May 30, 1933. L. HOYOIS 1,912,077

PROCESS AND APPARATUS FOR THE TREATMENT OF COALS, ORES, AND THE LIKE, MAINLY COMPOSED OF PARTICLES OF SMALL SIZES

Filed Oct. 10, 1927 2 Sheets-Sheet 1

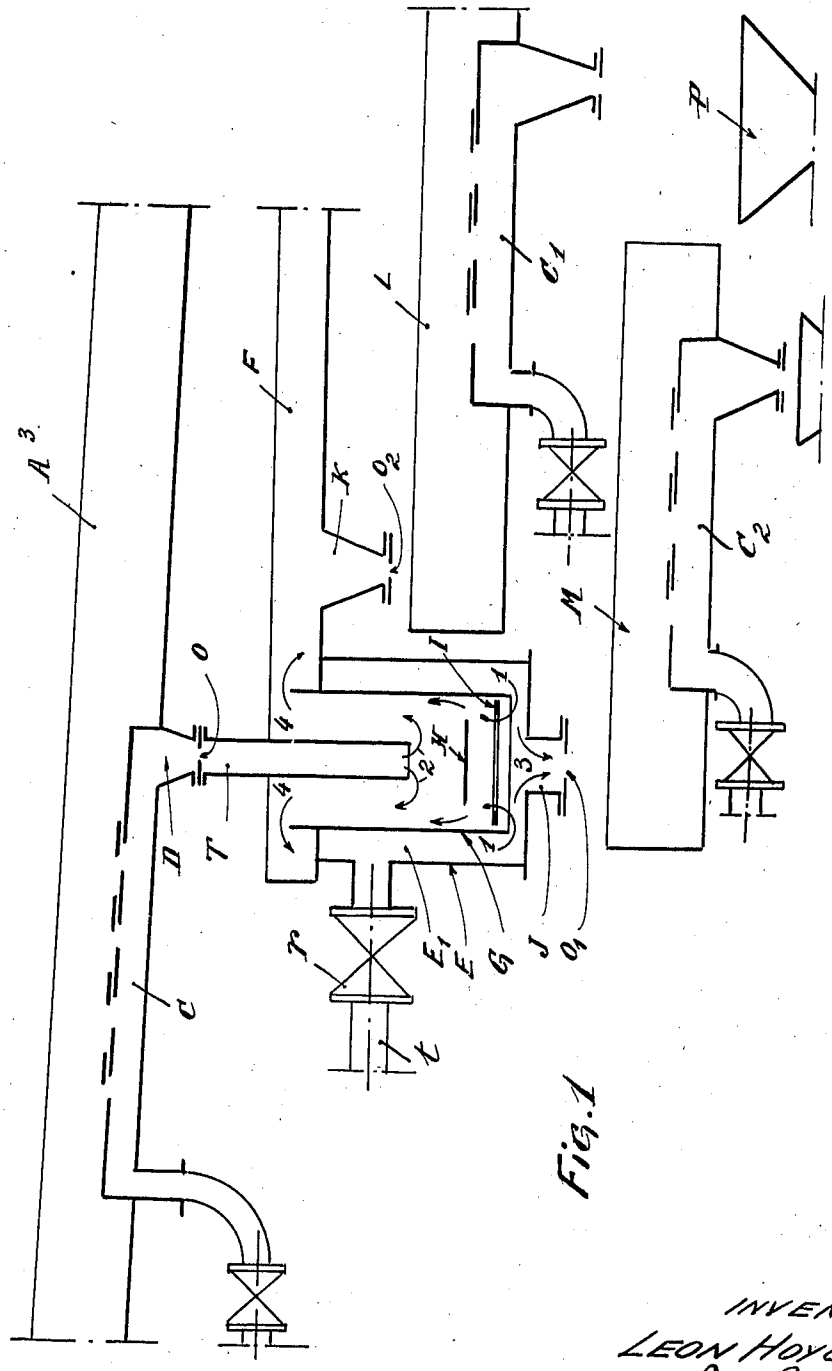


Fig. 1

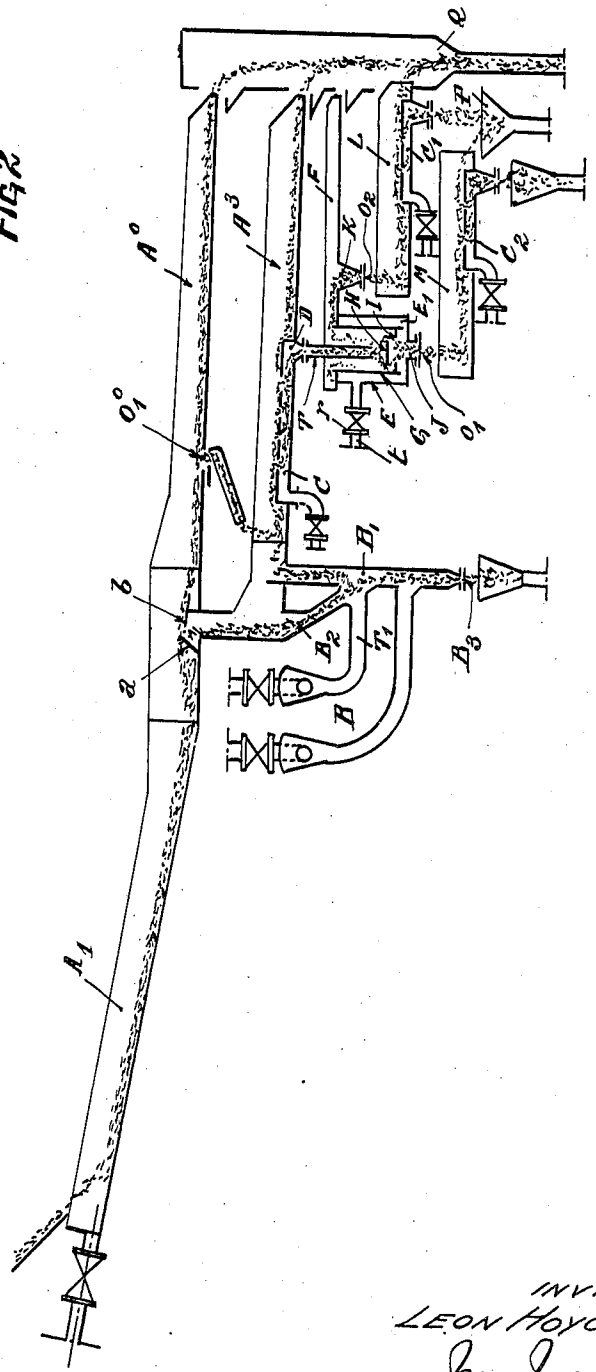
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Fig 2



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UNITED STATES PATENT OFFICE

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PROCESS AND APPARATUS FOR THE TREATMENT OF COALS, ORES, AND THE LIKE, MAINLY COMPOSED OF PARTICLES OF SMALL SIZES

Application filed October 10, 1927, Serial No. 225,258, and in Belgium October 19, 1926.

The present invention relates to the treatment of coals, ores and similar materials, and concerns especially the treatment of bodies or masses of material composed of particles of small sizes.

When a body or mass of material to be divided into various portions or grades of products, namely valuable particles, worthless particles and one or several classes of intermediate or mixed particles, contains large proportions of fine particles, experience shows that difficulties are encountered in removing all the valuable particles and separating the mixed particles, as the fine particles have a marked tendency to incorporate themselves with the shales to be eliminated, particularly when the transporting capacity of the currents carrying them decrease, for example because it is desired to separate grades less widely differentiated contained in a residual body of material.

The object of the invention is to provide a process enabling small particles, forming generally the residual masses from the treatment of coals, ores and other similar materials, to be separated into sharply distinct grades.

