Jan. 18, 1949. B. P. BAKER 2,459,612

COMPRESSED GAS CIRCUIT INTERRUPTER

Filed Dec. 22, 1944 2 Sheets-Sheet 1

Fig. 1.

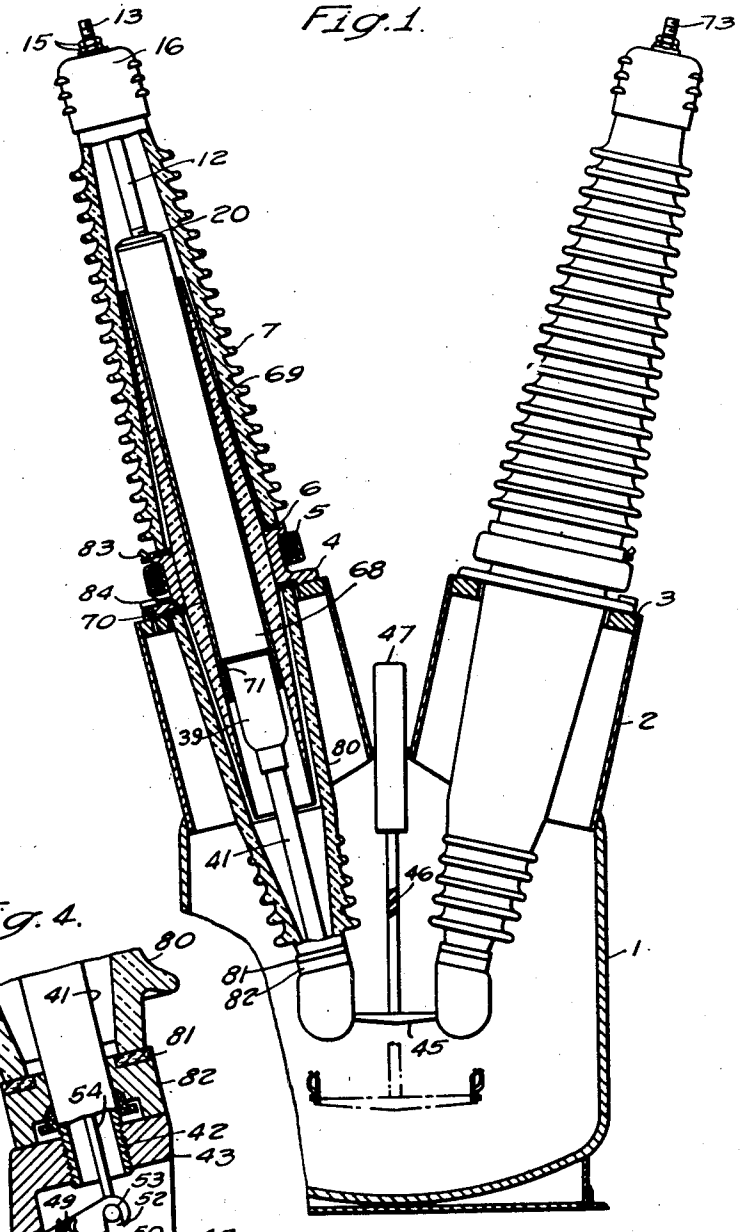


Fig. 4.

INVENTOR
Benjamin P. Baker.
BY
Ralph W. Swingle
ATTORNEY

Jan. 18, 1949. B. P. BAKER 2,459,612

COMPRESSED GAS CIRCUIT INTERRUPTER

Filed Dec. 22, 1944 2 Sheets-Sheet 2

Fig. 2.

