July 28, 1959 H. A. HIDDE NIJLAND 2,897,325

ELECTRIC SWITCHES FOR HIGH VOLTAGE

Filed Feb. 12, 1957

FIG.1

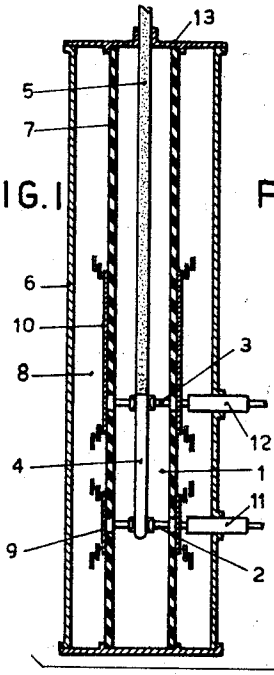


FIG.2

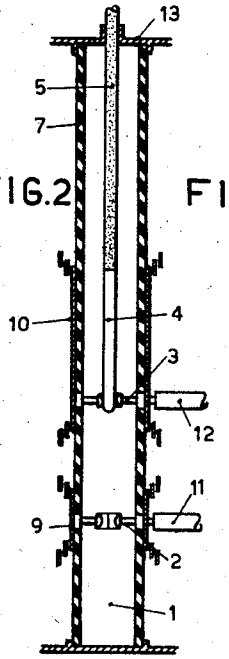
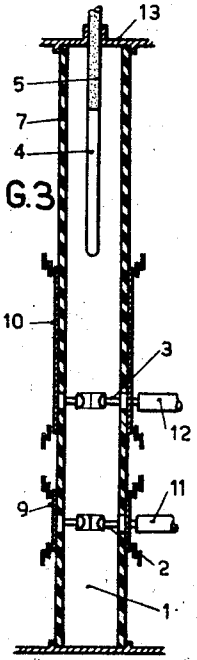


FIG.3



PRIOR ART

FIG.4

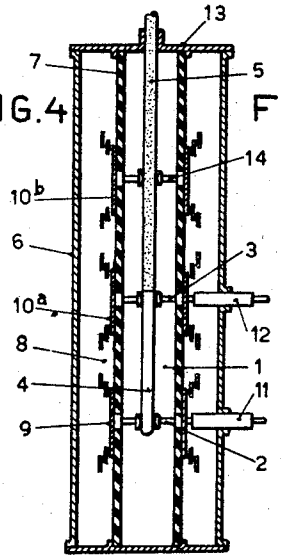


FIG.5

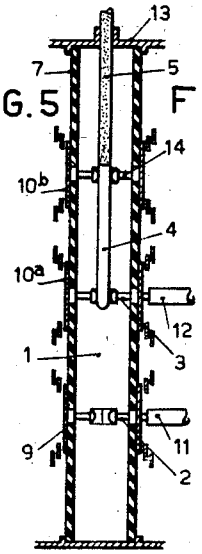
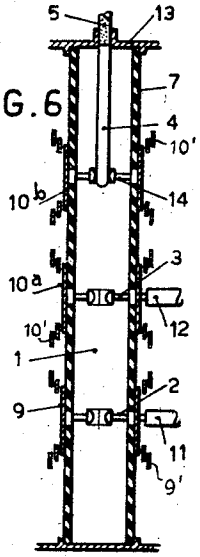


FIG.6



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2,897,325

ELECTRIC SWITCHES FOR HIGH VOLTAGE

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Claims priority, application Netherlands February 15, 1956

1 Claim. (Cl. 200—150)

This invention relates generally to electric switches and more particularly to an electric switch for interrupting high voltage currents.

The switch, according to the invention, comprises, in combination, an axially movable switching rod or make-and-break element and, cooperating therewith, two fixed switching contacts. One of the contacts is conductively releasably connected with the switching rod when the switch is both open and closed and the other contact is conductively connected with the rod only when the switch is in its closed position. A stationary supporting body having a metallic outer wall or casing is provided with an inner wall or casing of solid insulating material. The casings define an annular space for an insulating fluid and a central or inner switching compartment containing all the cooperating switching contacts. Metal screens are provided outside the central compartment and are conductively connected with and surrounding the fixed switching contacts. The screens are mounted to direct, at least the portions of the electric field having the greatest intensity outside of said central switching compartment, both when the switching rod is in its closed position and when it is in its open position.

A principal object of the invention is to provide a compact construction for a switch capable of interrupting high voltage currents without need of constructing the casings of the switch with large axial dimensions.

A feature of the switch, according to the invention, is that coaxial screen elements are provided disposed concentrically with the make-and-break element or switching rod for distributing the electric field in the switch in such a manner that the make-and-break element may be withdrawn axially from a liquid filled casing while the power is on.

The construction of the screen elements and their disposition allow the casing of the switch to be constructed axially shorter than the switches of this type formerly permitted, thus making it easy to axially remove the make-and-break element from the casing even when a voltage is being applied to the switch contacts.

Other features and advantages of the switch in accordance with the present invention will be better understood as described in the following specification and claim, in conjunction with the following drawings in which

Figs. 1 and 2 and 3 are elevation sectional views of a known switch with the make-and-break element shown in three positions and are illustrative of the need of constructing the axial dimensions of the switch relatively long, as shown,

Figs. 4, 5 and 6 are elevation sectional views of a switch according to the invention with the make-and-break element in three positions, corresponding to the positions in Figs. 1, 2 and 3 respectively, and are illustrative of the compact construction permitted by the screen element arrangement for distributing the electric field in the switch.

