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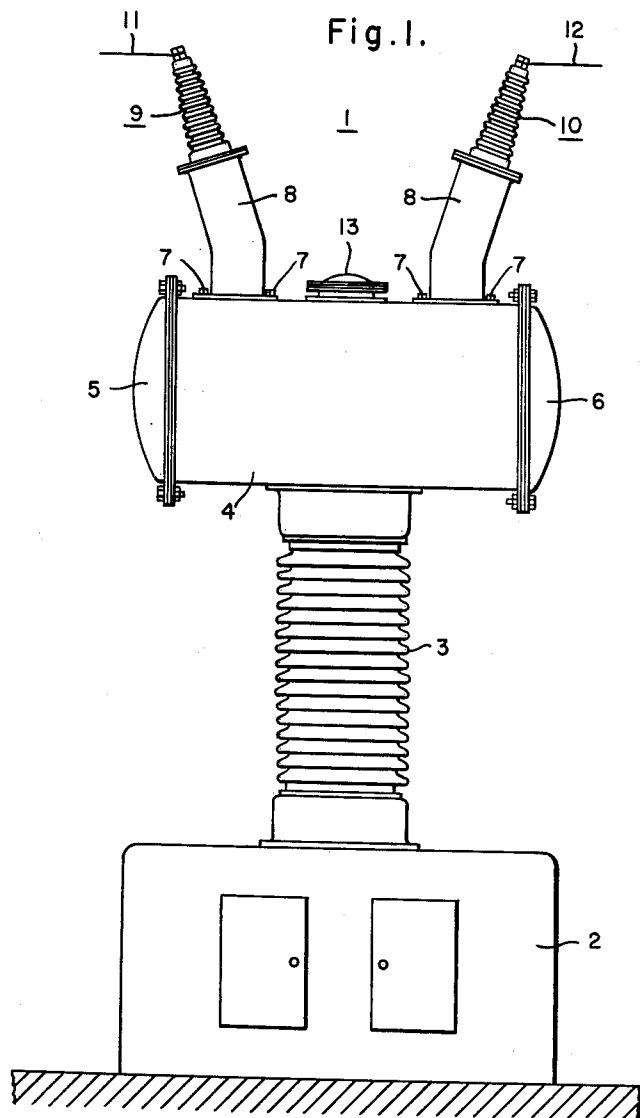
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COMPRESSED-GAS CIRCUIT INTERRUPTER

Filed Sept. 24, 1959

2 Sheets-Sheet 1



WITNESSES:

