Sept. 5, 1933. W. A. OGG 1,925,458

EFFECTING ENDOTHERMIC REACTIONS

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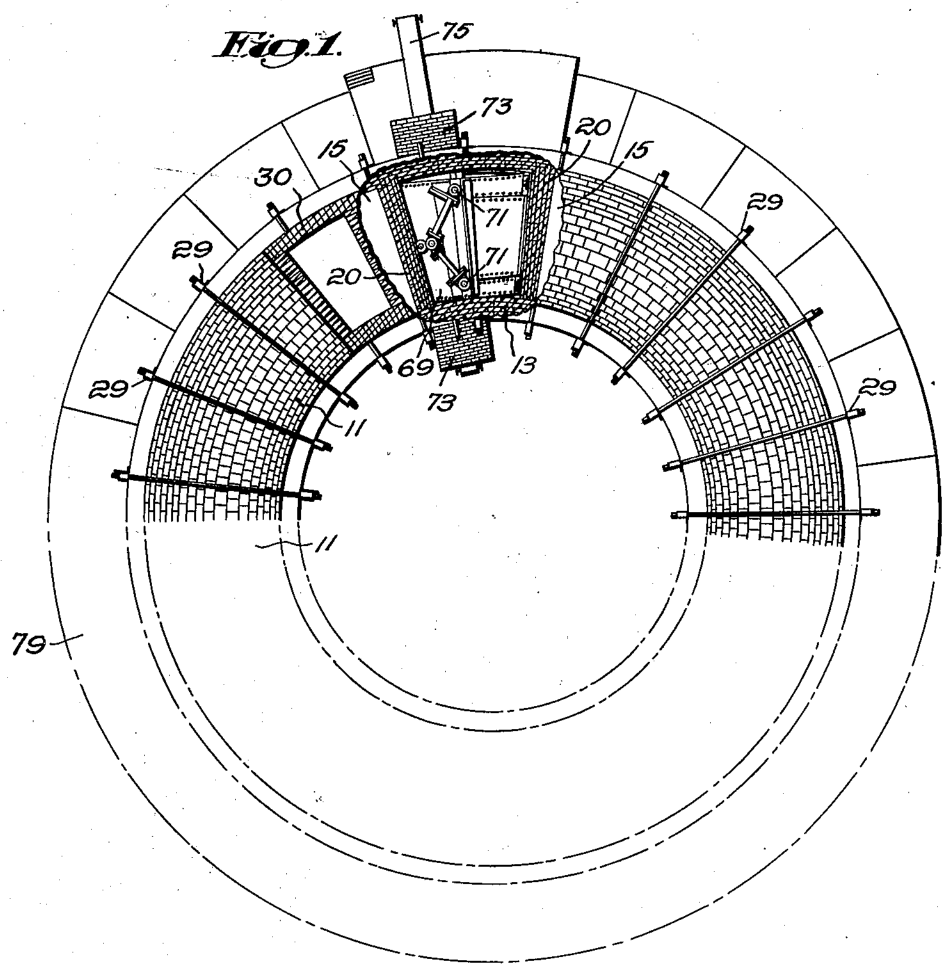
Fig. 1.



