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Cromer et al.

[11] **3,792,218**

[45] **Feb. 12, 1974**

[54] **GAS OPERATED BLAST VALVE FOR DOUBLE-FLOW INTERRUPTERS**

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[73] Assignee: **Westinghouse Electric Corporation,** Pittsburgh, Pa.

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[21] Appl. No.: **269,691**

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

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

[58] **Field of Search** .... 200/148 B, 148 BV, 148 R

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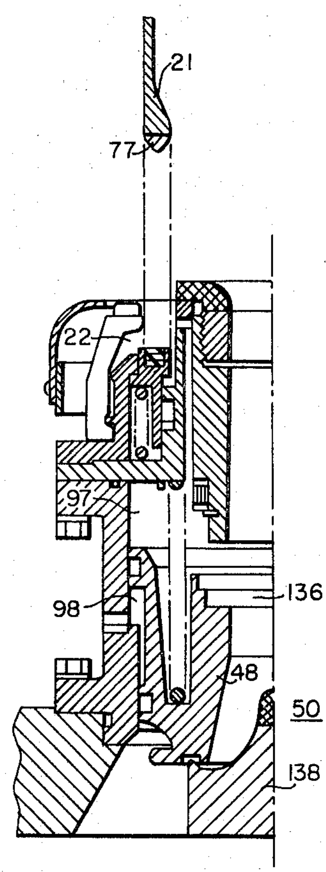
Primary Examiner—Robert S. Macon

Attorney, Agent, or Firm—H. G. Massung

[57] **ABSTRACT**

A compressed gas circuit interrupter of the dual pressure type in which one or more pair of contacts are separated in a high pressure gaseous environment, and the high pressure gas exhausts through both of the separable contacts. For each pair of contacts the continued exhaust of gas through the contacts is controlled by a mechanically operated main blast valve and a gas operated auxiliary blast valve. The auxiliary blast valve works in conjunction with the main blast valve and utilizes primarily the internal gas pressure for its operating power and control.

