

UNITED STATES PATENT OFFICE

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IRON ALLOY SUITABLE FOR ELECTRICAL RESISTANCES

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1 Claim. (Cl. 201-76)

This invention relates to iron alloys which are especially suitable for the manufacture of electrical resistances.

It is known that various alloys of iron, aluminum and carbon, with or without other metals such as chromium for example, are suitable for electrical resistance elements provided that the carbon content be very low, for instance below 0.05%. It is, however, a matter of expense and practical difficulty to maintain the carbon content sufficiently low to ensure that the resistance will withstand high temperatures for a considerable period of time. It has been found that during annealing of the wire for further drawing, for instance, the carbon content may be raised from 0.05% to 0.1% or 0.15% by carburization, the carbon originating in the lubricant ordinarily used in wire drawing.

According to the present invention, it is found that the addition of columbium (niobium) in an amount of at least six times the carbon percentage, but less than 5% in all, considerably improves the life of iron-chromium-aluminum alloys when used for the purpose of electrical resistance wire exposed to high temperature, notwithstanding that the carbon content after drawing and annealing may lie between the limits of about 0.1% and 1%. The columbium (niobium) may be wholly or partially replaced if desired by the element tantalum, the proportions of the said element being related to the carbon content, and being preferably at least 10 times the carbon, but less than 5%.

The range of constituents contemplated is:

Chromium, 6% to 30% and preferably 6% to 20%
Aluminum, 3% to 12%
Carbon, 0.3% to 1% and preferably to 0.5%

and suitable additions of one or both of the other elements mentioned.

The effects of these elements are approximately additive and when more than one is used, the preferred minimum amounts will be determined according to the following formula:

$$\frac{\% \text{Cb (Nb)}}{6} + \frac{\% \text{Ta}}{10} = \% \text{carbon}$$

It is preferred that the excess of the columbium (niobium) and tantalum above the minima specified should not exceed 2%. Certain impurities may be present and I have found for instance that the presence of up to say 0.75% manganese and up to say 0.30% silicon does not have any detrimental effect.

I declare that what I claim is:

Electrical resistance element composed of an alloy wire containing chromium 6% to 30%; aluminum 3% to 12%; carbon in a percentage sufficient detrimentally to affect the life of the element and between about 0.1% and 1%; and the balance principally iron and an effective amount of at least one element selected from the group consisting of columbium and tantalum, such amount being less than 5% but sufficient to overcome the detrimental effects of the carbon and being at least enough to satisfy the equation:

$$\frac{\% \text{Cb}}{6} + \frac{\% \text{Ta}}{10} = \% \text{carbon}$$

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