Nov. 2, 1926. 1,605,172

T. M. CHANCE

METHOD AND APPARATUS FOR COAL WASHING AND ORE CONCENTRATION

Filed July 26, 1924

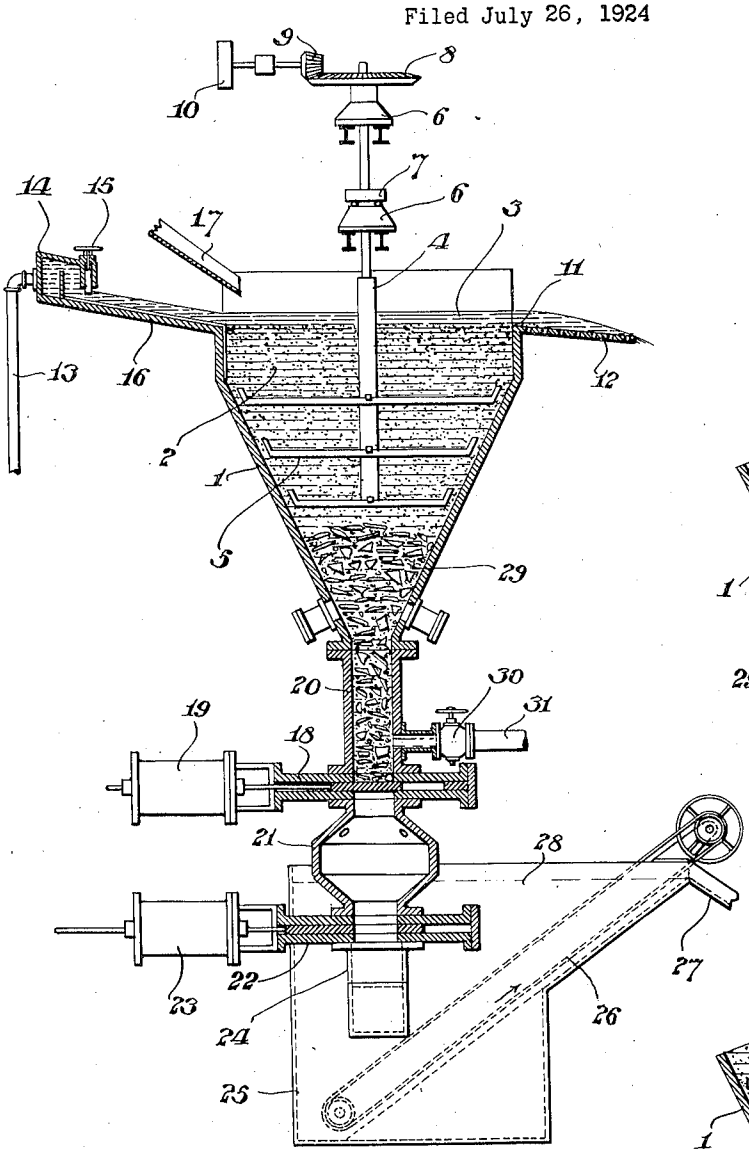


FIG. I.

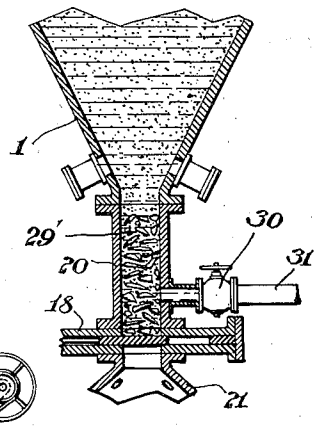


FIG. II.

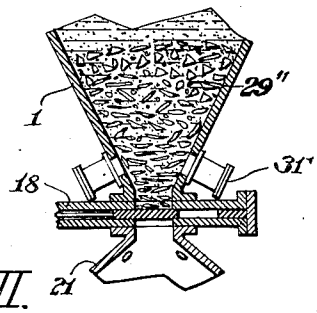


FIG. III.

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Patented Nov. 2, 1926. 1,605,172

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METHOD AND APPARATUS FOR COAL WASHING AND ORE CONCENTRATION.

Application filed July 26, 1924. Serial No. 728,417.

My invention relates to the cleaning of coal, concentration of ores and the separation of materials of different specific gravities by the flotational action of a fluid mass such as I have described in Patent Nos. 1,224,138 issued May 1, 1917, 1,392,399 issued October 4, 1921, and 1,462,881 issued July 24, 1923, and applies especially to apparatus in which the heavier materials sinking through such fluid mass are removed from the apparatus by being caused to fall through a pipe or conduit through which an upwardly rising current of the liquid, such as water, is used for upward current classification in said pipe or conduit and as a means of maintaining or assisting in maintaining the agitation of and controlling the specific gravity of the said fluid mass, but may also be used in operating apparatus which does not contain said classifying pipe or conduit.