9 Claims, 8 Drawing Figures



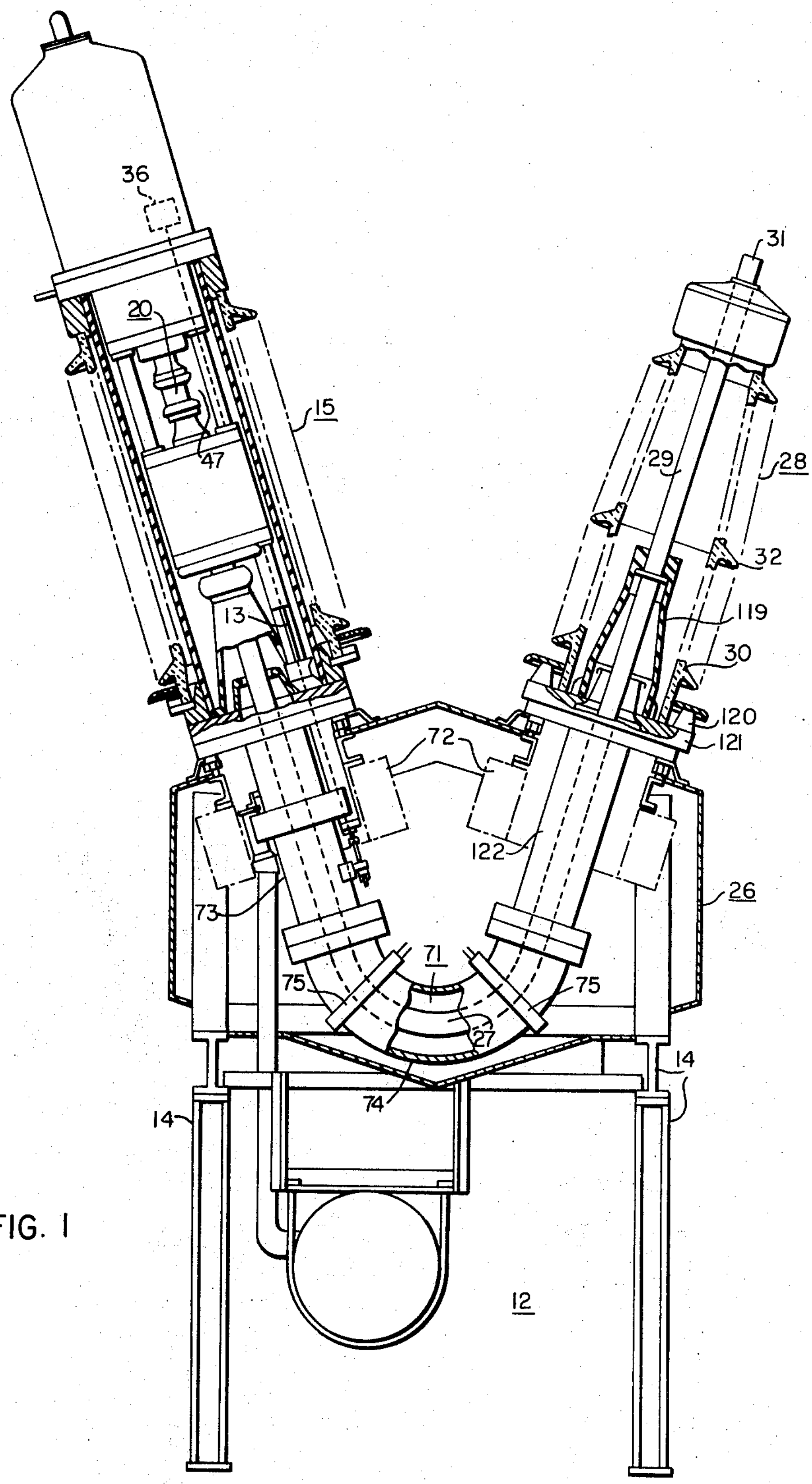

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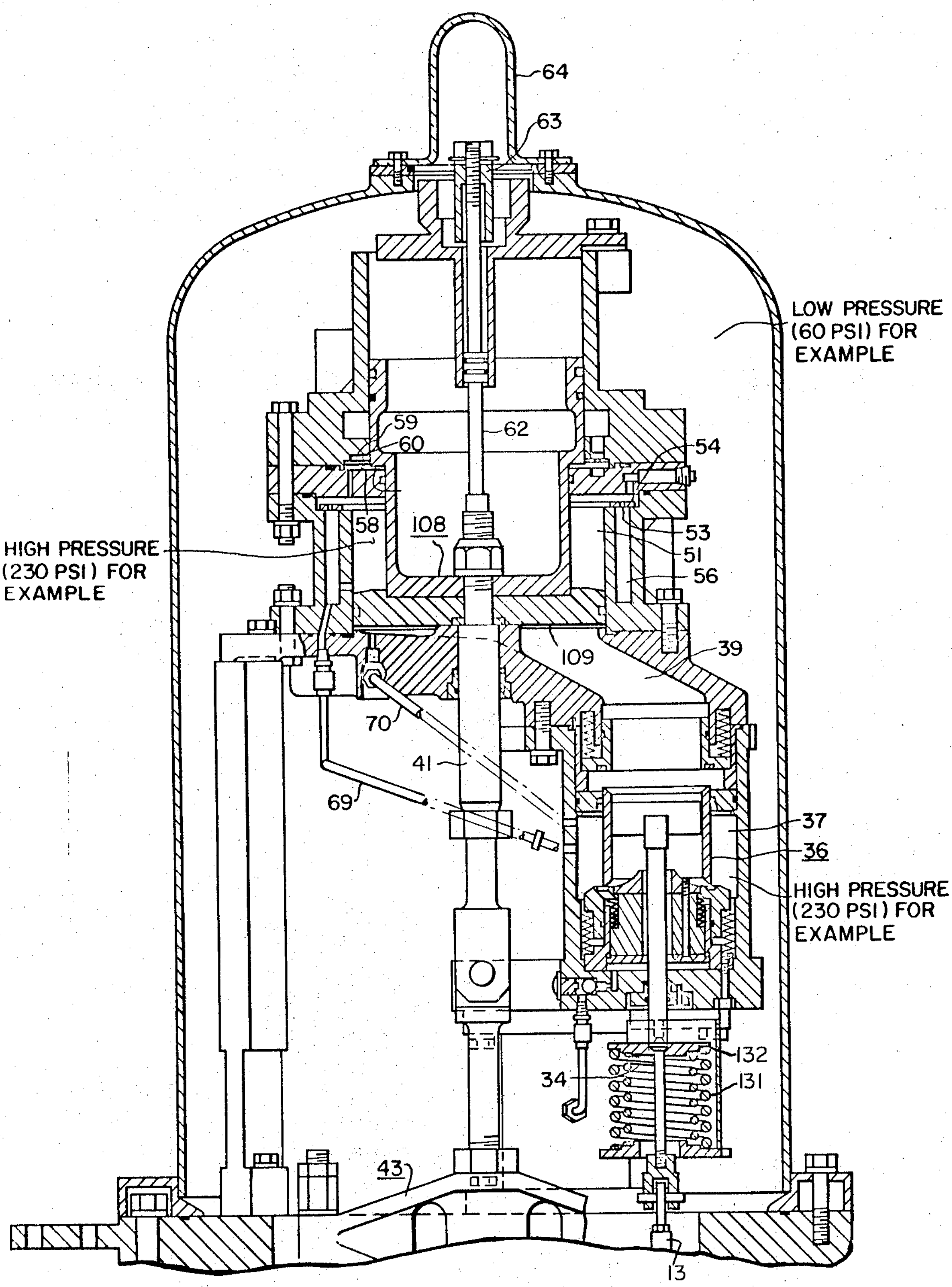
FIG. 1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LOW PRESSURE (60 PSI) FOR EXAMPLE
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HIGH PRESSURE (230 PSI) FOR EXAMPLE
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FIG. 2

