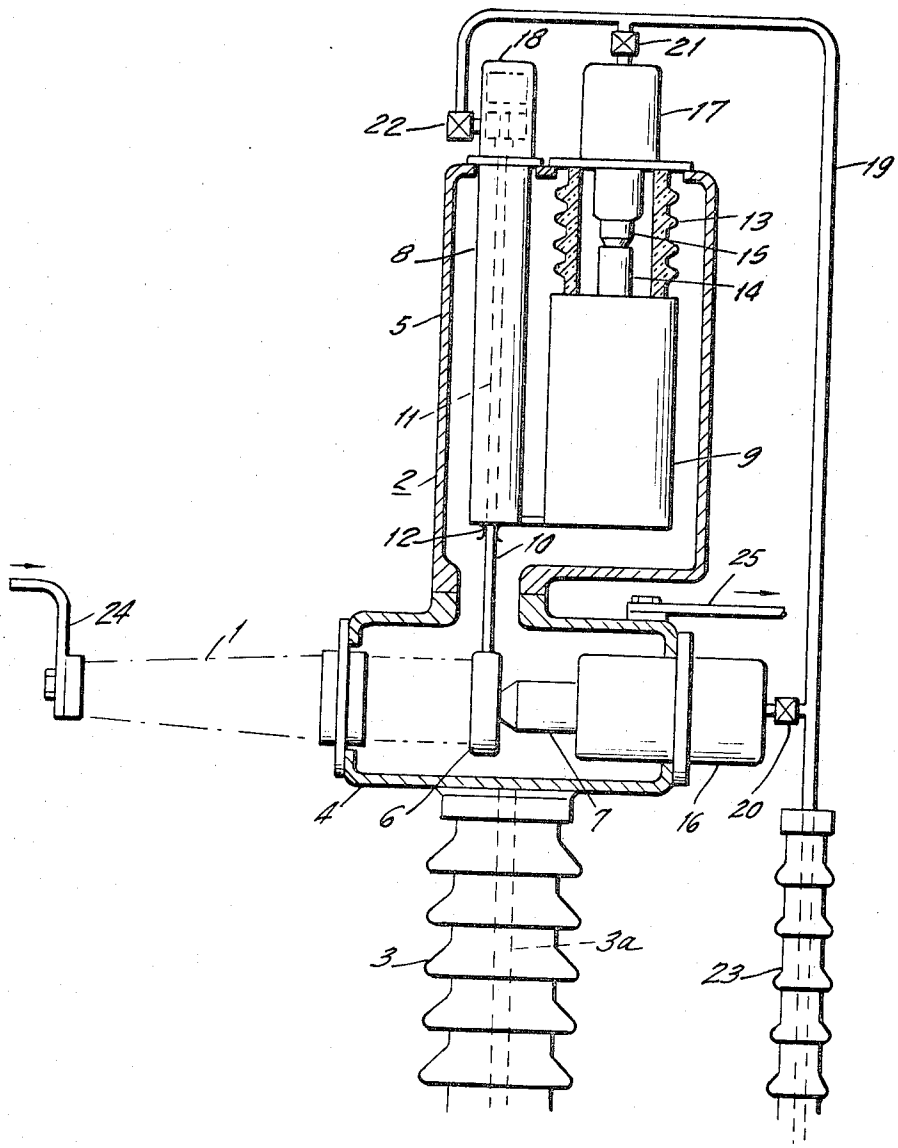
Dec. 17, 1968 H. FORWALD ETAL 3,417,217

AIR BLAST CIRCUIT BREAKER

Filed April 14, 1966

2 Sheets-Sheet 1

FIG. 1.



INVENTORS
HRAKON FORWALD
WALTER PUCHER
KARL GUSTAV SINDAHL
BY
Bailey, Stephens & Huettig
ATTORNEYS

