Dec. 25, 1928. 1,696,767

L. HOYOIS

METHOD OF WASHING COAL, ORES, AND OTHER SIMILAR MATERIALS, AND AUTOMATIC WATER CURRENT SEPARATOR FOR CARRYING THE METHOD INTO PRACTICE

Filed Feb. 18, 1927 2 Sheets-Sheet 1

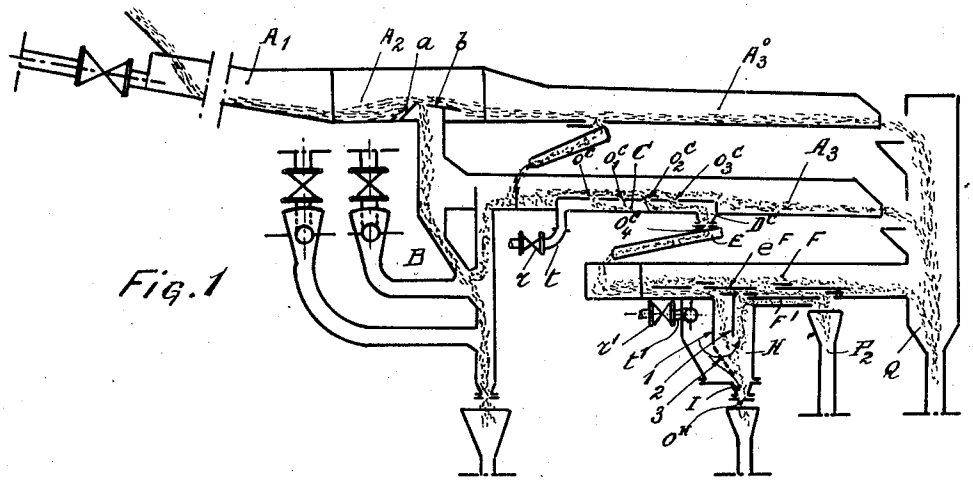


Fig. 1

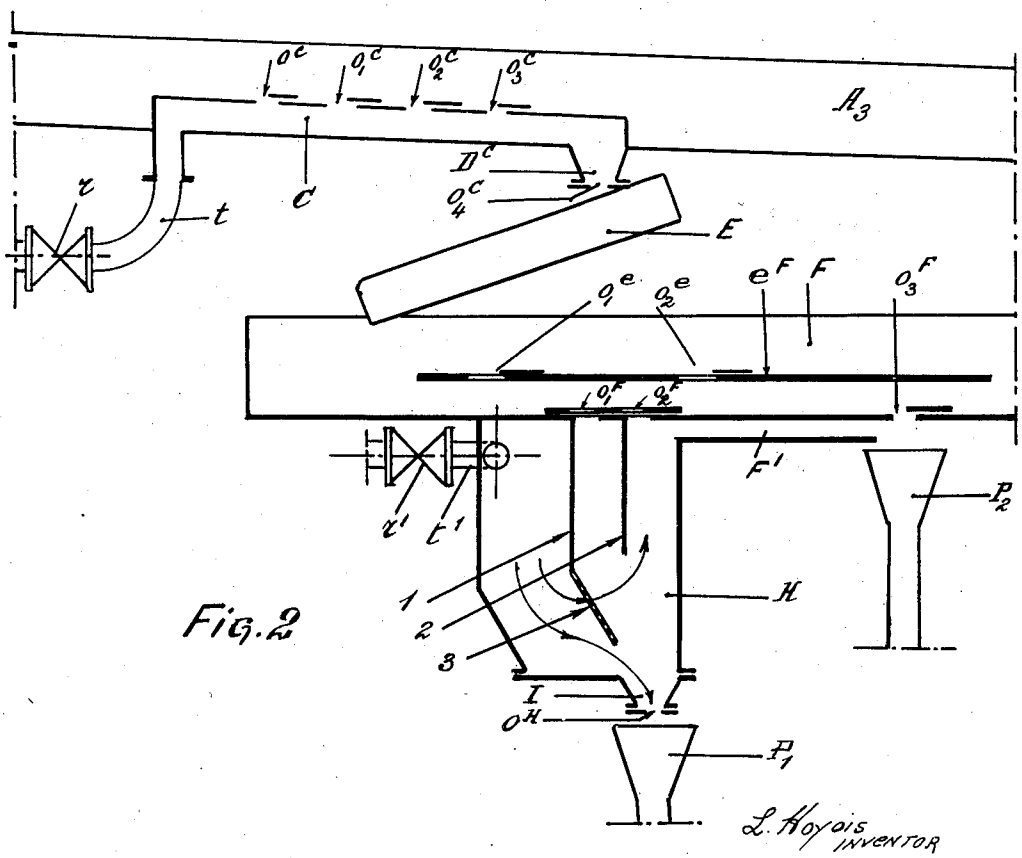


Fig. 2

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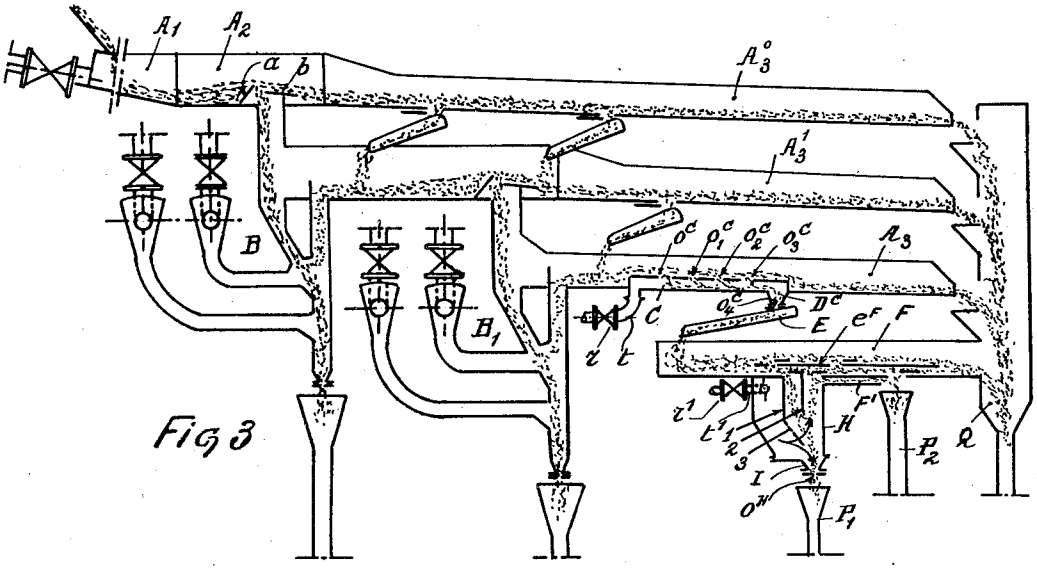


