(No Model.)

S. D. FIELD.

CUT-OUT.

No. 446,966. Patented Feb. 24, 1891.

Fig. 1.

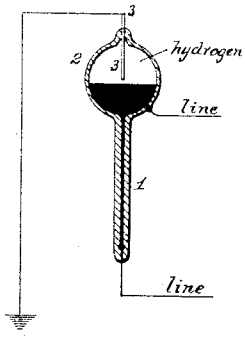


Fig. 2.

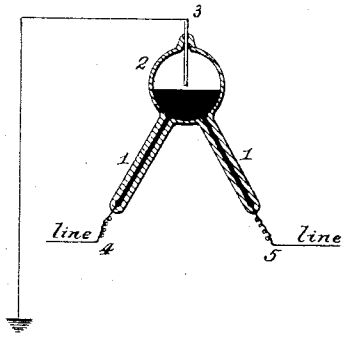
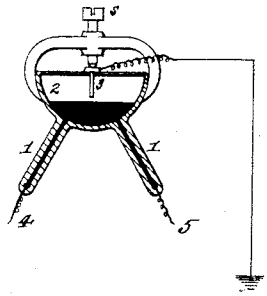


Fig. 3.



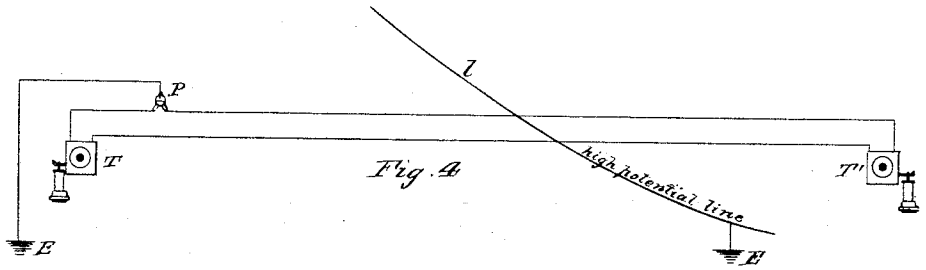


Fig. 4.

Fig. 5.

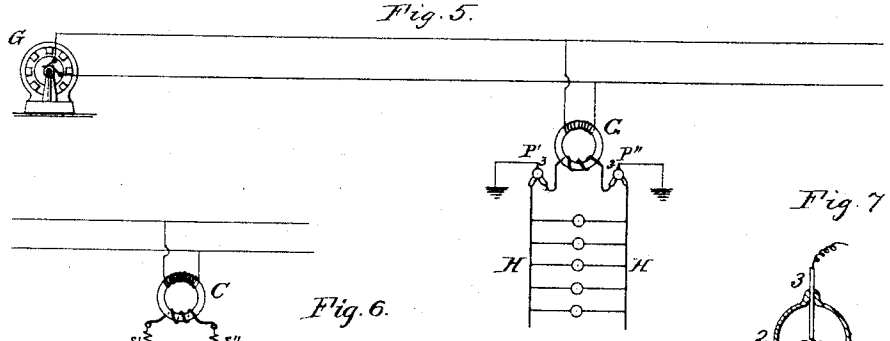


Fig. 6.

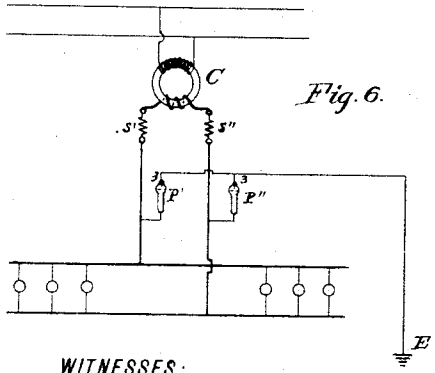
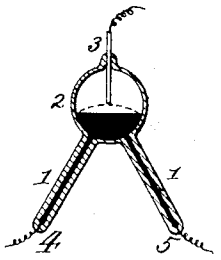


Fig. 7.



