United States Patent

Berkebile

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[54] **GAS-BLAST CIRCUIT INTERRUPTER WITH PRIMARY AND SECONDARY BLAST VALVES**

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[21] Appl. No.: **759,992**

[52] **U.S. Cl.**.....**200/148 R,** 200/148 BV
[51] **Int. Cl.**.....**H01h 33/82**
[58] **Field of Search**.....200/148 BV, 148 B, 148

[56] **References Cited**

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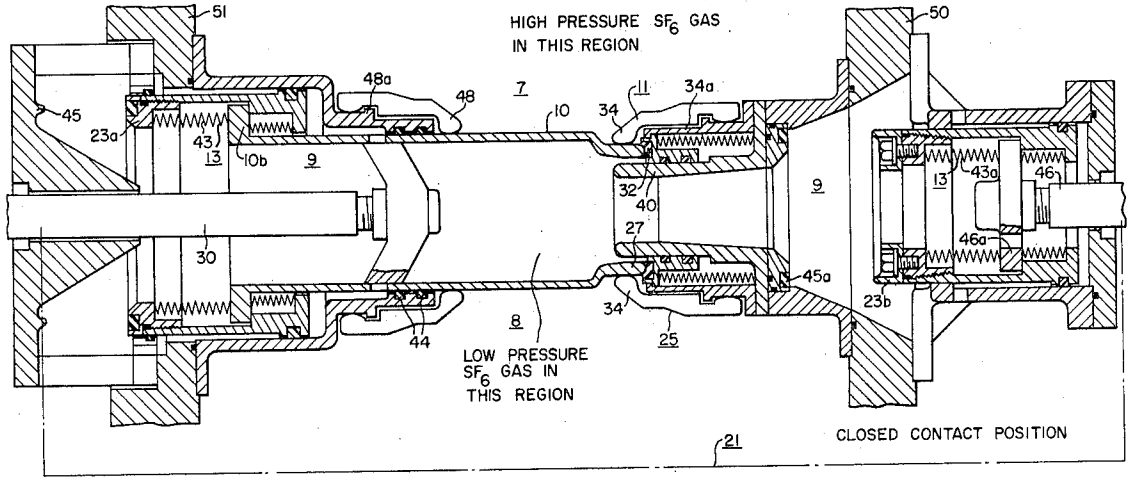
[57] **ABSTRACT**

A gas-blast type of circuit breaker is provided having separable contacts with a primary blast valve closely adjacent the point of abutment of the separable contacts, and a secondary blast valve controlling the flow of gas through at least one of the separable contacts.

In one embodiment of the invention, there is provided a pair of tubular separable contacts, through which the gas exhausts, and the region within both tubular separable contacts is controlled by downstream secondary blast valves mechanically connected together, and operated in response to opening motion of the separable contacts.