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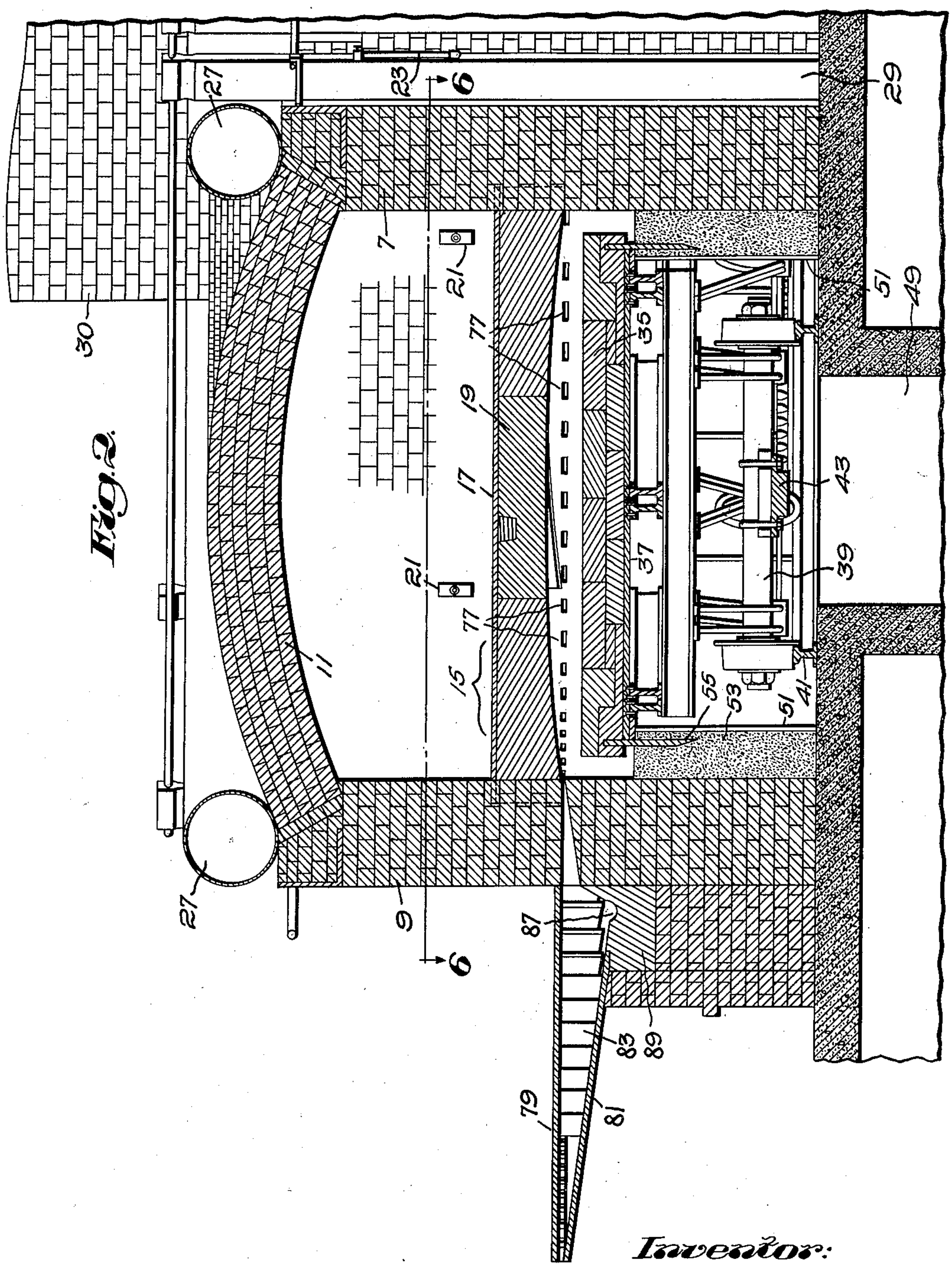

Fig. 2

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Fig. 3.

