Oct. 3, 1939. G. ANDERSON ET AL 2,174,559

VAPORIZING FURNACE FOR ZINC AND OTHER METALS

Filed May 28, 1937 3 Sheets-Sheet 1

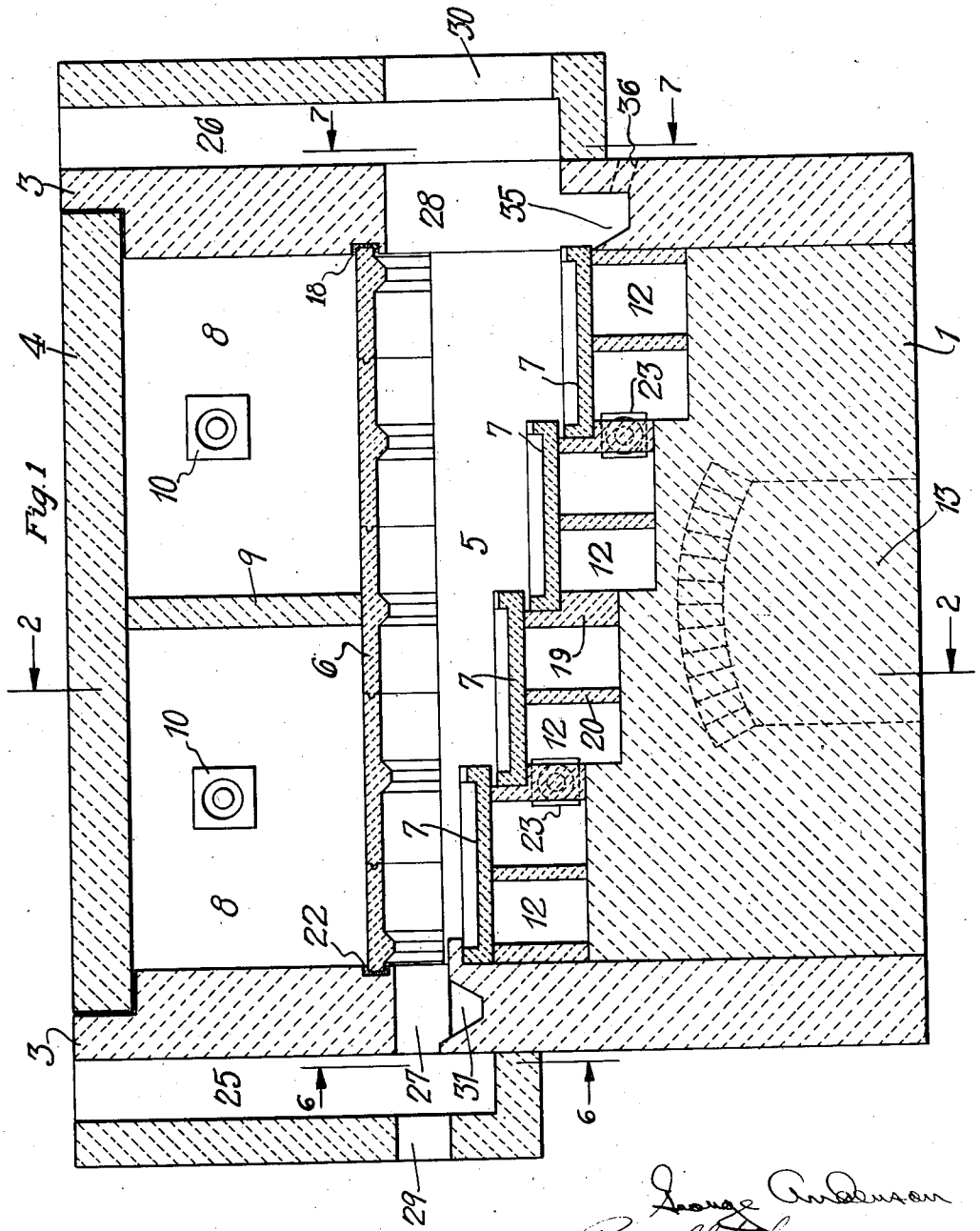


Fig. 1

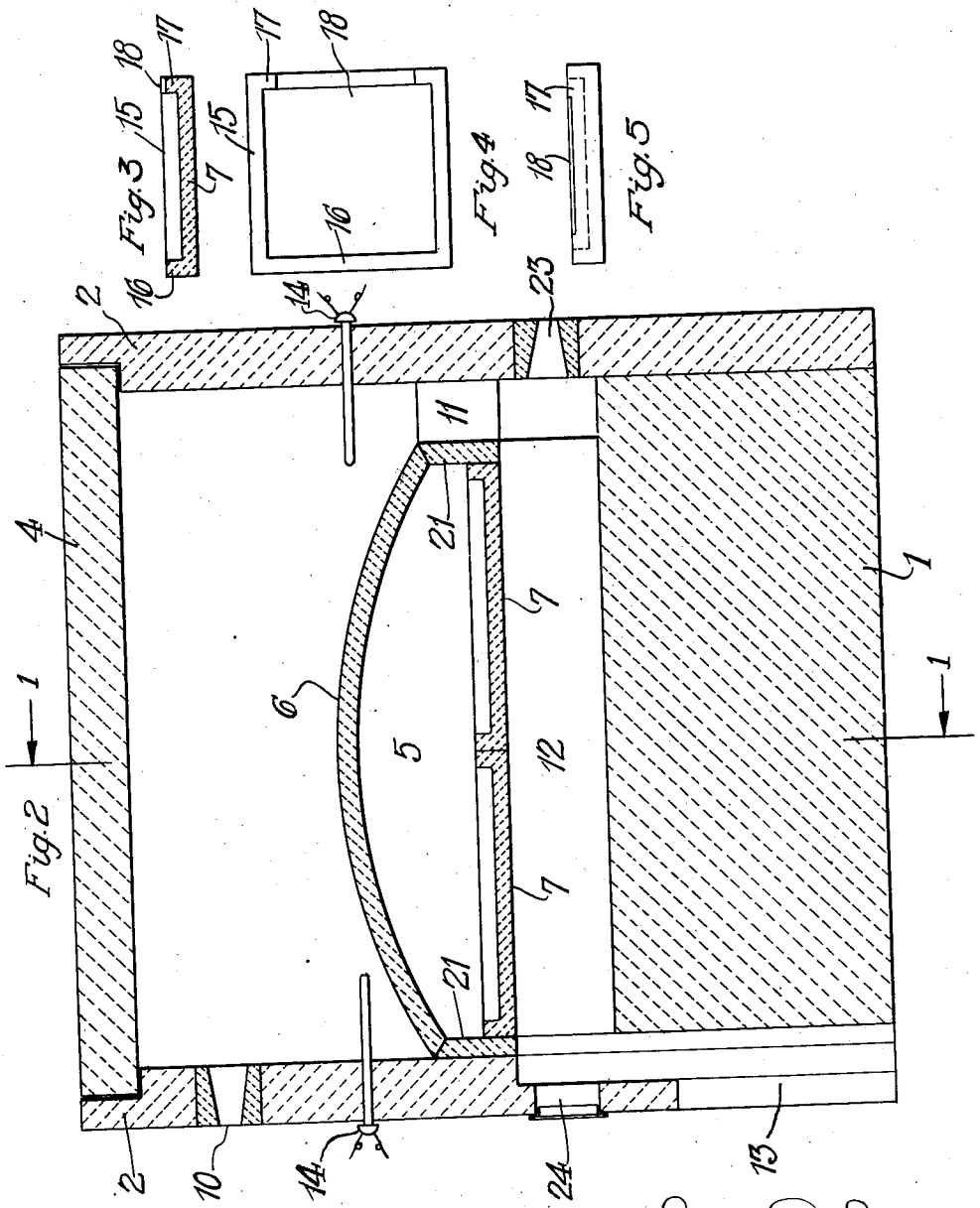
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VAPORIZING FURNACE FOR ZINC AND OTHER METALS

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Filed May 28, 1937 3 Sheets-Sheet 3

