COMPRESSED GAS SWITCH

Filed Sept. 11, 1929 2 Sheets-Sheet 1

Fig. 1.

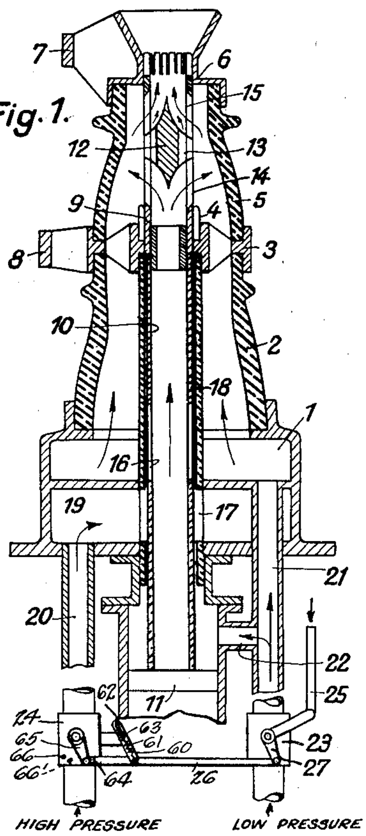


Fig. 2.

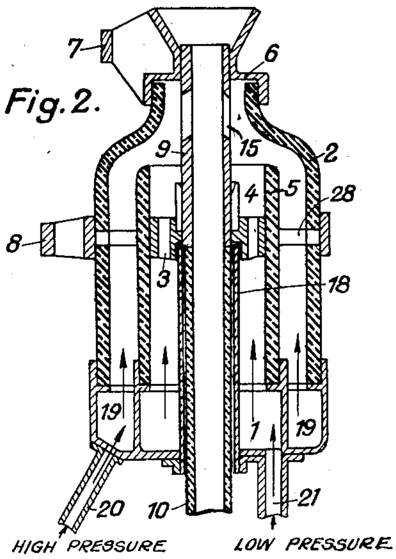


Fig. 4.

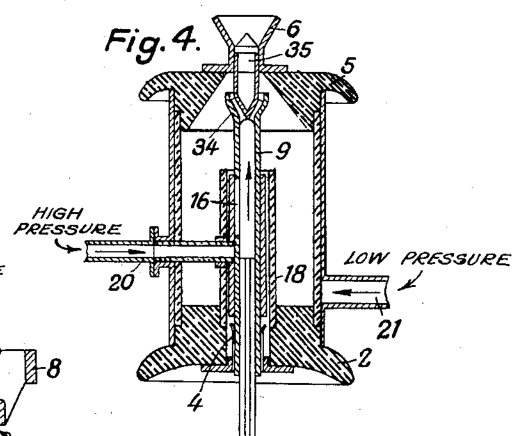


Fig. 3.

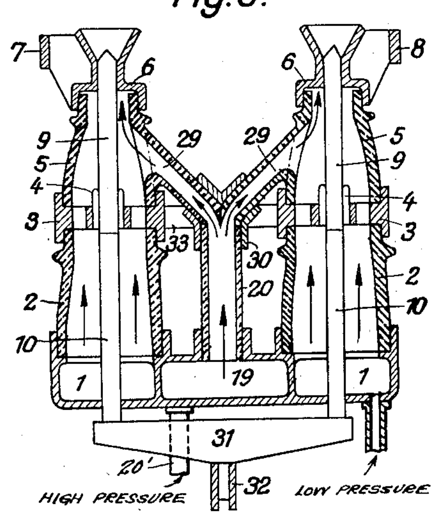
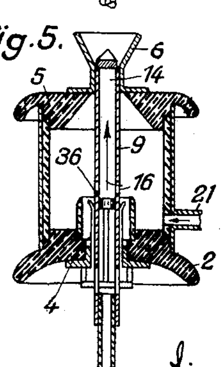


Fig. 5.



Inventor:

Nov. 28, 1933. S. RUPPEL 1,937,482

COMPRESSED GAS SWITCH

Filed Sept. 11, 1929 2 Sheets-Sheet 2

Fig. 6.

