May 9, 1933. C. HAHN 1,908,632

ZINC FURNACE

Filed May 14, 1931 4 Sheets-Sheet 1

Fig. 1

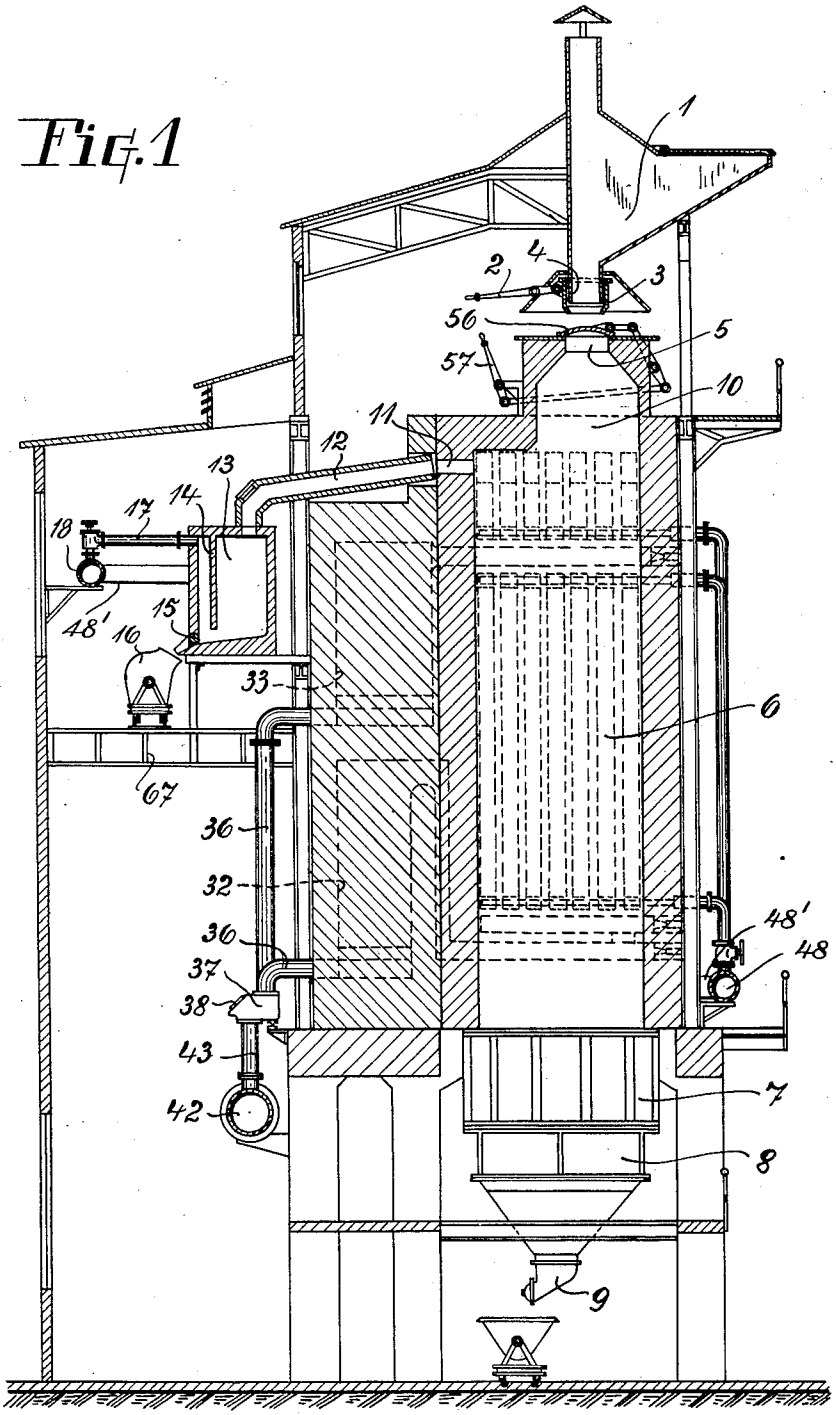

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Fig. 2