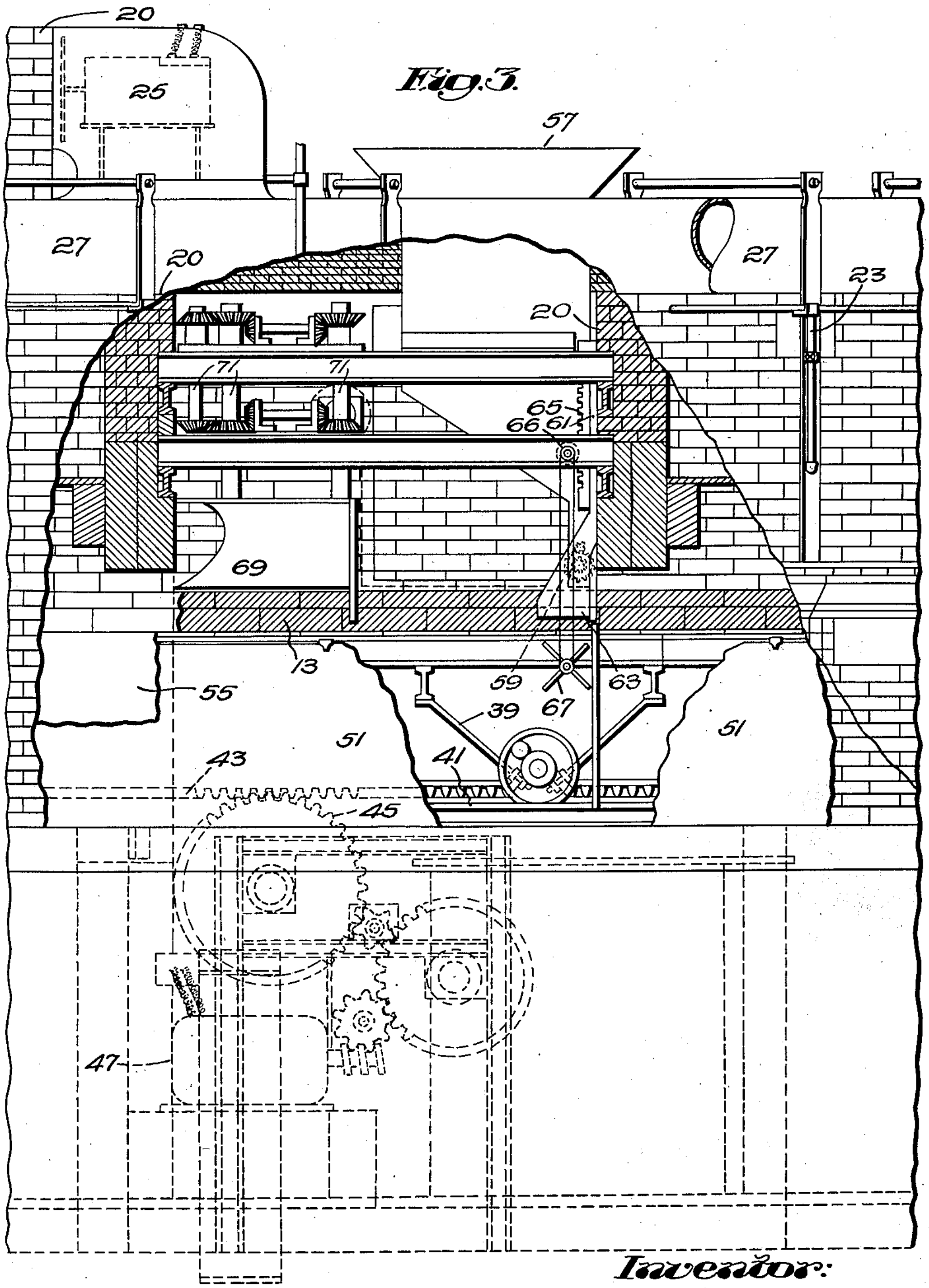

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Fig. 4.