6 Claims, 5 Drawing Figures



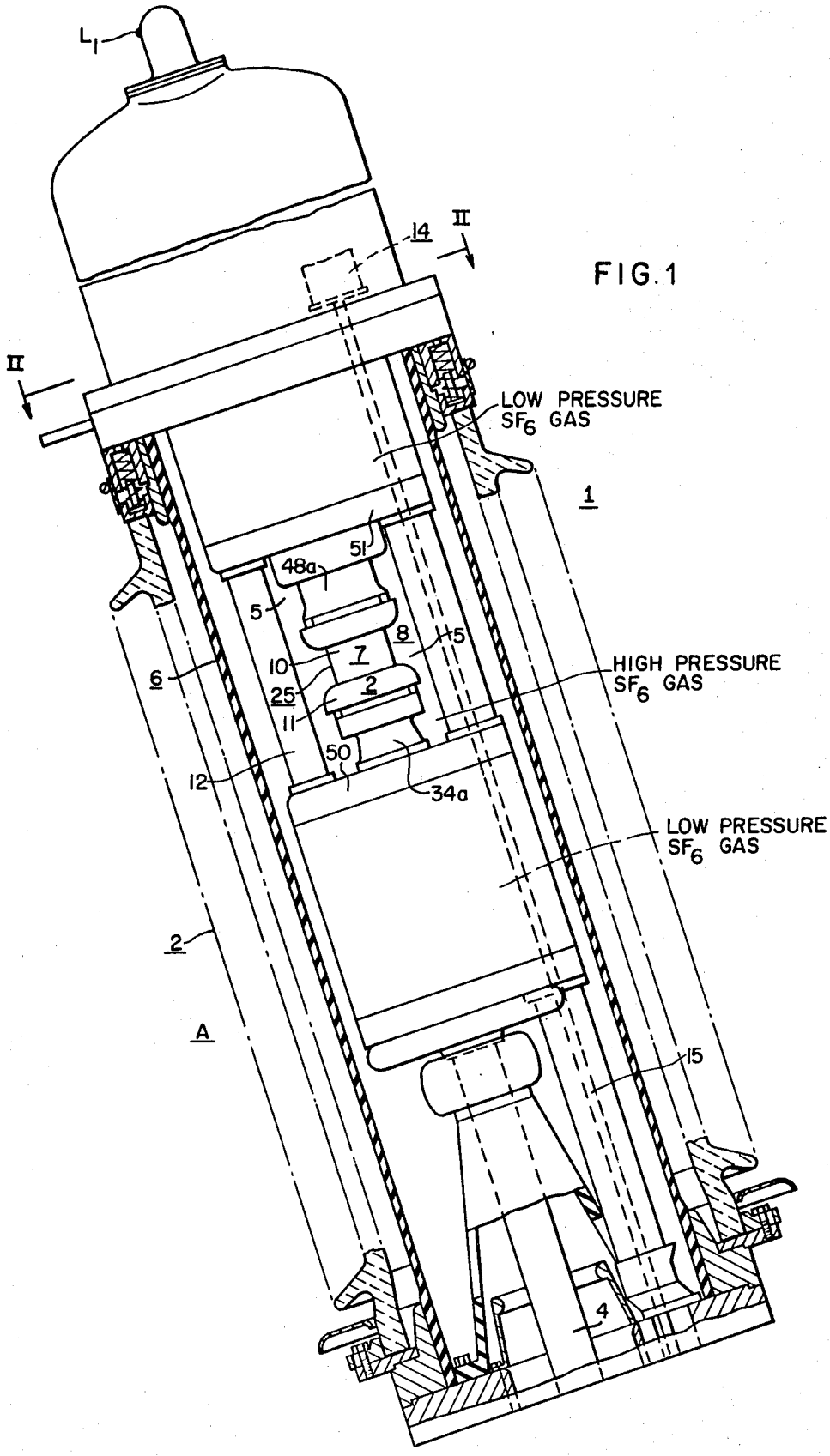
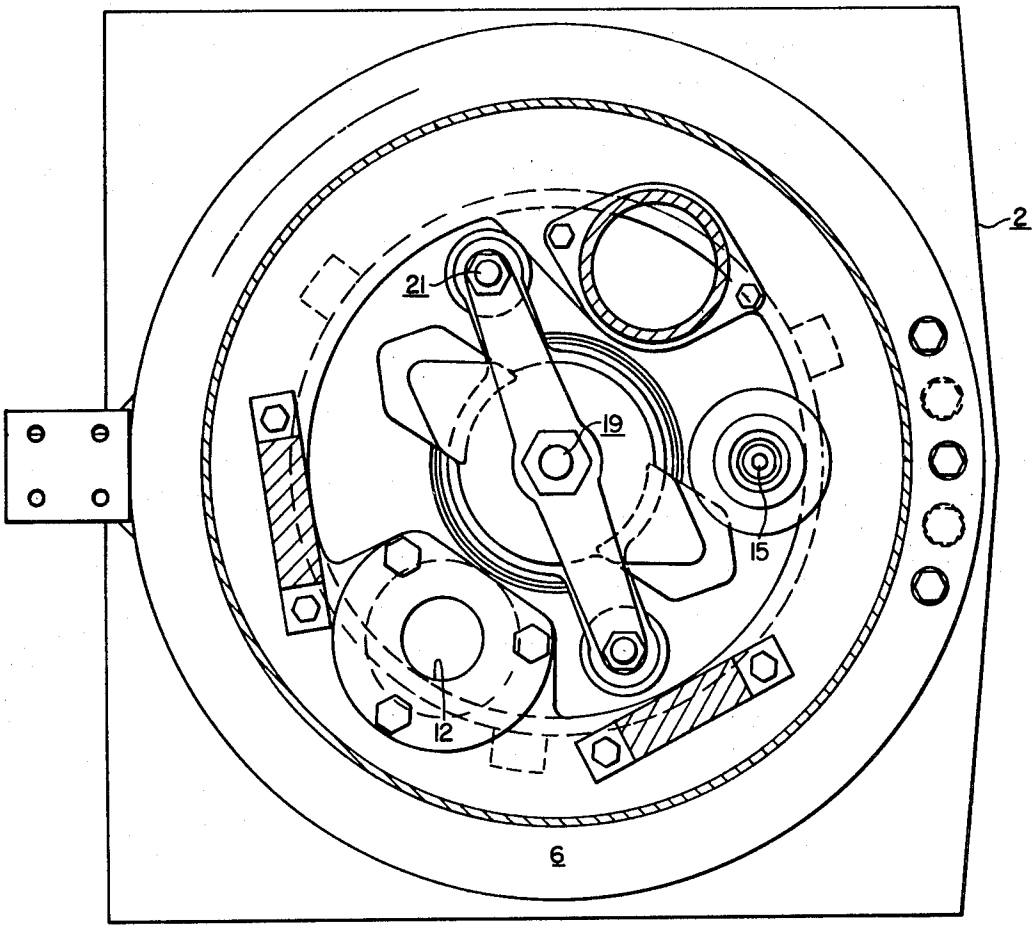