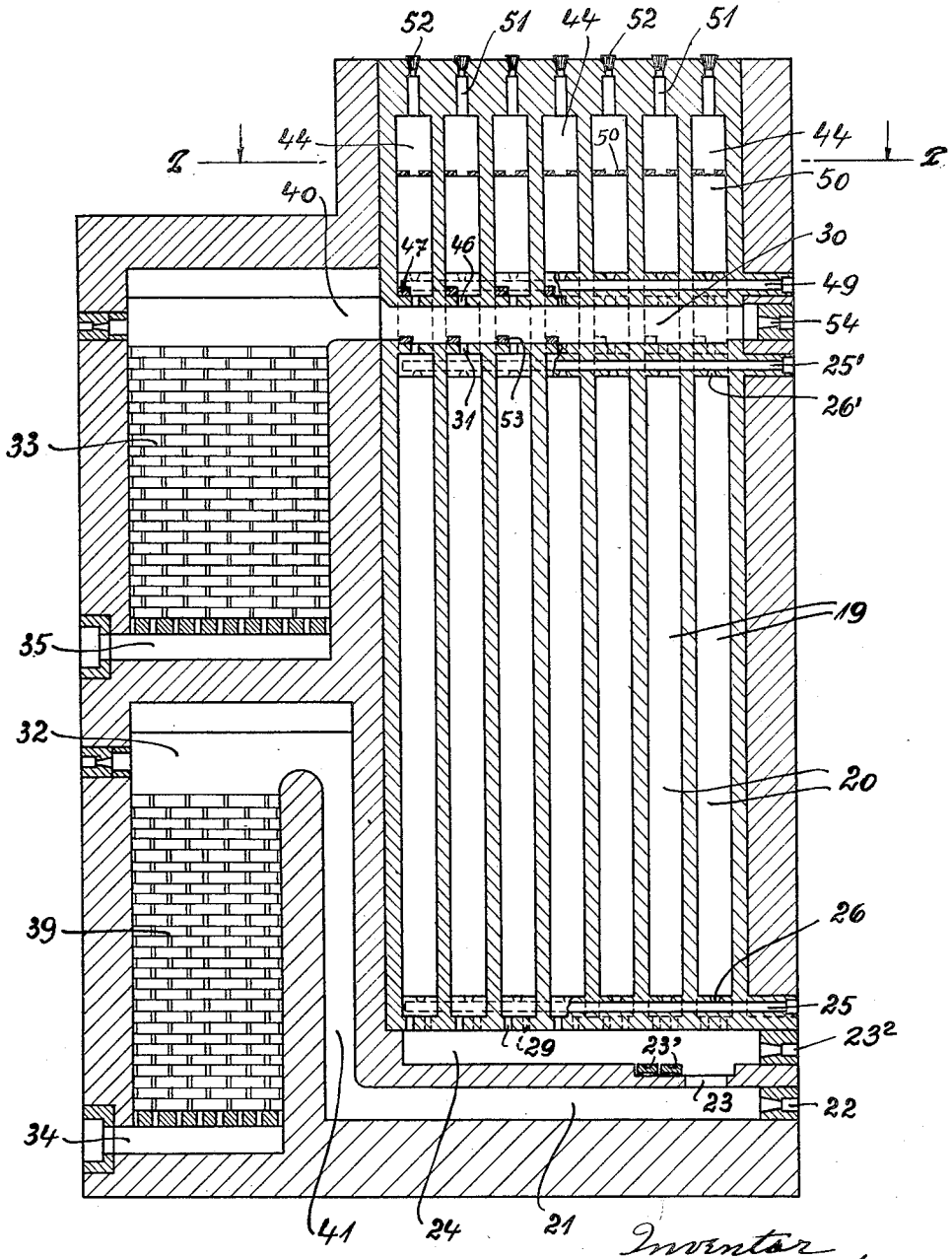

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Fig. 3

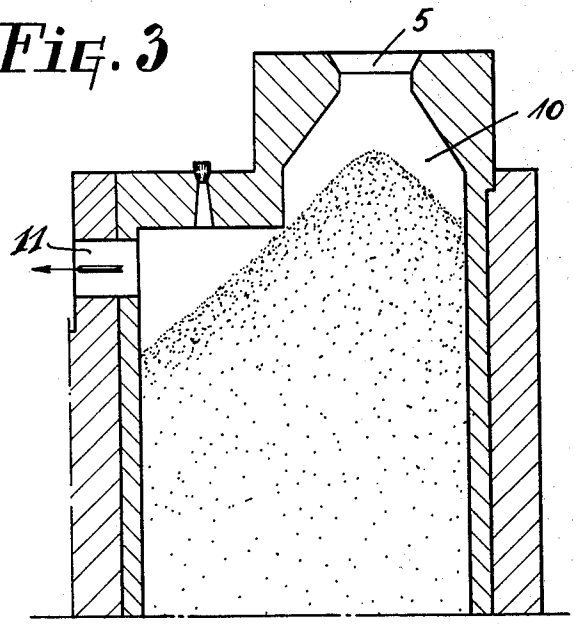

Fig. 5.

