

March 26, 1929.

C. W. RICE

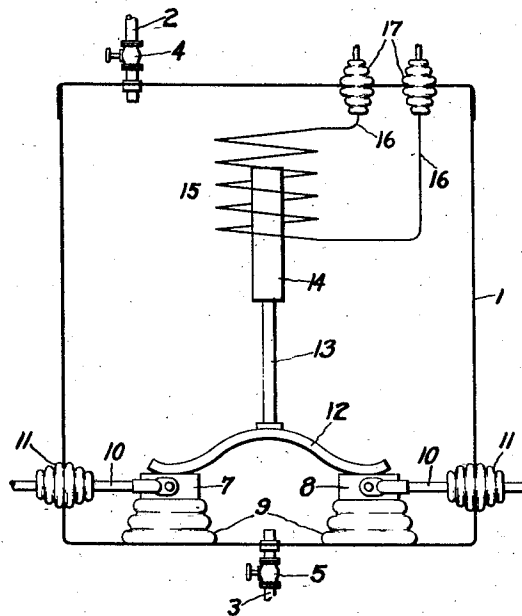
1,706,746

ELECTRIC SWITCH

Filed March 17, 1924

2 Sheets-Sheet 1

Fig. 1.



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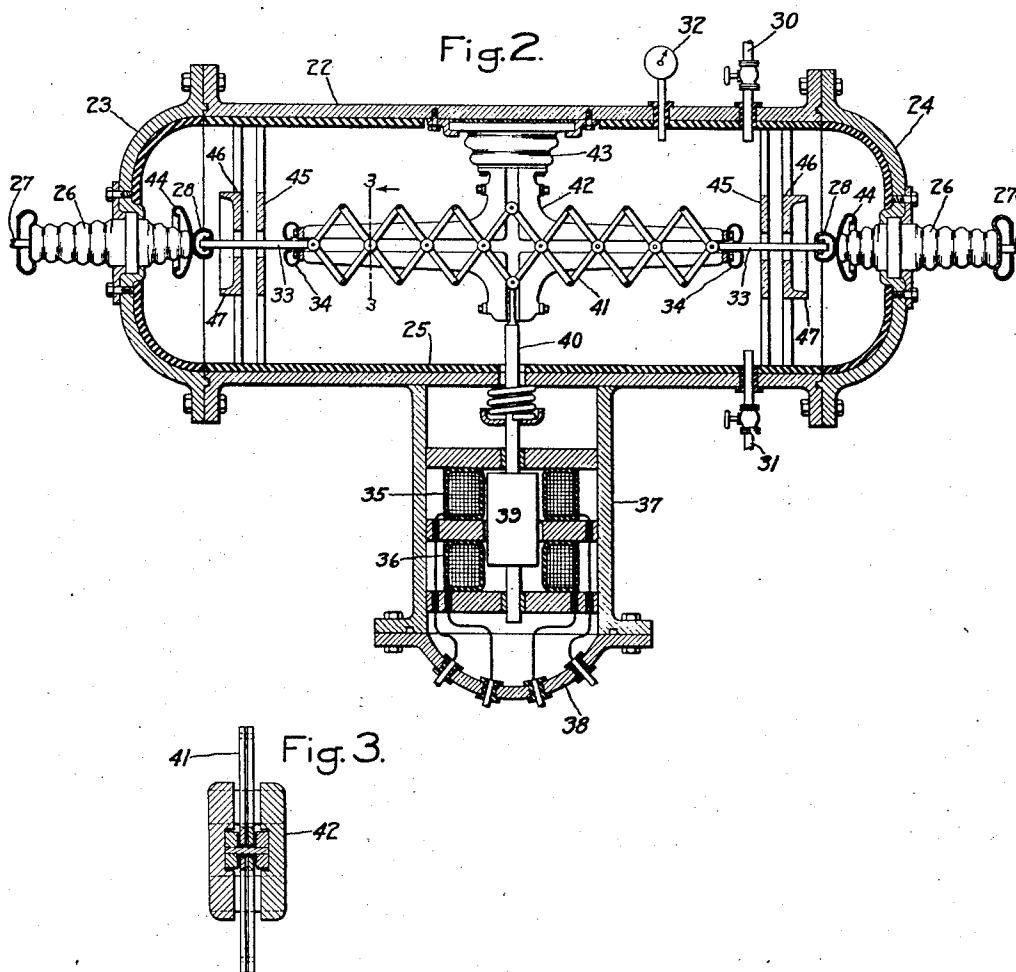
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

CHESTER W. RICE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC SWITCH.

