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METHOD OF CASTING PHOSPHORIZED COPPER

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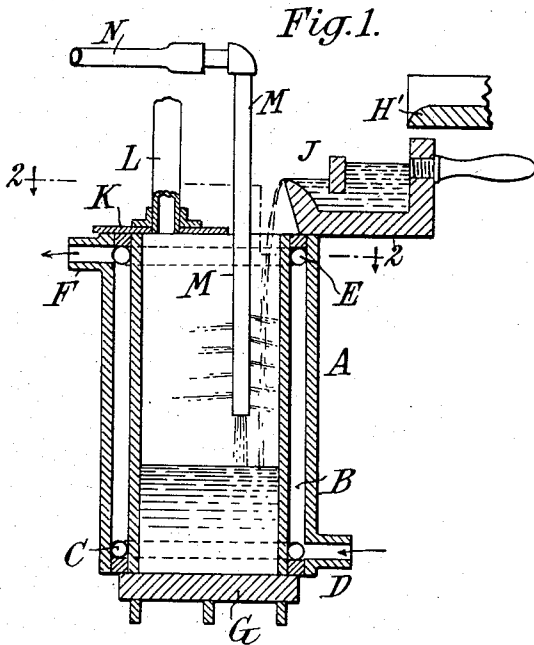
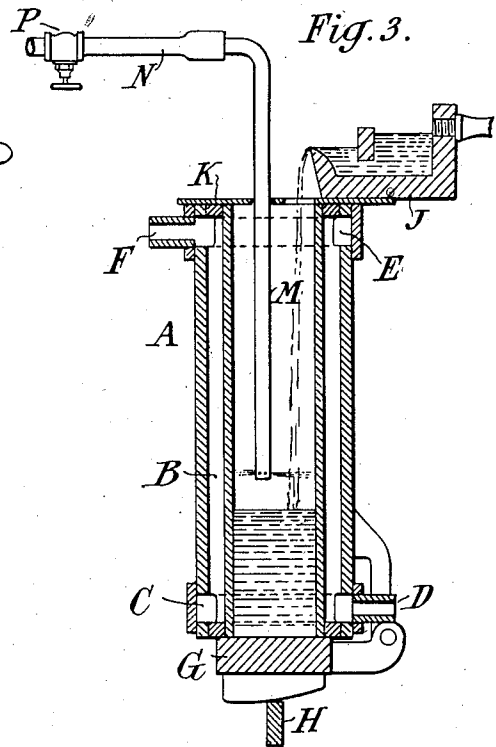


Fig. 2.

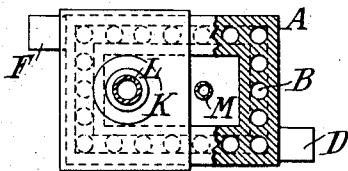


Fig. 4.

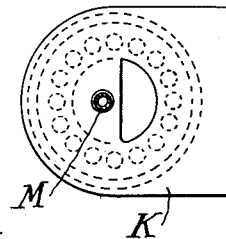
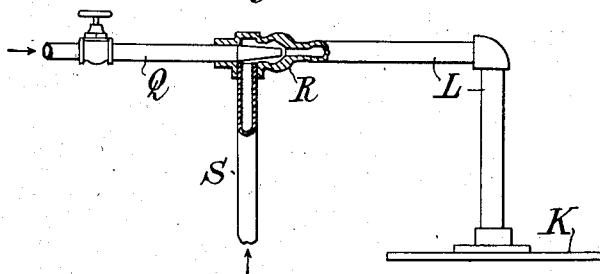


Fig. 5.



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UNITED STATES PATENT OFFICE

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METHOD OF CASTING PHOSPHORIZED
COPPER

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Application February 1, 1934, Serial No. 709,303

12 Claims. (Cl. 22-200)

This invention relates to the casting of phosphorized copper, and may be used for the casting of other deoxidized copper alloys. Phosphorized copper is a deoxidized copper containing a residual amount of phosphorus as a deoxidizing component and analyzes approximately .02 per cent. phosphorus.