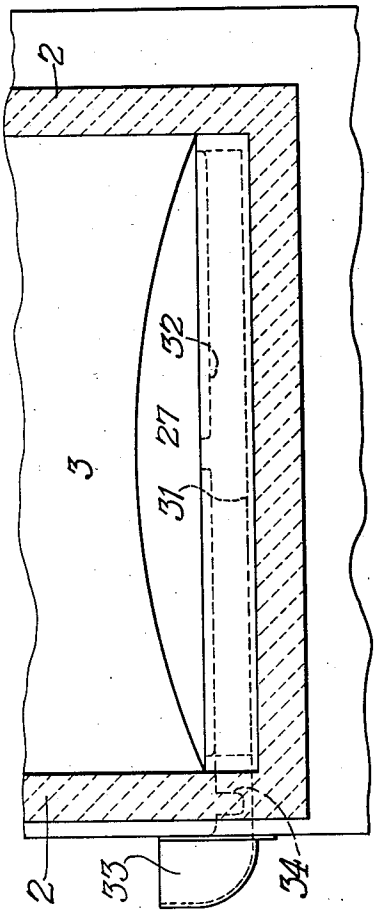


Fig. 6

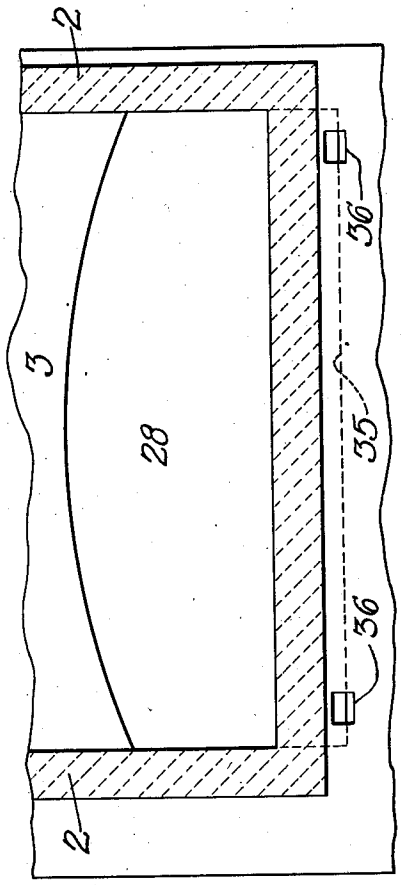


Fig. 7

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VAPORIZING FURNACE FOR ZINC AND OTHER METALS

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Application May 28, 1937, Serial No. 145,258

10 Claims. (Cl. 266—19)

The invention aims to provide improvements in furnaces and methods for vaporizing zinc and other metals which permits of the vaporizing of an unusually large quantity of metal rapidly and efficiently and with other advantages referred to in detail hereinafter.

Fig. 1 is a longitudinal vertical section of a furnace approximately on the line 1—1 of Fig. 2. Fig. 2 is a cross-section of the same approximately on the line 2—2 of Fig. 1. Figs. 3, 4 and 5 are respectively a longitudinal vertical section, a plan and an end elevation of a tray. Figs. 6 and 7 are respectively transverse sections on the lines 6—6 and 7—7 of Fig. 1.

The furnace is built with a bottom 1, side walls 2, end walls 3 and a top wall 4 of any usual or suitable refractory brickwork. A vaporizing chamber 5 extends continuously between the opposite end walls. It has a roof or cover 6 in the form of an arch built of blocks of silicon carbide, or other suitable refractory material of high heat conductivity. The base of the vaporizing chamber consists of a succession of trays 7 which may be of the same material as the roof. Above the roof of the vaporizing chamber are heating chambers 8 separated by a partition 9. Each has one or more burner openings 10 at one side. The combustion gases or heating gases pass through the chambers 8 and then by way of downward passages 11 at the opposite side of the vaporizing chamber through passages 12 leading across the furnace under the vaporizing chamber and outward through a port 13 to a smoke stack. Pyrometers 14 at opposite ends of each of the upper heating chambers extend through the walls so as to indicate to observers on the outside, and preferably also to record, the temperatures within the heating chambers at these points. Each of the trays 12 is an integral structure with low walls adapted to hold shallow pools of molten metal. They are shown in the form of a cascade at successively lower levels so that the metal will overflow from each one into the one next below it.

Figs. 3, 4 and 5 show the tray with low side walls 15 and a front wall 16 with a rear wall 17 having a notch 18 extending across its width through which the molten metal overflows into the next tray. Or the trays may be arranged all on the same level with the molten metal flowing from one to the other.

Each tray is supported individually as by walls 19 and 20 between which the passages 12 are located. Each tray carries only a small load and it is possible to remove broken units and replace the same with new parts without having to shut down the furnace or interrupt operations in the rest of the structure.

Fig. 2 shows the units still further reduced by the provision of two trays 7 in the width of the furnace. The size of the trays being determined, the width and length of the furnace may be made to accommodate a greater or smaller number of trays as desired.

The arch 6 of the vaporizing chamber is made of separate blocks with sealed joints sprung between side walls 21, Fig. 2, with cemented joints. The ends of the arch are sealed as in Fig. 1 by entering grooves in the side walls which are filled with a similar refractory cement 22 to form a seal. Thus combustion gases are prevented from entering the volatilizing chamber and zinc vapors are prevented from escaping into the combustion or heating chamber above.