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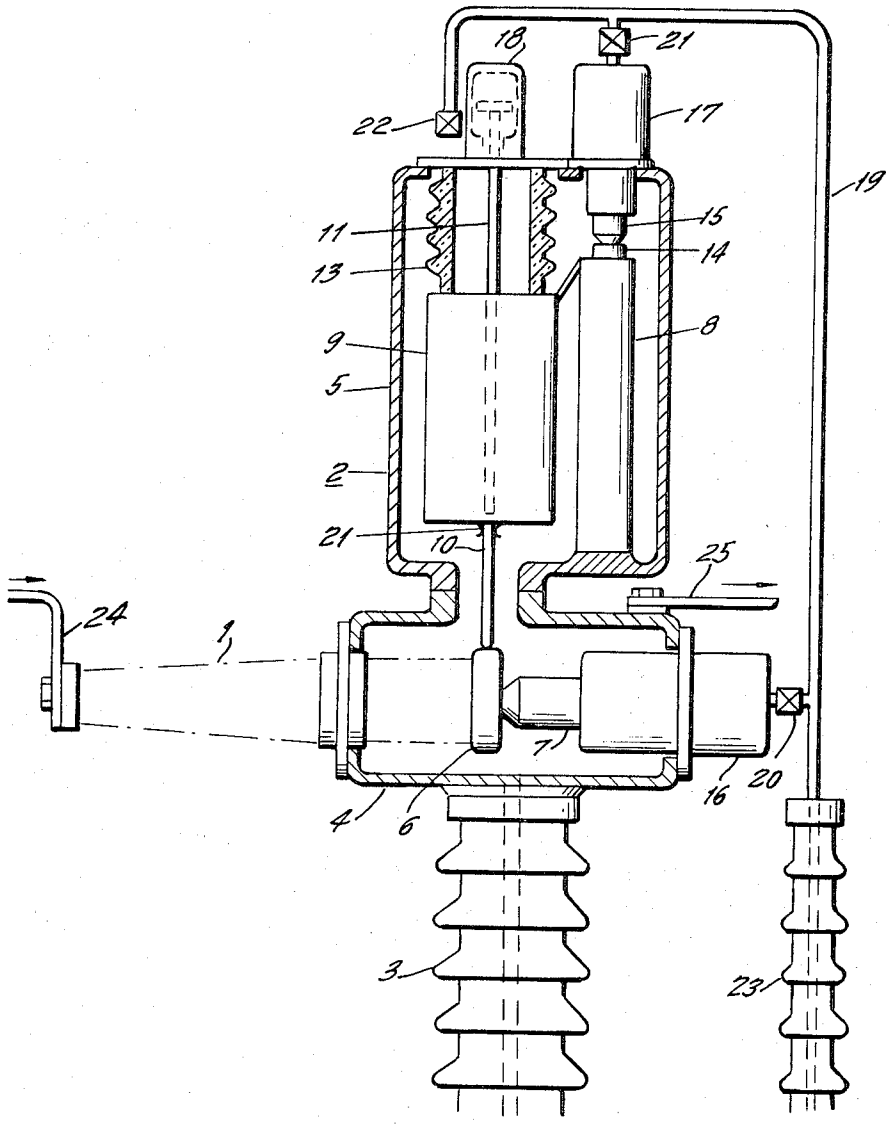
FIG. 2



INVENTORS
HAAKON FORWALD
WALTER PUCHER
BY KARL GUSTAV SINDAHL
Bailey, Stephens & Huettig
ATTORNEYS

United States Patent Office

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AIR BLAST CIRCUIT BREAKER

Haakon Forwald, Walter Pucher, and Karl Gustav Sindahl, Ludvika, Sweden, assignors to Allmänna Svenska Elektriska Aktiebolaget, Vasteras, Sweden, a corporation of Sweden

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6 Claims. (Cl. 200—148)

This invention relates to high voltage air blast circuit breakers, and more particularly relates to a novel interrupter construction for air blast circuit breakers which include a pair of main co-operating contacts and two pairs of resistor contacts immersed in high pressure air along with two respective resistors, while the operating mechanisms for the various contacts are located externally of the interrupter housing, thereby to permit a smaller housing volume.

Interrupters for air blast circuit breakers are well known to the art, and are described, for example, in U.S. Patent 2,803,724. It is common practice to provide a plurality of contacts which are immersed in high pressure air along with two resistors for a single interrupter. The first pair of contacts forms the main circuit interruption contact means for opening the circuit to be protected. The second and third pairs of contacts are then associated with a damping resistor and grading resistor, respectively, which resistors are to be selectively removed from the circuit after the operation of the main pair of co-operating contacts.

The function of the grading resistor is to insure the equal distribution of voltage across the contacts of two or more series connected interrupter structures. In some instances, this grading effect will also use capacitive means as well as the grading resistors. Once a successful interruption is obtained, however, the grading resistor is provided with its respective pair of contacts which open, thereby to remove the grading resistor from the circuit.

In addition to the grading resistor, it is also common practice to provide a damping resistor connecter in parallel with the main interrupter contacts where the damping resistor will operate to control the rate of rise and amplitude of transient recovery voltages across the breaker terminals during interruption, thereby to increase the interrupting capacity of the breaker. This is particularly important where the breaker is positioned in a high voltage network that sees extremely high rates of rise of recovery voltage, as where the fault may occur several kilometers from the breaker.

