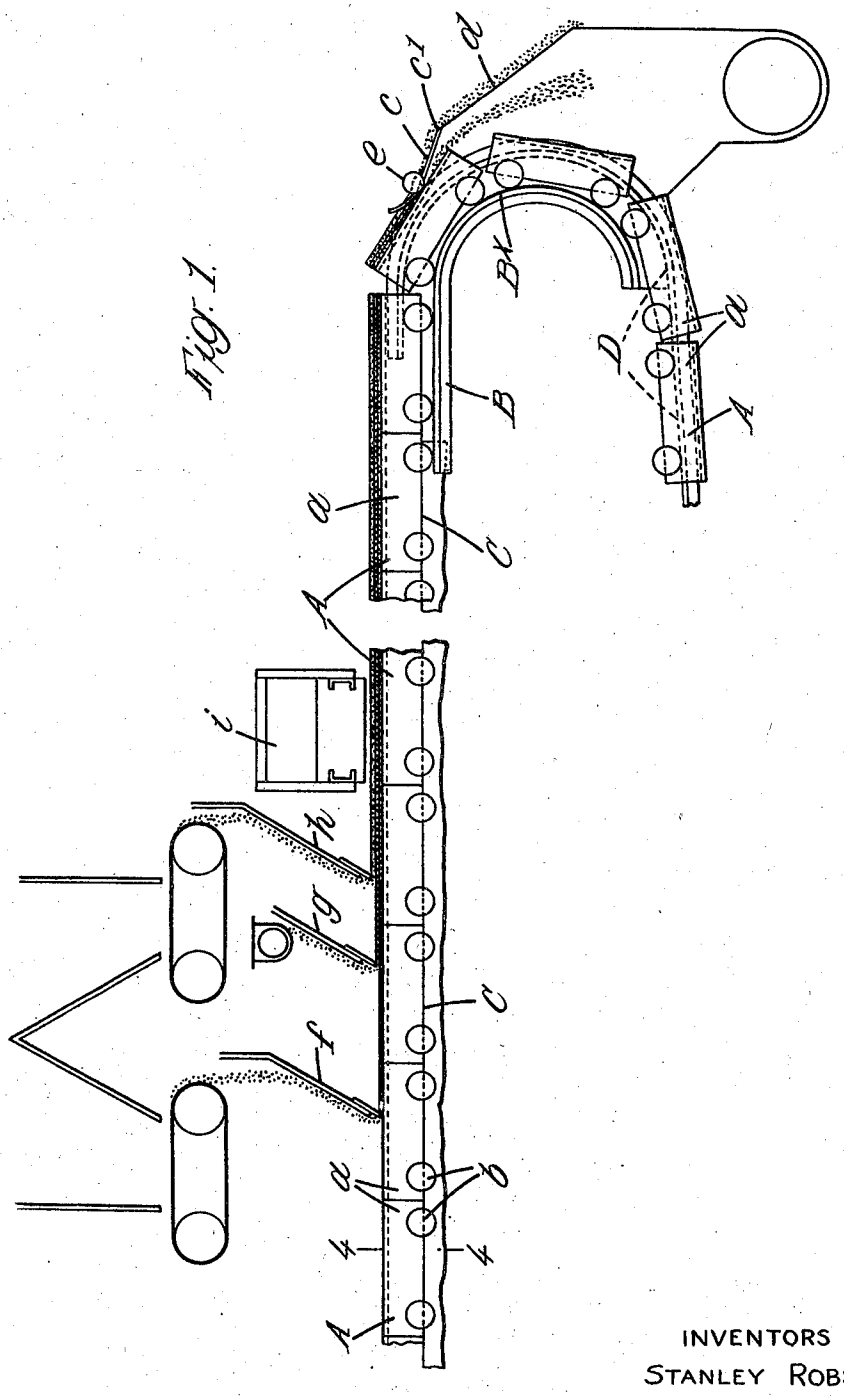
Oct. 4, 1938. S. ROBSON ET AL 2,131,786

ROASTING OF ORES, ESPECIALLY ZINC SULPHIDE ORES CONTAINING LEAD AND/OR CADMIUM

Filed May 15, 1937 2 Sheets-Sheet 1

Fig. 1.