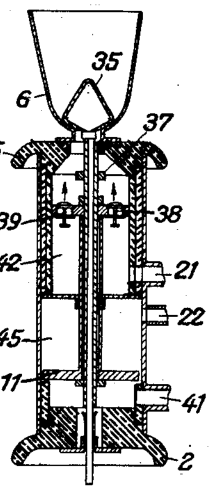


Fig. 8.

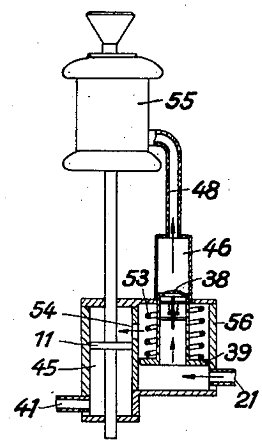


Fig. 7.

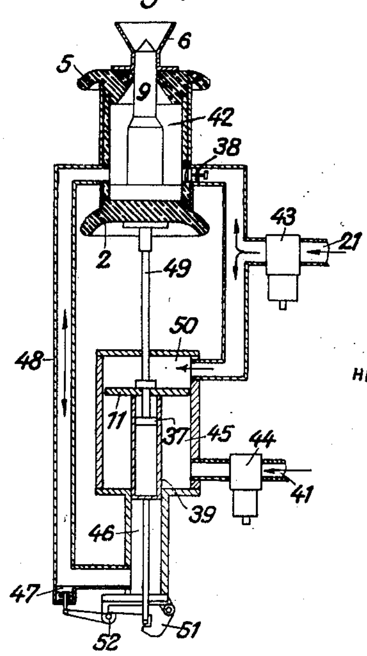
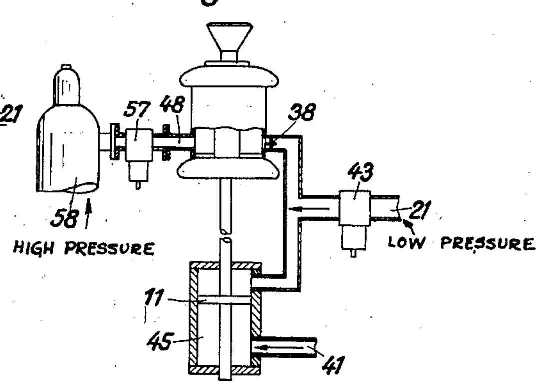


Fig. 9.



Inventor:

Sigwart Ruppel.

Patented Nov. 28, 1933 1,937,482

UNITED STATES PATENT OFFICE

1,937,482

COMPRESSED GAS SWITCH

Sigwart Ruppel, Frankfort-on-the-Main, Germany

Application September 11, 1929, Serial No. 391,944, and in Germany September 18, 1928

8 Claims. (Cl. 200—148)

This invention relates to electric switches of the gas-blast type wherein the arc gap is traversed by gas under pressure causing interruption of the circuit.

In the operation of gas-blast switches the use of a supplementary blast at higher pressure in connection with the normal blast is advantageous in that the interrupting capacity of the switch is correspondingly increased. In other words, the high pressure supplementary blast is effective to extinguish arcing within a very short interval, after which the normal blast is effective to prevent reestablishment or restriking of the arc across the contacts while they are still separated.

The principal object of the present invention is the provision of an improved gas-blast switch of the multiple blast type which shall have increased current interrupting capacity.

My invention will be more fully set forth in the following description referring to the accompanying drawings, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawings, Fig. 1 is an elevational view, partly in section, of a switch of the multiple-blast type; Fig. 2 is a similar view showing another form of multiple-blast switch; Fig. 3 is an elevational view, partly in section, of a double pole multiple-blast switch; Fig. 4 is an elevational sectional view of another form of multiple-blast switch; Fig. 5 is a similar view showing another form of switch wherein the supplementary blast is caused by opening of the switch; Fig. 6 is an elevational sectional view of a multiple-blast switch showing a differential piston arrangement for effecting the supplementary blast; Fig. 7 is an elevational view, partly in section, showing another arrangement for effecting the supplementary blast; Fig. 8 is an elevational view, partly in section, showing another means for causing a supplementary blast, and Fig. 9 is a similar view showing a gas-blast switch having two separate sources of gas pressure.