Two openings 23 in one of the side walls lead to the passages 12 under the trays and permit the introduction of hot or cold gases, if it be desired to control the temperature under the trays. By the use of hot gases, or burners, the temperature at the bottom may be raised. Or by the admission of atmospheric air or other cooling gases the temperature may be lowered under the trays. At the opposite ends of the passages 12 are clean-out openings 24, Fig. 2, for removal of any obstruction that may be deposited in the passages. Fig. 1 shows that the two openings 23 are in the same vertical planes with the burner openings 10 in the upper heating chambers. By these means the relative quantities of heat applied at the respective ends of the vaporizing chamber may be varied; and also the quantity and the relation between the heat above and below at each end of the vaporizing chamber.

At both ends of the furnace there are provided outlet flues 25 and 26 respectively communicating through passages 27 and 28 with the vaporizing chamber; the latter being in line with openings 29 and 30 through the outer walls of the flues for direct access to the vaporizing chamber. The flues are connected to any usual or suitable apparatus for the utilization or treatment of the zinc vapors.

The outlets 27, 29 and 28, 30 are also to be used for the purpose of cleaning residual products from the trays. In case of failure of any tray, these openings provide a way of easy removal of broken parts and replacement of new units, without interrupting furnace operations.

At the head of the vaporizing chamber there is arranged a charging trough 31, Figs. 1 and 6, for

the purpose of feeding molten metal to the trays. With this trough it is possible to have the metal flowing continuously into the volatilizing chamber and through the succession of trays at any rate desired, or to charge the trays periodically as in a batch process.

The openings 27, 28, 29 and 30 may also be used for supplying the charge; the openings 29 and 30 being closed during the vaporizing operations.

As shown in Fig. 6, the trough 31 has wide notches 32 over which the molten metal flows into the first tray. The molten metal is introduced into the trough at one end through a chute 33 and flows past a downwardly depending dam 34 forming a trap to prevent the escape of air between the trough 31 and the chute 33.

At the other end, normally the outlet end of the furnace, there is an overflow trough 35 running lengthwise across the furnace with downwardly inclined outlets 36; see Fig. 7. The overflow trough is for the purpose of removing excess metal during charging (either as a batch or as a continuous process) and for removing metal which may be enriched in higher-boiling-point impurities which are not vaporized and not desired in the zinc vapor which is taken from the chamber.

The tap holes 36 are completely plugged or only partly plugged thus permitting either batch or continuous operation. If completely plugged, periodic tapping will be required when more metal is charged than is vaporized. When partly plugged, continuous operation will be possible even though there be a portion of the charge which is not to be vaporized. The vaporizing process may be carried on selectively as hereinafter stated more fully to include in the vapor metals of higher or lower boiling points than the zinc or other metal which constitutes the main charge.

The described furnace has numerous advantages in detail besides the prime advantage of operating at once on a larger area and quantity of molten metal in a single vaporizing chamber than is generally feasible with old methods. The individually supported trays can be easily replaced when broken or damaged, without shutting down the whole furnace; which shutting down would cause premature failure of other units and would slow down production.

The present arrangement of trays also allows easy accessibility to them for cleaning. This is important because in the distillation of zinc certain residues collect in the containers and have to be removed at periodic intervals; which can be done with the present invention without shutting down or materially affecting production schedules.

The trays are very shallow so that the charge is carried in a series of shallow pools with a large area exposed to heat, resulting in an evaporation rate which is several times that of the conventional retort furnaces. This increased evaporating rate is obtained by applying heat at the top through the arch, under the trays and on one side (or by simple modification on both sides) of the vaporizing chamber. This gives a high exposure and a high efficiency in the application of the available heat.

The new design is particularly adapted to be made with vapor tight joints. Also the individual trays contain no joints exposed to hydrostatic pressure of molten metal. It has been found in practice that molten zinc will leak through ceramic joints, a hazard that is eliminated by the present design. The arrangement of the roof and sides of the chamber have been found in practice to hold back zinc vapor at high enough pressures for all ordinary operations. This is important, so as to prevent oxidizing gases entering the vaporizing chamber and crusting the metal bath. It is also necessary to exclude combustion gases. They not only tend to oxidize zinc vapor, but also produce deleterious effects upon the oxides which are made from zinc vapor in zinc oxide processes.

The furnace is designed also for the carrying out of a new selective process. The character of the vapor is controlled so as to permit the removal of vapors of different degrees of purity and containing different percentages of impurities; and the process may even be carried to the point of extracting at one time vapors of different compositions from the two ends respectively of the furnace.