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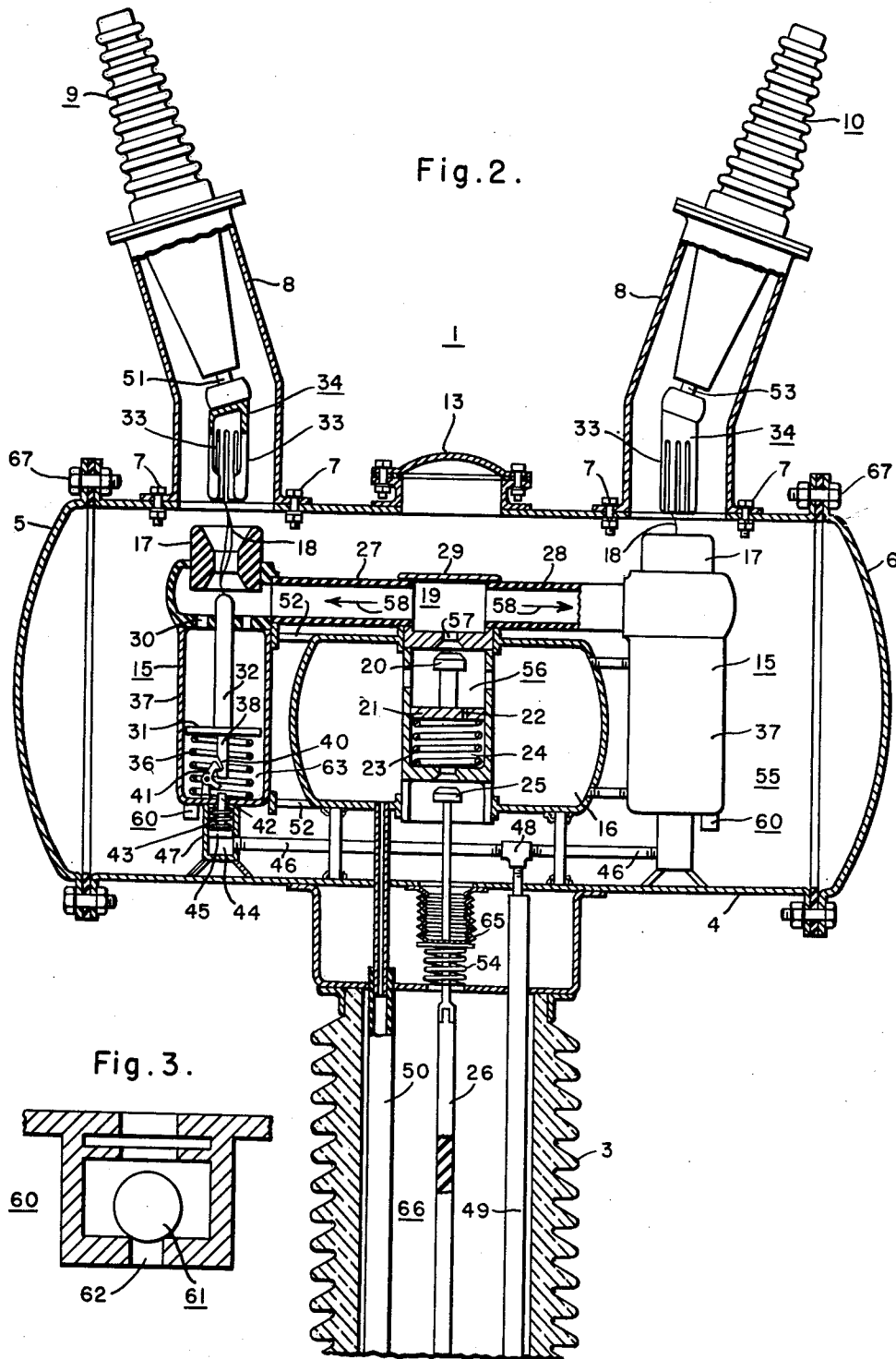
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COMPRESSED-GAS CIRCUIT INTERRUPTER
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This invention relates to circuit interrupters in general, and, more particularly, to circuit interrupters of the compressed-gas type.

In United States patent application filed August 27, 1959, Serial No. 836,405, by Benjamin P. Baker and Wayne S. Aspey, and assigned to the assignee of the present application, there was disclosed in one form of the invention, a metallic chamber at high potential supported by an upstanding insulating column. Two terminal bushings were described as extending downwardly into the chamber, and liquid sulfur hexafluoride (SF_6) was described as being the arc-extinguishing fluid, which was utilized for circuit interruption. In utilizing liquid SF_6 , necessarily high pressures, approaching 1000 p.s.i., are employed. For certain applications, the employment of such pressures may be somewhat undesirable, and it is, accordingly, a general object of the present invention to improve upon the interrupting structure set forth in the aforesaid Baker and Aspey patent application, rendering the same adaptable for lower pressures, and employing, preferably, a double-pressure extinguishing arrangement.

Another object of the present invention is to provide an improved compressed-gas circuit interrupter in which the storage tank, containing high-pressure gas, is disposed immediately adjacent to the contact structure, so that there will be little or no delay in applying the gas blast for effecting arc extinction.

Still a further object of the invention is to provide a simplified contact-operating arrangement, in which mechanical linkages and cumbersome operating levers are avoided, and yet simultaneous contact-opening and closing movement may be achieved in a simplified manner.

