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(No Model.)

S. D. FIELD.
ELECTRIC CUT-OUT.

Patented July 22, 1890.

No. 432,521.

FIG. 1.

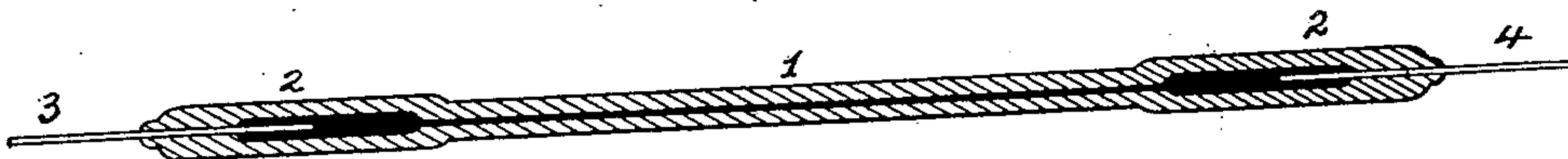


FIG. 2.

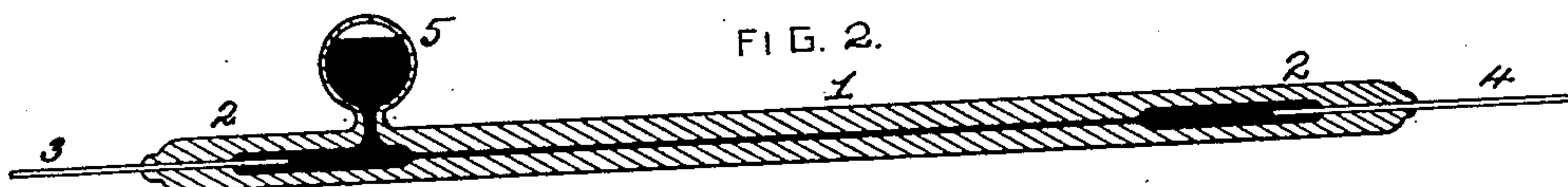


FIG. 3.

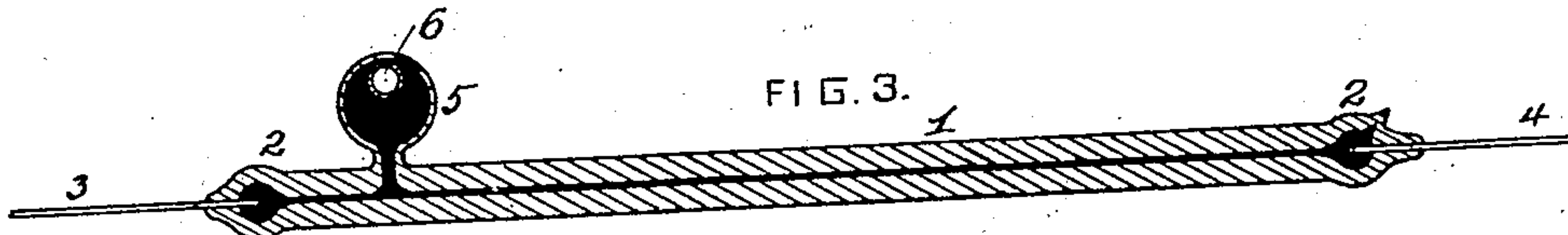


FIG. 4.

