Sept. 27, 1966 SHOJI MORIOKA 3,275,778

COMPRESSED-GAS CIRCUIT INTERRUPTER WITH PRESSURIZED ARCING CHAMBER AND DOWNSTREAM BLAST VALVE

Filed July 31, 1963 2 Sheets-Sheet 1

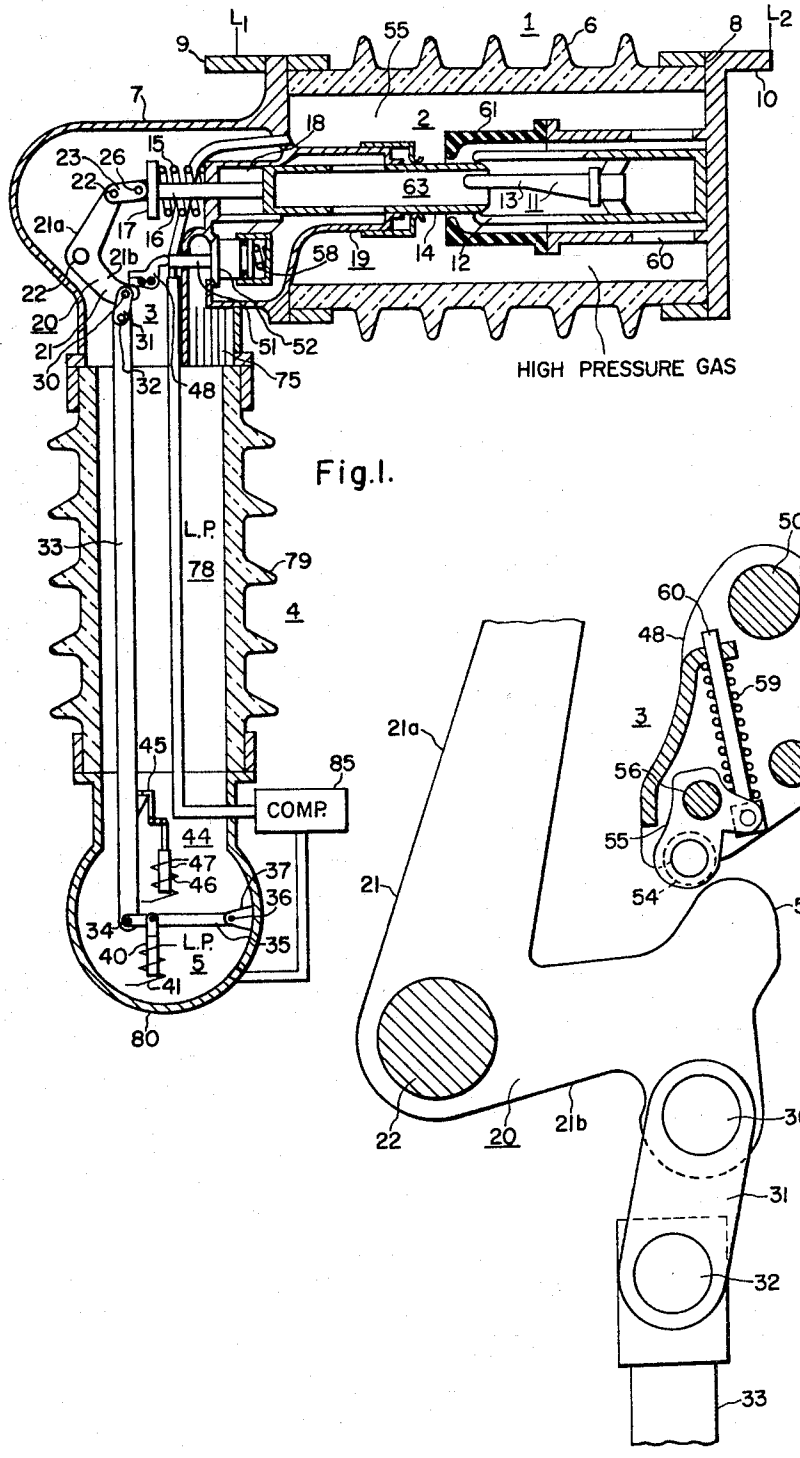


Fig.1.

Fig.3.

