June 23, 1925. 1,542,966

J. M. SAMUEL

METALLURGICAL APPARATUS

Filed Jan. 28, 1919 2 Sheets-Sheet 1

Fig: 1

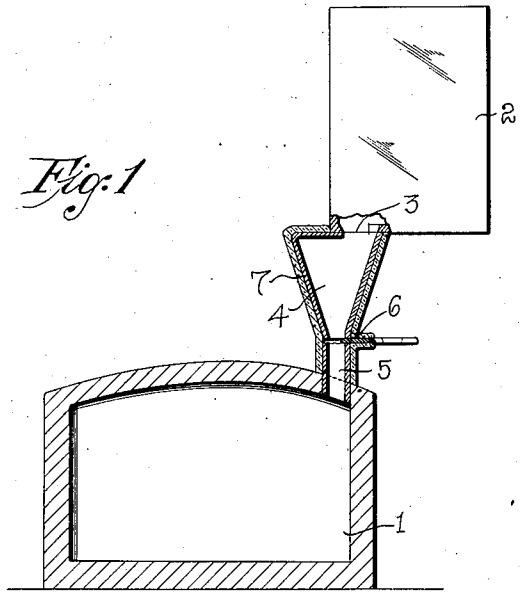


Fig: 2

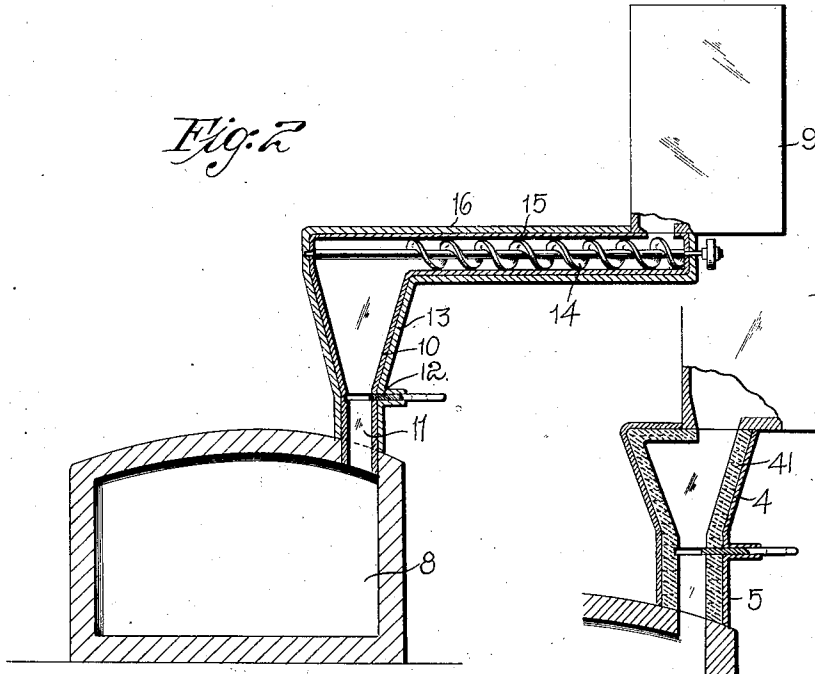


Fig: 5

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Fig. 3

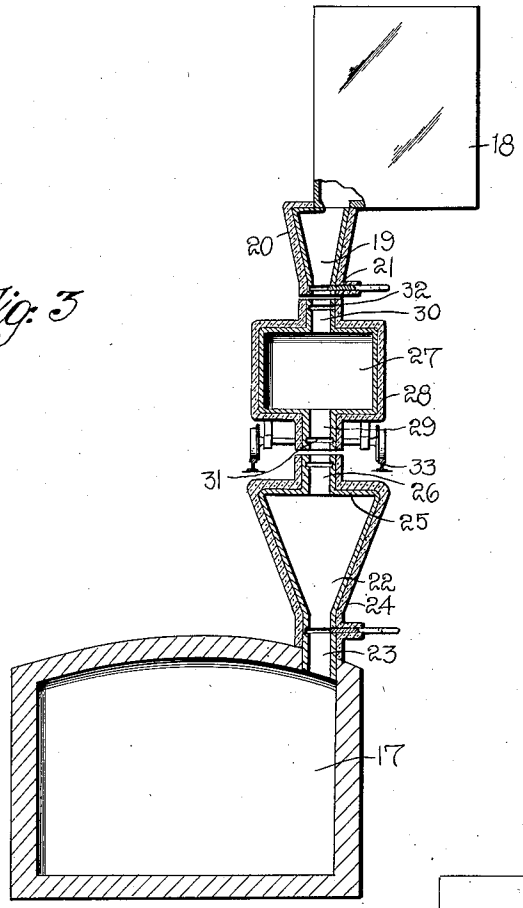
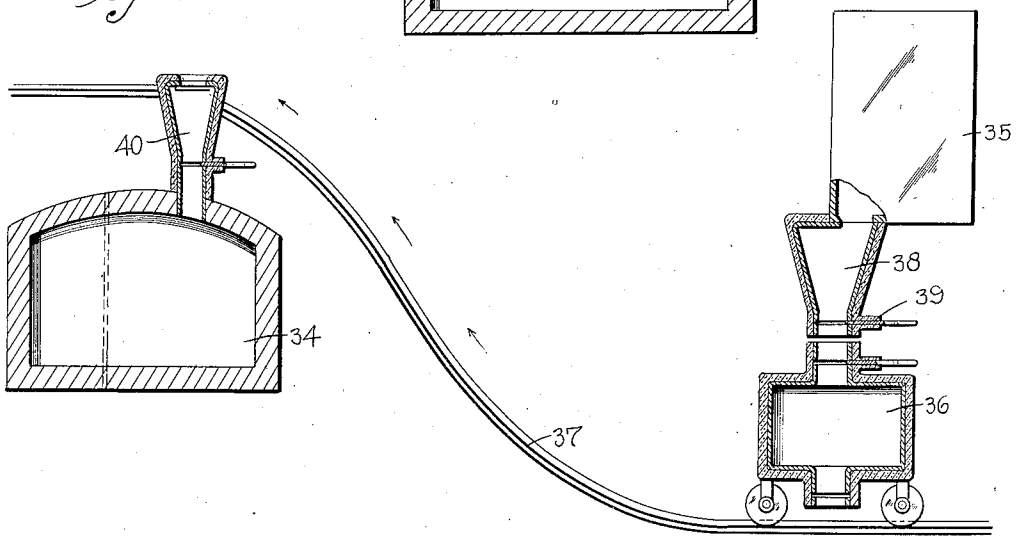


Fig. 4



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Patented June 23, 1925.

1,542,966

UNITED STATES PATENT OFFICE.

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METALLURGICAL APPARATUS.

Application filed January 28, 1919. Serial No. 273,559.

To all whom it may concern:

Be it known that JOHN MOORE SAMUEL, citizen of the United States, residing at Douglas, in the county of Cochise and State of Arizona, has invented certain new and useful Improvements in Metallurgical Apparatus, of which the following is a specification.

The present invention has as its object an improved method of transferring calcines from the roasters to the reverberatory furnaces. The lower hearths of roasters ordinarily operate at about 1300° F., but it is seldom that the calcines reach the reverberatory furnace at a temperature exceeding 800° F. This great loss of heat is occasioned by the methods heretofore employed in transferring the calcines from the roasters to the reverberatory furnaces. In fact, heretofore no particular care has been taken or efforts made to conserve this heat although it is self evident that if all of this heat could be conserved or retained, the treatment of the calcines could be more economically carried out and the cost of operation of the reverberatory furnace greatly reduced. The present invention, therefore, has as its primary object to disclose a method of transferring the calcines from the roasters to the reverberatory furnace in a manner to reduce to a minimum the loss of heat through radiation or otherwise so that the calcines will enter the furnace at approximately the same temperature at which they leave the roasters, and thus the fuel ratio will be greatly reduced.