For the purpose of subjecting the arc gap or space between the contacts to a multiple blast in the manner desired, compressed gas at different pressures may be supplied to the switch from different compressed gas sources or vessels, and a blast from one source may replace the other or act as a supplementary blast during circuit interruption. The timing of the different blasts may be effected in any suitable manner, as in accordance with the circuit interrupting operation, one method involving the control of the supplementary blast by the movable contact itself. The duration of the blast may be controlled, as by varying the opening period or the stroke of the gas-blast valve which may be controlled as required.

The blast pressure may also be made dependent upon the above factors and may, of course, be increased automatically if desired, by interconnecting compressed gas vessels or other sources of gas pressure. During closing of the switch a short blast across the contacts may also be advantageous for the purpose of preventing burning of the contacts during closing on heavy currents. Likewise a testing or cleaning blast is desirable when the switch is out of operation and disconnected from the circuit.

Fig. 1 illustrates a compressed gas switch having means for effecting gas blasts at different pressures. That is, a normal or comparatively low pressure blast is utilized to open the switch and to start flow of gas through the switch, and a high pressure blast which may be comparatively brief in duration, is utilized exclusively for extinguishing the arc formed between the separating contacts. The advantage of such a combination is apparent since the high pressure source could not well be connected directly to the switch operating piston because of the stresses involved. Furthermore, the normal or low pressure gas source is available for effecting interruption of arcing in the event that the supplementary high pressure source should fail.

Referring more particularly to the structure shown, a main gas collecting chamber 1, which is formed by housing structure 1' is adapted to be in communication with the low pressure or operating source and with the interior of the switch housing through which the arc extinguishing blast is directed. The switch housing comprises a pair of insulating shells 2 and 5 mounted on the housing 1', the shells 2 and 5 being separated by a terminal structure 3 including the current terminal 8.

The stationary contact structure comprises a nozzle-like contact 6 which includes the other current terminal 7, mounted on the upper end of the insulating shell 5. The coacting movable contact comprises a tubular member 9 arranged to engage at its upper end the nozzle contact 6. The movable contact 9 makes sliding contact with a sleeve contact 4 connected to the terminal structure 3, the switch circuit in the closed position from terminal 7 to terminal 8 including the stationary contact 6, tubular contact 9, and terminal structure 3.

The operating means for the movable contact comprises a piston 11 connected through an insulating tube 10 to the tubular contact 9. The movable contact structure is guided for reciprocal longitudinal movement within an insulating tube 18 which is provided with openings 17 at its lower end communicating with a gas chamber 19 leading from the high pressure source. The tube 10 is likewise provided with openings 16 adapted to register with the openings 17 so that the interior of the tube 10 may be in communication with chamber 19. In the closed circuit position shown, the openings 16 are closed by the guide tube 18.

The normal or low pressure source may be simultaneously connected by means of a valve 23 through pipe 22 to the switch operating piston 11 and through pipe 21 to the gas collecting chamber 1. From this chamber it is directed upwardly through the casing to the point of separation and through the nozzle contact.

The high pressure source may be connected by means of a valve 24 through the pipe 20 to the chamber 19 so as to cause a high pressure blast upwardly through the insulating tube 10 and contact 9 when the switch is opened sufficiently.

For the purpose of guiding in a predetermined manner the aforesaid high pressure gas blast the tubular contact 9 is provided with a deflector 12 arranged to deflect part of the high pressure blast from the tube 10 through the openings 14 and into the switch casing. Accordingly a blast of gas crosses the annular arc gap between the outside of the contact 9 and the nozzle contact 6. The deflector 12 is likewise provided with apertures 13 so that some of the high pressure gas may exhaust through the interior of the tubular contact. With this arrangement it is immaterial whether the arc impinges on the inner or outer surface of the tubular contact since an effective blast is available in either event. Likewise coacting with the deflector 12 are openings 15 in the tubular contact serving to direct part of the initial low pressure blast into the tubular contact.

