A. S. LOVENTHAL & E. C. NUNNELLEY.

MINERAL SEPARATING APPARATUS.

APPLICATION FILED AUG. 17, 1918.

1,297,372.

Patented Mar. 18, 1919.

2 SHEETS—SHEET 1.

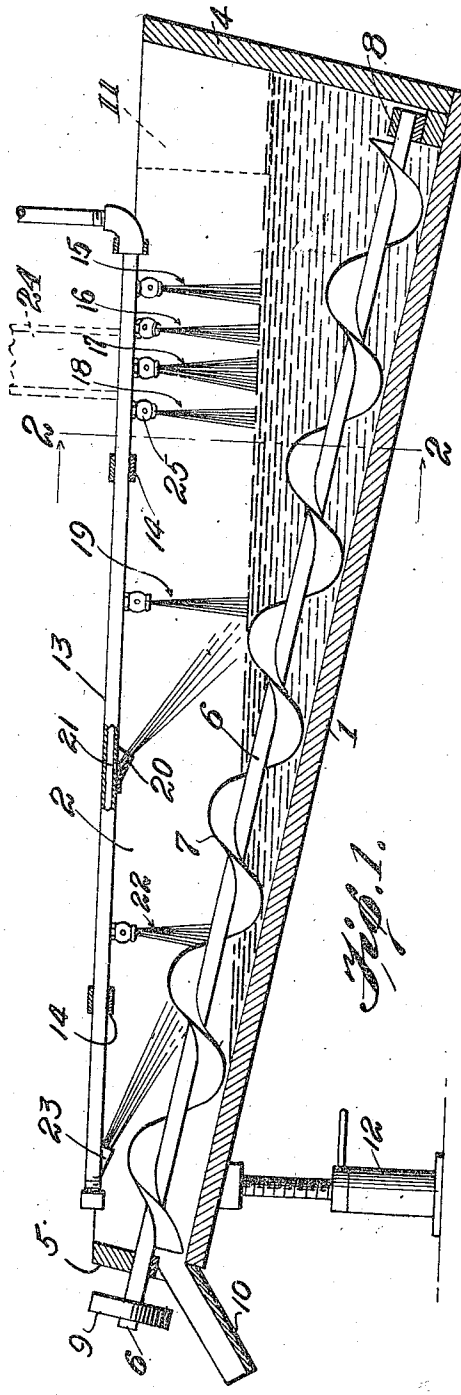


Fig. 1.

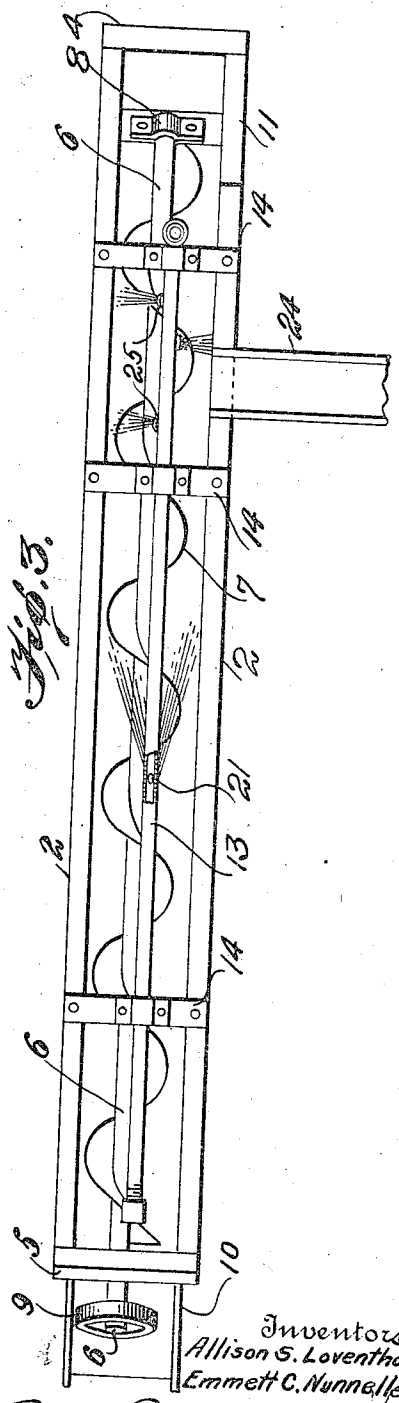


Fig. 3.