Assuming that, in a body or mass of coals of such particles and in the scale of densities of same, the density δ represents the upper limit of the so-called valuable particles and the density δ^1 represents the lower limit of the so-called worthless particles, the problem consists in dividing the body into one portion containing the particles having densities equal to or less than δ; one portion containing the particles the densities of which are comprised between δ and δ^1; and one portion containing the particles having densities equal to or greater than δ^1, taking into consideration the tendency of the said categories to mix with each other.

For this purpose the process consists, generally, in first dividing the said body or mass into two portions, selecting as the dividing line a suitable density comprised between δ and δ^1, and which may be designated δ^m; in separating out from the portion containing particles having densities less than δ^m, those particles the densities of which are greater than δ; in separating out from the portion containing particles having densities greater than δ^m those particles the densities of which are less than δ^1; and in uniting, in order to form the middle portion, the particles having densities comprised between δ^m and δ and those having densities comprised between δ^m and δ^1.

Aside from the above mentioned feature, the process is characterized in that the body or mass to be treated is carried in a descending current falling into a liquid body and upon a weir, thus causing the deflection of the current in upward direction in the form of a concentric vein with the blowing away into the body or mass of less dense particles and the spreading of the denser particles upon the weir, in combination with a directly ascending current issuing from the rear face of the weir and incorporating with the first current into the peripheral portions of its curve of deflection, in order to determine the action, upon the "dispersed" particles and those of the liquid sheet spreading over the weir, of currents having variable ascending forces, able to carry upwards the particles having densities up to δ^m.

Aside from the aforesaid process applied to bodies or masses of small particles, the invention also includes the methods of treatment of coals, ores or like materials, in which the said process forms a step of the complete treatment, as for example the methods where the process is applied to the treatment of one of the residual bodies or masses composed of the dense portions of the light part separated at one of the diverting partitions and of the light portions removed from the dense part, separated at the considered diverting partition, by the action of the ascending current of a column apparatus.

The invention further comprises the apparatus enabling the process to be carried into practice, either alone or as a step of a complex treatment, as more fully explained in the following description with reference to the annexed drawings in which;

Fig. 1 shows an apparatus enabling the

process to be carried into practice, starting from a body or mas of small particles.

Fig. 2 shows a plant, in which may be found the apparatus of Fig. 1, relating to the complete treatment of a complex mass of raw material, that is composed of particles of variable sizes mixed with small particles.

Referring first to Fig. 1, assuming that a body or mass of coal mainly composed of particles of small sizes is carried as a washing bed into the trough A^3, this trough will preferably be provided with a box C having several discharge openings enabling the removal of a residual mass composed of valuable particles, mixed particles and worthless particles, the lighter particles being retained in the trough and carried into a storing hopper provided at the end of the trough owing to an appropriate adjustment of the supply of water into the box.

From the particles passing through the openings of the box C, it is desirable to separate those particles the densities of which are less than or at least equal to the density δ of the pure material and those particles the densities of which are greater than or at least equal to the density δ^1 of the worthless particles, while leaving a residual mass of particles the densities of which are comprised between δ and δ^1 corresponding to the portion of mixed particles of the mixture.

To this effect this mass is divided, about a density δ^m, comprised between the densities δ and δ^1, and each of the portions is received into a separate trough arranged in the same manner as the trough A^3, that is combined with a box C having adjustable openings arranged so as to retain in the trough receiving the portion formed of the particles the densities of which are less than δ^m, those particles the densities of which are less than or equal to δ, i. e. arranged so as to isolate the portions δ^m—δ, and in the trough receiving the portion of the particles the densities of which are greater than δ^m, to remove the particles the densities of which are greater than or equal to δ^1 or, in other words to reject in the trough the portion δ^1—δ^m.

The meeting of the portions δ^1—δ^m and δ^m—δ gives the intermediate body or mass of mixed particles having yet an appreciable value.