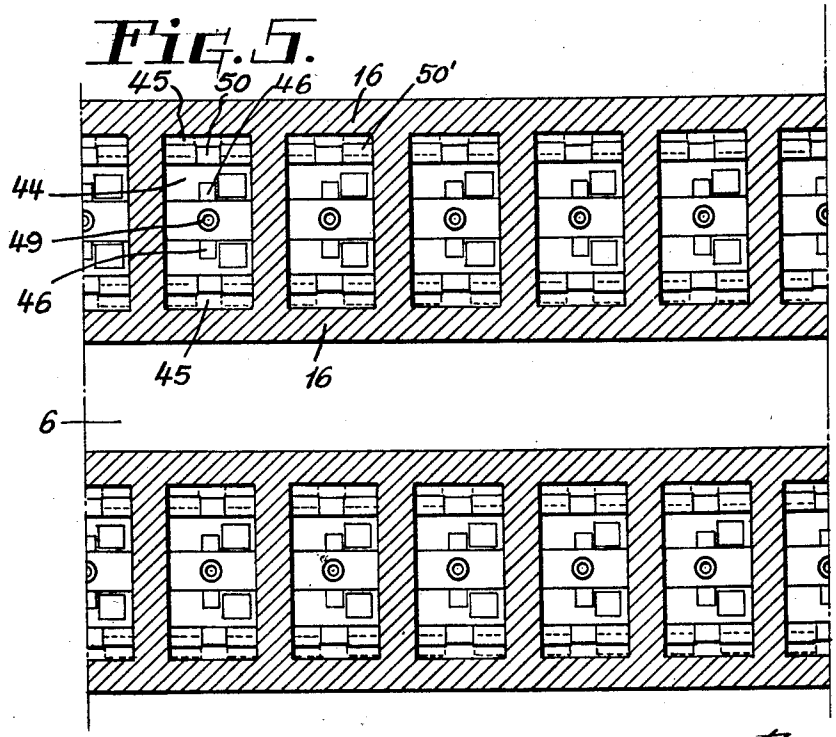

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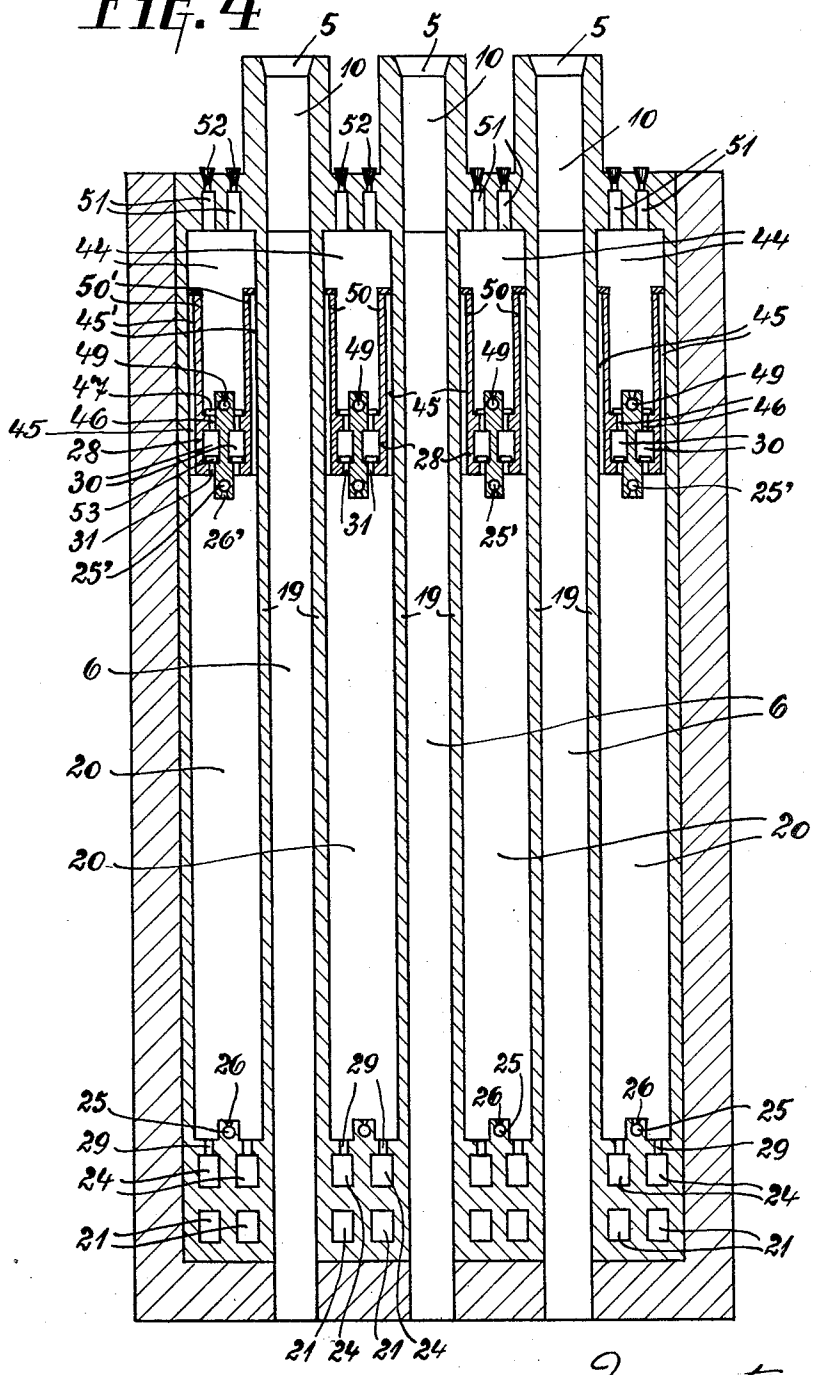
Fig. 4



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UNITED STATES PATENT OFFICE

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ZINC FURNACE

Application filed May 14, 1931, Serial No. 537,319, and in Germany May 9, 1930.

My invention relates to the recovery of zinc from zinc oxide-bearing substances which contain lead and is concerned with certain improvements in the furnaces used for carrying out this recovery of zinc, so that the lead is separated from the zinc more effectively than before.

Generally, zinc is recovered from zinc oxide-containing ores by heating these ores together with carbon preferably in a vertical shaft furnace. The gases thereby evolved, which for the greater part consist of zinc vapours, lead vapour and carbonic oxides, are preferably withdrawn at the top of the furnace and passed to a cooler outside the furnace, where the metallic vapours condense to liquid metal. In these zinc recovery furnaces, in order to prevent the liberated lead from passing into the cooler at the same time as the zinc, it has been customary hitherto to allow these distillation gases to sweep over a layer of cold distillation material before passing out of the shaft furnace into the cooler. This distillation material then absorbs a portion of the sensible heat of the gases and the latter are so cooled that the lead is deposited whilst the zinc still remains in the form of vapour. In actual practice however, it has been found that this arrangement can only be used for ores which are rich in zinc. If on the other hand, ores poor in zinc are treated, the quantity of the gases and metallic vapours evolved in the shaft furnace during the reducing is so small that they are insufficient to preheat the cold distillation product to such a temperature at which the lead will settle but the zinc vapours will not condense. On the contrary, the gases cool more rapidly and the zinc vapors also begin to condense, so that the efficiency of the reduction furnace suffers appreciably.

