

D. W. BLAIR.
PROCESS FOR TREATING COPPER.
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1,058,941.

Patented Apr. 15, 1913.

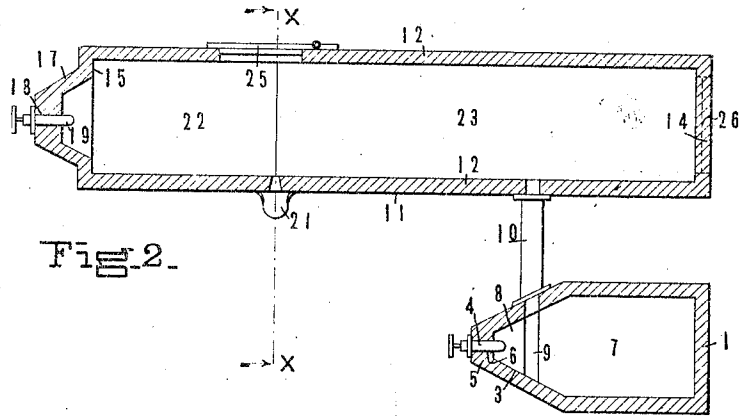


Fig. 2.

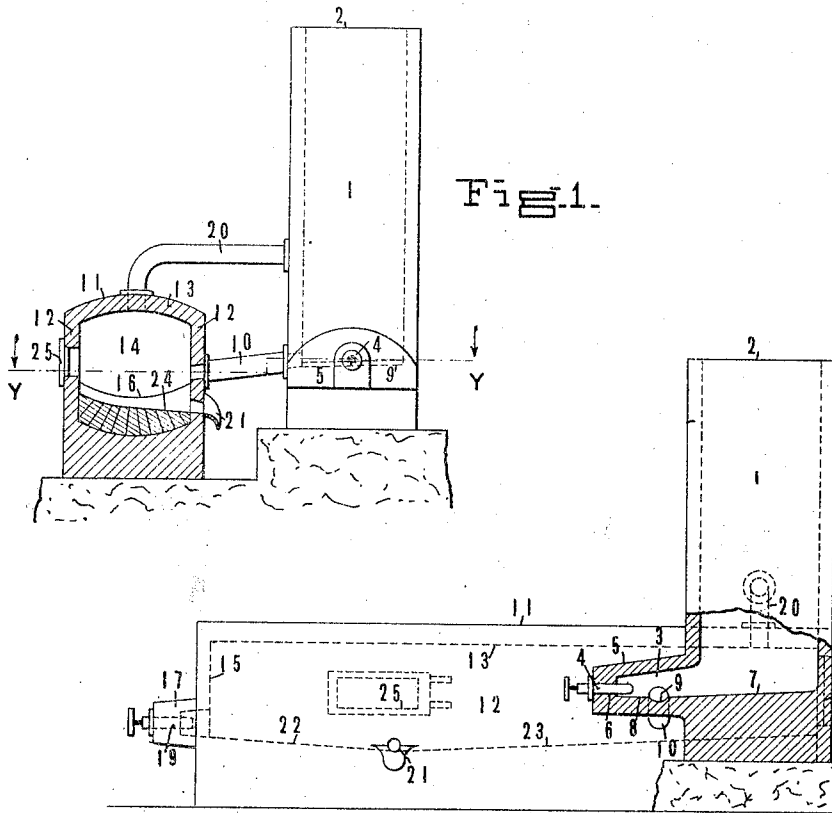


Fig. 1.

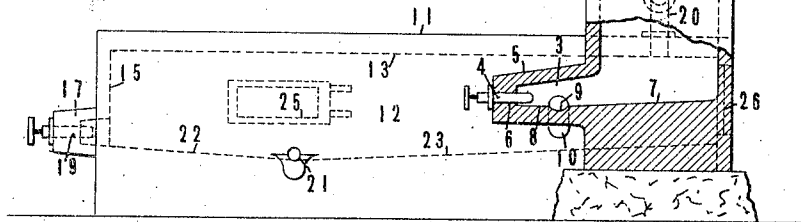


Fig. 3.