In operation, the low pressure valve 23 is first opened resulting in downward movement of the piston 11 and flow of gas through the switch casing to exhaust through the nozzle contact 6. The high pressure valve 24 is subsequently opened, at which time the openings 16 in the tube 10 communicate with the chamber 19. The resulting high pressure blast through the tube 10 causes parallel high velocity jets of gas to flow, both exteriorly and interiorly of the tubular contact 9 and through the exhaust of the nozzle contact 6 to extinguish arcing in the manner above described.

The means for effecting the desired operation of the valves 23 and 24 comprise by way of example an actuating rod 25 which may be operatively connected to the switch tripping mechanism. The rod 25 is operatively connected to the valve 23 by means of a bell crank 27, one arm of the bell crank being operatively connected through link 26 to the actuating arm 65 of the valve 24. The valve 24 is preferably biased as by a spring (not shown) to the closed position indicated. The link 26 is provided with a stop member 64 having camming engagement with the end of the valve arm 65. The link 26 is pivotally connected to the guide link 60 which is provided with a spring 61 connected at one end to the pivotal connection with the link 26 and at its other end to a fixed pin 63 mounted within a slot 62 in the link 60. Accordingly, when the circuit breaker is tripped the rod 25 is moved downwardly, rotating the crank 27 clockwise and opening the valve 23. This operation shifts the link 26 toward the left as viewed so that the stop member 64 causes opening movement of the high pressure valve arm 65. When, however, the high pressure valve has opened sufficiently, the arm 65 strikes an adjustable stop member located at 66 or 66′, as the case may be, causing the stop member 64 to ride underneath the arm 65 against the tension of the spring connection above described thereby releasing the arm 65 which immediately returns to the initial closed position.

Accordingly, the tripping operation may effect opening of the low pressure valve 23, predetermined opening of the high pressure valve 24, and immediate reclosing of the valve 24. This sequence of operation accomplishes the purposes of the low pressure and high pressure blasts above described.

Fig. 2 illustrates a compressed gas switch wherein the supply of compressed gas is directed through a casing surrounding the switch chamber. Mounted above the compressed gas collecting chamber 1 is an insulating cylinder 5 carrying current terminal structure 3 including the wiping sleeve contact 4. A second insulating cylinder 2 is mounted above the compressed gas chamber 19 so as to surround the insulating cylinder 5 and form therewith an annular gas passage communicating with the chamber 19. The cylinder 2 has mounted on its upper end the stationary nozzle contact 6 including the current terminal 7. The other current terminal 8 is electrically connected with the current lead ring 3 by means of a through bolt 28.

When the switch is closed, the movable tubular contact 9 interconnects sleeve contact 4, forming part of the terminal structure 8 and the nozzle contact 6. The tubular contact 9 is provided at 15 with openings for directing gas into the tubular contact in the manner previously referred to.

The gas chambers 1 and 19 are connected to the low and high pressure sources by means of pipes 21 and 20 respectively so that during the circuit opening operation the resulting arcing between contacts 9 and 6 is subjected to both an interior and exterior blast with respect to the movable contact 9. The low pressure blast is directed upwardly through the cylinder 5, whereas the high pressure blast is directed upwardly through the annular space between the cylinders 2 and 5. It will be apparent that the low and high pressure sources may be controlled in the manner described in connection with Fig. 1. For the purpose of increasing the extinguishing action of the gas, compressed gas may also be supplied, if desired, directly through the tube 16.

Fig. 3 illustrates a double-pole compressed gas switch having a double blast arrangement. The switch is similarly constructed to that of Fig. 1 and like reference numerals designate like parts. The hollow insulating support 5 carrying the stationary nozzle contact 6, referring to a single-pole, is provided with a supply pipe 29 for the high pressure blast. The supply pipes 29 are united in a T-piece 30 and are connected with the high pressure gas chamber 19 through the insulating pipe 20. The chamber 19 is suitably connected to a high pressure source by pipe 20′. The two wiping sleeve contacts 4 are electrically interconnected by the conducting bar 33, the course of the current in the closed circuit position being as follows: Terminal 7, nozzle contact 6, movable contact 9, terminal ring 3, wiping contact 4, bar 33, (referring now to the other pole) terminal ring 3, wiping contact 4, movable contact 9, and nozzle contact 6, to the other terminal 8.

