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FURNACE FOR TREATING PHOSPHATE MATERIAL

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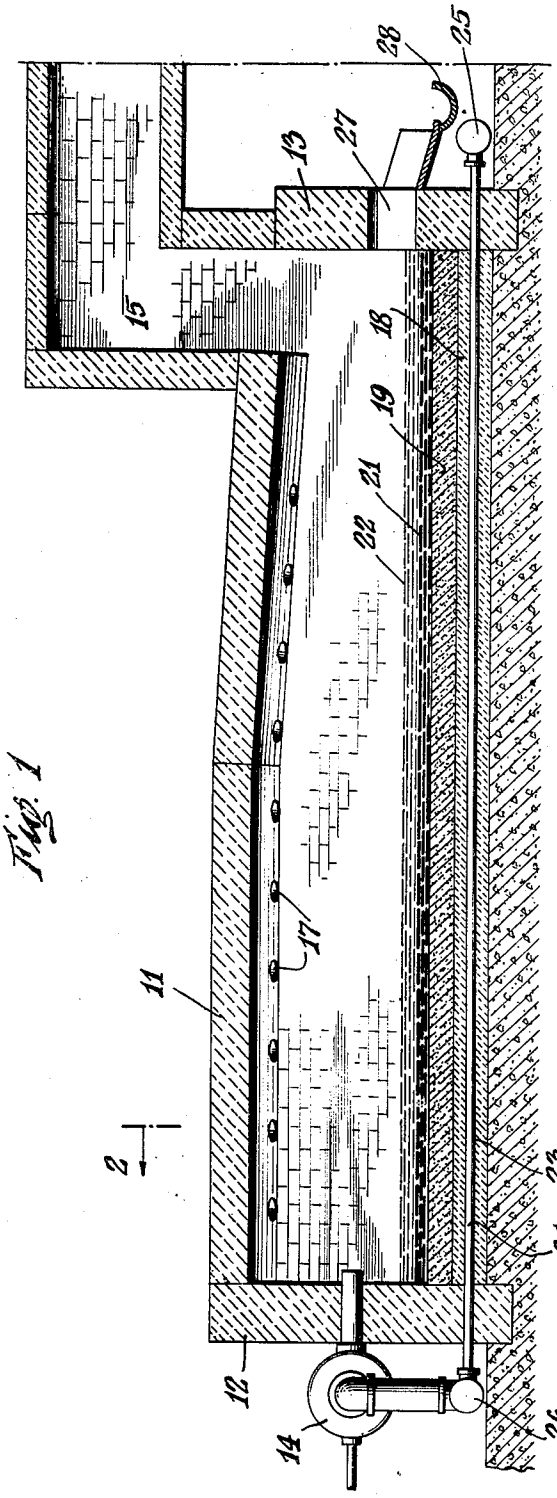



Fig. 1

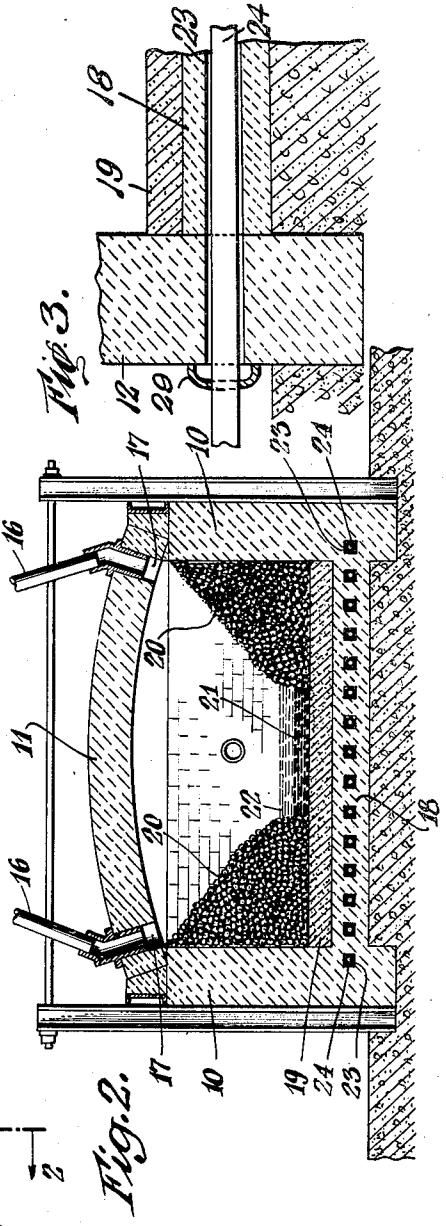



Fig. 3.

Fig. 2.

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## FURNACE FOR TREATING PHOSPHATE MATERIAL

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1 Claim. (Cl. 263—15)

In the furnacing treatment of phosphate rock for recovering the phosphorus content thereof in a more readily usable form the operation requires large amounts of heat at high temperatures, with correspondingly large consumption of fuel. In commercial operation the margin between the cost of the treatment and the value of the products obtained is relatively narrow, and it is therefore important to keep the cost down to as low a point as possible. A major item in the cost is the fuel employed, and it has therefore been proposed to utilize as much as possible of the heat that would otherwise be wasted, and for this purpose the practice has been to preheat the air required for burning the fuel by passing the air through pipes located in the path of the furnace gases. This plan has certain disadvantages, however, due in general to the inert covering with which it is necessary to cover the pipes in order to protect them from the furnace gases, which are in some cases, at least, highly corrosive.