Fig 3

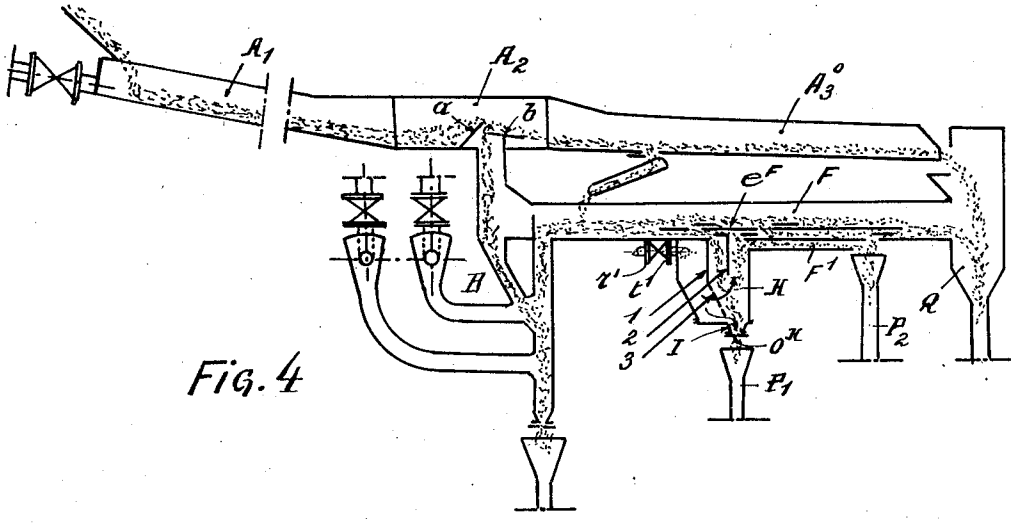


Fig. 4

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UNITED STATES PATENT OFFICE.

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METHOD OF WASHING COAL, ORES, AND OTHER SIMILAR MATERIALS, AND AUTOMATIC WATER-CURRENT SEPARATOR FOR CARRYING THE METHOD INTO PRACTICE.