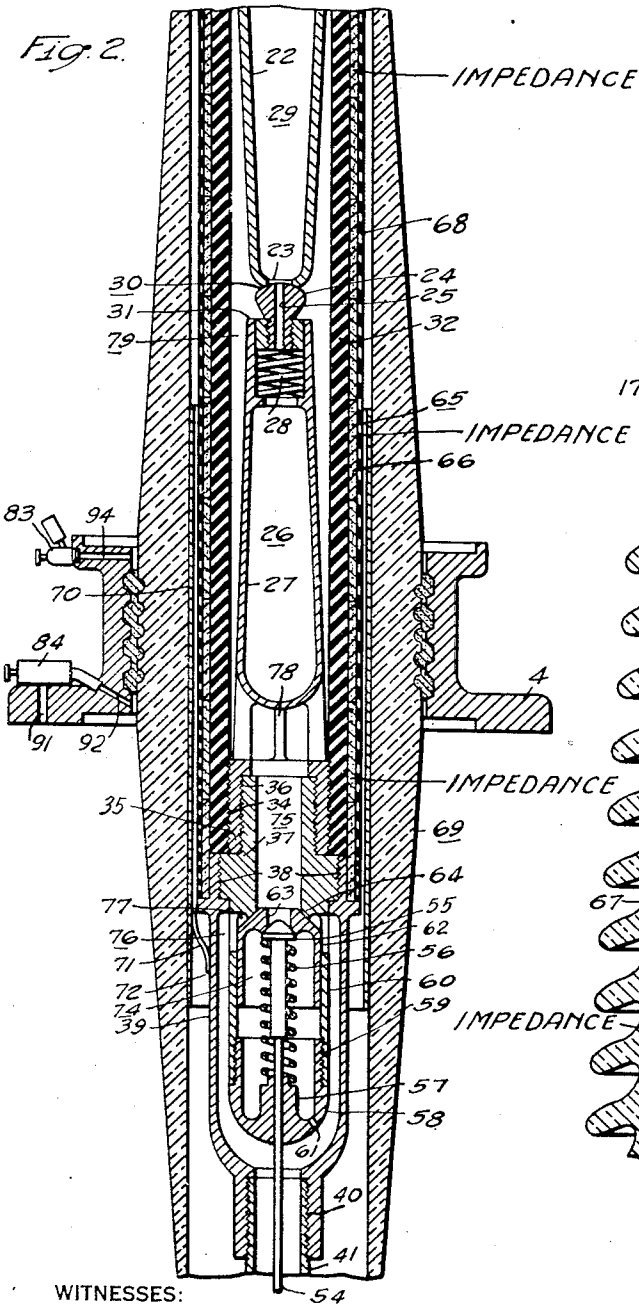
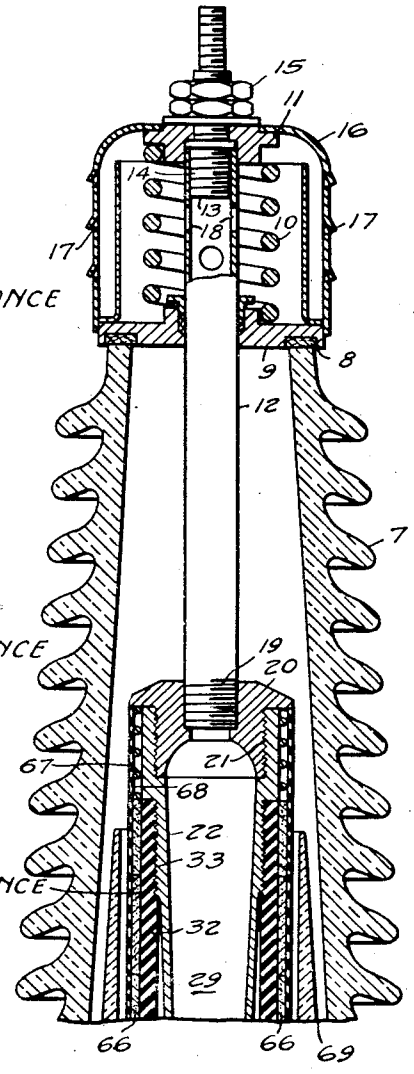


Fig. 3.



WITNESSES:

E. A. McCloskey.

W. R. Crout

INVENTOR

Benjamin P. Baker.

BY

Ralph W. Swingle

ATTORNEY

2,459,612

UNITED STATES PATENT OFFICE

2,459,612

COMPRESSED GAS CIRCUIT INTERRUPTER

Benjamin P. Baker, Turtle Creek, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application December 22, 1944, Serial No. 569,349

8 Claims. (Cl. 200—148)

1

This invention relates to circuit interrupters in general and, more particularly, to circuit interrupters of the fluid blast type.