I have accordingly been led to device my present invention, which has for its chief object to provide in a phosphate treating furnace an air-preheating system by which the air delivered to the burner or burners can be efficiently heated without possibility of corrosive injury to the piping through which the air is passed. Another object is to provide for the purpose indicated a preheating system in which the piping and other parts can be installed with ease and are readily accessible for replacement should occasion therefor arise. To these and other ends the invention comprises the novel features and combinations hereinafter described.

It will be understood that the walls of furnaces for the thermal treatment of phosphate rock are constructed of refractory material of low heat conductivity, as for example silica brick, not only to withstand the heat employed in the treatment but also to minimize loss of heat by conduction and by radiation. The low heat conductivity of the refractory material would appear to militate against effective heating of the air pipes if embedded in the furnace walls, but I have found that such is not the case, especially if the piping is located in the bottom wall of the furnace directly under the layer or body of molten iron-phosphorus alloy which accumulates on the furnace bottom and on which floats the slag resulting from the reduction of the phosphate of the rock treated. The molten alloy is thus in intimate contact with the furnace bottom, and I have found that the transfer of heat therefrom to the air pipes is rapid enough for heating large volumes of air even when the pipes, in accordance with an advantageous feature of the invention, extend loosely through the passages in the brickwork of the bottom.

Referring now to the accompanying drawing, in which I have illustrated the invention in its preferred form as embodied in a reverberatory furnace:

Fig. 1 is a longitudinal section of the furnace from the firing end to the gas outlet end;

Fig. 2 is a cross-section on line 2—2 of Fig. 1;

Fig. 3 is a detail section on the same plane as Fig. 1, at the front end of the furnace.

The furnace illustrated comprises side walls 10, an arched roof 11, and front and rear end-walls 12, 13 respectively. Projecting through the front end-wall is an oil burner 14, and at the rear is a flue 15 extending from the top or roof of the furnace for outflow of the gases and vapors. This flue leads through the usual dust collectors (not shown) to the point at which the useful content of the gases and vapors is recovered in the desired form. The material to be treated is delivered along the sides of the furnace by spouts 16 discharging through openings 17 in the roof. It will be understood that the flame projected into the furnace longitudinally thereof may be produced by the combustion of oil, gas, powdered coal, or any other convenient and suitable fuel.

The bottom wall of the furnace, resting on a foundation of concrete, brick or other suitable material is composed of silica brick 18 with or without a layer 19 of silica sand fused in place, on which rest the side piles 20 of the charge. The charge piles form a trough, as shown in Fig. 2, and it is in this trough that the layer 21 of molten iron-phosphorus alloy accumulates and above it the layer 22 of slag.

The brickwork of the bottom wall is provided with a plurality of longitudinal passages or openings 23, square in cross section, to receive the air-preheating pipes 24. It is desirable to have the pipes loose in their passages, to permit thermal expansion freely in all directions without injury to themselves or to the brickwork in which they are enclosed. At the rear end, under the flue 15, the pipes are connected to a manifold or bus 25, which is itself connected with a blower or other source of air under pressure, not shown, and at the front end they open into a manifold or bus 26 connected to the burner 14 for delivery of the preheated air.

Although the molten alloy layer 21 may oc-

cupy only a small part of the width of the furnace and the charge piles themselves, overlying a considerable number of the pipes, are at a relatively low temperature at their bottoms, I have found that a very effective transfer of heat to the pipes takes place. At the same time the pipes are perfectly protected from injury and can expand freely in response to changes of temperature incident to shutting down the operation of the furnace and starting it up again. The efficiency of the air heating system can be slightly increased by providing the pipes with sliding rings, as 29, Fig. 3, which can be shoved up against the walls to close the passages and thus prevent flow of air through the passage around the pipes.

An outlet (not shown) is provided at any convenient part of the furnace for withdrawing the molten ferrophos from time to time, as may be necessary.

The slag is discharged more or less continuously through an opening 27 in the rear wall 13 into a launder 28 through which a stream of water is flowing. Striking the water the slag granulates and is carried away.

It is to be understood that the invention is not limited to the form herein specifically illustrated and described but can be embodied in other forms without departure from its spirit as defined by the appended claim.

I claim—

A furnace for the thermal treatment of phosphate material, having bottom and side walls of refractory material and having means for delivering phosphate material into the furnace at the sides thereof to form side piles of the charge with a slag and alloy trough therebetween, air preheating piping extending through the refractory bottom wall of the furnace and wholly out of contact with the furnace gases and products of combustion but exposed to heat passing from slag and alloy in said trough by conduction through said refractory bottom wall, means for supplying air to said piping, a burner for projecting a flame of burning fuel longitudinally of said trough, and means for delivering preheated air from said piping to the burner.

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