INVENTORS

STANLEY ROBSON

THOMAS BENSON GYLES

BY Liddle, Berkeley & Montgomery

ATTORNEYS

Oct. 4, 1938. S. ROBSON ET AL 2,131,786

ROASTING OF ORES, ESPECIALLY ZINC SULPHIDE ORES CONTAINING LEAD AND/OR CADMIUM

Filed May 15, 1937 2 Sheets-Sheet 2

Fig. 2.

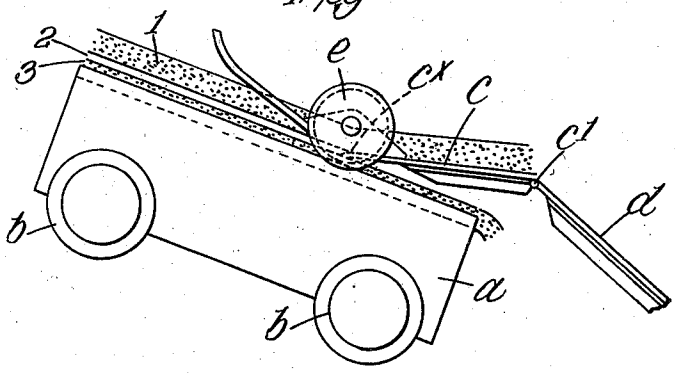


Fig. 3.

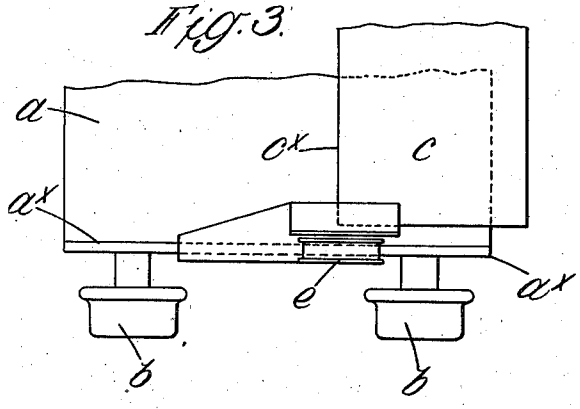
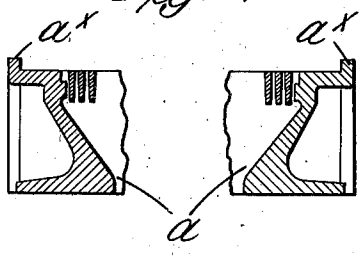


Fig. 4.



INVENTORS
STANLEY ROBSON
THOMAS BENSON GYLES
BY Kiddle, Bethell & Montgomery
ATTORNEYS

Patented Oct. 4, 1938

2,131,786

UNITED STATES PATENT OFFICE

2,131,786

ROASTING OF ORES, ESPECIALLY ZINC SULPHIDE ORES CONTAINING LEAD AND/OR CADMIUM

Stanley Robson, Durdham Park, Bristol, Gloucester, and Thomas Benson Gyles, Clifton, Bristol, Gloucester, England, assignors to National Processes Limited, London, England, an English joint-stock company

Application May 15, 1937, Serial No. 142,780
In Great Britain May 21, 1936

7 Claims. (Cl. 75—1)

This invention relates to processes and means for or relating to roasting ores particularly zinc sulphide ores, concentrates and the like (all hereinafter referred to as the ore) in which any suitable blast roaster machine may be employed, for example blast roasting apparatus of the well known "Dwight-Lloyd" type in which the ore to be sintered is delivered on to the surface of travelling grates so as to form thereon a bed or charge of such ore of suitable thickness which travelling bed of ore or charge is caused to pass beneath an ignition burner or burners and over a suction chamber or chambers whereby the ore is sintered and thereafter delivered off the machine, for example as described in British patent specification No. 306,569; or if desired in carrying out the present invention any other suitable form of blast roaster apparatus may be employed in which a current of air or oxydizing atmosphere is blown or drawn through a charge or bed of ore on a perforated travelling grate.