In the operation of apparatus of the type having upwardly rising liquid in a pipe or conduit which acts as a classifying current to restrain the fall of the solid constituent (such as sand) of the fluid mass while permitting the fall of larger and heavier materials which have sunk through the fluid mass, I have found that the heavier materials in falling through said upwardly rising water at times tend to carry with them more or less of the solid constituent of the fluid mass and also that if the volume of said falling materials becomes relatively small in quantity, or is interrupted, that the upward flow of liquid in said pipe or conduit, through the occurrence of eddy currents or possibly of reversal or circulating flow, permits the falling of considerable quantities of said solid constituent. Further, under such conditions, in which most of the upwardly flowing liquid may exist as a central flow in said conduit, at a velocity much greater than the average upward velocity, this liquid upon entering the overlying fluid mass does not so readily diffuse through or mix with it as when the upward flow is more evenly distributed over the cross-sectional area of said pipe or conduit.

The objects of my invention are to reduce the quantity of solid constituent of the fluid mass removed from the apparatus admixed with the heavier materials, and to insure the better distribution and more uniform velocity of the upwardly rising current of liquid at the region where it enters the overlying fluid mass, so that it will be more uniformly distributed, mixed with and diffused through said fluid mass, thus preventing excessive agitation, or a concentration of agitation, in any part of said fluid mass, or the development of eddy currents or circulatory vortexes which may interfere with efficient action of the fluid mass as a "float and sink" medium.

I accomplish these objects by retaining in the path of said upwardly rising liquid a sufficient quantity of the heavier materials that have sunk through the fluid mass to insure uniform diffusion through the fluid mass of said liquid, said materials being sufficient to fill or partially fill the said pipe or conduit and the lower part of the separating receptacle, thus providing a baffle or diffuser through which the said liquid must flow. The increased velocity of the upwardly rising liquid in passing through the voids or interstices of the materials filling the pipe or conduit tends to wash out and return to the fluid mass the solid constituent of the fluid mass which may have become mixed with said materials. The division of the upwardly rising liquid among the many paths of travel afforded by the interstices or voids of the said materials tends to an equalization of distribution of the upwardly flowing liquid, while the larger area and increased total voids in the materials overlying the upper end of said pipe or conduit, tends to reduce the velocity of upward flow, distributing it among a larger number of paths of travel and delivering it at the region where it merges with the fluid mass so distributed over an enlarged area and at average velocities well adapted to insure mixing and diffusion with minimum production of vortexes or eddy currents. To prevent the liquid from opening up paths of travel through which a large part of the upward flow might short circuit at relatively high velocity, the material filling the pipe is not permitted to remain undisturbed for more than relative short intervals, a portion of these materials being trapped out from below at frequent intervals, care being taken that a predetermined quantity of said materials remains in said pipe or conduit.

The drawing Fig. I is a vertical cross-section and elevation of apparatus similar to that used in washing coal by means of flotation in a fluid mass of the described type and illustrates the operation of my present

invention and adjunctive apparatus whereby the quantity of materials in and overlying the pipe or conduit may be indicated and controlled. Fig. II is a reproduction of a part of drawing of Fig. I, showing the condition when the materials above the pipe or conduit have been drawn down. Fig. III is a reproduction of a part of the drawing of Fig. I with the pipe or conduit removed.

The drawing Fig. I illustrates a type of apparatus used in the anthracite coal regions of Pennsylvania in the washing or preparation of coal for market. In this drawing 1 is a cylindro-conical receptacle containing a fluid mass 2 of the type already described, with a superposed body of water 3. Mechanical agitation is effected by the rotating agitator 4, provided with stirring arms 5, supported and centered by bearings 6, 6 and thrust bearing 7 and driven by bevel gear 8, pinion 9 and pulley 10. The tank 1 is provided with an overflow weir 11 discharging upon a chute or desanding screen 12. Water and sand removed from the tank 1 are returned by any suitable pump or elevating means through conduit 13 into a baffle box 14 with adjustable gate 15 discharging the sand and water through chute or launder 16 into tank 1. A chute 17 or other type of feeder furnishes a means for introducing the coal or other materials to be separated. The heavier materials sinking through the fluid mass are periodically discharged through slide valve 18 operated by thrust cylinder 19, said valve being connected to tank 1 by a pipe or conduit 20, the materials therein discharging through 18 into refuse chamber 21 from which they are dropped by gate valve 22 operated by thrust cylinder 23 through inclined chute 24 into a tank or receptacle 25 provided with a scraper line 26 or other means of removing said refuse from 25 and discharging same into a chute or desanding screen 27. If desired water can be maintained in this tank as indicated by dotted line 28, high enough to act as a water seal to prevent the admission of air into refuse chamber 21.

