United States Patent

Roidt

[15] **3,670,126**

[45] **June 13, 1972**

[54] COMPRESSED-GAS CIRCUIT INTERRUPTER HAVING A PAIR OF RAPID TRANSFER INSULATING NOZZLES

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[21] Appl. No.: **838,157**

[52] **U.S. Cl.** .....**200/148 R,** 200/148 B

[51] **Int. Cl.** **H01h 33/54**

[58] **Field of Search** .....200/148, 148.2, 148 B, 149, 200/151

[56] **References Cited**

UNITED STATES PATENTS

3,297,848	1/1969	Picard et al.	200/149 X

FOREIGN PATENTS OR APPLICATIONS

1,271,241	6/1968	Germany	200/148 BV
36,453	4/1965	Germany	200/148
181,356	3/1936	Switzerland	200/148

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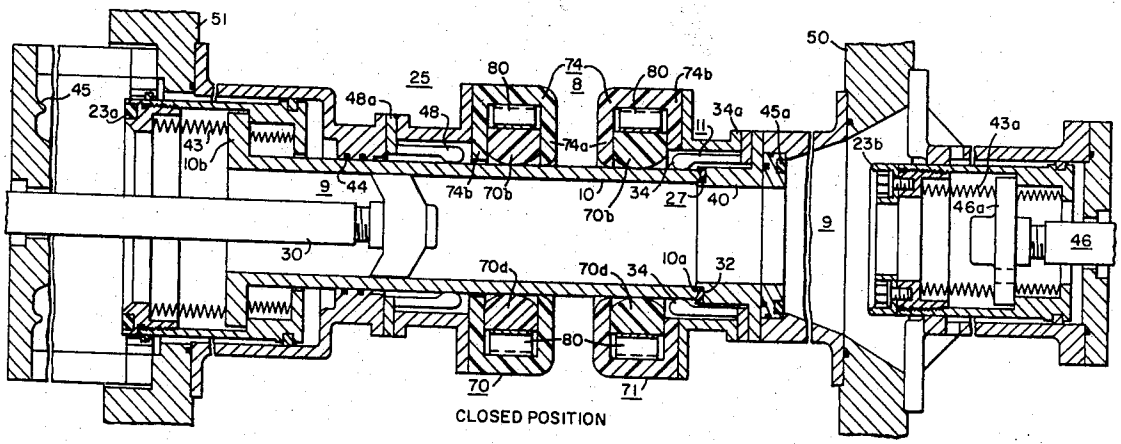
[57] **ABSTRACT**

A gas-blast type of circuit breaker is provided having a pair of separable contacts with a pair of contractable insulating nozzles disposed closely adjacent the point of separation 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 a pair of spaced contractable insulating nozzles are provided to locate the arc quickly axially and to control the gas-flow conditions.

5 Claims, 8 Drawing Figures



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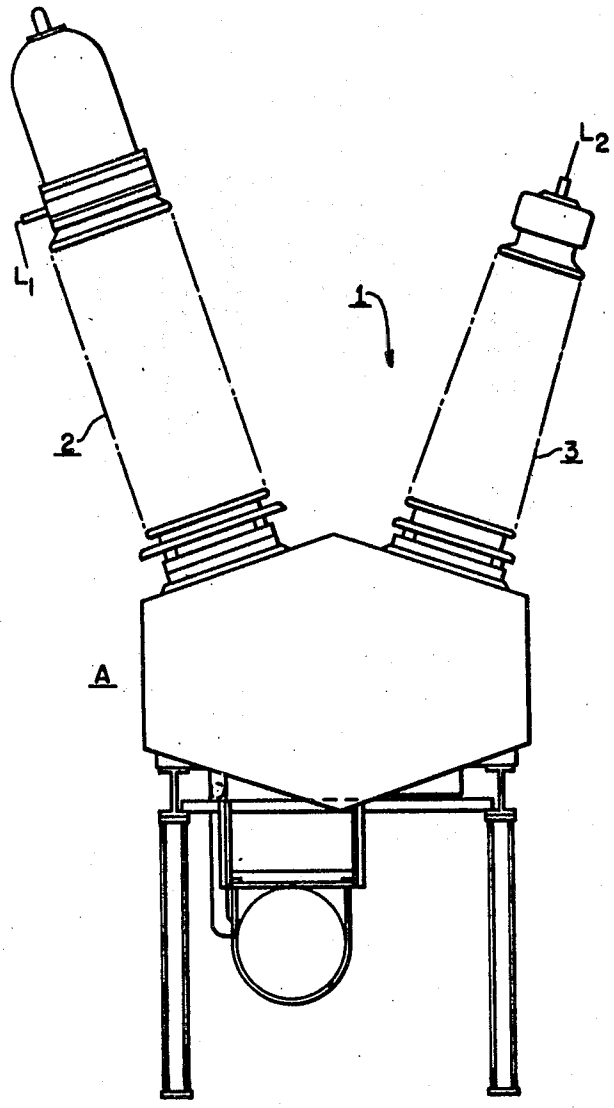

