

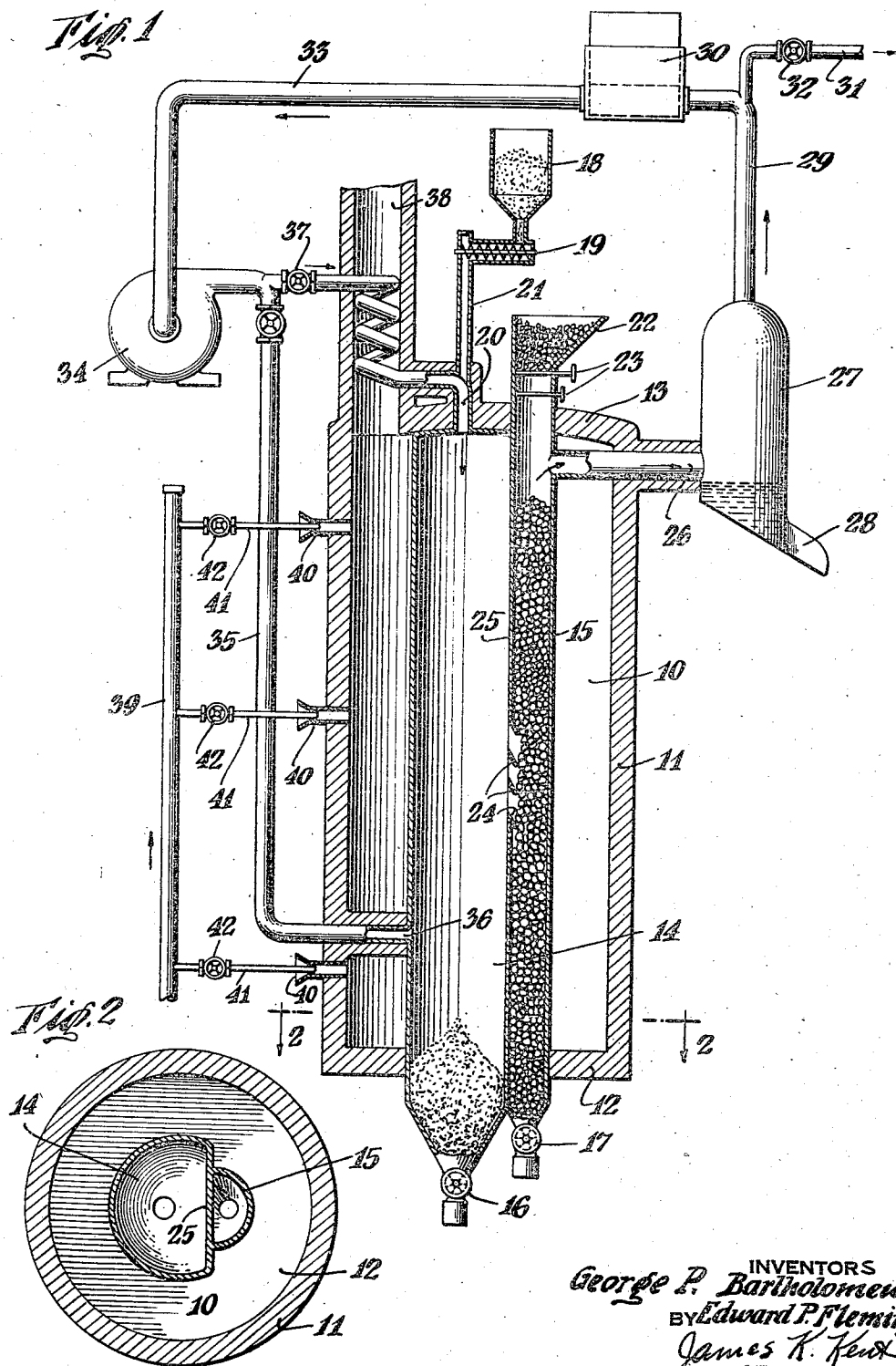
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PROCESS FOR REDUCING OXIDIZED ORES OF ZINC

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PROCESS FOR REDUCING OXIDIZED ORES
OF ZINC

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8 Claims. (Cl. 75-26)

This invention relates to the reduction of oxidized ores of zinc.

