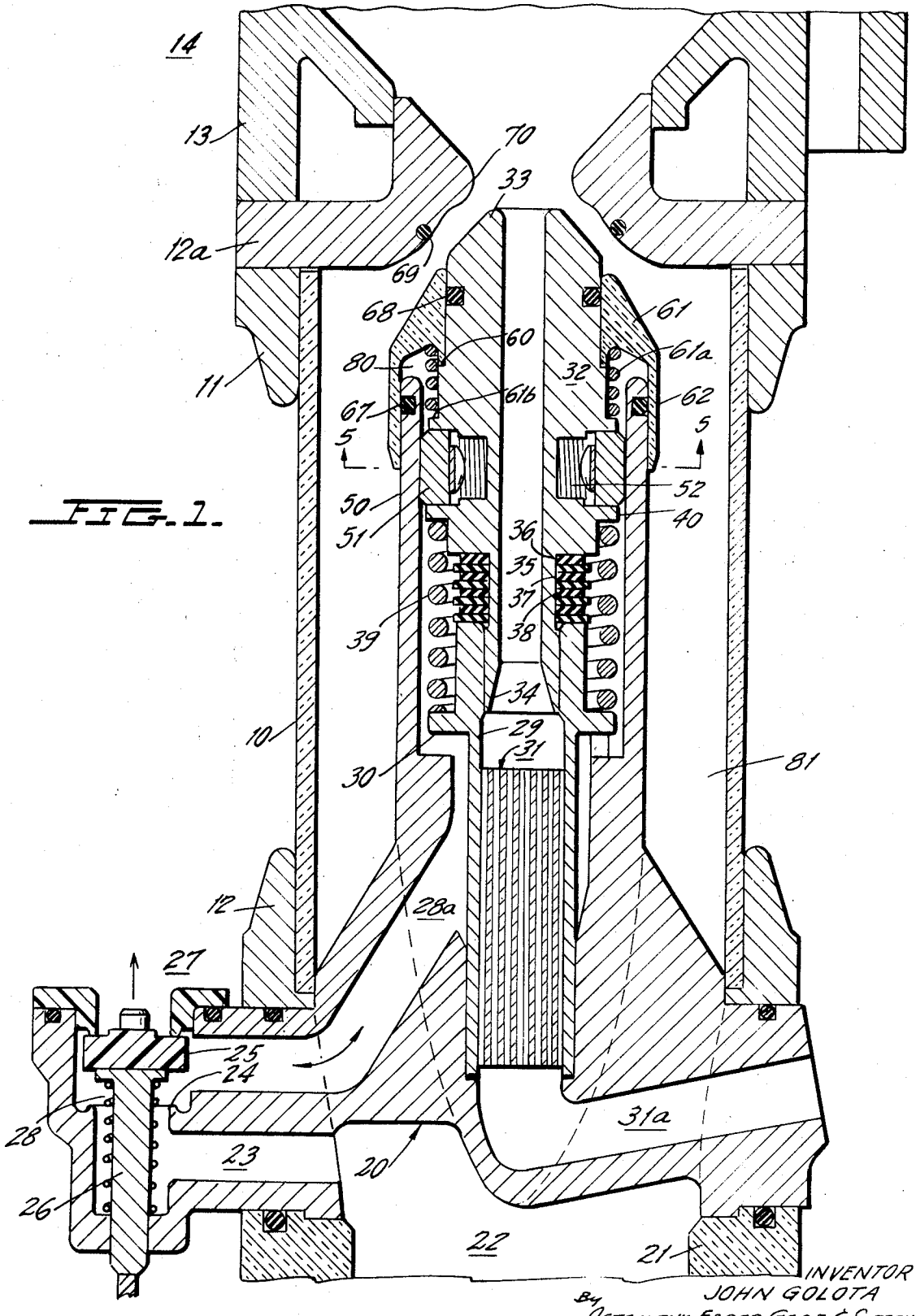
July 28, 1970 J. GOLOTA 3,522,400

ANNULAR SLIDING VALVE FOR AIR BLAST CIRCUIT BREAKER

Filed Dec. 15, 1966 3 Sheets-Sheet 1

FIG. 1.

