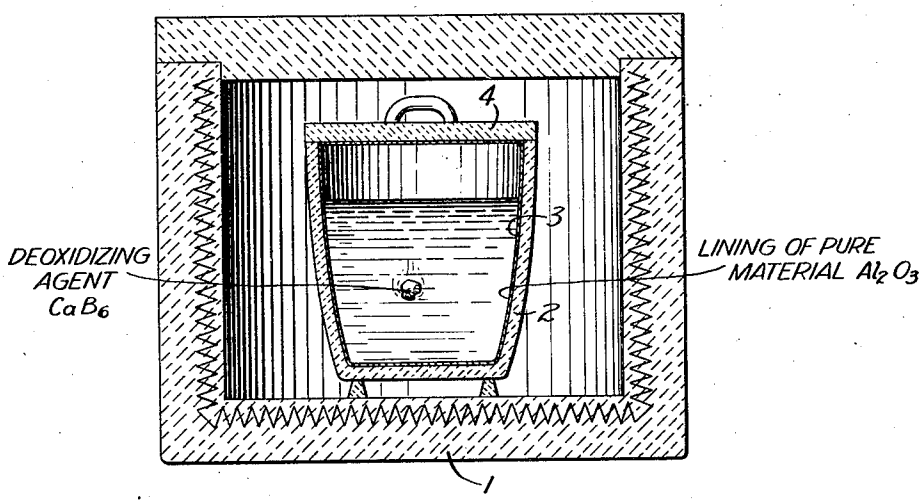
April 5, 1932. J. E. HARRIS ET AL 1,852,162

REFINING OF COPPER

Filed March 8, 1929



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UNITED STATES PATENT OFFICE

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REFINING OF COPPER

Application filed March 8, 1929. Serial No. 345,258.

The present invention relates to improvements in the refining of copper; it is of particular usefulness and finds ready application in the production of copper signaling conductors, particularly such conductors which are to be continuously loaded with magnetic material.

An object of the invention is to produce metallic copper which may be subsequently heated in a reducing atmosphere without becoming embrittled, and which at the same time possesses high electrical conductivity.

A feature of the invention relates to an improved method of producing copper and to copper with properties improved for the purpose of its utilization in manufacturing conductors loaded with magnetic material.

While it is known in the art to produce copper free from oxygen, this copper has a low electrical conductivity. The present improvements apply the discovery that if, first, copper having high electrical conductivity is melted in a receptacle lined with any material which in pure form may be applied as a lining to a crucible and which will not be readily reduced, at the temperature of molten copper, by the agent used for deoxidizing the molten copper, and if, second, a suitable deoxidizing agent is added to the molten bath immediately preceding its casting, there will result a copper which possesses the combined advantages of freedom from oxygen and high conductivity. It has been found that aluminum oxide is a material particularly suitable for lining the crucible or for the construction of the crucible in which the copper is to be melted since it can be made to readily adhere to the inside of a crucible, and the use of such oxide or its equivalent is consequently an important feature. Adherence to the crucible under conditions of operation is an important feature of the lining.

One method of practicing this invention will be described in connection with the accompanying drawing, in which is shown a furnace 1 of the electric resistance type by means of which the temperature inside the furnace may be easily controlled. The furnace encloses the crucible 2. The crucible 2 may be made of any suitable material; a mixture of fire-clay and graphite has been found to be particularly suitable. The inside of crucible 2 is lined as shown at 3 with a layer of aluminum oxide (Al_2O_3). Cover 4 is provided with the same lining. A simple procedure for applying the lining to the crucible is by washing the inside with a mixture of about 50% Al_2O_3 in water. The drying of the aluminum oxide may be accelerated by heating the crucible to a moderate temperature. If any fissures should develop in the lining, a second coat may be applied. After drying, pieces of commercially pure electrolytic cathode copper of dimensions about 2″ x 2″ x ¼″ are placed into the crucible and the crucible and contents inserted into the furnace. The electric current is turned on, and after the copper is molten and just before pouring, the deoxidizing agent is added; preferably calcium boride is to be used in an amount of about 0.1%. The calcium boride is well mixed with the copper bath by stirring and the heat is then immediately teemed into molds or ingots and after solidification is ready for rolling or forging. This procedure furnishes a copper which may be subsequently heated in a reducing atmosphere without becoming embrittled and which at the same time possesses a conductivity of around 101% (Matthissen standard) measured after annealing in hydrogen at 850° C. for about 30 minutes.

Copper possessing these properties is of particular usefulness in the manufacture of continuously loaded signaling conductors which require an annealing after the loading material has been applied thereto. During the annealing there are usually present in the space surrounding the conductor a certain amount of reducing gases which, if the copper contains oxygen, combine with the oxygen and thereby embrittle the copper. The attendant high conductivity of the product of this invention enhances its usefulness for this particular purpose.

While one method of practicing this invention has been described with particular reference to aluminum oxide as lining material and calcium boride as deoxidizing

agent, it is understood that the materials mentioned and the proportions and details of their use are only given by way of example and that other materials may be used without departing from the scope of the invention. For instance, magnesium oxide if used as a lining material was found to produce a copper of a conductivity of 96–98%.

Another method of practicing the invention is to dip or pour molten copper in a ladle lined with aluminum oxide and add calcium boride or place particles thereof in the ladle.

There is a reason to believe that the lining functions to prevent the copper from taking up from the crucible impurities, such, for example, as iron, which would tend to lower its conductivity.

What is claimed is:

1. Method of producing metallic copper having high electrical conductivity, which method comprises adding calcium boride to the copper when molten to deoxidize the copper and to render it immune to the action of hot reducing agents during subsequent annealing treatments, said addition taking place when the molten copper is contained in a vessel which presents to the copper only surfaces of pure aluminum oxide.

2. Method in accordance with claim 1 characterized in this, that the calcium boride is added to the molten copper bath immediately prior to the casting operation.

In witness whereof, I hereunto subscribe my name this 7th day of March, 1929.

JAMES E. HARRIS.

In witness whereof, I hereunto subscribe my name this 7th day of March, 1929.

JOHN H. WHITE.