March 26, 1957 N. H. ROSENBERG 2,786,918

SWITCH

Filed May 16, 1955

FIG. 1

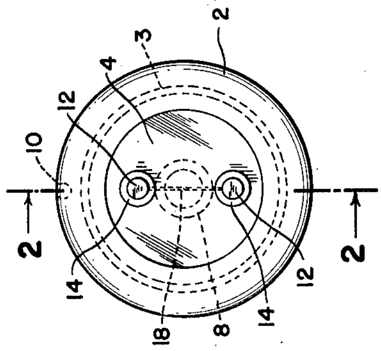
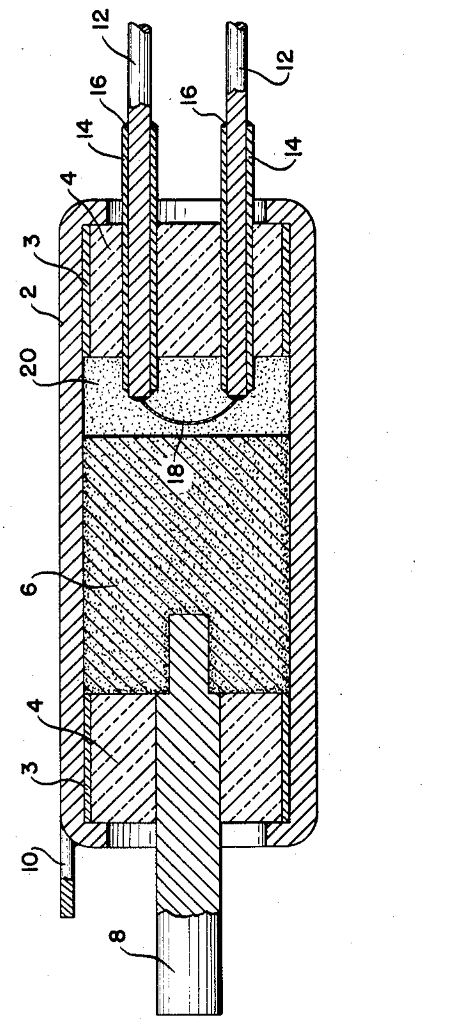


FIG. 2



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2,786,918
Patented Mar. 26, 1957

2,786,918

SWITCH

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Application May 16, 1955, Serial No. 508,555
4 Claims. (Cl. 200—142)

This invention relates to electric switches and more particularly to a switch that is actuated by a chemical change of a mixture of materials arranged in an electric circuit.

Within a suitable container, I arrange two leads forming a part of a circuit with a gap between them and this gap is filled with a mixture of two or more materials which are capable of combustion when a required amount of heat is supplied, and which, on burning, produce a conductive mass without substantial evolution of gas.

Such a switch may be used advantageously in many installations. For instance, it may be employed in a projectile fuze for arming it at a desired time. Many mixtures of materials, consisting of an oxidizer and a fuel, are available which will react or burn when brought to an elevated temperature. Such temperature may be produced by an electric igniter, which in a specific form, may be a high resistance wire or connector between the leads, or by a percussion cap.

Various mixtures of materials may be employed in the construction of the switch. The preferred composition consists of a mixture of powdered boron and powdered ferric oxide in stoichiometric proportions, although mixtures containing either ingredient in some excess are also useful and permit obtainment of other burning rates. The preferred composition consists of 22 parts by weight of boron to approximately 160 parts of ferric oxide. In addition to controlling the burning rate by using an excess of one ingredient, it is also possible to increase the burning rate by decreasing the particle size and to decrease the rate by increasing the particle size.

Many other similar mixtures may be employed. I may use any mixture of two or more materials that are preferably in powdered form, the mixture is initially substantially non-conductive, the materials react at a temperature such as may be obtained by passing an electric current through a resistance element, and the product formed by combustion is a relatively high conductor of electricity.

Thus I may use a mixture of powdered magnesium and powdered ferric oxide, or a mixture of magnesium and cuprous oxide, or zirconium and cuprous oxide. Any of such mixtures may be used in approximately stoichiometric proportions, but as in the case of the boron-ferric oxide mixture, either ingredient may be present in some excess. In the quantities in which such mixtures are present in an embodiment of the invention which has been tested, all of these mixtures had an electrical resistance between 0.5 and 50 megohms before combustion and less than 0.1 ohm after combustion.

In the accompanying drawing, I have illustrated one embodiment of the invention. In this showing.

Fig. 1 is an end view of a switch constructed in accordance with the invention; and

Fig. 2 is a sectional view on line 2—2 of Fig. 1.