The movable contacts are connected to insulating tubes 10 mounted on a bridging member 31 which is operated by a transverse bar 32. As in the previous cases, the low pressure source is connected to the chamber 1 and the high pressure source to the chamber 19 for effecting the arc extinguishing blast in the manner desired.

Fig. 4 illustrates a compressed gas switch in which the supplementary high pressure gas may be directed from a pipe 20 to the point of circuit interruption through the movable hollow contact 9. In this case, the movable contact 9 is provided with a contact extension 35 which is mounted above an enlarged or flared portion 34 of the tubular contact in such a manner that a current of gas annular in cross section impinges on the contact extension. While gas at normal pressure flows through pipe 21 during initial opening, the hollow contact 9 itself controls by means of the opening 16 admission of the high pressure blast to the point of circuit interruption. The other reference numerals employed in this figure have the same significance as in the preceding figures.

For the purpose of creating a supplementary high pressure blast by operation of the switch itself various arrangements may be employed. Thus, for example, the pressure normally supplied to the switch can be increased within the switch chamber, within the driving cylinder, or hollow contact structure, or within special pressure chambers and from there directed to the point of circuit interruption. This compression may be effected in the course of the circuit opening movement by the switch operating gear, the operating gear causing separation of the contacts only when a predetermined degree of compression has taken place. A particular advantage of increasing the pressure of the supplementary blast, in addition to the increased circuit interrupting capacity, is that the gas layer at high pressure interposed between the contacts prevents "backfiring" of the arc at high voltage. This "backfiring" of the arc is due to the counter-pressure or resistance of the arc to displacement by the gas blast and may result in shifting of the arc to a point where it is not subjected to effective action of the blast. However, after the arc is extinguished and the contacts have been separated an appreciable distance it is sufficient to continue the blast at the lower or normal pressure.

Since the action of the gas blast on the electric arc leads in a short time to its extinction, due to movement of the arc base points, cooling and mechanical disruption of the arc and other factors, the supplementary high pressure gas blast need last only for about 0.02 to 0.03 seconds; that is, several alternations of the current, so that the volume of gas necessary is comparatively small.

Fig. 5 shows a compressed gas switch having a supplementary high pressure blast arrangement in which the increase of pressure is effected in the hollow contact 9 itself. Compressed gas flows through the supply pipe 21 into the switch chamber and passes through the opening 16 into the hollow contact 9. When the switch begins its switching off movement—i. e. when contact 9 moves downwards—the stationary piston 36 closes the openings 16 and compresses the pressure gas present in the hollow contact 9. On continuation of the switching off movement, the openings 14, that have until then been closed by the nozzle shaped coacting contact 6, are uncovered and the pressure gas compressed in the contact 9 flows out through these openings. The result of the compression of gas within the tube 9 is that the circuit-breaking takes place with a certain amount of retardation during which the movable contact is located in the most favorable arc extinguishing position. At this position, which is beneath the narrowest part of the passage through the nozzle contact 6, the compressed gas is directed from the hollow contact into the annular space between the contacts 6 and 9. The blowing takes place along the middle contact towards the base point of the middle contact and against the arc, which is extinguished during the blowing with the compressed gas. The contact then moves rapidly (the restraint being removed by the compressed gas) into the switching off or open circuit position.