The present invention now aims in the first place at an improvement in the recovery of zinc from lead-bearing oxidiferous ores in a gas-fired shaft furnace. According to the process, the charge under distillation is maintained at the temperature just essential for the condensation of the lead, in the top portion of the shaft furnace, independent of the quantity of gas evolved in the bottom portion of the shaft. The improvement consists in this, that the walls of the distillation retorts are externally heated from the bottom discharge opening for the residue of distillation up to the distillate gas offtake opening at the upper end of the retort. The heating is graduated according to the height however, in such a way that in the top portion near the distillate gas discharge opening, the heating walls are kept at a temperature at which the material in the upper part of the retort will be at about 950° so that lead vapours condense, but the zinc vapours do not, whereas in the lower portion of the retorts, the heating walls are kept at such a heat as to produce the temperature of about 1350° in the charge necessary for releasing the metals.

The invention also relates to a zinc distillation furnace which comprises one or more vertical distillation retorts for heating the ore and carbon mixture, the walls of these retorts being provided throughout their entire length with vertical heating passages or combustion flues. In the top section of the vertical heating passages, at the level of the limit of the condensation and reduction zone, a horizontal partition wall provided with adjustable openings is arranged. Underneath this partition the heating passages are heated by direct flames, whereas the heating passages above this partition are traversed by a portion of the hot combustion gases evolved in the bottom section of the vertical heating flues.

Further, the invention is concerned with the arranging of gas and air passages in the horizontal partition wall and at the bottom of the vertical heating flues, so that the bottom sections of the vertical heating passages are alternately fired downwards from above and upwards from below.

Finally the invention has for its object the arranging of gas and air jets at the top of the horizontal partition wall in order that the top sections of the heating passages may also be heated by flames.

Further objects of the invention relate to the provision of dampers for the openings and at the combustion points of the partition

wall in order that the top sections of the heating passages may be regulated.

The invention will be better understood by referring to the accompanying drawings, which show a preferred embodiment of the plant for carrying out the process. This is only by way of example however and it is understood that the arrangement is capable of modification without thereby departing from the spirit of the invention.

Referring to the drawings,

Fig. 1 represents a vertical section of a complete arrangement for recovering zinc from lead-bearing oxidiferous ores according to the invention.

Fig. 2 is a vertical section through the heating walls and regenerators drawn to a larger scale.

Fig. 3 is a vertical section through the reduction retorts or chambers.

Fig. 4 shows a vertical section through the reduction retorts and the heating walls longitudinally of the row thereof.

Fig. 5 is a horizontal sectional view taken on the line 4—4 of Fig. 2.

In the arrangement shown in the drawings, the oxidiferous zinc ore is conveyed, for example by means of a bucket elevator, into the storage bunker 1 arranged in the top of the furnace structure. The outlet 4 of this bunker is provided with a movable connecting pipe 3, which may be moved downwards by means of a hand lever 2. Underneath the bunker outlet there is arranged the charging opening 5 of an externally heated continuous vertical retort 6 of approximate rectangular cross-section. The charging opening 5 may be closed by means of a cover 56 which can be pushed over the charging opening 5 by means of a hand lever 57. Adjoining the bottom of the reduction retort there is arranged a frame type cooler 7 of cast iron or the like. At the bottom opening of the latter there is the usual delivery device 8 which passes into a discharge hopper 9. The zinc ore and carbon mixture is charged into the retort through the opening 5 and the residue of distillation is continually extracted or drawn off at the bottom part thereof, through the quenching or cooling device 7 into the continuous extractor cylinder 8 and the hopper 9. In the measure that material is withdrawn from the retort at the bottom, new material is charged into the retort at the top from the bunker 1 and thus there is a continuous gradual descent of the material through the retort chambers so that an unfavorable accumulation of lead does not occur in the top of the retort chambers.

The lead is condensed from the zinc vapors in the upper part of the retort, and the condensed lead passes downwardly with the charge and also flows down the walls of the retort past the hot zone to the discharge device 9. It is not revolatilized in passing the hot zone because the retort is not heated to the boiling point of lead, i. e. 1525° C. but is heated to a lower temperature but high enough to volatilize zinc at its boiling point, i. e., 918° C.

In the lower portion of the externally heated retort 6, the zinc ore and carbon mixture is brought to such a temperature, that the metal oxides are reduced. This produces carbonic oxide gases and metal vapours. The gases and vapours evolved rise in the retort 6 up through the charge and leave the retort through an opening 11, which is provided at the top of the retort laterally of the charging shaft and which is connected to a condenser 13, through a heat-insulated passage 12. The metallic vapours deposit themselves in the condenser 13, which is provided with a baffle surface 14. The metal accumulating in the condenser, is continuously drawn off through the opening 15 and passes into the conveyer vessel 16, which is transportably arranged on a platform 67 of the furnace structure, in front of the condenser.