In accordance with the invention, zinc oxide in a finely-divided state is introduced into a suitable reducing atmosphere under such conditions that the zinc is almost instantaneously reduced to zinc vapor which, after passage through a suitable reducing and filtering medium, is readily condensed to metallic zinc.

Although the novel features which are believed to be characteristic of the invention are particularly pointed out in the appended claims, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, will be better understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof, in which

Fig. 1 is a view of an apparatus suitable for practising the process of the invention; and

Fig. 2 is a cross-section taken along the line 2-2 of Fig. 1.

Referring to the drawing, 10 represents a combustion chamber defined by wall 11, floor 12 and roof 13. Positioned in combustion chamber 10 are vertical retort 14 and coke filter 15 which terminate at their lower ends into seals 16 and 17 respectively. Insulated storage bin 18 having feeding device 19 is connected to inlet 20 of retort 14 via pipe 21 while bin 22 associated with gates 23 is positioned above filter 15. Passageways between retort 14 and filter 15 are provided by means of baffles 24 in the common wall 25.

A pipe 26 leads from the top of filter 15 to condenser 27 equipped with tapping spout 28. Pipe 29 leads from the top of condenser 27 to storage container 30. An offtake pipe 31 with valve 32 is inserted in pipe 29 between condenser 27 and storage container 30. Pipe 33 leads from container 30 to booster blower 34 while pipe 35 connects the latter with retort 14 at inlet 36. Pipe 37 from blower 34 connects with inlet 20 after passing through flue 38. The fuel supply line 39 is operatively associated with burners 40 by means of pipes 41 equipped with valves 42.

Employing the above apparatus, the invention may be practised as follows: The retort 14 and coke filter 15 are brought to the proper temperature, preferably above 1100° C., by heat supplied by burners 40 inserted in the refractory wall 14 of combustion chamber 10. The preheated charge comprising an intimate mixture of oxidized zinciferous material and coke dust in a finely divided state, preferably minus 200 mesh, is fed from bin 18 into pipe 21 by feeding

device 19. The charge passes downwardly through pipe 21, is atomized and injected into preheated retort 14 through inlet 20 with carbon monoxide gas which has been preheated by passing through the coil in the flue 38 as shown in the drawing. Upon entering the retort which contains carbon monoxide gas introduced through pipe 35, the zinc is almost instantly reduced in gaseous suspension according to the reaction $\text{ZnO} + \text{CO} \rightarrow \text{Zn} + \text{CO}_2$ while the carbon present reacts with the carbon dioxide to form carbon monoxide according to the reaction $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$.

The zinc vapor, carbon monoxide and any carbon dioxide then pass from retort 14 into coke filter 15 through the opening formed by baffles 24 in common wall 25. By passing the zinc vapor and gases through the incandescent coke column, any carbon dioxide is converted to carbon monoxide so that only zinc vapor and carbon monoxide enter the condenser 27. The coke filter also serves to separate out any dust carried over from the retort. The level of coke in the filter is maintained by introducing the coke as needed from hopper 22 via gates 23 and residues from the retort and coke filter are periodically removed through seals 16 and 17 respectively.

In condenser 27 the zinc vapor is condensed to metal and may be removed through spout 28 while the carbon monoxide passes to storage container 30 from whence it is withdrawn as needed and supplied by blower 34 to inlets 20 and 36. Any carbon monoxide in excess of that needed for use as the reducing agent in the retort may be withdrawn from the system through pipes 31 by opening valve 32 and used as fuel for heating the combustion chamber 10 by means of suitable connections (not shown) with fuel supply line 39.