FIG. I.

WITNESSES

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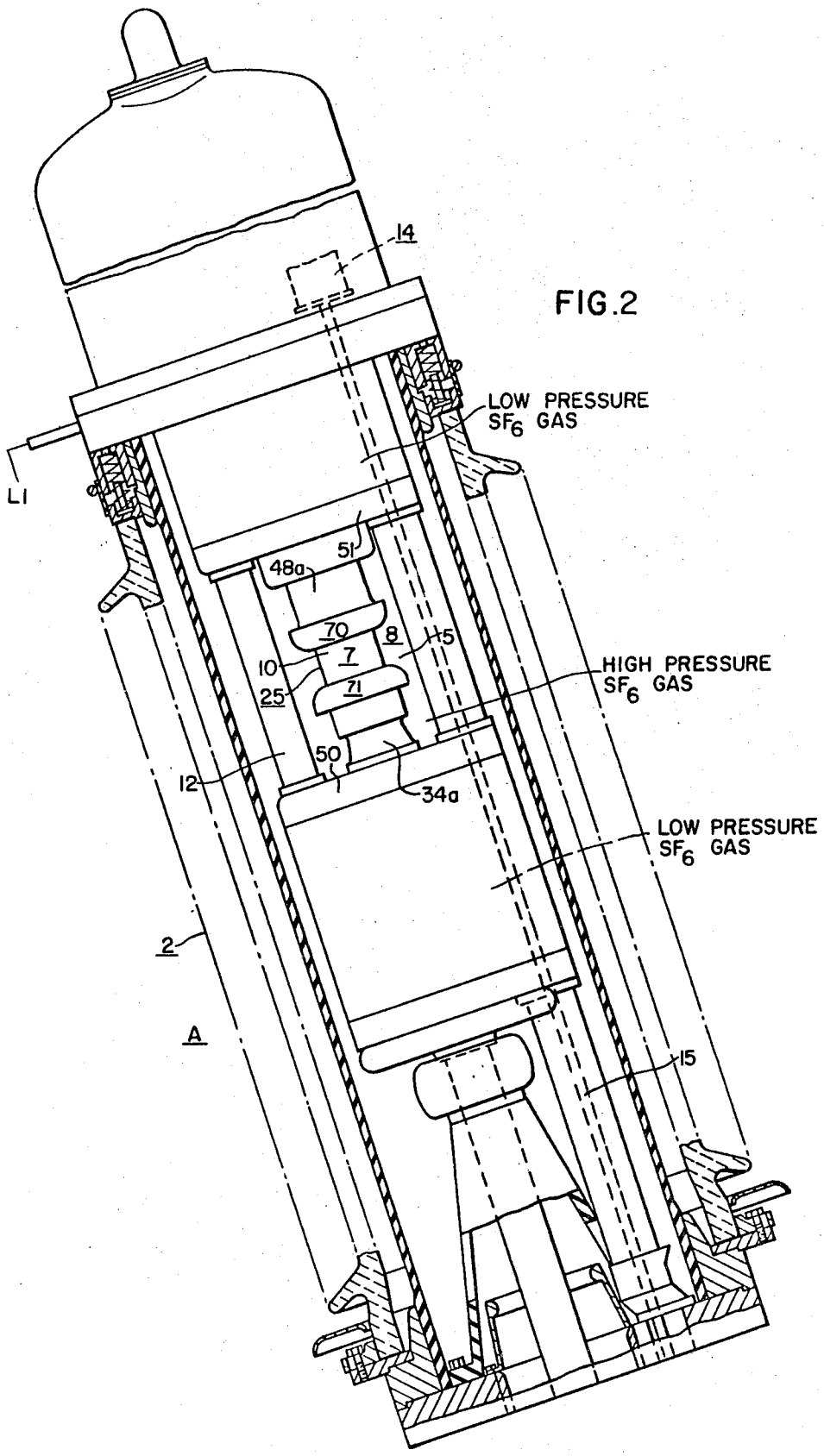

