

(No Model.)

A. O. VICUÑA.

PROCESS OF AND FURNACE FOR SMELTING COPPER.

No. 525,773.

Patented Sept. 11, 1894.

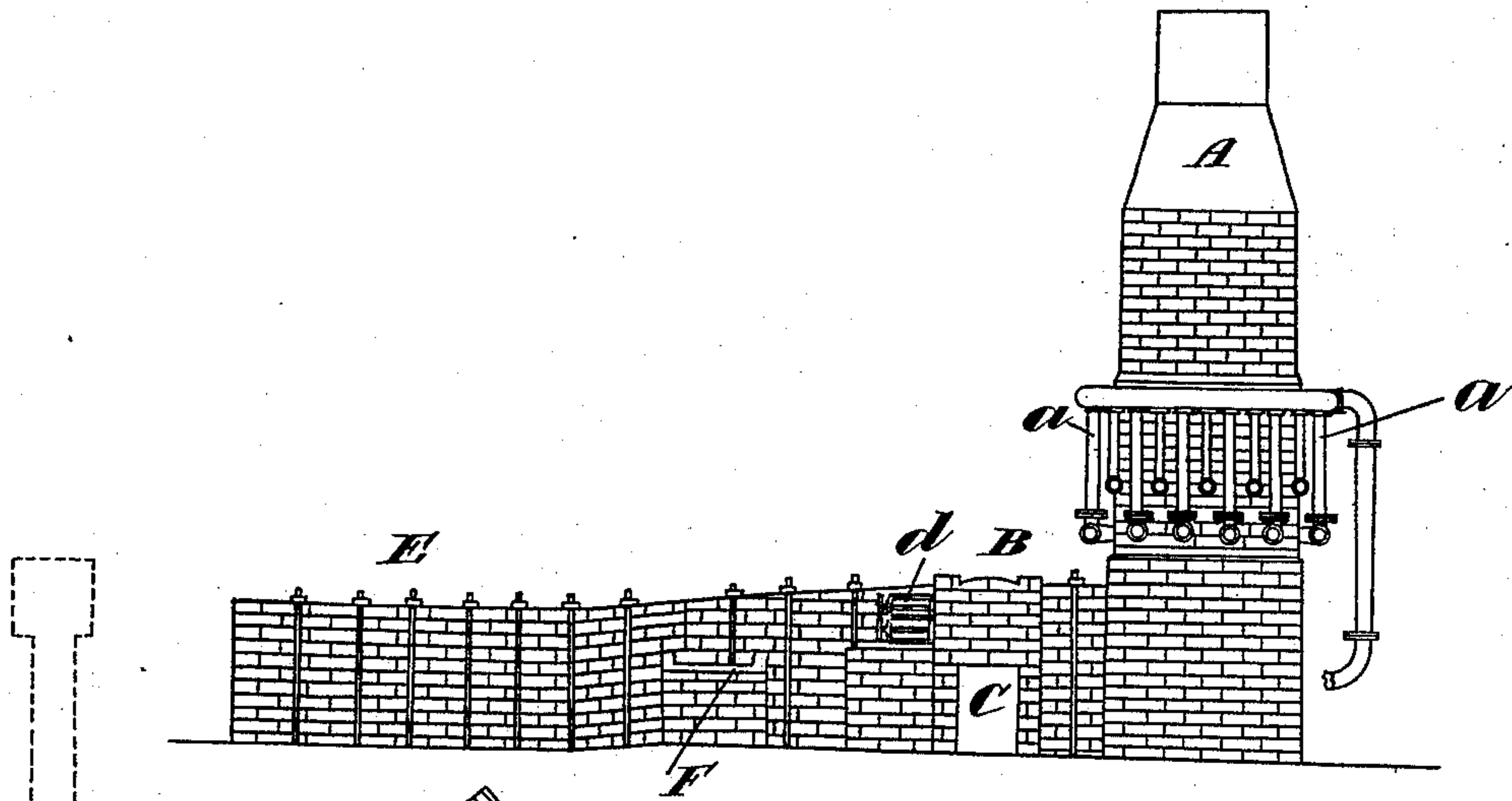


Fig. 1.