A further object of the present invention is to provide a high-speed, compressed-gas circuit interrupter of simplified construction which is highly effective in operation.

Another object of the present invention is to provide an improved compressed-gas circuit interrupter utilizing a relatively low-pressure exhaust tank at high potential, within which is interiorly disposed a high-pressure storage tank; and blast-valve means are employed to release a blast of gas from the high-pressure storage tank toward the established arcs to effect arc extinction.

Another object of the invention is to provide an improved compressed-gas circuit interrupter of the type specified in the immediately preceding paragraph, in which a balanced-pressure blast valve is employed, and a pilot valve is actuated from ground potential for dumping the pressure in back of the balanced-pressure blast valve for obtaining rapid circuit interruption.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings, in which:

FIGURE 1 is a side elevational view of one pole-unit of a compressed-gas circuit interrupter embodying the principles of the present invention;

FIG. 2 is a fragmentary, vertical sectional view taken through the tank assembly of the pole-unit of FIG. 1, with the contact structure and the blast-valve mechanism being shown in the open-circuit position; and,

FIG. 3 is a detailed view of a one-way-acting ball valve to obtain rapid closing operation of the movable contacts.

Referring to the drawings, and more particularly to FIG. 1 thereof, the reference numeral 1 generally designates a compressed-gas circuit interrupter pole-unit, including, generally, a mechanism compartment 2, an upstanding insulating column 3, which may be formed from porcelain, and a high-potential, metallic, relatively-low-pressure exhaust tank 4. The ends of the metallic tank 4 are preferably closed by inspection cover plates 5, 6.

Disposed at the upper side of the metallic tank 4 and bolted thereto, as at 7, is a pair of canted, cylindrical metallic supports 8, into which extend a pair of terminal bushings 9, 10. Line connections 11, 12 may be made to the extremities of the terminal bushings 9, 10 in a manner well known to those skilled in the art. An additional inspection cover 13 may be employed, the purpose for which will appear more fully hereinafter.

With reference to FIG. 2, which illustrates a vertical sectional view taken through the tank structure 4, it will be noted that a pair of identical arc-extinguishing units 15 are disposed at the opposite ends of a high-pressure storage tank 16, which is disposed interiorly within the outer relatively-low-pressure exhaust tank 4.

Associated with the upper end of each of the two arc-extinguishing units 15 is an orifice structure 17, through which an arc 18 is drawn. Although FIG. 2 illustrates the position of the several parts in the fully open-circuit position of the device, nevertheless, for purposes of illustration, the arc 18 has been drawn into the figure.

Blast-valve means 19 are associated with the high-pressure storage tank 16, and, in this instance, includes a balanced-pressure blast valve 20. As well known by those skilled in the art, the balanced-pressure blast valve 20 includes an operating piston 21, which, by virtue of an aperture 22, has normally high-pressure gas on both faces of the piston 21. In addition, the operating piston 21 is biased to a valve-closed position by a compression spring 23. The blast valve 20 is opened by dumping the pressure below the operating piston 21, within the region 24, by the opening of a pilot valve 25, which is manually operated through an insulating rod 26, which extends downwardly interiorly through the porcelain column 3 to the operating mechanism disposed within the mechanism compartment 2 (FIG. 1).

A pair of oppositely extending blast tubes 27, 28 extend from a manifold box 29, and lead to the orifice structures 17 to bring about extinction of the arcs 18.

Not only does the released blast of gas from the high-pressure storage tank 16 effect arc extinction but also, by the provision of apertures 30, the issued blast of gas acts downwardly upon operating pistons 31, attached to the movable contacts 32, and forces the same downwardly to an open-circuit position, as illustrated in FIG. 2.

As also shown in FIG. 2, the upper ends of the movable contacts 32 cooperate with resilient, relatively stationary contact fingers 33, constituting collectively a relatively stationary contact structure 34.

