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Filed Dec. 6, 1963, Ser. No. 328,704
Claims priority, application Austria, Dec. 17, 1962, A 9,813/62
4 Claims. (Cl. 200—148)

The present invention generally has reference to an improved gas-blast circuit-breaker or switch.

Gas-blast circuit-breakers are known to the art wherein the arc-extinguishing current or stream is generated in the switch or circuit-breaker itself by means of a pump piston by virtue of the circuit-opening movement or the arc energy. This known technique is usuable when employing air as the extinguishing medium for only relatively small circuit opening or breaking capacity. If, on the other hand, electro-negative gases are employed which are under a pressure greater than atmospheric pressure as the extinguishing and insulating medium, which leads to a gas-tight construction and a closed circulation system, then a considerably higher circuit-opening capability can be achieved. The attainable circuit-opening capacity, however, is considerably dependent upon the utilization of the energy available for the generation of the stream of extinguishing medium, that is, from the effectiveness of the construction.

It is, therefore, a primary object of the present invention to provide an improved construction of gas-blast switch, circuit-breaker or the like wherein the extinguishing effect is greatly improved and therewith its efficiency is increased.

A further important object of the present invention resides in the provision of an improved circuit-breaker or switch of the type described manifested by its relatively simple construction, yet highly reliable operation, particularly with respect to the arc-extinguishing function.

In the achievement of the aforementioned objects the present invention contemplates the provision of an improved gas-blast circuit-breaker incorporating an extinguishing compartment or chamber arranged in a housing closed at all sides, preferably filled with electro-negative gases, and wherein a current or stream of extinguishing medium is generated by means of a pump piston due to the switching movement. In the circuit-breaker or switch of the subject invention the extinguishing chamber is provided with a stationary cylinder enclosing stationary contacts as well as a movable cylinder operatively connected to the pump piston, said movable cylinder being capable of sliding past the aforesaid stationary cylinder.

Further, the pump piston has seated thereon a sealing piston which partially encloses a movable contact and which in the circuit-closing position of the circuit-breaker seals the stationary cylinder from the pump piston. Moreover, upon opening the circuit-breaker this sealing piston first then moves out of the stationary cylinder when the movable contact has moved through a path favorable for arc-extinguishing, and prior to reaching the terminal switching-out position the movable cylinder slides past the stationary cylinder whereby a chamber appears between the open confronting ends of both of these cylinders which is completely filled by extinguishing medium.

Further objects and the entire scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

In the drawing wherein like reference numerals have been generally employed for the same or similar elements:

FIGURE 1 is a sectional view through the active portion of a gas-blast circuit-breaker or switch constructed according to the invention provided with contacts and depicted in closed-circuit condition, and which can continuously conduct the rated current;

FIGURE 2 depicts a modifications of the circuit-breaker of FIGURE 1 designed for handling larger rated currents and provided with additional parallel contacts, such circuit-breaker being illustrated in closed circuit position;

FIGURE 3 illustrates the circuit-breaker of FIGURE 2 in an intermediate operating position; and

FIGURE 4 illustrates the circuit-breaker of FIGURE 2 in its open circuit position.

Referring now to the drawing and, more specifically to the embodiment of FIGURE 1, it is to be appreciated that a housing 1, conveniently shown in phantom lines, is advantageously closed at all sides and preferably filled with electro-negative gas, for example SF₆ (sulfur hexafluoride). A connecting terminal 2 conducts the current to stationary contacts 3. A movable contact 4 is displaced by means of any suitable actuating mechanism (not shown) and is rigidly operatively connected with a pump piston 5 adapted to slide within pump cylinder 6. The actual extinguishing chamber of the circuit-breaker or switch, in accordance with the invention, embodies a stationary cylinder 7 encircling the stationary contacts 3 and a movable cylinder 8 erected at the pump piston 5. This movable cylinder 8 can advantageously telescopically slide past the stationary cylinder 7, as will be more fully explained hereinafter.

Furthermore, a sealing piston 9 is seated upon the pump piston 5 and partially encloses the movable contact 4, and in the closed-circuit position of the circuit-breaker obturates the stationary cylinder 7 in the direction of the pump piston 5. At the inner wall of the pump cylinder 6 there are arranged slide contacts 10. Thus, in the embodiment of circuit-breaker or switch incorporating the physical structure shown in FIGURE 1, the entire current flows from the connecting terminal 2 via the stationary contacts 3, the movable contact 4, the slide contacts 10 and the pump cylinder 6 to the other connecting terminal 11 operatively associated with the aforesaid pump cylinder 6. Moreover, suitable openings or ports 12 are provided at the pump piston 5, and in the wall of the pump cylinder 6 there is arranged a one-way or non-return valve 13 which, as should be apparent, closes in the presence of internal pressure within pump cylinder 6.