In a patent application filed November 28, 1944, Serial No. 565,456 by Leon R. Ludwig and Benjamin P. Baker and assigned to the assignee of the instant application there is disclosed and claimed a novel circuit interrupting structure of the gas blast type in which a container is employed filled with a suitable arc extinguishing gas under elevated pressure. Two bushings extend through the container and a movable traverse electrically interconnects the lower ends of the terminal means extending through the two bushings in the closed circuit position of the interrupter. In other words, the aforesaid application attempts to adapt gas blast circuit interrupters in a way to employ the advantageous constructional details of dead tank oil circuit breakers. The initial opening movement of the movable traverse actuates valve means disposed within each bushing to permit a flow of gas from the pressurized container through the bushings to effect the extinction of an arc disposed adjacent each bushing, the gas exhausting out through each bushing to the atmosphere externally of the container.

It is an object of my present invention to improvise a circuit interrupter of the type described in the aforesaid application in which are incorporated improved constructional details.

Another object is to provide an improved circuit interrupter in which a movable contact engages an orifice in the closed circuit position and to provide an opening through the movable contact which communicates with a substantially enclosed storage region into which the movable contact is retracted during the opening operation.

Another object is to provide an improved circuit interrupter of the type described in the aforesaid application in which improved means are employed to relieve the electrical stress between the conducting terminal members extending through the bushings and the grounded flange means which are utilized to support the bushings.

Another object is to provide an improved circuit interrupter of the aforesaid type in which impedance means are used to uniformly distribute the recovery voltage longitudinally of the bushing to minimize the electrical stress imposed upon the interrupting structure disposed in each bushing.

Another object is to provide an improved circuit interrupter of the foregoing type in which the dielectric strength of the bushings are improved by maintaining a portion of the bushing at an elevated pressure.

2

A more general object of my invention is to improvise an improved circuit interrupter of the gas blast type which embodies in advantageous commercial form the basic ideas set forth in the aforesaid application.

Another object is to provide an improved circuit interrupter of the type employing a container filled with gas at an elevated pressure in which the mechanical stress imposed on the bushings extending into the container is greatly relieved by novel tensioning means extending through the bushings.

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

Figure 1 is an elevational view, partially in section, of a complete circuit interrupter embodying my invention and shown in the closed circuit position;

Fig. 2 is an enlarged vertical sectional view through a portion of the bushing means utilized in Fig. 1;

Fig. 3 is the upper portion of the bushing means shown in Fig. 2; and

Fig. 4 shows the lower portion of the bushing means shown in Fig. 2.

Referring to the drawings and more particularly to Fig. 1 thereof, the reference numeral 1 designates a container, in this instance a grounded metal tank, which is filled with a suitable arc extinguishing gas at an elevated pressure, say 250 pounds per square inch. The upper portion of the container has welded thereto two upstanding cylindrical metal members 2 having their upper ends closed by metallic ring-shaped plates 3. Each plate 3 supports a grounded flange 4 about which is disposed a current transformer 5.

A gasket 6 is disposed between the flange 4 and a porcelain bushing 7. Referring to Fig. 3 it will be observed that a second gasket 8 is provided at the top of the bushing 7 which supports a plate 9 serving as the lower seat of a compression spring 10. The upper end of the compression spring seats against a plate 11 which is maintained at the top of a conducting tube 12 by a stud 13 threadedly secured at 14 to the top of the tube 12 and nuts 15. The nuts 15 may be employed to attach the line terminal to the stud 13. A cup-shaped conducting cover 16 is provided having louvre openings 17. Apertures 18 are provided at the upper end of the tube 12 externally of the plate 9.

The lower end of the tube 12 is threadedly secured at 19 to a conducting cap 20, the latter being threadedly secured at 21 to a conducting exhaust member 22. The lower end of the exhaust member 22 forms an orifice 23 clearly shown in Fig. 2. Cooperable with the orifice 23 is a movable contact 24 having an opening 25 extending therethrough which communicates with a substantially enclosed storage chamber 26 formed by a conducting casting 27.

A compression spring 28 biases the movable contact 24 upwardly into engagement with the orifice 23 so that the storage chamber 26 communicates only through the opening 25 to the region 29 provided by the exhaust member 22.