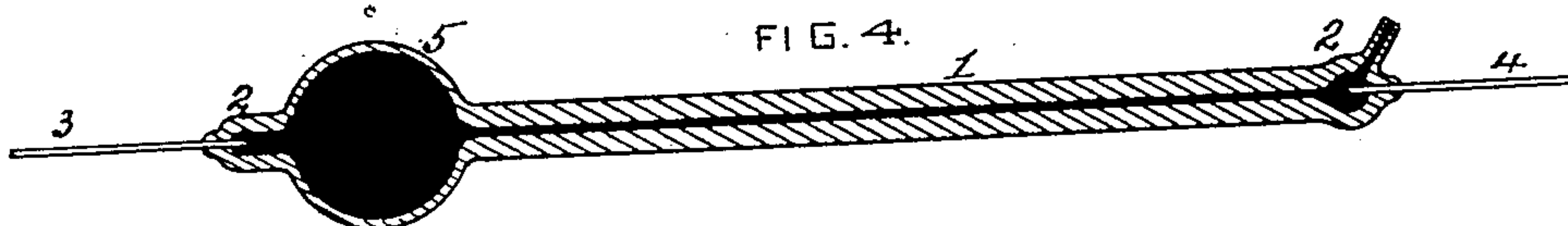
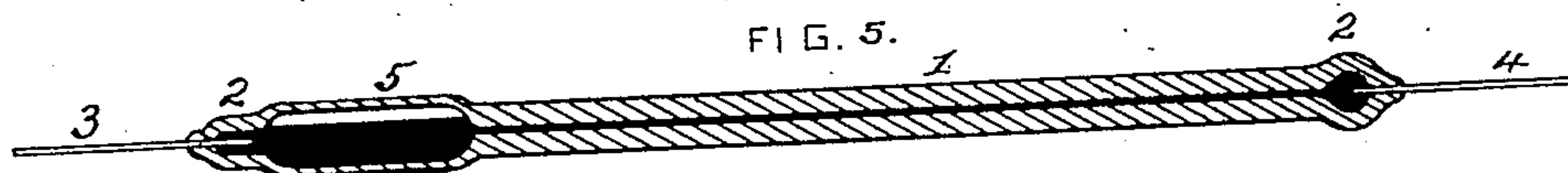


FIG. 5.



WITNESSES

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ELECTRIC CUT-OUT.

SPECIFICATION forming part of Letters Patent No. 432,521, dated July 22, 1890.

Application filed March 22, 1890. Serial No. 344,878. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN DUDLEY FIELD, a citizen of the United States, residing at Stockbridge, in the county of Berkshire and State of Massachusetts, have invented certain new and useful Improvements in Electric Cut-Outs; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to safety-catches for electrical circuits of various kinds, wherein the object is to provide a means whereby abnormal currents flowing over the circuit will cause an interruption therein, and thus secure the safety of any apparatus which may be included in the circuit, which otherwise might become injured by the passage of too great a quantity of electrical energy. Such automatic cut-outs or safety-catches may be generally classified into two divisions, in one of which the action is by means of an electro-magnetic device and in the other by means of a wire or strip of metal inserted in the circuit, which melts at the temperature produced by an abnormal current, and thus opens the circuit. When it is attempted to apply the fusible wire or alloy as a protection to telegraphic and other circuits, it is difficult to obtain a wire or alloy which is sensitive and prompt enough in its operation to work with certainty when relied upon to protect any delicate apparatus. Lack of uniformity in gage of wire or composition of alloys, together with great fragility, owing to the fine gage usually found necessary when adjusted for small currents, give rise to great uncertainty of action.

The object of my invention is to overcome these objections and at the same time provide an apparatus which may be not alone automatic in performing the function of opening the circuit, but under proper conditions will also automatically reclose the circuit should the cause of the abnormal current be removed therefrom; and in carrying my invention into effect I have devised an entirely new type of thermal cut-out.

Accordingly my invention consists in a

safety-catch or thermal cut-out composed of a column of conducting material in a fluid state, normally forming part of the circuit, inclosed in an insulating tube or case and substantially filling the same, and so arranged that the passage of an abnormal current will cause the vaporization of the fluid-conductor at some portion of the column and cause a separation.

My invention further consists in the construction and arrangement of parts, substantially as hereinafter more fully described, and pointed out in the claims.

In the accompanying drawings, which form part of this specification, Figures 1, 2, and 3 are longitudinal sections illustrating a simple form of my invention in three of its modifications. Figs. 4 and 5 are similar sections, taken at right angles to each other, of another modification.

The simplest form of my invention is shown in Fig. 1. I take a glass tube 1, preferably of the same general character as the capillary tubes ordinarily used in the construction of thermometers, and I enlarge the ends 2, so as to form chambers of somewhat larger bore. The tube 1 and its two end chambers 2 are supplied with mercury, which is indicated in the figure by solid black, and the conducting-wires 3 and 4 are hermetically sealed into the closed ends of the structure and in good contact with the mercury contained therein. The passage of an abnormal current through the column in the capillary portion of the device in this instance will make the mercury-column hotter at some one point than another, and at this point the mercury will become vaporized, pressure will be generated, and the tube will be ruptured, thereby opening the circuit.