Application filed March 17, 1924. Serial No. 699,660.

My invention relates to electric switches, and particularly to electric switches which are adapted to control high potential circuits.

For the control of such circuits it is customary to employ switches of the fluid break type in which the initial breaking of the circuit and the final closing thereof is effected between contacts immersed in an insulating oil. With such a switch the arc drawn upon the separation of the contacts causes a rapid dissociation of the oil, giving rise to the sudden formation of a relatively large volume of highly heated gas which in the case of a heavy overload or short-circuit on the line may result in the production of an enormous pressure. Although strong steel containers have been employed to withstand the pressure developed under such conditions much difficulty has been experienced in preventing the expulsion of hot oil and gas which has often resulted in causing short circuits in the vicinity of the oil switch and the starting of fires as well as the loss of considerable quantity of oil from the switch.

An object of my invention is to provide a switch of an improved type which can be successfully employed for the control of high potential circuits without the difficulties and dangers heretofore encountered with switches of the oil break type.

According to my invention the switch contacts are mounted to be separated in a vessel filled with hydrogen under pressure. Among the more important advantages of the use of hydrogen as a medium in which the contacts of a high potential switch are separated, there may be mentioned the following: first, the large amount of heat consumed in dissociating the molecular hydrogen into atomic hydrogen in the arc stream; second, the high heat conductivity of molecular and atomic hydrogen whereby the intense heat of the arc is rapidly conducted away, thus assisting in the cooling and final breaking of the arc; third, the absence of any permanent gas formation due to the products of dissociation of the medium in which the arc is drawn; fourth, the possibility of increasing the rate of recombination of the atomic hydrogen by placing catalyzing materials or surfaces in the vicinity of the arc stream; and fifth, the high dielectric strength as compared with oil which may be obtained by using a gas such as

hydrogen, particularly when it is confined under pressure. This last is of importance in preventing the reforming of the arc.

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.

In the drawing, Fig. 1 is a diagrammatic illustration of my invention; Fig. 2 is a cross-sectional view of a form of switch embodying my invention; and Fig. 3 is a fragmentary cross-section drawn to a larger scale taken on line 3—3 of Fig. 2.

Referring first to Fig. 1, a gas-tight chamber is represented at 1 to which two pipes 2 and 3 connect, the pipes being controlled respectively by valves 4 and 5. Two similar stationary contact members 7 and 8 are shown supported by insulators 9 on the bottom of the chamber, each contact having attached thereto a lead 10 passing through the side of the chamber and being insulated therefrom by means of an insulating bushing 11. The movable contact member 12 bridges the stationary contact members 7 and 8 when the switch is closed and is attached at its central portion to a rod 13 which is carried by the solenoid core 14. The solenoid 15 for raising the movable contact member surrounds the core 14 and is connected to leads 16, passing out through the chamber by means of insulating bushings 17. By means of the two pipe connections 2 and 3 the air within the chamber may be removed and hydrogen at the desired pressure substituted therefor.

In Fig. 2 the gastight chamber is shown comprising the cylindrical body portion and two end-heads 23 and 24 secured thereto. The chamber has a lining 25 of insulating material and in each end-head is secured an insulating bushing 26 through which extends the conducting rod 27, a suitable stationary switch contact 28 being mounted on the inner end of each rod 27. For admitting hydrogen to the chamber and for scavenging the same of air two pipes 30 and 31 each having a control valve are shown entering the body portion; a third pipe connects the pressure gauge 32 to the chamber. This pressure gauge obviously may be arranged to control a valve by which hydrogen may be admitted to the chamber from a storage reser-

voir, thereby retaining the desired pressure of gas in the chamber in the event of a slight leak therein.

The movable elements of the switch comprise two solenoid operated contact members 33 which engage the two stationary contacts 28 and against which bear the brushes 34. The two solenoids 35 and 36 are contained in a cylindrical member 37 firmly secured, as by welding, to the body 22 and being closed at its outer end by the head 38 through which pass the wires leading to the solenoids. The armature plunger 39 is adapted to be raised or lowered in accordance with which one of the two solenoids is energized and is shown operatively connected to the movable contacts through the rod 40 and the double lazy tong mechanism 41. This mechanism is shown supported and guided by the member 42 which is secured to the body portion 22 of the chamber by means of an insulating post 43. To prevent a deposit of metal on the bushings 26 by the arc between the metallic contacts I have provided each bushing with a shield 44.

