UNITED STATES PATENT OFFICE.

LAWRENCE ADDICKS, OF ELIZABETH, AND AUGUST MARKS, OF CHROME, NEW JERSEY, ASSIGNORS TO UNITED STATES METALS REFINING COMPANY, OF CHROME, NEW JERSEY, A CORPORATION OF NEW JERSEY.

PROCESS OF CASTING COPPER BARS, INGOTS, AND OTHER ARTICLES.

980,584. Specification of Letters Patent. Patented Jan. 3, 1911.

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To all whom it may concern:

Be it known that we, LAWRENCE ADDICKS, a citizen of the United States, residing at Elizabeth, in the county of Union and State of New Jersey, and AUGUST MARKS, a citizen of the United States, residing at Chrome, in the county of Middlesex and State of New Jersey, have invented certain new and useful Improvements in Processes of Casting Copper Bars, Ingots, and other Articles, of which the following is a full, clear, and exact description.

In the production of "fine" copper bars, ingots, etc., from the cathodes produced in electrolytic refining processes, the cathodes are melted down, preferably in a suitable reverberatory furnace, and from the furnace the metal is poured out into the proper molds. The cathodes are substantially pure but carry nevertheless small amounts of occluded or entrapped electrolyte, and additional impurities also find their way into the molten mass, as from the gases of combustion, etc. These foreign substances are removed before the metal is cast into the desired ingots or bars, and the removal is usually effected by an oxidizing or scorifying process. For this purpose air is blown through the molten metal, with the result that cuprous oxid is formed which acts as a scorifying agent, the oxidized impurities floating on the bath. The resulting slag collects on the surface of the metal and is skimmed off in the usual way, the bath retaining considerable cuprous oxid in solution. The degree of oxidation must now be ascertained, and this can be effected by observing the "set" of the copper. When the metal cools in the open mold it shrinks more or less, giving the top a wrinkled appearance, commonly known as the "set". If the set is too "low", that is, if the wrinkles or folds are too deep, the presence of too much oxid is indicated, and more or less of the same must be reduced. This is done usually by means of hydrocarbon gas as the reducing agent, by introducing wooden poles into the metal so that the heat will volatilize some of the hydrocarbons in the wood, the operation being known as "poling". If the poling is carried too far, too much of the oxids is reduced, and the set becomes "high"; in which case "spews" or "worms" may be thrust out of the solidifying metal, which, in the subsequent rolling of the bar or ingot, produce slivers or similar defects in the rolled product. The set is thus a criterion of the condition of the metal, showing whether or not it possesses the necessary degree of dissolved oxid to make perfect castings.

Heretofore the practice has always been to operate the furnace by charges, or on the "fill and empty" principle, the peculiar sensitiveness of copper and the difficulty of controlling the set having led to the belief, universal among foundrymen in this art, that it was impossible to make the process continuous, or even lengthen the period of operation without proportionately diminishing the rate of casting. We have discovered, however, that the operation can be extended with the result of greatly increasing the per diem output, and can even be continued indefinitely within limits set by the durability of the furnace, labor conditions, etc.

The essential feature of our process is the addition of solid metal to the molten metal in the furnace from time to time during the casting, the sum total of the additions being sufficient in amount to keep the furnace in operation for the desired length of time. For example, if the process is to be continuous the additions are made sufficient in amount to compensate, in the long run, for the withdrawals.

As a specific example of our process we will now describe the procedure which we are employing with complete success, increasing the output enormously without impairing the quality of the product. In starting, the furnace employed is charged with cathode copper to the amount of 340,000 pounds or thereabout. When this charge is melted the molten metal is scorified and in the usual way poled to bring the metal to the desired condition of purity as evidenced by the set. Some 10,000 pounds of the metal may be consumed in this step, leaving 330,000 pounds, more or less, in the furnace. These operations take about eighteen hours more or less. The casting is now begun, at the rate of about 70,000 pounds an hour, and after half an hour unmelted cathode copper, to the amount of say 40,000 pounds, is added to the molten copper in the furnace. In making this, and subsequent additions of solid metal, the cathodes are stacked one on

