June 21, 1966 H. W. LERCH 3,257,532

ARC-EXTINGUISHING CIRCUIT-BREAKERS

Filed Dec. 6, 1963

Fig. 1

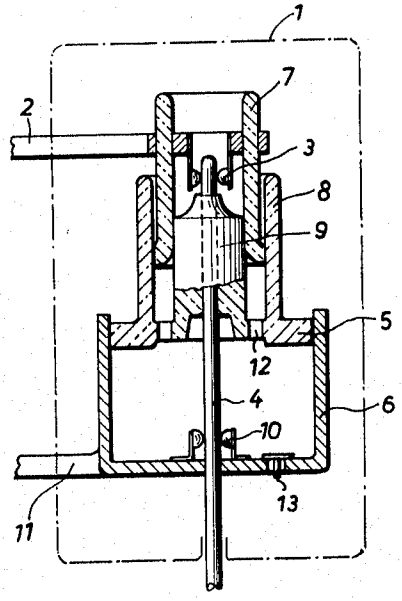


Fig. 2

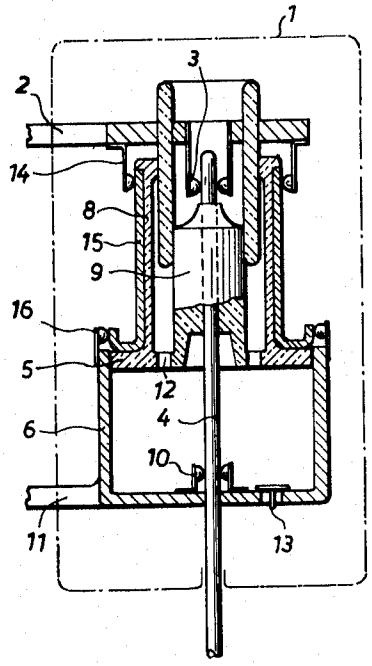


Fig. 3

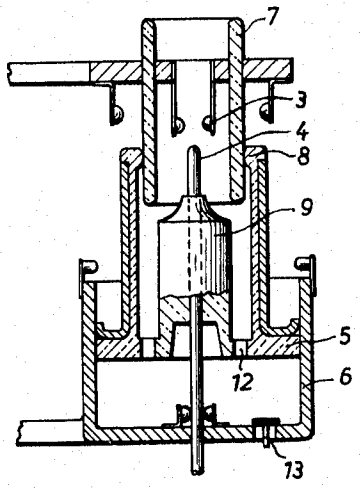
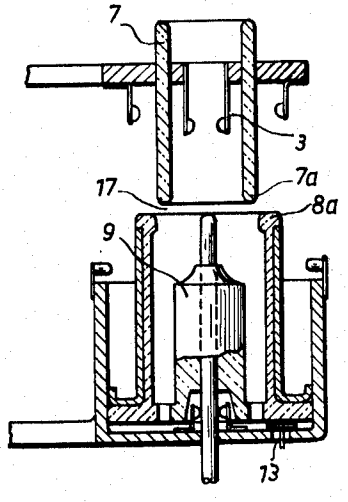


Fig. 4



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ARC-EXTINGUISHING CIRCUIT-BREAKERS

Hans Werner Lerch, Aarau, Switzerland, assignor to Fabrik Elektrischer Apparate Sprecher & Schuh A.G., Aarau, Switzerland

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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 useable 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 efficaciousness 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 encirculing 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 gases, for example SF_6 (sulphur 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 operably 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 connnecting 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 **7***a* and **8***a* (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 **13**. 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 material simultaneously serves as carrier for the slide contact means **15** with circuit-breakers designed for larger rated currents.

(c) The pump cylinder **6** consisting of electrically conductive material simultaneously serves as carrier for the contacts **10** and **16**, respectively.

(d) Suppression of arcing with open-switch contacts is positively guaranteed by a purely extinguishing medium-insulation path **17**.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

Having thus described the present invention what is desired to be secured by United States Letters Patent is:

1. Arc-extinguishing circuit-breaker, comprising:

a closed housing; an arc-extinguishing medium within said housing;

and having within said housing:

a first stationary cylinder open at either end; stationary first electrical contact means located interiorly of said first stationary cylinder; a movable cylinder for sliding on the outer surface of said first stationary cylinder, and defining first and second ends, said second end being remote from said first electrical contact means; a piston means, surrounded by said movable cylinder, in slidable, sealing engagement with the interior surface of said first stationary cylinder, and having first and second ends, said second end being remote from said first electrical contacts; second electrical contact means, rigid with said piston means, for contacting said stationary electrical contact means; a pump piston means, rigid with said movable cylinder at said second end, for supporting said piston means at said second end of the latter, said piston means, movable cylinder, and pump piston means thus moving as a unit between a first end position, wherein the circuit is closed, and a second end position, wherein the circuit is open and said piston means and movable cylinder are moved out of contact with said first stationary cylinder; a second stationary cylinder open at one end for slidably receiving said pump piston means, whereby said second stationary cylinder, in cooperation with the pump piston means and the second end of the piston means, forms a chamber; one-way valve means, located in a wall of said second stationary cylinder, for admitting said medium from said housing into said chamber; port means in said pump piston means for venting said chamber to the region between said piston means and said movable cylinder;

said piston means, first stationary cylinder, and second electrical contact means being of such relative lengths that contact between said first and second electrical contact means is broken first; contact between the piston means and the first stationary cylinder broken second; and contact between the first stationary and movable cylinders broken lastly, to form, before reaching the second end position, a spacing between the respective confronting ends of said first stationary cylinder and the movable cylinder, which spacing is substantially completely filled with said medium;

whereby when said piston means is moved towards the second end position, the medium compressed in said chamber is first forced through said port means into one end of the first stationary cylinder, through the cylinder, where it completely surrounds the first and second electrical contact means and quenches the arc, and out the other end into said housing, and then is forced through said spacing into said housing.

2. The circuit-breaker of claim **1**, including additional electrical contact means in parallel with said first and

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.

References Cited by the Examiner

UNITED STATES PATENTS

2,246,171	6/1941	Grosse	200—148
2,442,010	5/1948	Leeds et al.	200—150
2,933,575	4/1960	Baker	200—150
3,158,723	11/1964	Buechner	200—150

ROBERT S. MACON, *Acting Primary Examiner.*