According to this invention the bed or charge of ore to be sintered is composed of 3 layers of differing materials in the contiguous layers which are each prepared and laid, superimposed, on one another, on the travelling grate so that when the complete bed of ore or charge thus formed on the travelling grate has been subjected to the sintering operation the thus sintered bed of ore or charge will produce or provide a plane of easy or ready cleavage whereby this sintered travelling bed or charge of ore can be readily separated into two layers advantageously when about to leave or as same leave the travelling grate.

This invention refers particularly to the blast roasting of zinc sulphide ores (blende) containing impurities, notably lead and/or cadmium compounds or other compounds which may be present and which readily volatilize when the said ores are heated in processes of the type in which the roasted product is obtained in a sintered form and we will proceed to describe our present invention with reference to this kind of ore.

It has been observed in practice that the lead or/and cadmium present in the sintered charge from a zinc sulphide ore (blende) charged on to a sintering machine is not evenly distributed therethrough on completion of the sintering operation—i. e. the bottom portions of the sinter cake now having a much greater proportion of these elements than the top portions which latter are relatively free thereof.

It is an object of this invention to produce a sintered cake (on the travelling grate of the sintering machine) which can be easily separated into two layers so that the upper layer of the cake which is relatively free from lead or cadmium may be separated from—and delivered separately from—the lower layer of the charge in which the lead or/and cadmium is concentrated or mainly concentrated.

According to the invention a process for roasting zinc sulphide ores containing lead and/or cadmium consists in arranging the ore charge on the travelling bed of a sintering machine in 3 layers adapted to be readily separated, by interposing a layer of material which is either (*a*) inert during the roasting operation or (*b*) of different grain size or (*c*) of different sulphur content of fuel value from the main charge, whereby when the charge is sintered a plane of cleavage in the charge is formed between the upper and lower layers of the ore charge.

The following are examples of three alternative methods of producing the plane of cleavage in the sintered cake which can be employed viz.:—

(*a*) an inert layer may be interposed between the top and bottom layers by spreading over the bottom portion (bottom layer) of the charge a zinc ore containing no sulphur such for example as calamine or already desulphurized zinc ore or sinter. In this case the interposed layer will remain inert during the roasting process, whereas the layer above and layer below it being the normal charge containing, for example, green ore and returned sinter will form two sinter layers separated by the interposed inert and loose layer, thus forming a plane of cleavage.

(*b*) A layer of differing grain size may be interposed by dusting very fine sintered "returns" on to the bottom layer before feeding on to same the top layer material; or by using for the intermediate layer the same mixed charge material as the top and bottom layers, but having for the intermediate layer a particle size coarser than the rest of the charge. In this latter case, although the shrinkage may be of or about the same order as the upper and lower layers, yet the difference in particle size will cause the coarser material of the intermediate layer to form a loose rubbly layer which easily parts between the upper and lower layers.

(*c*) An interposed layer of different sulphur content or fuel value can be produced by making a different mixture of green ore than the main charge so as to produce a mixture for the intermediate layer having either a higher or lower sulphur content than that of the main charge. In this case, the different roasting intensity will

cause a different shrinkage between the interposed layer and the layers above and below thus forming a plane of cleavage. The same effect will also be obtained by forming the interposed layer of desulphurized sinter with which sufficient fuel is admixed which burning in the air current will produce a different temperature in the interposed layer and consequently form a cleavage plane.