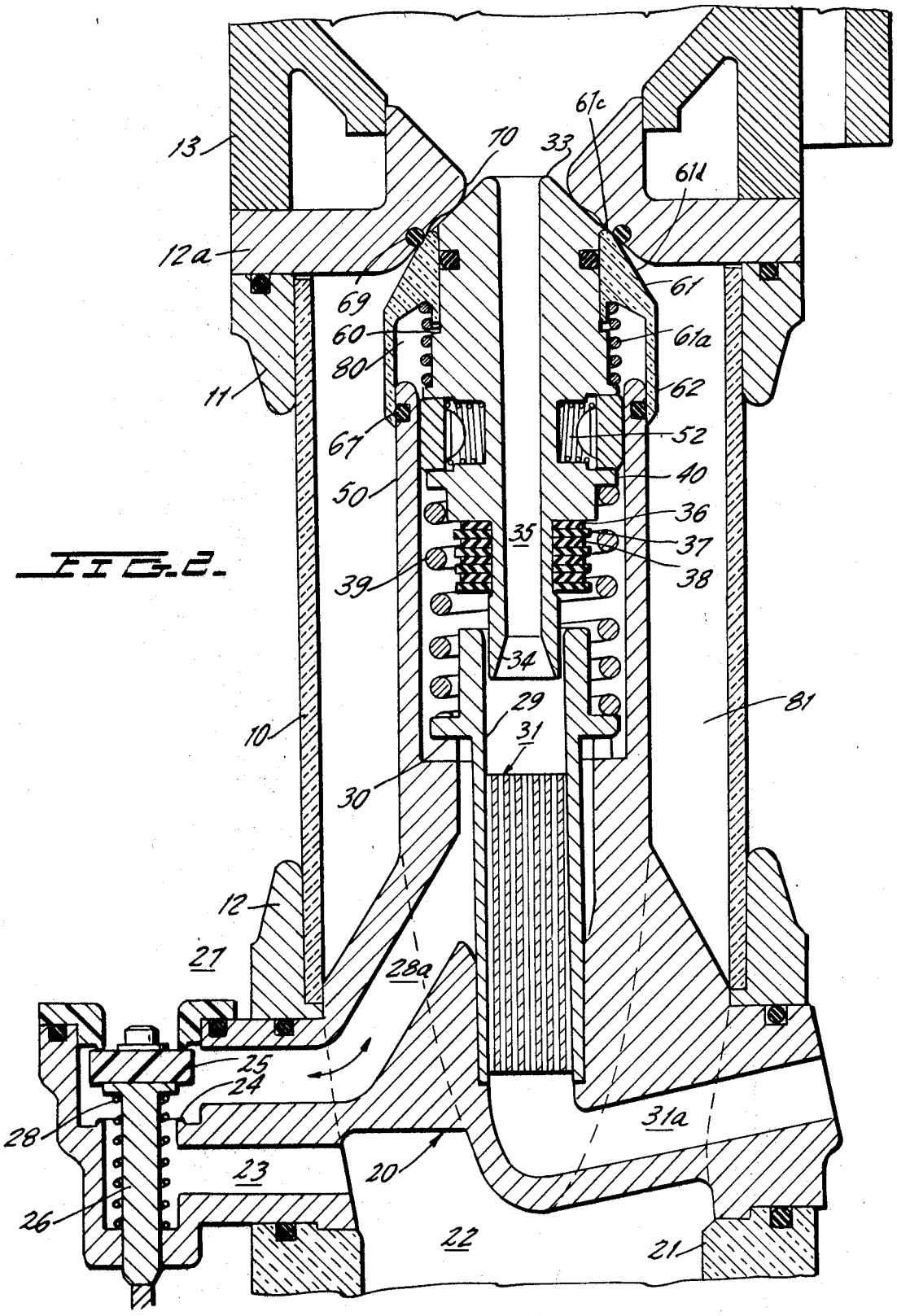


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ANNULAR SLIDING VALVE FOR AIR BLAST CIRCUIT BREAKER

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FIG. 2.



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ANNULAR SLIDING VALVE FOR AIR BLAST CIRCUIT BREAKER

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FIG. 4.