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In a known method of washing material such as ores, coal and the like, the material is treated by dividing the original mass into two portions, the one mainly comprising the light particles and the other mainly comprising the dense particles, retreating the light portion by separating therefrom the denser particles and directly eliminating the remainder, retreating the dense portion by separating therefrom the lighter particles and directly eliminating the remainder, the denser particles of the light portion and the lighter particles of the dense portion being caused to form a residual mass containing a relatively small proportion of worthless products, a relatively small proportion of pure valuable products, and all or almost all of the intermediate products.

According to the nature of the raw material submitted to the treatment said residual mass is either simply divided into various categories of products or submitted once or several times to the same process before the final division of a last residual mass is effected.

It has been found in practice that in the washing of a raw material including a considerable proportion of intermediate products, as for example of a coal mass containing the entire range of mixed and veined particles the division will not result into products of accurately defined grades.

The object of the invention is to improve the accuracy of the separation into defined categories of products, of the residual mass subjected to the treatment.

The invention consists in the improved method of treatment of a residual mass mainly composed of mixed products with relatively small proportions of worthless and valuable particles comprising the removal from the said mass of all other particles than the valuable particles together with a very small proportion of the latter, regrading the removed portion into mainly worthless particles and mainly mixed particles, the latter including the small proportion of valuable particles, and allowing for the successive elimination of the worthless particles and of the mixed particles while the elimination of the remaining valuable particles is avoided.

The invention further consists in the improved treatment as stated in the preceding paragraph in which the residual mass is received as a movable washing bed in a trough including a stationary washing bed and a single separating box fed with adjustable water currents, in which box pass all other than the valuable particles together with a small proportion of the latter, the particles so removed being allowed to regrade themselves in a movable bed from which first the whole of the worthless particles with a part of the mixed particles and subsequently the remaining portion of the mixed particles are separated.

The invention further consists in an improved treatment as stated in the preceding paragraphs in which, after the regrading of the portion removed at the said box, said portion is divided by means of a horizontal diverting partition into two parts i. e. one part comprising mainly the mixed particles including a small proportion of worthless particles and the small proportion of the valuable particles and a part comprising mainly the worthless particles with a small proportion of mixed particles, the first mentioned part being cleared from its worthless particles and later on from its mixed particles, while the second mentioned part, after incorporation of the worthless particles from the first part, is cleared of the worthless and of a part of its mixed particles, and, after incorporation of the mixed particles from the first part, is cleared of its mixed particles.

The invention also comprises the treatment according to which the residual mass is directly submitted to the treatment as stated in the preceding paragraph.

The invention further consists in the details of the methods and the apparatus for washing coals as hereafter more fully explained with reference to the annexed drawings showing, by way of example and diagrammatically, embodiments of the said apparatus, and in which:

Fig. 1 shows a first construction.

Fig. 2 shows, on an enlarged scale, the detailed construction of the apparatus used for the complete treatment of the final residual mass.

Fig. 3 shows a construction similar to that of Fig. 1, suitably arranged for the treatment of material of a more complex nature.

Fig. 4 shows a similar construction to that of Fig. 1.

The body of raw material to be treated is conducted into the trough A_1 and carried along in the latter by an adjustable current of water, with the formation of a washing bed upstream from the weir a in a trough A_2 and the division, by means of a diverting partition b, in order to submit the portion comprising mainly the worthless and mixed particles to the treatment in a column apparatus B with separation of the valuable and mixed particles contained in this portion, and treating the remaining part in a trough A_3^0 for separating out the dense particles contained therein.

The reunion of the light particles from the column apparatus B and of the dense particles from the trough A_3^0 either forms the final residual mass, the treatment of which will be subsequently more fully explained, or else the said material is subjected to a repeated treatment as above mentioned, once or several times, before constituting the final residual mass.

The apparatus used for this purpose are shown in Figs. 1, 3 and 4.

In the trough A_3, as is shown particularly in Fig. 2, is mounted a box C, projecting above the bottom of the trough, and provided with openings such as o^c, o_1^c, o_2^c, o_3^c, and with a water inlet t which can be regulated by means of the valve r.

The said box also comprises a discharge nozzle D^c fitted with an adjustable opening o_4^c.

The residual mass to be treated, brought into the trough A_3, forms, upstream from the box C, a movable bed flowing over a stationary bed, the adjustable openings o^c, o_1^c, o_2^c, o_3^c, allowing the passage of the successive layers, of successively decreasing densities.