top of another and the stack or stacks are introduced through a suitable opening in the furnace wall, such opening being closed at other times. On being deposited in the furnace the stack of cathodes sinks into the molten metal and most of the stack, if not all, is submerged, the submerged portion being thus protected from oxidation or other effects of the gases of combustion flowing through the furnace. The pouring or casting now proceeds at the rate mentioned, and in about three quarters of an hour another addition of 40,000 pounds of cathode copper is made, and an hour and a quarter later a third addition of the same amount. 120,000 pounds have now been added to the 330,000 pounds remaining after the scorification, and, at the rate of 70,000 pounds per hour, 175,000 pounds have been withdrawn, leaving some 275,000 pounds of metal in the furnace. At this point the additions may cease and the casting continue, in which case the furnace is emptied within the next four hours, the total operation occupying twenty-four and a half hours with an output of 450,000 pounds, as against twenty-two and a half or three-quarters hours and an output of 330,000 pounds by the old method, or, if desired, the additions may be continued in the same amounts, but preferably in smaller amounts so as to bring the run to an end gradually. During the operation care is exercised to keep up the fire to maintain the metal in the furnace at a suitable casting temperature, and if the set shows signs of becoming too low the metal is poled to the extent needed to keep the set within the limits of permissible departure from the standard. The set will hardly become too high except as the result of unskilful or too prolonged poling.

As stated, the process may be continued as long as desired by keeping up the additions of solid copper. In general we prefer to add enough solid metal, at suitable intervals, to increase the period of operation and the output in about the proportion described above. The method may also be employed to advantage in the casting of anodes from pig copper, anode scrap, etc.

What is claimed is:

1. The herein described process of making ingots, bars, and other copper articles of a substantially constant degree of purity of the metal, comprising melting a mass of copper having the requisite degree of purity, drawing off the molten copper in relatively small amounts into suitable molds, and from time to time adding solid copper to the molten mass, while maintaining the heat of the mass at a proper casting temperature.

2. The herein described process of making ingots, bars, and other copper articles of a substantially constant degree of purity of the metal, comprising melting a mass of electrolytically refined or "cathode copper", drawing off the molten copper in relatively small amount into suitable molds, and adding solid cathode copper to the molten mass from time to time, while maintaining the heat of the mass at a proper casting temperature.

3. The herein described continuous process of making fine copper bars, ingots, and other articles, comprising melting a mass of electrolytically refined or "cathode copper", drawing off the molten copper into suitable molds, adding solid cathode copper to the molten mass to replenish the same, while maintaining the heat of the mass at a proper casting temperature, and from time to time treating the molten mass with suitable reagents to maintain the proper oxid content therein.

4. The herein described process of making ingots, bars, and other copper articles of a substantially constant degree of purity of the metal, comprising melting a mass of copper having the requisite degree of purity, drawing off the molten copper in relatively small amounts into suitable molds, and from time to time adding solid copper to the molten mass by submerging such solid copper more or less in the molten metal, while maintaining the heat of the mass at a proper casting temperature.

5. The herein described process of making ingots, bars, and other copper articles of a substantially constant degree of purity of the metal, comprising melting a mass of electrolytically refined or "cathode copper", drawing off the molten copper in relatively small amounts into suitable molds, and from time to time adding solid cathode copper to the molten mass by submerging the cathodes more or less in the molten metal, while maintaining the heat of the mass at a proper casting temperature.

6. The herein described process of making ingots, bars and other copper articles of a substantially constant degree of purity of the metal, comprising melting a mass of electrolytically refined or "cathode copper", treating the molten mass to remove impurities therefrom, drawing off the molten copper in relatively small amounts into suitable molds, and adding solid cathode copper to the molten mass from time to time, while maintaining the heat of the mass at a proper casting temperature.

In testimony whereof we affix our signatures in the presence of two subscribing witnesses.

LAWRENCE ADDICKS.
AUGUST MARKS.

Witnesses:
EDWARD J. BULFIN,
A. W. DEACON.