Commercial zinc for vaporizing often contains impurities in the form of other metals, for example, tin and cadmium which are lighter than zinc, and lead and copper which are heavier than zinc. By confining the application of the heat to the top of the molten charge there is less turbulence than where the heat is applied at the bottom or entirely around the retort. There is, therefore, less bringing of the heavier impurities, such as lead and copper, to the surface, and there is less of these elements in the vapor taken off, and more of the light impurities, such as tin and cadmium. Conversely if the quantity of head applied to the bottom is greater there will be a turbulence in the bath, the heavier metals such as lead and copper will be carried to the surface and taken off in the vapor to a greater extent.

The arrangement illustrated permits adjustment of the operation in order to selectively secure a vapor of different compositions. By admitting cooling air through the ports 23 into the lower passages 12 under the trays, the bottom of the charge will be the coolest. There will be little turbulence, the evaporation will be confined largely to the surface and to the metals at the surface including the lighter impurities. By introducing hot gases, however, into the passages 12 the temperature at the bottom of the charge may be brought up so as to increase turbulence in the charge which will carry the heavier impurities to the surface and vaporize them with the zinc.

Again, we may vary the conditions at different ends of the furnace, Fig. 1. At the right-hand end we may introduce hot gases in the passages 12 sufficient to cause an agitation of the charge and a vaporizing of the heavier elements, drawing them off through the right-hand opening of the stack 26. At the same time, at the left end, we may introduce cooling current through the opening 23 into the lower passages 12 which will tend to a quiet vaporization from only the surface of the charge; drawing off through the left-hand flue 25 this vapor containing a larger percentage of the light impurities. Which of these methods we adopt depends on the composition of the tin and on the use to be made of the resulting vapors.

Various modifications may be made without departing from the invention as defined in the following claims.

What we claim is:

1. A vaporizing furnace for zinc or other metals having a vaporizing chamber and a metal supporting floor for said furnace comprising a

series of trays each independently supported in said chamber so as to carry only its own load of molten zinc.

2. A vaporizing furnace for zinc or other metals having a vaporizing chamber and a metal supporting floor for said furnace comprising a series of trays each independently supported in said chamber so as to carry only its own load of molten zinc, said trays being separately removable.

3. A vaporizing furnace for zinc or other metals having a vaporizing chamber and a metal supporting floor for said furnace comprising a series of trays in said chamber in which the molten zinc is carried, said trays being arranged at successively lower levels so that molten zinc overflows from one into the next.

4. A vaporizing furnace for zinc or other metals having a vaporizing chamber and a metal supporting floor for said furnace comprising a series of trays therein and means for feeding molten zinc thereto.

5. A vaporizing furnace for zinc or other metals having a vaporizing chamber, a metal supporting floor for said furnace comprising a series of trays removably supported in said chamber, a roof over said trays and a heating chamber over said roof.

6. A vaporizing furnace for zinc or other metals having a vaporizing chamber, a metal supporting floor for said furnace comprising a series of trays removably supported in said chamber, a roof over said trays and a heating chamber over said roof and means for applying heat also beneath said trays.

7. A vaporizing furnace for zinc or other metals having a vaporizing chamber, a metal supporting floor for said furnace comprising a series of trays removably supported in said chamber, a roof over said trays, a heating chamber over said roof, means for applying neat also beneath said trays and means for varying the relation between the quantities of heat applied above and below the vaporizing chamber.

8. A vaporizing furnace for zinc or other metals having a vaporizing chamber, a metal supporting floor for said furnace comprising a series of trays removably supported in said chamber, a roof over said trays, a heating chamber over said roof, means for applying heat also beneath said trays, means for varying the relation between the quantities of heat applied above and below the vaporizing chamber and means for varying the operation at different ends of the chamber so as to produce vapors of different compositions, and means for taking off at the opposite ends such vapors of different compositions respectively.

9. A vaporizing furnace for zinc or other metals which comprises a plurality of metal holding trays positioned to form a metal holding furnace floor, a common vapor receiving chamber above said floor, and means to supply molten metal to said furnace at one side of said floor, said trays being arranged to permit a flow of molten metal from one tray to another of said floor.

10. A vaporizing furnace for zinc or other metals which comprises a plurality of metal holding trays positioned at successively lower levels from one side of the furnace to the other to form a continuous floor for said furnace, a common vapor receiving chamber above said floor, and means to supply molten metal at one side of said furnace to the uppermost of said trays, said trays having overflow edges to permit said metal to flow from a tray at a higher level to one at a lower level.

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