

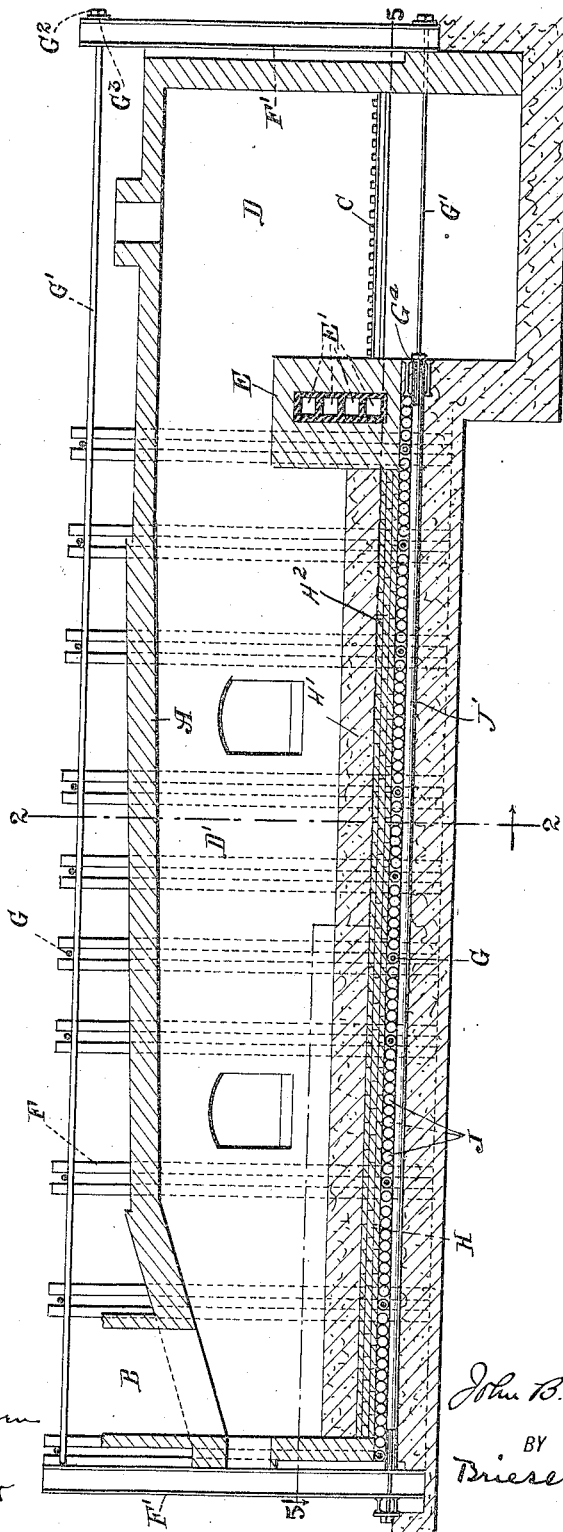
1,047,521.

J. B. F. HERRESHOFF.
REVERBERATORY FURNACE.
APPLICATION FILED JULY 28, 1909.

Patented Dec. 17, 1912.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES
G. V. Rasmussen
John H. Beck

INVENTOR
John B. F. Herreshoff
BY
Driesend Knauth
ATTORNEYS

J. B. F. HERRESHOFF.
 REVERBERATORY FURNACE.
 APPLICATION FILED JULY 28, 1909.

1,047,521.

Patented Dec. 17, 1912.

3 SHEETS—SHEET 2.

Fig. 3.

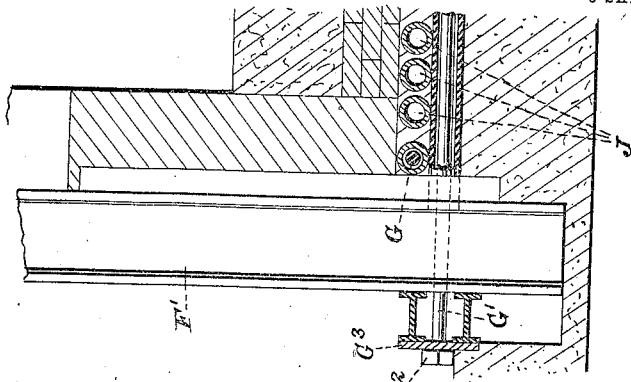


Fig. 2.