The process of the invention may be employed in any well-known sintering processes to which same may be applicable as, for example, in the well-known two-stage process (patent specification No. 1,401,733) in which the material is sintered (after previous roasting in a pre-roasting furnace) using green ore as the additional fuel. The invention may also be applied to similar processes as, for example, where coal or coke or carbon is used as the fuel in the sintering of materials previously desulphurized.

The invention is, however, particularly applicable in carrying out the process set out in British patent specification No. 306,569 and in carrying out the process set out in British patent specification No. 433,861. In these processes the invention may be employed in any of the ways described above, but a convenient method is for the interposing layer or layers to consist of normal "returns" without the addition of any green ore.

In carrying out either or both of these last named processes we have found that an inert layer of "returns" say from $\frac{1}{16}$ of an inch to about ½ an inch thickness acts very satisfactorily. The roasting action initiated at ignition, and passing down through the charge passes satisfactorily through an interposed layer of limited thickness, the necessary heat being transmitted therethrough by air currents and by radiation and conduction. If for any reason, e. g. the desire to maintain higher gas strengths (SO_2) or higher heat intensities or to use a thicker interposed layer, it is undesirable to use an entirely inert material, then one or other of the means indicated above can be used to increase the fuel value of the interposed layer.

The interposed layer can be inserted by means of any convenient mechanical arrangement. For example, a thickness of the normal charge to form the bottom layer can be fed on to the travelling grate in one or other of the well-known or recognized feeding devices, and then from a similar and separate device the requisite thickness of the intermediate layer (to form the parting layer) can be fed, followed by feeding on of the normal charge to form the top layer. In the case of using simply coarser portions of the charge as the interposed layer to form the parting zone, this can be accomplished by carrying on the first operation as above, and then passing to the third operation, but arranging the feeding on in such a manner as to allow the coarser particles to roll down the feed heap, thus forming the coarser zone in between the other two.

The separate discharging of the layer or layers to be selected at or towards the discharge end can be accomplished by any convenient device, as for example the edge of a metal blade or plate, or a row of prongs or forks on which the top layer, easily detached from the lower, rides over and reaching a conveyor is separately transported. The under portion of the charge together with loose material takes the normal route of the sintering equipment, for example in the process of British patent specification No. 306,569 is used as returns. Alternatively, the upper portion can be returned or transported, and in general regarded as the normal product, while the under portion at some convenient place in the equipment is diverted as the special output.

The position of the interposed layer within the cake can be chosen to suit the quality requirements of the products, or the characteristics of the process. More than one layer can, if desired, be inserted e. g. two inserted layers, giving three divisions of the charge.

Some practical examples will serve to illustrate various modes of operation:—taking the case of the process of British Patent No. 306,569, with certain zinc ores high in lead, say 4.5% Pb. In the normal process it will be found that the lead percentage in the sintered cake ranges from say 0.5% in the top to as high as 30% in the very bottom. By the use of two inserted layers, it is thus possible to divide the output into three portions:—the bottom portion high in lead and cadmium, which can be used for the recovery of lead and cadmium therefrom, the middle portion which can be used as normal output and/or for the supply of returns; the top portion low in lead and cadmium, which can be used for zinc distillation, or zinc oxide production, or other purposes. Any deficiencies in the amount of returns required for the process can be made up from one or other of the other portions, preferably the middle portion in normal modes of operation.

In the accompanying drawings there is illustrated a form of blast roasting apparatus designed for carrying on the process of the present invention; but it is to be understood that any other suitable form of blast roasting apparatus may be employed in carrying on the said process.