14
LOW PRESSURE
SF_6 GAS
L1
51
48a
70
8
15
7
10
25
71
HIGH PRESSURE
SF_6 GAS
50
12
34a
LOW PRESSURE
SF_6 GAS
2
A
15

FIG.2

FIG. 3.

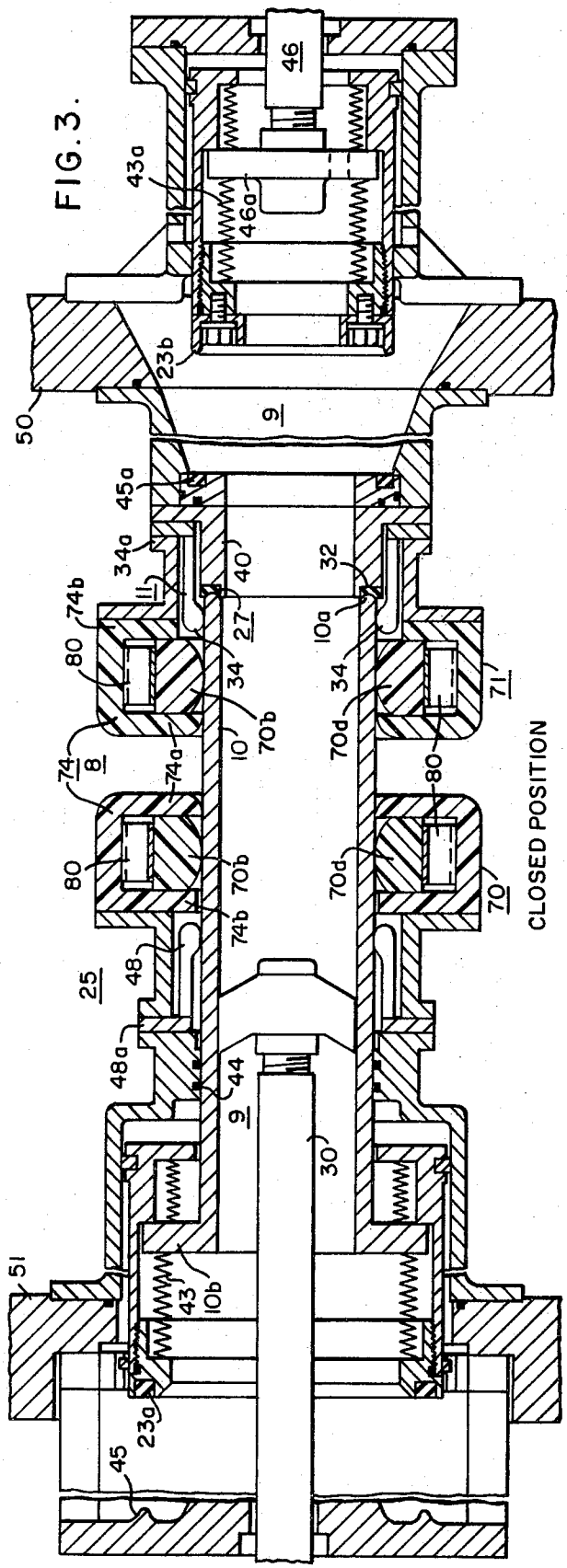
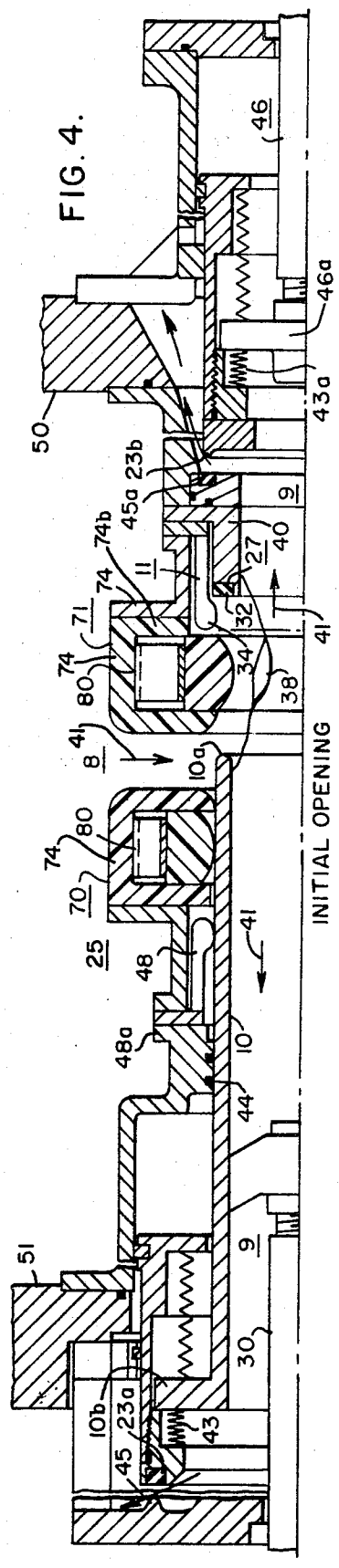