L1
14
II
II
LOW PRESSURE SF6 GAS
1
48a
51
5
8
5
10
7
6
25
2
HIGH PRESSURE SF6 GAS
11
50
12
34a
LOW PRESSURE SF6 GAS
2
A
15
4

FIG. 1

FIG. 2



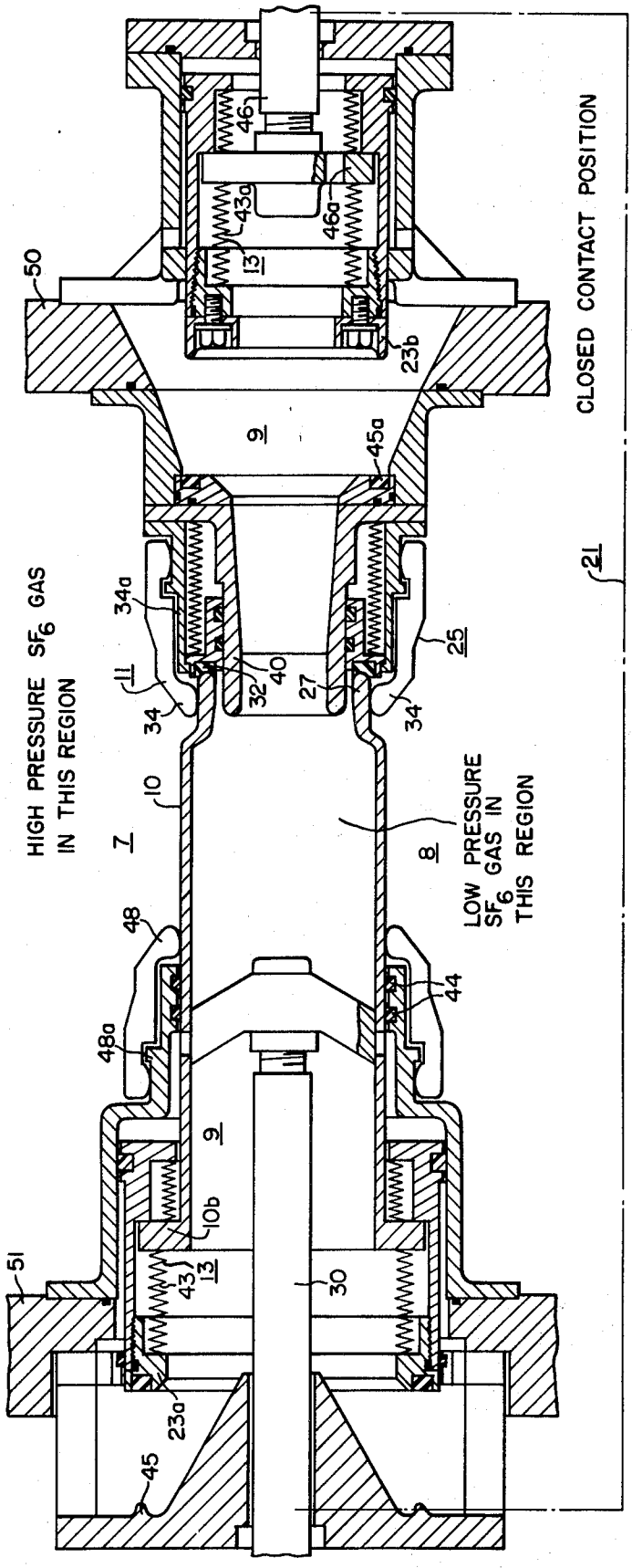
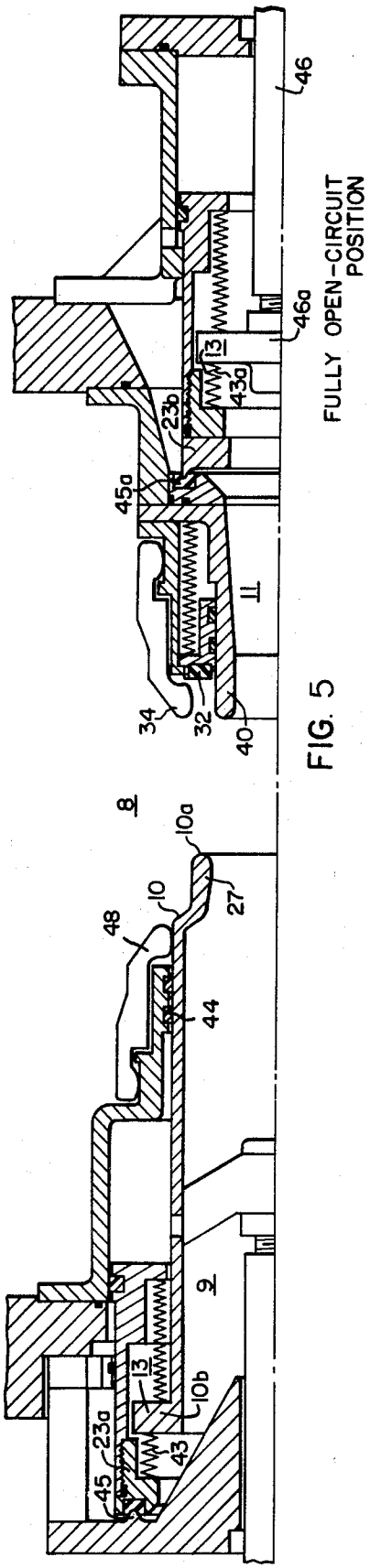
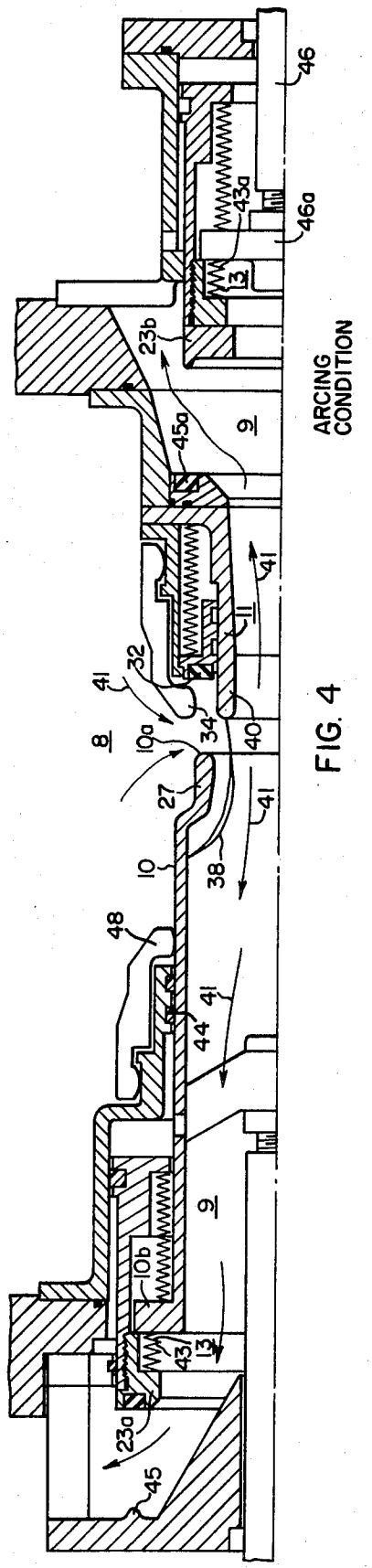