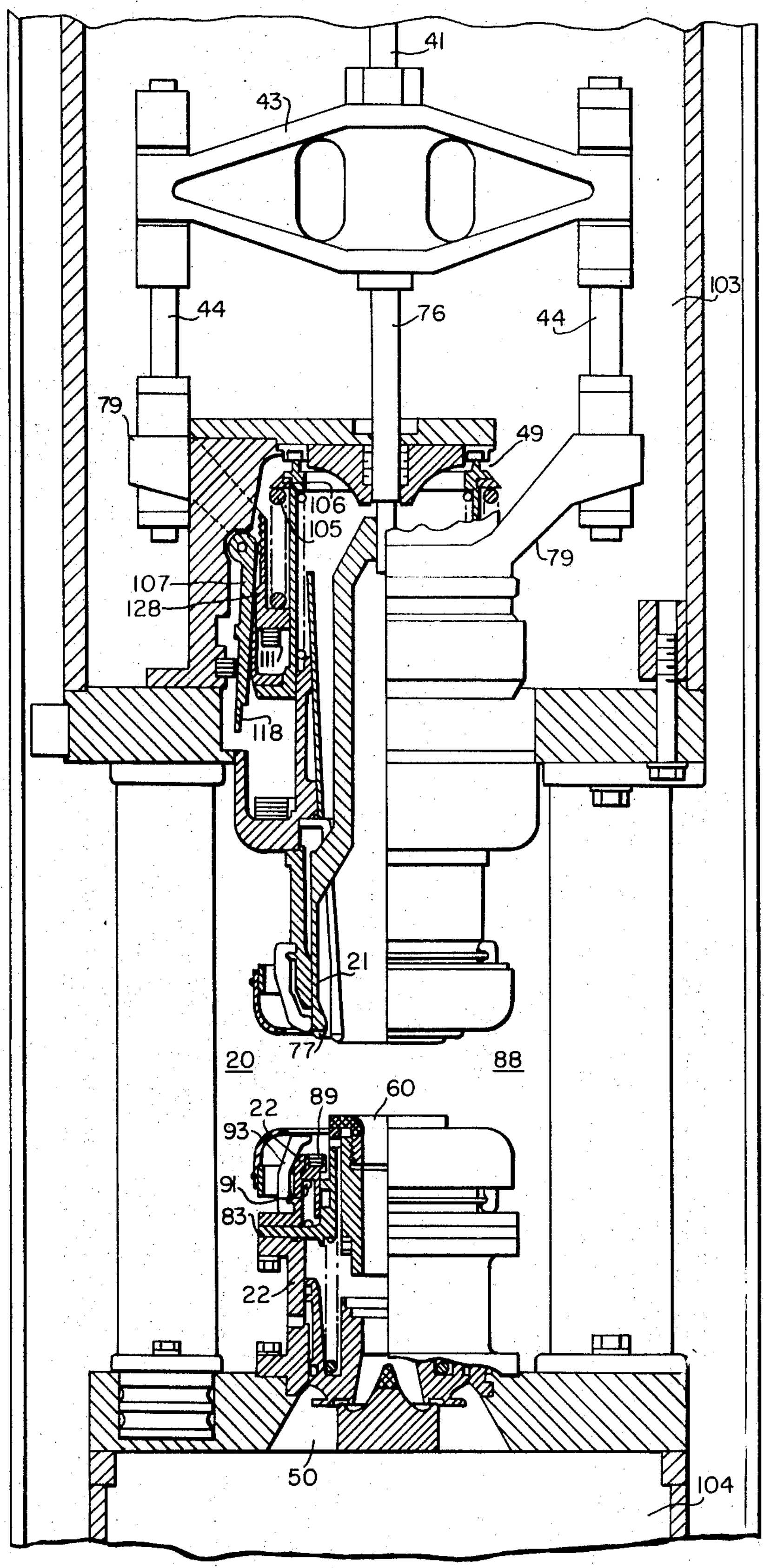
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FIG. 3