Fig. 6 illustrates an arrangement wherein compression of pressure gas further to increase the pressure is effected by the switch-driving mechanism 45. Compressed gas flows through the pipe 21 into the switch chamber 42 and is admitted to the upper part of the switch chamber by the spring-controlled pressure valves 38. After admission of pressure gas to the switch chamber 42 compressed gas is admitted into the opening 41 below the driving piston 11. The compressing piston 39 carrying the valves 38 is rigidly connected, as by a sleeve, with the piston 11. The correct ratio of the diameters of the piston 11 and the piston 39 is not shown in the drawings. The area of the piston 11 is a multiple of that of the piston 39. The pressure gas present above the piston 39 is consequently compressed and, on the continuation of the switching off movement, the contact 35 is separated from contact 6 through the intermediary of the stop 37. The compressed pressure gas above the piston 39 which now is at greater pressure than the gas admitted to chamber 42 flows out with a powerful blast across the arc gap, during the favorable extinguishing position of the contacts. After the pressure above the piston 39 has fallen below that prevailing in the switch chamber 42 beneath it, further blowing with pressure gas of normal pressure is continued through the inlet openings 21 and valves 38 by reason of the aforesaid pressure differential. The ratio of the quantity of compressed pressure gas to the quantity of pressure gas that follows it at normal pressure may be chosen so that the compressed pressure gas is sufficient for extinguishing the arc at break of circuit and prevents a re-ignition in the extinguishing position, whereas the following compressed gas prevents re-ignition on further switch movement. The pipe 22 represents the compressed gas inlet for the switching on operation. In this case also reference numerals have the same significance as those used in the case of the preceding figures.

Fig. 7 shows an embodiment in which the piston 11 of the compressed gas driving gear 45 effects the compression of the pressure gas that is necessary for the high pressure blast. The switching out operation is as follows:—the pressure gas flowing in through the tube 21 and switching off valve 43 fills the space 50 above the driving piston and, by way of the pressure valve 38, the switch blowing chamber 42 and also the compression chamber 46 through the pipe 48.

The piston 11 which is rigidly connected with the compression piston 39, is prevented by the latch comprising the catch 51 and the half shaft 52 from moving until the pressure-controlled releasing piston 47 responds to the presence of gas pressure, at the pressure admitted to the chambers 42 and 46. The piston 47 then liberates the catches 51 and 52 and the driving piston 11 and compression piston 39 move downwards under the influence of the pressure acting upon the piston 11 in the chamber 50, without, however, taking the contact 9 with it through the insulating rod 49. The compression piston 39 compresses in chamber 46 the pressure gas present beneath it and the pressure valve 38 closes. On continuation of the switching off operation, the piston 11 takes the contact 9 along with it by means of the lost motion connection comprising the stop 37 and insulating rod 49. The velocity of the switching off operation will, during the circuit-breaking, be damped, and increased after the circuit-breaking because in one case diminution of pressure of the compressed gas flowing through the pipe 21 to the blowing position will be avoided and, in the other case the compression below the piston 39 will be reduced by the blast due to the compressed pressure gas flowing through pipe 48, blowing chamber 42 and exhaust contact nozzle 6. After the completion of the switching off operation, compressed gas continues to flow between the contacts by way of pipe 21 and pressure valve 38 until the valve 43 stops this gas supply. The pipe 41 and the valve 44 constitute the supply means of the compressed gas for switching on. The reference numerals in this figure have the same significance as those in the preceding figures.

Fig. 8 shows a compressed gas switch 55 in which the compressed gas driving gear 45 is combined with a pressure increasing vessel 56. The switching off operation is effected as follows:— The compressed gas passes through pipe 21, beneath the piston 39, through the valve 38, the compression chamber 46 and the pipe 48, into the switch-blowing chamber 42. When the pressure prevailing in the latter is the same as that of the inflowing compressed gas, the valve 38 closes under the action of its closing spring. The piston 39 now compresses the pressure gas present in the compression chamber 46 above it, and then, shortly before its final position, uncovers the inlet openings 54 to the driving piston 11, whereupon switching off takes place. By suitably choosing the size of the chamber 46, it is possible to have an increased pressure blast during the circuit-breaking and also shortly after for withstanding the return voltage. The spring 53 returns the piston 39 to its initial position after the switching off operation has been completed. The pipe 41 is the inlet for the compressed gas for switching on and the remaining numerals have the same significance as in the preceding figures.

If, as shown in Fig. 9, the switch has a supplementary higher pressure blast, a pressure valve 38 must be arranged in the supply pipe in front of or behind the valve 43.