According to the drawings like reference numerals denote like or corresponding parts. In Figs. 1, 2 and 3 which are illustrative of a known switch an inner switching compartment **1** is provided, in which fixed switching contacts **2** and **3** and an axially movable switching rod or make-and-break element **4** are accommodated. The switching rod **4** is electrically conductive and connected by an insulator **5** to an operating mechanism (not shown). The switching compartment **1** is formed by a double fluid-tight casing construction consisting of a metallic outer wall or tubular casing **6**, an inner wall or tubular casing **7** substantially of solid insulating material and radially spaced inwardly of casing **6** forming an annular space or compartment **8** between said casings, **6**, **7** and filled with an insulating fluid of high quality. The fixed switching contacts **2**, **3** are conductively connected with metal screens **9** and **10**, which are situated within the insulating space **8**. Lead-in insulators **11**, **12** are provided with axial bores for connecting the fixed switching contacts **2**, **3** to external or lead-in conductors.

In Fig. 1 the switch is shown in a closed condition. The switching compartment is electrically stressed, very little since the screens **9** and **10** keep the parts of the electric field having the greatest intensity between the energized parts **2**, **3**, and **4** of the switch and the grounded metal casing **6**, within the space **8** containing insulating fluid of high quality. The screen **10** extends in an axial direction an extent such that when the switch is also in its open condition, as shown in Fig. 2, the electric field between all switching contacts and the upwardly displaced switching rod **4**, and the metal casing **6** is substantially contained within the compartment **8**.

The switch is constructed to make it possible to withdraw the switching rod **4** from the top of the switch in the manner shown in Fig. 3, while the fixed contacts **2**, **3** remain energized. The axial length of the casings **6**, **7**, accordingly, must be sufficient to guarantee sufficient insulating distance between the upper edge of the energized screen **10** and the lower end of the switching rod **4** on one hand and between the upper end of the switching rod **4** and the lid **13** of the grounded casing **6** on the other hand. These insulating distances extend in the insulating fluid contained in the switching compartment **1**, which is generally contaminated by the switching process, so that when these distances are calculated a safety factor is taken into account. Due to these requirements the electric switch illustrated in Figs. 1, 2 and 3 is of a large axial dimension.

A switch in accordance with the invention is shown in Figs. 4, 5 and 6 which correspond to the operating conditions of Figs. 1, 2 and 3 respectively. The screen **10** of the switch shown in Figs. 1, 2 and 3 is divided, according to the invention, into two separate coaxial parts **10***a* and **10***b*. The screen parts are conductively interconnected by the switching rod **4** when the switch is in its open condition (Fig. 5) and distribute the electric field, between the switching rod **4** and the metal casing, externally of the switching compartment **1** just as well as the screen **10** in Figs. 1, 2 and 3. The screen **10***b* is conductively connected to the switching rod **4** by means of a third contact **14** when said rod is in a switch opening position.

In this switch the switching rod **4** is removable (Fig. 6) axially from the switch while the fixed switching contacts **2**, **3** are energized. The screen **10***b* is disconnected from the fixed switching contact **3**, as soon as the switching rod **4** is moved axially away from fixed switching contact **3**. In that case, only the screen **10***a* remains directly connected with energized parts, whereas the screen **10***b* is grounded, and the insulating separation of the screens **10***a* and **10***b* is nearly entirely situated inside the compartment **8** of high insulating quality.

The control of the axial potential gradient, of the electric field in the switch, obtained by means of the

division of or splitting up of the screen **10** makes it possible to construct the switch considerably shorter in an axial direction as is apparent when the switches shown in Figs. 1–3 and Figs. 4–6 are compared with one another.

It will be understood, that the screen **10** may be divided into more than two coaxial parts, each of which is conductively connected with the switching rod **4** when it is in its open position of Fig. 5. The screens **9**, **10***a* and **10***b* may be mounted in the space **8**, as shown, or incorporated in the insulating inner wall **7**.

In order to control the electric field at the edges of each of the screens, the edges thereof are circumferentially surrounded by a number of concentric rings **9'** and **10'**, which in the manner of the plates of a condenser, are insulated with respect to one another and produce a favorable potential gradient.

While a preferred embodiment of the invention has been shown and described, it will be understood that many modifications and changes can be made within the scope of the invention.

What I claim is:

A switch for high voltage currents comprising, two vertical fluid-tight substantially concentric radially spaced tubular casings each adapted to be filled with an insulating fluid, the inner one of said casings being of electrically non-conductive material, at least three vertically spaced fixed contacts mounted on said inner casing and extending inwardly thereof, at least two lead-in-conductors

directly electrically connected only to the two lowermost ones of said fixed contacts respectively, each fixed contact situated above the said two lowermost fixed contacts lacking a direct connection with a lead-in-conductor, an axially displaceable conductive contact-rod mounted for reciprocation in the axis of the inner casing and adapted to be removed from and inserted into said inner casing through a top end thereof, said contact-rod being operative between a closed circuit position in which it engages and electrically interconnects the two lowermost fixed contacts and an open circuit position in which it engages and electrically interconnects all fixed contacts with the exception of the lowermost one, and at least three vertically spaced electrically conductive screen elements surrounding the space within the inner casing and mounted on said casing removed from the inner surface thereof, each screen being conductively connected to a corresponding fixed contact and extending axially a given length in both directions away from its corresponding fixed contact.

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