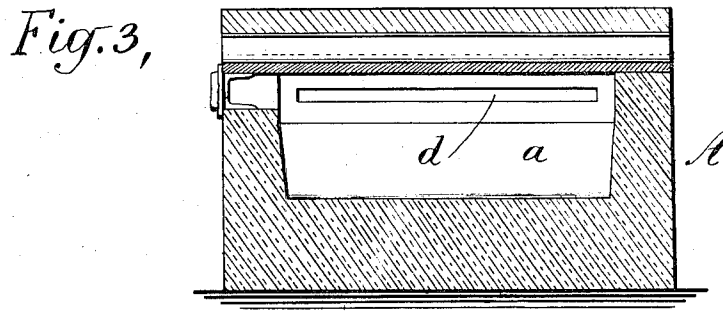
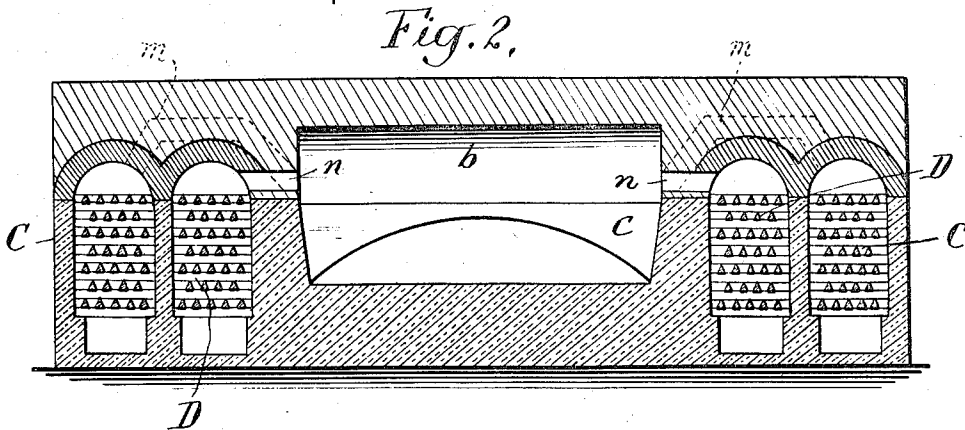
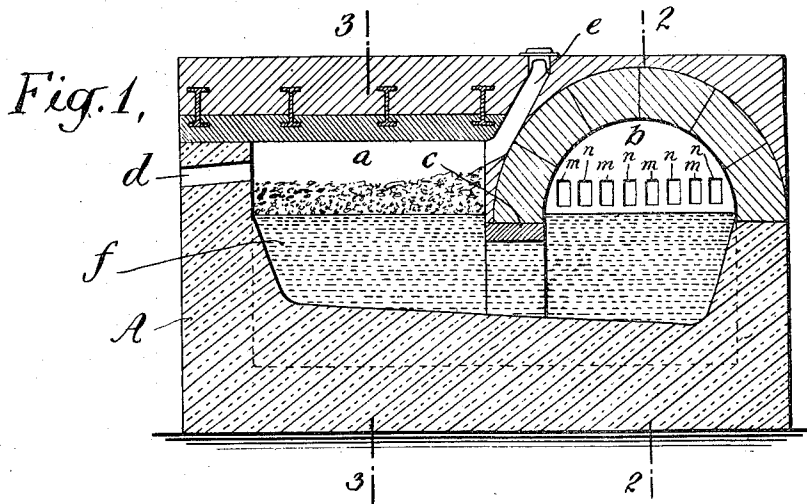


F. L. CLERC.
METALLURGY OF ZINC.
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1,002,037.

Patented Aug. 29, 1911.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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METALLURGY OF ZINC.

1.002,037.

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To all whom it may concern:

Be it known that I, FRANK L. CLERC, a citizen of the United States, residing at Boulder, county of Boulder, State of Colorado, have invented certain new and useful Improvements in the Metallurgy of Zinc; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to certain new and useful improvements in the metallurgy of zinc, and particularly to the furnace reduction of zinc oxid and the distillation of the metal, preliminary to its ultimate recovery as spelter.

The invention comprises broadly the fundamental and characteristic features of supplying the zinc oxid to be reduced, together with the necessary amount of reducing material for making the customary charge, to the upper surface of a trapped body of molten metal forming the bottom of the retort or muffle and extending outside of the retort chamber to form an open well which counterbalances the body of molten metal within the retort, and which is heated in any way suitable for maintaining the metal in the molten condition, during the reduction of the zinc oxid and the distillation of the zinc.

The metal chosen for the purpose of forming the liquid bottom for the retort or muffle will be of a melting point and conductivity to heat appropriate to insure the proper temperature conditions for the desired reduction and distillation within the retort. It will form an effective seal against the entry of oxidizing gases into the retort and also against the escape of zinc vapor from the retort.

In the accompanying drawing, Figure 1 represents a cross-sectional view of one form of apparatus suitable for the practice of my invention; Fig. 2 represents a longitudinal sectional view on a plane indicated by the line 2-2 of Fig. 1; Fig. 3 represents a cross-sectional view on a plane indicated by the line 3-3 of Fig. 1.

Similar letters of reference indicate similar parts throughout the several views.