I have discovered that loss of heat by the calcines, in the ordinary methods of transferring the calcines from the roaster to the reverberatory furnace is greatly increased when the calcines are exposed so that heat radiates directly from them to the air. For example, there is great loss of heat from the calcines when they are allowed to drop from the roaster into the calcine car and when they are permitted to drop through the air from the calcine car into the calcine hopper over the reverberatory furnace. There is also loss of heat when the calcines are allowed to fall from the last mentioned hopper into the reverberatory furnace through pipes which are not insulated and which have loose and open connections with the top of the reverberatory furnace. Furthermore, there is great loss of heat through radiation when the calcines are exposed in the larry cars in which they are sometimes conveyed from one part of the furnace to another.

As before stated, so far as I am aware, no efforts have heretofore been made to conserve the heat of the calcines while transferring them from the roaster to the reverberatory furnace. It is true that there have been attempts made to provide more or less closed connections between the roaster calcine hoppers and the calcine cars, but these connections have not in any way been insulated, nor were they in any sense intended for the purpose of conserving the heat of the calcines but solely and primarily for the purpose of preventing dust being raised in discharging the calcines into the car. That in providing such connections there was absolutely no intention of conserving the heat of the calcines, is evident from the fact that in other ways and at other points the calcines were left exposed to such an extent as to cause great loss of heat before being introduced into the reverberatory furnace. For example, calcines have been left exposed in the larry cars and in the travel of these cars from the roasters to the reverberatory furnaces, heat of course is rapidly lost by radiation from the calcines. In fact, no attempt has been made to provide closed connections at any point where the calcines would, in the ordinary operation of the plan, be permitted to remain quiescent, because under such conditions there would be no formation of dust and, as before stated, connections were not provided nor any other steps taken with the object in view of preventing the escape of heat from the calcines.