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UNITED STATES PATENT OFFICE.

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CUT-OUT.

SPECIFICATION forming part of Letters Patent No. 446,966, dated February 24, 1891.

Application filed May 28, 1890. Serial No. 353,453. (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 Potential Cut-Outs for Electric Circuits; 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.

My present invention relates to a species of safety appliances for electric circuits which I term a "potential cut-out"—*i. e.*, a device adapted to ground a circuit on the rise of electric pressure therein above a predetermined limit.

The invention involves features of novelty which will hereinafter be definitely indicated in the claims.

In the accompanying drawings, which form part of this specification, Figure 1 represents one form of my new potential cut-out in vertical section. Fig. 2 is another form for direct insertion in the circuit. Fig. 3 represents another form of the same with adjustment for the earth-terminal. Fig. 4 is a diagram illustrating the application of my invention to a metallic telephone-circuit liable to be crossed by a conductor carrying high pressure, but grounded at some point. Fig. 5 is a diagram illustrating the application of the invention to the secondary or house circuit of an alternating-current system of distribution; and Fig. 6 is a similar diagram illustrating an additional safety feature on the secondary side of the converter; and Fig. 7 is a detail.

The invention is partly based upon the fact that various gases have a lower resistance than atmospheric air. This is especially true of hydrogen, and I prefer to use it, though I wish to state that other gases have similar characteristics and may be used without departing from the spirit of my invention.

Referring now to Fig. 1, in carrying out my invention I prefer to construct by taking a glass tube 1, containing mercury, and connect the latter with the circuit to be protected. The other end of the tube is enlarged to a bulb or chamber 2, which I fill partly with mercury and partly with some gas—*e. g.*, hydrogen—of higher conductivity than air. In this gas bulb or chamber 2 I insert a terminal 3 in greater or less proximity to the mercury, such terminal being directly grounded, as shown. An increase of potential in the circuit of course causes an increase of potential in the column of mercury, and the presence of the hydrogen gas permits such potential to overcome the resistance of said gas, whereupon a spark passes across through the hydrogen to the earth-terminal. The increased flow of current produced causes volatilization of the mercury in the column and the circuit is opened by the consequent rupture of continuity which takes place in the column of mercury. The circuit is restored upon the condensation of the mercury and the operation above described will be repeated until the cause of the presence of abnormal potential is removed.

In many instances it is desirable to place the device directly in the circuit as an integral part thereof. Figs. 2 and 3 show a construction suitable for that purpose. It consists of two mercury-tubes 1 1, terminating in a single bulb or chamber 2, provided with the earth-point 3. (In Fig. 3 this is shown adjustable by means of the hermetically-sealed terminal 3 in the yielding top of the chamber and the adjusting-screw *s*.) The tubes 1 have the respective terminals 4 and 5 for connection into the circuit. As soon as the potential on the line in which the device is inserted rises above a certain predetermined limit the resistance of the gas contained in chamber 2 is overcome and the circuit is opened by the volatilization of the mercury in one or both of the tubes 1, caused by the increased current flowing on the passage of the spark from the surface of the mercury to the earth-terminal 2, as before described.

Fig. 4 illustrates the application of the invention to an ordinary metallic circuit for telephone or telegraph use, wherein the circuit is liable to be crossed by a conductor *l*, carrying a high-potential current and accidentally grounded at some point, as E. I insert my potential cut-out P in the telephone-circuit, as indicated, and connect it, as before described, to an earth-point E. The telephones T and T′ are by this arrangement fully protected against the possibility of shock to

the user, for upon contact taking place between the high-potential line and the telephone-circuit the potential in the cut-out P rises and the spark passes from the mercury to the earth-point, thereby, as before, volatilizing the mercury in one or both of the tubes 1 and causing a rupture of the telephone-circuit.