As shown, the operating pistons 31, attached to the movable contacts 32, are moved downwardly by the blast pressure in opposition to biasing action exerted by compression springs 36, which are disposed within operating cylinders 37. A lower extension 38 of each movable contact 32 has a notch 40 provided therein, which cooperates with a latch 41, which serves to retain the movable contact 32 in the open-circuit position, as shown.

Preferably, the latch 41 is biased toward a latching position by a coil spring, not shown. To effect releasing of the latch 41, a plunger 42 is provided, spring-biased downwardly by a compression spring 43 to a limiting position, and is moved upwardly to release the latch 41 by the raising of the pressure within the region 44 below a piston 45 attached to the plunger 42. Pipe connections 46 conduct a closing blast of gas into the operating cylinders 47 for moving the pistons 45 upwardly to release

the latches 41. The pipes or conduits 46 interconnect, as at 48, and lead into a vertically extending, insulating closing conduit 49. Thus, compressed gas, passing upwardly through the closing conduit 49, and outwardly through the pipes 46, effects upward movement of the plungers 42 to thereby effect releasing rotative movement of the latches 41 and consequently contact reclosure.

As shown in FIG. 2, the high-pressure storage tank 16 is supplied with high-pressure gas through an upstanding feed conduit 50, composed of insulating material and extending upwardly interiorly within the insulating column 3.

In the closed-circuit position of the circuit interrupter 1, the electrical circuit therethrough includes transmission line 11, terminal stud 51, extending axially through the terminal bushing 9, relatively stationary contact structure 34, movable contact 32, operating piston 31, walls 37 of the operating cylinder (flexible connectors may be employed), to conducting laterally extending supports 52, to which the operating cylinder 37 is bolted, through the metallic walls of the high-pressure tank 16, through the metallic supports 52 at the right-hand end of the high-pressure chamber 16, and through the right-hand arc-extinguishing unit 15 in a similar manner, through right-hand terminal stud 53, and interiorly through terminal bushing 10 to the transmission line 12 (FIG. 1).

In the closed-circuit position of the device, as is obvious, the movable rod-shaped contacts 32 make contact-engagement with relatively stationary fingers 33 of the relatively stationary contact structures 34. To effect opening of the circuit interrupter 1, suitable mechanism, disposed interiorly within the mechanism compartment 2, effects downward opening movement of the insulating operating trip rod 26. The downward movement of the trip rod 26 effects downward opening movement of the pilot valve 25 in opposition to the biasing action exerted by a pilot-valve closing spring 54.

The opening of the pilot valve 25 dumps the high pressure within the region 24 below the operating piston 21 into the general interior 55 of the tank 4, which is at a relatively low pressure, say 30 p.s.i.

Since the pressure within the region 56 on the top side of the operating valve piston 21 is now higher than the relatively low pressure within the region 24, the valve piston 21 will move downwardly, and compress the spring 23, permitting a high-pressure blast of gas to issue through the opening 57 and into the blast tubes 27, 28. The high-pressure gas, passing outwardly through the blast tubes 27, 28 in the direction indicated by the arrows 58, acts downwardly upon the movable contact operating pistons 31 and causes their downward opening movement in opposition to the biasing action exerted by the compression springs 36. Simultaneously, a blast of the gas passes upwardly and out through the orifices 17 to effect extension of the serially related arcs 18. This blast of gas then exhausts into the general interior 55 of the relatively low-pressure exhaust tank 4.

The latches 41 latch to the movable contacts 32, when the latter have attained their fully open-circuit position.

It will be noted that in the fully open-circuit position of the circuit interrupter 1, there are provided two isolating gaps, as afforded by the contact structures 32, 34, due to the latching engagement of the latches 41. The mechanism for operating the insulating trip rod 26 is so adjusted that substantially at the time of arc-extinction the insulating trip rod 26 is released, and the compression spring 54 effects closure of the pilot valve 25. Due to the presence of the aperture 22 through the valve piston 21, the pressure equalizes within the regions 24, 56, and the closing spring 23 brings about closure of the blast valve 20. This is desirable to conserve the supply of high-pressure gas within the high-pressure tank 16. Any loss of the gas pressure within the high-pressure tank 16 is replaced by a flow of high-pressure gas up through the feed con-

duit 50 to replenish the supply of compressed gas within the high-pressure storage tank 16.