It will be seen that by suitably adjusting the size of the openings o^c, o_1^c, o_2^c, o_3^c, as well as the flow of water, it is possible to cause all the shale and all the mixed products to pass into the box, while in order to be sure that all the shales and mixed products are removed, the adjustment can be such that coal is carried away through the opening o_3^c together with the other particles eliminated.

The remaining coal of the treated mass follows along the trough A_3 so as to discharge into the hopper Q.

From the box C, the body of the separated products carried along by the water current flows into the final separating trough F by following the channel E.

In this trough F the mass regrades itself into superimposed layers of decreasing densities and is treated therein either as a whole, as will be explained later on, or else, and preferably as follows:

The mass of material is divided in the trough F by a partition e^F located at a certain distance above the bottom of the said trough. The upper part of the mass of material, diverted by the partition, is almost exclusively composed of particles of coal but includes a certain quantity of mixed products and a few of shale particles, whereas the part remaining in the bed contains almost all the shales, most of the mixed products and only a few of grains of coal.

Considering the portion diverted by the partition e^F, said portion encounters, in its travel, two adjustable openings o_1^e and o_2^e, which are so regulated that the shale and part of the mixed products are eliminated through the opening o_1^e, and the remaining mixed products with some coal through the opening o_2^e. The remaining portion of the bed, only formed of coal, meets the trough F at the end of the partition e^F.

The lower portion of the movable bed formed at the entrance of the trough F to which are added the particles falling from the opening o_1^e, or the entire bed, if the above subdivision has not been effected, encounters successively two openings, formed in the bottom of the trough, such as those designated by o_1^F and o_2^F, such openings enabling the particles to fall into moving currents of liquid produced in an apparatus H built as follows:

In a box-shaped casing are fitted vertical partitions such as 1 and 2, arranged so as to divide the casing into a number of compartments, the successive partitions being of decreasing height.

A water inlet t^1 controlled by the valve r^1, is provided in the first compartment, and below the dividing partition of the adjacent compartment is fitted an inclined perforated metal plate 3 serving as a guide and preventing entrance to the first compartment.

A discharge nozzle I with adjustable opening o^H is provided in the bottom of the casing H and discharges into a hopper P_1.

Beyond the last compartment the casing terminates, at the upper part, in a passage F^1 which conducts the material to be diverted into a hopper P_2. Above said hopper the trough F is provided with an opening, as shown.

The operation can be described as follows:

The current of water entering the casing H through the pipe t^1 divides, in the case considered, into two separate currents, one moving upwards in the last compartment, and the other passing through the discharge opening o^H.

The said opening being adjusted according to the particular operating conditions to be obtained and the size of the particles to be discharged, the flow therefrom will reach a constant value, and at the same time the flow of the upward current through the last compartment towards the passage F^1 can be regulated.

The openings o_1^F and o_2^F are adjusted so that the moving bed circulating into the

trough will give up all its shales and the greater part of its mixed products. The opening o_1^F allows the shales and a small quantity of mixed products to pass through, while a part of the mixed products, together with the small quantity of shale not separated out at o_1^F, passes through the opening o_2^F.

The current issuing from the first compartment takes up from the downward current of shale any particles of mixed products contained therein, and carries them up in the third compartment towards the passage F^1, owing of the offset arrangement of the partitions 1 and 2.

The descending current of mixed products passing through the opening o_2^F is similarly subjected to the action of the ascending current, the mixed particles being carried away towards the trough F^1, while the shales continue their downward movement so as to be discharged at the opening o^H in the nozzle I.

The mixed products follow the trough F^1 and are discharged into the hopper P_2.

After the extraction at the openings o_1^F and o_2^F, mixed products and coal remain in the trough, to which are added, (if a previous subdivision is effected) the mixed products and coal falling from the opening o_2^e. A more precise grading of these classes of products is obtained during the movement of the movable bed towards the opening o_3^F, this latter being adjusted so that the last particles of mixed products are discharged therefrom.

In Fig. 4, relating to the case in which the residual mass to be treated can be rather easily graded, the said residual mass is brought directly into the trough F which replaces the trough A_3, the operations performed therein being the same as before.

It will be noted, that various modifications of the details can be made both in the method and in the apparatus, without departing from their principles.

