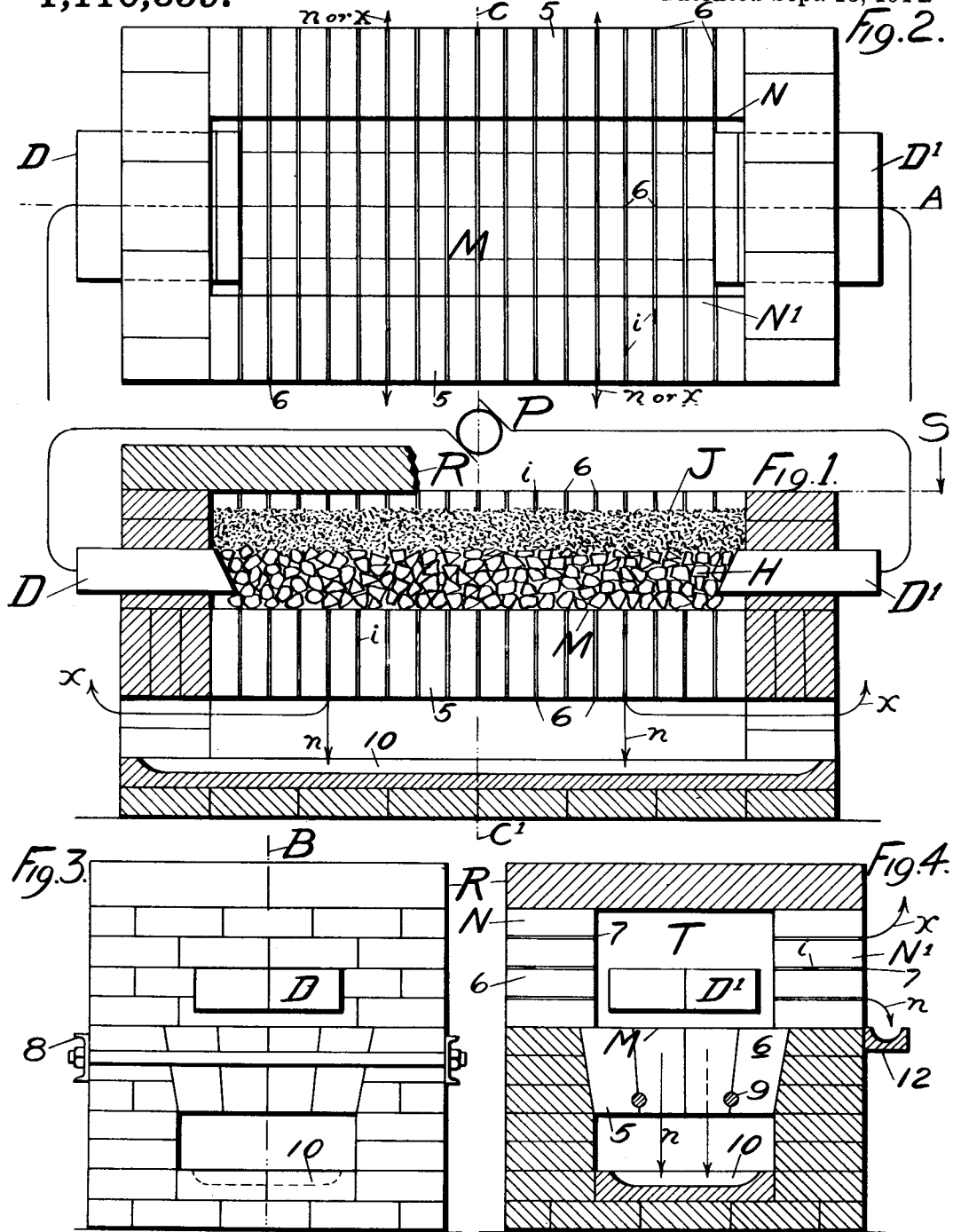


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ELECTRIC ZINC FURNACE WITH INTEGRAL CONDENSER.
APPLICATION FILED MAY 21, 1913.

1,110,359.

Patented Sept. 15, 1914.



WITNESSES:

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ELECTRIC ZINC-FURNACE WITH INTEGRAL CONDENSER.

1,110,359.

Specification of Letters Patent.

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Application filed May 21, 1913. Serial No. 768,917.

To all whom it may concern:

Be it known that I, CHARLES VICTOR THIERRY, a citizen of the Republic of France, and a resident of the city of Paris, in said Republic of France, have invented certain new and useful Improvements in Electric Zinc-Furnaces with Integral Condensers, (Case A,) of which the following is a specification.