Fig. 5 illustrates the application of the invention to the protection of the secondary circuit in an alternating-current-distribution system. G is the generator, and C is one of the converters whose primary is connected to the circuit of the generator G. The secondary circuit is connected to the house-circuit H (which contains the lamps or other devices to be supplied with energy) through the potential cut-outs P′ P″, the other leg of which is connected to the other side of the house-circuit H. The terminals 3 of the respective potential cut-outs P′ P″ are connected directly to earth. In this case I prefer to make the columns of mercury in the potential cut-outs heavy, so as to carry the requisite current without injury. The device thus applied is useful for protection against temporary increase of potential in circuits which it is desired to restore to normally closed condition on cessation of the high potential.

Fig. 6 illustrates the application to an alternating-current-distribution system of my potential cut-out combined with safety-catches to effect a complete rupture of the circuit when operated. In this case the secondary circuit of the converter C has one terminal connected directly to the house-circuit H through an interposed fusible wire or safety-catch *s′*, and the other terminal of the secondary circuit is connected to the corresponding side of the house-circuit through a similar safety-catch *s″*. At points between the safety-catches and the corresponding sides of the house-circuit I connect the lower ends of the respective cut-outs P′ P″. The earth-points 3 of these cut-outs are connected together to the same earth E. The action of the device will be as follows: Should the high-potential primary become in any way crossed or connected with the low-potential secondary, the consequent rise of potential in the latter will cause contact to be made between the mercury of one of the potential cut-outs and the earth, whereupon the increased flow of current through the safety-catches will cause one or both of them to "blow out" or melt and permanently open the circuit if the flow of current continues to a sufficient degree. If the flow of current is not sufficient to melt either of the safety-catches, the high-potential current will have a direct path to earth on either side of the circuit through the potential cut-outs, and there will be no liability of shock to any individual happening at the time to be in contact with the circuit H, while himself connected to earth by standing on a wet floor or otherwise. Obviously, if desired, the body of gas may be placed under pressure with the result of making its conductivity still better relatively to that of air. I prefer to use mercury as the conducting-column of fluid, because it has the advantage of altering its surface to a convex form under the influence of increased electric pressure, as shown in the detail, Fig. 7.

I claim as my invention—

1. A potential cut-out for electric circuits, consisting of an inclosed fluid-conductor, such as mercury, connected to the circuit, a grounded terminal adjacent to such conductor, and an interposed gaseous body of relatively higher conductivity than air.

2. A potential cut-out for electric circuits, consisting of a sealed tube containing a column of conducting-fluid connected to the circuit, a grounded terminal adjacent to such conductor, and an interposed gaseous body of relatively higher conductivity than air.

3. A potential cut-out for electric circuits, consisting of a sealed tube containing a column of mercury connected to the circuit, a grounded terminal adjacent to the end of the mercury column, and an interposed gaseous body of relatively higher conductivity than air.

4. A potential cut-out for electric circuits, consisting of a sealed tube containing a column of mercury connected to the circuit, a grounded terminal adjacent to the end of the mercury column, and an interposed body of hydrogen gas.

5. A potential cut-out for electric circuits, consisting of a tube containing a body of conducting-fluid connected to the circuit and a grounded terminal adjacent to said body of fluid and having means of adjustment to and from the same, and an interposed gaseous conductor.

6. A potential cut-out comprising a tube containing a fluid-conductor and provided with terminals for insertion in an electric circuit, and an auxiliary conductor for connection with earth within sparking distance of the main conductor, whereby upon a definite increase of potential an earth is established and the main circuit opened by the volatilization of the fluid-conductor.

7. In a system of electrical distribution, the combination, with a high-potential or primary circuit, a low-potential or secondary circuit, and an interposed converter, of a cut-out in the secondary circuit, a normally-open ground established by said cut-out on abnormal rise of potential, and a fluid-conductor for opening the secondary circuit by volatilization under the ground discharge and restoring the circuit to its normal condition upon return to the normal flow of current.

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

STEPHEN DUDLEY FIELD.

Witnesses:
CHAS. E. EVANS,
J. H. PANDERSON.