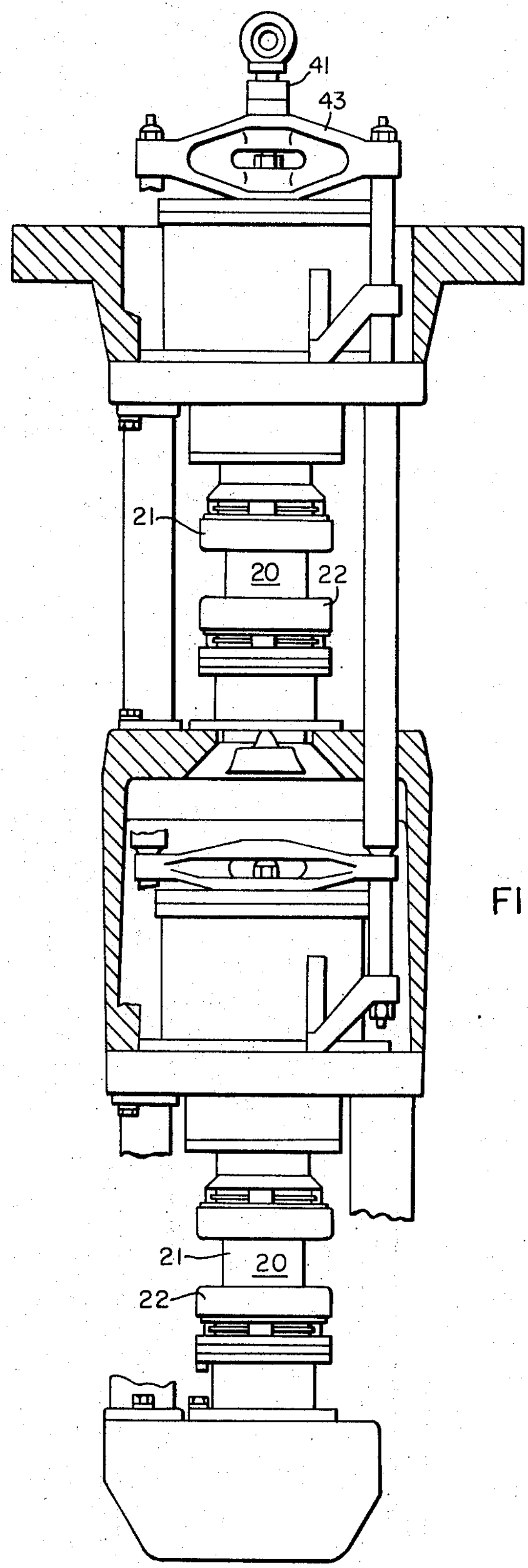

FIG. 4

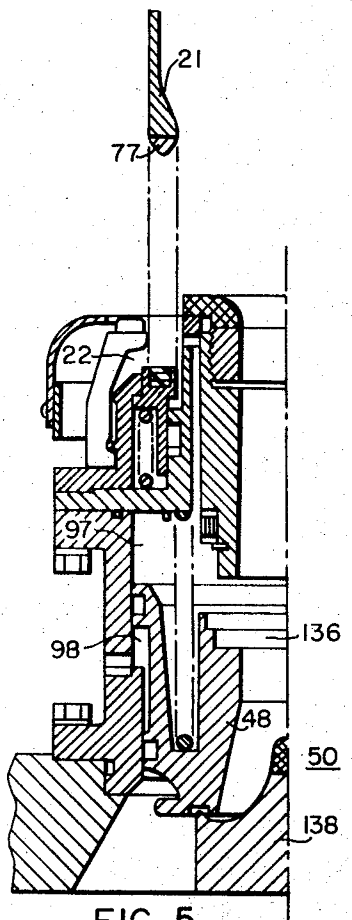

FIG. 5

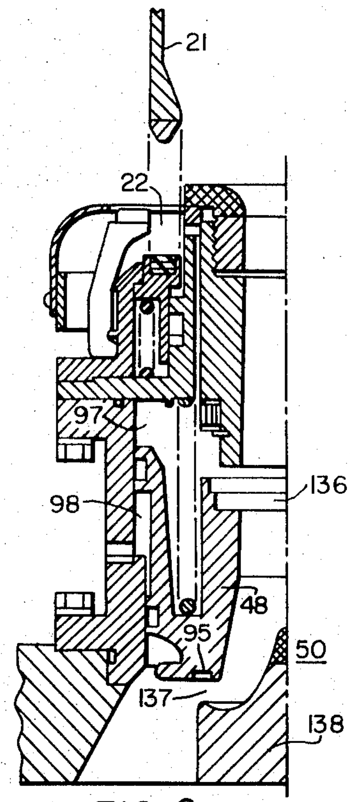

FIG. 6

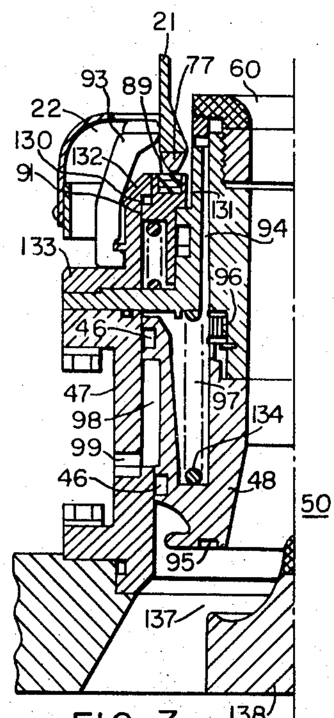

FIG. 7

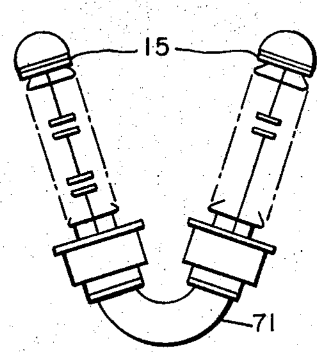

FIG. 8

GAS OPERATED BLAST VALVE FOR DOUBLE-FLOW INTERRUPTERS

BACKGROUND OF THE INVENTION

This invention relates to a compressed gas circuit interrupter of the dual pressure type, in which one or more pairs of contacts are separated in a high pressure gaseous environment and the high pressure gas exhausts through both of the separated contacts. More particularly the present invention relates to the downstream blast valves which control the continued exhaust of relatively high pressure gas through the separable contact structure.

In prior art compressed gas circuit interrupters of the dual pressure type, as described in detail in U.S. Pat. No. 3,596,028 issued July 27, 1971 to Richard E. Kane et al. and assigned to the same assignee as the present application, a high pressure gas, which aids in extinguishing the arc, surrounds the contact structure. During circuit interruption, the contacts separate and an arc is formed therebetween. To help interrupt this arc the high pressure gas immediately available at the separable contact structure passes through the interior of one or both of the separable contacts and is controlled by one or more downstream blast valves. The downstream blast valves are mechanically controlled by the movable contact structure. Circuit interruption and blast valve movement is accomplished by a pneumatic operator at the top of the arc extinguishing assembly. The pneumatic operator is controlled by a three-way tripping device which itself is controlled by an insulating operating rod extending downwardly interiorly of the interrupter to a ground potential operating mechanism. The output force of the pneumatic operator, and the complexity of mechanically interconnecting the blast valves, limits the number of blast valves which the pneumatic operator can control. Due to these limitations not all contact structures utilize gas flow through the interior of both of the separable contacts. In some instances, contact structures which utilize gas flow through only one of the separable contacts are used.

SUMMARY OF THE INVENTION

The interrupting capability of gas blast interrupters can be greatly increased by providing for gas passage through the interior of both of the separable contacts. When the insulating gas can flow through the interior of both of the interrupter contact nozzles this is referred to as double flow interruption, as opposed to single flow interruption when the high pressure gas can flow through only one of the contacts. This invention discloses a means for providing a double flow interrupter, by using a mechanically operated main blast valve, which is connected to the pneumatic operator as in prior art applications, and a gas operated auxiliary blast valve, which operates from the internal gas pressure and is not mechanically connected to the pneumatic operator. Double flow interruption is accomplished without mechanically coupling the auxiliary blast valve to the contact driving mechanism and thus avoiding additional loading of the pneumatic operating mechanism. Thus, double flow interruption is attained with the same operating mechanism which is used on prior art applications, for single flow interruption. The operating mechanism can be used without redesign, without additional mechanical connections or additional mechanism cost. Thus apparatus which is presently using single flow interruption can be converted to double flow interruption to increase interrupter capability without altering the pneumatic operator mechanism or the mechanically operated main blast valve.

On contact opening, during circuit interruption, a means is provided for closing the gas operated auxiliary blast valve after the interrupting function is completed. On a contact closing operation, means are provided for opening the gas operated auxiliary blast valve and the main blast valve, after the contacts have closed, thus providing a system in which full differential pressure exist across the interrupted contacts on initial contact parting. When the contacts are in the closed position, high pressure gas, in a chamber of the gs operated auxiliary blast valve, forces the blast valve to the open position. During circuit interruption, as the main contacts part, high pressure gas flows through the inside of the contacts, to accomplish circuit interruption. This high pressure gas also flows through metering holes, in one of the contact assemblies, into a first chamber of the auxiliary blast valve to start closing the auxiliary blast valve. The time delay from contact opening until the auxiliary blast valve starts to close can be determined by the flow through the metering holes. As the auxiliary blast valve continues to close high pressure gas comes in contact with additional areas of the auxiliary blast valve, increasing the closing force on the auxiliary blast valve and slamming the valve to the closed position. A sliding portion of the auxiliary blast valve closes against a resilient seat, which provides a gas tight seal between the high pressure gas inside the contact and the low pressure gas chamber.