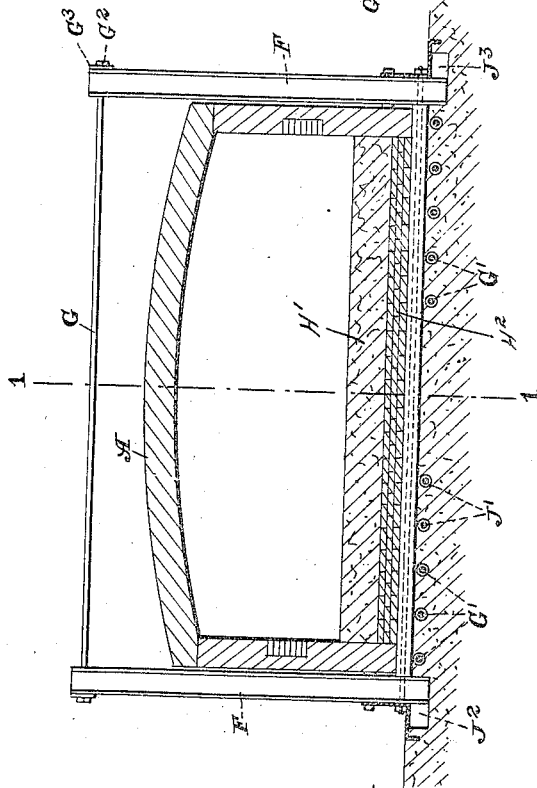
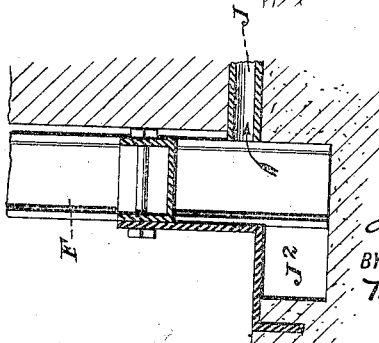


Fig. 4.



