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AIR BLAST CIRCUIT BREAKER HAVING A SERIES CONNECTED BREAKING GAP IN A BUSHING

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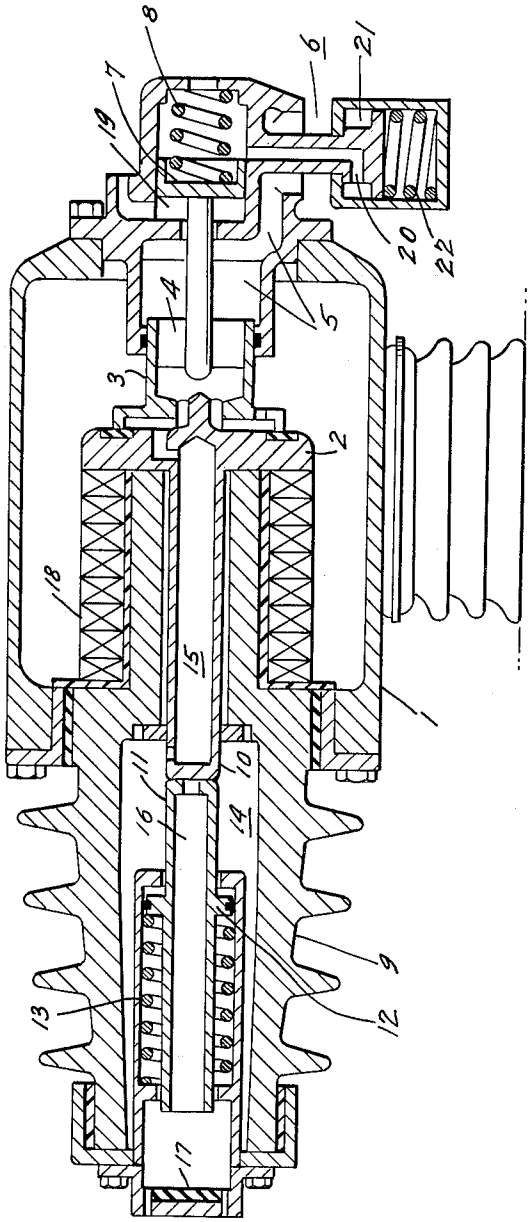

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AIR BLAST CIRCUIT BREAKER HAVING A SERIES CONNECTED BREAKING GAP IN A BUSHING

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This invention relates to air blast circuit breakers wherein the bushing carrying the main stationary contact of the circuit breaker with respect to a conductive housing further contains internally thereof a pair of contacts which can normally be immersed in high pressure air.

High voltage air blast circuit breakers are well known to the art wherein the main breaking gap is enclosed within a conductive container which has sufficient high pressure air therein for at least one contact operation.

The conductive container is carried through the ground by pillar insulator means with one contact of the main breaking gap being mechanically and electrically connected to the conductive container while the other contact is carried from the container by an insulating bushing which projects into the container. With this type of structure it has been very difficult to maintain the flash-over strength of that portion of the bushing entering the container, which is external of the container, sufficiently high.

It will be noted that the portion of the bushing within the container is not subjected to this difficulty because the high pressure air within the container provides a relatively high di-electric strength. However, that portion of the bushing external of the container is not immersed in such high pressure air so that there can be considerable difficulty in maintaining a sufficiently high flash-over strength for the external bushing portions.

It has been found that a mere increase of the length of the bushing external of the compressed air container is insufficient to overcome this problem. That is, at high voltages, the electric field strength at the area at which the bushing is fastened to the wall of the container is so high that the limit for corona effect is reached. Thus, increasing the length of the bushing to have any notable effect on the flash-over strength must be considerable so that the space occupied by the circuit breaker can become prohibitively large.

It has been found that this high di-electric strength at the point at which the bushing is connected to the container is due to the relatively short distance between the conductive container wall and the inner conductor of the bushing when the circuit breaker is in its open position. The novel circuit breaker of the present invention overcomes this disadvantage by increasing the distance between the conductive wall of the container and the live portions of the inner conductor of the bushing when the circuit breaker is in its open position.

Moreover, a series connected breaking gap is connected in series with the main breaking gap and is contained within a single bushing which is terminated by the stationary contact of the main breaking gap. To maintain high flash-over voltage between the open contacts of the series connected breaking gap contained within the bushing, when the contacts are at least in their open position, this internal bushing portion is filled with compressed air. This can be obtained, for example, by causing the internal volume of the bushing to communicate with the internal volume of the conductive compressed air container when the main breaking gap within the compressed air container is open and by causing

the volume within the bushing to be exhausted to free air when the main breaking gap is closed.

Furthermore, the movable contact of the series connected breaking gap within the bushing is provided with appropriate means for maintaining the contacts open so long as there is compressed air within the volume. When this volume is connected to free air and is thereby depressurized, the movable contact of the series connected breaking gap within the bushing will close. The cooperating contacts of the main breaking gap may act as a control valve for the operation of the contacts contained within the bushing whereby the series connected gap within the bushing will open only after the main breaking gap is opened. During the closing sequence, the series connected breaking gap will close only after the main breaking gap is closed.

The present invention also permits a simplification in the connection of a parallel resistance across the main breaking gap. That is to say, the series breaking gap contained within the bushing can additionally serve as an auxiliary breaking gap for current flow through a control resistance in parallel with the main breaking gap after operation of the main breaking gap. Thus, special arrangements in an auxiliary breaking gap within the compressed air container are not needed whereby there is a substantial simplification of the contact structure.

