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METHOD OF MAKING NICKEL-CHROMIUM ALLOYS

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1 Claim. (Cl. 75—171)

The present invention relates to a process of making alloys of nickel and chromium in which the nickel content is in excess of the chromium content. Such nickel-chromium alloys usually contain at least 60% nickel and 10% or more chromium, and are employed extensively in articles intended to resist corrosion and oxidation. They are especially valuable as heating elements in electrical appliances because of their high electrical resistivity and excellent resistance to oxidation and deterioration at high temperatures.

The present practice in manufacturing nickel-chromium alloys is to add pieces of chromium metal to a bath of molten nickel and to superheat the bath to a degree necessary for complete solution and alloying of the chromium. The alloying action under these conditions is slow because of the wide difference in melting points of the nickel and chromium. Considerable time or considerable super-heating is required for satisfactory alloying, as a result of which the melt may become contaminated by the inclusion of gases, carbon from electrodes, and oxidation products of the chromium. It is the usual procedure to deoxidize and to degasify the melt in order to refine it to the necessary degree of purity.

In its general aspect, the present invention resides in a novel process of making alloys of nickel and chromium in which a high-chromium prealloy of chromium and nickel is added to a bath of molten nickel. The prealloy has a melting point of about 1650° C., which is substantially lower than that of chromium metal. It dissolves in nickel much more readily than does chromium metal, and alloying is accomplished in much less time and at lower temperatures with consequent production of alloys of superior quality. This method of producing nickel-chromium alloys is less expensive than the present practice because less time and heating are required and because less extensive deoxidizing and degasifying operations are needed.

The chromium content of the prealloy may vary between about 60% and about 97% and the nickel content may accordingly vary between 40% and 3%. Part of the nickel may be replaced by iron and/or manganese. Carbon may be present in the prealloy up to about 0.5%, silicon up to about 3%, and aluminum, calcium, and/or zirconium up to 5% and preferably up to about 1%. The compositions of typical prealloys according to the present invention are given in the following table by way of example:

	1	2	3	4	5	6	7
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Ni	24.06	12.83	11.13	14.62	14.22	14.40	12.97
Cr	74.02	84.48	84.79	84.30	82.30	82.70	83.67
Fe	0.89	0.61	0.84	0.61	0.69	0.64	0.64
Si	0.07	1.21	1.48	0.21	2.40	1.69	2.27
C	0.14	0.16	0.13	0.06	0.073	0.08	0.08
Mn	None	0.08	1.45	None	0.04	0.04	0.04

It has been found that a chromium-nickel alloy containing from 10% to 20% nickel is somewhat more brittle and hence more readily crushed than alloys of higher nickel content. Ready crushability is advantageous in facilitating the production of small pieces suitable for addition to the furnace.

The prealloy may be made by aluminum or silicon reduction of chromium and nickel oxides, with chromium or nickel possibly also present in the smelting batch in metal or alloy form. Because of its lower melting point as compared with chromium, the prealloy may be tapped readily from the smelting furnace which is a distinct advantage over the use of chromium because of the difficulty of attaining sufficient temperature and fluidity when using metallic chromium. Treatment of the prealloy with deoxidizers or addition agents is easily accomplished because of its high fluidity at smelting temperatures and in this manner a first-stage alloy high in aluminum or silicon can be refined in the fluid state to the final aluminum or silicon content desired with comparative freedom from slag and oxide inclusions.

I claim:

Method of making nickel-chromium alloys containing at least 60% nickel and over 10% chromium without prolonged superheating of the principal part of the nickel, which comprises reducing oxides of nickel and chromium in proportions to yield an alloy containing between 10% and 24% nickel and the remainder chromium, and tapping such alloy and adding it to a bath of nickel held at a temperature between about 1650° C. and the melting point of the nickel.

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