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2 SHEETS—SHEET 2.

Fig. 2.

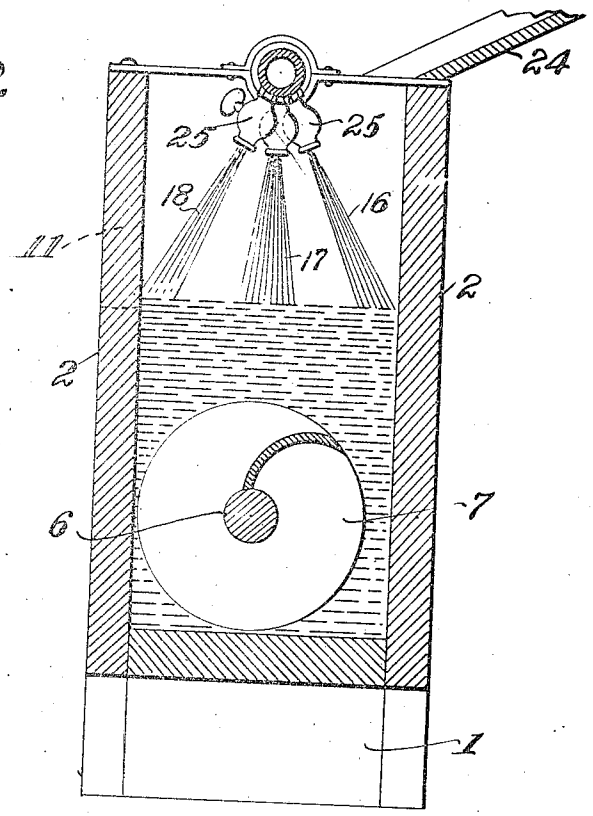


Fig. 5.

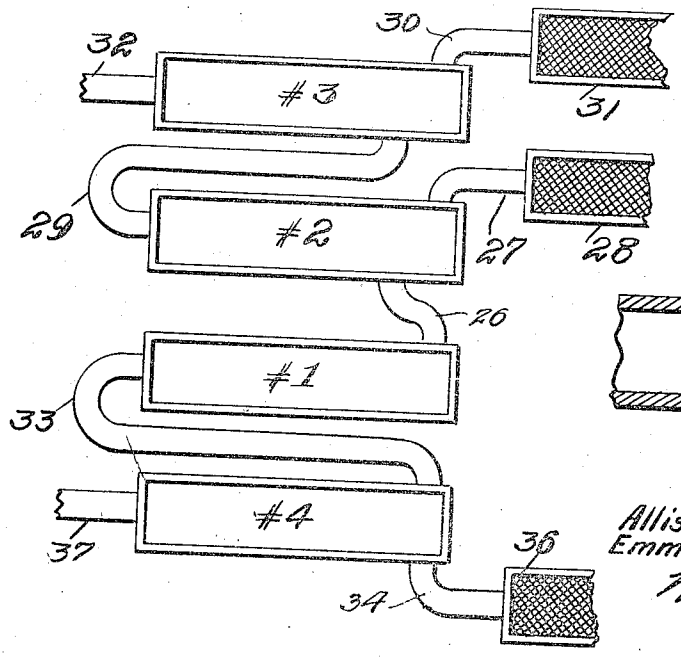
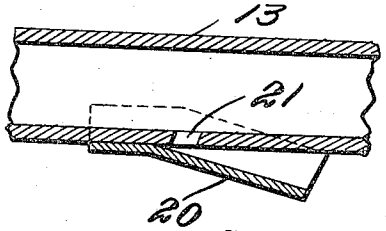


Fig. 4.