The damping resistor, in order to properly serve its function, must have a relatively low ohmic value so that a relatively large current such as 1 to 2 kiloamperes will pass through the resistor when the main contacts have opened. The grading resistor, however, should have a relatively high ohmic value in order to obtain desired voltage division between various series connected interrupter structures.

In the past, all of the equipment mentioned above for defining a single interrupter unit was completely housed within the pressurized interrupter container. Thus, the container had to be sufficiently large to contain the three sets of contacts, the two resistors, and the operating mechanisms for the various contacts.

Moreover, this arrangement caused complicated insulation problems for insulating the various members from one another within the container.

The principle of the present invention is to provide a

novel housing arrangement for the above noted type of equipment wherein the operating mechanisms for the various contacts are carried externally of the interrupter housing to decrease the housing volume. This construction then simplifies the insulation problems which were previously faced, and permits the various operating mechanism housings to be connected to the common potential, thereby to simplify the arrangement of control air conduits, and permits such control air conduits to be of metallic materials.

As another important feature of the invention, one of the resistor contacts can have a fixed contact in common with the fixed contact of the main pair of contacts with a moving contact arrangement formed in a novel manner, in which an insulation operating rod support moves centrally through one of the resistors. Moreover, where the resistors are of the cylindrical type, the axes of the cylindrical resistors can be parallel to one another and perpendicular to the main current path through the main contacts, thereby further reducing the dimensions of the interrupter.

Accordingly, a primary object of this invention is to provide a novel interrupter structure which has a reduced size.

Yet another object of this invention is to provide a novel interrupter structure wherein the operating mechanisms for various contacts within a pressurized container are operated by mechanism external of the container and mounted on the container exterior.

Yet another object of this invention is to provide a novel interrupter structure wherein a plurality of contact operating means are housed directly on the interrupter container and are connected to a common potential.

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

FIGURE 1 is a cross-sectional view partially schematically illustrating an interrupter constructed in accordance with the invention.

FIGURE 2 is similar to FIGURE 1 and illustrates a second embodiment of the invention.

Referring now to FIGURE 1, I have illustrated therein an interrupter housing **2** which is of metallic material and has extending therefrom a lead-through bushing **1**. The entire container **2** is then supported atop a hollow insulator **3** which insulates the container with respect to ground. Container **2** consists of two sections **4** and **5** which are sealed to one another to define a pneumatically sealed housing which can contain high pressure air. A compressed air supply (not shown) is connected to conduit **3***a* which extends through insulator **3** and into the interior of container **2**.

Container portion **4** receives the main interrupter contacts which consist of a fixed contact **6** supported at one end of bushing **1** and a movable contact schematically shown as movable contact **7**.

A grading resistor **8** and damping resistor **9** are contained in housing portion **5**, and are each connected in parallel with the main contacts **6** and **7**. Grading resistor **8** can, for example, have a resistance of 3,000 ohms, while the damping resistor may have a resistance of approximately 100 ohms.

A pair of resistor contacts are provided for grading resistor **8** and include a movable contact **10** carried on an insulating operating rod **11** which is movable into and out of engagement with the main stationary contact **6**, the parts of which thus form contacts of two pairs of contacts. The lower end of resistor **8** is electrically con-

nected to the moving contact **10** by a suitable sliding contact arrangement **12**, while the upper end of the resistor **8** is directly connected to the metallic housing section **5**.

In order to connect and disconnect damping resistor **9** with respect to contacts **6** and **7**, a stationary contact **14** is directly connected to the upper end of resistor **9**, while a movable contact **15** is movable into and out of engagement with contact **14**, and is electrically connected to container **5** at its upper end. The lower end of resistor **9** is connected to sliding contact **12** which engages contact **10**.

It will be noted that the co-operating contacts **14** and **15** are contained within a hollow support insulator **13** which is directly connected to the top of resistor **9** and serves as a support for resistor **9**. The interior of insulator **13** is in communication with the interior of housing **2** through suitable opening channels (not shown) so that the interior of insulator **13** is at the same high pressure as the remaining interior volume of the interrupter.

In order to operate the various moving contacts **7**, **15** and **10**, there are provided three operating mechanisms **16**, **17** and **18**, respectively, which are connected directly adjacent respective openings in container **2** in such a manner as to hermetically seal the container. In addition, the housings of operating mechanisms **16**, **17** and **18** are of conductive material and are in direct electrical contact with the metallic housing **2**.

While the operating mechanisms **16**, **17** and **18** could take any desired form, one particular example of the type operating mechanism that could be used is described in the above noted U.S. Patent 2,803,724 which illustrates a mechanism for selectively opening and closing compressed air channels in order to cause mechanical actuation of a movable contact.