The non-condensing portions of the gases and vapours passing into the condenser 13, leave the condenser through the pipe line 17 and pass to a collecting main 18 from whence the combustible components are delivered by conduit 48′ to the main 48 and thence to the burners for heating the retorts.

The heating of the zinc ore reduction furnace will be seen from drawings 2 to 4. According to Fig. 4 several reduction retorts 6 are arranged alongside each other in a battery according to the invention. Every retort has a special charging opening 5. The heating walls 19 separating the reduction retorts from each other form the sides of the retort chambers and comprise vertical heating flues 20. The heating walls 19 are heated by these heating flues 20 from gases which are burnt inside the flues downwards from above and upwards from below alternately, and then removed therefrom at the top or bottom. The combustible gases for heating the furnace are delivered to the heating flues 20 from a main 48 through a horizontal conduit 25 which has a gas inlet jet or port 26 in each heating flue 20. The heating gases for downwardly heating the passages are however delivered to a conduit 25′ with jets 26′ which is arranged at the underside of a partition wall provided in the top section of the heating passages.

The air for burning the heating gases is supplied to the heating flues from below through a passage 21, which is accessible for control purposes through a sight hole 22. At 23, the passage 21 has an opening which leads to the distributing flue 24. The clear cross-section of the opening 23 may be varied by damper bricks 23′ which are adjusted by means of regulating rods inserted through access openings 23^2. From the distributing flue 24 a number of jets or ports 29 pass into

the heating flues 20, these jets or ports entering at the bottom of the flues.

The air for burning the hot gases passed into the heating flues 20 from above, is delivered through upper horizontal flues 30, which are arranged in the horizontal partition wall 28 in the heating flues 20. At their bottoms, the horizontal flues 30, are connected to the heating flues 20, through openings 31. The clear cross-section of the openings 31 may be varied by dampers 53 which may be operated by means of operating rods inserted from outside through a wall opening 54 of the passage 30.

Pre-heating the combustion air for the battery according to the invention is carried out by regenerators 32 and 33 which are heated from the hot waste gases coming from the heating flues 20. As usual, the regenerators are lined with refractory bricks 39, which serve to store the heat from the waste gases and transfer this heat to the cold combustion air in alternation. The regenerators 32 and 33 are arranged in the furnace block above each other and laterally of the reduction retorts. The top regenerator is connected through the opening 40 to the upper horizontal air flue 30. The bottom regenerator 32 is connected at the top to the bottom air inlet passage 21 through a vertical conduit 41. Lower passages 34 and 35 are provided in the bottom part of the regenerators. Outside the furnace block, these are connected by the pipe lines 36 to an elbow piece 37 of usual type. As is customary, this elbow piece is provided with an air door 38 which is opened at times and allows the entry of combustion air into the pipe line 36 and thence to the regenerators 32 and 33.

Further, a pipe line 43 leading to the waste gas collecting flue 42 is connected to the elbow piece 37 and, by suitable arrangements inside the elbow piece, is alternately connected to the pipe 36 when the air-inlet valve door 38 is closed, and is closed to the pipe 36 when the door 38 is open. The air and exhaust gas valves for regenerator 32 operate in alternation with the similar valves for the regenerator 33.

As already mentioned, the flues 20 are alternately heated from above and from below. If for instance the heating flues are heated from above, gas is passed into the upper gas flue 25′. Further the elbow piece 37 is so set that air is drawn into the previously heated regenerator 33. The air is preheated in this regenerator. Then it passes into the upper air distributing conduit 30 and from there through the jets 31 into the heating flue, where it is brought into contact with the gas issuing from the jets 26′ to give rise to flame formation.

The waste gases traverse the heating flues in a downward direction when the heating is from above. They pass through the openings 29 over into the bottom distributing conduit 24, passing from here through the opening 23 into the bottom passage 21 and then into the vertical flue 41, finally traversing the regenerator 32 whose brickwork they heat up. When the waste gases have given up their heat, they pass over at the bottom of the regenerator 32 into the passage 34, then traveling through the pipe line 36 over the suitably set elbow piece 37 into the waste heat flue 42 and thence to the chimney, (not shown). If required in order to obtain sufficient draught, a fan may also be inserted in the pipes leading to the chimney.