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MINERAL-SEPARATING APPARATUS.

1,297,372. Specification of Letters Patent. Patented Mar. 18, 1919.

Application filed August 17, 1918. Serial No. 250,408.

To all whom it may concern:

Be it known that we, ALLISON S. LOVENTHAL and EMMETT C. NUNNELLEY, citizens of the United States of America, residing at Birmingham and Ashland, respectively, in the counties of Jefferson and Clay and State of Alabama, have invented certain new and useful Improvements in Mineral-Separating Apparatus, of which the following is a specification.

Our invention relates to an improvement in apparatus for the separation of minerals and particularly, but not exclusively, for the separation of graphite from crushed graphitic ores.

One object of our invention is to design a separating box wherein the mineral is subjected to a novel arrangement of agitating jets and water sprays and caused to pass through a body of liquid therein from which a conveyer in the box emerges and discharges the tailings at one end while the fines float out with the overflow from the other end of the box.

It is an important feature of our invention that the bottom of the separating box should be not only inclined to a horizontal plane but adapted for ready adjustment as to its inclination so that the water level in the box can be regulated to permit a conveyer acting to raise and discharge the tailings to emerge a sufficient distance from the tailings discharge to drain the fluid from the tailings back into the box and also to expose the tailings to the direct action of jets.

A further novel feature of our invention relates to the manner of discharging the tailings from the separating boxes and to this end we preferably employ a screw conveyer which emerges from the fluid and is arranged to provide an ample clearance at one side so that the fluid drained from the tailings will flow in a stream lengthwise along the agitated mass of tailings being acted on by the conveyer and will collect therefrom appreciable quantities of the graphite and carry it back into the zone of intense agitation when it passes off with the fines.

Our invention further contemplates the utilization of a number of these separating boxes having the construction above described and which are arranged to act in definite sequence on the material under treatment. Our process is first, to separate the heavy sand from the bulk of the graphite, the heavy sand and the small percentage of graphite therein being delivered to a similar separating box having its water jets and sprays suited to the coarsest grade of sand so as to recover the graphite therefrom and pass it to a dewatering screen. The fine sand and main bulk of the graphite overflow from the initial separating box and are passed successively through two other similarly constructed separating boxes referred to as boxes No. 2 and No. 3. In box No. 2 the jets and sprays are adapted to cause the overflow of the major portion of the graphite to a dewatering screen while its tailings are treated in box No. 3 and the graphite recovered passed to its respective dehydrating screen.

Our invention further contemplates the provision of novel water jetting arrangements suited to act on the different grades of material in the different separating boxes to the end that the desired agitation will be obtained, preferably in the presence of an oil which will bring about the necessary separation and induce the flotation of the fines toward the fluid discharge.

Our invention further comprises the novel details of construction and arrangements of parts, which in their preferred embodiments only are illustrated in the accompanying drawings, and in which:—

Figure 1 illustrates in vertical section one of our improved separating boxes.

Fig. 2 is a section taken on the line 2—2 of Fig. 1.

Fig. 3 is a plan view of Fig. 1.

Fig. 4 is a detail view illustrating the structure and arrangement of the water spray; and

Fig. 5 is a diagrammatic view illustrating the process of treatment of the material in a plurality of separating boxes.

Similar reference numerals refer to similar parts throughout the drawings.