This pressure valve 38 is for preventing the passage of compressed gas at higher pressure into the lower pressure pipe. When the switch is operated with valve 57 closed, the compressed gas flowing in through pipe 21 performs both the operation of the switch by the compressed gas driving gear 45 and the blowing. If during the switching off movement the valve 57 is opened, as by time or current relays, the valve 38 closes because gas at a higher pressure is blown out of the compressed gas cylinder 58, through the pipe 48 and into the switch chamber. The result of this is that the switching off movement is accelerated because a diminution of pressure of the gas flowing in through the pipe 21 towards the blowing position is avoided. In this way the result is obtained that the switch velocity is at not too high a standard and the circuit-breaking velocity only increases after the gas at higher pressure is admitted to effect the disconnection and withstand the return voltage.

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

1. An electric circuit interrupter of the gas-blast type comprising a casing forming a gas-containing chamber, relatively movable electrodes separable at one end of said chamber to form an annular arc gap through which gas may exhaust at high velocity from said chamber to extinguish the arc formed in said gap, means for directing a gas blast across said gap upon initial separation of said electrodes, and means for controlling application of a subsequent blast of gas at a different operating pressure across said gap upon continued opening movement of said electrodes.

2. An electric circuit interrupter of the gas-blast type comprising relatively movable electrodes separable to form an arc gap, means controlling the application of gas to said arc gap, and means controlled by said electrodes for directing a subsequent application of gas at a different pressure so that said arc gap is traversed in a predetermined order by different gas blasts.

3. A gas blast circuit interrupter comprising a casing forming a gas-containing chamber, relatively movable electrodes separable at one end of said chamber to form an annular arc gap through which gas may exhaust to interrupt the arc, one of said electrodes comprising a tubular member, means for directing a gas at an operating pressure into said chamber and across said gap, and means controlled by said tubular electrode for admitting gas at a different pressure to said chamber and said gap upon predetermined opening movement of said tubular electrode.

4. A gas blast circuit interrupter comprising a casing, relatively movable electrodes separable to form an arc gap through which gas under pressure within said casing may exhaust, means including a differential piston for increasing the gas pressure within said casing, means for directing gas under pressure to actuate said piston, causing separation of said electrodes, and means for supplying a blast of gas at high pressure to said gap from said differential piston.

5. A gas blast circuit interrupter comprising a casing forming a gas-containing chamber, relatively movable electrodes disposed at one end of said chamber, one of said electrodes movable to form an arc gap through which gas from said chamber may exhaust to extinguish the arc, a differential piston operatively connected to said movable electrode, means for directing a gas at an operating pressure into said chamber, and means for directing gas under pressure to actuate said piston so that the gas pressure within said chamber is increased during opening of said electrodes for extinguishing the arc in said gap.

6. A gas blast circuit interrupter comprising a casing forming a gas-containing chamber, relatively movable electrodes separable at one end of said chamber to form an arc gap through

which gas under pressure from said chamber may exhaust to extinguish the arc, a differential piston operatively connected to one of said electrodes, means for directing gas at an operating pressure to said chamber and to said piston to cause opening of said electrodes, said differential piston developing a higher gas pressure than said operating pressure, means for directing gas at said higher pressure to said chamber for extinguishing the arc in said gap, and valve structure for confining the flow of gas at said higher pressure through said chamber and across said gap, said valve structure operable to re-admit gas at said operating pressure upon decrease in gas pressure within said chamber whereby gas continues to traverse said gap at said operating pressure.

7. A gas-blast circuit interrupter comprising relatively movable electrodes separable to form an arc gap, means directing gas under pressure to said circuit interrupter, and means including a differential piston utilizing said gas pressure to effect a suplementary blast of gas at higher pressure across said arc gap.

8. A gas-blast circuit interrupter comprising relatively movable electrodes separable to form an arc gap, means directing gas under pressure to said circuit interrupter, means responsive to said pressure separating said electrodes, means including a differential piston utilizing said gas pressure to effect a supplementary blast at higher pressure across said arc gap, and means operatively connected to said piston controlling separation of said electrodes.

SIGWART RUPPEL.