The casting of phosphorized copper involves considerable difficulty. It must be cast under very different conditions from those required in the casting of electrolytic copper or tough pitch fire refined copper. For these the molds must be heated preferably in the neighborhood of 100° C. and the mold surfaces or casting cavity dressed with a wash of bone ash. For phosphorized copper, on the contrary, the mold must be kept cold and the mold dressing is an oil mixture.

In the production of phosphorized copper the addition of phosphorus in the form of a rich phosphorized copper alloy to the molten copper bath imparts certain characteristics to the bath which make it difficult to obtain a satisfactory casting unless special precautions are taken.

Phosphor copper when coming into contact with air appears to form a certain amount of a compound very rich in phosphorus, assaying as high as 33% P, which compound when it comes in contact with the cold mold surface almost immediately sets and causes a hole or depression in the finished casting, making it unsuitable for ordinary commercial uses. In order to avoid this result, a stream of oxygen-excluding gas, such as a gas containing carbon monoxide produced in a charcoal or other fuel gas producer, is directed into the mold during the casting period.

This procedure, however, does not in itself produce a satisfactory casting although somewhat better than when air is not excluded, as it appears that the mold dressing is not completely decomposed by the heat of the molten copper, and there remains on the mold walls a solid decomposition product of the oil which also prevents the production of a satisfactory surface on the finished casting.

I have discovered that by adding water to the mold the difficulties heretofore encountered are avoided, resulting in the production of copper cakes, billets or other castings, having a satisfactory surface condition, with no perceptible increase in the internal porosity of the casting.

Water may be variously added to provide a water film coating on the walls of the casting cavity by first introducing a pool of water into the mold which may be drained therefrom prior to

pouring the molten metal, or by spraying water into the mold during the pouring, or by introducing a stream of water together with the pouring, or by introducing atomized water, or a spray or fog or other moist condition carried into the mold with the producer gas. The use of water is advantageous either with or without the use of such gas in casting.

The preferable mode of practicing the invention is as follows: The casting may be accomplished in any known or suitable mold, preferably in an upright mold of copper cooled by circulation of water through a surrounding water jacket. After the mold dressing is applied, water is sprayed into the mold over the sides of the cavity and at the bottom thereof; then, during the pouring, as soon as the metal within the mold has formed a substantial pool (to a depth of two or three inches, for example) water is added to the mold in a small stream or spray in sufficient quantity so that a fairly large pool of water is kept on the surface of the molten metal, preferably both in front of and behind the stream of metal entering the mold. When sufficient water has been thus added the water stream may be shut down, or may be diminished so that the additional water introduced is only sufficient to just compensate for the loss in evaporation.

The use of water in this manner appears to serve two purposes; the water sprayed on the sides of the mold cavity is transformed into steam when the hot metal makes contact with it, and the bubbles of steam thus formed appear to prevent the high phosphor compound or slag from coming into contact with the sides of the cold mold and congealing thereon. The force of the steam thus generated appears to be sufficient to throw this compound, together with any carbon formed from the decomposition of the oil dressing, towards the center of the mold, where it is caught in the larger pool of water and kept floating or suspended therein until the mold is filled with the copper, and in this manner it is prevented from coming into contact with the sides of the mold and congealing thereon in the manner which heretofore gave trouble in creating a cavity in the surface of the casting.

Satisfactory results have been obtained with both vertical cake molds and vertical round billet molds. It is preferable but not essential to introduce producer gas into the mold prior to and during the pouring. This use of gas is advantageous, but is not necessary in the casting of billets; but in the casting of cakes it has greater advantage, and in some cases appears to be a

necessary procedure to the attainment of successful castings.

It is impossible to state with exactness the quantity of water to be added during the casting. In casting billets, the interior of the mold after dressing should be sprayed with water until its surface is totally covered with fine drops. For such casting this alone has proved a sufficient addition of water, although it is desirable also to introduce a fine stream into the mold during the pouring period. The water may be introduced in the form of steam, although this has not proved as satisfactory as a spray of water.