FIG. 4.



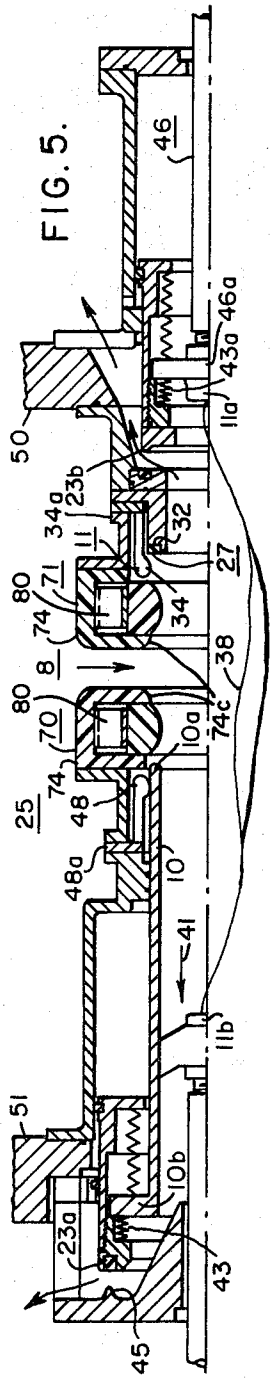


FIG. 5.

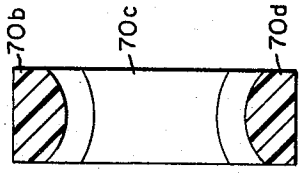


FIG. 8.

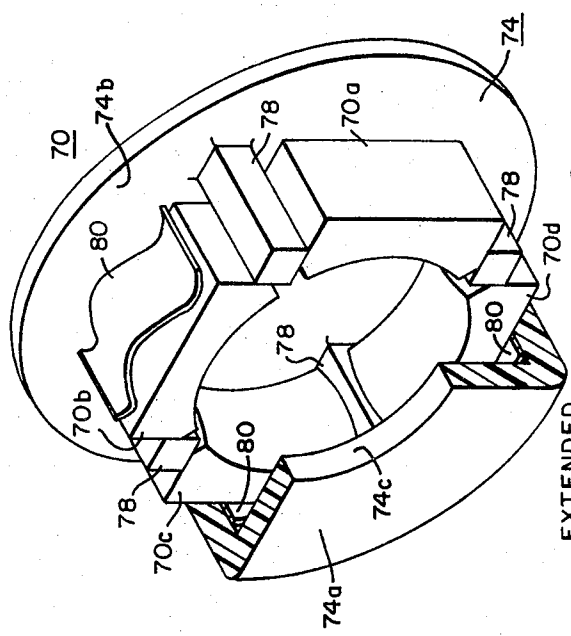


FIG. 6.