The interrupting means generally designated by the reference numeral 30 comprising the movable contact 24 and orifice 23 are enclosed within a region 31 defined by an insulating cylindrical member 32 which is threadedly secured at its upper end to the exhaust member 22 at 33. The lower end of the cylindrical member 32 is threadedly secured at 34 to a portion 35 integrally formed with the casting 27.

The portion 35 is in turn threadedly secured at 36 to a valve casting member 37. The casting 37 is threadedly secured at 38 to a valve housing 39, the lower end of which is threadedly secured at 40 to a conducting tube 41.

Referring to Fig. 4 it will be observed that the lower end of the conducting tube 41 is threadedly secured at 42 to a stationary disconnect member 43 having stationary disconnect fingers at 44. The stationary disconnect fingers 44 electrically engage in the closed circuit position as shown in Figs. 1 and 4 with a conducting traverse 45 vertically actuated in a reciprocal manner by an insulated operating rod 46 actuated by suitable operating means disposed within a housing 47 which may be of a conventional type. At the opposed outer ends of the traverse 45 are friction fingers 48 which frictionally engage a pin 49 rigidly secured to a link 50, the left-hand end of which is pivotally mounted at 51 to a fixed pivot which is supported on the disconnect member 43.

The right-hand end of the link 50 has a notch 52 formed therein through which passes a pin 53 secured to the lower end of a rod 54 passing through the tube 41 and serving to actuate a pilot valve 55 spring biased upwardly by a compression spring 56. The lower end of the compression spring 56 seats against a portion 57 of a cap 58 threadedly secured at 59 to a cylindrical portion 60 of the valve casting 37. A port 61 is provided in the cap 58, the purpose for which will appear more fully hereinafter. Guided by the cylindrical portion 60 of the valve casting 37 is a cylindrically formed blast valve 62 having an orifice 63 formed therein which is normally closed by the pilot valve 55. Thus it will be apparent that the compression spring 56 not only biases the pilot valve 55 upwardly to close the orifice 63 in the blast valve 62, but also the compression spring 56 forces the blast valve 62 to seat against a portion 64 formed by the valve casting 37.

Disposed about the cylindrical member 32 are impedance means 65, in this instance assuming the form of resistance sleeves 66. Thus the impedance means 65 serve to uniformly grade the recovery voltage transient along the cylindrical member 32 to relieve the imposition of electrical stress thereon and other functions hereinafter set forth. A compression spring 67 (Fig. 3) serves to maintain the resistance sleeves 66 in proper abutting engagement.

Externally of the compresison spring 67 and the resistance sleeves 66 is an insulating cylinder 68 more clearly shown in Fig. 1. Disposed externally of the cylinder 68 is an elongated cylindrical porcelain member 69 rigidly secured in place by the flange 4 and having a conducting metallic coating provided on its interior surface at 70. A spring clip 71 is attached to the member 69 to electrically interconnect the metallic coating 70 with the conducting portion 72 of the valve housing 39, the purpose for which will appear more fully hereinafter.

The operation of the interrupter will now be explained. In the closed circuit position of the interrupter as shown in Fig. 1 the electrical circuit therethrough comprises the stud 13, conducting tube 12, cap 20, conducting exhaust member 22, orifice 23, movable contact 24, conducting casting 27, valve casting member 37, valve housing 39, conducting tube 41, stationary disconnect member 43, disconnect fingers 44, through the conducting traverse 45 and through the other bushing to the terminal stud 73 of the other bushing.

To open the electrical circuit passing through the interrupter, suitable means, not shown, disposed within the housing 47 causes downward movement of the insulating operating rod 46 and hence downward movement of the conducting traverse 45. The initial downward movement of the conducting traverse 45 causes the fingers 48 to frictionally carry the pin 49 therewith and hence to cause clockwise rotation of the link 50 about the fixed pivot 51 thereby lowering the rod 54 and causing the opening of the pilot valve 55. The opening of the pilot valve permits the high pressure gas within the region 74 to exhaust through the orifice 63 to the region 75 which is normally maintained at atmospheric pressure. When the high pressure gas exhausts from the region 74 the high pressure gas within the region 76 acts downwardly on the conical portion 77 of the blast valve 62 to cause a downward movement of the same, and hence a permitting of the high pressure gas to flow from the region 76 past the valve seat 64 through the region 75 past the spider portion 78 of the casting 27 and into the region 79.