CLOSED CONTACT POSITION
HIGH PRESSURE SF_6 GAS IN THIS REGION
LOW PRESSURE SF_6 GAS IN THIS REGION
50
46
43a
46a
13
23b
9
45a
21
34a
11
34
32
40
27
25
10
7
8
48
48a
44
10b
43
30
51
23a
45

FIG. 3



FULLY OPEN-CIRCUIT POSITION

FIG. 5



ARCING CONDITION

FIG. 4

GAS-BLAST CIRCUIT INTERRUPTER WITH PRIMARY AND SECONDARY BLAST VALVES

CROSS-REFERENCES TO RELATED APPLICATIONS

The broad concept of a high gas-pressure region surrounding the region of separation and abutment of the separable contacts with the gas blast arranged to flow through the separable contacts and controlled by a downstream blast valve is set forth in U.S. Pat. application filed Sept. 22, 1965 Ser. No. 489,228 now U.S. Pat. No. 3,454,734, issued July 8,1969 to Robert G. Colclaser, Jr. and Russell N. Yeckley.

BACKGROUND OF THE INVENTION

Prior-art gas-blast circuit breakers generally involve a pair of seperable contacts with an arrangement for providing a gas blast to effect extinction of the arc drawn thereat. To create this gas blast, previous gas-blast types of circuit breakers have employed blast valves that open just prior to contact part. Opening the blast valves creates a pressure differential, and this differential pressure creates the gas blast. A limitation to this method is the time needed for the gas blast to travel from the blast valves to the arc at the moving contacts. This time delay requires that the blast valves must be opened before the moving contacts are separated. In such a system, the maximum pressure differential (and therefore the greatest gas blast) does not occur at the moving contacts at the time of contact part. This inherent time delay for maximum pressure differential limits the interrupting capability of such prior-art compressed-gas circuit breakers in their operation.

A typical patent illustrating the use of a gas-blast valve disposed remotely from the separable contacts is U.S. Pat. No. 2,568,008 issued Sept. 18, 1951 to G. E. Janssen.

More recently, there has been proposed the use of separable contacts separating in a high-pressure atmosphere with the gas blast exhausting through at least one of the separable contacts. Such an arrangement is set forth in U.S. Pat. No. 3,275,778 issued Sept. 27, 1966 to Shoji Morioka.