In describing our invention, reference will first be made to a typical separating box shown in Figs. 1 to 3. The box is narrow having a bottom wall 1, side walls 2 and a deep end wall 4 at one end while the other end wall is omitted and replaced by a cross bearing 5 for the upper end of the shaft 6 of a screw conveyer 7 which extends from end to end of the box along its bottom wall 1 and is set to one side of the center as more clearly shown in Figs. 2 and 3. The lower

end of the shaft 6 turns in a bearing 8 secured to the end wall 4, while the upper end of the shaft projects beyond the bearing 5 and carries a driving pulley 9. Below the open end of the box is a tailing chute 10 and near the wall 4 is an overflow opening 11 in a side wall 2. The bottom of this opening, which fixes the fluid level in the tank, is below the upper end of the bottom 1 so that the fluid level will leave a substantial portion of the upper end of the conveyer exposed. The box is mounted in any suitable manner, preferably having its raised tailing discharge end supported by an adjustable element such as a jack 12 by means of which the angular disposition of the bottom wall 1 and the point of emergence above the water level of the conveyer can be adjusted to suit different conditions.

A water spray pipe 13 is disposed lengthwise of and centrally above the water tank and is supported by suitable cross straps 14 made fast to the top of the box. The water under pressure is delivered to this pipe from any suitable source and is discharged into the tank by means of a series of jets and sprays which are more clearly illustrated in Fig. 4. Our preferred arrangement of these jets and sprays comprises four jets 15, 16, 17 and 18 arranged in the pipe end nearest the overflow 11 and opposite the point of admission of the crushed ore. In practice these jets have been spaced on seven and one-half inch centers, but this may be varied to suit the peculiar conditions under treatment. These jets are set at different angles to produce the most effective agitation of the fluid in the tank, our preferred arrangement being to set the jets 15 and 16 at opposite angles of approximately 15° to a vertical plane lengthwise of the box. The jet 17 is arranged vertically and the jet 18 is angularly inclined like the jet 15 toward the conveyer. Next to the jets 15 to 18 and widely spaced therefrom is a vertical jet 19 which comes substantially opposite the center of the box. Next to the jet 19 is a spray formed by a plate 20 mounted on the pipe and disposed at a rearward inclination so as to catch and discharge the fluid passing through an opening 21 in the bottom of the pipe. This spray is disposed to strike the top of the water a few inches to the right (Fig. 1) of the point of emergence of the screw conveyer. A jet 22, similar to 19, is arranged substantially above the point of emergence of the screw conveyer, and a rearwardly inclined spray 23, similar to 20, is arranged and disposed to strike the conveyer and the exposed tailings near the latter's point of discharge. The crushed ore is delivered into the box by means of a chute 24 which enters opposite the jet 17. Each of the jets 15, 16, 17, 18, 19 and 22 is controlled by its respective pet cock 25 so that the volume of each jet may be regulated to the desired point required in the treatment of the mineral. Preferably the jets 15 and 16 are light while the jet 17 is heaviest and strongest and the jet 18 is slightly less forcible than the jet 17. The jets 19 and 22 are light like the jets 15 and 16.

In operation, the crushed ore enters by the chute 24 and falls into the body of liquid in the box opposite the heavy jet 17 which is strong enough to penetrate to the bottom of the tank and agitate the liquid and tailings there. This jet 17 and the adjacent divergent jets 15, 16 and 18 produce a considerable agitation of the fluid which causes the lighter particles to tend to separate themselves from the tailings and to rise and overflow through the discharge 11. The tailings together with a portion of the lighter particles settle to the bottom of the tank and are there acted upon by the conveyer 7 and forced thereby upwardly toward the tailing chute 10. The tailings are agitated by the jets 19 and 22 which act with increasing intensity thereon due to the decreasing depth of liquid and by stirring up the tailings 10 to liberate any lighter particles therein. The spray 20 acts to drive any floating particles toward discharge 11. As the conveyer emerges from the fluid the body of tailings being agitated and fed thereby is subjected to the action of the spray 23 and also to the stream of fluid returning between the conveyer and the wall 2, which liquid drains from the tailings and in flowing back into the body of liquid in the box it collects and carries an appreciable amount of graphite which would otherwise pass off with the tailings.

