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PROCESS FOR TREATING COPPER

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This invention relates to treatment of copper in molten state and has for its object a process for treating copper to improve its character and for removing the oxygen content from copper in molten state by introducing hydrogen thereinto before casting, copper being thus obtained which is in an improved state and is particularly adapted for undergoing welding operations.

To carry out the process of this invention, copper is smelted in usual manner, the top surface of the bath being protected against action of air by conventional means; at the time the bath is in condition for casting, hydrogen is introduced therein and said bath is subsequently cast.

The operation may be carried out by means of a nozzle of refractory material or of metal able to withstand the bath temperature, said nozzle being connected with a source of hydrogen; the said hydrogen injection nozzle is moved to and fro with its outlet submerged in the bath to stir the molten metal while hydrogen is introduced thereinto from said nozzle.

The described operation may be continued for a few minutes; the casting or pouring operation is effected immediately said stirring and hydrogen-introducing operation is completed. The metal is poured into moulds provided with cooling jackets to secure a very rapid cooling, the hydrogen in excess in the metal being thus evolved and sound ingots entirely free from blisters and blow holes or cavities are obtained.

Copper cast in the above described conditions is found to be entirely oxygen free and the amount of hydrogen existing therein in the state of hydride or of a copper compound, or of a solid solution, imparts to copper a character making it particularly proper for welding; further, owing to the fact that it does not contain foreign substances as those ordinarily used for deoxidizing operation, the copper treated in accordance with this invention has very high electrical conductivity and physical characters, particularly in respect of torsion or twisting and bending tests.

The described hydrogen-treatment of copper may be carried out with advantage also after introduction of slag-forming substances or after refining operations.

It has been found that the amount of hydrogen introduced in the copper bath must be within certain ranges because when the amount of hydrogen is lacking or is in excess with respect to a proper amount for the purpose aimed at, troubles are incurred which may be due to an incomplete removal of oxygen or to noticeable flaws, blow holes or cavities in the cast copper.

Thus said amount of hydrogen may be such as no hydrogen is contained in copper after the removal of oxygen is completed or else the amount of hydrogen introduced in copper may be in excess over that necessary to remove oxygen, a residual content of hydrogen being thus left in copper; in this last case the copper must be vigorously cooled in a very rapid manner immediately after casting to prevent hydrogen from being evolved after casting as it would happen should said copper be permitted to cool slowly.

More particularly it has been found that best results are obtained when an amount of hydrogen ranging from two to ten cubic centimetres of hydrogen for each 100 grammes of copper exists in the cast and cooled metal.

For determining the quantity of hydrogen which must be introduced in copper of a particular type, preliminary treatments are effected on portions of the metal available by employing for each of these portions a different quantity of hydrogen and subsequently determining by means of tests the characteristics of the differently treated copper samples and deciding which of these samples gives the best results for the applications to which the metal is destined.

The precise amount of hydrogen which must be introduced in the bath when treating on a large scale is then deduced and naturally the process will be carried out by effecting the fusion under the same conditions and at the same temperatures as in the preliminary testing operations.

In proceeding in this manner, the exact quantity of hydrogen which must be introduced in the bath of copper to be treated for obtaining a desired result can be determined and consequently the quantity of hydrogen introduced will always be that which is required by the copper to be treated—that is to say, by the nature and the amount of the impurities contained in the said copper.

The injection of hydrogen into the copper bath is conveniently made by means of a constant pressure calibrated meter, which enables the operator to ascertain the amount of hydrogen actually introduced in the metal bath in the operation.

By operating in the abovedescribed manner the amount of hydrogen introduced to be operative in the metal is correctly adjusted with respect to the composition of the metal and to the temperature of casting.

As above suggested it is essential that the metal is vary rapidly cooled after an operation carried out in the described manner; this re-

quirement depends upon the fact that the rate of solubility of hydrogen in copper varies to a large extent with temperature and thus it is essential that a very rapid cooling of the metal is effected to avoid that hydrogen in solution in the molten metal (either in the state of a hydride or of solid solution) evolves during cooling as it would happen should cooling be slow, and forms bubbles which would remain included in the solidified metal and cause troubles and cavities.

The metal cast in jacketed moulds is rapidly cooled by means of a vigorous circulation of water in the mould jackets; of course, any other cooling means may be availed of, as expansion of gases or the like.

What I claim as my invention and desire to secure by United States Letters Patent is:

1. A process for removing oxygen from copper containing it and treating copper, in which an amount of hydrogen is introduced in the bath of molten copper before casting it, said amount being in excess over that necessary to combine with and remove the oxygen content of and from said copper bath, said copper bath is cast and the cast copper is vigorously and rapidly cooled to cause said excess hydrogen to remain absorbed in cast copper.

2. A process for treating copper, in which hydrogen is introduced and distributed in the mass and immediately after this introduction the copper is cast into cooled molds to cause an amount of hydrogen to remain in the cast copper.

3. A process for removing oxygen from copper containing it and treating copper, comprising introducing an amount of hydrogen in the bath of molten copper before casting it, said amount being in excess of that necessary to combine with and remove the oxygen content of said copper bath, casting the treated copper, and vigorously and rapidly cooling the cast copper to cause an amount of hydrogen to remain in the cast copper.

4. A process for removing oxygen from copper containing it and treating copper, comprising introducing an amount of hydrogen in the bath of molten copper before casting it, said amount being in excess of that necessary to combine with and remove the oxygen content of said copper bath, casting the treated copper, and vigorously and rapidly cooling the cast copper to cause an amount of hydrogen between 2 and 10 cubic centimeters per 100 grams of copper to remain in the cast copper.

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