Referring to the accompanying drawings:—

Fig. 1 is a local view in side elevation of the upper portion of a blast roasting apparatus and showing diagrammatically the means for separately feeding the respective 3 layers onto the endless travelling grate and the means for effecting the separation of the top and bottom main layers after roasting, and for removing said top layer and discharging the latter (separately from the bottom layer) from the delivery end of the sintering machine;

Fig. 2 is a view in side elevation—on a greatly enlarged scale—of: (*a*) one of the pallets pans or link members, forming the endless travelling grate, in the tilted position which it is caused to assume on its arrival at the discharge end of the endless travelling grate (as shown in Fig. 1) and (*b*) means for effecting the separation of the top and bottom main layers after roasting and for removing said top layer and delivering the latter separately from the bottom layer, as each said pallet in succession arrives at and passes under said means for separating the top and bottom layers.

Fig. 3 is a fragmentary view, in plan, of Fig. 2;

Fig. 4 is a cross-sectional view on an enlarged scale on line 4—4 of Fig. 1, of one of the pallets of the endless travelling grate.

A is the endless travelling grate formed of pallets, pans or link members *a* (hereinafter referred to as the pallets *a*) which are linked to one another, in any known or suitable manner to form the endless travelling grate of the blast roasting apparatus.

Each pallet *a*, on each side of its upper surface, is provided with a side flange a^x (Fig. 4), and is provided with flanged wheels *b* which run on the guide rails B, B^x and D by which the

pallets are guided except during their travel along the longitudinal upper part of the roasting apparatus. During the travel of the pallets *a* along said upper part of the roasting apparatus, the bottom part of each pallet *a* slides along the upper surface of the longitudinal member C on each side of the apparatus.

At the discharge end of the apparatus the wheels *b* encounter and then run on the rail B which is curved downwards as indicated at $B^{\times}$ (see Fig. 1). After delivering the sintered material off the pallets at the discharge end of the apparatus the pallets *a* pass downwards around said curved end rail $B^{\times}$, their wheels *b* then engaging the further rail D which runs along the lower part of the apparatus.

c is the knife or plate having knife edge $c^{\times}$ of the full width of the layers of material carried on the endless travelling grate between the flanges $a^{\times}$ of the pallets *a* forming the endless travelling grate.

The knife or plate *c* is adjustably mounted, for example hinged at c^{1}, so that the edge end $c^{\times}$ of said knife or plate can be raised or lowered (and fixed in its adjusted position) to divide the top layer of any desired thickness from the bottom layer on the grate.

d is shoot, down which the top layer divided by the knife or plate *c* is separately delivered, for example to a conveyor (not shown).

e is roller, engaging on flange $a^{\times}$, on each side of the endless travelling grate A.

f is shoot, down which is fed the desired material or mixture of materials for initially forming the bottom layer 3, (see Fig. 2) of the desired thickness, on the pallets *a* of the endless travelling grate A.

g is shoot, down which is fed onto the top of the No. 3 layer the desired material for forming the intermediate layer 2 (of the desired thickness) to be interposed between the top layer 1 and bottom layer 3—see Fig. 2.

h is shoot, down which is fed onto the top of the intermediate layer 2 the desired material or mixture of materials forming the top layer 1 of the desired thickness.

i is the igniter.

A simple mode of operation is the insertion of only one interposed or parting layer, and with ores as above; assuming that the main aim is not only, while sintering, (*a*) to cause the upper layer to become relatively free from lead or/and cadmium but also (*b*) to cause the segregation of the lead or/and cadmium in the bottom layer to enable the lead or/and cadmium to be recovered from said bottom layer after the latter has been separated, and delivered separately, from the upper layer; then the interposed layer would be inserted near the bottom of the charge on the grate. In this case the top portion can be utilized for returns, as well as normal output; while the separated bottom layer is selected and treated as aforesaid for lead or/and cadmium recovery.

With ores lower in lead content, the insertion of a parting layer near the top, and the selection of the top layer as output gives a good low lead product which results in a good grade of metal (zinc) in the zinc distillation process or a good grade zinc oxide.

When sintering zinc ores containing say 1.5% Pb, the uneven lead distribution makes it possible by the insertion of a cleavage layer to obtain a top portion assaying 0.01% Pb and lower.