During a closing operation as the contacts close the main blast valve, after a fixed time delay, is opened discharging the high pressure gas within the contacts into the low pressure chamber. WHen the pressure inside of the contacts which drives the gas operated auxiliary blast valve closed falls below a critical level, the force tending to hold the auxiliary blast valve closed is exceeded by the opening force provided by the high pressure gas in a second chamber of the auxiliary blast valve. The auxiliary blast valve then moves rapidly to its fully open position.

The present invention has the advantage of providing for double flow interruption without mechanical connection to the operating means and without redesign of the operating means or the main blast valve assembly of prior art single flow interrupters.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is an end elevation view of a compressed gas dual pressure type circuit interrupter embodying the principles of the present invention;

FIG. 2 is an enlarged vertical section view taken through a portion of the interrupter shown in FIG. 1 illustrating the pneumatic operating assembly;

FIG. 3 is an enlarged vertical section view of a portion of the interrupter shown in FIG. 1 illustrating a contact assembly embodying the teachings of the present invention;

FIG. 4 is a sectional view of a portion of an interrupter which has two contact assemblies for double break, double flow operation;

FIG. 5 is a sectional view of a portion of an auxiliary gas operated blast valve in the closed position;

FIG. 6 is a view similar to FIG. 5 with the gas operated blast valve in an intermediate position;

FIG. 7 is a view similar to FIG. 5 with the gas operated auxiliary blast valve in the opened position; and

FIG. 8 is a schematic view of a circuit breaker comprising two interrupters, one interrupter is of the single break construction, and the other interrupter is of the double break construction.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and more particularly to FIG. 1 there is shown a compressed gas dual pressure type circuit interrupter or breaker **12**. The circuit breaker **12** is supported by a metallic framework composed of suitable structural members **14** such as angle iron, braces, channels, I-beams or H-beams. The circuit breaker **12** is of the dual pressure type involving the use of a suitable arc extinguishing gas, such as sulfurhexafluoride, SF6, at two different pressures, such as a high pressure of approximately 230 psi, suitable for extinguishing an arc formed during circuit interruption, and a low pressure of approximately 60 psi. The dual pressure circuit breaker **12** comprises three portions, an interrupter or arc extinguishing portion **15**, a grounded housing **26**, and a terminal bushing structure **28**, which are assembled into a generally U-shaped structure as can best be seen in FIG. **1**. When more breaks are required in the circuit than can be supplied with the standard circuit breaker **12** as shown in FIG. **1**, the terminal bushing structure **28** can be replaced with an interrupter assembly **15** for additional circuit breaks, as shown schematically in FIG. **8**. In this configuration, shown in FIG. **8**, both legs of the U-shaped structure are circuit interrupters **15**.

In the circuit breaker **12** a suitable highly effective arc extinguishing gas such as sulfurhexafluoride, SF6, may be used as the arc extinguishing gas and also as an insulating gas to enable a close spacing of the energized, or the live parts. This insulating gas is also used within the terminal bushing structure **28** as described in detail in U.S. Pat. No. 2,757,261. The terminal bushing structure **28** comprises an axially extending high voltage terminal stud **29**, having a threaded upper end **31**. Surrounding the terminal stud **29**, in spaced relation therewith, is an outer weather-proof insulating shell or casing **30** having a plurality of weather sheds **32** for increased surface creepage distance. Although the gas pressure in the lower U-shaped bend **71** is of a high pressure, of approximately **230** psi, it is desirable to reduce the pressure acting internally upon the weatherproof casing **30** to approximately **25** psi. This may be accomplished by a pressure reducing valve (not shown) interconnecting the high pressure space in the U-shaped bend **71** with the interior space of the weatherproof casing **30**. A frusto-conical insulating support member **119** is used to provide a barrier between the high pressure region in the U-shaped bend **71** and the relatively low pressure region internal to the weather casing **30**.

The lower end of the weather casing **30** may have an annular flange **120** secured thereto, which in turn may be bolted by a plurality of circumferentially spaced bolts to the supporting flange **121**. The supporting flange **121** is in turn welded or otherwise secured to the upper tubular portion **122** of the lower U-shaped high pressure reservoir **71**.

For the measurement of current passing through the circuit breaker **12** one or more current transformers (CT's) **72** may be utilized surrounding the high pressure U-shaped reservoir **71**. Conducting stud **29**, of terminal bushing **28**, at its lower end connects to a U-shaped conductor **27**, which runs internal to the U-shaped high pressure reservoir **71**. The U-shaped conductor **27** carries the load current. The high pressure U-shaped reservoir **71** contains gas at a high pressure, of approximately **230** psi, and is comprised of three flanged tubular portions **73, 74** and **122**. Flanged portions **73, 74** and **122** are bolted together with gaskets interposed therebetween and surrounding the inner U-shaped conductor **27**, which is at a high voltage during normal circuit breaker operation. This construction not only provides a U-shaped high pressure reservoir **71** for admittance of high pressure gas upward into the space **47** of interrupter **15**, external of contact structure **20** of interrupter **15**, but also due to the high pressure insulating characteristics of the gas permits the close spacing between the inner high voltage conducting U-shaped stud **27** and the grounded U-shaped casings **73, 74** and **122**. In addition this construction provides a compact apparatus with ready accessibility provided for maintenance operations, when required. Since sulfurhexafluoride, SF6, gas at a pressure of 230 psi liquefies at about 50°F, band type heaters **75** are connected around the U-shaped reservoir **71** to keep the gas temperature above approximately, 75°F. The high convection heat transfer coefficient of the insulating gas at the pressure of 230 psi insures almost constant temperature throughout the high pressure reservoir in the U-bend **71** of the breaker **12**. No heating is required in the lower pressure areas as liquefaction at these pressures occurs well below the minimum operating temperature.

