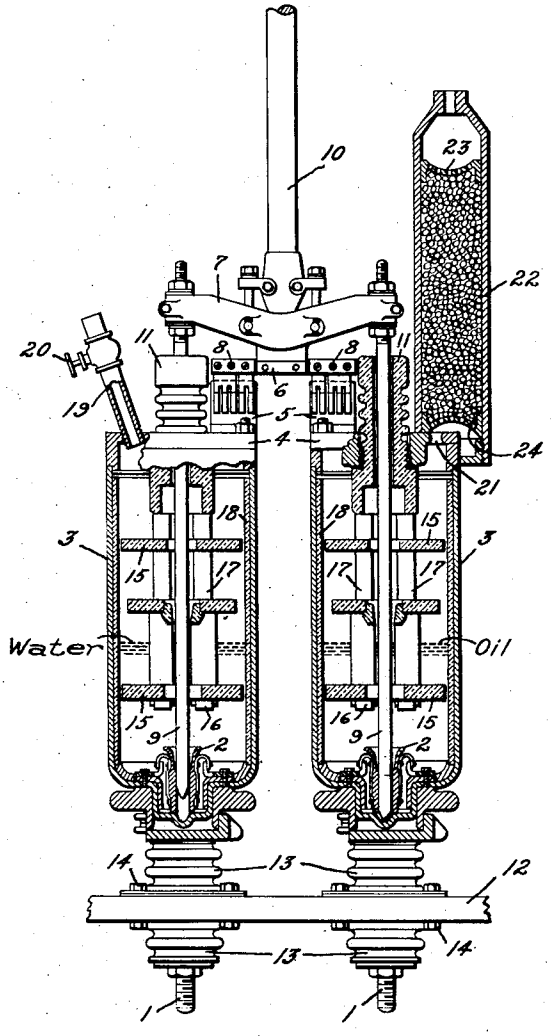
May 5, 1925. 1,536,852

J. D. HILLIARD

ELECTRIC SWITCH

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Inventor:
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His Attorney.

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UNITED STATES PATENT OFFICE.

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ELECTRIC SWITCH.

Application filed January 2, 1923. Serial No. 610,099.

To all whom it may concern:

Be it known that I, JOHN D. HILLIARD, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Switches, of which the following is a specification.

This invention relates to electric switches, and especially to switches having sets of contacts separable within an insulating or arc-extinguishing fluid to interrupt a circuit by a plurality of breaks in series with each other.

Heretofore the use of various materials has been proposed for the purpose of quenching an arc formed between the switch contacts upon their separation, the most common of these materials being oil, water, air under high pressure, carbon tetrachloride, and other poly chloro derivatives. While all of the materials mentioned have characteristics which fit them to the purpose of extinguishing an arc, they also possess certain undesirable features.

The interrupting capacity of a well designed fluid break switch is largely determined by the pressure which its tank will withstand and this pressure, in turn, is dependent upon the volume of gas generated at the interruption of the circuit. The control and disposition of the gas generated at an arc between the contacts, therefore, becomes a consideration of paramount importance. The volume of this gas is to some extent determined by the character of the fluid in which contacts are immersed. If the contacts are separated in a liquid of comparatively low resistance, the I^2R heat of the liquid is added to the I^2R heat of the arc and the interrupting capacity of the switch may be greatly reduced due to the fact that the volume of gas generated is many times that produced by the arc alone. Where large amounts of energy are to be interrupted it is therefore important that an arc-extinguishing fluid of high resistance be used.

Where small amounts of power at high voltage are to be interrupted there is not the same necessity for a high resistance fluid as where large amounts of energy are to be interrupted. Under these conditions it might appear desirable to use a fluid of comparatively low resistance because of the fact that the opening movement of the switch would be greatly accelerated due to the piston action exerted on the contact rods by the increased pressure which is a direct result of the greater volume of gas generated. With a single break in the circuit, however, if the resistance of the liquid becomes so low as to conduct a substantial amount of current the amount of gas generated with large currents will be destructive to the switch. On the other hand, if the resistance is high, for example substantially equal to that of distilled water, the amount of gas generated when opening low currents will be too small to give any effective acceleration to the contacts and if the pressure of the gas alone is relied upon to produce the separation of the contacts an arc may be maintained for a sufficient length of time to coat the switch chamber with metal from the switch contacts and thereby render the switch inoperative. Where however an oil break switch is used in series with the water break switch there is no danger of such an arc being maintained with low current values since the oil switch will interrupt such currents instantly. I prefer to employ operating mechanism of the type commonly used with oil switches for positively and rapidly separating the contacts and with heavy currents the pressure due to gas formation in both the water and oil switch chambers materially accelerates the separation of the switch members. This action in oil switches is well known to be of importance in securing a quick break. If the resistance of the liquid in the water switch becomes lowered the series break at the oil switch will still keep the pressure developed in the water switch at a safe value. And during normal conditions the water switch greatly reduces the duty on the oil switch.

The use of oil as an arc extinguishing agent is advantageous in that it possesses excellent insulating characteristics, but under certain conditions is disadvantageous because it is vaporized and dissociated at the high temperature of the arc to form vapor and permanent gases of an inflammable nature and to set free a certain amount of carbon which reduces the dielectric strength of the oil and is eventually deposited in the bottom of the switch tank as sludge.

The ejection of a mixture of oil, hot vapor and hot gases from the tank by the pressure produced at an arc between the switch contacts greatly increases the risk of fire and is open to the less serious objection that it forms dirty spots on objects with which it comes into contact.