Thus it will be apparent that the region 79 which was originally at atmospheric pressure is caused to increase in pressure as a result of opening the valve 62. The rise in pressure within the region 79 causes a downward movement of the movable contact 24 against the biasing action of the compresison spring 28 to thereby establish an arc between the orifice 23 and the movable contact 24. When the movable contact 24 moves downwardly to open the orifice 23 the high pressure gas within the region 79 exhausts through the orifice 23 adjacent the drawn arc, through the region 29 and upwardly out of the tube 12, through the apertures 18 and out the louvre openings 17 of the cup-shaped cover 16.

It will be observed that the initial downward movement of the movable contact 24 permits the high pressure gas within the region 79 to pass downwardly through the opening 25 into the storage chamber 26 defined by the casting 27. Originally this storage region 26 was at atmospheric pressure inasmuch as it communicated by way of the opening 25 through the orifice 23 to the region 29 which also originally was at atmospheric pressure. The velocity of the gas flow through the opening 25 will be a maximum when the movable contact 24 first begins its downward movement away from the orifice 23 to draw the

arc therebetween. Consequently, the high velocity of gas flow through the opening 25 takes place at a time when the arc is initially established and thus creates conditions advantageous for arc extinction. The arc drawn between the orifice 23 and the contact 24 is looped upwardly through the orifice 23 and being subjected to the intense gas blast through the orifice 23 is quickly extinguished.

Meanwhile, the traverse 45 has moved downwardly so that the fingers 48 have separated from the pin 49 permitting the compression spring 56 to cause a reclosure of the pilot valve 55 and the blast valve 62 to cease the air flow past the valve seat 64. Consequently, the gas pressure within the region 79 lowers because of the closing of the blast valve 62 thereby permitting the compression spring 28 to effect a reclosure of the movable contact 24 against the orifice 23. The closure of the movable contact 24 permits the accumulated gas within the storage region 26 to exhaust through the opening 25 and into the region 29 which is at atmospheric pressure.

Consequently, the contacts reclose and the regions 29, 26, 79, 75, drop to atmospheric pressure. Prior to the reclosure of the contacts 23, 24 the conducting traverse separates from the stationary disconnect fingers 44 to introduce two isolating gaps into the electrical circuit following arc extinction, the two isolating gaps being formed in the container 1 which is filled with the high pressure gas.

Since the gas within the container 1 is at an elevated pressure the dielectric strength thereof is considerably increased and hence the isolating gap distance may be considerably reduced over that which would be necessary if the isolating gap were formed in air at atmospheric pressure.

It will be observed that the porcelain bushings 7 and 80 are placed in compression, the lower end of the porcelain bushing 80 resting on a gasket 81 (Figs. 1 and 4) held in position by a sleeve 82, the lower end of which rests upon the stationary disconnect member 43. Thus the high pressure gas within the container 1 maintains the bushing 80 in compression and the tensioning means provided within the entire bushing means comprising the two tubes 41, 12 and members 32, 39 being maintained in tension as a result of compression of the compression spring 10.

Thus the porcelain 7 is maintained in compression by the aforesaid tensioning means whereas the porcelain bushing 80 is not only maintained in compression by the aforesaid tensioning means but also by the presence of the high pressure gas within the container 1.

From the above description it will be apparent that in the fully open circuit position no voltage appears between the ends of each bushing inasmuch as the arcing contacts reclose following arc extinction. All the voltage appears across the isolating gaps within the container 1. Since the breaker tank 1 is pressurized, that is, contains an air pressure of several atmospheres the disconnect gap need be relatively short to withstand the line voltage.

To close the breaker the pole unit mechanism enclosed in the housing 47 lifts the traverse 45 into engagement with the lower ends of the terminal breaker units. Thus the circuit is always opened on the arcing contacts after which the high pressure air gap is placed in series with the line, and the circuit is always closed on the high pressure disconnect air gaps so that the striking

distance and consequently, the pre-arcing times are kept to a minimum.