The process of the invention marks a distinct advance in the art of reducing oxidized ores of zinc. By atomizing the ore, thus obtaining a maximum surface for reaction with the reducing gas, and injecting the minute particles into the preheated reducing atmosphere, the reducing reaction is accelerated to such a degree that it takes place practically instantaneously which is a remarkable improvement over the prior art retort processes which required hours for the complete reduction of a comparatively small charge.

In the example given, carbon monoxide has been specified as the reducing gas but inasmuch as one of the features of the invention resides in treating the zinciferous material in an extremely

finely-divided state in gaseous suspension, it will be readily appreciated that other reducing agents may be employed within the scope of the invention. Of these, methane (CH_4) is probably the most important. In fact, it is superior to carbon monoxide in some respects, for example, the reduction proceeds at a more rapid rate and is effected at lower temperatures. Also, with methane, the addition of carbon to the charge may be eliminated.

In addition to treating oxidized ores of zinc, the invention is applicable to the treatment of oxides of other metals, for example, cadmium, which require for reduction, a temperature greater than the boiling point of the metal.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. The process of treating zinciferous ore which comprises injecting an intimate mixture of such ore and coke in a finely-divided state into a hot carbon monoxide atmosphere thereby reducing the zinc to vapor, passing the products of reaction through a bed of incandescent coke thereby filtering out flue dust and reducing any carbon dioxide to carbon monoxide and condensing the zinc from the gases emerging from the coke filter.

2. In reducing zinc, the process which comprises injecting an intimate mixture of zinc oxide and coke in a fine state of subdivision into a preheated atmosphere of carbon monoxide, passing the products of reaction through a bed of incandescent coke and condensing the zinc vapor emerging from the bed of coke.

3. In reducing oxidized ores of zinc, the method which comprises injecting an atomized charge of such ore and coke dust into a preheated retort filled with carbon monoxide, passing the products of reaction through an incandescent layer of coke and into a condenser in which zinc vapor is condensed to liquid zinc, withdrawing carbon monoxide from said condenser and recycling same to the retort for treating further quantities of such atomized charge.

4. The process for recovering zinc from oxidized ores thereof which consists in preheating a comminuted charge comprising said ore and a solid reducing agent, feeding said charge into a preheated retort out of contact with air in a manner calculated to reduce the ore in sus-

pension, passing the products of reaction through a coke filter maintained under conditions favoring the reaction $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$ and suitably condensing the zinc vapor emerging from said filter.

5. A process for reducing oxidized ores of zinc which comprises forming an intimately mixed charge of comminuted zinc ore and solid carbonaceous reducing agent, preheating said charge and passing same through a preheated retort maintained at zinc reduction temperatures thereby effecting practically instantaneous and substantially complete reduction of the ore, withdrawing the resulting zinc vapor and gaseous products of reaction from the retort through a bed of incandescent coke and recovering zinc therefrom by condensation.

6. The process for treating oxidized ores of metals having reduction temperatures in excess of the boiling points of the respective metals which comprises forming a comminuted charge of such an ore and a solid carbonaceous reducing agent, preheating said charge, passing said preheated charge through a retort maintained at reduction temperatures thereby reducing the ore in suspension, conducting the resulting gases and metal vapor from said retort to a condenser through an incandescent bed of carbonaceous reducing agent and condensing the metal vapor.

7. The process for reducing oxidized ores of zinc which comprises continuously charging such ore and carbonaceous reducing agent to a retort maintained at zinc reduction temperatures, said ore and said reducing agent being charged to the retort in finely-divided form and reduced therein in suspension, withdrawing the resulting zinc vapor and gaseous products of reaction from the retort and passing same through a bed of carbonaceous reducing agent maintained at a temperature above that at which zinc passed there-through will condense and treating the vapors emerging from said bed for recovery of their zinc content.

8. The process for treating zinc in the oxidized state to produce metallic zinc which comprises continuously passing oxidized zinciferous material in a finely-divided state through a hot reducing atmosphere to reduce said zinciferous material in gaseous suspension, passing the resulting zinc vapors and gaseous products of reaction through an incandescent, carbonaceous bed, and suitably condensing zinc from the vapor emerging from said bed.

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