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UNITED STATES PATENT OFFICE

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ALLOY

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My invention relates to alloys and has for its object the provision of an alloy which is heat resisting or capable of withstanding high temperatures in air without excessive oxidation.

More specifically my invention relates to electric resistance heating alloys and to alloys which may be cast to form various articles required to withstand high temperatures.

In carrying out my invention I provide an alloy having an iron base and containing from 15 to 35% of chromium and from 5 to 12% of aluminum. Preferably I use 25% of chromium, and 10% of aluminum, the remainder consisting substantially of iron.

For the purpose of improving the physical quality of the alloy, about 1% of a suitable grain refining and purifying element may be added in making the alloy, such as titanium, zirconium, molybdenum, uranium, vanadium or the like, although this is not absolutely necessary. The alloy may and probably will not contain the percentage of grain refining element added to the mixture, since all or a large portion of it may go off with the slag.

This alloy may be forged or drawn into wire and has the other characteristics essential to a satisfactory resistance heating conductor such as durability or the property of withstanding high temperatures without excessive oxidation, sufficient resistivity to generate the required amount of heat when a current is passed through it, and a zero temperature coefficient of resistance throughout its normal heating range. It also may be cast and has sufficient tensile strength to permit its use in making various articles required to withstand high temperatures, such as annealing boxes, furnace structures, etc. Due to the moderate cost of the ingredients, this alloy may be produced at comparatively low cost, whereby it is particularly adapted for castings.

As the aluminum content is increased within the range previously mentioned, the resistivity increases, varying from 900 to 1250 ohms per mil foot, and the durability also increases, while the ductility becomes less. The temperature coefficient of resistance is practically zero throughout the ranges of the various elements given, and the alloy shows very little oxidation when run for long periods at temperatures above 1000° C. The composition of the alloy actually used would therefore be determined by the relative importance of cost of the materials, resistivity, durability, and mechanical quality.

The metal forming the base of the alloy may be ordinary low carbon steel or even commercial iron. A steel containing .02% or less of carbon, .04% or less of sulphur, .03% or less of phosphorus and 0.15% or less of silicon is satisfactory for my purpose.

In making the alloy it is preferable to use an electric furnace, since this furnace lends itself more readily to the controlling of an alloy. The furnace should preferably have a basic lining since if an acid lining were used a certain amount of silicon in the lining would be reduced by the aluminum and enter into the alloy. Even a small percentage of silicon in the alloy is objectionable. When the aluminum is not added in the furnace but is added in the ladle, the basic lining becomes less important.

The iron and chromium are melted in the furnace and then tapped on to the aluminum, which has been preheated to a molten condition in the ladle. Care should be taken to have the iron and chromium mixture thoroughly deoxidized before adding it to the aluminum. It is preferable to have the carbon as low as possible in case the material used runs a little higher than approximately .01% in carbon, the carbon should be reduced in the furnace before making the alloy. This applies also to the elements phosphorus and sulphur. None of the furnace slag should be allowed to come into contact with the alloy after the aluminum has been added. The molten aluminum and also the alloy after the addition of the aluminum should be kept covered with a special slag of cryolite or a cryolite lime mixture to protect the aluminum from oxidation. Cryolite is used because of its solubility for aluminum oxide. Care should be taken to have the metal in the furnace just hot enough to pour cleanly from the ladle but not superheated. The cooler

it is when cast the better the grain obtained.

When casting the alloy every precaution should be taken to prevent oxidation. This may be done by filling the molds beforehand with a non-oxidizing gas such as nitrogen or carbon dioxide, or by dusting the molds lightly but thoroughly with cryolite to dissolve the oxide film formed between the ladle and the mold. This prevents the formation of cold shuts and subsequent cracks due to them. The cryolite method is preferred to the gas method.

While I have described a specific embodiment of my invention in accordance with the provisions of the patent statutes, it should be understood that I do not limit my invention thereto, since various modificaions thereof will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

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

1. A heat resisting alloy containing approximately 25% of chromium, and 10% of aluminum, the remainder consisting of iron and not more than 1% of a grain refining element.

2. A heat resisting alloy having an iron base and containing approximately 25% of chromium and 10% of aluminum, the remainder consisting of an appreciable amount but not more than 1% of a grain refining element.

3. A heat resisting alloy having an iron base and containing approximately 25% of chromium and 10% of aluminum, the remainder consisting of an appreciable amount but not more than 1% of titanium.

4. A resistor containing about 25% chromium, about 10% aluminum and about 65% iron, said alloy having a substantially zero temperature coefficient of resistance throughout its normal operating range.

In witness whereof, I have hereunto set my hand this 6th day of June, 1923.

WILLIAM E. RUDER.