

UNITED STATES PATENT OFFICE

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METHOD FOR CASTING COPPER OR EQUIVALENT METALS

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This invention relates to the casting of copper or other metals or alloys having substantially like properties, for the production of flat cakes or other shapes.

5 In the production of high grade sheet copper or copper strips from electrolytically refined copper or copper of similar purity, the best results have been attained by pouring into upright water-cooled molds having a
10 vertical casting cavity with parallel sides or sides closely approaching to parallelism, under such conditions that the cast metal is rapidly solidified and caused to shrink free from the walls of the casting cavity, so that
15 it may be discharged therefrom by gravity. The practice of this method, however, involves certain difficulties which the present invention is designed to overcome.

According to the present invention the
20 cooling water (or other cooling medium) entering the mold is maintained at a temperature lying between approximate extremes of 160° to 212° Fahrenheit. For this purpose a water tank is provided having means for
25 heating and for cooling the water therein, with pipes leading therefrom to the mold jackets and returning from the latter to the tank and with a pump for circulating the water with suitable rapidity. The apparatus for best performing this process is illustrated in the accompanying drawing, where-
30 in—

Figure 1 is a side elevation, partly in vertical section.

35 Fig. 2 is a plan, partly in horizontal section.

Referring to these figures, A A are molds of the character hereinbefore described, and T is a tank of suitable capacity in proportion to the number and size of the molds used.
40 L is the usual ladle for pouring the molten copper into the molds. A pipe 10 leads from the tank T and connects with the inlet pipes C C, leading to the mold jackets. The outlet
45 pipes D D from the mold jackets connect with a pipe 11 leading back to the tank T. A pump 12 in either of these pipes is driven by suitable power, such as an electromotor 13, its purpose being to circulate the water with
50 the required velocity. The tank T has some

means for heating the water which may suitably be a steam inlet pipe 14 having a suitable valve. The tank also has a water inlet pipe 15 controlled by a suitable valve. The tank also preferably has an internal baffle
55 plate 16 to cause an admixture of the water before it flows out through the pipe 10. For discharging excess vapor, the tank has an open top outlet 17. It may also have an overflow pipe 18 for discharging surplus water
60 from the tank. The return pipe 11 may be tapped by a pipe 19 with a suitable valve by which excess of hot returning water may be delivered to a hot well or to waste.

On commencing the operation the tank T
65 being filled with water, steam is admitted to heat the water to preferably about 190° to 200° Fahrenheit. Before starting the casting the pump 12 is started, which causes the water to circulate from the tank through the
70 mold jackets and back. As many molds may be provided as is desired to give the required casting capacity; and these molds may be mounted on a revolving carrier, the metal being poured at one point in the travel of the
75 mold, and the hardened cast cake may be delivered out at another point in its travel. The heat of the molten metal adds to the heat of the water in the mold jackets, so that the water returns to the tank at a much higher
80 temperature. To control the temperature of the water leaving the tank to keep it at (say) 190° Fahrenheit, a part of the hot returning water is run to waste or cooled through coils and its place is taken by fresh
85 cold water admitted through the pipe 15. The control may be accomplished by hand, a thermometer 20 being provided to assist the operator; or thermostatic means may be provided for automatically controlling the
90 temperature of the water.

For casting copper cakes or ingots weighing about 250 to 600 pounds, the cooling water entering the mold jackets should most efficiently have a temperature approximat-
95 ing 190° to 200° F. On leaving the jackets the water will have been heated to from about 210 to 220° F., approximately. Because of the heating effect of the molten metal, it is necessary, in order to keep the temperature
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from rising too high, to circulate the water through the mold jackets with considerable rapidity. It is desirable to be able to vary the speed of the pump 12 in order that the temperature control may be varied as circumstances may change. In making larger or smaller castings the temperatures of the water on entering and leaving the molds may be varied as required.

10 The proper cooling of the mold is important to successful operation, and particularly to casting at a rapid rate. If the cooling is insufficient, the cast copper as it hardens will not shrink rapidly enough to so far separate it from the inner walls of the casting cavity as to insure the free discharge of the cast cake or billet when the mold bottom is dropped open. If the water is too cold, so that the cooling is too rapid, the exterior portion of the casting is solidified and caused to contract too much in advance of the solidification of the interior portion, with the result that imperfect castings will be formed.

I am aware that it has been proposed to 25 cast copper and other metals in jacketed molds, through the jackets of which water is circulated to cool the mold, presumably by connecting to an ordinary service pipe supplying water at temperatures approximating 30 50 to 60° F. My experience has shown that the cooling of the mold by water entering at such a low temperature cannot produce castings of the high grade, uniform character throughout the cake and perfect surface required for the production of flat cakes for 35 rolling.

In the Patent No. 1,748,333, granted February 25, 1930, to United States Metals Refining Company, the water entering the mold jackets is heated to between 212 and 270° F. 40 My experience has shown that for casting parallel-sided, flat cakes in vertical undivided molds, such temperatures for the entering water are too high to produce the best results. Especially for the casting of large 45 cakes, the liberation of heat from the molten metal is so great that the water, immediately after entering the mold jacket, becomes heated to a much higher degree, requiring a considerable pressure to avoid the vaporization of the water and the consequent impairment of the effective cooling of the water jackets, and having the result that the cast cakes are not contracted sufficiently to enable 50 them to free themselves from the molds so as to be dumped out by gravity.

The present invention is based upon my discovery as a result of long and varied practice in the casting of such copper cakes with 60 the apparatus set forth in said patent that a thoroughly successful result, especially when pouring successive molds at rapid intervals, requires the use of heated water at a temperature materially below the boiling 65 point and the forced circulation of the water

through the mold jackets at high velocity, so that the temperature of the water will be raised only a comparatively few degrees during its circulation through the jackets. To 70 attain successful results I introduce the water at much lower temperature than that set forth in the last named patent, and circulate it at much higher velocity, so that when entering at approximately 190 to 200° F. it will 75 emerge at approximately 210 to 220° F. To accomplish this with molds of different capacities it is essential to control the velocity of the circulating water with proper relation to the rate of discharge of heat from the 80 molten metal to the mold jackets. The pressure upon the water in the mold jackets when its temperature exceeds 212° F. is maintained by the frictional head imposed by the return pipe 11 so that the displacement of the circulating water by steam in the mold jackets 85 is avoided.

I claim as my invention:

1. The method of casting copper or equivalent metals in a water-cooled mold having a vertical casting cavity with substantially 90 parallel walls which consists in cooling the mold by a constant and rapid circulation of water through its cooling passages, the water entering at temperatures approximating 190° to 200° Fahrenheit. 95

2. The method of claim 1, further characterized in that the water is circulated with such rapidity that its temperature while flowing through the cooling passages is increased not exceeding approximately 20° Fahrenheit. 100

3. The method of casting copper or equivalent metals in a water-cooled mold having a vertical casting cavity with substantially 105 parallel walls, which consists in cooling the mold by a constant and rapid circulation of hot water through its cooling passages, the water being circulated with such rapidity that its temperature while flowing through the cooling passages is increased not exceeding approximately 20° Fahrenheit. 110

In witness whereof, I have hereunto signed my name.

WILLIAM F. EPPENSTEINER. 115