WITNESSES

B. V. Rasmussen
John A. Schenck

INVENTOR

J. B. F. Herreshoff

BY

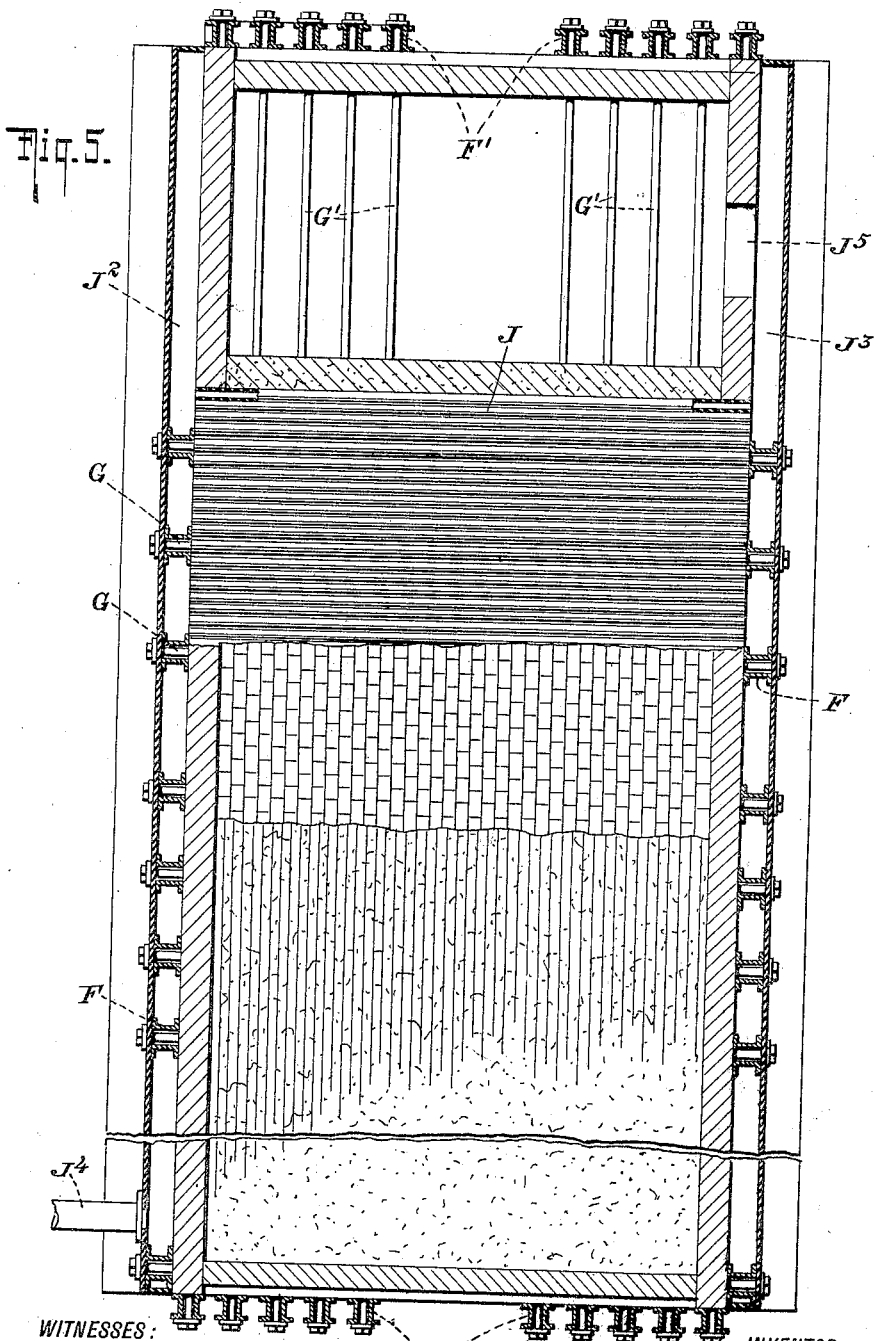
Thierstein Knauts
 ATTORNEYS

J. B. F. HERRESHOFF.
 REVERBERATORY FURNACE.
 APPLICATION FILED JULY 28, 1909.

1,047,521.

Patented Dec. 17, 1912

3 SHEETS—SHEET 3.



WITNESSES:

G. V. Rasmussen
John A. Tolbert

INVENTOR

John B. F. Herreshoff

BY
Briesend Knauth
 ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHN B. F. HERRESHOFF, OF NEW YORK, N. Y., ASSIGNOR TO NICHOLS COPPER CO., OF
NEW YORK, N. Y., A CORPORATION OF NEW YORK.

REVERBERATORY FURNACE.

1,047,521.

Specification of Letters Patent. Patented Dec. 17, 1912.

Application filed July 28, 1909. Serial No. 510,148.

To all whom it may concern:

Be it known that I, JOHN B. FRANCIS HERRESHOFF, a citizen of the United States, and resident of the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Reverberatory Furnaces, of which the following is a specification.

My invention relates to reverberatory furnaces and particularly to a reverberatory furnace for refining copper.

The principal object of my invention is to provide means in connection with the bed of a furnace of the type described, which shall prevent disintegration and "floating up" of said bed during the operation of the furnace; a further object of my invention is to so arrange the furnace bed that molten copper, while being refined, may not break through the bed at one or more points, thereby necessitating not only large expenditure for reconstruction of the furnace bed, but also for recovery of the particular lot of copper involved.

Further objects of my invention, pertaining to details of construction, will appear as the specification proceeds.

A type of reverberatory furnace which has been commonly used heretofore in copper refining has been provided with a special bed comprising a top layer, having considerable thickness, of a special sand which, by suitable preliminary heat treatment is partially vitrified. This sand is laid upon a suitably formed foundation of fire brick; which is itself supported by iron plates resting upon short pillars or equivalent means of support. A certain space is cleared away under these plates so as to constitute a vault, through which, in the operation of the furnace, air is passed for the purpose of cooling the bed. Furnaces of this type are generally made on a very large scale and so as to contain masses of copper at one time weighing as much as 250 tons. In practice it has frequently happened that the molten copper has worked its way down into the sand bed and into the fire brick beneath so as to cause the bed and fire brick to break up and float to the surface of the copper, thus necessitating a correspondingly frequent renewal of the bed. Occasionally also the copper will work its way entirely through both the sand bed and the fire brick and then through the supporting iron plates into the vault be-

neath. The cost of reconstructing the furnace and of recovering the copper which has thus broken through amounts to many thousands of dollars. I have found that this disintegration of the bed and breaking through of the copper into the vault beneath is due largely to the imperfect and inefficient cooling obtained by means of the vault. While ample volume of air can be passed through such a vault, it has proven quite impossible to control this volume so that the cooling is uniform over the bed, so that hence there may be parts of the bed which are quite cool, while other parts are relatively much warmer. Under the intense heat in the furnace the vitrified bed tends to crack at its surface and the molten copper to work down these cracks. If the bed is sufficiently cooled this copper will solidify as it thus works down and acts to hold the bed together rather than to break it up. The lack of a thoroughly rigid foundation under the entire bed may also have something to do with its frailty.