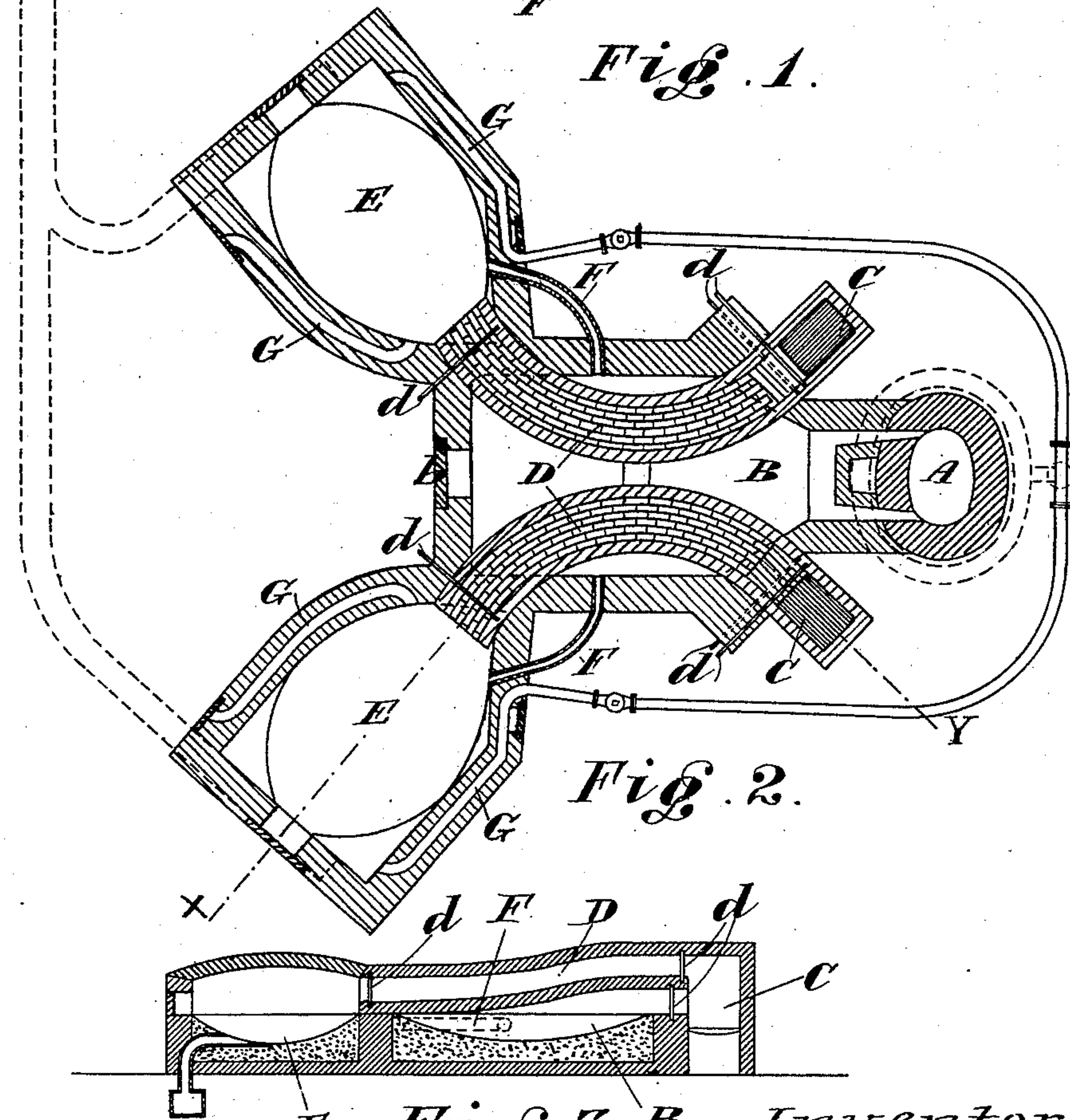


Fig. 2.



Fig. 3.

Witnesses:  
L. B. Bolton  
H. van Oudenmeel

Inventor:  
Alfredo Ovalle Vicuña  
By *Richard R.*  
his Attorneys.



# UNITED STATES PATENT OFFICE.

ALFREDO OVALLE VICUÑA, OF VALLENAR, CHILE.

## PROCESS OF AND FURNACE FOR SMELTING COPPER.

SPECIFICATION forming part of Letters Patent No. 525,773, dated September 11, 1894.

Application filed October 5, 1893. Serial No. 487,291. (No model.)

*To all whom it may concern:*

Be it known that I, ALFREDO OVALLE VICUÑA, residing at Vallenar, Province of Alacama, Chile, have invented an Improved Process and Furnace Used Therewith for Copper Smelting and Refining, of which the following is a specification.

My invention relates to an improved method of smelting copper ores, and to the construction of an improved compound furnace used therefor, consisting of a combination of a cupola blast or reverberatory furnace with several subsidiary hearths and auxiliary furnaces therewith, by means of which copper sulphurous ore may be reduced to "copper bar" in one heat and by a single and continuous operation.