SUMMARY OF THE INVENTION

In accordance with an embodiment of the present invention, there is provided a pair of separable contacts in a high-pressure gaseous atmosphere. A primary blast valve is disposed closely adjacent the point of abutment of the separable contacts, so that upon separation of the contacts there occurs an immediate radial inward flow of high-pressure gas into at least one of the separable contacts. Controlling the flow of exhausting gas through said one contact, or in particular arrangements through both separable contacts, is one or more secondary blast valves disposed downstream of the gas flow.

The mechanical arrangement is such that the downstream secondary blast valves remain open for a predetermined time to insure an interruption of the arc established between the separable contacts. At the point in time, where assurance is had that the arc has been extinguished, the mechanical arrangement is such that the secondary blast valves close, thereby halting any further exhausting of the high-pressure gas through the separable contacts.

During a closing operation of the circuit breaker, the primary blast valve, disposed immediately adjacent the point of abutment of the separable contacts, insures a sealing condition at this point, and the mechanical arrangement during such a closing operation is such as to open the one or more secondary blast valves, to thereby permit a lowering of the pressure communicating with the region interiorly of the separable contacts.

Accordingly, a general object of the present invention is to provide an improved high-speed compressed-gas circuit interrupter having primary and secondary blast valves, the primary blast valve being disposed closely adjacent the point of separation of the separable contacts, and the one or more secondary blast valves being located downstream of the gas flow.

Another object of the present invention is the provision of an improved compressed-gas circuit interrupter in which the separated open-circuit condition of the contacts occurs in a high-pressure medium, thereby assuring a minimum separation distance because of the high-dielectric strength of the high-pressure gas.

Still a further object of the present invention is the provision of an improved high-speed gas-blast circuit interrupter in which the time occurring between the opening of the blast valve and the separation of the separable contacts is at a minimum.

Another object of the present invention is the provision of an improved compressed-gas circuit interrupter in which the consumption of the gas flow during an opening operation is maintained at a minimum.

Another object of the present invention is the provision of an improved simplified-type of compressed-gas circuit interrupter of low cost and highly efficient in operation.

Still a further object of the present invention is the provision of an improved compressed-gas circuit interrupter in which the arcing time is maintained at a minimum to prevent voltage surges on the line, and a loss of synchronism of equipment connected to the line.

Further objects and advantages will readily become apparent upon reading the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view taken through a circuit interrupter embodying my invention, the contact structure being illustrated in the closed-circuit position;

FIG. 2 is a sectional view taken substantially along the line II–II of FIG. 1;

FIG. 3 is an enlarged view of the separable contact structure showing the primary blast valve closed with the secondary blast valves opened, the contact structure being illustrated in the closed-circuit position;

FIG. 4 is a view similar to FIG. 3, but showing the separable contact structure at an intermediate point during the opening operation, with the primary blast valve opened and the secondary blast valves opened; and,

FIG. 5 illustrates the open-circuit position of the contact structure with the primary blast valve opened and with the secondary blast valves closed.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and more particularly to FIG. 1 thereof, the reference numeral 1 designates generally a compressed-gas circuit interrupter.

The lower end of the arc-extinguishing assemblage 2 of FIG. 1 is electrically connected by a curved electrical conductor 4 to the other terminal of the interrupter, not shown.

The compressed gas circuit interrupter 1 of the present invention is generally of the dual-pressure type in which high-pressure gas 5 is stored in a tank, not shown, and is disposed within container means 6 immediately adjacent the separable contact structure 7 in the region designated by the reference numeral 8 in FIGS. 1, 3–5. The region 9 (FIG. 3) rearwardly of both contact structures 10, 11 is at relatively low pressure. These regions are designated by the reference numeral 9, and are pneumatically interconnected by at least one interconnecting conduit designated by the reference numeral 12 in FIG. 1 of the drawings.

Generally, the manner of operation of the circuit interrupter 1 illustrated in FIGS. 1–5 is the actuation of tripping valves. The actuation of such tripping valves through a linkage causes the entrance of high-pressure gas 5 below piston structures not shown.