In my invention herein described I have arranged a series of closely laid pipes in the furnace bed in such a way that a sufficient volume of a cooling fluid such as air may be passed through the bed at every desired point so as to carry off any desired amount of heat and thus keep the bed cool. I have also dispensed entirely with the vault beneath the furnace bed as in the prior art, placing this bed upon a solid foundation throughout. By this improved construction I find that the above referred to disintegration of the bed and breaking through of the copper contents of the furnace is substantially done away with.

A preferred form of my invention is illustrated in the accompanying drawings hereby made a part of this specification, in which—

Figure 1 is a longitudinal section taken along the line 1—1 of Fig. 2; Fig. 2 is a cross section taken along line 2—2 of Fig. 1; Fig. 3 is an enlarged partial section of the left-hand end of Fig. 1; Fig. 4 is a similar view of the left-hand end of Fig. 2; and Fig. 5 is a horizontal section along the line 5—5 of Fig. 1.

The furnace shown in the drawings has a transversely arched top wall A slanting downwardly toward the outlet B; at the other end is a grate C above which is formed the combustion chamber D separated from

the main chamber D' by a bridge wall E. This bridge wall may contain pipes E' through which air passes on its way to the grate (connections not shown), thus serving the double purpose of preheating said air so as to more efficiently support combustion and of cooling the bridge wall. The brick work of the furnace is held by means of uprights F and F', and by tie rods G and G' with the aid of nuts G² and washers G³, the nuts and the rods being screw-threaded. The bed H of the furnace comprises a thick, specially prepared layer of sand H' and supporting bed H² of fire brick, and below the fire brick a layer of transverse pipes J is embedded in cement. These transverse pipes J are arranged above the outside floor level and have their opposite ends in communication with longitudinally extending passages or channels J² J³ (Figs. 2 and 4). The ends of each passage J² J³ are closed, the passage J² being connected by means of a pipe J⁴ with a fan blower of any improved construction or other means for introducing an appropriate cooling fluid, while the passage J³ communicates through an opening J⁵ with the furnace below the grate if air is used as the cooling fluid. Thus air is blown into the passage J² through the pipe J⁴ by the blower and passes in parallel through the tubes J to the channel J³ and thence to the furnace. In its passage through the pipes J the air absorbs heat from the bed of the furnace, thus cooling the same and finally reaches the furnace just below the grates in a preheated condition.

Longitudinal pipes J' are similarly embedded in the furnace bed below pipes J and serve to accommodate the lower tie rods G' used to secure the lower ends of uprights F' in position. By providing these pipes J' for the rods G' said rods may be easily and quickly removed and replaced without requiring the ripping up of the furnace bed. Similar rods G also extend through some of the pipes J so as to fasten the lower ends of the uprights F against displacement. In the form of invention shown the uprights F, F' are arranged in sets of two, and transverse tie rods G, G' extend between the two uprights of each set. All the tie rods are sufficiently smaller than the pipes through which they pass to permit air to be driven through the annular space surrounding said rods. The pipes J' which contain the tie rods G' are closed at the end adjacent to the grate by a nipple G⁴. The tie rod beneath the furnace bed is therefore always surrounded by a body of air, but no circulation is provided as for pipes J.

The cooling effect of the air passed through pipes J extends upwardly from said pipes so that the bed for a considerable thickness may be prevented from becoming excessively heated. These cooling pipes

should be laid quite close together, although not necessarily in contact; I prefer that the distance between said pipes should be less than their diameter. With the pipes thus closely laid it follows that a horizontal stratum of the furnace bed bounded by the margin of the arrangement of pipes which is used will have substantially the same temperature at all points. If a sufficient volume of air is passed through the pipes any molten metal which may work into the bed will solidify and act as a binder to hold the bed together as soon as the copper reaches a sufficiently cooled stratum.