In the casting of copper cakes, experience has indicated that it is important to spray the mold with water before any metal is added and thereafter to continue introducing water in a stream or spray in sufficient quantity to maintain always a small pool on the molten copper, which should be both in front of and behind the metal stream. The pool of water which is maintained on the surface of the molten metal need only be of sufficient depth to float and prevent the slag or dross containing the phosphorus from coming in contact with the molten metal or the sides of the cold metal.

While it is practicable to introduce the water in the form of steam or water vapor or atomized water into the stream of producer gas which is introduced into the mold, this method does not have any advantage over the introduction of water directly through a small pipe, and the latter is believed to afford greater facility for the control of the introduction of water.

No special apparatus is required, but as an illustration of suitable means reference may be made to the accompanying drawing, wherein—

Figs. 1 and 2 show respectively in vertical section and in partial horizontal section a vertical mold for casting rectangular copper cakes; and

Figs. 3 and 4 are similar views showing a vertical billet or ingot mold for casting cylindrical billets or analogous shapes.

Fig. 5 is a sectional elevation of pipes for introducing water and gas together into the furnace.

In the drawing, A designates the mold, which is water-jacketed, this being provided by forming a closely related series of vertical ducts or bores B communicating at bottom with a passage C extending around within the mold wall and receiving cooling water from an inlet D; and united at the top in a passage E extending around within the upper wall of the mold, whence the water issues through an outlet F. The bottom of the mold cavity is closed by a door G, which may be hinged as shown in Fig. 3 and held up by a bail H or other support wedged beneath it, by removing which the door may be dropped open and the casting dumped out. Such molds are known and regularly used for making copper castings.

The phosphorized copper is taken from the furnace or other container by a spout H', whence it pours into a ladle J of usual construction, which may rest on the top of the mold as shown, and from which the metal pours over into the mold cavity as indicated in Figs. 1 and 3. When the metal is to be cast without access of air, the spout and ladle may be hooded over in the well known manner to form a chamber into which suitable oxygen-excluding gas is introduced.

All these features form the customary casting means and require no alteration in the practice of the present invention.

For casting under gas protection, it is common

to cover over the top of the mold with a plate K through an opening in which gas is introduced through a pipe L, as shown in Figs. 1 and 2.

For the introduction of water in the form of jets or spray or steam, any suitable pipe may be employed, an example of which is shown at M. This may be an iron pipe coupled at its top to a hose N. This pipe may be introduced through the free pouring space to the right of plate K, as shown in Figs. 1 and 2; or it may be introduced through the plate K, as shown in Fig. 3, in case no separate gas pipe L is used. The pipe M is freely movable up and down and may be grasped by tongs or otherwise manipulated by the operator, who will initially lower it and turn on sufficient water, and then during the casting will lift it gradually as the casting proceeds, or when enough water has been introduced in his judgment, he may take it out and finish the pouring without it. Any suitable valve P is provided within convenient reach of the operator by which he can control the flow of water.

If the water is to be introduced with the gas it is desirable to spray or atomize the water into the stream of gas, which may be accomplished as shown in Fig. 5 where the water is introduced under pressure through a pipe Q under control of a valve, into an atomizing, commingling nozzle R, to which gas is conducted through a pipe S, and the flow of commingled gas and spray or mixture is conducted thence through the pipe L to the mold.

As one example, it may be stated that experience has shown that suitable results are secured when a quantity of water varying from 0.1 to 2.4 litres (3 fl. oz. to 2.6 qts.) is used with a mold wherein the pouring occupies a very short period; say around 15 seconds, and more with larger molds where the pouring takes longer, as for example, with a 600 lb. casting, which may take over 2 minutes; but success may be attained when less or even more water is used.