The upward movement of the piston structure, not shown, causes a corresponding upward opening motion of the mechanical linkage, or reciprocal operating means 19 (FIG. 2) which, in turn, causes upward movement of a generally ladder-type operating rod linkage 21, (FIG. 2) which interconnects the two secondary blast valves 23*a*, 23*b* associated with the arc-extinguishing unit 25 of the assemblage 2. In more detail, referring to FIGS. 3–5 of the drawings, it will be noted that there is a pair of separable contacts 10, 11 having a primary blast valve structure 27, and a pair of secondary blast-valve structures 23*a*, 23*b*. The secondary blast-valve structures 23*a*, 23*b* are mechanically interconnected by the ladder- shaped operating linkage 21 (FIGS. 1 and 2), and are simultaneously actuated.

Accordingly, to effect the opening operation of the compressed-gas circuit interrupter 1 of the present invention, the tripping valves is opened to cause the entrance of high-pressure gas 5 upwardly through the conduits and against the lower surfaces of the a piston structure, not shown. This causes upward opening movement of the ladder linkage arrangement 21, and, in addition, causes upward movement of an operating rod 30 mechanically connected to the movable contact structure 10. Reference may be directed to the operating rod 30 of FIG. 3, which is connected mechanically to the same operating rod 19 as shown in FIG. 2 of the drawings.

Upward opening movement of the ladder-shaped linkage 21 causes opening of the movable contact 10 away from the primary blast-valve seat 32 and separation thereof from the stationary contact fingers 34, which make engagement therewith in the closed-circuit position of the device, as illustrated in FIG. 3 of the drawings.

During the initial portion of the opening operation, both blast valves 23*a*, 23*b* are opened, and the high-pressure gas in the region 8 flows radially inwardly and through both separable tubular contacts 10, 11 exhausting therethrough into the regions 9 downstream of the separable contacts 10, 11. This exhausting flow is controlled by the secondary blast valves, 23*a*, 23*b* which are operated in unison.

With reference being particularly directed to FIGS. 3–5 of the drawings, it will be observed that the arc 38, which is drawn between the contact fingers 34 and the extremity 10*a* of the moving tubular contact, is quickly transferred to the inner stationary tubular arcing contact 40 being subjected to a flow of gas, as indicated by the arrows 41 in FIG. 4 of the drawings. During this time, both primary and secondary blast valves 27, 23*a*, 23*b* are opened. When the arc 38 has been extinguished, it is desirable to halt the further consumption of high-pressure gas, and to effect this end, closure of the secondary blast valves 23*a*, 23*b* is desirable. This closing motion of the secondary blast valves is achieved by a flange portion 10*b* secured to the movable contact 10, which compresses a compression spring 43 and following the overcoming of friction at the seal 44, the secondary movable blast valve 23*a* is closed up against its seat 45, as illustrated in FIG. 5, thereby halting the further flow of compressed gas. The right-hand secondary blast valve 23*b*, as illustrated in FIGS. 3–5 of the drawings is mechanically connected to the ladder-shaped operating linkage 21, and therefore moves simultaneously with the left-hand secondary blast valve 23*a*. In other words, both the moving contact 10 and the flange portion 10*b* thereof, and also the operating rod 46, together with its actuator portion 46*a*, causes compression of the compression spring 43*a* and corresponding closure of the right-hand secondary blast valve 23*b* against its seat 45a. The breaker is now in the open-circuit position with the primary blast valve opened, and both secondary blast valves 23*a*, 23*b* closed, as shown in FIG. 5. The compression springs 43, 43*a* constitute a biasing means 13, tending to close the secondary blast-valves 23*a*, 23*b*, which is steadily compressed, or stressed, during the opening operation to mechanically cause the closing of the secondary blast-valves.