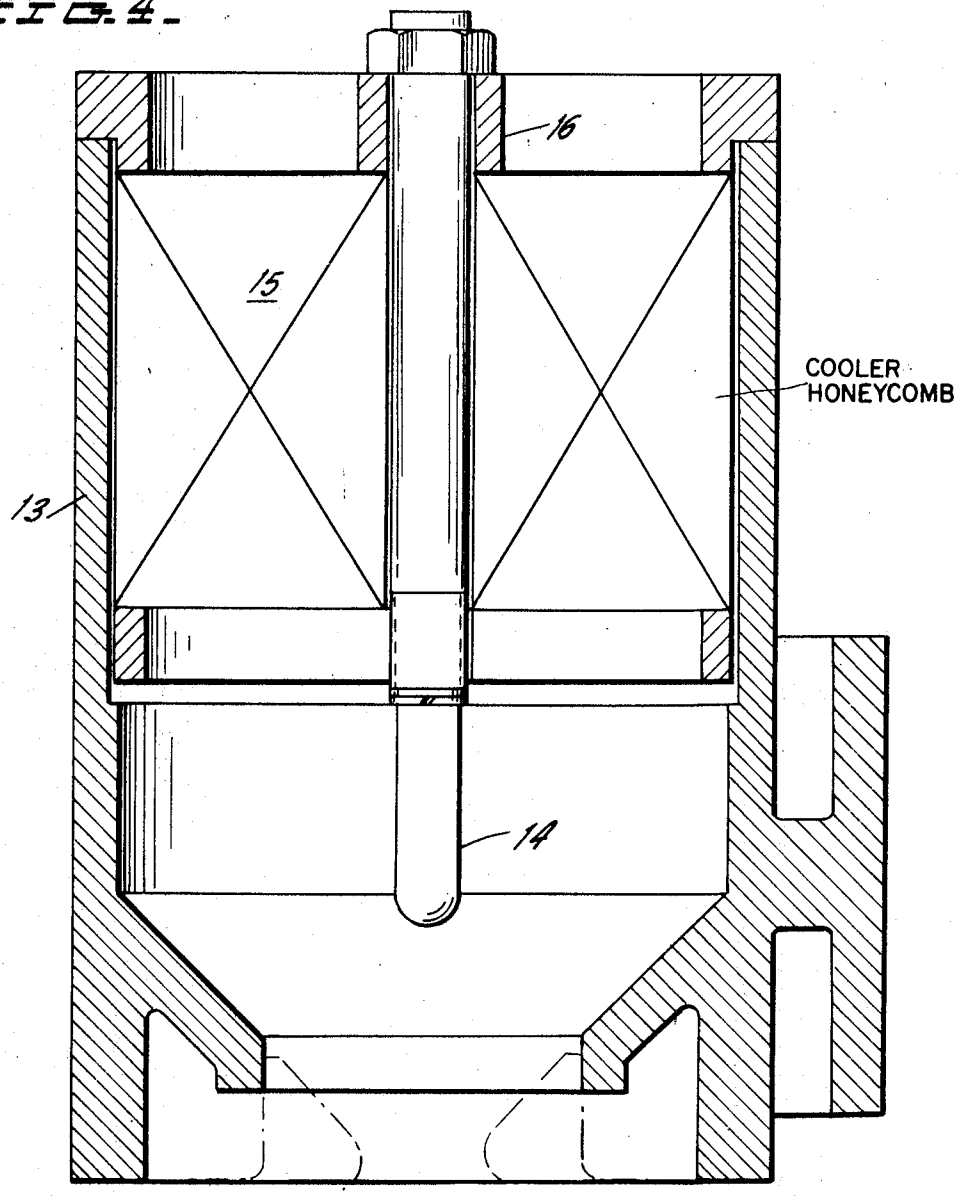


FIG. 5.

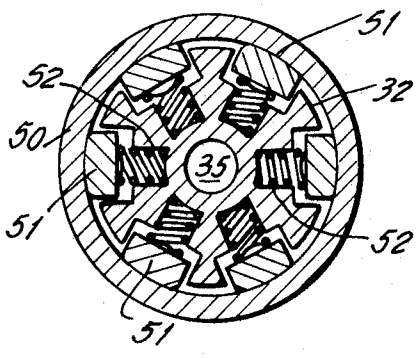
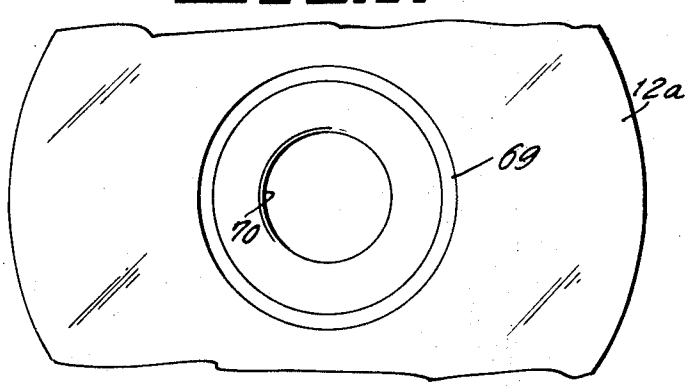


FIG. 3.