In a normal calcine charge, the heat of formation of the silicates exceeds the heat abstracted by the fusion of the slag and matte so that these two latter will be superheated approximately 400° F. by this excess

heat. Therefore it follows that the influence of the calcine temperature on the fuel ratio is of great importance in reducing the cost of the smelting operation. With a calcine charge entering the reverberatory furnace at approximately 500° F., there must be produced in the reverberatory furnace approximately 4,800,000 B. t. u. per ton of charge in order to effect smelting of the charge. If the calcines enter the reverberatory furnace at approximately 800° F., 3,600,000 B. t. u. must be produced in the furnace per ton of charge to effect the smelting. Further, if the calcines enter the reverberatory furnace at 1200° F. it will require only about 1,900,000 B. t. u. per ton of charge to effect the smelting of the charge. Consequently if the heat of the calcines is conserved to such extent that the calcines when they enter the reverberatory furnace have a temperature of approximately 1200° F. or a temperature between this and the temperature of the lower hearths of the roaster, which is approximately 1300° F., there will be a vast reduction in the number of British thermal units required to be produced in the reverberatory furnace for effecting smelting of the charge and thus the smelting operation may be conducted on a much more economical basis than if the calcines were introduced into the reverberatory furnace at a much lower temperature.

There are various ways in which the principles of the present invention may be brought into use and therefore the accompanying drawings are intended to merely indicate in a general manner several of the means which may be employed for utilizing the principles of the invention.

In the accompanying drawings:

Figure 1 is a view partly in elevation and partly in section, illustrating in a conventional manner one arrangement of roaster and reverberatory furnace and the means provided for transferring the calcines from the roaster to the furnace under air and heat-insulated conditions;

Figure 2 is a view similar to Fig. 1, illustrating another arrangement of apparatus;

Figure 3 is a similar view, illustrating another arrangement of apparatus;

Figure 4 is a similar view, illustrating still another arrangement;

Figure 5 is a sectional view through a portion of a conduit illustrating a modification of the invention.

As before stated, the accompanying drawings are intended merely as illustrating in a general way the manner in which the principles of the invention may be utilized and it is to be understood that I am not to be limited to any particular type of apparatus in carrying out the method, as any one of the four arrangements illustrated in the drawings, as well as various other arrangements, may be employed for this purpose.

In Figure 1 of the drawings the numeral 1 indicates in general a reverberatory furnace and the numeral 2 a roaster, both of the ordinary type. In this particular arrangement of apparatus, the roaster is located above the reverberatory furnace and the calcines are discharged from the roaster through an opening 3 in the bottom thereof into a hopper 4 which is provided with a spout 5 which leads into the reverberatory furnace through the top thereof, a suitable valve or gate 6 being provided in the spout 5 or bottom of the hopper 4 so as to control the discharge of calcines from the hopper into the reverberatory furnace. The hopper and spout are both entirely covered with insulating material as indicated by the numeral 7. This material may be asbestos or any other heat-insulating substance or combination of substances and it is to be of such thickness as to effectually preclude radiation of heat from the calcines through the wall of the hopper and its spout. The top of the hopper is connected directly with the bottom of the roaster so that the calcines are not in any way exposed to the atmosphere in passing from the roaster into the hopper 4; nor do these calcines suffer any loss of heat in passing downwardly through the hopper and spout into the reverberatory furnace as the connection of the spout 5 with the furnace top is to be an air-tight connection and the hopper and spout are, as stated above, to be provided with a covering of heat-insulating material. In this arrangement of apparatus it will be evident that the calcines will pass almost directly from the roaster into the reverberatory furnace and this transfer takes place under air and heat-insulated conditions so that there is little if any loss of heat through radiation from the calcines and they enter the furnace at approximately the same temperature at which they leave the lower hearths of the roaster.

In Figure 2 of the drawings, the reverberatory furnace is indicated by the numeral 8 and the roaster by the numeral 9, these parts being, as previously stated, of the usual construction. In this instance also the roaster is located above the reverberatory furnace but is disposed to one side with relation to the furnace. The furnace hopper is indicated by the numeral 10 and its spout by the numeral 11 and the spout leads from the hopper and conducts the calcines into the reverberatory furnace through the top thereof, a suitable valve 12 corresponding to the valve 6 being provided for regulating the supply of calcine from the hopper to the furnace. As in the previously described form, the hopper 10 and its spout 11 are in-

sulated by providing these parts with a covering 13 of asbestos or other heat-insulating material. In order that the calcines may be conveyed from the roaster into the hopper, the roaster being displaced with relation to the upper end of the hopper, a screw conveyer 14 is provided and the screw of this conveyer works in a tubular trunk 15 which extends from the bottom of the roaster 9 to the top of the hopper 10. This trunk is provided with a covering 16 of heat-insulating material and it will be evident by reference to the drawings that in the operation of this arrangement of apparatus, the calcines as they are delivered from the bottom of the roaster, are carried by the screw conveyer 14 to the upper end of the hopper 10 where they are discharged into the hopper.