These difficulties may be largely avoided by the use of distilled water or a mixture of water and glycerine where the switch is to be used at a temperature below the freezing point of water. Distilled water possesses excellent arc-extinguishing characteristics in that it does not form inflammable vapor and gases, is but slightly affected by repeated subjection to the arc temperature, and quickly evaporates if ejected from the tank. While water is vaporized and to some extent dissociated at the arc temperature, the gases into which it is dissociated for the most part recombine to form water vapor which is readily condensed. The high specific heat of water and steam, the facility with which the dissociated gases recombine, and the readines with which the resulting vapor is condensed to form water all contribute to make water a desirable arc-extinguishing fluid. Other conditions being equal, it is possible to interrupt a greater amount of energy in water than in oil. The use of water alone, however, is objectionable in that slight impurities render it more or less conductive and make impracticable its use as an insulating medium between the contact when the switch is open. Even though the contacts be entirely removed from the water there is great danger of leakage across the moisture film formed upon the inner tank surfaces. In accordance with my invention, means are provided for interrupting the circuit by a plurality of series connected breaks, some of the breaks being made in oil and some of them being made in water. This not only makes it feasible to utilize the greater interrupting capacity of water but also makes it possible to take advantage of the better insulating properties of oil. The interrupting capacity of a given switch may be further increased by the provision of means for initially interrupting the circuit at the water immersed contacts, thereby reducing the heat generated in the oil.

An object of my invention, therefore, is to provide means for employing two or more arc-extinguishing media in such a way as to utilize their desirable qualities and neutralize their undesirable characteristics. By the use of a plurality of arc-extinguishing fluids, the interrupting capacity of a given switch structure is greatly increased.

A further object of my invention is to provide means by which the danger of fire and explosions caused by the operation of the switch is greatly reduced.

Other objects and advantages will become apparent as my invention is described in detail.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the single figure of the drawing, there is shown, partly in elevation and partly in section, a switch provided with terminals 1 electrically interconnected with auxiliary stationary contacts 2 and tanks 3 upon the covers 4 of which are mounted the main stationary contacts 5. Bridging members 6 and 7 arranged to interconnect electrically the main movable contacts 8 and the auxiliary movable contact members 9 respectively, are mechanically associated with the operating rod 10 which may be made of insulating material and which is arranged to be moved by any suitable mechanism to operate the switch. Insulators 11 are supported through suitable openings in the covers 4 of the tanks 3 for the purpose of insulating the auxiliary contact rods 9 from the top and tank casings. The switch as a whole is supported upon the member 12 and is insulated therefrom by the insulators 13, these insulators being suitably held to the support 12 by means of bolts 14.

Baffles 15 are supported within the tanks 3 from the covers 4 by rods 16, insulating sleeves 17 being provided for the purpose of spacing these baffles from each other, to form a tortuous passage for any material ejected from the lower part of the tanks 3 by pressure produced at an arc between the contacts 2 and 9. The tanks 3 are adapted to contain different arc-extinguishing fluids as is indicated on the drawing by the legends "water" and "oil," the "water" tank being provided with a discharge pipe 19 which may contain a valve 20 and the "oil" tank being interconnected through an opening 21 with a chamber 22 having perforated members 23 and 24 between which is placed a baffle composed of granular material such as gravel and the purpose of which is to cool the hot gases and condense the vapor and oil ejected from the tank by pressure created at an arc between the switch contacts If the switch is to be used at a temperature below the freezing point, a mixture of water and glycerine may be used in the "water" tank in lieu of water alone.

In operating the switch from the closed position shown in the drawing, the operating rod 10 is moved upwardly to separate the main contacts 5 and 8 which normally carry the most of the load current and which are connected between the switch terminals 1 in parallel with the auxiliary contacts 2 and 9 when the switch is in the illustrated closed position. By further upward move-

ment, the auxiliary contacts 2 and 9 are separated to completely interrupt the circuit, the set of contacts in the "water" tank being shown as arranged to separate slightly in advance of those in the "oil" tank for the purpose of drawing most of the arc in the water or water mixture which is but slightly affected by repeated exposures to high temperatures. In closing the switch, the rod 10 is moved downwardly to close the circuit first at the auxiliary contacts 2 and 9 and then at the primary contacts 5 and 8.

My invention may be embodied in other forms than that shown and described and I, therefore, intend to cover by the appended claims all changes and modifications apparent to those skilled in the art and within the scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. An electric switch of the type wherein a circuit is broken by means of series-connected sets of contacts arranged upon the separation of the contacts in each set to extinguish any arc which may be formed by drawing the same within an arc-extinguishing liquid, characterized by the fact that the respective sets of contacts are immersed in arc-extinguishing media of different characteristics whereby the desirable characteristics of said media are utilized and their undesirable characteristics are neutralized.

2. An electric switch comprising a plurality of series-connected sets of contacts, one of said sets of contacts being separable in an arc-extinguishing medium having the characteristics of distilled water and another of said sets of contacts being separable in an arc-extinguishing medium having the characteristics of oil.

3. An electric switch comprising a set of contacts separable in water, and another set of contacts in series therewith separable in oil.

4. In an electric switch comprising a pair of switch tanks, one of which contains water and the other of which contains oil, a fixed contact secured in each tank beneath the surface of the liquid contained therein, a pair of movable contacts arranged respectively to cooperate with said fixed contacts, and means for operating said movable contacts arranged first to separate the contacts which are immersed in water and subsequently separate the contacts which are immersed in oil, the separable pairs of contacts being arranged to produce series breaks in the circuit controlled by the switch.

5. The method of interrupting a power circuit which consists in opening the circuit at a point under water whereby an arc is drawn, and during the drawing of said arc opening the circuit at another point under oil.

In witness whereof I have hereunto set my hand this 29th day of December, 1922.

JOHN D. HILLIARD.