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ANNULAR SLIDING VALVE FOR AIR BLAST CIRCUIT BREAKER

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Int. Cl. H01h 33/83
U.S. Cl. 200—148 7 Claims

ABSTRACT OF THE DISCLOSURE

A compressed gas circuit breaker in which an axially extending movable contact carries a blast valve slidably mounted thereon. One end of the movable contact engages a nozzle opening in a stationary contact and the blast valve mounted on the end of the movable contact engages a sealing ring on the stationary contact. The blast valve, when closed, isolates a high-pressure source from a low-pressure source. When the blast valve slides down on the movable contact, high-pressure air is immediately adjacent the point of contact separation between the movable and stationary contacts.

This invention relates to a novel interrupter structure for compressed air circuit breakers, and more specifically relates to an interrupter structure having few moving parts, and having an annular air blast valve placed in close proximity to the breaking gap to minimize consumption of compressed air and to reduce operating gas pressure to a minimum.

Air blast circuit breakers are well known to the art where a blast valve controls high pressure air so that a blast of air is passed through cooperating contacts when they are operated in order to extinguish the arc drawn between the contacts. Such blast valves are commonly positioned remote from the point at which the contacts separate. This requires suitable channels for leading the pressurized air to the contact region. These channels cause a pressure drop in the gas pressure at the contact region, and also cause a delay in the time it takes for the pressurized air to reach the point of contact interruption. The delay produces a consequent delay in circuit interruption after the operation of the blast valve, and requires that the blast valve be opened some substantial amount of time prior to the actual separation of the contacts and until the arc is extinguished. Therefore, there is a loss of pressurized air greater than required solely for arc interruption. Moreover, relatively high pressure sources are required in order to compensate for the pressure drop in the various connecting conduits between the remote blast valve and the contacts to obtain the necessary pressure in the contact region.

The principle of the present invention is to provide a novel annular blast valve which seats directly around the annular contact area at the region at which current interruption occurs. Thus, the instant the valve is opened, high pressure gas is applied directly to the arcing area without pressure loss and without delay. Consequently, the valve need be opened only long enough for arc extinction purposes to conserve pressurized gas; and the pressurizing equipment need not be over-designed to compensate for pressure drops in gas conducting conduits leading from the blast valve to the contact. The latter advantage has been found to permit the use of pressure supply equipment of the order of 250 p.s.i. so that commercially available pressure handling equipment can be used whereas, the use of pressure carrying conduits from blast valve to contacts required the use of higher and nonstandard pressure equipment.

In the preferred embodiment of the invention, nozzle-type contacts are used in the interrupter with a movable nozzle-type contact surrounded by a relatively movable annular valve. A novel pressurizing arrangement is then provided for forcing the annular valve into sealing engagement with the stationary contact when the movable contact engages the stationary contact. The annular valve member is then movable with relation to the movable contact such that in opening the breaker, the annular valve member will initially move away from the stationary contact to open the valve seal, with this motion immediately followed by the rapid movement of the movable contact, with both movable contact and movable valve thereafter moving toward a disengaged position in unison. The annular valve member of the invention operates as a free piston-type of member, and is proportioned to provide a "popping" action with the same pressures moving both the annular valve and movable contact in sequence. Thus, contact opening speed will not be dependent on the rate of pressure drop beneath the movable contact so that a small pilot type dump valve can be used in place of the usual large supplemental blast valve for controlling blast valve operation and contact movement.

Accordingly, a primary object of this invention is to provide a novel gas blast circuit interrupter which requires relatively low supply gas pressures.

Yet another object of this invention is to provide a novel gas blast interrupter structure for high power circuit breakers which places a blast valve in close proximity to the contact break.

A still further object of this invention is to provide a novel blast valve for gas blast interrupters which conserves high pressure gas.