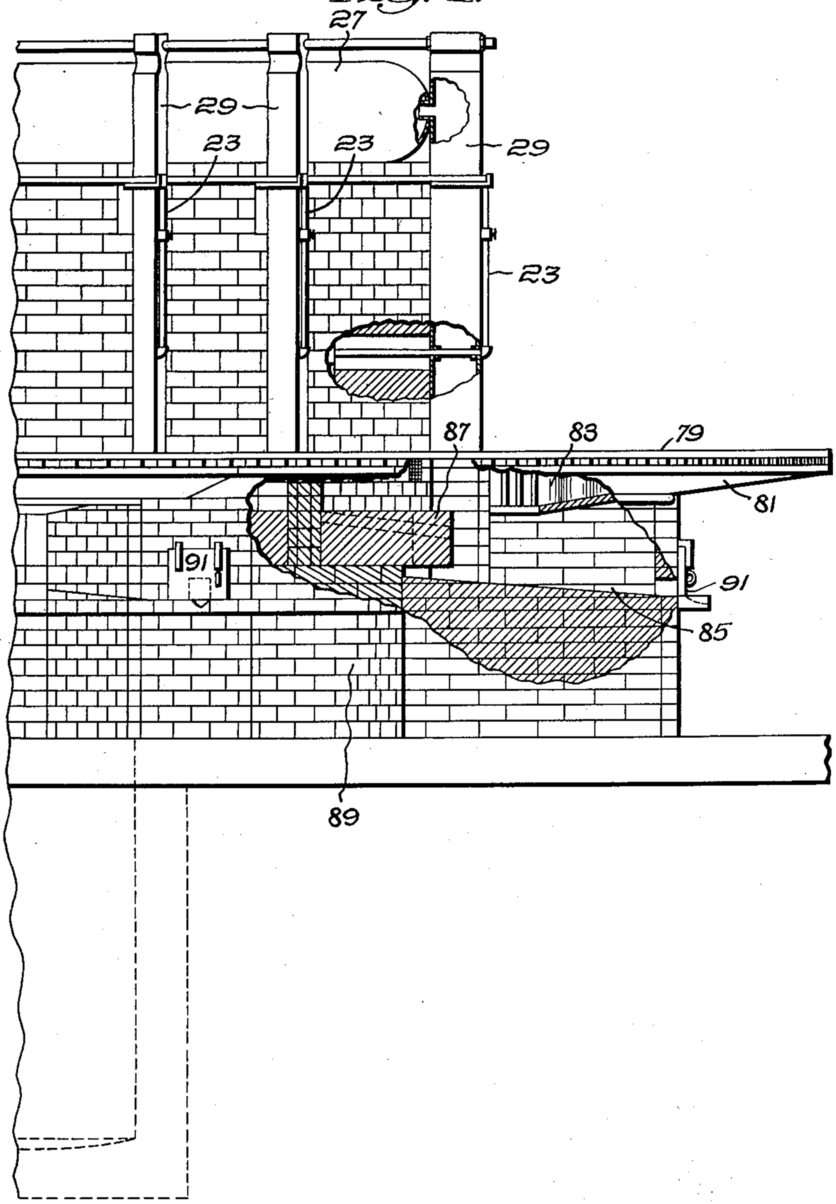

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Fig. 5.

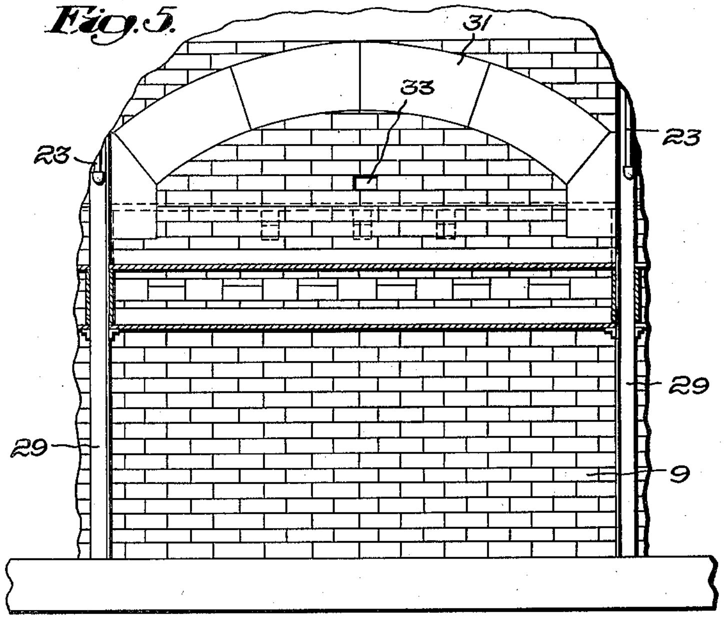
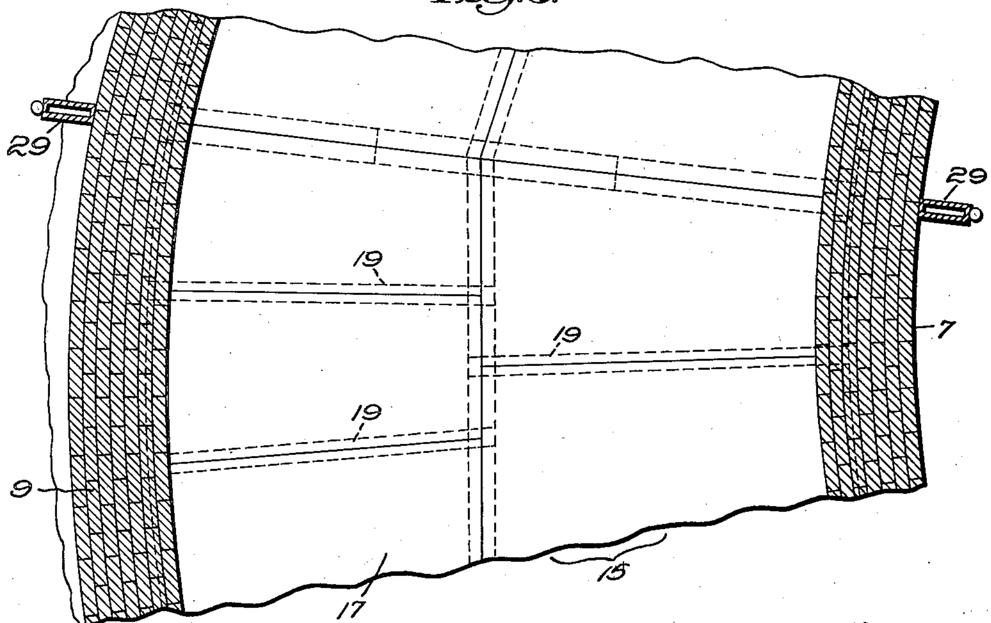