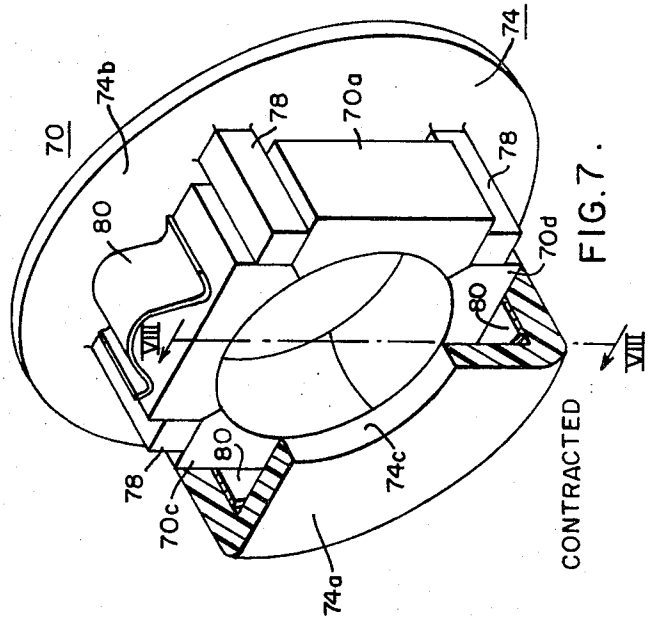


FIG. 7.

COMPRESSED-GAS CIRCUIT INTERRUPTER HAVING A PAIR OF RAPID TRANSFER INSULATING NOZZLES

CROSS-REFERENCES TO RELATED APPLICATIONS

The present application has relationship with pending U.S. Pat. application filed Sept. **16, 1968**, Ser. No. **759,992**, by Lee E. Berkebile entitled "Gas-Blast Circuit Interrupter With Primary and Secondary Blast Valves," and assigned to the assignee of the instant application.

BACKGROUND OF THE INVENTION

In compressed-gas circuit breakers of the type involving a pair of separable tubular relatively movable contacts, it has been customary to provide a high-pressure gas region exteriorly of the separable contacts, and upon opening, or separation thereof, the high-pressure gas flow extends radially inwardly and may exhaust through one or both of the separable contacts. U.S. Pat. application Ser. No. 759,992, filed Sept. 16, 1968 by Lee E. Berkebile illustrates such a construction. In the open-circuit position of the interrupter, as set forth in the aforesaid Berkebile circuit breaker construction, high-pressure gas may exist in the region between both fully open separated contacts. As utilized in the aforesaid patent application, downstream secondary blast valves may be employed to halt the exhausting of high-pressure gas flow through the separated contacts in the fully open-circuit position of the interrupter.

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 with a pair of contractable insulating spaced nozzles disposed adjacent the point of contact separation. Preferably, the separable main contacts themselves provide a primary blast valve, so that upon separation of the contacts, there may occur a 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 the particular arrangement involving both separable contacts, is one or more secondary blast valves, which are disposed downstream of the gas flow. A pair of contractable insulating spaced nozzles move radially inwardly upon being released by opening movement of the movable contact, and these contractable insulating nozzles serve to force the established arc axially along the center-line of the movable vented separable contacts to increase the efficiency of arc extinction.

The mechanical arrangement is such that the downstream secondary blast valves remain open for a predetermined time to assure an interruption of the arc established between the separable contacts. At a point in time, where assurance is had that the arc has been extinguished, the mechanical arrangement is such that the secondary blast valves are closed, 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 a high-speed compressed-gas circuit interrupter utilizing a pair of contractable nozzles for increasing the efficiency of arc extinction.

Another object of the present invention is the provision of improved means for axially locating the arc established in a compressed-gas circuit interrupter of the type in which a radial inward gaseous flow occurs.

Still a further object of the present invention is the provision of an improved compressed-gas circuit interrupter of the type

utilizing a primary blast valve, one or more secondary blast valves, and a pair of contractable insulating nozzles, which are collapsed during the opening operation to assure an accurate centering of the arc axially along the center-line of the contact structure.