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PROCESS FOR TREATING COPPER.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, DAVID WESLEY BLAIR, a citizen of the United States, residing at 386 Manhattan avenue, New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Processes for Treating Copper, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a method of treating copper, and with respect to its more specific features, to a process for melting and refining copper.

One of the objects of the invention is to provide a continuous process of the type described which will be simple and economical.

Another object is to provide a practical and efficient process of the type described which will exert a minimum deterioration on the walls of the chamber in which it is carried out.

Another object is to provide a cheap and rapid process of the type described.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the several steps and the relation and order of one or more of such steps with relation to each of the others thereof, which will be exemplified in the hereinafter disclosed process, and the scope of the application of which will be indicated in the claims that follow.

In order to provide a more complete and readily understandable idea of some of the salient points of the herein-described process, a suitable novel apparatus in which it may be carried out is shown.

Referring to the accompanying drawing,—Figure 1 represents a front elevation of the apparatus, a part being shown in section on the line $x-x$ of Fig. 2; Fig. 2 represents a sectional plan view thereof, taken on the line $y-y$ of Fig. 1; and Fig. 3 represents a side elevation thereof with a part broken away.

Similar reference characters refer to similar parts throughout the various views of the drawing.

In the drawing is shown a vertical upright furnace 1 which comprises an opening at

the top 2 through which the copper may be conveniently charged, and a combustion chamber 3 in which is situated a fluid fuel burner 4. As shown, the furnace is substantially rectangular in cross-section, and the combustion chamber, which is located near the bottom thereof and projects laterally and in front of the front wall of the furnace, is provided with walls 5 which converge away from the furnace and surround at their outer extremity an opening 6 through which the fluid fuel burner 4 projects. The bottom or floor of the furnace, denoted by 7, is sloped toward the fluid fuel burner, as more clearly shown in Fig. 3. The floor 8 of the combustion chamber adjoins and is preferably substantially a continuation of the floor 7 of the furnace. The floor of the combustion chamber slopes in substantially the same direction as the bottom of the furnace and is provided with a sloping passage or gutter 9 which passes from one side of the combustion chamber transversely to the other side in a direction substantially perpendicular to the longitudinal axis of the fluid fuel burner, where it emerges and joins a tube or conduit 10 which leads to an inlet in a horizontal refining furnace or chamber 11.

As shown in Fig. 2, the refining chamber is generally rectangular in form and is long, low and narrow. It is provided with upright side walls 12, an arched top 13, upright end walls 14 and 15, and a bottom having the form of an inverted arch 16. The inverted arch structure is made up preferably of blocks of refractory material and the arch structure itself terminates at either end against the side walls of the furnace. It will be noted in connection with this structure that there is substantially no opportunity for the metal contained in the furnace to force the blocks of the arch out of place, for if any metal descends between the blocks and collects thereunder, the pressure of the metal on the under side will be resisted by the inverted arch structure of the blocks. It will hence be seen that there is substantially no chance to contaminate the copper in the refining furnace by means of dislodged pieces of the lining of the bottom and furthermore the life of the lining will thus be increased. The upright front wall

15 is provided with a combustion chamber 17, projecting laterally in front of the front wall, whose walls converge as shown to form an opening 18 through which projects a fluid fuel burner 19. As shown in Fig. 1, the refining chamber 11 is provided in its arched top wall with a flue 20 which leads therefrom to the upright furnace 1, and projects through the wall thereof to the interior at a point preferably above the combustion chamber 3.

The products of combustion from the burner 4 will generally pass upward through the furnace 1 and will emerge at the top thereof. The gases from the burner 19 will also pass out through the furnace 1 and, under ordinary conditions, these two heating mediums will not join until they meet in the furnace 1. In this way the products of combustion of the two furnaces will not contaminate the product of either.