During the closing operation, the high-pressure gas is exhausted from the lower surface of the piston structure, not shown, and the high-pressure gas which is constantly present above the piston structures causes the downward closing motion thereof. This is communicated through the ladder-shaped linkage 21, and also through the operating rod 30 (FIG. 3) connected to the movable contact 10. As a result, the moving contact 10 moves downwardly, as viewed in FIG. 1 of the drawings, and the operating rod 19, being connected to the ladder-shaped linkage 21, also moves downwardly to thereby effect opening of the right-hand secondary blast valve 23*b* of FIGS. 3–5. The circuit breaker is now in the closed-circuit position.

To enable the circuit breaker 1 to carry considerable current, there is provided the two pairs of stationary contact fingers 34, 48 each of which is supported by its contact holder 34*a* or 48*a*. The contact holders are, as readily apparent in FIG. 3, bolted to the plate portions 50, 51 constituting the ends of the low-pressure regions rearwardly of the stationary and movable contact structures 10, 11 reference being had to FIG. 1 in this connection.

From the foregoing description it will be apparent that there has been provided an improved high-speed compressed-gas circuit interrupter in which the contacts separate in a high-pressure atmosphere, or environment **8**. The separation of the separable contacts not only causes opening of the primary blast valve **27** to result in a radial inward flow of the high-pressure fluid exhausting through the contacts, but continued opening motion effects a subsequent closure of the secondary blast valves **23***a*, **23***b* and a cessation of the exhausting gas flow occurring through both contacts. This results in the contacts being separated in a high-pressure region **8** while in the open circuit position, thereby taking advantage of the high-dielectric-strength of the high-pressure gas. As well known by those skilled in the art, this results in a minimum separation distance in the open-circuit position of the interrupter.

Certain features of the operating mechanism are set forth and claimed in U.S. Pat. application filed Sept. 25, 1968, Ser. No. 762,479, now U.S. Pat. No. 3,590,189, issued June 29, 1971 and assigned to the assignee of the instant application.

Certain other features relating to the general configuration of the circuit interrupting structure with the generally U-shape are set forth and claimed in U.S. Pat. application filed Dec. 9, 1968, Ser. No. 782,365, now U.S. Pat. No. 3,596,028, issued July 27, 1971, and likewise assigned to the assignee of the instant application.

Although there has been illustrated and described specific structures, it is to be clearly understood that the same were 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:

1. A compressed-gas circuit interrupter comprising, in combination:

a. a pair of separable contacts at least one of which is tubular;

b. container means refining a high-pressure atmosphere about said separable contacts when they are in the closed-circuit position;

c. means defining a primary blast-valve located closely adjacent the point of separation of the separable contacts and preventing the inward flow of said high-pressure atmosphere through the tubular separable contact when in the closed-circuit position;

d. means defining at least one downstream secondary blast-valve independently movable from the movable tubular contact, and pneumatically connected to the region internally of said one tubular contact to halt the continued flow of compressed gas through the tubular contact when the circuit-interrupter is in the open-circuit position;

e. reciprocal operating means for effecting the opening and closing movements of said one tubular venting contact;

f. biasing means provided to tend to close the secondary blast-valve;

g. a movable secondary blast-valve actuator responsive to the opening and closing movements of said reciprocal operating means for mechanically effecting the stressing of said biasing means during the opening operation and also effecting the subsequent closing of the secondary blast-valve at a predetermined time during the opening operation to prevent thereby the further exhausting of compressed gas through the tubular venting contact at such time; and,

h. said movable secondary blast-valve actuator mechanically effecting the opening of the secondary blast-valve during the closing operation of said operating means to thereby exhaust the region within the tubular venting contact in the closed-contact position.

2. The compressed-gas circuit interrupter of claim 1, in which both separable contacts are tubular and two secondary blast-valves are provided.

3. The combination of claim 1, wherein the primary blast-valve is immediately adjacent the point of abutment of the separable contacts.

4. The combination of claim 1, wherein two spaced stationary sets of contacts fingers bear on said one tubular separable contact for increased current flow.

5. The combination of claim 1, wherein an inner arcing horn is associated with the other separable contact.

6. The combination of claim 5, wherein the inner arcing horn is tubular and exhausts gas therethrough.

* * * * *