Fig. 6.



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Patented Sept. 5, 1933 **1,925,458**

UNITED STATES PATENT OFFICE

1,925,458

EFFECTING ENDOTHERMIC REACTIONS

William A. Ogg, Newton, Mass.

Application January 15, 1931. Serial No. 508,924

5 Claims. (Cl. 75—28)

This invention relates generically to a method for effecting endothermic reactions and in particular in one of the embodiments thereof to the recovery from crude materials of the metal values of volatile metals, notably zinc.

My invention is characterized by the application of heat substantially by radiation only with resultant avoidance of disadvantages incident to prior methods. The principle of my invention will be well understood by consideration of the specific application of the same to zinc smelting and I have shown in the accompanying drawings an illustrative embodiment of a zinc smelting furnace designed for the production of spelter. After I have described the construction of the particular furnace shown reference to certain preferred methods of its operation will indicate in an illustrative manner the improved method of my invention.

In the drawings:—

Fig. 1 is a plan of the furnace;

Fig. 2 is a radial section on a larger scale;

Fig. 3 is an interior elevation with parts broken away showing the charging and discharging means;

Fig. 4 is a partial side elevation with parts broken away;

Fig. 5 is a fragmentary exterior side elevation; and

Fig. 6 is a section on the line 6—6 of Fig. 2.

Referring first to Fig. 2 of the drawings, I have there shown a furnace structure embodying side walls 7 and 9 and a roof 11 of suitable masonry construction. The particular furnace shown is adapted for continuous operation, if desired, and is therefore conveniently of the partly annular form illustrated in Fig. 1, a chamber 13 completing the annulus and being not heated but providing for housing the loading and discharging mechanism hereinafter to be described. Referring again to Fig. 2, the furnace chamber formed by the walls 7 and 9 and the roof 11 may be divided by a horizontally extending partition 15 of high heat-conducting capacity, herein shown (see also Fig. 6) as formed of plates 17 of silicon carbide (carborundum) or the like supported on beam-like supports 19 which may be formed of suitable silica brick shapes. The partition 15 and the roof 11 together with suitable end walls 20 (Fig. 3) define a heating chamber in which gases may be burned to provide for radiating heat through the partition 15. Herein a mixture of fuel gas and air is supplied through the ports 21. The gas may be supplied through pipes 23. Air for combustion may be forced by a blower 25 (Fig. 3) through mains 27 at either side of the furnace chamber to the hollow buckstays 29 through which it is delivered to the combustion chamber. Stack 30 provides for carrying off the products of combustion.

Access to the heat radiating partition 15 may be provided (see Fig. 5) by constructing arches 31 in wall 9, permitting the bricks beneath the same to be removed when desired. Removable bricks 33 for inspection purposes are provided.

The heat radiated from the partition 15 is applied to the material to be treated on a suitable table or support 35 of refractory material opposing the same, the table and the partition constituting walls of a reaction chamber. Herein the table 35 is annular and may be built up from suitable silica shapes mounted on metal plates 37, which are in turn supported on trucks 39 running on the circular rails 41. An annular rack 43 attached to the dead axles of the trucks is engaged (see Fig. 3) by a pinion 45 driven through a suitable train of gearing by the electric motor 47 whereby the table may be rotated beneath the arch. A suitable pit 49 between the tracks provides for access to the trucks and other mechanism.

Suitable means are provided for sealing the reaction chamber and herein retaining walls 51 adjacent the side walls of the furnace chamber provide receptacles for receiving a body of sand 53 into which dip seal aprons 55 consisting of plates, preferably of chrome iron alloy, depending from the sides of the table 35.