A control trip rod **13** extends from the grounded housing **26** upward into the top of the arc extinguishing assembly **15** and operates the three-way control valve **36**. Referring now to FIG. **2** of the drawings, there is shown a sectional view of the upper end of the interrupter **15**. The upper end of the valve control trip rod **13** is biased upward by a battery of compression springs **131** seating upon a spring seat **132** affixed to the valve control rod **13**, or an extension thereof, as at **34**. The compression spring **131** serves to bias a pressure balanced three-way control valve **36** to its upper closed position. To effect an opening operation of circuit breaker **12** the valve control rod **13** is moved upward approximately ¾ of an inch so as to permit the admission of high pressure gas existing within region **37**, upwardly through a conduit **39** and across the entire lower surface of the dual acting piston structure **108**. Dual acting piston structure **108** is connected by means of a piston rod **41** and other mechanical lingakes to the movable contact **21**, of the contact assembly **20**. The piston structure **108** is mechanically tied by means of the piston rod **41** to a generally ladder-shaped structure **43**. The dual acting piston **108** has differential annular areas for opening and closing the contact structure **20**.

To effect an opening operation of the interrupter **15**, actuation of the three-way control valve **36** is brought about by an upward motion of the valve control tripping rod **13**. The control valve **36** then admits high pressure gas upon the lower face **109** of the piston structure **108**, thereby causing upward motion of piston structure **108** and the movable contact **21.** As the piston structure **108** moves upward high pressure gas is trapped within the space **51,** for shock absorbing action, this trapped gas slowly creeps through the ports **53** provided in the annular check valve **54.**

During a closing operation the piston structure **108** is forced downward. Upon downward movement of the piston structure **108** the check valve **54** rises and permits high pressure gas, which is constantly present within the region **56,** to flow past the ring-shaped check valve **54** and into the shock absorbing region **51.** During closing a stepped portion **110,** of the movable piston **108,** moves into the space **58** which contains gas of relatively high pressure. Movement of stepped portion **110** into space **58** performs a shock absorbing function during closing stroke, the gas trapped in space **58** leaks through perforations provided in a ring-shaped check valve **60.**

Fixedly attached to the piston structure **108** and in effect constituting an extension of the piston rod **41** is an indicator stem **62,** which carries a green flag **63.** The green flag **63** projects upwardly into a transparent cap **64** provided at the upper end of the interrupter **15.** The green flag **63** clearly indicates in a positive manner the fact that the circuit breaker **12** has its contact structure **20** in the fully open position.

To take care of the situation where a low ambient temperature may be encountered and liquefaction of the high pressure sulfurhexafluoride gas results, liquid drain pipes **69** and **70** are provided. The liquid will flow downward by gravity through pipes **69** and **70** into the high pressure reservoir within the arc interrupter **15** and then into the lower U-shaped bend **71** where suitable heaters **75** are located to vaporize any liquified gas.

As can best be seen in FIG. **3,** the movable contact **21** is mechanically connected to the ladder-shaped member **43,** which in turn is mechanically adjustably secured to the lower end of piston rod **41.** A pair of spaced insulating operating rods **44** extend from the ends of member **43.** A downwardly extending stem portion **76** which is adjustably secured to the hollow movable contact **21** is attached to the center of member **43.** The side operating rods **44** are secured to a movable blast valve actuator **79.** The movable contact **21** makes separable engagement with the stationary hollow contact structure **22** which is fixedly supported upwardly from a base support **83.** During circuit interruption an exhaust flow of arc extinguishing gas at high pressure occurs, in opposite directions, through the interior of both the movable contact **21** and the stationary hollow contact **22.**

There is provided a primary blast valve **88** constituted by the lower tip portion **77** of the movable contact **21** making abutting engagement with the relative stationary primary blast valve seat **89.** The primary blast valve seat **89** is resiliently supported upon the stationary contact support **83,** as shown in FIG. **3.** A compression spring **91** provides the desired contact pressure therebetween, and also provides for a limited amount of over-travel of the movable contact **21.** Additionally, there is provided a plurality of circumferentially disposed stationary contact fingers **93** which make contacting engagement with the external side of the movable tubular contact **21.**

In addition to the primary blast valve **88** there is provided a mechanically operated main blast valve **49** and a gas operated blast valve **50,** which is the subject of the present invention and which will be described in greater detail hereinafter. Depending upon the voltage range and current being interrupted, the interrupter **15** is adaptable to accommodate multiple sets of coctact assemblies **20.** FIG. **3** illustrates an arrangement in which only a single pair of separable contacts **21** and **22** are provided. However, for the higher voltage ratings where double break is desired a construction as shown in FIG. **4** may be used. With reference to FIG. **4** it will be observed that there is provided a pair of serially related assemblies **20.** For each contact assembly, during circuit interruption, there is double flow; that is the arc extinguishing gases flow through both the stationary contact **22** and the movable contact **21.**