In Fig. 2 the construction is similar in all respects, except that I introduce a feature which provides for the automatic reclosing of the circuit and at the same time serves as a means of protecting the device against absolute destruction. At one end chamber I construct the tube with an enlargement or bulb 5, and in filling the device with mercury I partially fill the chamber 5. In the operation of this modification the air which occurs

pies a portion of the chamber 5, being an elastic medium, allows the expansion due to the vaporization of the mercury in the capillary portion to take place without rupturing the structure, as the air becomes compressed and the separation of the column of mercury in the capillary tube can take place, thus again opening the circuit in a most reliable manner without destroying the apparatus.

10 In Fig. 3 the construction is similar to that shown in Fig. 2, except that instead of leaving an open air-space in the chamber 5, I insert in the said chamber a small elastic ball 6, of rubber or other material, filled with air, 15 and then completely fill the said chamber 5 with mercury. This prevents the escape of the air from the chamber 5 into the capillary tube in transporting or handling the apparatus, while affording a sufficiently elastic 20 medium to preserve the apparatus from destruction by the vapor-pressure generated in its operation.

In Figs. 4 and 5 I have shown the relief-chamber 5 in the form of a flattened enlargement of the structure with one or both faces 25 6 made thinner than the other portions, so as to become in themselves a yielding body in the nature of a diaphragm, and in this case the mercury may be made to entirely or only 30 partially fill the interior.

In any of the above constructions, except Fig. 1, the action of the abnormal current is to heat the mercury to the vaporizing-point in the capillary portion of the apparatus, and 35 the vapor forms in the tube and drives the mercury remaining therein so far apart as to absolutely preclude the possibility of current being conveyed. The circuit being thus opened, the cause of the heat is obviously removed, and the temperature of the apparatus 40 at that point will at once begin to fall, and finally reach such degree that condensation of the mercury-vapor will take place and the capillary column will assume its original condition, being assisted in the operation by the 45 pressure at the chamber 5.

Among the practical advantages obtainable by my invention I may state the following: If using only pure distilled mercury, it 50 is possible to have absolute uniformity in the conductivity of a given size of cut-out. The construction of capillary tubes of glass has reached such a stage of perfection that it is entirely practicable to have a given diameter uniformly reproduced, and, furthermore, 55 the diameter may be very much smaller than it is possible to draw any of the known fusible wire metals or alloys. Again, mercury has a very high co-efficient of resistance. It 60 therefore becomes possible and entirely practicable to construct thermal cut-outs of this character so as to permit an exceedingly-small fraction of an ampere to volatilize the mercury at the point of least diameter, and

the action will take place invariably at the 65 same critical temperature.

Obviously the particular construction hereinbefore set forth may be greatly modified without departing from the spirit of my invention. For instance, the number and particular location of the chamber 5 is not of the 70 essence of the invention and may be modified to suit the requirements of the particular circumstances in which the device is to be used.

I claim as my invention—

1. A safety-catch or cut-out for an electric circuit, comprising a column of conductive fluid normally forming part of the circuit, inclosed in an insulating tube or case and substantially filling the same. 80

2. A safety-catch or cut-out for an electric circuit, consisting of a column of mercury normally forming part of the circuit, inclosed in an insulating tube or case and substantially filling the same. 85

3. A safety-catch or cut-out for an electric circuit, consisting of a capillary glass tube substantially filled with a fluid-conductor normally forming part of the circuit. 90

4. A safety-catch or cut-out for an electric circuit, consisting of a capillary glass tube containing a column of mercury substantially filling the same and normally forming part of the circuit. 95

5. A safety-catch or cut-out for an electric circuit, consisting of a capillary glass tube containing mercury substantially filling the same, and having terminal wires hermetically sealed in the ends in contact with the 100 mercury, the latter forming part of the circuit.

6. A safety-catch or cut-out for an electric circuit, consisting of a capillary tube of insulating material enlarged at the ends, substantially filled with a column of conducting-fluid, and having terminal wires sealed into said ends in contact with the fluid, the latter normally forming part of the circuit. 105

7. A safety-catch or cut-out for an electric circuit, consisting of a confined column of conducting-fluid normally included in the circuit, inclosed in an insulating tube or case and substantially filling the same, in combination with means for permitting the expansion of said fluid. 110

8. A safety-catch or cut-out for an electric circuit, consisting of a tube of insulating material substantially filled with a vaporizable fluid-conductor normally included in the circuit, in combination with a relief-chamber communicating with the interior of said tube. 115

In testimony whereof I affix my signature in presence of two witnesses.

STEPHEN DUDLEY FIELD.

Witnesses:

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JAMES H. PUNDERSON.