It will be obvious to those skilled in the copper casting art that the mode of introducing the water or mixture into the mold may be greatly varied without departing from the present invention.

While the described process has proven highly efficacious and valuable with phosphorized copper, it appears to be also available for improving the casting of other copper alloys having similar properties of behavior during casting. While the theory of the operation of the method is not known with certainty, the efficacy of the addition of water is believed to be due partly to the mechanical action of the generated steam, as above stated, and also partly to its dissolving the phosphoric oxide produced from the phosphorus component of the phosphorized copper, which forms a black slaggy material and is so far eliminated by the solvent action of the water as to avoid its occlusion in the casting. The invention is accordingly applicable to other copper alloys, wherein a water soluble oxide or compound is produced during the casting operation. It may perhaps also be available in the case of those alloys wherein the compound formed during casting is not water soluble, as in the case of copper containing silicon; but its applicability to the casting of such other alloys has not yet been determined.

What I claim is:

1. The process of casting deoxidized copper containing a small amount of deoxidizer, comprising coating the walls of the casting cavity

with a film of water preliminary to pouring the molten metal into the mold.

2. The process of casting deoxidized copper containing a small amount of deoxidizer, comprising introducing water into a cooled mold so as to provide a water film coating on the walls of the casting cavity preliminary to the pouring of the molten metal and introducing water into the mold together with the molten metal.

3. The process of casting deoxidized copper alloys containing a small amount of deoxidizer, comprising introducing water into the mold so as to provide a water film coating on the walls of the casting cavity preliminary to the pouring of the molten metal and providing a pool of water in the mold above the molten metal of merely sufficient depth to float the dross, by introducing water into the mold together with the molten metal after a pool of metal has formed in the mold.

4. The process of casting deoxidized copper according to claim 2 wherein the water is introduced into the mold in subdivided form.

5. The process of casting deoxidized copper according to claim 2 wherein the water is introduced into the mold in the form of steam.

6. The process of casting deoxidized copper according to claim 2 wherein the water is introduced into the mold together with an oxygen-excluding gas.

7. The process of casting deoxidized copper according to claim 2 wherein the water is introduced into the mold together with gas containing carbon monoxide.

8. The process of casting deoxidized copper alloys containing a small amount of deoxidizer, comprising dressing the walls of the casting cavity with an oil mixture, providing a water film coating upon said dressed walls preliminary to the pouring of the molten metal, and introducing

water into the mold during the pouring of the molten metal.

9. The process of casting deoxidized copper alloys consisting in dressing the walls of the casting cavity with an oil mixture, providing a water film coating upon said dressed walls preliminary to the pouring of the molten metal, and introducing water into the mold during the pouring of the molten metal to provide a pool of water in the mold above the pool of molten metal.

10. The process of casting phosphorized copper comprising coating the walls of the casting cavity with a film of water preliminary to pouring the molten metal, and introducing water during the pouring of the molten metal to provide a pool of water in the mold above the pool of molten metal of merely sufficient depth to float the dross, and adding said water in amounts to compensate for evaporation of water from the mold to maintain the pool of water above the molten metal in the mold.

11. The process of casting deoxidized copper, comprising pouring molten metal into a mold, and after a pool of metal has been formed therein, introducing water into the mold during the pouring of the molten metal in merely sufficient quantity to provide and maintain a pool of water above the surface of the molten metal to float the dross and to compensate for evaporation of water from the pool, said pool of water having no practical cooling effect upon the molten metal.

12. The process of casting deoxidized copper, comprising pouring molten metal into a mold, and after a pool of metal has been formed therein, introducing water in subdivided form into the mold during the pouring of the molten metal in merely sufficient quantity to provide and maintain a pool of water above the surface of the molten metal.

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CERTIFICATE OF CORRECTION.

Patent No. 2,023,957.

December 10, 1935.

RUSSELL HEWGILL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 26, for "metal" read mold; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of January, A. D. 1936.

Leslie Frazer

Acting Commissioner of Patents.

(Seal)