Since by the cooling means above referred to I am able to thoroughly and efficiently cool the furnace bed, I no longer require the cooling vault beneath the bed, but build said bed upon a solid foundation. Therefore, even if a crack should form in the bed of my improved furnace and extend into the bed far enough to enter the zone which is sufficiently cooled by the air passing through pipes J, this metal will immediately harden and fill the crack, thus automatically repairing the damaged bed; any such metal could be recovered at any convenient time.

I have described my invention as having a bed cooled by pipes. By the term "pipe" I intend to include other forms of tubular construction as well as the conventional pipes of commerce. Any arrangement of passages underlying or in contact with the furnace bed and so arranged that when air is passed therethrough a horizontal stratum of the bed is cooled substantially to the same temperature at all points lies within the spirit of my invention.

In the drawings the pipes J have been shown apparently in contact; this is due to the very small scale on which the drawings have here necessarily been made. In practice I prefer to keep these pipes about $\frac{3}{4}$ " apart, but they may be placed farther apart or closer together without going outside the scope of my invention. Preferably these pipes should be spaced apart by a distance not exceeding their diameter. Other changes of detail may be made without departing from the spirit of my invention.

I claim as my invention:

1. In a reverberatory furnace for refining molten copper, a solid foundation, a bed capable of supporting a body of molten copper, said bed comprising a stratum of finely divided solid material, a stratum of closely associated, parallel, transverse cooling pipes, and a stratum of longitudinal cooling pipes, said pipes being interposed between said foundation and said stratum of finely divided material, and having a total cooling capacity sufficient to prevent molten copper from reaching said foundation.

2. In a furnace of the class described, the combination with a bed capable of support-

ing a body of molten copper, of a solid foundation beneath and supporting the bed, and a plurality of imperforate closely associated cooling pipes located between the bed and the foundation, said cooling pipes being sufficiently numerous and of sufficient cooling capacity to prevent molten copper from reaching said foundation, substantially as and for the purpose described.

3. In a furnace of the class described, the combination with a bed capable of supporting a body of molten copper comprising a top stratum of sand and a supporting stratum of fire-brick, of a stratum of cooling pipes beneath the bed and a solid foundation beneath and rigidly supporting all of the aforementioned strata, said cooling pipes being sufficiently numerous and of sufficient cooling capacity to prevent molten copper from reaching said foundation, substantially as and for the purpose described.

4. A copper refining furnace comprising side walls and end walls, and a bed, said bed being capable of supporting a body of molten copper, and comprising a layer of sand, a layer of bricks therebelow, and cooling pipes associated therewith, said pipes arranged close together and having a cooling capacity sufficient to prevent molten copper from passing downwardly therebetween, in combination with a solid foundation supporting said bed.

5. In a reverberatory furnace for refining molten copper, a solid foundation upon which is a bed capable of supporting a body of molten copper, said bed comprising a stratum of finely divided solid material, a stratum of brick work between said foundation and said stratum of finely divided solid material, a stratum of closely associated, parallel transverse cooling pipes and a stratum of longitudinal cooling pipes, said

pipes being interposed between said foundation and said stratum of finely divided material, and having a total cooling capacity sufficient to prevent molten copper from reaching and destroying said foundation.

6. A copper refining furnace comprising side walls and end walls, and a bed, said bed comprising a layer of sand, a layer of bricks therebelow, and cooling pipes associated therewith, said pipes arranged close together and having a cooling capacity sufficient to prevent molten copper from passing downwardly therebetween, said bed resting directly upon a solid foundation.

7. A furnace provided with a bed having cooling pipes embodied therein and tie-rods which extend through sundry of said cooling pipes with a sufficient clearance to allow for the passage of the cooling medium.

8. A furnace provided with a grate and a bed extending adjacent to said grate in combination with longitudinal cooling pipes embedded in said bed and reaching to a point adjacent to the grate, tie-rods which pass through sundry of said cooling pipes and nipples for closing the ends of the cooling pipes adjacent to the grate.

9. A furnace provided with a grate and a bed adjacent thereto in combination with longitudinal cooling pipes embedded in said bed, and terminating near the grate, the other ends of said pipes being open to the surrounding air, and means for cooling the ends of the pipes adjacent to the grate.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

J. B. F. HERRESHOFF.

Witnesses:

JOHN A. KEHLENBECK,
G. V. RASMUSSEN.