For the purpose of increasing the rate of recombination of the atomic hydrogen into molecular hydrogen I may provide catalyzing means within the switch chamber. Such means will be most effective when arranged in the vicinity of the arc stream. The rate at which the arc stream is cooled will thereby be increased. In Fig. 2 the catalyzing means is indicated as consisting of ring-shaped members 45, 46 which may be composed of tungsten, or may be composed of quartz having ground surfaces. Other known catalyzing agents may be used such as ordinary glass with a ground surface or catalyzers comprising thorium or aluminum. Where catalyzing members of quartz are used, these members may be arranged side by side parallel to the arc stream with their lower edges slightly above the line of the break. Thus arranged the arc will be divided up into a series of small arcs in parallel and the quenching of each arc will be facilitated by the catalyzing effect. The quartz is capable of withstanding the high temperatures without injury.

In the arrangement shown in Fig. 2 each member 46 is shown as having a flange 47 which partially shields the lining of the chamber from the metal vapor, the members 45 and 46 are preferably supported in such a way as to provide a free circulation of hydrogen within the chamber. If, after continued use, the catalyzing members become ineffective, as for example by reason of deposits thereon due to the vapor of the arc stream they may be replaced. Where catalytic effects are found desirable, hydrogen which is dry and free from oxygen, is preferably used since water vapor and oxygen have a poisoning effect on the catalyzer. Where the switch chamber is lined with a

material which has marked catalyzing properties, it may be found under certain circumstances that the lining itself is a sufficient catalyzer to improve the action of the switch. In such case the construction must be such that the lining and casing are not damaged by the heat produced as a result of the recombination of the hydrogen atoms. The catalyzing action may be controlled by the admission of a slight amount of water vapor or oxygen to the chamber deliberately to poison the catalyzing surfaces. If, therefore, in any case the catalyzing action is such as to tend to damage the lining it may be eliminated by the introduction of a poisoning agent. It is deemed preferable to employ catalyzing members supported adjacent the arc stream and provide a lining which does not possess catalyzing properties to any considerable degree. The catalyzing action may be preserved by the insertion of caesium and calcium in the chamber which will take up oxygen and water vapor.

By means of the pipe connections 30 and 31 the chamber may be scavenged of air and filled with hydrogen. Since the dielectric strength of hydrogen increases with the pressure, it is preferable, where practicable, to maintain the gas at a relatively high pressure within the chambers, for example, 10 to 20 atmospheres. My invention is not, however, limited to such pressures since marked advantages are secured by the use of hydrogen at pressures approximating atmospheric pressure. Comparative tests made with a switch operating under similar conditions in an atmosphere of air and in an atmosphere of hydrogen have shown that in hydrogen the length of arc drawn before final rupture is only about one-tenth that drawn in air.

It will be obvious from an inspection of the drawing that the energization of solenoid 36 will shift the plunger 39 and thereby contract the lazy tong mechanism to move the movable contacts to open circuit position. The resulting arc, being drawn through hydrogen under pressure and in the immediate vicinity of the catalyzing agents, is quickly extinguished, and the medium in which the arc was drawn upon cooling, will return to substantially its original condition as regards pressure and composition. Energization of the other solenoid 35 likewise effects the closing of the switch.

While I have described certain embodiments of my invention, I do not wish to be limited to the arrangements shown and described as it will be apparent that many modifications therein may be made without departing from the scope of my invention as set forth in the appended claims.

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

1. A switch comprising a closed chamber containing hydrogen, relatively movable

metal contacts in said chamber, means for insulating one of said contacts from said chamber, and shielding means for preventing metallic deposits on said insulating means
5 due to an arc produced upon separation of said contacts.

2. A switch comprising a closed chamber containing hydrogen, relatively movable cooperating contacts mounted therein, and catalyzing means in said chamber whereby
10 atomic hydrogen is caused to recombine into molecular hydrogen.

3. A switch comprising a closed chamber containing a polyatomic gas dissociable under the influence of an electric arc, relatively
15 movable, cooperating contacts mounted in said chamber whereby the arc formed upon the separation of said contacts may dissociate a portion of said gas, and catalyzing means
in said chamber for causing a recombination
20 of said dissociated portion.

In witness whereof, I have hereunto set my hand this 14th day of March, 1924.

CHESTER W. RICE.