Yet another object of this invention is to provide a novel gas blast interrupter structure which is simple in construction and easy to maintain, and is highly reliable.

These and other objects of this nivention will become apparent from the following description when taken in connection with the drawings, in which:

FIG. 1 is a cross-sectional view of the novel interrupter structure of the invention in the open position.

FIG. 2 is similar to FIG. 1 and shows the interrupter structure in its closed position.

FIG. 3 is a bottom plan view of the stationary contact of FIG. 1.

FIG. 4 is a cross-sectional view of the upper terminal structure for the interrupter for FIGS. 1 and 2.

FIG. 5 is a cross-sectional view of FIG. 1 taken across lines 5—5 in FIG. 1.

Referring now to the drawings, the interrupter chamber is comprised of an insulation tube **10** of suitable material which is fitted and sealed in conductive mounting disks **11** and **12** at its upper and lower ends, respectively. Upper disk **11** is then secured to the disk-shaped stationary contact **12***a*, shown in bottom plan view in FIG. 3. A gas conducting discharge outlet including tube **13** shown in FIG. 4 is connected atop contact **12***a* and contains a standard stationary arcing contact finger **14** surrounded by a cooler honeycomb **15**, schematically illustrated, which conducts blast gas through openings in terminal plate **16** to the exterior of the interrupter. The bottom disk **12** is then secured to bottom casting **20**.

Bottom casting **20** is secured and sealed on the end of a suitable hollow support insulator **21** with a source of high pressure gas, such as air (not shown) connected to the bottom of insulator **21** and thus to central chamber **22** beneath casting **20**. Casting **20** has a channel **23** for conducting this high pressure gas through valve seat **24** formed in casting **20**. A valve member **25** carried on rod **26** is then movable between valve seat **24** and valve seat **27** which is suitably fastened to bottom casting **20**, with

valve member 25 normally biased toward engagement with valve seat 27 by the compression spring 28. A suitable operating mechanism (not shown) is connected to rod 26 from some remote position and is responsible for movement of valve 25 as will be later described.

Channel 23 then communicates with channel 28*a* in bottom casting 20. The upper portion of channel 28*a* leads into an annular channel surrounding lower conductive member 29 which is secured to casting 20. Conductive member 29 has a flange 30 thereon and concentrically surrounds a cooler honeycomb 31 through which arc products and gases may pass to the outlet channel 31*a* in bottom casting 20 to the external atmosphere.

A movable contact rod 32 having an upper contact section 33 and a lower tail section 34 is then provided with the lower section 34 in sliding relation within member 29 as illustrated. The movable contact rod 32 has an opening 35 extending therethrough, and is provided with a series of resilient buffer plates such as plates 36, 37 and 38, the bottom plate of which is received by the top of member 29 when the movable contact 32 is in the open position shown in FIG. 1.

A biasing spring 39 contained between flange 30 of fixed member 29 and flange 40 of the movable contact rod 32 then biases the contact rod 32 upwardly toward the position of FIG. 2.

Contact rod 32 is in sliding contact engagement with upper conductive cylinder portion 50 of bottom casting 20 by means of a plurality of sliding contacts 51 which surround the contact rod 32. By way of example, six such sliding contacts 51 can surround rod 32 as illustrated in FIG. 5. Each of contacts 51 is then biased outwardly and into sliding engagement with member 50 as by suitable compression springs 52.

The exterior surface of contact rod 32 is then provided with a shoulder 60 which serves as a stop for annular blast valve member 61 which telescopes over the upper end of contact rod 32. A spring 61*a* is provided between shoulder 61*b* on movable contact rod 32 and the interior of valve 61 which biases valve 61 upwardly with respect to contact rod 32. Blast valve member 61 has a lower cylindrical skirt 62 which fits over member 50 with a gas-tight seal formed between members 61 and 50 by the O-ring 67. A second seal is formed between member 61 and contact rod 32 by the O-ring 68.

Annular valve 61 is then movable from the lower open position of FIG. 1 to the valve closed position of FIG. 2 where the outer surface annular valve 61 seats against O-ring 69 carried in the stationary contact 12*a*.

It is to be noted that movable contact rod 32 is movable independently of valve 61 to the disengaged position (from the position of FIG. 2 to the position of FIG. 1), and that when the contact 32 engages stationary contact 12*a*, it engages on a radially inwardly directed portion 70 of the inverted S-shaped engaging surface of stationary contact 12*a*.