The section 44 of the heating flues 20 situated above the partition walls 28 is so heated in the zinc distillation furnace according to the invention, that the heating wall 19 assumes such a temperature in the upper part, that the lead vapours which are liberated along with the zinc from the zinc ore just condense, but the zinc vapours do not. Hence in the top part of the reduction retorts 6 there is brought about a separation of the lead vapours from the zinc vapours. Consequently the metal vapours which escape through the opening 11, consist practically of pure zinc.

Preferably the upper heating flue sections 44 are heated by passing a portion of the hot waste gases into the upper heating flues 44 from the bottom heating flues 20 before the gases are drawn into the regenerator 33. For this purpose there are provided in the horizontal partition walls 28 vertical passages 45 which connect the bottom heating flues 20 and the top heating flues 44 to each other. The clear cross-section of the passages 45 of the partition wall 28 may be varied from above by means of damper bricks similar to the bricks 47.

Openings 46 controlled by dampers 47 are also provided in the horizontal partition wall 28 between the horizontal flues 30 and the heating flues 44. When the top regenerator 33 is changed over to waste heat, the waste gases drawn into the heating flue 44 may be led away through these openings. The openings 31 and 46 and the passages 45 must be so regulated that a difference of draught sufficient to draw in the hot waste gases through the section 44 is present between the passages 45 and the openings 31.

The direction of combustion is changed about every thirty minutes, since that period has been found best for high heat efficiency of the regenerators. When the heating flues are fired downwards from above, in the above described method of heating the flues 44 are traversed not by hot waste gases but only by the hot preheated combustion air.

During downflow combustion such limited heating of the section 44 may also be ef-

fected by a special flame. For this purpose, the horizontal partition wall 28 is provided at the top also with a gas conduit 49 into which the gas is passed when the gas conduit 25' is also in service. In this case the waste gases of the flame produced during the combustion of the gas emerging from the gas conduit 49 are drawn off through the passages 45 into the bottom heating flue 20, whence the gases are drawn off through the bottom passage.

In order to give a particularly intensive heating to the top heating flue sections 44, it is advisable to provide guide walls 50 in the continuation of the passages 45. By means of these guide walls, the waste gases in the top heating flue 44 are caused to pass along the walls 19 for a longer time.

In order to set the dampers which are arranged in the upper heating flues 44, openings 51 are provided in the roof of the furnace as usual, these being capable of being closed by means of removable closure plugs 52.

Instead of the upper heating passages being heated by a horizontal partition wall being provided for this purpose in the heating flues, it is also possible according to the invention, to bring out a graded heating of the reduction retorts 6 by the thickness of the walls 19 being increased in the top portion of these retorts.

I claim:

1. A furnace battery for the recovery of zinc from lead-bearing zinc ore admixed with carbon, comprising vertical retorts for distilling the zinc ore and carbon mixture, heating walls forming the sides of the retorts and comprising upper and lower sections of heating flues provided with inlet and outlet openings for gas and air or waste gases, means whereby the walls of the retorts are brought to a lower temperature in their upper section than in their lower section, a gas offtake for each retort for the gases and vapours produced during the distilling of the zinc ore, the said offtakes being arranged below the tops of the retorts and on a level with the upper section of the heating flues.

2. A furnace battery for the recovery of zinc from lead-bearing zinc ores, comprising vertical retorts for distilling the zinc ore and carbon mixture, heating walls forming the sides of the retorts and comprising heating flues provided with inlet and outlet openings for gas and air or waste gases, means whereby the upper sections of the heating walls of the retorts are brought to such a temperature that the zinc ore and carbon mixture in the upper portion of the retort is brought to a temperature of about 950 degrees, means whereby the lower section of the heating walls of the retort are brought to such a temperature that the zinc ore and carbon mixture in the lower portion of the retort assumes a temperature of about 1350 degrees, a gas offtake for each retort for the gases and vapours evolved during the heating of the zinc ore and carbon mixture, the said gas offtakes being arranged below the tops of the retorts and inside the zone of the less highly heated section of the retort.