Referring now to Figs. 1 and 3, opposing the table at the discontinuity of the partly annular furnace chamber and received within the unheated chamber 13 above referred to are means to feed the material to be treated to the table 35 and to remove residues therefrom. Referring to Fig. 3, the table 35 may be considered to move left to right in that figure. In the present instance the table is charged with loose, uncompacted, granular material. A hopper 57 opposes the table and may be provided with suitable means 59 for positively feeding material therefrom. A regulating plate 61 extending over the top of the table 35 between the side plates 63 may be raised and lowered by means of the rack 65 connected thereto and herein shown as driven by a suitable pinion 66 chain driven from a hand wheel 67 and will determine the depth or thickness of the layer of material delivered to the table. Material piled up by the hopper in front of the regulating plate serves as a seal for the intake end of the furnace chamber. To remove material from the surface of the table 35 as it passes from the furnace chamber I may provide a plow 69 adapted to be raised and lowered by means of the intergeared screw shafts 71. The plow may be utilized to clear off the table after it passes from beneath the heat radiating wall and before it re-enters the furnace chamber. The residues discharged by the plow may be dumped to the hoppers 73 (Fig. 1) and carried off by the belt conveyor 75.

The volatile products produced in the reaction chamber may be withdrawn therefrom (see Fig. 2) through the ports 77. In the present instance these volatiles comprise zinc vapors which may be condensed in condensers formed by the upper and lower annular series of plates 79 and 81 projecting from the side wall 9, the condensing chamber between these plates being provided with suitable baffles 83. The lower plate 81 slopes inwardly and downwardly as shown so that the condensing metal drains inwardly either (see Fig. 4) to one of the spelter collecting pots 85 located at intervals about the furnace wall or to an inclined channel 87 of one of the blocks 89, which channel discharges to a collecting pot 85. Suitable doors 91 permit the metal collecting in the pots 85 to be tapped off at suitable intervals.

Since the annular construction of furnace herein shown is adapted for continuous operation, it will facilitate understanding of the more comprehensive scope of my invention if I first describe that method of operating this particular furnace. The table 35 may be slowly and continuously rotated while there is deposited thereon from the hopper 57 a thin layer, preferably pulverulent and uncompacted, of mixed roasted zinc ore (crude zinc oxide) and reduction material to a depth of, say, half an inch or preferably much less, and as the table so charged rotates beneath the radiating wall 15 the metal is distilled off. Radiant heat is effective on the exposed surface of the charge on which it falls, which surface is in some degree renewed as the reaction proceeds, and, referring to a layer of the thinness described, is effective by conduction throughout the layer, at least during the continuance of the process, to such an extent that substantially constant thermal efficiency is attained, the evolution of vapors being at a substantially constant rate, the curve of production dropping, as would be expected, towards the end of the process when a substantially complete commercial yield of metal values has been attained but quite sharply. There is no such accumulation of residues and/or excess fuel as occurs adjacent the wall of a loaded retort to present an effective impediment to heat transmission and cause a marked decrease in efficiency. Cadmium is usually present and will be disengaged first. As there are a number of collecting pots, a selective separation of the cadmium is thus provided for. At the completion of the rotation any residues remaining on the table may be scraped off by the plow 69. Alternatively the plow may be intermittently operated only after the table has completed a number of revolutions, successive deposits of reaction material being made, each layer being on the residue of the old, a fresh, thin layer of material always being exposed in opposition to the heat radiating wall. The residue may accumulate to a considerable amount and then be scraped off.

I have described the table as being continuously and slowly rotated, but obviously it may be rapidly turned to load and stopped to remain stationary with its charge in opposition to the heat radiating wall for as long as is necessary or desired to effect the reaction. When solid reduction material is mixed with the crude oxide, to obviate the heat insulating effect of the excess of material it is preferable to use it in substantially theoretical proportions and utilize material as ash-free as possible. For instance, oil coke is commercially feasible and contains little ash. In this case the mixture wastes away substantially completely to expose fresh surfaces to radiant heat without substantial accumulation of ash and gangue to form a heat intercepting layer. Therefore a layer of crude oxide and reduction material of a considerable thickness, say about four inches, may be deposited on the table, advanced into the furnace and treated, the material wasting away substantially completely so that successive strata are effectively subject to radiant heat, the conduction in the initially thick layer not being relied upon. This wasting away may, I believe, be facilitated in certain instances by a slagging of the inert constituents of the crude oxide used, the resultant slag trickling through the unreduced ore to the bottom. This conception of the action is deduced from the character of the residual products. While the slag may absorb a certain amount of zinc which cannot be directly recovered in the process, the resultant removal of inert material from the top of the unreduced zinc oxide and carbon in such manner that it will not interfere with the radiation of heat to the material permits the use of thicker layers.