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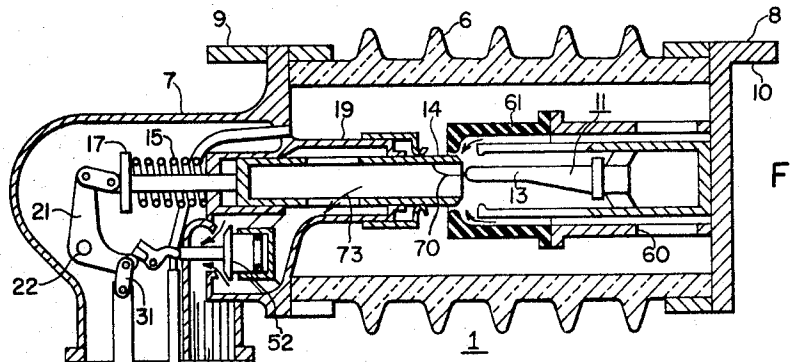
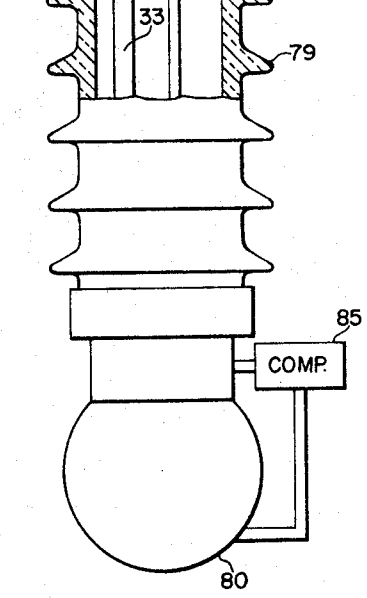


Fig.2.



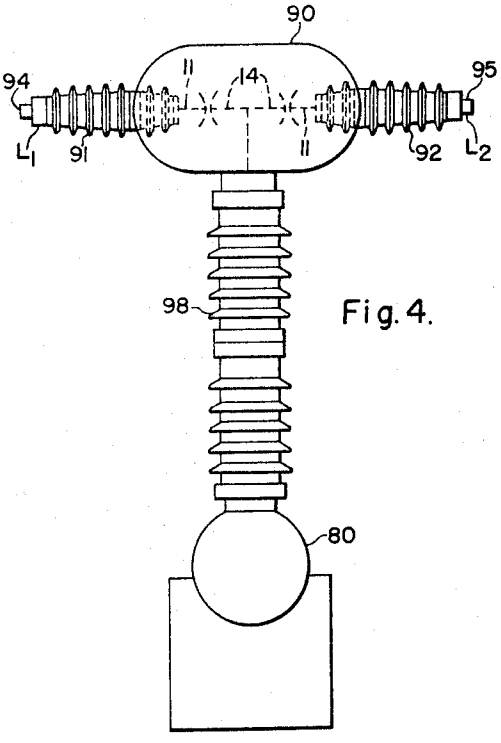


Fig.4.

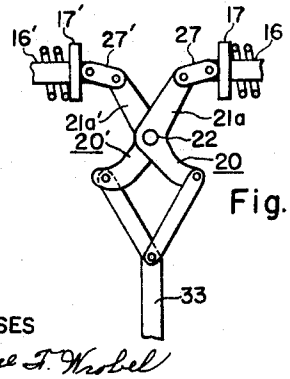


Fig.5.

WITNESSES

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COMPRESSED-GAS CIRCUIT INTERRUPTER WITH PRESSURIZED ARCING CHAMBER AND DOWNSTREAM BLAST VALVE

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8 Claims. (Cl. 200—148)

This invention relates generally to compressed-gas circuit interrupters and, more particularly, to improved arc-extinguishing structures therefor.

A general object of the present invention is to provide an improved compressed-gas circuit interrupter in which the contacts are always disposed in a high-pressure region for fast arc extinction and a minimum of prestriking during the closing operation of the interrupter.

Still a further object of the present invention is the provision of an improved compressed-gas circuit interrupter capable of interrupting considerable power and requiring only a relatively small amount of space.

Still a further object of the present invention is the provision of a high-speed compressed-gas circuit interrupter in which arc extinction is achieved in a highly efficient manner, and in which the isolating gap between the separable contacts may be a minimum due to the presence of high-pressure gas surrounding the contacts at all times.

