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METHOD AND APPARATUS FOR TREATING SEPARATING SUSPENSIONS

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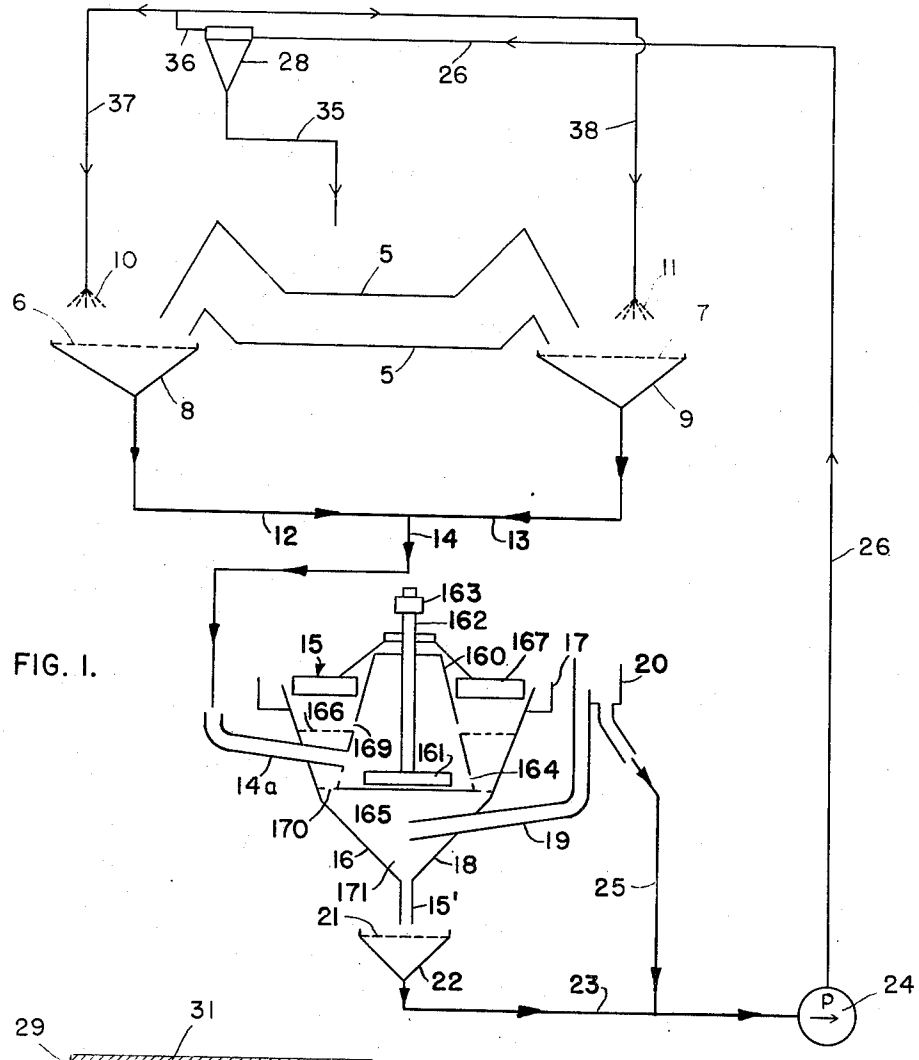

FIG. 1.

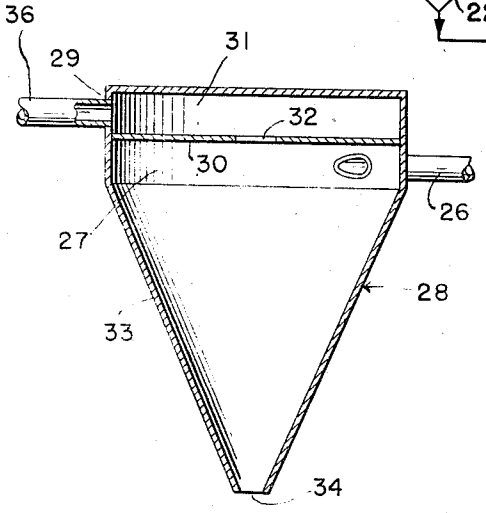

FIG. 2.

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METHOD AND APPARATUS FOR TREATING SEPARATING SUSPENSIONS

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4 Claims. (Cl. 209—12)

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In washery plants using separating suspensions, it is necessary, for practical operation, to recover and reuse the suspension particles resulting from the de-watering and rinsing of the separated products. For one thing, the suspension particles are generally of too great value to be thrown away and, additionally, the contamination of the separated products by the suspension particles is unpermissible. In the case of coal, for example, these suspension particles would increase the ash content of the cleaned coal.