To effect closing of the circuit interrupter 1, high-pressure gas is fed upwardly through the closing tube 49, and into the regions 44 below plunger pistons 45. The raising of the plungers 42 will release the latches 41, and permit the contact-closing springs 36 to effect reclosure of the movable contacts 32 with the stationary contact fingers 33. The circuit is hence closed through the interrupter 1.

To insure a fast reclosing operation of the contact structure, one-way-acting ball valve assemblies 60 are provided. With reference to FIG. 3, it will be noted that each ball-valve assembly 60 comprises the ball valve 61, which closes an aperture 62. During the closing stroke of the movable contact 32 and its associated operating piston 31, suction is not permitted to take place within the region 63 below the operating piston 31, since at this time the ball valve opens and permits free flow of gas through the valve assembly 60. As a result, the contact-closing spring 36 provides unimpeded closing movement of the movable contact 32 into engagement with the stationary contact fingers 33.

A Sylphon bellows 65 is provided to prevent passage of the relatively low-gas pressure, which may be of the order of 30 p.s.i., into the interior region 66 within the upstanding supporting insulating column 3. However, where the supporting column 3 is able to withstand the same pressure as is present within the exhaust tank 4, the bellows 65 may be omitted.

In order to effect servicing of the circuit interrupter 1, it will be noted that there need be only an unbolting of the end inspection cover plates 5, 6 by unfastening the bolts 67. After the inspection covers 5, 6 are removed, the arc-extinguishing units 15 may be removed laterally out of the ends of the exhaust tank 4 by unbolting the operating cylinders 37 from the support brackets 52.

From the foregoing description, it will be apparent that there is provided a simplified circuit-interrupting structure employing a novel contact-operating arrangement. As shown in FIG. 2, the main exhaust tank 4 may be filled with a suitable arc-extinguishing gas, such as sulfur hexafluoride (SF_6) gas at a relatively low pressure of 30 p.s.i. High-pressure gas is stored at a high-pressure of say 150 to 200 p.s.i. in both a reservoir at ground potential, not shown, and also in the auxiliary high-pressure storage tank 16 disposed within the main tank 4, all at high potential. When the pilot valve 25 is opened by downward movement of the insulating trip rod 26, pressure is dumped from behind the blast-valve piston 21, which immediately moves downwardly. High-pressure gas flows outwardly to the pair of contact opening pistons 31, which are displaced downwardly and latched in the open position. The arcs 18, drawn through the polytetrafluoroethylene orifices 17, are extinguished by the high-pressure sulfur hexafluoride gas-blast through the orifices 17, and into the main body of the tank 4 at relatively low pressure. The simplified closing operation merely involves the admittance of gas to the pistons 45 under each latch 41, which results in the plungers 42 knocking the latches off, and allowing the contact-closing springs 36 to close the contacts. Particular advantages of the present construction are that less sulfur hexafluoride is required in the gaseous form than in the liquid form, when used in the design disclosed in the aforesaid patent application. Another distinct advantage is that no separate contact operating mechanism is required with heavy operating rods or interphase linkages. A third advantage is that the maximum pressure is only 200 p.s.i., or thereabouts.

Although there has been illustrated and described a particular circuit-interrupting structure 1, it is to be clearly 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 a relatively low-pressure metallic exhaust tank disposed at high potential, a pair of terminal bushings extending into said metallic exhaust tank and carrying relatively stationary contact structures at their interior ends, a high-pressure storage tank disposed at high potential and positioned interiorly within said relatively low-pressure metallic exhaust tank, insulating means for supporting the relatively low-pressure metallic exhaust tank up in the air above ground potential, a pair of movable contacts cooperable with the aforesaid relatively stationary contact structures to establish a pair of arcs, supporting means including said high-pressure storage tank for supporting said pair of movable contacts, and means connecting the two movable contacts in series.