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 an end elevational view of a compressed-gas circuit interrupter embodying the principles of the present invention;

FIG. **2** illustrates a vertical sectional view taken through the interrupting chamber of the circuit interrupter of FIG. **1**, the contact structure being illustrated in the closed-circuit position;

FIG. **3** is an enlarged vertical sectional view illustrating the contact structure in the closed-circuit position thereof;

FIG. **4** is a view similar to FIG. **3**, but illustrating the disposition of the several parts during the initial portion of the opening operation;

FIG. **5** is a view similar to FIGS. **3** and **4**, but illustrating the disposition of the parts at a later point in time during the opening operation;

FIG. **6** is a fragmentary perspective view of the contractable insulating nozzle construction;

FIG. **7** is a view similar to that of FIG. **6**, but illustrating the contractable nozzle construction in the contracted position thereof; and,

FIG. **8** is a vertical sectional view taken through one of the two contractable nozzle arrangements.

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. As viewed in FIG. **1**, it will be noted that there is provided an end view of a three-phase compressed-gas circuit interrupter, each phase unit, such as phase unit A, comprising a leftwardly slanting arc-extinguishing assemblage, generally designated by the reference numeral **2**, and a right-hand slanted terminal-bushing structure, generally designated by the reference numeral **3**.

The lower end of the arc-extinguishing assemblage **2** is electrically connected by a curved electrical conductor **4** more clearly illustrated in FIG. **2** of the drawings. Accordingly, it will be apparent that there is provided a generally U-shaped circuit-breaker structure **1** with one leg of the "U" constituting the arc-extinguishing assemblage **2**, whereas the right-hand leg of the "U" constitutes generally the terminal-bushing structure **3**. Lead connections L_1, L_2 are attached to the upper extremities of the generally U-shaped circuit interrupter **1**, as indicated in FIG. **1** of the drawings.

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 immediately adjacent the separable contact structure **7** in the region designated by the reference numeral **8** in FIGS. **3–5** of the drawings. Such region **8** is also illustrated in FIG. **2** of the drawings, and designated by the same reference numeral. The region **9**, 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. **2** of the drawings.

Generally, the manner of operation of the circuit interrupter **1**, illustrated in FIGS. **1–3**, is the actuation of tripping valves, generally designated by the reference numeral **14** in FIG. **2** of the drawings. The actuation of such tripping valves **14** through a linkage **15**, hereinafter described, causes the entrance of high-pressure gas **5** below a piston structures, one of which is provided at the upper end of each of the three arc-extinguishing assemblages **2**.

The upward movement of the piston structure causes a corresponding upward opening motion of a mechanical linkage, which, in turn, causes upward movement of a generally ladder-type operating rod linkage, which inter-connects 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, and are simultaneously actuated.

Accordingly, to effect the opening operation of the compressed-gas circuit interrupter **1** of the present invention, the tripping valves **14** in the three phase units are simultaneously opened to cause the entrance of high-pressure gas **5** upwardly through the conduits, and against the lower surfaces of the piston structures. This causes upward opening movement of the piston structures and corresponding upward movement of the ladder linkage arrangements, 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**.

Upward opening movement of the ladder-shaped linkage 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 secondary 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 **10**, 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 FIGS. **4** and **5** 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**, 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, 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 **45***a*. 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.

During the closing operation, the high-pressure gas is exhausted from the lower surface of the piston structures, 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 and also through the operating rod **30** 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, being connected to the ladder-shaped linkage, also moves downwardly to thereby effect opening of the secondary blast valves. 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. **2**, 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. **3** in this connection.

It is a distinct purpose of the present invention to provide a new type of circuit-breaker configuration which will allow retention of the important characteristics associated with finger nozzle contacts, as set forth in U.S. Pat. application filed Jan. **8**, **1968**, Ser. No. **696,415** by Stan Milianowicz. Basically, the device comprises two spring-loaded sectioned contractable nozzles **70**, **71**, which slide into place behind separating contact cylinders to force an initially axial arc **38**, and eliminate the need for flow-forced transfer. A perspective view of the contractable nozzle **70** is illustrated in FIGS. **6** and **7** of the drawing, and the sequence of the interrupting procedure is illustrated in FIGS. **3–5** of the drawings.

