

UNITED STATES PATENT OFFICE.

WILLIAM S. HADAWAY, JR., OF EAST ORANGE, NEW JERSEY.

ELECTRICAL HEATING RESISTANCE AND METHOD OF MAKING SAME.

SPECIFICATION forming part of Letters Patent No. 670,671, dated March 26, 1901.

Original application filed September 24, 1898, Serial No. 691,770. Divided and this application filed December 1, 1900. Serial No. 39,024. (No specimens.)

To all whom it may concern:

Be it known that I, WILLIAM S. HADAWAY, Jr., a citizen of the United States, residing in East Orange, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Electrical Heating Resistance and Method of Making the Same, of which the following is a specification, this being a division of my pending application, Serial No. 691,770, filed September 24, 1898.

A great variety of compositions of matter has been hitherto put into use in making electrothermal resistances for heaters. In general these consist of finely-powdered carbon, serving as the conducting element, intimately mixed with some non-conducting powder which serves to reduce the conductivity of the mass in proportion as more or less thereof is employed.

In many kinds of tools a very high temperature is required, and hitherto electric heating by means of electrothermal-resistance conductors has not been possible in such connections, owing, mainly, to two related causes—first, because the ohmic resistance of the compounds hitherto employed has been found to decrease rapidly as the temperature was raised, and, second, because the compositions used rapidly deteriorated and finally fell to pieces and became useless when so heated. The principal causes to which these difficulties are ascribable are the fact that the various powders used to dilute the carbon have always formed carbids with the same when subjected to very high temperatures, the reduction in volume which occurs when the compounds hitherto used are frequently subjected to very high temperatures, and the relaxation of pressure in part due to this contraction, which relaxation deprives the frail resistance material of necessary support.

My invention embodies the discovery of a material which mixed with powdered graphite or other forms of carbon will not form a carbid when heated and which is already in its state of maximum density, thus preventing further contraction in use.

My improved compound is composed of an intimate mixture of finely-powdered carbon, preferably graphite, and finely-powdered

crystalline magnesium oxid united by any of the appropriate binding cements. Resistances of any desired shape and size can be molded from this composition, as is well understood in the art.

In order to produce a thoroughly-durable compound which can be relied upon to preserve a predetermined specific ohmic resistance unchanged at very high temperatures, I prefer to employ the following steps in preparing the same:

Magnesium oxid (MgO) is capable of existing in a number of allotropic forms. As most widely distributed in nature and as manufactured it is granular or amorphous; but upon cooling after fusion at an extremely high temperature it takes a crystalline form, which is that of maximum density. This occurs in some cases in volcanoes.

In the practice of my preferred process ordinary magnesia is subjected to the action of an electric furnace and fused by the arc, so as to form a crystalline mass of maximum density on cooling. These crystals should be separated from the amorphous magnesia surrounding them as they come from the furnace and are reduced to a very fine powder. The graphite is very finely powdered and then thoroughly baked at a temperature exceeding that to which it is designed to be subjected in practice. I prefer, indeed, to bake the graphite at the same temperature as that to which the magnesia is subjected in fusion, taking the usual precautions to exclude the air. By thus baking the constituents of my resistance compound at a temperature far above that employed in its practical use I reduce them to their maximum density, and thus avoid injurious contraction during use. The two powders are thoroughly mixed in any well-known way in such proportions as are appropriate to the voltage of the heating-current, size and shape of resistances, degree of heat desired, and other conditions. I have found the mixture of ten per cent. of graphite and ninety per cent. of magnesia suitable for use with a one-hundred-and-ten-volt current in flat iron-work where a temperature of about 900° Fahrenheit is required. The mixture so produced is molded into the required shape with molasses-water or other appro-

riate cementing material, as well understood in the art, and is then after baking ready for use.

What I claim is—

1. An electrothermal-resistance compound consisting of a mixture of powdered carbon and powdered crystallized magnesia.

2. The process of forming an electric-resistance compound for electric heaters which consists in mixing powdered carbon and powdered crystallized magnesia and baking the mixture at a temperature higher than that intended to be produced by the resistance compound in practice.

3. The process of manufacturing a resistance compound which consists in fusing magnesia, separating the crystallized portions of

the resultant mass after cooling, reducing the same to powder, powdering and baking graphite at a temperature higher than that intended in practice, and mixing the two powders.

4. The process of manufacturing a resistance compound which consists in fusing magnesia, separating the crystallized portions of the resulting mass after cooling, reducing the same to powder, mixing said powder with finely-powdered carbon and uniting the mixture by means of an appropriate cement.

WILLIAM S. HADAWAY, JR.

Witnesses:

P. T. TUNISON,
H. S. MACKAYE.