The suspension caught beneath the screens is very dilute. It has been customary heretofore to send this dilute suspension to a second screen with very fine meshes. This second screen must have a high capacity and due to its fine meshes, it wears out quickly.

In the separation of raw coal in a washing box using a separating suspension, the suspension particles become contaminated with small coal particles already present upon delivery of the raw coal to the washing box and resulting also from disintegration arising from the action in the box. It is usually desirable to recover these coal particles since they are of value in themselves and, moreover, should be removed from the separating suspension since they adversely affect the latter.

A principal object of the present invention is to greatly reduce the scope of the second screening action by separating the suspension into fractions of relatively high concentration and relatively low concentration, substantially all of the suspension particles of the low concentration fraction being smaller than a predetermined size. Hence, by the invention it is only necessary to screen the fraction of relatively high concentration for the removal of unwanted particles above the said predetermined size. It is also an object of the invention to recover the coal particles from the suspension. Suitable apparatus for the practice of the invention is shown by way of example in the accompanying drawing in which:

Figure 1 diagrammatically shows an installation, and

Figure 2 shows in axial section a cyclone which appears in Figure 1.

Referring to Figure 1, reference numeral 5 designates a washing box of the sink-float type of known design, the box discharging at one end onto a screen 6 and at its other end onto a screen 7, receiving tanks 8 and 9 being disposed below the screens. Water and particles which will pass the screen drop therethrough immediately upon delivery to the screens and spray heads 10 and 11

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are provided above the screens so as to rinse the separated products as thoroughly as possible as they pass along the screens.

The tanks have bottom outlets connected through pipes 12 and 13 to a pipe 14 which delivers to a separator 15 here shown as being of the froth flotation type and acting also as a hydraulic classifier. Preferably a Kleinbentinck machine is used, the machine including a generally conical tank 16 with froth removal at 17, a sump 18, and a riser 19 to a side overflow trough 20. A machine of this type is described on pages 430 to 432 of "The Cleaning of Coal" (1928) by Chapman and Mott. Because the Kleinbentinck machine is to operate as a hydraulic classifier as well as a froth flotation unit, it will include the following arrangement: An inner chamber 160 of truncated cone shape is centrally disposed in the tank 16 and contains a screw 161 fixed on a shaft 162 driven by a pulley 163. The diluted suspension from line 14 is admitted to the inner mixing chamber 160 through a pipe 14a and a frothing agent is added at the top of this chamber. The materials are thoroughly mixed in chamber 160 and pass with entrained air through the holes 164 disposed close to the base 165 of the mixing chamber into the outer chamber or sump 18. At about half the height of the outer chamber an annular screen 166 is fixed horizontally to insure quiescent conditions in the space above it. The frothed coal particles pass through the screen and are scraped off by a scraper 167 into a surrounding launder 17. The non-floating material returns through a series of holes 169 to the mixing chamber, where it is again agitated. Finally, the particles pass through the openings 170 into the lower cone 171 and are discharged through a pipe 15'. This fraction contains those particles which have the highest settling velocity, viz., the coarser particles. The finer particles which settle slower are evacuated through the pipe 19 and an overflow 20 together with the bulk of the water. The purpose of this overflow in a Kleinbentinck machine is to maintain the level of the liquid in the frothing chamber constant. If this level is too high, too much water and fine heavy particles discharge with the froth. The sump has a bottom opening 15' discharging onto a screen 21 above a receptacle 22 and a pipe 23 leads from a bottom opening 15' of the receptacle to a pump 24, trough 20 having a bottom outlet connected by a pipe 25 with pipe 23. The pump delivers through a pipe 26 tangentially into the inlet compartment 27 of a cyclone 28, the cyclone including an upper cylindrical portion 29 divided by a wall 30 into the inlet compartment and an

overflow compartment 31, the wall having a central outflow opening 32. The cyclone comprises a lower conical portion 33 coaxial with portion 29 and having an apex opening 34 aligned with opening 32. The apex discharge, Figure 1, is directed to the washing box 5 through a conduit 35. The overflow chamber is connected by a pipe 36 with pipe 37 and 38 going to the spray heads 10 and 11, respectively.