It is well known to use a compressed-gas circuit interrupter utilizing a highly efficient arc-extinguishing gas, such as sulfur hexafluoride (SF_6), or selenium hexafluoride (SeF_6), or similar gases having excellent arc-extinguishing properties. However, it has been customary heretofore to utilize such compressed-gas circuit interrupters with a double-pressure arrangement in which an exhaust tank is provided, and the separable contacts are provided in a region of relatively low pressure. As set forth in such prior art structures, there is usually provided a high-pressure gas reservoir tank disposed in the immediate vicinity of the contact structure, and the arrangement is such as to permit a discharge of high-pressure gas from said gas reservoir into the arc-extinguishing chamber through an appropriately disposed nozzle, whereby an interruption of the drawn arc is achieved.

However, there arise certain disadvantages to such a type of structure as described above inasmuch as the high-pressure gas reservoir chamber may require considerable space and, consequently, to accommodate such a reservoir, the exhaust tank itself must be fairly large.

Additionally, in such a double-pressure type of compressed-gas circuit interrupter the time delay necessarily encountered for the actual gas blast to reach the arc must be considered and from a recovery-voltage standpoint, it is undesirable to permit to the space between the contacts to be under a relatively low pressure following interruption.

To sum up the foregoing disadvantages, it is proposed in the instant invention to provide an arc-extinguishing chamber filled with gas under high pressure, and to provide a downstream blast valve so that the contacts will always be in a high-pressure region. As a result, there is no necessity for providing a low-pressure exhaust vessel in the immediate vicinity of the arc-extinguishing chamber, and of considerable importance is the fact that during a closing operation, prestriking is reduced to a minimum with a consequent diminution of erosion, or wear imposed upon the separable contacts.

Accordingly, it is a further object of the present invention to provide an improved high-power compressed-gas circuit interrupter particularly adapted for high-voltage application, when necessary, and requiring very little space with a small amount of contact separation obtained by the fact that the arc-extinguishing chamber is at all times filled with gas under high pressure. By utilizing a downstream blast valve, the supporting column for the arc-extinguishing chamber may itself be utilized as a low-pressure exhaust tank. Preferably, a suitable compressor is provided for re-compressing the exhausted gas and forcing such re-compressed gas back into the high-pressure arcing chamber.

Further objects will readily be apparent upon reading the following specification taken in conjunction with the drawings in which:

FIG. 1 is a vertical sectional view taken through an improved compressed-gas circuit interrupter embodying features of the present invention, the contact structure being illustrated in the closed-circuit position;

FIG. 2 is a view similar to that of FIG. 1, but showing the disposition of the several parts at an intermediate point in the opening operation;

FIG. 3 is a considerably enlarged view of the blast-valve operating mechanism;

FIG. 4 illustrates a modification of the present invention utilizing a metallic tank structure; and,

FIG. 5 fragmentarily illustrates a portion of the operating linkage for the embodiment of the invention illustrated in FIG. 4.

Referring to the drawings, and more particularly to FIG. 1 thereof, the reference numeral **1** generally designates a compressed-gas circuit interrupter. As shown, the compressed-gas circuit interrupter **1** comprises a high-pressure arcing chamber **2**, a blast-valve operating mechanism **3**, a supporting structure **4**, and suitable operating mechanism and compressor structure **5** at ground potential.

More specifically, as shown, the arc-extinguishing chamber **2** comprises an insulating outer weatherproof casing **6** having disposed at opposite ends thereof, and suitably clamped thereto, a terminal casting **7** and a cooperable terminal casting **8**. As shown, the casting structures **7**, **8** include terminal pads **9**, **10**, to which line connectors L_1 and L_2 may be fixedly attached.

Disposed interiorly of the arc-extinguishing structure **2** is provided a relatively stationary contact structure **11** comprising a plurality of circumferentially-disposed contact fingers **12** and an interiorly-disposed arcing contact **13**. As shown, the resilient circumferentially-disposed contact fingers **12** make contacting engagement with a tubular movable contact **14**, which is biased, by a compression spring **15**, to an open position. More particularly, the movable tubular vented contact **14** includes a contact extension **16** and a spring seat **17** fixedly secured thereto. The accelerating compression spring **15** seats upon the spring seat **17** at one end, and against a guide cylinder **18** at the other end, and constantly biases the movable tubular contact **14** in a circuit opening direction.

The relatively stationary and movable contacts **11**, **14** are maintained in contacting closed position, as shown in FIG. 1, by a thrust linkage **20** comprising a bell-crank lever **21** pivotally mounted, as at **22**, on a stationary shaft. One arm **21***a* is pivotally connected, as at **22**, to a floating link **23**, the right-hand end of which is pivotally connected, as at **26**, to the spring support **17**.