In Fig. 5 we illustrate a diagrammatic layout for a plant utilizing our separating boxes in which the box designated No. 1 received the crushed ore from the mill. The fines flow therefrom by a trough 26 to the separating box No. 2 and are there acted upon in the manner described with the fines, recovered from box No. 2, passing off through chute 27 to a dehydrating screen 28, while the tailings from box No. 2 pass off by a chute 29 to the box No. 3 and are again acted upon there, the fines passing off by a chute 30 to a dehydrating screen 31 while the tailings pass along a chute 32 to the dump. The tailings from the separating box No. 1 are conducted by a chute 33 to the separating box No. 4, whence the fines pass by a chute 34 to the dehydrating screen 36 while the tailings pass by a chute 37 to the dump. By this arrangement the separating box No. 1 does not directly recover any mineral but serves to separate the bulk of the tailings from the graphite and the lighter sand and mud. The heavy tailings are rewashed in washer No. 4 before passing to the dump while the graphite and lighter

sand and mud are washed twice in the boxes No. 2 and No. 3 before the tailings from those two boxes reach the dump by the chute 32.

The arrangement of jets and sprays described is that which we have found best adapted for our purposes, but it should be understood that they may be varied as to their spacing, angularity and as to the intensity of the jets all as may be empirically determined to be best in each case. The type or arrangement of conveyer is that which we have found best suited to the recovery of graphite, but other equivalent forms of conveyers may be substituted with approximate results.

This invention is not intended to be restricted in scope to the specific embodiments shown, but contemplates such modifications as come within the spirit and scope of the claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. In a mineral separating apparatus, a narrow elongated fluid containing tank having at one end an overflow port and being tilted upwardly to expose at its other end a portion of its bottom above the level of fluid therein, a screw conveyer working lengthwise through said tank to elevate and discharge the tailings, means to introduce the crushed ore at an intermediate point into the tank, and a plurality of jets and sprays to agitate the fluid in the tank, said screw conveyer being set close to one side and the bottom of the track and adapted to leave between it and the more remote side of the tank a narrow water way for the back flow of drainage water, and said jets being disposed divergently at different angles transversely of the tank while the sprays are sharply inclined toward the overflow end of the tank.

2. In a mineral separating apparatus, a narrow elongated tank containing liquid and tilted to increase the depth of said liquid toward one end, there being an overflow for fines at said latter end, a conveyer for moving the tailings toward the elevated end of the tank and discharging them there, which conveyer emerges from the liquid in the tank, and a water pipe extending lengthwise and centrally over the tank and having a plurality of divergent water jets, opposite the point of admission of crushed mineral and other jets and sprays arranged at intervals toward the elevated end of the tank, the sprays being inclined counter to the direction of movement of the tailings to impinge on the water surface at an acute angle.

3. In a mineral separating apparatus, an elongated narrow tank containing liquid and tilted to increase the depth of said liquid toward one end, there being an overflow for fines at said latter end, a conveyer for moving the tailings toward the elevated end of the tank and discharging them there, which conveyer emerges from the liquid at an intermediate point in the tank and is disposed to leave a substantial clearance between it and one side wall only of the tank, a water pipe extending lengthwise over the tank and having a plurality of divergent water jets opposite the point of admission of crushed mineral, a plurality of jets and sprays arranged between said divergent jets and the elevated end of the tank, said sprays being directed to induce a current toward said overflow for the fines, and said jets being directed to agitate the mineral while under motion responsive to said conveyer.

4. In a mineral separating apparatus, a narrow elongated tank, a screw conveyer working lengthwise in the bottom thereof, adjustable means to tilt the tank to expose the desired length of the discharge end of the conveyer, there being an overflow port for fines at the lower end of the tank and an outlet for tailings at the raised end of the tank, and a plurality of water jets and sprays arranged lengthwise of and disposed to act on the mineral on the tank, the sprays being inclined toward said overflow for fines and the jets being set at variant angles laterally of the tank, substantially as described.

In testimony whereof we affix our signatures.

ALLISON S. LOVENTHAL.
EMMETT C. NUNNELLEY.

Witness:
NOMIE WELSH.