The operating mechanisms **16**, **17** and **18** are pneumatically connected to one another by a metallic control air conduit **19** (since they are at the same potential). Suitable valves **20**, **21** and **22** are arranged between the concuit **19** and the individual housings **16**, **17** and **18** for regulating and controlling the operating time sequences during which air is to be applied to the various operating mechanisms, thereby to operate the various contacts **7**, **15** and **10** in their proper sequence.

Air conduit **19** is connected to a hollow control air insulator column **23** which leads toward the bottom support frame of the breaker (not shown) where a suitable air control system can be connected to conduit **19** for suitable control of the air to be applied to operating mechanism **16**, **17** and **18**.

Note, however, that it is possible and desirable where there are extremely high potentials applied to housing **2** with respect to ground to eliminate insulator column **23** and to derive high pressure air directly from the interior of housing **2** through a suitable control mechanism which would be placed at the high potential of housing **2**.

The main terminals of the single interrupter illustrated in FIGURE 1 are defined by terminal **24** extending through bushing **1** and terminal **25** which is connected to housing **2**. It will, of course, be understood that a plurality of interrupters identical to that of FIGURE 1 may be connected in series in a suitable interrupter bank in order to form a full breaker pole. Clearly, the number of series connected interrupters to be used would depend on the circuit breaker voltage.

It will be apparent from FIGURE 1 that the invention decreases the required volume of container **2** by removing the various operating mechanisms **16**, **17** and **18** to the exterior of container **2**. Moreover, by placing these operating mechanisms **16**, **17** and **18** at the same potential as housing **2**, it further becomes possible to use the common metallic conduit **19** to supply control air to the various operating mechanisms.

FIGURE 2 is similar to FIGURE 1 where similar identifying numerals identify components identical to those

of FIGURE 1. FIGURE 2, however, shows the resistors **8** and **9** in reversed position and a modification in the electrical connection between resistors **8** and **9** and the contacts **6** and **7**.

Thus, whereas in FIGURE 1 resistors **8** and **9** were connected in parallel with contacts **6** and **7** during power interruption, in FIGURE 2 only the damping resistor **9** will be connected in parallel with contacts **6** and **7**.

With regard to the operating sequence of valves **20**, **21** and **22** where the resistor **9** having a low ohmic value is to be used to damp recovery voltage for short line faults, the valves should be controlled in such a way that contacts **14** and **15** are opened by the initial opening of valve **21** prior to the operation of valves **20** and **22**.

If, on the other hand, the damping resistor **9** is to be used to damp high transient voltages during switching, both valves **21** and **22** should be arranged to close their contacts before contact **7** is closed by valve **20**.

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.

We claim:

1. An interrupter structure for air blast circuit breakers comprising a conductive housing filled with high pressure gas; first, second and third pairs of contacts supported within said interrupter; first and second resistors supported within said conductive housing; said second pair of contacts being connected in series with said first resistor; said second pair of contacts and said first resistor being connected in parallel with said first pair of contacts; said third pair of contacts being connected in series with said second resistor; said third pair of contacts and said second resistor being connected in parallel with said first resistor; one contact of each said first, second and third pairs of contacts being movable between an engaged and disengaged position with respect to the other contact of each pair; and first, second and third operating mechanisms connected to each of said movable contacts of each of said first, second and third pairs of contacts; each of said operating mechanisms having a conductive housing; each of said conductive housings of said first, second and third operating mechanisms being mounted on the exterior of said conductive housing of said interrupter structure.

2. The device as set forth in claim **1**, wherein said first, second and third operating mechanisms each have respective pneumatic input connections; a common metallic conduit having one end connectable to a source of air pressure connected to each of said pneumatic input connections

3. The device as set forth in claim **1**, which includes slide contact means connected to one end of each of said first and second resistors; said slide valve contact means including a sliding contact slidably engaging said movable contact of said second pair of contacts; said movable contact of said second pair of contacts being movable into and out of engagement with the stationary contact of said first pair of contacts.

4. The device as set forth in claim **3**, an insulating rod connected to said second operating mechanism; said movable contact of said second pair of contacts being connected to said insulating rod; said first and second resistors having central openings therethrough; said insulation rod extending through the center of said first resistor.

5. The device as set forth in claim **1**, wherein said first resistor has a relatively high resistance compared to said second resistor.

6. The device as set forth in claim **1**, wherein said first and second resistors are cylindrical; said first and second

resistors having parallel axes perpendicular to the major path of current through said first pair of contacts.

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ROBERT S. MACON, *Primary Examiner.*

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