Referring to the drawing, the switch is mounted in a casing 2 which may be of any suitable size and shape,

and which may be made of any suitable material, such as metal, or a plastic having the ability to withstand rough handling and usage. The ends of the casing may be closed by seals 4 preferably formed of an insulating material, such as glass contained in cylinders 3 of Kovar metal. Within the casing between the seals I place a filling 6 of the powdered mixture. As stated, this may be a mixture of powdered boron and powdered ferric oxide. A terminal or connection 8 extends through one of the seals and a second terminal 10 may be connected to the casing, if the casing is made of metal. If a nonmetallic casing is employed, the second electrode projects into the powdered mixture with its end spaced from the end of electrode 8.

One means of raising the temperature of the mixture 6 to a point that will cause the necessary reaction is by passing an electric current through a resistance wire or element in the powdered mixture. For this purpose a pair of lead wires 12 extend into the casing, for instance, through one of the seals 4, as shown in Fig. 2. These lead wires are arranged in tubes 14 of Kovar metal which is bonded to the glass seal. The tubes 14 are sealed to lead wires 12 by solder 16. A resistance wire 18 extends between the ends of the leads 12.

It is at times advantageous to provide an ignition charge 20 which burns without substantial evolution of gas in contact with the main charge 6 and surrounding the ignition wire 18. The ignition charge may consist of a mixture of 25% by weight of finely divided zirconium and 75% by weight of barium chromate, or any of the other ignition compositions used in gasless electric detonators. When the metal component of charge 6 is highly reactive, one such as zirconium, the ignition mixture may have the same composition as charge 6 but in uncompressed or slightly compressed form.

The unit is assembled by crimping in place the seal containing terminal 8. Then, the required amount of charge 6 is added as a loose powder and compressed. The ignition powder is then added and lightly compressed by insertion of the seal, which is crimped in place. Both seals may then be waterproofed by application of a suitable layer of wax, plastic, or lacquer.

When a current is passed through leads 12, the wire 18, being of much smaller cross-section and being formed of an alloy that is normally used in resistance elements, becomes heated to a red heat. This causes combustion of the ignition mixture 20, which in turn causes a reaction between the poorly conducting reducing element or compound, such as boron, and the oxidizing agent to produce small globules of the metal of the oxide. Such metal, iron, copper or the like, is sufficiently conductive to provide a current path between the leads 8 and 10 of the primary circuit.

The switch thus formed has a number of advantages. It is not affected by extremes of temperature which cause inoperativeness or difficulties in connection with many forms of mechanical switches. It is very durable and shock-resistant, thus being particularly useful in artillery shells, where the set-back forces frequently are a source of trouble with switches of known construction. Its components are all very stable producing a switch of indefinite life. As it contains no moving parts, it is less apt to become disabled than various forms of conventional switches. The simplicity of the switch is also clearly apparent.

I claim:

1. A switch comprising a casing, a pair of terminals extending into the casing and spaced from each other, a mixture of a fuel and an oxidizing agent in the casing bridging the space between the ends of the terminals, the mixture being a relatively poor conductor of electricity, and having an electrical resistance between 0.5 and 50

megohms but being such that an increase of temperature will cause combustion and the production of a material that is a relatively good conductor of electricity having an electrical resistance less than 0.1 megohms to form an electrical connection between the ends of the terminals, an electrical resistance element in the mixture, leads connected to said element, and an ignition mixture in the casing surrounding the resistance element.

2. A switch comprising a casing, a pair of terminals extending into the casing and spaced from each other, a mixture of a fuel and an oxidizing agent in the casing bridging the space between the ends of the terminals, the mixture being a relatively poor conductor of electricity, but being such that an increase of temperature will cause combustion and the production of a material that is a relatively good conductor of electricity to form an electrical connection between the ends of the terminals, an electrical resistance element in the mixture, leads connected to said element, and a mixture of finely divided zirconium and barium chromate surrounding the resistance element.

3. A switch comprising a metal casing, a seal of insulating material in the casing, a terminal extending through the seal into the casing and spaced from the casing, a second terminal connected to the casing, a mixture of a fuel and an oxidizing agent in the casing, the mixture surrounding the end of the first terminal and forming a connection between it and the casing, said mixture being a relatively poor conductor of electricity having an electrical resistance between 0.5 and 50 meghoms and thus normally opening the circuit between said terminals, but being such that upon combustion it will produce a material that is a relatively good conductor of electricity having an electrical resistance less than 0.1 megohms and form an electrical connection between the terminals, and means for raising the temperature of the mixture to cause combustion of it.

4. A switch comprising a metal casing, a seal of insulating material in the casing, a terminal extending through the seal into the casing and spaced from the casing, a second terminal connected to the casing, a mixture of a fuel and an oxidizing agent in the casing, the mixture surrounding the end of the first terminal and forming a connection between it and the casing, said mixture being a relatively poor conductor of electricity having an electrical resistance between 0.5 and 50 megohms and thus normally opening the circuit between said terminals, but being such that upon combustion it will produce a material that is a relatively good conductor of electricity having an electrical resistance less than 0.1 megohms and form an electrical connection between the terminals, an electrical resistance element in the mixture, and leads connected to said element.

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