2. A compressed-gas circuit interrupter including a relatively low-pressure metallic exhaust tank disposed at high potential, a pair of terminal bushings extending into said metallic exhaust tank and carrying relatively stationary contact structures at their interior ends, a high-pressure storage tank disposed at high potential and positioned interiorly within said relatively low-pressure metallic exhaust tank, insulating means for supporting the relatively low-pressure metallic exhaust tank up in the air above ground potential, a pair of movable contacts cooperable with the aforesaid relatively stationary contact structures to establish a pair of arcs, blast-valve means for releasing a blast of gas from said high-pressure storage tank to extinguish the arcs, and means including the high-pressure storage tank for connecting the two movable contacts in series.

3. A compressed-gas circuit interrupter including a relatively low-pressure metallic exhaust tank disposed at high potential, a pair of terminal bushings extending into said metallic exhaust tank and carrying relatively stationary contact structures at their interior ends, a high-pressure storage tank disposed at high potential and positioned interiorly within said relatively low-pressure metallic exhaust tank, insulating means for supporting the relatively low-pressure metallic exhaust tank up in the air above ground potential, a pair of movable contacts cooperable with the aforesaid relatively stationary contact structures to establish a pair of arcs, a pair of insulating orifices through which the pair of arcs are drawn, blast-valve means for releasing a blast of gas from said high-pressure storage tank to extinguish the arcs, and means including the high-pressure storage tank for connecting the two movable contacts in series.

4. A compressed-gas circuit interrupter including a relatively low-pressure metallic exhaust tank disposed at high potential, a pair of terminal bushings extending into said metallic exhaust tank and carrying relatively stationary contact structures at their interior ends, a high-pressure storage tank disposed at high potential and positioned interiorly within said relatively low-pressure metallic exhaust tank, insulating means for supporting the relatively low-pressure metallic exhaust tank up in the air above ground potential, a pair of movable contacts cooperable with the aforesaid relatively stationary contact structures to establish a pair of arcs, supporting means including said high-pressure storage tank for supporting said pair of movable contacts, blast-valve means for releasing a blast of gas from said high-pressure storage tank to extinguish the arcs including a balanced-pressure blast valve, a pilot valve actuated from ground potential for dumping the pressure in back of the balanced-pressure blast valve, and means connecting the two movable contacts in series.

5. A compressed-gas circuit interrupter including a relatively low-pressure metallic exhaust tank disposed at high potential, a pair of terminal bushings extending into said metallic exhaust tank and carrying relatively stationary contact structures at their interior ends, a high-pressure storage tank disposed at high potential and positioned interiorly within said relatively low-pressure metallic exhaust tank, insulating means for supporting the relatively low-

pressure metallic exhaust tank up in the air above ground potential, a pair of movable contacts cooperable with the aforesaid relatively stationary contact structures to establish a pair of arcs, supporting means including said high-pressure storage tank for supporting said pair of movable contacts, blast-valve means for releasing a blast of gas from said high-pressure storage tank to extinguish the arcs including a balanced-pressure blast valve, a pilot valve actuated from ground potential for dumping the pressure in back of the balanced-pressure blast valve, means connecting the two movable contacts in series, and an insulating rod extending upwardly interiorly within said insulating means for opening said pilot valve.

6. The combination in a compressed-gas circuit interrupter of an upstanding insulating column, a low-pressure metallic exhaust tank supported at the upper end of the upstanding insulating column, a pair of terminal bushings extending downwardly interiorly within the low-pressure metallic exhaust tank and carrying a pair of relatively stationary contacts at their interior ends, a high-pressure storage tank filled with gas at high pressure and disposed within said exhaust tank, a pair of movable contact structures disposed at opposite ends of said high-pressure storage tank and at least partially supported thereby, and said movable contact structures being cooperable with said pair of relatively stationary contacts to draw two arcs in series.