This invention relates to the metallurgy of zinc and the object thereof is to produce metallic zinc fumes by the reduction of oxid of zinc (ZnO) by carbon (C) and to subsequently condense said zinc fume to liquid metal.

The heat necessary for decomposing the ZnO and C is preferably derived from an electric current passed through a "resistor", and the invention especially resides in particular means designed to accomplish the objects above stated.

The resistor is comprised in a bed of carbon, usually made of coke, which is disposed upon a sole or hearth and is confined by side walls. The size and shape of the carbon pieces as well as the depth, width and length of the resistor bed may be variously modified to obtain any desired electrical resistance and intensity of current, which is brought to the two ends of the resistor by blocks of amorphous carbon or graphite situated in the end walls of the reaction chamber, that is, the resistor is interpolated between the two terminals. The reaction chamber of the furnace is made of sufficient depth to receive the resistor and the charge; the latter being placed directly upon and sustained by the said resistor.

The charge in its entirety is either a mixture or alternate layers of igneous or commercial oxid of zinc and of carbon in preferably substantially such relative proportions as will effect, when suitably heated, practically the complete reduction and evolution of the charge in the forms of zinc fume (Zn) and monoxid of carbon (CO), that is to say, the amount of inert residual matter unevolvable in the gaseous form will usually be negligible for a considerable period of time.

As has already been intimated, the electric energy is transformed into caloric energy in the resistor bed of the furnace and the heat thus generated, if the temperature is adequate, effects the decomposition of the

superimposed mass, the following representative chemical reaction ensuing: $\text{ZnO} + \text{C} = \text{Zn} + \text{CO}$.

The walls of the furnace immediately adjacent to the longitudinal sides of the resistor and its superimposed charge and also the sole or hearth of the reaction chamber are utilized to condense the zinc fume and to evacuate the liquid metal and the residual gases to atmosphere. In other words, the longitudinal walls and the bottom of the reaction chamber, either or both, are utilized as the condenser.

The reaction and its result represented by the classical formula, $\text{ZnO} + \text{C} = \text{Zn} + \text{CO}$, is not ordinarily precisely realizable in practice; which is due to impurities in the reacting materials. However, as the present applicant has set forth in his patent No. 1,030,350, of June 25, 1912, it is nevertheless quite feasible not to collect sufficient inert residual matter to materially interfere with runs of satisfactory duration.

The accompanying drawing illustrates one form of apparatus in which the invention is realized.

In said drawing: Figure 1 is a longitudinal center section, as on the lines A and B, of Figs. 2 and 3; Fig. 2 is a top plan view, developed from the plane S of Fig. 1; Fig. 3 is an elevation, as from the right or left hand ends of Fig. 1, and Fig. 4 is a transverse center section, as on the lines C and C', of Figs. 1 and 2.

P denotes the power circuit; D, D', the carbon terminals; H the bed-of-carbon resistor; J the charge; M the resistor-sole or hearth; N, N', the reaction chamber side-walls; R a cover and T the reaction chamber.

The drawings purposely indicate what is regarded as a simplest possible construction which realizes the invention. In building the furnace and condenser illustrated the hearth and the reaction chamber side walls are constructed of spaced suitable refractory bricks, blocks, slabs or tiles, as 5, which are set without mortar or cement (as in the usual manner) and the adjacent non-contacting surfaces provide therebetween fissures, slits, slots or crevices. These crevices may be vertical, as 6, or horizontal, or approximately horizontal, as 7, and both of these vertical and horizontal fissures may be combined in the same wall, or in the

hearth, or in both. But in every case the said fissures or slits are characterized by the fact that their ends open respectively to the reaction chamber and to atmosphere.

5 The brick-work of the furnace should be bound together, as by the outer bracing, 8, Fig. 3, and by the embedded tie-rods, as 9, Fig. 4. In order to take the thrust of the bracing and also to maintain the initial spacing of the refractories, thin strips, or buttons, as *i*, are variously inserted between the adjacent members, or such strips or buttons may be substituted by dabs of cement.

10 It is to be borne in mind that igneously produced or commercial oxid of zinc and coke or coal (carbon), as employed in a commercial operation, contains a sensible amount of moisture, entrained or in chemical combination; hence when a charge of these materials is inserted in the furnace the first effect will be to produce and drive off this moisture in the form of vapor. It is also a fact that CO' forms at a temperature considerably lower than and up to and even beyond that at which the reaction begins and when CO is evolved. The consequence of the foregoing conditions is that a certain volume of hydrous vapor and gas will be primarily produced in the reaction chamber and will find escape through the numerous fissures that are located at the sides of the charge and also at the sides and the bottom of the previous resistor. As this vapor and gas will be under some pressure it will prevent the entry of air and will also assist in progressively heating the sidewalls of the fissures. In the meantime the inner faces of the refractories, adjacent to the reaction chamber, will become heated to a temperature approximating that of the resistor and the charge, while the said refractories will be heated by conduction in a progressively diminishing ratio toward their outer surfaces. The foregoing conditions are favorable to the condensation of zinc-fume to liquid metal.