The dual-acting piston **108** of the circuit interrupter **15** is used to open and close the contact assembly **20.** The movable contact **21** of the interrupter **15** forms a seal with mating stationary contact **22** constituting a primary blast valve **88.** When the breaker contact assembly **20** is closed, the seal between the tip **77** and the seat **89** at the primary blast valve **88** prevents the high pressure gas from flowing into the interior of both of the separable contacts. When the primary blast valve **88** is closed the main blast valve **49** and the gas operated auxiliary blast valve **50** are open. When the movable contact **21** separates from the stationary contact **22,** during the circuit interruption, the blast valves **49** and **50** go closed after arc extinction to stop the exhaust gas flow into low pressure chambers **103** and **104.** It should be noted that the low pressure chambers **103** and **104** can be connected directly to atmosphere so the insulating gas is exhausted external of the breaker **12.** Since the movable contact can reach the open position while there is still an arc between the contacts **21** and **22,** it is necessary that blast valves **49** and **50** remain open at this time, to allow gas flow to interrupt the arc. Hence, the closing of blast valves **49** and **50** must have a travel curve which is delayed from that of the moving contact **21.** The main blast valve **49** is mechanically operated from the dual acting piston **108.** The blast valve activator **79** is directly connected to movable contact **21** and has the same travel as the movable contact **21.** As a movable contact **21** moves from the closed position, the blast valve activator **79** starts compressing a coil compression spring **105.** As the movable contact **21** moves to the open position, this compression spring **105** becomes loaded, since the opposite spring seat **106** is prevented from moving. The spring seat **106** is part of the blast valve **49** assembly and the blast valve **49** is prevented from closing by two latches **107** which are spaced 180° apart. A lip **118** on spring loaded latch **107** engages a portion of the blast valve **49** and prevents it from closing. After the activator **79** has moved a specific distance and thereby compressed the spring **105** a protrusion **128** on the activator **79** pushes the latch **107** back, disengaging it from the blast valve **49.** The blast valve **49** can then go closed with a travel curve which is delayed in relationship to the opening of the movable contacts **21.** When the blast valve **49** is closed, there is some pressure on it due to the position of activator **79** compressing the spring **105,** plus a differential pressure holding the blast valve **49** closed due to the geometry of the face of the blast valve **49.**

During clsoing of the circuit breaker 12, when the movable contact 21 moves into engagement with the stationary contact 22, the main blast valve 49 is opened. As the movable contact 21 moves to the closed position, the activator 79 with its rubber bumper 111 strikes the blast valve 49 and moves it to the open position. A small gas dash-pot is formed between the activator 79 and the blast valve 49 to help reduce shock. As the movable contact 21 closes, the lip 118 of the latch 107 engages a portion of the blast valve 49 and the blast valve 49 is then ready for another opening operation.

For double flow interruption a gas operated auxiliary blast valve 50 operates in conjunction with mechanically operated blast valve 49 to provide gas flow into and through both the moving contact 21 and the stationary contact nozzle 22, during circuit interruption. The gas operated blast valve 50 operates without mechanical coupling to the dual acting operating piston 108 and thus avoids additional loading of the piston 108. Thus, this construction of a gas operated auxiliary blast valve allows for double flow interruption in all instances without redesign of the operating piston 108 or the addition of new mechanical parts. Operation of the gas operated auxiliary blast valve 50, as can best be understood from FIGS. 3, 5, 6 and 7, will now be described in detail. FIGS. 3 and 5 show an interrupter 15 in which the moving contact 21 is shown in the open position and the gas operated blast valve 50 is in the closed position. FIG. 7 shows a movable contact 21 in the closed position. As long as the movable contact 21 is in the closed position, blast valves 49 and 50 are in the open positions and the contact nozzle region 60 communicates directly with the low pressure chambers 103 and 104. A first auxiliary blast valve chamber 97 communicates with the nozzle chamber 60 through the fixed area metering holes 94 and will, after transient flow ceases, be at the same pressure as the nozzle chamber 60. Under these conditions a sliding portion 48 of the auxiliary gas operated blast valve 50 will be moved to and held in the open position by the force which the high pressure gas exerts in a second auxiliary chamber 98. Chamber 98 is formed by the sliding portion 48 of blast valve 50 and a blast valve guide 47. Seals 46 effectively prevent leakage of the high pressure insulating gas from high pressure chamber 98 to low pressure areas. Chamber 98 will always be at the same pressure as the high pressure system since it communicates directly with the high pressure system through inlet 99 in the blast valve guide 47.

As moving contact 21 starts to open, spring 91 and the pressure biased moving contact follower seat 89, follow tip 77 until the projecting lip 130 of the follower assembly 131 comes into contact with the stop 132 which is part of the finger housing 133. Thereafter, an increasing annular opening is formed between the movable contact 21 and the stationary contact 22. High pressure gas from the surrounding reservoir rushes through this opening into the low pressure nozzle chamber 60 completing circuit interruption. This high pressure gas also flows through the fixed area metering holes 94 and into the auxiliary blast valve chamber 97. When the force produced by the gas pressure in chamber 97 plus the force of the biasing spring 134 exceeds the holding force of the high pressure gas in the chamber 98 the gas operated auxiliary blast valve 50 starts to close. The time delay from the startup motion of the moving contact 21 to the startup motion of the sliding portion 48 of blast valve 50 is determined by the area of the metering holes 94.

As the sliding portion 48 of the auxiliary blast valve 50 moves towards the closed position, its motion continues to be controlled by the metering hole 94. However, gas flow through the nozzle and over the surface of the sliding portion 48, results in additional driving force which tends to accelerate gas operated blast valve 50 towards the closed position. A barrier projection 136 on the sliding portion 48 of the auxiliary blast valve 50 delays the in-rush of high pressure gas into the chamber 97 for a predetermined portion of the time of travel of the blast valve 50. Further travel of the blast valve sliding portion 48 reduces the annular discharge area 137 between parts 48 and 138 so that the vena-contracta of the flow system is shifted from the primary blast valve 88 nozzle area to area 137 and results in a rapid pressure rise in the nozzle chamber 60. The resulting rapid pressure rise in the nozzle chamber 60 produces sudden pressure rise in chamber 97 and slams the sliding portion 48 of the blast valve 50 to the closed position as shown in FIG. 5. The gas operated auxiliary blast valve 50 is now closed and prevents high pressure gas from passing into the low pressure chamber 104. The resilient valve seat 95 provides a gas tight seal between the sliding portion 48 of blast valve part 50 and the lower arc horn 138, so that, the pressure gas system which now extends inside the stationary contact assembly 22 is prevented from leaking into the low pressure chamber 104. Differential pressure between these two systems acting on the differential area of the sliding portion 48 of blast valve 50 inside the chamber 97 provides a holding force which contains the blast valve sliding portion 48 in the closed position.