In the operation of the system, the dilute suspension reaching the separator 15 is separated into three fractions; (1) a froth fraction leaving at 17 and containing the undesirable coal particles which can be sent, for example, to a froth flotation plant to be recleaned, as the ash content of this froth may be rather high; (2) an overflow fraction to trough 20 containing fine suspension particles which can be used again in the separating bath; and (3) a thickened fraction leaving the sump through bottom opening 15' and containing undesired coarser particles in addition to the usable suspension particles. Fraction #3 goes to the screen 21 and the through-put of the screen is combined with fraction #2 and sent to the cyclone thickener with the thickened product being then returned to the washing box. While a cyclone thickener is preferred, other types, for example, the Dorr type, can be used.

An example of performance is as follows: The output products of a washing box, using a loess suspension, are de-watered and rinsed on the screens 6 and 7 at the rate of 80 metric tons per hour. The diluted suspension caught in tanks 8 and 9 at the rate of 65 cubic meters per hour has a concentration of 94.4 grams per liter, and 5% of the particles are above .5 mm. in size. This suspension is sent to a Kleinbentinck machine as described above with a diameter of 2 meters and the entering suspension will be separated in this box into (1) 1.8 cubic meters per hour froth, (2) 44.3 cubic meters per hour effluent with a concentration of 80 grams per liter solid material of which the particles are all less than .5 mm. in size, and (3) 18.9 cubic meters per hour of thickened suspension with a concentration of 121.5 grams per liter solid material of which 13.3% has a particle size greater than .5 mm.

Fraction number 3 goes to the screen 21 of which the openings are .5 mm. square. The area of the screen is one square meter.

Thus, the capacity of screen 21 need be only sufficient to accommodate a relatively small percentage of the total dilute suspension collecting in tanks 8 and 9. If the diluted suspension went directly to the screen, the latter would have to have an area of 3 square meters. Without removal of the fine coal particles they would recirculate and accumulate. However, if it is not required that the coal particles in the dilute suspension be recovered, any suitable separator, for example a cyclone, which will separate the bulk of the particles from the bulk of the water can be used.

The described procedure is of especial importance if the content of fine solid material in the dilute suspension is high.

Variations in procedure and form of apparatus are possible within the scope of the invention as defined in the following claims.

I claim:

1. In combination, a washing box using a separating suspension, screens arranged to receive the separated fractions, rinsing spray heads above the screens, tanks below the screens to receive sprayed liquid and suspension, a hydraulic classifier in receiving relation to said tanks and operating to separate the received suspension into fractions of relatively high concentration and relatively low concentration of which the former contains all the particles larger than a predetermined size and a portion of particles smaller than said size, a screen arranged to receive the fraction of high concentration and having a mesh of said predetermined size, a receptacle arranged to receive the through-put of the last-named screen, a thickener, means for feeding to the thickener the suspension received in said receptacle together with said fraction of low concentration, and means for directing the heavy fraction from the thickener to said washing box.

2. In combination, a coal washing box using a separating suspension, screens arranged to receive the separated fractions, tanks below the screens to receive sprayed liquid and suspension, rinsing spray heads above the screens, a classifier in receiving relation to said tanks and including means to separate coal particles from the suspension particles by froth flotation and means to hydraulically separate the remaining suspension into fractions of relatively high concentration and relatively low concentration of which the former contains all the particles larger than a predetermined size and a portion of the particles smaller than said size, a screen arranged to receive the fraction of high concentration classifier and having a mesh of said predetermined size, a receptacle arranged to receive the through-put of the last-named screen, a thickener, means for feeding to the thickener the suspension received in said receptacle together with said fraction of low concentration, and means for directing the heavy fraction from the thickener to said washing box.

3. The method of treating a separating suspension of liquid and particles which comprises rinsing the suspension from the separated products, separating the thus obtained diluted suspension by hydraulic classification into a fraction of relatively high concentration and a fraction of relatively low concentration and so that the fraction of high concentration contains all the particles larger than a predetermined size and a portion of the particles smaller than said size, screening the last-mentioned fraction to remove particles above said size, combining the through-put of said screening with the fraction of low concentration, and thickening said combined fractions and returning them to the washing box.

4. The method of treating a wash box separating suspension containing intermixed coal particles which comprises rinsing the suspension from the separated products, separating the coal particles from the thus obtained diluted suspension by froth flotation and separating the remainder of the diluted suspension by hydraulic classification into a fraction of relatively high concentration and a fraction of relatively low concentration and so that the fraction of high concentration contains all the particles larger than a predetermined size and a portion of the particles smaller than said size, screening the last-mentioned fraction to remove particles above said size, combining the through-put of said screening with the fraction of low concentration, and thickening said combined fractions and returning them to the washing box.

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