United States Patent [19]
Stawicky et al.
[11] 3,891,426
[45] June 24, 1975

[54] METHOD OF MAKING COPPER-NICKEL ALLOYS

[75] Inventors: Wolfgang Stawicky; Horst Ossig, both of Altena, Germany
[73] Assignee: Vereinigte Deutsche Metallwerke AG, Frankfurt am Main, Germany

[22] Filed: Aug. 12, 1974
[21] Appl. No.: 496,905

[30] **Foreign Application Priority Data**
Aug. 11, 1973 Germany 2340766

[52] U.S. Cl. .... 75/10 R; 75/49; 75/82; 75/129
[51] Int. Cl. C22d 7/06; C21c 7/10; C22c 1/00
[58] Field of Search 75/10, 49, 129, 82, 159, 75/130.5

[56] **References Cited**
UNITED STATES PATENTS

2,546,340	3/1951	Hilty	75/130.5
2,622,978	12/1952	Audette	75/129
2,968,548	1/1961	Clark	75/129
3,635,701	1/1972	Davies	75/129
3,682,623	8/1972	Diercky	75/82

Primary Examiner—P. D. Rosenburg
Attorney, Agent, or Firm—Karl F. Ross; Herbert Dubno

[57] **ABSTRACT**

A method of making copper-nickel alloys wherein nickel oxide is a starting material and in which the nickel oxide is smelted with graphite in an electrical-arc furnace to yield the melt containing about 0.5% by weight carbon. The melt is then superheated to a temperature of about 1700°C and preheated copper is then introduced. The material may be statically or pressure cast, preferably after a vacuum degazing step.

5 Claims, No Drawings

METHOD OF MAKING COPPER-NICKEL ALLOYS

FIELD OF THE INVENTION

The invention relates to the fabrication of nickel-copper (cupronickel) alloys and articles, ingots or bodies composed of such alloys.

BACKGROUND OF THE INVENTION

Copper-nickel alloys are commonly produced in electric furnaces in which the copper is smelted under oxidizing conditions and the nickel is then added. The copper and nickel may be added together or in the form of scrap (shot) or can be added in combination with scrap (shot) or other materials containing both copper and nickel. The oxidizing smelting is necessary to eliminate the gases, especially hydrogen, which result upon smelting to keep the level of included or occluded gases at a low level.

Consequently, it is important to treat the melt with deoxidation substances, e.g. phosphor-copper, manganese, magnesium or like deoxidizing agents and to adjust the carbon content before the melt is cast under pressure or in a static casting step.

The disadvantage of the earlier system described above is principally that expensive starting materials must be used. For example, high purity nickel is required for direct use as well as for the formation of nickel or copper-nickel shot or scraps.

OBJECT OF THE INVENTION

It is the principal object of the present invention to provide a process for the production of copper-nickel alloys at lower cost than could be achieved heretofore.

SUMMARY OF THE INVENTION

This object is achieved, according to the invention, by the use of nickel oxide as the starting material. Nickel oxide is a precursor in the production of pure nickel and is an intermediate in many metallurgical processes in the production of pure nickel and, indeed, there have been proposals for using nickel oxide as a source of nickel in the production of alloy (e.g. stainless) steels. However, in these systems the reducing agent was the unprocessed steel melt of iron or chromium which had a higher affinity for oxygen than nickel. Up until now it could not be conceived that a similar approach might be applicable to the formation of copper-nickel alloys since copper has an oxygen affinity greater than that of nickel only at temperatures above 1600° C. Thus, copper could not have been conceived as capable of playing the role of a reducing agent via-a-vis nickel oxide. This is especially the case since oxidation of copper is in any event undesirable and uneconomical.

The simple introduction of nickel oxide into copper-nickel alloy melts also poses substantial problems since nickel oxide has a melting point of about 2000° C, well above the usual melt temperatures so that it would be expected that only a small quantity of nickel oxide would be integrated into the melt upon the addition thereof to a normal bath. This obviously means that it is difficult to control the composition of the alloy formed by addition of nickel oxide to a copper-nickel melt.

Investigations have also shown that the mere melting of nickel oxide and the incorporation of copper therein

is also not capable of bringing about a satisfactory copper-nickel melt. In practice it is observed that the oxygen level in such a system is excessive and prevents passage of copper into the melt except after long treatment periods. In this case, the treatment times become so long that saving in cost, because of use of nickel oxide, are offset by higher production costs because of the longer treatment times which are necessary. In such systems, moreover, there is always the danger of boil-over of the melt.

We have now discovered, most surprisingly, that the cost advantage of using nickel oxide for the production of copper nickel alloys can be fully gained and the aforementioned disadvantages completely obviated when nickel oxide is smelted with addition of graphite in an electric-arc furnace to a melt having a carbon content of about 0.5% by weight, the melt is then superheated to a temperature of 1700°C and preheated copper is introduced into the melt.

Because of the superheating of the carbon-enriched nickel melt and the preheating of the copper, the copper is melted extremely rapidly to release carbon which interacts with the oxygen of the nickel oxide in a violent carbon monoxide evolving boiling reaction which effects the discharge of gases, including detrimental hydrogen, and a significant mixing of the melt.

Since the copper rapidly goes into the liquid state, copper metal is not exposed to the burning spot of an electrode for any significant period and hence no significant amount of copper is vaporized. The metal losses by evaporation of copper is thus held to a minimum.

The melt is then die-cast (pressure-cast) or cast into static molds under ambient pressure. Before casting it is preferred to apply a vacuum treatment.

The advantage of the system, according to the present invention, is that it allows the cost of the starting material to be significantly reduced without increasing the other costs of the process. The copper-nickel alloys have no qualitative difference from the copper-nickel alloys produced from the pure metal or other conventional techniques.

SPECIFIC EXAMPLE

A copper-nickel alloy containing 75% by weight copper and 25% by weight nickel is prepared by melting nickel oxide (NiO) in an electric-arc furnace with addition of graphite to form a melt of about 750 kg, the graphite addition being regulated to ensure, when gaseous evolution ceased, that the product contain about 0.5% by weight carbon.

1800 kg of refinery-grade copper was then introduced into the melt gradually after being heated to a temperature of about 900° C. The melt was violently agitated during the period of copper addition. When the melt had reached the quiescent state, it was subjected to vacuum degasification at 10^{-2} torr for a period of 10 minutes until further gas evolution ceased. A portion of the resulting products were cast into upwardly open molds by gravity under ambient pressure while the other half of the melt was die cast under pressure. In both cases the product was found to have properties identical to those of 75% copper - 25% nickel alloys produced by conventional processes.

We claim:

1. A process for the production of a copper-nickel alloy comprising the steps of:

smelting nickel oxide with addition of graphite in an electric-arc furnace and adjusting the addition of graphite until the resulting melt has a carbon content of about 0.5% by weight;

superheating the melt to a temperature of about 1700°C; and

introducing preheated copper into the superheated melt.

2. The process defined in claim **1**, further comprising the step of casting the melt after the introduction of copper into same.

3. The process defined in claim **2** wherein the melt is cast under ambient pressure.

4. The process defined in claim **2** wherein said melt is pressure-cast.

5. The process defined in claim **2**, further comprising the step of vacuum-treating said melt prior to the casting thereof.

* * * * *