With the production of sintered material extremely low in Pb and Cd thus made possible, high grade zinc oxides and/or high grade metallic zinc can be produced therefrom.

With a negligible or very low lead and cadmium content in the top layer when sintered, the metal from both vertical and horizontal retort distillation processes can be delivered substantially free from lead and cadmium.

Further, we have found that with these low or negligible lead sinters treated in the horizontal distillation process any small amounts of lead left in the sinter come over in the earlier taps of the process, while the metal from the later taps is almost entirely free from lead and cadmium.

This is contrary to experience with sinters or ores containing higher lead percentages, and it can be seen, therefore, that with these low lead sinters produced by the present invention, a high grade of zinc metal substantially free from both lead and cadmium can be obtained during the latter part of the distillation period.

It will be obvious that the present invention may be employed for re-sintering already sintered ore for the purpose of separately de-leading or de-cadmiumizing such already sintered ore; namely by the addition to and admixture with the already sintered ore of carbon (e. g. coal or coke) in that part of the charge for forming the top and bottom layers of such sinter mixture and forming the intermediate layer as in either of the foregoing Examples *a* or *b* or *c*; except that in the case of Example *c* being employed a different coke mixture would be employed in the intermediate layer instead of green ore.

If desired the process or method of the present invention may be employed in the blast roasting of any ore or ores (as well as for zinc sulphide ore) to which same may be applicable.

What we claim is:—

1. In the operation of sintering ore on the travelling grate of a blast roasting apparatus and the removal or substantial removal from the ore, during the sintering operation, of lead and/or cadmium and/or other impurities present in the ore; the method of forming the charge to be sintered on the travelling grate which consists in delivering onto said travelling grate the charge material in three superimposed layers of differing characteristics by interposing, between the top and bottom layers of the charge material, an intermediate layer of charge material having differing characteristics from the top and bottom layers and such that after the completion of the sintering operation this intermediate layer will constitute a plane or zone of cleavage in the sintered charge thereby to enable the now substantially impurities-free sintered top layer of the charge to be readily separated from the bottom layer and to be separately delivered from the travelling grate; and separating said top layer from the bottom layer and delivering from the grate said top layer separately from said bottom layer.

2. In the operation of sintering ore on the travelling grate of a blast roasting apparatus and the removal or substantial removal, from the ore, during the sintering operation, of lead and/or cadmium and/or other impurities present in the ore; the method of forming the charge to be sintered on the travelling grate, which consists in delivering the charge to be sintered onto said travelling grate in more than three superimposed layers of material of differing characteristics in such wise that an intermediate layer, formed of material of differing characteristics from the

other layers, is interposed between the top layer and bottom layer and will, after completion of the sintering operation constitute a plane or zone of cleavage in the sintered charge thereby to enable the now substantially impurities-free sintered top layer to be readily separated from the lower layers and to be separately delivered from the travelling grate and separating said top layer from the lower layers and delivering said top layer separately from said lower layers.

3. In the method of sintering ore according to claim 1, forming an intermediate layer between the top and bottom layers of a material which remains inert throughout the sintering operation.

4. In the method of sintering ore according to claim 1, forming an intermediate layer between the top and bottom layers of a material of coarser grain size than that of the layer next above and below said intermediate layer.

5. In the method of sintering ore according to claim 1, forming an intermediate layer between the top and bottom layers of a material of finer grain size than that of the layer next above and below said intermediate layer.

6. In the method of sintering ore according to claim 1, forming an intermediate layer between the top and bottom layers of a material of different fuel value from that of the layer next above and below said intermediate layer.

7. In the method of sintering ore according to claim 1, forming an intermediate layer between the top and bottom layers of a material of different sulphur content from that of the layer next above and below said intermediate layer.

STANLEY ROBSON.
THOMAS BENSON GYLES.