When a condition of no differential pressure exists in the breaker 12, and the breaker contact 21 and 22 are open, such as occurs during initial filling or equalization of pressures, the biasing spring 134 provides sufficient force to close the sliding assembly 48 and maintain adequate loading on the resilient seat 95 to provide a gas tight seal between the sliding assembly 48 and the arc horn 138. When an equalization of pressures occur and the contacts 21 and 22 are in the closed circuit position the sliding assembly 48 moves to the spring biased closed position in contact with arc horn 138. As the gas differential pressure is restored the sliding assembly 48 moves from the spring biased closed position to the ready open position as shown in FIG. 7.

The moving contact 21 is mechanically connected to the main blast valve 49 through a cross arm activator 79, the operation of which has been described hereinbefore in detail. With the moving contact 21 in the open position the main blast valve 49 is closed and high pressure exists inside both the moving contact nozzle 21 and the stationary contact nozzle 22. As the moving contact 21 starts to close, the main blast valve 49, after a fixed delay is opened, providing a discharge path for the high pressure gas which was trapped within the contact nozzle assembly. Initially the pressure drop in the stationary contact 22 nozzle and blast valve chamber 97 will be produced by the gas flow through moving contact 21 nozzle and out of the main blast valve 49. However, when the pressure in chamber 97 falls below a critical valve such that the holding force towards the closed position is exceeded by the opening force, provided by the high pressure gas in chamber 98, the auxiliary blast valve sliding portion **48** starts to move toward the open position. As the auxiliary blast valve **50** moves toward the open position the resulting opening **137** provides an additional exit for discharging gas from the stationary contact **22** nozzle and the chamber **97.** As the area **137** increases, the auxiliary blast valve **50** moves rapidly to its fully open position and is ready for another opening operation. A resilient cushion **96** is held in position by a suitable means, such as a retaining ring, is provided as a shock absorber for the sliding assembly **48** during its opening stroke.

The present invention provides a means for increasing the interrupting capacity of single flow interrupters by converting them into double flow interrupters. This conversion from a single flow interrupter to a double flow interrupter is accomplished without mechanically coupling to the moving contact driving mechanism and thus avoiding additional loading and without redesign or additional parts being added to the operating mechanism. This invention is especially useful for interrupters of the type shown in FIG. **4,** where multiple circuit breaks are required. In the interrupter **15** shown in FIG. **4** for example, if it was desired to have double flow interruption with prior art interrupter **15** it was necessary to have a pneumatic piston **108** which was powerful enough to operate four main blast valves **49.** Utilizing the teachings of the present invention, a pneumatic piston **108** which can operate two main blast valves **49** is used, and two auxiliary gas operated blast valves **50** are used for double flow interruption at each set of contacts **20.**

Since numerous changes may be made in the above described apparatus and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all the matter contained in the foregoing descriptions and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. A compressed gas circuit interrupter comprising an enclosure, an insulating gas contained within said enclosure, a first hollow tubular contact means disposed within said enclosure, a second hollow tubular contact means disposed within said enclosure, said first hollow tubular contact means being movable into and out of engagement with said second tubular contact means, an operator means mechanically linked to said first hollow tubular contact for moving said first hollow tubular contact into and out of engagement with said second contact a first blast valve means mechanically linked to said operating means to seal off the end of said first hollow contact means after said first hollow contact means separates from said second hollow contact means, a second blast valve means to seal off the end of said second hollow contact means after said first hollow contact means separates from said second hollow contact, said second blast valve means being pressure sensitive so as to close off the end of said second hollow contact means when the gas pressure within said second hollow contact means is equal to the gas pressure surrounding said second tubular hollow contact means.

2. A compressed gas type circuit interrupter as claimed in claim **1** wherein said insulating gas comprises a gas compressed to a high pressure and a gas compressed to a low pressure.

3. A compressed gas type circuit interrupter as claimed in claim **1** wherein said insulating gas comprises a gas compressed to a high pressure and means for venting said gas to atmosphere during circuit interruption.

4. A compressed gas type circuit interrupter as claimed in claim **2** wherein when said first hollow contact means engages said second hollow contact means said high pressure insulating gas surrounds the outer surfaces of said first contact means and said second contact means, and where said low pressure gas is present inside of said first hollow tubular contact and said second hollow tubular contact, whereby when said first hollow tubular contact is separated from said second hollow tubular contact, said high pressure gas surrounding the outside of said first contact means and said second contact means rushing to the inside of and through said first contact and said second contact means.

5. The combination as claimed in claim **2,** wherein the force to operate said second blast valve is derived from the differential in pressure of the said high pressure gas and said low pressure gas acting on said second blast valve means.

6. A compressed gas circuit interrupter as claimed in claim 4 wherein said first movable contact means is in engagement with said second contact means, said high pressure gas which surrounds said second hollow tubular contact means acts on said second blast valve means to hold said second blast valve means in the fully open position.

7. The combination as claimed in claim **4,** wherein when said first contact means separates from the said second contact means said high pressure gas flows internal of said second contact means forcing said second blast valve means to the closed position.

8. A compressed gas type circuit interrupter as claimed in claim **7** wherein said second contact means comprises at least one fixed area metering hole, said high pressure gas flowing through said metering hole to operate said second blast valve means, so that the closing time of said second blast valve means is determined by the area of said fixed area metering hole.

9. A compressed gas type circuit interrupter as claimed in claim **5** including a spring biasing means to hold said second blast valve in the closed position when there is no differential pressure in pressure between said high pressure gas and said low pressure gas, said second blast valve constructed so that the pressure of said high pressure gas can be increased with said first contact in engagement with said second contact, and said second blast valve constructed so that the pressure of said high pressure gas can be increased when said first contact is out of engagement with said second contact.

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