As a result of the high pressure in the tank, the isolating gap need be only a small fraction of the length which would be required if this gap were at atmospheric pressure as is the case in the conventional compressed air high voltage outdoor circuit breaker. It is therefore possible to close the blast valve and consequently the arcing contacts very soon in time after arc extinction has been obtained, and thus the use of a conservator is made unnecessary. This means that the use of air will be kept to a minimum without the mechanical complications of an air conservator as is frequently used.

When the breaker is in the closed position, line potential exists throughout the entire length of the terminal breaker units, thus full voltage is placed across the space between the center metal part and the current transformer and flange 4. In order to place this voltage on the poreclain 69 which is best able to withstand it, the coating of metal 70 or conducting paint is provided which is electrically connected to the metal at the lower end of the cylinder 32 by the spring clip 71. Thus when the breaker is standing in the open position, the same electrical conditions exist. However, during the opening operation immediately following the current zero at which arc extinction is obtained, the full voltage will exist between the orifice 23 and the movable contact 24. This will place full voltage across the length of the insulating tube 32. In order to make this gap better able to withstand the restored voltage, the insulating tube 32 is necessarily made long and the impedance means 65 consisting of rings of graphite 66 are placed externally thereto and inside of the porcelain 69. These graphite rings 66 are held in engagement by the spring 67. The functions of the impedance means 65 are several; to produce a uniform voltage gradient along the full length of the insulating tube 32, to evenly divide the restored voltage between the two terminal breaker units enclosed within the two bushings to assist in discharging the disconnected line of an open ended transmission system during line dropping operations, and to change the rate of rise of the restored voltage and the amount of overshoot of the restored voltage when interrupting inductive loads. Also other beneficial electrical effects on arc extinctions will be apparent to those skilled in the art. The residual current drawn by this resistor after arc extinction is interrupted in the isolating gaps between the lower end of the terminal breaker units and the traverse 45.

In order to make this breaker and its associated parts entirely free from oil or liquid insulation and thus preclude the possibility of having leaks between either the high pressure air spaces, liquid filled spaces or atmospheric pressures, I propose to eliminate the use of liquid insulation and fill the spaces inside of the porcelains 7, 80 with gas at several atmospheres pressure. This gas is taken from the pressure tank 1 through a passage 91 in the flange 4 and then directed, after regulation by a bleeder valve 84, through passage 92 which is in communication with the hollow spaces inside the porcelains 7 and 80. The bleeder valve 84 may be of a conventional type also known in the art as a needle valve and need not be further described. In order that closer regulation of the pressure within the porcelains 7 and 80 may be obtained, a pressure release valve 83 is provided on the flange 4 which communicates with the

hollow portions within the porcelains by way of passage 94. The release valve 83 is also of conventional design and need not be further described. This pressure will also be registered on a gauge, not shown, which is mounted at ground potential and readily visible. By the use of pressurized bushings, that is, bushings which are filled with several atmospheres of compressed gas, it is possible to obtain the same insulating values normally obtained from oil and at the same time insures that the bushing is constantly filled with a dry, clean pressure fluid.

From the foregoing description it will be apparent that I have provided a novel circuit interrupter which comprises a suitable resistance providing a conducting path external to and surrounding the insulating member 32 which forms the arcing chamber of the interrupting element and which is arranged so that immediately following the last current zero of an interruption the restored voltage places electrical pressure across this resistance in such a manner that the flow of current through this resistance is regulated to give a proper voltage gradient along the entire length of the insulating member 32 forming the interrupting chamber. This resistance is arranged to also function to divide the voltage evenly or according to some prearranged value between the two or more interrupters of the breaker. Also the resistance functions as a means for assisting in the discharging of an open end transmission line during a line dropping operation. Furthermore, the resistance functions as a means of decreasing the rate of rise of restored voltage and limiting the overshoot of the restored voltage immediately following the interruption of an inductive circuit.

Also from the above description it will be apparent that I have provided an improved gas blast circuit interrupter having a container pressurized so that the disconnect gaps may be considerably shorter than are provided in conventional compressed air interrupters which have their disconnect gap formed in air at atmospheric pressure.

