contact, and means biasing said one isolating contact to the closed position.

5. A compressed-gas circuit interrupter including an arc-extinguishing unit, said arc-extinguishing unit having a pair of separable arcing contacts at one end thereof and a pair of isolating contacts at the other end thereof, means defining a substantially closed isolating chamber within which said pair of isolating contacts separate, an operating cylinder positioned within said substantially closed isolating chamber, a piston for opening one of said isolating contacts and movable within said operating cylinder, a vent for said operating cylinder, means causing a blast of gas to extinguish the arc at said pair of separable arcing contacts and to exhaust into said substantially closed isolating chamber to effect opening of said one isolating contact, a movable closing valve movable with said piston for closing said vent at the end of the opening movement of said one isolating contact, and said pair of isolating contacts remaining open in the open-circuit position of the interrupter.

6. A compressed-gas circuit interrupter including an arc-extinguishing unit, said unit including a pair of separable arcing contacts and a serially related pair of isolating contacts, said pair of isolating contacts remaining open in the open-circuit position of the interrupter, means defining a substantially closed isolating chamber, means for sending a blast of gas adjacent the pair of separable arcing contacts to effect the extinction of the arc drawn thereat, said blast of gas exhausting at least in part into

said substantially closed isolating chamber, means responsive to a rise of pressure within said substantially closed isolating chamber to effect separation of the isolating contacts, and said pair of isolating contacts separating in an ambient of high-pressure gas to permit minimum contact separation therebetween. 5

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