The side wall 12 is provided with a tap 21, at a point about midway between the front and rear walls, through which the copper in the refining furnace may be tapped into suitable molds or other apparatus. In order that the metal may be directed toward this tap, the inverted arched bottom of the furnace is sloped downwardly from the front end wall and rear end wall, respectively, to a line in a plane passing through the tap perpendicularly to the side walls. The slope from the front end wall is designated 22 (see Fig. 3) and the slope from the rear end wall is designated 23. Along the above-mentioned line, which forms the juncture of these two surfaces, and transversely of the furnace, another sloped portion 24 is provided for the furnace bottom from a point opposite and in the rear of the tap toward the tap (see Fig. 1). The refining chamber 11 is provided with a side door 25 through which instruments may be introduced for conducting the process carried on in the furnace. A panel 26 may be provided through which an operator may enter for repairs or other purposes.

In carrying out the process of treating copper, the upright furnace 1 is first thoroughly dried and heated to a suitable temperature, preferably by means of the fluid fuel burner projecting into the combustion chamber 3. The refining furnace is also similarly dried and heated. Cathode copper plates or copper plates of the kind desired are charged into the upright furnace through the charging opening 2 at the top thereof and melting of the copper is begun by causing the flame of the fluid fuel burner 4 to impinge upon the lower cathode plates. The fluid fuel burner 4 is preferably supplied with a hydrocarbon oil and is preferably so regulated that the flame of the fluid fuel produces an oxidizing atmosphere within the combustion chamber. The cop-

per is heated and melted in this oxidizing atmosphere by means of the highly heated products of combustion of the fuel supplied to the burner, flows down the sloping bottom wall 7 of the furnace, and is removed in a path toward the fluid fuel burner along the floor 8, until it reaches the gutter 9. It passes through this gutter to the tube 10 and thence to the refining chamber 11, passing therein through the orifice provided therefor. It is to be noted in connection with this melting of the copper that a movement of the plates above the point of melting, or melting zone, occurs and an automatic feed of the copper into this zone is thereby secured by gravity. The flame of the burner may be regulated to produce a comparatively high temperature with little danger of deteriorating the inner walls of the furnace, for the copper melts and is removed sufficiently rapidly from the combustion chamber to a point exterior thereof to provide little chance for radiation of the heat absorbed thereby to the walls of the upright furnace, with consequent eating away of these walls. The life and efficiency of the furnace is consequently increased by just so much. The melted copper delivered to the refining chamber will hence ordinarily contain an amount of slightly oxidized copper, and the process which is carried on in the refining chamber is intended to free the copper from such oxides and to render it pure. The melted copper is removed from the oxidizing atmosphere in the furnace 1 and entering the refining chamber is heated and maintained in its melted state by means of the fluid fuel burner 19, which is also preferably provided with hydrocarbon fuel and which is so regulated that it maintains a sufficiently high temperature in the refining chamber to secure the desired maintenance of the melted state of the copper during the processes of reduction, poling and tapping referred to below. The copper, having been received in the refining chamber, is subjected to the influence of a reducing medium, which is preferably carbon spread over or otherwise intimately commingled therewith, whose action is supplemented by subjecting the copper to a poling process, by means of which and the added carbon the oxide of the copper or other impurity is decomposed, oxygen or other impurity is liberated and passes off from the copper, and substantially pure copper is obtained. It is to be understood that any suitable reducing medium might be employed.

It has been found in practice that by either introducing oxygen into the copper in the melting furnace or in some manner insuring the presence of oxygen in the copper after melting, a means for controlling the process of refining in the refining furnace

is secured. For example, if the copper in the refining furnace should become overpoled, in order to remove an excess of carbon therefrom the stream of oxidized copper is continued from the melting furnace into the refining furnace and the poling operation or reduction is suspended until the excess of carbon is removed. Hence, the flame of the burner in the melting furnace is preferably so controlled that it is an oxidizing flame. The necessary carbon and the length of the poling process will generally be comparatively small.

After the copper has been treated in the refining furnace, it is tapped out and casting or other processes are carried on.

The heat which is supplied to the melted copper in the refining chamber is not high in temperature, and it has been found in practice, due partly to this fact, that the lining of the refining furnace will last for a long period without renewal. Under these conditions the product which is tapped from the furnace after intermixture with carbon and after poling is a substantially pure copper and contains practically no slag. This is an advantageous feature when compared with that of providing the bottom of the furnace with a layer of refractory material, such as sand.