To this purpose, the products separated at the box C are carried to a discharge nozzle D, having an adjustable opening O (the size of which controls the removal in the box), and fall, through the pipe T, into a barrel E depending from a trough F.

The barrel is provided with an internal partition G extending a certain height above the bottom of the trough F and ending at a certain distance from the bottom of the barrel, so as to provide externally an annular space E_1 in which opens the mouth of a water intake pipe t controlled by the valve r.

Inside the partition G there is provided a deflecting plate H facing at a suitable distance the mouth of the pipe T and, below the deflecting plate H, there is provided another annular deflecting plate I.

The barrel is provided, at its base, with a discharge J the opening of which may be modified at will by means of a diaphragm O_1.

By suitably adjusting the supply of water through the pipe t it may be arranged that, with a given discharge, there are obtained ascending currents passing in the direction of the arrows 1, externally around the deflecting plate H and incorporating in the peripheral portion of the liquid vein descending the pipe T and deflected in upward direction, along the arrows marked 2, upon the liquid body or mass contained in the barrel and the deflecting plate H.

Owing to this arrangement there are provided, in the space inside the partition G, ascending currents the intensity and supporting force of which go increasing from the center towards the periphery, such currents discharging into the trough F as indicated by the arrows 4.

The mass or body of the particles entering the barrel through the pipe T will open in the barrel E and it will be readily understood that the ascending currents will efficaciously act upon the thus "opened" mass to take up the particles capable of being carried.

The particles which have escaped their actions or which are not capable of being raised, will spread open upon the deflecting plate H by moving towards the peripheral edge of the latter, to finally fall into the liquid currents moving upwards in the lower part of the barrel.

At this point of their path these currents have their maximum intensity and take up, in the "open" mass of particles passing at the periphery of the deflecting plate, any of the particles capable of being carried along.

The particles, the densities of which are too great, fall in the upward current first upon the annular deflecting plate I at the inside edge of which may take place a new selection, and afterwards into the currents such as 3 through which they are moved towards the outlet of the barrel by passing through the nozzle J.

The portion of the particles raised by the ascending currents, carried into the trough F enter the discharge hopper K while the water escapes by following the trough.

The hopper K discharges, through an ad-

justable opening O_2, into a trough L provided with a box C_1 having an adjustable water supply, where takes place the removal of the particles the densities of which are comprised between δ and δ^m, those particles the densities of which are less than or equal to δ being retained in the trough to pass in the hopper Q of the valuable products, (shown in Fig. 2).

The products separated at the box C_1 pass into the hopper P of the mixed products as shown in the drawings.

The portion discharged at the opening O_1 and which comprises all the particles the densities of which are greater than δ^m, is collected into the trough M and reformed in the same into a washing bed, said trough comprising a box C_2 provided with an adjustable water supply enabling the particles the densities of which are less than or equal to δ^1 to be separated, that is to maintain in the through M the particles the densities of which are comprised between δ^1 and δ^m.

These latter particles are collected at the end of the trough into the hopper P for the mixed products, while the products separated at the box are discharged with the worthless products.

When the described process is only a step of the treatment of an initial mass of more complex composition, it will preferably be used to obtain the separation of the various grades or categories of products forming one or any of the residual masses of the treatments described in the said patents and, by way of example, Fig. 2 shows an arrangement enabling a combination of this kind.

The body or mass of raw material is fed in a trough A_1 so as to form therein, upstream of a weir *a*, a movable bed carried upon a stationary bed.

Downstream of the weir, a diverting partition *b* divides the body or mass into two portions, one of which comprises the particles, mainly light, passing into the trough A^0 and the other, comprising the particles mainly dense, falling into a liquid body or mass filling the branch B_2 of a column apparatus B at the base of which it is submitted to the action of a current issuing from a pipe T_1 with the separation of the light particles carried away in upward direction within the column B_1 and the discharge of the worthless particles at the opening B_3.