The other arm **21***b* is pivotally connected, as at **30**, to a floating link **31**, the lower end of which is pivotally connected, as at **32**, to an upstanding insulating operating rod **33**.

The lower end of the insulating operating rod **33** is pivotally connected, as at **34**, to an operating lever **35**, which, in turn, is pivotally connected, as at **36**, to a bracket

structure 37. Suitable means may be provided to effect counterclockwise rotation of the operating lever 35 in a circuit-closing direction. As shown, such a means may include a solenoid 40 having an energizing coil 41, which may be energized in any suitable manner by a suitable closing circuit, not shown.

In the closed-circuit position of the circuit interrupter 1, as shown in FIG. 1, the upstanding insulating operating rod 33 is latched in the closed position against the force exerted by the accelerating spring by a latching device 44 including a latch 45, which may be actuated to release the operating rod 33 by energizing a coil 46 associated with an armature 47. A suitable tripping circuit, not shown, may be provided to effect energization of the tripping coil 46.

The blast-valve mechanism 3 comprises a thrust lever 48 pivotally mounted upon a stationary shaft 49, and having a thrust pin 50, which is in alignment with a blast-valve stem 51. The blast-valve stem 51 is directly connected to a blast valve 52, which is biased toward a closed position by a blast-valve compression spring 58. To effect opening of the blast valve 52, the bell-crank linkage 20 is rotated in a counterclockwise direction about the shaft 22 to thereby move a cam portion 53 into engagement with a roller 54, which is carried by a roller lever 55, itself pivotally supported, as at 56, upon a pivot pin carried by the blast-valve lever 48. Preferably, spring means, such as a compression spring 59, surrounding a spring rod 60 is provided to bias the roller lever 55 in an operative clockwise direction about its pivotal support 56.

It will, therefore, be apparent that during counterclockwise rotative movement of the bell-crank lever 20, the cam portion 53 will cam the blast-valve lever 48 in a clockwise direction about the shaft 49, and effect thereby opening movement of the downstream blast valve against the opposition afforded by the blast-valve closing spring. On the other hand, during a closing operation, the cam portion 53 of the bell-crank lever 21 will rotate the roller lever 55 to an inoperative position about its pivotal support 56, and thereby cause the blast valve to remain closed during such a closing operation.

A blast manifold structure 19 guides the gas flow through the vented movable contact 14 and, in addition, assists in the reciprocal guiding motion of the movable contact 14.

The opening operation of the improved compressed-gas circuit interrupter 1 of the instant invention will now be described. To effect an opening operation, suitable means, not shown, effect energization of the tripping solenoid 46. This will cause release of the latch 44, and thereby permit the compression spring 15 to effect opening movement of the movable contact 14. Simultaneously, or at a desired time relationship therewith, the blast valve will be forced open by the cam action exerted by the cam portion 53, so that high-pressure gas 55, such as sulfur hexafluoride (SF_6) gas, will pass through openings 60, associated with an orifice structure 61, and pass interiorly within the region 63 of movable contact 14 to carry the arc terminal 70 therein, as shown more clearly in FIG. 2 of the drawings. Because of the opening of the downstream blast-valve the gas flow will pass in the direction indicated by the arrows 73, and will pass through a cooling structure 75 to be collected within the interior 78 of the upstanding supporting column 79. If desired, an additional collecting tank 80 may be provided at the lower end of the supporting column 79, and a suitable compressor 85 associated therewith to effect re-compression of the exhausted gas. If, for certain applications, the upstanding insulating column 79 itself is of adequate volume, there will be no necessity for providing the additional storage volume 80 in the supporting base of the circuit interrupter 1.

It is to be clearly understood that the present invention is not confined solely to an arrangement in which the arc-extinguishing chamber is made of an insulating material, such as the casing member 6. For example, FIG. 4 illustrates a modification of the invention involving a metallic high-pressure tank 90 having extending therewithin terminal bushings 91, 92 carrying stationary contact structures 11 adjacent their inner ends. Suitable terminals 94, 95 may be provided at the extremities of the terminal bushings 91, 92 respectively to carry the controlled circuit L_1, L_2.

The metallic high-pressure storage tank 90 is preferably supported up in the air an adequate distance above ground potential by a supporting insulating column 98, which preferably carries a feed tube, not shown, and an insulating rod structure, which performs the functions of the insulating operating rod 33 hereinbefore described.