An annular cavity 80 is then provided within skirt 62 which is connected to channel 28*a* to permit compressed gas from cavity 22 to fill cavity 80. Channel 22 is connected to main annular chamber 81 formed between the interior of tube 10 and the exterior of extension 50 by virtue of the spider type construction of casting 20 as illustrated by dotted lines in FIGS. 1 and 2. Note that channel 28*a* and chamber 81 are in communication with one another only when valve 25 is in the position shown in FIGS. 1 and 2, through the common channels 23 and 28. When valve 25 moves down (and seats on valve seat 24), channel 28*a* and chamber 81 are isolated by valve 25.

The operation of the interrupter of FIGS. 1 and 2 is as follows:

With the circuit interrupter in the closed position of FIG. 2, compressed air is admitted through chamber 22 through conduits 23 and 28, the valve 25 being in its upper position where it seats against valve seat 27. The pressure from chamber 28 is then applied under flange

40 of movable contact 52 to aid spring 39 in closing contact rod 32, and to the interior volume 80 under valve 61 to aid spring 61*a* to close the valve 61, thereby to bias both valve 61 and contact 32 to the engaged position in FIG. 2. The valve 61 seats on ring 69, thereby to prevent compressed air in chamber 81 from escaping through the center of contact 12*a* or through channel 35 in contact rod 32.

In order to open the circuit interrupter, the valve 25 is remotely actuated through a suitable operating mechanism which is unimportant for purposes of the present invention, whereby the valve 25 is moved down to seat against valve seat 24. This then vents chamber 28*a* to the external atmosphere, thereby permitting the pressure beneath the annular valve 61 to fall off rapidly. The valve 61 is so proportioned that the area under the valve within chamber 80 is less than the area at the top of the valve exposed to the pressure within the outer chamber 81, thereby tending to move the valve toward its lower or open position against the force of spring 61*a*. Moreover, when the pressure has fallen sufficiently to allow the valve to move downwardly and break the seal at gasket 69, the area on top of the valve subject to the higher chamber pressure will now be equivalent to the full area of the valve including the area which was internal of seal 69 which was exposed only to external pressure. This sudden increase in area and resultant multiplication of opening force will then drive valve 61 rapidly down against shoulder 60 of movable contact 32 and independently of movement of movable contact 32.

When the valve 25 vents chamber 28*a*, pressure under flange 40 of movable contact rod 32 was also removed. However, the force of spring 39 is still sufficient to hold contact rod 32 in engagement with stationary contact 12*a*. As soon as valve 61 leaves seal 69, however, the entire upper surface of contact 32 is exposed to the high pressure of chamber 81 which is sufficient to move contact rod 32 rapidly downward against the force of spring 39. That is, in FIG. 2, the surface of valve 61 is divided into an interior annular region 61*c* and an exterior annular region 61*d*, by engagement of gasket 69 and valve 61. When the valve opens, both areas 61*c* and 61*d* are exposed to high pressure.

Consequently, in operation, valve 61 is initially unsealed from seal 69 whereupon it immediately moves downward independently of contact 32, with a "popping" type action once the remainder of its internal area within seal 69 is exposed. Similarly, the movable contact is exposed to high operating pressure immediately after valve 69 is opened whereupon contact 32 also moves down with a "popping" action. Since valve 69 opens immediately prior to separation of contacts 32 and 12*a*, a strong air blast will be established between the separating contacts to extinguish any arc drawn therebetween. This air blast is then conducted through the cooler honeycomb 15 (FIG. 4) to external atmosphere, and through central opening 35 and through honeycomb 31 to external atmosphere. Note further that there is no delay in application of blast air to the contact after the blast valve is opened since this air (and the blast valve) surrounds the contact area and need not be conducted through auxliiary channels. Thus, air blast need continue only long enough to extinguish the arc whereby compressed air of the supply is conserved. Moreover, the air pressure at the contacts has the same pressure as the supply source (as measured in cavity 22), and it is not necessary to increase the air supply pressure to account for pressure drops in conduits leading from the blast valve to the contact.