In that arrangement of apparatus shown in Fig. 3 of the drawings, the reverberatory furnace is indicated by the numeral 17 and the roaster by the numeral 18, the roaster being located above the said furnace and, for example, at one end thereof. In this arrangement the roaster is provided at its bottom with a hopper 19 through which the calcines may pass, this hopper being furnished with a covering 20 of heat-insulating material and being provided at its discharge end with a valve or gate 21 whereby when material is not being discharged from the hopper, air may be prevented from entering the hopper and lowering the temperature thereof or of any calcines contained in the hopper. The numeral 22 indicates one of a number of hoppers which are provided each with a spout 23 extending through the top of the furnace 17, these hoppers being arranged at suitable intervals throughout the length of the furnace and they and their spouts being provided with a covering 24 of heat-insulating material. The hoppers 22 are not fully open at their tops and each hopper is in fact provided with a closed top 25 having an upstanding spout 26 which likewise is provided with a covering of insulating material. The numeral 27 indicates a larry car which is not open at its top as ordinarily, but which is completely closed on all sides and provided with a covering 28 of heat-insulating material. In its bottom this car is provided with a heat-insulated discharge spout 29, and a similar spout 30 extends from the top of the car, the spouts 29 and 30 being, respectively, provided with valves or gates 31 and 32 which may be closed when the car is being moved over its tracks 33, so as to retain the heat within the car. Any suitable form of connection is provided so that when the car is positioned beneath the roaster 18 the spout 30 of the car may be connected with the spout or discharge end of the hopper 19 and then after the car has received its charge of roasted calcines, the valve or gates 31 and 32 are closed and the car may be run along the tracks until positioned over one or another of the hoppers 22 whereupon its spout 19 may be connected with the spout 26 and the valve or gate 31 opened to permit the roasted calcines to pass from the car into the hopper and thence into the reverberatory furnace.

As in the previously described arrangement of apparatus, it will be evident that in this instance, although the calcines are carried in the larry car, they do not suffer loss of heat to any appreciable extent while being carried from the roaster to the reverberatory furnace, but they are on the other hand so protected by reason of the fact that the car as well as all conduits of the apparatus are insulated, that they enter the reverberatory furnace substantially at the same degree of temperature at which they left the roaster.

Where the roaster is to be located substantially on the same level with the reverberatory furnace, an arrangement such as illustrated in Fig. 4 of the drawings may be restorted to. In this figure the numeral 34 indicates the reverberatory furnace and the roaster is indicated by the numeral 35. The numeral 36 indicates a larry car constructed as above described in connection with Fig. 3 of the drawings and this car is designed to travel over the track 37 leading from a point beneath the roaster 35 to a point above the reverberatory furnace 34. The roaster is provided at its bottom with a hopper 38 corresponding to the hopper 19 and closed by the valve or gate 39, and the reverberatory furnace is provided with one or more hoppers 40 with the spouts of which the discharge spout of the larry car may be connected in any convenient manner as previously described.

I have previously described a method of transferring calcines from the roaster to the reverberatory furnace under air and heat insulated conditions which consists in conducting the calcines through a conduit or conduits provided with an exterior covering of heat insulating material of one kind or another. However, the invention also comprehends such transfer of the calcines through a conduit or conduits provided with a lining of heat insulating material. For example in Fig. 5 of the drawings there is illustrated the hopper 4 and spout 5 shown in Fig. 1, but in this instance the said hopper and spout are provided with a lining 41 of heat insulating material. This lining may be in the nature of heat insulating brick or in fact of any other suitable heat insulating material and the lining may, of course, be either in bricks or sections, or it may be integral throughout. Furthermore, if it is deemed advisable, the conduit may be provided both with

the lining shown in this figure and with the covering shown in the other figures of the drawings.

Having thus described the invention, what is claimed as new is:

An apparatus of the kind described, comprising an ore-roasting furnace provided with an outlet, a smelting furnace provided with an inlet, a heat-insulated transfer conduit operative between the outlet of the roasting furnace and the inlet of the smelting furnace and having air-tight connection therewith, respectively, and means for closing communication between the two furnaces through the conduit.

In testimony whereof he affixes his signature.

JOHN MOORE SAMUEL. [L. S.]