7. The combination in a compressed-gas circuit interrupter of an upstanding insulating column, a low-pressure metallic exhaust tank supported at the upper end of the upstanding insulating column, a pair of terminal bushings extending downwardly interiorly within the low-pressure metallic exhaust tank and carrying a pair of relatively stationary contacts at their interior ends, a high-pressure storage tank filled with gas at high pressure and disposed within said exhaust tank, a pair of movable contact structures disposed at opposite ends of said high-pressure storage tank and at least partially supported thereby, said movable contact structures being cooperable with said pair of relatively stationary contacts to draw two arcs in series, and blast-valve means operated from ground potential for releasing a blast of gas from the high-pressure storage tank toward the arcs to effect the extinction thereof.

8. The combination in a compressed-gas circuit interrupter of an upstanding insulating column, a low-pressure metallic exhaust tank supported at the upper end of the upstanding insulating column, a pair of terminal bushings extending downwardly interiorly within the low-pressure metallic exhaust tank and carrying a pair of relatively stationary contacts at their interior ends, a high-pressure storage tank filled with gas at high pressure and disposed within said exhaust tank, a pair of movable contact structures disposed at opposite ends of said high-pressure storage tank and at least partially supported thereby, said movable contact structures being cooperable with said pair of relatively stationary contacts to draw two arcs in series, a pair of oppositely extending blast tubes, a pair of orifice structures, and blast-valve means for releasing a blast of high-pressure gas through said blast tubes and through the orifice structures to effect extinction of the arcs.

9. A compressed-gas circuit interrupter including a relatively low-pressure metallic exhaust tank disposed at high potential, a pair of terminal bushings extending into said metallic exhaust tank and carrying relatively stationary contact structures at their interior ends, a high-pressure storage tank disposed at high potential and positioned interiorly within said relatively low-pressure metallic exhaust tank, insulating means for supporting the relatively low-pressure metallic exhaust tank up in the air above ground potential, a pair of movable contacts cooperable with the aforesaid relatively stationary contact structures to establish a pair of arcs, supporting means including said high-pressure storage tank for supporting said pair of

movable contacts, means connecting the two movable contacts in series, means latching the pair of movable contacts in the open position, and pressure-actuated means for releasing said latching means.

10. The combination in a compressed-gas circuit interrupter of an upstanding insulating column, a low-pressure metallic exhaust tank supported at the upper end of the upstanding insulating column, a pair of terminal bushings extending downwardly interiorly within the low-pressure metallic exhaust tank and carrying a pair of relatively stationary contacts at their interior ends, a high-pressure storage tank filled with gas at high pressure and disposed within said exhaust tank, a pair of movable contact structures disposed at opposite ends of said high-pressure storage tank and cooperable with said pair of relatively stationary contacts to draw two arcs in series, supporting means including said high-pressure storage tank for supporting said pair of movable contacts, means latching the pair of movable contacts in the open position, and pressure-actuated means for releasing said latching means.

11. The combination in a compressed-gas circuit interrupter of a conducting reservoir tank, a pair of spaced gas-blast interrupting units at least partially supported on opposite sides of said conducting reservoir tank, each in-

interrupting unit including a spring-biased-closed movable contact, latching means associated with each interrupting unit to latch the respective movable contact in the open circuit position, means including said conducting reservoir tank for electrically interconnecting the two movable contacts in series, and blast-valve means for releasing a blast of gas from said conducting reservoir tank toward both gas-blast interrupting units to effect arc extinction therein.

12. The combination set forth in claim 11 wherein gas-actuated releasing means are associated with each unit to effect release of the respective latching means for bringing about contact reclosure.

13. The compressed-gas circuit interrupter according to claim 2, wherein the metallic exhaust tank is electrically connected to the movable contacts and is at line potential in the closed circuit position of the interrupter.

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