In order to shut off the blast of air and reset the contacts, the operating mechanism moving valve 25 is suitably arranged so that the valve 25 is automatically returned to the position shown in the drawings where the valve 25 seats against valve seat 27. This action will permit compressed air to enter channel 28*a* and chamber 80, thereby moving the valve 61 upwardly to seal against

O-ring **69** with a snap action. The closing of valve **61** removes the pressure from the top of contact **32** whereby the pressure beneath flange **40** and spring **39** will move contact **32** toward its engaged positon with a subsequent snap action.

Note that a supplemental isolating contact means (not shown) will be connected in series with the interrupter contacts in the usual manner. This interrupter is synchronized with the operation of valve **25** to establish an open circuit to prevent the reclosing of contact **32** from re-establishing the circuit which has been opened.

It is to be particularly noted that the air pressure within the movable contact chamber acts independently on both contact **32** and annular valve **61**. In this manner, the contact force is made independent of the sealing force and adds to the force obtained from the main closing spring **39**. This results in high contact pressure between contacts **32** and **12***a* up to the instant of contact separation. At the same time, the force under annular valve **61** is proportionally lower so as to not develop excessive sealing pressure, thereby allowing the valve to be of light construction so that it will be rapidly movable under the differential pressures applied thereto during opening.

Although this invention has been described with respect to its preferred embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred, therefore, that the scope of the invention be limited not by the specific disclosure herein, but only by the appended claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. A gas blast circuit breaker comprising, in combination: a stationary contact; an elongated movable contact movable bewteen an engaged and disengaged position with respect to said stationary contact; an annular blast valve of insulation material surrounding the end of said elongated movable contact; said annular blast valve having an interior surface portion extending along a major portion of the axis thereof; said interior surface portion engaging and being axially slidably movable on the exterior surface of said end of said movable contact and in sealed engagement with said exterior surface of said end of said movable contact; said annular blast valve having first and second opposite annular surfaces facing respectively toward and away from said stationry contact; a first chamber in communication with said second annular surface of said blast valve; a high pressure gas source; valve means for selectively connecting said first chamber to said high pressure source or to a low pressure exhaust region respectively; a second chamber connected to said high pressure gas source; said movable contact and said annular blast valve contained within said second chamber; an opening in said second chamber adjacent the end of said elongated movable contact and in the region where said movable contact engages said stationary contact; seal ring means disposed in said opening and engageable by an exterior annular region on said first annular surface of said annular blast valve; said annular region dividing said first annular surface into an interior annular portion and an exterior annular portion; said opening in said second chamber communicating with a low pressure region; said end of said movable contact exposed to said low pressure region when said first annular surface of said annular blast valve engages said seal ring means and said movable contact engages said stationary contact; connection of said first chamber to said low pressure region by said valve means permitting the release of said first annular surface of said annular blast valve from said seal ring means whereby high pressure from said second cramber is connected over the full surface area of said first annular surface of said blast valve to move said blast valve down along said movable contact and said high pressure source is connected over the end surface of said movable contact, thereby to move said movable contact down and away from said stationary contact with the opening of said blast valve permitting a blast of high pressure gas through the region between the separating movable and stationary contacts.

2. The device as set forth in claim **1** wherein said stationary contact has a ring shape coaxial with the axis of said elongated movable contact; said seal ring means embedded in the interior surfce of said ring shaped stationary contact facing said blast valve.

3. The device as set forth in claim **1** which includes gasket means between the sliding cooperating surfaces of said blast valve and said end of said movable contact for forming a gas tight seal.

4. The device as set forth in claim **1** which includes first spring bias means connected to said blast valve for biasing said blast valve toward its sealed position with respect to said seal ring means and second spring bias means for biasing said movable contact toward its engaged position with respect to said stationary contact.

5. The device as set forth in claim **1** wherein the pressure of said source of high pressure gas is no greater than 250 p.s.i.

6. The device as set forth in claim **1** which includes a stationary conductive support for said annular valve and movable contact; said stationary conductive support having an elongated sleeve; said elongated movble contact having a lower portion thereof slidably disposed within said sleeve and in sliding electrical contact therewith; said annular valve having a bottom relatively large diameter skirt slidably disposed about the upper exterior diameter of said sleeve; and pressure seal means between said skirt and sleeve.

7. The device as set forth in claim **1** wherein a lower portion of said movable contact is contained in said first chamber whereby gas pressure acting against said lower portion of said movable contact biases said movable contact toward engagement with said stationary contact.

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