Claims:

1. Improvements in the method of washing materials such as ores, coals and the like consisting in dividing the body of material to be treated into two portions, one portion comprising most of the light particles and the other portion comprising most of the dense particles, extracting the denser particles from the light portion and extracting the lighter particles from the dense portion, subsequently mixing the particles extracted from each of said portions to form a residual mass composed of mixed products with relatively small proportions of heavy and light particles; removing from said mass all other particles than the light particles together with a very small proportion of the latter, regrading the removed portion into mainly heavy particles and mainly mixed particles, the latter including the light particles, and causing the successive elimination of the heavy particles and of the mixed particles while the elimination of the remaining light particles is avoided.

2. Improvements in the method of washing materials such as ores, coals and the like, which improvements consist in forming a residual mass composed from the lighter particles of a dense portion and the denser particles of a light portion, said residual mass being composed of mixed products with relatively small proportions of heavy and light particles; removing from the said mass all other particles than the light particles together with a very small proportion of the latter, regrading the portion removed into mainly heavy particles and mainly mixed particles, the latter including the light particles, and causing the successive elimination of the heavy particles and of the mixed particles while the elimination of the remaining light particles is avoided.

3. In a treatment as claimed in claim 2, receiving the residual mass as a movable washing bed upon a stationary washing bed, subjecting the movable bed to the action of adjustable water currents and separating therefrom all other than the light particles together with a small proportion of the latter, regrading the removed particles into a movable washing bed and separating from this latter washing bed the whole of the heavy particles with a part of the mixed particles and subsequently the remaining portion of the mixed particles.

4. In a treatment as claimed in claim 2, receiving the residual mass as a movable washing bed upon a stationary washing bed, subjecting the movable bed to the action of adjustable water currents and thus separating therefrom all other than the light particles together with a small proportion of the latter, regrading the removed particles, dividing horizontally the mass so formed into a part comprising mainly the mixed particles including the light particles and a part comprising mainly the heavy particles; removing from the first named part first the heavy particles and later on the mixed particles; incorporating the heavy particles from the first part into the second named part and separating the heavy and a part of the mixed particles, incorporating the mixed particles from the first part and separating then the remainder of said mixed particles.

5. In a treatment as claimed in claim 2, receiving the residual mass as a movable bed upon a stationary washing bed, dividing horizontally the said movable bed into a part comprising mainly the mixed particles including the light particles and a part comprising mainly the heavy particles, separating from the first named part the heavy particles and later on the mixed particles, incorporating into the second named part the heavy particles of the first part and separat-

ing then from said second part the heavy and a part of the mixed particles, subsequently incorporating the mixed particles from the first named part into the remainder of the second named part and separating from said second named part the remainder of its mixed particles.

6. In the treatment as claimed in claim 2, causing the heavy particles together with the part of the mixed particles to fall into moving bodies of liquid, allowing for the descending movement of the heavy particles while the mixed particles are carried away and lead into their storage hopper.

7. An apparatus for carrying out a process of washing materials such as ores, coals, and the like of the kind described, comprising in combination, a trough receiving the material to be treated, a weir and a diverting partition, adjustable discharge means between such weir and such partition, a column apparatus depending from said trough below said discharge means, a trough following the diverting partition, and provided with an adjustable opening or openings, a chute or chutes receiving the products discharged at the said opening or openings and leading same into another trough, a box in this latter trough, said box provided with several adjustable openings and supplied with adjustable currents of water, a nozzle having an adjustable discharge opening provided at the end of the box and leading the products into a lower trough, a horizontal partition located at a certain distance above the bottom of this latter trough, said partition provided with adjustable discharge openings and the discharge end of the partition located towards the end of said latter trough, said latter trough provided with adjustable discharge openings below said partition, and a casing provided in the trough opposite the said openings.

8. In an apparatus as claimed in claim 7, the casing including depending and spaced partitions, such partitions of successively decreasing heights starting from the intake compartment, a discharge nozzle with an adjustable opening at the base of the casing and a discharge passage near the top of the casing beyond the last compartment.

9. An apparatus for carrying out a process of washing materials such as ores, coals and the like of the kind described, comprising in combination a trough receiving the material to be treated, a weir and a diverting partition, adjustable discharge means between such weir and such partition, a column apparatus depending from said trough below said discharge means, a trough following the diverting partition and provided with and an adjustable opening or openings, another trough disposed so as to receive the products delivered by the column apparatus and said openings, a substantially horizontal partition arranged in the last named trough at some distance from the bottom thereof, the partition and the trough provided with adjustable openings, a casing with depending partitions of decreasing heights suspended on the last named trough in registered relation with some of the openings in said trough, adjustable means for supplying liquid currents entering said casing, and hoppers arranged in registered relation with the discharge opening of the casing and of the last named trough.

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