Although I have shown and described a specific structure it is to be clearly understood that the same was merely for the purpose of illustration and that changes and modifications may be made therein by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a gas blast circuit interrupter, a container containing gas under pressure, two bushings extending into the container, conducting means extending through each bushing, a traverse member within said container movable into and out of bridging relation with respect to said conducting means, valve means disposed in each bushing actuated by said member to permit an exhausting of gas from the container out through each bushing, and contact means disposed within each bushing opened upon a predetermined rise of pressure as a result of opening the valve means.

2. In a gas blast circuit interrupter, a container containing gas under pressure, two bushings extending into the container, conducting means extending through each bushing, a traverse member within said container movable into and out of bridging engagement with the inner ends of said conducting means, valve means disposed in each bushing actuated by said member to permit an exhausting of gas from the container out through each bushing, contact means disposed within each bushing opened upon a predetermined rise of pressure as a result of opening the valve means, and means biasing the contact means to the closed position following separation of the traverse member from the inner ends of said conducting means.

3. In a gas blast circuit interrupter, a container containing gas under pressure, two hollow bushings extending into the container, conducting means extending through each bushing, a traverse member within said container movable into and out of bridging relation with respect to said conducting means, valve means disposed in each bushing actuated by said member to permit an exhausting of gas from the container out through each bushing, contact means disposed within each bushing opened upon a predetermined rise of pressure as a result of opening the valve means, and gas flow control means disposed between said container and a hollow portion of each bushing for maintaining a portion of each bushing at an elevated pressure for increasing the dielectric strength of the bushings.

4. In a gas blast circuit interrupter, a container containing gas under pressure, two bushings extending into the container, conducting means extending through each bushing, a traverse member within said container movable into and out of bridging relation with respect to said conducting means, valve means disposed in each bushing actuated by said member to permit an exhausting of gas from the container out through each bushing, contact means disposed within each bushing opened upon a predetermined rise of pressure as a result of opening the valve means, and impedance means extending along each bushing to grade the voltage uniformly along the contact means.

5. In a gas blast circuit interrupter, a container containing gas at an elevated pressure, bushing means extending through a wall of the container, separable contact means disposed within said bushing means, the bushing means comprising two bushing members disposed adjacent to one another adjacent a wall of the container, and tensioning means including said contact means extending through the bushing means for maintaining the two bushing members in compression.

6. In a circuit interrupter, a metal casing, a tubular member of insulating material supported by said casing, conducting means including separable contacts extending through said tubular member, a plurality of annularly shaped impedance sleeves disposed about said tubular member, and resilient means for maintaining said sleeves in abutting engagement with each other and the two end sleeves in contact with said conducting means to provide a bridging impedance across said separable contacts.

7. A circuit interrupter comprising a hollow conducting member having an orifice therein, a movable contact having an opening therethrough and engaging at least one rim of said orifice in the closed circuit position, a cylinder, a piston attached to said movable contact and operable in said cylinder to move said movable contact to open position, and a hollow storage chamber having a greater capacity than said cylinder and communicating with the cylinder to receive and store gas flowing through said opening at least during movement of said movable contact to open circuit position.

8. A circuit interrupter comprising a tubular member having an orifice in one end thereof, a

movable contact having an opening therethrough and engaging at least one rim of said orifice in the closed circuit position, a cylinder, a piston attached to said movable contact and operable in said cylinder to move said movable contact to open circuit position, a gas storage chamber integral with but having a greater capacity than said cylinder, said storage chamber communicating with said cylinder to receive and store gas admitted thereto through said opening, and means biasing said movable contact to closed position against said orifice to permit communication between said storage chamber and said orifice only when the movable contact is in the closed circuit position.

BENJAMIN P. BAKER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,531,522	Steinberger	Mar. 31, 1925
1,703,409	Smith	Feb. 26, 1929
1,928,470	Whitney et al.	Sept. 26, 1933
1,965,551	Kopeliowitsch	July 3, 1934
2,071,965	Biermanns	Feb. 23, 1937
2,153,400	Trencham	Apr. 4, 1939
2,279,536	Thommen	Apr. 14, 1942
2,306,186	Rankin	Dec. 22, 1942
2,336,316	Thommen	Dec. 7, 1943
2,367,934	Flurscheim	Jan. 23, 1945