

UNITED STATES PATENT OFFICE.

ALBERT L. MARSH, OF DETROIT, MICHIGAN, ASSIGNOR TO HOSKINS MANUFACTURING COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

ELECTRICAL RESISTANCE ELEMENT.

1,057,756.

Specification of Letters Patent.

Patented Apr. 1, 1913.

No Drawing.

Application filed September 30, 1912. Serial No. 723,196.

To all whom it may concern:

Be it known that I, ALBERT L. MARSH, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented a new and useful Improvement in Electrical Resistance Elements, of which the following is a specification.

My invention consists in a novel resistance element adapted for general use for which articles of the class are intended, more especially, suited for use in heating appliances. For this purpose, it is well understood that the principal requirement is durability, and this durability depends upon so many varying conditions that it can only be determined by actual tests under approximately the conditions of use.

In my Patent No. 811,859, wherein is described a resistance element of nickel and chromium in which the desirable percentages mentioned are chromium 10 and 15%, it is also stated that iron-chromium alloys are not satisfactory. In my application, filed on even date herewith and allotted Serial Number 723,194, I have pointed out that I have since discovered that in certain different proportions than said application mentioned, iron and chromium form fairly durable alloys.

I have further discovered that if iron-chromium alloys with the chromium of even smaller percentages than those mentioned in the application referred to have added to them small percentages of either silicon or aluminum, both the life and the resistivity of the elements are greatly augmented. In the present state of my knowledge on the subject, I prefer to add about 5% of either aluminum or silicon to the iron-chromium alloy. Preferably, the iron-chromium base will be made in the percentages set forth as preferable in the application referred to, which is an iron-chromium alloy inherently of great durability, that is, the chromium will be 25% and the iron 75% of the total of those constituents. When 5% of silicon is added to such an alloy, a specific resistance of 112 microhms per centimeter cube is obtained, and when the added element is aluminum of equal quantity, the resistivity is 121 microhms per centimeter cube, and in both cases the element is made extraordinarily durable. I have tested these elements in common with a very large number

of elements of other types and have obtained at 1000° C. the greatest life within my knowledge from the resistance element herein specified. It is to be understood, however, that while I prefer to use as the base the iron-chromium alloy of my application aforesaid, the aluminum and silicon have such an extraordinary effect in prolonging the life of the iron-chromium element at high temperatures that it is not necessary to use the iron-chromium in the percentages within that application, but the chromium may be used with the iron in such percentages as would render the resistance element, with the aluminum or silicon omitted, quite useless for practical purposes.

I am aware that silicon and aluminum do not fall into any common chemical category, but I find that for the particular purpose herein mentioned they are equivalents and, therefore, in the claims I shall speak of materials having the properties herein described of aluminum and silicon for want of any better way of expressing the common properties. The exact quality of these metals which for this purpose renders them equivalent, I am unable definitely to state. A large factor, however, in the durability of any resistance elements at high temperatures is the character of its oxid coating or scale, and though there are many metals of tough adherent scales in themselves, it is difficult, if not impossible, to determine except by test whether the scale of any given alloy will partake of the characteristics of the scales of its constituents. In the present alloy iron has a very heavy, loose, porous scale, and alone is useless as a resistance element. Chromium has almost no scale at all, from which it may be presumed that such as does exist is tough and adherent, although the scale is of beautifully soft-appearing texture. The scales of silicon and aluminum, on the other hand, are of well known chemical character, and quite tough and impermeable. Now, by actual experience, I have learned that for the purpose of increasing the life of an iron-chromium alloy silicon and aluminum are equivalents, as already stated, and this is probably, although not certainly, because of the fact that the scale of the iron-chromium alloy to which either silicon or aluminum has been added is much more tough and im-

penetrable than when these metals are omitted.

What I claim as new and desire to secure by Letters Patent is—

- 5 1. A resistance element composed of an iron-chromium alloy to which has been added a relatively-small quantity of a metal having the properties hereinabove described of aluminum and silicon.
- 10 2. An electrical resistance element formed of an iron-chromium alloy, with the chromium in the proportion of approximately one third of the iron, and an added material having the hereinabove described prop-
15 erties of aluminum and silicon added in

proportion of about 5% of the total of the other ingredients.

3. An electrical resistance element formed of an alloy consisting of iron and chromium with an added quantity of a material hav- 20 ing the hereinabove described properties of silicon and aluminum.

In testimony whereof I have hereunto set my hand and affixed my seal this 18th day of September, A. D. 1912. 25

ALBERT L. MARSH. [L. s.]

In the presence of two subscribing witnesses:

J. G. ANDERSON,
J. LANDESMAN.