Referring to the drawing, A indicates the main furnace structure, provided with a retort or muffle chamber *d*, and a heating chamber *b* adjacent thereto and separated

therefrom at the bottom by the arched passage *c*. The retort or muffle is provided with an exit port *d* for delivering the distilled zinc vapors to a suitable condenser, and is furthermore provided with a feeding spout *e* for supplying the usual mixture of zinc oxid and coal or like charge familiar to the art.

The bottom of the retort or muffle consists of a trapped body of molten metal *f* terminating within the heating chamber *b* in an open well, as shown, thereby sealing the retort and counterbalancing the molten metal trapped therein. The molten metal may conveniently consist of an alloy, having a melting point higher than the temperature (1040° C.) at which zinc is reduced from its oxid by carbon. A suitable alloy for the purpose would be an alloy of zinc and copper, an alloy of zinc and aluminum, or, in some cases, a ternary compound, the composition of the alloy to be chosen according to the particular circumstances of the case and particularly according to the temperature conditions to be realized in the retort.

The liquid metal constituting the bottom of the retort may be maintained in the molten condition, as hereinbefore indicated, in any suitable manner, by the heating effect of the electric current or by the combustion of fuel. When, for instance, the electric current is employed as the heating agent, it may be supplied as in the simple resistance furnace, the electric arc furnace, the combined arc and resistance furnace, or some modification of the induction furnace. When fuel is employed as the agent for heating the metal it may be used as solid fuel burned upon a grate, sprayed hydro-carbons or pulverized coal with an air jet, natural gas with heated air, or artificial gas with heated air as in the Siemens system of double recuperation.

In the drawing, I have chosen as an illustration of the preferred practice, the application of the air and gas recuperators C and D as shown in Fig. 2 to the heating of the combustion chamber *b*. The preheated air and preheated gas from the air recuperator C and the gas recuperator D, respectively, (both of which have the usual checker-work filling of refractory brick-work) are delivered through the air ports *m* and gas ports *n* and the resulting products of combustion pass over the upper surface of the open well, finally making their exit

through the corresponding pair of recuperators at the other end of the combustion chamber, as will be readily understood, the direction of the flow of air and gas and consequently of the products of combustion being reversed from time to time in accordance with the customary practice of operating recuperator furnaces.

The higher metal values present in the charge will be recovered in the molten metal bottom, and the slag or scoria will be removed from the retort or muffle in any suitable manner. The zinc vapors resulting from the reduction of the zinc oxid and the distillation of the zinc, will pass through the port *d* and will be recovered as spelter in a condenser, while the accompanying carbon monoxid will be burned for any useful purpose, after washing from it any blue powder and zinc oxid it contains.

In the Belgian and the Silesian practice, the heat required to expel the zinc is conducted to the charge, from without through the inclosing walls of the retort. I retain this distinctive advantage, keeping the charge isolated within its retort or muffle walls, and transmitting the heat to it, from without, through the trapped molten metal constituting the bottom wall.

Having thus described my invention, what I claim is:

1. The method of reducing zinc oxid by carbon and recovering the resulting zinc vapors, which consists in establishing a trapped body of molten metal in the bottom of a retort, said trapped body of metal terminating outside of the retort in an outer well, supplying a charge of zinc oxid and carbon to the surface of the trapped portion within the retort, heating the metal in the outer well, and reducing the zinc oxid of the charge by the carbon by means of heat conducted from the well through said molten metal, to the surface of the portion trapped within the retort; substantially as described.

2. The method of reducing zinc oxid by carbon and recovering the resulting zinc vapors, which consists in establishing a trapped body of substantially quiescent molten metal in the bottom of a retort, said

trapped body of molten metal terminating outside of the retort in an outer well, supplying a charge of zinc oxid and carbon to the surface of the trapped portion within the retort, heating the metal in the outer well, and reducing the zinc oxid by the carbon of the charge by means of heat conducted from the well through said molten metal, to the surface of the portion trapped within the retort; substantially as described.

3. Apparatus for reducing zinc oxid by carbon, comprising a retort, closed at its bottom by a trapped body of substantially quiescent molten metal terminating in a well exterior to the retort, and means for supplying heat to the metal in the well sufficient to maintain the trapped metal in a molten condition by conduction; substantially as described.

4. Apparatus for reducing zinc oxid by carbon, comprising a retort, closed at its bottom by a trapped body of substantially quiescent molten metal terminating in a well exterior to the retort, a heating chamber inclosing the well, and means for applying heating gases to the upper surface of the metal in the well; substantially as described.

5. Apparatus for reducing zinc oxid by carbon, comprising a retort, closed at its bottom by a trapped body of substantially quiescent molten metal terminating in a well exterior to the retort, a heating chamber inclosing the well, and means for directing fuel in combustion across the upper surface of the metal in the well; substantially as described.

6. Apparatus for reducing zinc oxid by carbon, comprising a retort, closed at its bottom by a trapped body of substantially quiescent molten metal terminating in a well exterior to the retort, a heating chamber inclosing the well, and recuperators for supplying gas and air to the chamber for combustion therein; substantially as described.

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

FRANK LAURENT CLERC.

Witnesses:

E. L. MERRIMAN,
D. R. McNAUGHTON.