The use of pipe or conduit 21 as an upward current classifier may not always be essential when the method of operation herein described is adhered to, because the heavier materials 29 accumulating in the lower part of the receptacle 1 and conduit 20 may perform efficiently the function performed by 20 as an upward current classifier when materials 29 are not permitted to accumulate, so that when using the described method of operation the conduit 20 may in some cases be eliminated, its function being performed by the accumulation 29 in the lower part of tank 1. Water for effecting agitation of the fluid mass and for producing classifying action in 20 and in 29 is supplied from any suitable source through pipe 31 controlled by valve 30.

Drawing Fig. II is a reproduction of a portion of the drawing of Fig. I, showing the condition after that part of the heavier materials 29 in tank 1 has been drawn down, leaving the conduit 20 filled or partially filled with heavier materials 29′.

The drawing shown by Fig. III is a reproduction of a portion of the drawing of Fig. I showing the elimination of the conduit 20, reliance being placed upon the accumulation 29″ retained to perform the classifying function of conduit 20 or of materials contained in conduit 20. The supply of water for producing the agitation of the fluid mass in 1 and the classifying action in 29″ is shown as supplied by pipe 31′ controlled by valve 30′. It will be understood that a number of similar inlets for water may be provided at the base of the conical portion of the receptacle 1.

In operating apparatus of the type illustrated by Fig. III it will be desirable to permit the accumulation 29″ of a larger quantity of the materials than when operating with the apparatus as shown by Fig. I, in order to produce proper diffusion of the agitating liquid, and to enable the operator to draw a relatively large quantity of these materials at each opening of valve 18, without completely emptying the tank 1 of the accumulated materials.

I do not desire to limit the operation of my invention to the precise details of construction and arrangement shown and herein set forth, as it may be usefully employed when the separating receptacle is of different shape than that shown and when the heavier materials are not periodically trapped out through valves but are removed continuously by gravitational discharge or by mechanical elevating means such as bucket or scraper elevators, screws or by hydraulic or pneumatic elevating methods, and it is obvious that various modifications may be made therein without departing from the essential features of my invention as defined in the appended claims.

Having described my invention I claim,

1. The method of washing coal and concentrating ores in which separation of impurities is effected by flotation of the lighter and sinking of the heavier materials in a fluid mass the specific gravity of which is greater than that of said lighter and less than that of said heavier materials, said fluid mass being an agitated mixture of liquid and comminuted solids heavier than said liquid and substantially insoluble therein, the agitation of said fluid mass being assisted by liquid under pressure introduced below said fluid mass and rising therethrough, which consists in maintaining an accumulation of said heavier materials be-

low said fluid mass; in passing said liquid used for said agitation through said accumulation; in removing a portion of the lower part of said accumulation through a path of travel below the center of said accumulation, thereby causing the balance of said accumulation to fall by gravity vertically to fill the space occupied by the portion removed, said descent causing the individual particles to become rearranged during said downward movement; in continuing to pass said liquid through said accumulation during the said removal of said portion thereof; in repeating the withdrawal of materials from the lower part of said accumulation as the depth of said accumulation grows from accretions thereto and in regulating the rate of withdrawal to one approximating the rate of said accretion, whereby said liquid is constrained to pass through channels afforded by the voids of such accumulated material and thus enters the fluid mass diffused over a relatively large area.

2. Apparatus for separating materials of different specific gravities comprising in combination a receptacle adapted to contain a fluid separating medium; a fluid separating medium contained therein adapted to separate said materials by flotation of the lighter and sinking of the heavier of said materials; means for removing the heavier of said materials, said means being located at a point centrally below the bottom of said receptacle; an inlet for liquid under pressure adjacent to the bottom of said receptacle; a baffle comprising a body of said heavier materials occupying the lower part of said receptacle and above said inlet, and located centrally and vertically above said means for removal and means for regulating the volume of said body of heavier materials and the rate of said removal.

Signed at Philadelphia, Pennsylvania, this 24th day of July, 1924.

THOMAS M. CHANCE.