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HEAT-RESISTING IMPLEMENT

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4 Claims. (Cl. 75—171)

This application is a division of my copending patent application Serial No. 9,806, filed Mar. 7, 1935.

This invention relates to heat-resisting implements constructed from alloys of metals of the iron group and the sixth group of the periodic system of the elements.

The heat resistance of implements constructed from alloys of metals of the iron group and the sixth group of the periodic system of the elements, e. g., constructed from chrome-nickel alloys is to be ascribed in the first place to the fact that the high chromium content in association with nickel forms a strongly adherent oxide layer which protects the remaining metal from burning. It was formerly supposed that the heat resistance of implements constructed from such alloys could be considerably improved when elements more electropositive than nickel, the oxides of which are stable above 1500° C. were added thereto. It has, however, been shown that these considerations are by no means generally applicable and that although certain of these electropositive elements increase the heat resistance, others on the contrary do not. Thus, for example, the heat resistance of an implement constructed from a chrome-nickel alloy is considerably reduced by addition of titanium or also vanadium; even additions of aluminum bring about improvements of the heat resistance only under particular conditions, whereas in small quantities they have disadvantageous influences. Since titanium and aluminum are nearly related to the rare earths, it was consequently to be expected that the latter analogously with the former elements would behave in a similar manner, that is to say would not give rise to any increase in the heat resistance of implements made of chrome-nickel alloys. Thorough research has now shown that these rare earth metals in contradistinction to titanium and aluminum have the property of increasing to a considerable extent the heat resistance of implements constructed from alloys of metals of the iron group and the sixth group of the periodic system of the elements, e. g., constructed from chrome-nickel alloys. Thus, for example, the life of a 0.4 mm. wire in the form of a small spiral wound on a 3 mm. mandrel heated electrically to 1050° C. for alternate periods of two minutes with interposed breaks of 2 minutes, was about 120 hours. A similar wire made of the same alloy with an addition of 0.2% of a metal of the cerium group or 0.2% of "cerium mixed metal" i. e., cerium mixed or alloyed with other metals of the rare earths had a life period of about 200 to 280 hours. Higher percentages of cerium give a corresponding increase in improvement except that with larger additions the effect is not wholly proportional to the amount introduced, a content of about 0.8–1% of cerium or "cerium mixed metal" giving about the maximum effect a content of 1.2% being the upper limit coming into consideration.

The addition of metals of the rare earths required for obtaining an appreciable increasing of the life period of heat resisting implements such as heating wires or bands for electrically heated furnaces, structural elements of the inner parts of heating and annealing furnaces, e. g. conveying chains, supporting sheet metal, pyrometer protecting tubes &c, need be very small, inasmuch as additions of 0.02 percent of rare earth metals to the molten base metal or a content of 0.01% in the final alloy already suffice to give a noticeable effect. The base metal for the heat resisting implements to which the rare earth metals are added may contain besides metals of the sixth group of the periodic system of the elements metals of the iron group as the main constituent, namely 50 to 98% of nickel, and up to 48% of iron or iron plus cobalt, the amount of cobalt not exceeding 20% of the final alloy. The percentage of the metals of the sixth group of the periodic system of the elements namely chromium, molybdenum, tungsten and uranium may amount to 1 to 48%, the chromium contents being 1 to 30%; the amount of each of the metals molybdenum, tungsten and uranium should not exceed 20%. When several of the elements cobalt molybdenum, tungsten and uranium are contained at the same time in the alloy, their sum should not exceed 20%. The alloys may further contain small additions for deoxidation or for improving the malleability such as manganese, magnesium or silicon each up to an amount of 2%, the sum of these additions not exceeding 2%.

I claim:—

1. A high temperature oxidation resistant alloy containing .01 to 1.2% Ce, 1 to 30% Cr, the balance consisting of iron group metals.

2. A high temperature oxidation resistant alloy containing .01 to 1.2% Ce, 1 to 30% Cr, the balance consisting of at least one of the metals of the iron group.

3. A high temperature oxidation resistant alloy containing .01 to 1.2% Ce, 1 to 30% Cr, up to 2% of a deoxidizer from the group consisting of manganese silicon and aluminum and the balance consisting of at least one of the metals of the iron group.

4. A high temperature oxidation resistant alloy containing .01 to 1.2% Ce, 1 to 30% Cr, a small but effective amount up to 20% Co, the balance consisting of nickel.

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