In the case of treating blue powder in which no gangue is present and but very little carbon is required to reduce the material, the layer might be a foot or even more in thickness.

In the smelting of zinc in the prior art the crude oxide and reduction materials have been packed in externally heated retorts. Heat was applied to the mixture by conduction. This is slow and inefficient. Obviously there was a great loss of thermal efficiency in treating the central portion of the retort charge as compared with those portions in contact with the wall. In the treatment of finely divided material in order to provide such porosity to the charge as would permit heat conduction, an excess of fuel was used, in itself having insulating qualities and objectionably contaminating the residues. In some instances charges have been built up of briquets but the same condition of inefficient conduction to the center of the briquets has prevailed while the shape-retaining quality of the briquets has prevented access of heat to the interior. In the arrangement herein described the application of heat is substantially by radiation only to a charge disposed in such manner that a large area of reaction material may be treated with substantially constant thermal efficiency. Rapid and thorough disengagement of the metal values is effected. The mechanism is simple and the labor costs are low.

While I have particularly described the operation of zinc smelting, the application of the principles of my invention to other materials will be well understood.

I am aware that the invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and I therefore desire the present embodiment to be considered in all respects as illustrative and not restrictive; reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

I claim:

1. The method of recovering zinc from an uncompacted mixture of crude oxide and carboniferous reduction material characterized by the features that the mixture is treated in an indirectly heated furnace as an extended mechanically undisturbed layer and that heat is applied substantially uniformly throughout the surface of the layer substantially by radiation alone, the layer being of such maximum thickness that the residue accumulated during the complete utilization of the material during the process will not substantially impair the transfer of heat, as manifested by a substantial decrease in the rate of vapor evolution.

2. The method of recovering zinc from an uncompacted mixture of crude oxide and carboniferous reduction material characterized by the features that the mixture is deposited on a support in an indirectly heated furnace in successive layers and that heat is applied to said layers substantially uniformly over the surface thereof substantially by radiation alone while they remain mechanically undisturbed, each layer being of such maximum thickness that the residue accumulated during the complete utilization of the material during the process will not substantially impair the transfer of heat, as manifested by a substantial decrease in the rate of vapor evolution.

3. The method of recovering zinc from an uncompacted mixture of crude oxide and carboniferous reduction material characterized by the features that the mixture is applied in a layer to a support in an indirectly heated furnace on which support it rests mechanically undisturbed and that the surface of such layer is exposed substantially uniformly throughout its area to a source of radiant heat, such layer being of such maximum thickness that the residue accumulated during the complete utilization of the material during the process will not substantially impair the transfer of heat, as manifested by a substantial decrease in the rate of vapor evolution.

4. The method of recovering zinc from an uncompacted mixture of crude oxide and carboniferous reduction material characterized by the features that the constituents of said mixture are supplied in substantially theoretical proportions and exposed in a mechanically undisturbed extended layer in opposition to an externally heated radiator substantially coextensive with the surface thereof to be heated substantially entirely by radiation therefrom, whereby the layer is adapted substantially entirely to waste away at its heat exposed surface and to present fresh material to the incident radiant heat and the residue accumulating during the process will not substantially impair the transfer of heat, as manifested by a substantial decrease in the rate of vapor evolution.

5. The method of recovering zinc from an uncompacted mixture of crude oxide and carboniferous reduction material characterized by the features of successively depositing layers of the mixture on a support in an indirectly heated furnace, each layer being of such maximum thickness that the residue accumulated during the complete utilization of the material during the process will not substantially impair the transfer of heat as manifested by a substantial decrease in the rate of vapor evolution, exposing each layer successively while the material therein rests mechanically undisturbed on the support to radiant heat applied substantially uniformly throughout its area to effect the reaction and at less frequent intervals removing the accumulated residue.

WILLIAM A. OGG.