If switches or circuit-breakers are to be designed for rated currents which are so large that they can no longer be continuously conducted by the switch contacts themselves, then the provision of additional parallel contacts comes under consideration. Such a construction of circuit-breaker is shown in the variant embodiment of FIGURES 2, 3 and 4. Since the basic construction of the physical structure of this embodiment is quite similar to that previously described in conjunction with the embodiment of FIGURE 1, like reference numerals have here again conveniently been employed for the same or analogous structure. However, in this embodiment there is provided a second current path which is parallel to the current path formed by the contacts 3, 4 and 10. This second current path conducts a considerable portion of the total current coming from the connecting terminal 2 via the upper contacts 14, here shown arranged at the underside of the aforesaid connecting piece, to the movable sliding contact means 15, from there to the lower
contacts 16 and then to the connecting terminal 11. In this embodiment it is particularly advantageous to construct the slide contact means 15 as the jacket or covering for the movable cylinder 8, as well as to arrange the lower contacts 16 directly upon the electrically conducting pump cylinder 6.

The mode of operation of the aforedescribed circuit-breakers will be set forth in conjunction with the embodiment specifically depicted in FIGURES 2, 3 and 4. Due to the general similarities in basic physical structure common to both embodiments herein described, the mode of operation of the first embodiment as depicted in FIGURE 1 should then be apparent. Thus, it should be understood that in FIGURE 2 the switch or circuit-breaker is shown in closed-circuit condition, that is, not only are contacts 3 and 4 closed but also the parallelly connected contacts 14, 15 and 16. In order to open the switch the non-illustrated actuating mechanism rapidly downwardly displaces the contact 4 together with the members 5, 8, 9 and 15. Immediately after having initiated the open-circuit movement, the slide contact 15 moves away from the stationary contacts 14 and 16, whereby the entire current now only flows via the contacts 3 and 4. Hence, it should be appreciated that from hereon the remaining descriptive portion of the operation of the circuit-breaker is generally applicable to both embodiments herein described.

The pump piston 5, which also has been moved, downwardly compresses the extinguishing medium located in the pump cylinder 6 which initially cannot escape because the non-return valve 13 closes and the sealing piston 9 still extends into the stationary cylinder 7. Only after the contacts 3 and 4 have also separated and there has been completed the interruption or break path most favorable for arc-extinction, does the sealing piston 9 move out of the stationary cylinder 7, as clearly shown in FIGURE 3, so that the extinguishing gas in pump cylinder 6, compressed by pump piston 5, flows through ports 12 into the stationary cylinder 7 to sweep-over and extinguish the arc between contacts 3 and 4. The movable cylinder 8 slides past the stationary cylinder 7 already prior to reaching the end or terminal switch-out position, whereby there appears between the open, confronting ends 7a and 8a (see FIGURE 4) of both of these cylinders 7 and 8, respectively, a compartment or space 17 which is only filled with extinguishing gas, and eliminates, the possibility that a creepage path can form between the open switch contacts. FIGURE 4 illustrates the circuit-breaker in its switch-out terminal position. Upon renewed closing of the circuit-breaker, the contact 4, the pump piston 5 together with the thereon seated members 8, 9 and 15 move upwardly, and the pump cylinder 6 again fills-up with the inflowing extinguishing gas which at the beginning of this operation streams-in from above and during the further course of the switching-in operation flows in through the now opened non-return or one-way valve 15. It is here further to be mentioned that while the members 5, 8 and 9 of the aforedescribed embodiments can advantageously be formed as an integral unit, such could also obviously be formed as separate members which are connected together in any convenient manner.

The present invention permits achieving at least the following advantages with relatively simple constructional means:

(a) By suitably designing the end of the sealing piston 9 at the side of the contacts 3 and by selection of its stroke or degree of penetration into the stationary cylinder 7 it is possible to conduct the stream of extinguishing gas towards the arc to be extinguished in the most effective direction and in the most favorable moment of the circuit-opening movement and, indeed, only after the extinguishing gas has already been pre-compressed.

(b) The movable cylinder 8 formed of insulating mate-
second contact means to provide a parallel electrical path, said additional contact means being separated before said first and second contact means during opening of the circuit-breaker.

3. The circuit-breaker of claim 2, wherein said additional contact means include at least one stationary third contact means, located exterior of said movable cylinder, and at least one fourth contact means located on the outer surface of said movable cylinder.

4. The circuit-breaker of claim 3, wherein the movable cylinder is of electrically insulating material and the fourth contact means comprises an electrically conductive jacket on the outer surface of the movable cylinder.

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