3. A furnace battery for the recovery of zinc from lead-bearing zinc ores admixed with carbon comprising vertical retorts for distilling the zinc ore and carbon mixture, heating walls comprising vertical heating flues forming the sides of the retorts, the said heating flues being provided with inlet and outlet openings for gas and air or waste gases, a horizontal flue arranged in the heating flues to provide a less highly heated upper portion in the heating flues and a more highly heated lower portion in the heating flues.

4. A furnace battery for the recovery of zinc from lead-bearing zinc ores admixed with carbon, comprising vertical retorts for distilling the zinc ore and carbon mixture, heating walls comprising vertical heating flues forming sides of the retorts, the said heating flues being provided below with inlet and outlet openings for gas and air or waste gases, a horizontal partition wall arranged in the heating flues and adapted to form the boundary between an upper less highly heated section and a lower more highly heated section in the heating flues, gas and air delivery conduits arranged in the said partition wall, inlet and outlet openings for gas and air or waste gases provided at the under side of the partition wall, and vertical passages arranged in relation to said partition wall, whereby the bottom and the top section of the heating flues are connected together.

5. A furnace battery for the recovery of zinc from lead-bearing zinc ores admixed with carbon, comprising vertical retorts for distilling zinc ore and carbon mixture, heating walls comprising vertical heating flues forming the sides of the retorts, the said heating flues being provided below with inlet and outlet openings for gas and air or waste gases, a horizontal partition wall in the heating flues, arranged to form the boundary between an upper less highly heated flue section and a lower more greatly heated flue section in said heating wall, gas and air delivery conduits arranged in the said partition wall and porting into the upper section of the heating flue, inlet and outlet openings for gas and air or waste gases porting from said partition wall into the lower section of said heating flues, vertical passages arranged in relation to the said partition wall, whereby the lower and upper sections of the heating flues are communicably connected together, dampers for the vertical passages connecting the upper and lower heating flue sections, the

said dampers being capable of regulation from the outside.

6. A furnace battery for the recovery of zinc from lead-bearing zinc ores admixed with carbon comprising vertical retorts for distilling the zinc ore and carbon mixture, heating walls comprising vertical heating flues forming the sides of the retorts, the said heating flues being provided at the bottom with inlet and outlet openings for gas and air or waste gases, a horizontal partition wall in the heating flues forming the limit between an upper less highly heated flue section and a lower more greatly heated flue section in said heating walls, inlet and outlet openings for gas and air or waste gases arranged at both the upper and lower sides of the said partition walls, so arranged that the upper and lower heating flue sections are each heated by separate means.

7. A furnace battery for the recovery of zinc from lead-bearing zinc ores admixed with carbon comprising vertical retorts for distilling the zinc ore and carbon mixture, heating walls comprising vertical heating flues forming the sides of the retorts, the said heating flues being provided at the bottom with inlet and outlet openings for gas and air or waste gases, a horizontal partition wall in the heating flues forming the limit between an upper less highly heated flue section and a lower more highly heated flue section in said heating walls, gas and air delivery passages arranged in the said partition wall, inlet and outlet openings for gas and air or waste gases arranged at both the upper and lower sides of the said partition wall, so arranged that the upper and lower heating flue sections are each heated by separate means, passages arranged in relation to said partition wall communicably connecting the upper and lower heating flue sections, the said passages being adapted to draw the waste gases from the upper heating flue section into the lower heating flue section, and regenerators connected with said air or waste gas passages and openings.

8. A furnace battery for the recovery of zinc from lead-bearing zinc ores admixed with carbon, comprising vertical retorts for distilling the zinc ore and carbon mixture, heating walls comprising vertical heating flues forming the sides of the retorts, a horizontal partition wall in the heating flues and forming upper and lower flue sections, vertical conduits, whereby the upper and lower flue sections are communicably connected together, the said connecting conduits entering into the upper heating flue sections directly alongside the portion of the walls facing the retort, guiding walls arranged on the horizontal partition wall and forming an extension of the vertical connecting conduits, the said guiding walls terminating below the upper end of the upper heating flue sections so that the connecting conduits communicate therewith at the upper ends of the upper flue sections.

In testimony whereof I affix my signature.

CONRAD HAHN.