When the reaction is in progress the volatilized products thereof ($Zn+CO$) will more or less permeate the charge and the resistor thence passing to the hot inlets of the fissures and finally traversing through their constantly diminishing zones of temperature. The result thereof is that the zinc fume will condense and trickle down the side-surfaces of the fissures, as indicated by the arrow *n*, while he CO, as indicated by the arrows *x*, will pass into the atmosphere as such or it may be burned to CO'.

The liquid zinc formed in the fissures of the bottom, or hearth, may be conveniently collected in an underlying receptacle, as 10, while that produced in the side-walls may be permitted to flow down their outer surfaces into collecting troughs, as 12, Fig. 4.

It will be evident that the uniformity of

the reaction, along the zone of the reaction, will be indicated by the discharge of zinc and CO from the numerous fissures or vents and thereby, as when the flow from the hearth-fissures becomes diminished, this will serve as a signal that inert residual matter in or beneath the resistor has accumulated. Yet, even if or when the fissures beneath the resistor become clogged, this would not necessarily terminate a period of operation, as the furnace may still be run up to the maximum rate at which the side-walls will in themselves effectively condense. Consequently, there may be portions of a total period when all, or essentially all, of the condensation is effected in the walls.

The charging of the furnace may either be of a character to effect continuous or intermittent operation, as circumstances may determine. Thus, if continuous the cover may be omitted in which case the side-walls or at least the upper portions thereof would be built up without fissures, thereby forming a shaft or trench in which an over-burden of charge-material can readily be maintained.

It is preferable that the width of each discharge slot or fissure should be comparatively narrow and that the aggregate cross-sectional or flow-area of all the fissures shall bear a certain relation to the evolved volume of fume and gas; for if the said area is too great a back-flow of air may result, producing oxid, or if too restricted the pressure and velocity of discharge would be objectionable. The fissures should be of sufficient width so that in case they should become clogged they could readily be cleaned.

While this system of condensing has been described as combined with a broken bed-of-carbon resistor it is not necessarily restricted thereto in that it is applicable to various other modes of producing reaction by electric energy, as, say, by means of an overhead resistor acting upon the charge by radiated heat. The "horizontal" fissures may be inclined whereby to effect a more rapid outflow of condensed zinc.

I claim as my invention:

1. An electric zinc furnace having a fume condensing system contained in the longitudinal side-walls and sole or bottom of the reaction chamber.

2. An electric zinc furnace having at the sides of a bed-of-carbon resistor longitudinally extending walls between which is located the reaction chamber and below the resistor a sole or bottom, each of the walls and the bottom being provided with a plurality of fissures the ends of which open respectively to the reaction chamber and to atmosphere.

3. A combined electric zinc furnace and condenser in which the longitudinal side-walls and sole or bottom of its reaction

chamber are provided with a plurality of spaces or fissures opening respectively to the said chamber and to atmosphere.

4. In the metallurgy of zinc an electric furnace having a carbon resistor adapted to support a superimposed charge of reacting material bounded by pierced walls in which zinc fume is condensed and from which the residual fume and gases escape directly to atmosphere.

5. An electric zinc furnace having a carbon resistor arranged so that a charge of reacting material can be placed on the resistor in physical contact with retaining walls which are provided with a plurality of horizontally disposed continuous condensing channels, ducts, slits or fissures that lead directly from the reaction chamber to atmosphere.

6. An electric zinc furnace, a reaction chamber whose longitudinal side walls have portions that are contiguous to a bed-of-carbon resistor and the zone of the charge-reaction, and which are formed from tiles,

slabs, bricks or blocks, so laid or set as to produce a plurality of horizontally disposed continuous ducts, slots, vents, slits, or fissures in which the fume is condensed and from which residual fume and gases escape directly to atmosphere.

7. In the metallurgy of zinc an electric furnace having therein a reaction chamber whose side walls are provided with narrow crevices or openings for condensing therein vapor to liquid zinc.

8. An electric zinc furnace provided with a bed-of-carbon resistor supported on a wall having narrow crevices or openings through which products of the reaction pass and in which the zinc fumes are condensed to liquid zinc.

This specification signed and witnessed this 5th day of May A. D. 1913.

CHARLES VICTOR THIERRY.

Signed in the presence of—

RAOUL THOMAS,
HANSON C. COXE.