

# UNITED STATES PATENT OFFICE.

HARRY E. HEATH, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## RESISTANCE UNIT.

940,151.

Specification of Letters Patent.

Patented Nov. 16, 1909.

No Drawing.

Application filed October 3, 1906. Serial No. 337,158.

*To all whom it may concern:*

Be it known that I, HARRY E. HEATH, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Resistance Units, of which the following is a specification.

This invention relates to resistance elements for use on electric circuits and has for its object the provision of a device of this character which will adapt itself to many uses, and which will operate under a variety of conditions in a reliable and efficient manner.

One of the objects of my invention is to provide a resistance element which is flexible and which may be rendered more or less conductive in a very simple manner.

In carrying out my invention, I take a flexible insulating material which is porous in structure, and render the same more or less conductive by depositing a conductor upon or within the same. For this purpose, I preferably use a cloth or fabric which is loosely woven or felted so as to be absorbent. Various materials may be adopted, depending upon the use to which the resisting element is to be put. For instance, if it is desired that the element be heat refractory, asbestos or a material containing something of this nature may be used. Since it is the object of my invention to produce a resisting element which is quite flexible, at least as flexible after treatment as before, it is essential that the process used in depositing metal shall not destroy the fiber or render it brittle. I have found that the fabric may be chemically treated so as to produce within the material a conducting body, the density of which will within certain limits depend upon the treatment. If desired, the extent to which the material is rendered conductive by the chemical process may be slight and it may afterward be treated electrolytically, so as to further deposit metal thereon. One method which I have found to be very satisfactory for chemically depositing metal into the fiber or texture of the fabric, is that of depositing silver from a silver nitrate solution, and in the use of this process the reducing powers of the aldehydes have been utilized very satisfactorily. I have found that an ammoniated solution of silver nitrate acts very satisfactorily to precipitate the silver. I have taken a dilute

solution of silver nitrate and added thereto sufficient ammonia to clear the solution. By immersing the fabric or cloth alternately in the solution and then in formalin, the fiber of the material is smoothly and evenly coated with metallic silver. Other methods of depositing metal may be used, which depend upon the action of the chlorides and nitrates. For instance, the dilute solution of silver nitrate may be caused to precipitate silver by means of phosphorous fumes under a bell jar. Other means of depositing conductors within the material may be used as well as other metals, as for instance, copper or even gold where it is intended to use this deposit merely as a cathode for a further deposit in an electrolytic bath. If desired, a further deposit of the same metal as the chemical deposit may be made electrolytically or a base metal may be deposited upon the chemically deposited metal.

It will be found that by this method a very satisfactory resistance unit may be obtained. By the term resistance unit or element I do not mean to merely include those elements which are used for resistance purposes, and in which the generation of heat is merely incidental, but I also mean to include electric heaters, that is, those resistance units in which heat is intentionally produced. In fact my invention is particularly well adapted for heating devices, such as heating pads, rugs, etc., which it is essential shall be flexible. A device of this character is much cheaper and more desirable than fabrics in which wires are embedded. Where the fabric is to be used as a heater, it may be found desirable as above noted, to use a heat resisting material such as asbestos or the like, although in the case of some heaters where only a low temperature is desired, an ordinary cotton fabric will serve the purpose.

The chemical treatment may be used simply as a base for a further electrolytic treatment or the process may be entirely chemical, depending altogether upon the amount and quality of deposit desired and the use for which it is intended.

It should be understood of course that the above process is described in accordance with the patent statutes, merely as a means of carrying out my invention; that it is illustrative merely, and that many modifications will suggest themselves to those skilled in



the art without departing from the spirit of my invention, the scope of which I have indicated in the claims annexed hereto.

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

1. An electrical resistance comprising a flexible heat refractory insulating material having a conductor chemically deposited therein.
- 10 2. An electrical resistance comprising a flexible heat refractory insulating material having a conducting material precipitated therein.
3. An electrical resistance comprising a  
15 sheet of flexible heat refractory insulating material having a conductor deposited in the texture thereof.

4. An electric heating resistance comprising a sheet of heat refractory insulating fabric rendered partially conductive by 20 chemically deposited metal distributed throughout the same.

5. An electric heating resistance comprising a sheet of flexible heat refractory insulating material rendered partially con- 25 ductive by a deposit of metal on the inner fiber thereof.

In witness whereof, I have hereunto set my hand this twenty eighth day of September, 1906.

HARRY E. HEATH.

Witnesses:

JOHN A. McMANUS, Jr.,  
HENRY O. WESTENDARP.