The nozzle **70**, illustrated in FIG. **7**, comprises four sections, **70***a*, **70***b*, **70***c*, **70***d* but for certain types of interrupters, perhaps three might be found preferable. The nozzle sections are designed so that the moving contact cylinder **10** forces them apart during contact reclosure. The distance the nozzle sections **70**, **71** move would not be very great since their primary function is simply to force the arc **38** toward the centerline and prevent arcing upstream of the minimum nozzle area. They also force the arc **38** away from the steady state operation contact point.

The fundamental intention behind the present invention is the step toward obtaining the maximum possible interrupting capability for a given nozzle area and operating pressure.

In more detail, it will be noted, with reference to FIGS. **6** and **7** of the drawings that the nozzle sections are captive within an insulating nozzle holder **74** having end-plate portions **74***a*, and axially positioned bosses **78**, which limit the guiding motion of the nozzle sections **70***a*, **70***b*, **70***c*, **70***d*. FIG. **7** illustrates the nozzle **70** in the collapsed or retracted position, whereas FIG. **6** illustrates the nozzle **70** in its expanded condition, which is the state as set forth in FIG. **3** of the drawings. FIG. **8** is a sectioned view taken through the nozzle **70** of FIG. **7**, taken along the line IX—IX of FIG. **7**.

For the purpose of biasing the nozzle portions **70***a*, **70***b*, **70***c*, **70***d* radially inwardly, leaf springs **80** may be provided as illustrated in FIG. **7** of the drawings.

It will be noted that the first contractable insulating nozzle structure **71** additionally delays application of the inward blast of gas upon the arc **38** during the initial establishment thereof. This is desirable because the arc **38** cannot be extinguished prior to its attaining a predetermined length as well known by those skilled in the art. Consequently, this additional action on the part of the first nozzle structure **71** minimizes the generation of arcing energy at a time when arc interruption is not possible, and avoids voltage surges on the connected line.

The nozzle sections would preferably be made from a suitable arc-resistant dielectric material, such as polytetrofluoroethylene and sold under the tradename "-Teflon."

From the foregoing description it will be apparent that there has been provided an improved interrupting structure **25** which leads to highly effective gas-flow conditions and to a proper centering of the arc **38** during the interrupting operation.

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-pres-

sure 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 occuring 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 Nov. **18, 1968**, Ser. No. **776,510** 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** 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 circuit-interrupter of the gas-flow type, comprising, in combination:

a. a relatively stationary tubular venting contact through which gas may exhaust;

b. a relatively movable tubular venting contact cooperable with said relatively stationary venting contact to establish an arc and through which gas may also exhaust during interruption;

c. primary blast-valve means disposed closely adjacent the point of contact separation;

d. casing means for confining a high-pressure gas externally of said separable contacts;

e. opening of said primary blast-valve means enabling an inward flow of high-pressure gas to flow from said casing means into both of said separable contacts to bring about arc interruption interiorly of said tubular venting separable contacts;

f. a first contractable insulating nozzle structure supported at the relatively stationary contact and comprising a plurality of inward-biased nozzle portions disposed interiorly of an annular nozzle holder (**74**)*a* having a nozzle opening (**74***a*);

g. said first contractable insulating nozzle structure delaying application of said inward flow of gas prior to the withdrawal of said movable tubular venting contact out of said nozzle opening;

h. a second contractable insulating nozzle spaced axially along the line of contact travel from said first nozzle structure and also including a plurality of inward-biased nozzle portions;

i. said movable tubular venting contact passing interiorly through both said first and second contractable insulating nozzle structures during the closing operation of the interrupter to thereby expand the nozzle portions in both nozzle structures; and,

j. the contraction of said nozzle portions of the nozzle structures tending to center the established arc axially for better arc interruption characteristics.

2. The circuit-interrupter combination of claim **1**, wherein the separable contacts themselves define the primary blast-valve means.

3. The circuit-interrupter combination of claim **1**, wherein a pair of secondary blast-valves are provided downstream of the arcing region, and means are provided to open the secondary blast-valves during the opening operation of the interrupter.

4. The circuit-interrupter combination of claim **1**, wherein leaf spring means are provided to bias the plurality of inward-movable nozzle portions to an inward position.

5. The circuit-interrupter combination of claim **1**, wherein the nozzle holders have boss portions to guide the radial inward and radial outward motion of the nozzle portions.

* * * * *