In the trough A^0, the opening O_1^0 together with the chute disposed under said opening provide for the separation of the dense particles contained in the light portion, said dense particles being mixed, in the trough A_3, with the particles coming from B_1 to form a so called residual mass the particles of which have such characteristics that they may conveniently be submitted to the described process.

The drawings show the general arrangement which, after the trough A^3 is similar to that described with reference to Fig. 1.

It is to be noted that the invention is not limited to the details of the process and apparatus described and illustrated, especially for the arrangement of the barrel E but that it includes also the alternatives and the modifications based on the same principles.

I claim:

1. A classifier comprising a barrel provided with an internal partition in the form of a peripheral annular wall forming a peripheral annular space in which takes place the entrance of an adjustable supply of water, the partition ending at a certain distance from the base of the barrel and extending a certain distance into the discharge trough on which the barrel is suspended; the base of the barrel being formed with an adjustable opening; a descending pipe occupying the middle of the inner free space; a deflection plate facing the mouth of the descending pipe and an annular deflection plate disposed below the first, between the latter and the end of the partition, in such an arrangement that the current descending the central pipe is deflected in upward direction in the form of a concentric vein in which incorporate directly ascending currents issuing from the rear face of the deflection plate so as to finally obtain series of ascending currents of increasing portable force and intensity from the center towards the periphery of the barrel.

2. A process of treating ores, coals and similar materials comprising the grading of the mass in the form of superimposed layers circulating as a movable washing bed on a stationary washing bed, separating several of the successive lower layers of said movable bed and uniting same to form a single dense portion of the original mass, causing said portion to fall as a whole centrally into a body of liquid and spread open in a radially expanding sheet therein, subjecting the particles forming the portion to the action of concentric, upwardly directed liquid currents of increasing portable force toward the periphery of the body, collecting the particles carried upward and collecting the particles falling down and uniting the whole of the dense portion of the particles carried upward with the whole of the light portion of the particles falling down.

3. An apparatus for treating ores, coals and similar materials comprising a trough, a box extending above the bottom of the trough to form a weir in the trough, adjustable discharge means in the upper face of the box, adjustable means to cause liquid current to flow longitudinally through said

box, adjustable discharge means at the end of the box, a hydraulic sorter including a barrel open to said last named adjustable discharge means, means in the hydraulic sorter to form therein a series of ascending currents of increasing portable force and intensity, an upper overflow and a lower discharge for the barrel, a collection trough receiving the overflow, a lower trough receiving the material from the collection trough, a box extending above the bottom of the lower trough to form a weir in such trough, adjustable inlet means in the upper face of the box, adjustable means to cause a liquid current to flow longitudinally through the box, a collecting trough below the discharge of the barrel, a box extending above the bottom of the collecting trough, with means on the box to form a weir in the trough, adjustable discharge means in the upper face of said latter box, and adjustable means thereon to cause a liquid current to flow longitudinally therein.

4. An apparatus for treating ores, coals and similar materials, comprising a trough, a box extending above the bottom of the trough whereby means are provided to form a weir in the trough, adjustable discharge means in the upper face of the box, adjustable means to cause a liquid current to flow longitudinally through said box, adjustable discharge means at the end of the box, a descending pipe connected to said adjustable discharge means, a hydraulic sorter including a barrel and said descending pipe extending into said barrel, means in the hydraulic sorter to form therein series of ascending currents of increasing portable force and intensity, an upper overflow and a lower discharge on the barrel, a collecting trough following the overflow, a lower receiving trough and said collecting trough discharging into said lower receiving trough, a box extending above the bottom of the lower receiving trough, whereby means are provided to form a weir in such trough, adjustable inlet means in the upper face of the last named box, adjustable means to cause a liquid current to flow longitudinally therein, a collecting trough below the discharge of the barrel, a box extending above the bottom of the last named collecting trough, with means on the box to form a weir in such trough, adjustable means in the upper face of said latter box, and adjustable means thereon to cause a liquid current to flow longitudinally therein.

In testimony whereof I affix my signature.

LÉON HOYOIS.