Moreover, the resistor may be wound around the projecting end of the bushing within the conductive container.

Accordingly, a primary object of this invention is to provide a novel high voltage air blast circuit breaker.

Another object of this invention is to provide a novel high voltage air blast circuit breaker wherein corona at the point at which a bushing enters a conductive high pressure air container is eliminated.

Another object of this invention is to provide a simple mechanical arrangement for an air blast circuit breaker having two series connected breaking gaps.

Another object of this invention is to provide a novel air blast circuit breaker wherein a bushing which enters a conductive container and has a stationary contact terminated thereon additionally includes an auxiliary pair of contacts contained within the bushing to be connected in series with the main circuit breaker contacts.

A further object of the invention is to provide a bushing having a stationary contact at the end thereof which projects deeply into a conductive compressed air container and has a resistive wire wrapped thereon.

These and other objects of the invention become more apparent from the following description when taken in connection with the drawing which shows a cross-sectional view of one embodiment of the invention.

More specifically, the drawing illustrates a conductive container 1 which is permanently filled with compressed air and which carries the main breaking gap of the circuit breaker. The main breaking gap is formed of a stationary contact 2 and a movable contact 3 where movable contact 3 is electrically connected to container 1 and is provided with an outlet channel 4 through which compressed air may flow.

The outlet channel 4 communicates with channel 5 under the control of a stop valve 6 which is closed only in the open position of the main breaking gap which includes contacts 2 and 3. When the main breaking gap is in its closed position, compressed air is kept from flowing out of container 1 because of an extending flange carried by movable contact 3 which tightly engages an appropriate circular gasket means in the surface of stationary contact 2 in the usual manner.

The movable contact 3 is carried by a piston 7 and is normally biased to the closed position by a biasing spring

8. The stationary contact 2 is carried at the end of an insulating bushing 9 which is secured to one wall of container 1.

Bushing 9 is provided with an internal cavity which receives an auxiliary breaking gap which includes a stationary contact 10 and a movable contact 11 which is carried by a piston 12. The movable contact 11 is biased to a closed position by a biasing spring 13.

The cavity or volume 14 within bushing 9 and which contains the series connected breaking gap communicates with outlet channel 4 by means of the communicating channel 15 through the stationary contact 10. Volume 14 may be vented to the open air through a blast air channel 16 in movable contact 11 when the movable contact 11 moves toward the left to expose the vent at the right-hand end of movable contact 11. Thus, blast air channel 16 is sealed when contact 11 moves to its leftmost position engaging a gasket 17 which seals off the left-hand end of blast channel 16.

The right-hand portion of bushing 9 which extends into container 1 has a control resistance 18 formed of a wound wire wound thereon and connected from container 1 to the stationary contact 2 whereby resistance 18 is connected in parallel with contacts 2 and 3.

In order to operate the circuit breaker, compressed air is applied to volume 19 which is to the left of piston 7 by a source of control air not shown. This will cause the piston 7 and contact 3 which is connected thereto to be moved to the right. The compressed air within container 1 then flows out through the separating contacts and through the outer channel 4, channel 5 and the open stop valve 6 which, when the circuit breaker is completely opened, is closed when compressed air from volume 19 flows through channel 20 and into volume 21.

Simultaneous with the separation of the main breaking gap contacts, channel 15 is opened so that container 1 is connected to volume 14 which will be filled with compressed air. The pressure on piston 12 will, therefore, increase so that the movable contact 11 is moved to the left and toward its open position.

After the arc between the contacts 2 and 3 of the main breaking gap has been extinguished, an arc remains between the contacts 10 and 11 of the series breaking gap, the arc current being connected in series with resistance 18. This latter arc between contacts 10 and 11 will be extinguished by the compressed air flowing through channel 16 prior to the time that contact 11 seats against gasket 17 to close off the air blast.

When the circuit breaker is to be closed, the volume 19 is connected to open air whereby contact 3 is moved to its closed position under the influence of spring 8. In this position, stop valve 6 is opened by spring 22 with the compressed air in volume 21 flowing out through channel 20.

When the main breaking gap, including contacts 2 and 3, is fully closed, the volume 14 is again connected

to open air through the connecting channel 15, outlet channel 4, channel 5 and open stop valve 6. Thus the contact 11 will be moved to the right by the spring 13 so that contacts 10 and 11 are re-closed.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of my invention within the scope of the description herein are obvious. Accordingly, I prefer to be bound not by the specific disclosure herein but only by the appended claims.

I claim:

1. In an air blast circuit breaker, a conductive compressed air container connected to a source of compressed air, a first pair of contacts, a second pair of contacts and an insulating bushing; said insulating bushing entering said compressed air container and having one of said first pair of contacts secured to the end thereof within said compressed air container; the other contact of said first pair of contacts being connected to said compressed air container and having an outlet channel therethrough, means mounted on said other contact for closing said outlet channel from the container in the closed position of the first pair of contacts; a cavity within said insulating bushing; said second pair of contacts being contained within said cavity in said insulating bushing and being connected in series with said first pair of contacts, first means for connecting the cavity in the closed position of the first pair of contacts, with the open air to close said second pair of contacts, said first connecting means including a permanently open connecting channel between said cavity and said outlet channel, said connecting means in the open position of said first pair of contacts connecting said cavity with the container through said connecting channel to open said second pair of contacts, and second means responsive to the opening of said second pair of contacts to connect said cavity with the open air independently of said outlet channels.

2. In a device as set forth in claim 1, resistance means connected in parallel with said first pair of contacts, said resistance means being mounted on the portion of said bushing entering said compressed air container.

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