The following arrangement of combined furnace has been practically worked for many months and has been found to effect the following advantages: First, the cupola furnace which is part of my improved furnace, smelts with a greater rapidity than is usual, because only soft and easily reducible ores are treated in it, the dust and refractory silicious ores being treated in the reverberatory hearths of my combined furnace; second, the first reverberatory hearth receiving as it does the molten charge from the cupola, requires little additional heat from the auxiliary furnaces to slag the iron by the addition therein of silicious ores, or to melt the dust ores which as is well known cannot be conveniently smelted in cupola furnaces; third, the addition of subsidiary hearths beyond the first hearth where the slagging and removal of the iron takes place, enables the resulting matte to be there desulphurized by oxidation and refined until reduced to "copper bar" with small addition of heat and little expenditure of time or labor; fourth, the usual operations in smelting and refining copper, of calcination and of the handling and moving of the calcined ore; the pulverization of the matte and consequent handling and moving; the calcination of the pulverized matte in calcining furnaces, the consequent handling and moving, and the final smelting in refinery furnaces are avoided and saved; fifth, the cost of my combined furnace for the continuous process from ore to "copper bar" is much less than the cost of the usual smelting furnaces, calcining fur-

naces and refinery furnaces usually required, and the means of transport and handling of the ores in the usual known processes is obviated; sixth, poor ores, which by existing processes cannot be treated at a profit, may be smelted in my combined furnace to advantage; seventh, the heat from the cupola furnace may be utilized in my combined furnace for the reduction of the ores to "bar copper" in my auxiliary hearths.

Figure 1 is an outside elevation of my improved furnace and Fig. 2 is a sectional plan of the same. Fig. 3 is a sectional elevation upon the curved lines  $x-y$  through the flue D.

A is a cupola furnace of known construction which receives the first charge of sulphurous copper ore and coke or other fuel, and it is provided with the usual blast or tuyere pipes  $a$ . After the charge has been smelted in this cupola furnace, the molten charge is discharged into the first auxiliary hearth B with the accompaniment of a considerable amount of heat and flame. In this hearth B, the molten matte or copper sulphide settles to the bottom, the slag floating on the surface, which slag is removed in the usual way, through the door  $b$  in the front of the hearth. This hearth B has on either side a diagonal grate or furnace C, which serves to increase the heat in the hearth B, or by means of flues D to throw the heat into the further hearths E E, when the communication below the flues between the grates C and the hearth B has been closed and the flues D opened by dampers  $d$  or other suitable means. In the hearth B may be added the dust and silicious ore or other material which it is not convenient to smelt in the cupola furnace.

The secondary hearths E E serve to receive the discharge of the molten matte from the first hearth B where the slag has already been removed. The outflow of the matte from the first hearth B to the secondary hearths E is received by the open and curved channels F. The matte, thus freed from slag is exposed alternately in the secondary hearths E E to a desulphurizing and oxidizing current of air, and heat, either from the hearth B or from the grates C, or when desired by the admission of air by small doors or air holes in the walls of the secondary hearths E E and



near the bridges. Hot air tuyere pipes connected with the main wind-tube of the cupola furnace may also be fitted to these hearths. The pipes *b* are sunk into the sides of the hearth so that the air may be heated from the said hearth before it is discharged onto the bath of metal to prevent the bath from being too rapidly cooled.

Before the matte gets cool and begins to redden, which cooling may have been effected by closing the communication with the fire grates *C*, the dampers of the flues *D* may be again opened to reheat the charge in the secondary hearths *E* and any remaining iron and impurities in the matte may be removed by the addition of a silicious red ore which will slag the remaining iron and other impurities. The bath in the said secondary hearths *E* may thus be alternately reheated and treated with silicious ores or oxidized by the admission of air for desulphurization, until the copper, in a single heat, from its first smelting as an ore, may be reduced to fine copper bars of recognized commercial value, and with the economy as to time, fuel, labor and capital outlay, as hereinabove specified. If desired, the ordinary "poling" with timber poles may be carried out in the secondary hearths *E* to bring the copper bath therein to any pitch as refined copper.

Though I have described a cupola furnace with auxiliary hearths as the preferred example of my improved furnace, my auxiliary hearths and grates and the process of treat-

ment hereinabove described may be used with an ordinary reverberatory furnace in place of the cupola, though, in such case, the copper pyrites ore must be previously calcined before treatment in the reverberatory furnace.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. A process for the manufacture of bar copper from sulphurous copper ores consisting in first smelting selected ore by open blast, secondly subjecting the molten matte with dust and silicious ores to additional heat and air and finally effecting the desulphurizing and purification of the still molten charge in a distinct stage and chamber by additional heat and air, substantially as described.

2. In combination, a cupola furnace, an auxiliary hearth *B* receiving the discharge from the cupola, auxiliary grate furnaces on either side of the hearth *B*, secondary hearths *E* located in rear of the hearth *B*, the flue *D* leading to said hearths *E* from the auxiliary furnaces *C* and the channels *F* between the hearths *B* and *E*, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALFREDO OVALLE VICUÑA.

Witnesses:

AUGUST MOLLER, Jr.,  
J. MANUAL CAMPBELL.