The furnace of the present invention may be operated without shutting down for repairs or alterations for a comparatively long time, due partly to the before-mentioned heating conditions, and again to the form of the furnace bottom, which, as mentioned above, consists of blocks of refractory material placed to form an inverted arch and so positioned with respect to the side walls that there is little chance for portions of it to become detached and be commingled with the copper.

In practice all the steps of the process, including melting, removing the copper, refining, tapping, etc., which have been described in detail above, are preferably conducted continuously.

An economy in heat and hence in fuel is effected by means of the flue 20, through which the gases which have traversed the refining chamber pass and are conducted into contact with the copper cathodes at a point above the zone of melting, thus providing a preheating of these copper cathodes and also securing at the same time a flue for the discharge of the products of combustion of the burner 19. It will thus be seen that a simple process is provided wherein the objects enumerated above, among others, are obtained.

As many changes could be made in carrying out the above process without departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative

and not in a limiting sense. It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The process of treating copper, which consists in melting copper in a chamber by means of the highly heated products of combustion of a hydrocarbon fuel regulated to produce an oxidizing atmosphere, thereby producing an amount of copper oxid in said copper in sufficient quantity to react with the carbon used in the poling process, removing the melted copper to a point exterior of said chamber, delivering the melted copper into a refining chamber, subjecting the copper to the influence of carbon intimately commingled therewith, and poling said copper.

2. The process of treating copper, which consists in melting copper in a chamber by means of the highly heated products of combustion of a hydrocarbon burner regulated to produce an oxidizing atmosphere, removing the copper to a point exterior of said chamber, delivering the copper into a refining chamber, heating the copper while in said refining chamber, subjecting the copper to the influence of carbon intimately commingled therewith, poling said copper, and tapping said copper from said refining chamber.

3. The process of treating copper, which consists in melting copper in a chamber by means of the highly heated products of combustion of a hydrocarbon burner regulated to produce an oxidizing atmosphere, delivering the copper into a refining chamber, heating the copper while in said refining chamber, and poling the copper.

4. The process of treating copper, which consists in melting copper cathodes in an oxidizing atmosphere, removing the same from the oxidizing atmosphere, and poling the copper, while applying heat to maintain it in a molten condition.

5. The process of treating copper, which consists in continuously melting copper cathodes in an oxidizing atmosphere, removing the same from said atmosphere, poling the copper, while applying heat thereto to maintain it in a molten state, and continuously discharging the molten copper.

6. The process of treating copper, which consists in continuously melting copper in a chamber by means of the highly heated products of combustion of a fluid fuel, removing the melted copper to a point exterior of said chamber, continuously delivering the melted copper into a refining chamber, sub-

jecting the copper to the influence of carbon intimately commingled therewith, and poling said copper.

7. The process of treating copper, which
5 consists in continuously melting copper in a chamber by means of the highly heated products of combustion of a hydrocarbon fuel, continuously removing the copper to
10 a point exterior of said chamber, continuously delivering the copper into a refining chamber, heating the copper while in said refining chamber, subjecting the copper to the influence of carbon intimately commingled therewith, poling said copper, and
15 continuously tapping said copper from said refining chamber.

8. The process of treating copper, which consists in continuously melting copper in
20 a chamber by means of highly heated products of combustion, continuously removing

the copper to a point exterior of said chamber, continuously delivering the copper into a refining chamber, and poling said copper.

9. The process of treating copper, which consists in continuously melting copper in
25 a chamber by means of the highly heated products of combustion of a hydrocarbon burner regulated to produce an oxidizing atmosphere, thereby producing an amount of copper oxid in said copper, and liber-
30 ating the oxygen from said oxid by commingling with the copper a quantity of carbon, and poling said copper.

In testimony whereof I affix my signature, in the presence of two witnesses.

DAVID WESLEY BLAIR.

Witnesses:

J. W. ANDERSON,
L. A. WATSON.