Cooperable with the two stationary contacts structures 11 are a pair of movable contact structures 14, which may be of the type hereinbefore described, and associated with a blast-valve supporting and guide structure, such as previously described. The operation of the device of FIG. 4 is identical to that previously described with the exception that two serially-related contact structures are provided.

FIG. 5 more clearly shows a portion of the movable contact operating linkage for the double-break compressed-gas interrupter of FIG. 4. As shown in FIG. 5, the two movable contact extensions 16, 16', having the spring seats 17, 17', are pivotally connected by lines 27, 27' to a pair of bell-cranks 20, 20' pivotally mounted upon a common stationary support shaft 22. The lower arms of the bell-cranks 20, 20' are linked, as shown, to the common upstanding insulating operating rod 33 extending upwardly interiorly of the hollow supporting column 98.

It will be obvious that upward unlatching movement of the operating rod 33 will permit the two accelerating springs 15 to force the two movable contacts 14 in the opening direction toward each other, as viewed in FIG. 4. In a similar manner, downward closing movement of the operating rod 33 will force the two movable contacts 14 outwardly, as viewed in FIG. 4, into closing engagement with the stationary contacts 11.

From the foregoing description, it will be apparent that there is provided an improved compressed-gas circuit interrupter of minimum dimensions and utilizing a pair of separable contacts constantly disposed in a high-pressure region. For effecting rapid arc-extinction, a downstream blast valve is provided, which, in conjunction with suitable orifice and gas-flow directing structure, is effective for rapid and efficient arc-extinction. During the closing operation, prestriking is reduced to a minimum by the fact that high-pressure gas is adjacent the separable contact structure.

Although there have 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 provided therein by those skilled in the art, without departing from the spirit and scope of the invention.

I claim as my invention:

1. In a compressed-gas circuit interrupter, in combination, means defining an arcing chamber containing gas under high pressure, separable contact means including a movable venting tubular contact disposed therein and separable to establish an arc, means defining a downstream blast-valve for venting the arcing chamber through said movable venting tubular contact, unrestricted passage means connecting the interior of said pressurized arcing chamber through said movable venting tubular contact with said downstream blast-valve, and means synchronizing opening of the downstream blast-valve with separation of the separable contact structure whereby an immediate flow of high pressure gas through the movable venting tubular contact occurs prior to contact part.

2. The combination set forth in claim 1, wherein a supporting column is utilized to support the high-pressure

arcing chamber up in the air an adequate distance above ground potential.

3. The combination according to claim 1, wherein spring means biases the movable contact means toward the open position, and bell-crank means are provided to effect release of said spring means and compression thereof during the closing operation.

4. The combination according to claim 3, wherein cam means are associated with the bell-crank means for effecting the opening of said downstream blast-valve means.

5. A compressed-gas circuit interrupter including upstanding insulating hollow column means, a pressurized arcing chamber supported up in the air by said hollow column means, contact means disposed interiorly of said pressurized arcing chamber and separable to establish an arc, said contact means including a tubular movable contact, means providing a downstream blast-valve operable to exhaust pressure into said hollow column means through scaid tubular movable contact, unrestricted passage means connecting the interior of said pressurized arcing chamber through said movable venting tubular contact with said downstream blast-valve, and gas-flow guide means for directing the exhausted gas to flow through said tubular movable contact upon actuation of said downstream blast-valve whereby an immediate flow of high pressure gas through the movable venting tubular contact occurs prior to contact part.

6. The combination according to claim 5, wherein accelerating spring means is employed to bias the contact means to the open-circuit position, and thrust means including a crank device is effective to maintain the contact means closed despite the opposition afforded by said accelerating spring means.

7. The combination according to claim 6, wherein the crank device is effective to effect opening of the downstream blast-valve.

8. In combination, a compressed-gas circuit interruption including a pressurized chamber having an exhaust manifold structure, a pair of separable contacts disposed within said pressurized chamber at least one of which is a movable tubular venting contact and guided for reciprocal opening and closing movement by said exhaust manifold structure, means defining a downstream blast-valve associated with said manifold structure, unrestricted passage means connecting the interior of said pressurized chamber through said vented contact with said downstream blast-valve, and means synchronizing the separation of said contacts with opening of the blast-valve, whereby the gas from the pressurized chamber is exhausted through the vented contact to effect arc-extinction, whereby an immediate flow of high pressure gas through the movable venting tubular contact occurs prior to contact part.

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