UNITED STATES PATENT OFFICE.

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ELECTRICAL HEATING ELEMENT OF ALLOY-STEEL.

1,385,740. Specification of Letters Patent. Patented July 26, 1921.

No Drawing. Application filed December 2, 1919. Serial No. 341,967.

To all whom it may concern:

Be it known that I, PERCY A. E. ARMSTRONG, a subject of the King of Great Britain, and residing at Loudonville, in the county of Albany, State of New York, have invented certain new and useful Improvements in Electrical Heating Elements of Alloy-Steel, of which the following is a specification.

My invention relates to elements for electrical heating purposes, and particularly to hot or cold rolled or wire drawn elements.

Elements in accordance with my invention are made of alloy steel containing iron, chromium, silicon, cobalt and iron, and may contain chromium from about 3% to 30%, cobalt from about .5% to about 5%, silicon from about .5% to about 7%, but the silicon should preferably not exceed the cobalt for elements to be run at high temperatures, say about 2000° F., and carbon should be below about 1.5% for elements made by hot working, and preferably below .50% for cold drawn elements. Cold drawing can be more readily done with still less carbon down to about .05%. The principal portion of the remainder is made up of the iron base. The material may contain more or less of the metalloids, such as phosphorus and sulfur, but the proportions of the same are preferably kept low. Manganese may also be present in the usual proportions encountered in steel making, say up to about .85%. Higher percentages are not desirable and the manganese may be dispensed with, if desired.

I have obtained very good results for elements used at high temperatures, as in heating furnaces running at about 2000° F., which corresponds to a temperature of about 2150°–2200° F. within the material of the electric heating elements used for source of heat, from elements made of alloy steel containing chromium about 20%, silicon about 2%, cobalt about 2%, carbon up to about 1.5%, and the principal portion of the remainder iron. Carbon up to about 1.5% can be used where the heating element is made by hot working, as by being rolled. For drawing into wire, the carbon is preferably lower, and with decreasing percentages of carbon down to about .05%, cold drawing becomes increasingly easier. About 2% of cobalt gives good results with both the hot and cold worked material and about this amount of cobalt is necessary in order to get satisfactory working qualities even with the lower carbon content referred to. I have found that nickel cannot be substituted for cobalt for such high temperature elements. For relatively high temperature electrical heating elements, the chromium may be from 15% to about 30%. With such material the silicon should not materially exceed the cobalt, but with about 2% of cobalt, silicon up to about 2.5% may be used.

When the chromium content is relatively low, the silicon used may be in substantial excess of the amount of cobalt up to about 7% of silicon.

Proportions given herein are by weight.

The alloy of the present invention is substantially rustless, having a high degree of resistance to oxidation and to the action of acids or other corroding agents. It is thus well adapted for such uses as heating of water or other liquids by means of bare elements of the improved alloy submerged in, and coming into direct contact with, the liquid to be heated.

I claim:

1. An electrical heating element made of alloy steel containing chromium about 20%, silicon about 2%, cobalt about 2%, carbon under about 1.5%, and the principal part of the remainder iron.

2. An electrical heating element made of alloy steel containing chromium about 3% to about 30%, silicon about .5% to about 7%, cobalt about 2% to about 5%, carbon under about 1.5%, and the principal part of the remainder iron.

3. An electrical heating element made of alloy steel containing chromium about 15% to about 30%, silicon about .5% to about 2.5%, cobalt about 2%, carbon under about 1.5%, and the principal portion of the remainder iron.

4. An electrical heating element made of alloy steel containing chromium about 3% to about 30%, silicon about .5% to about 7%, cobalt about .5% to about 5%, carbon under about 1.5% and the principal portion of the remainder iron.

5. Electrical heating wire made of alloy steel containing chromium about 20%, silicon

about 2%, cobalt about 2%, carbon under about .50%, and the principal part of the remainder iron.

6. Electrical heating wire made of alloy steel containing chromium about 15–30%, cobalt about 2%, silicon over about .5% and not to exceed the cobalt, carbon under about .50%, and the principal portion of the remainder iron.

In testimony that I claim the foregoing, I hereto set my hand, this 29th day of November, 1919.

PERCY A. E. ARMSTRONG.