

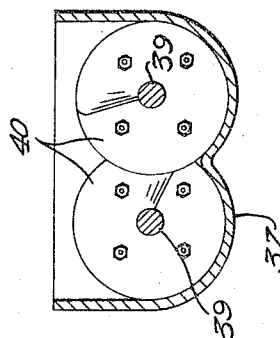
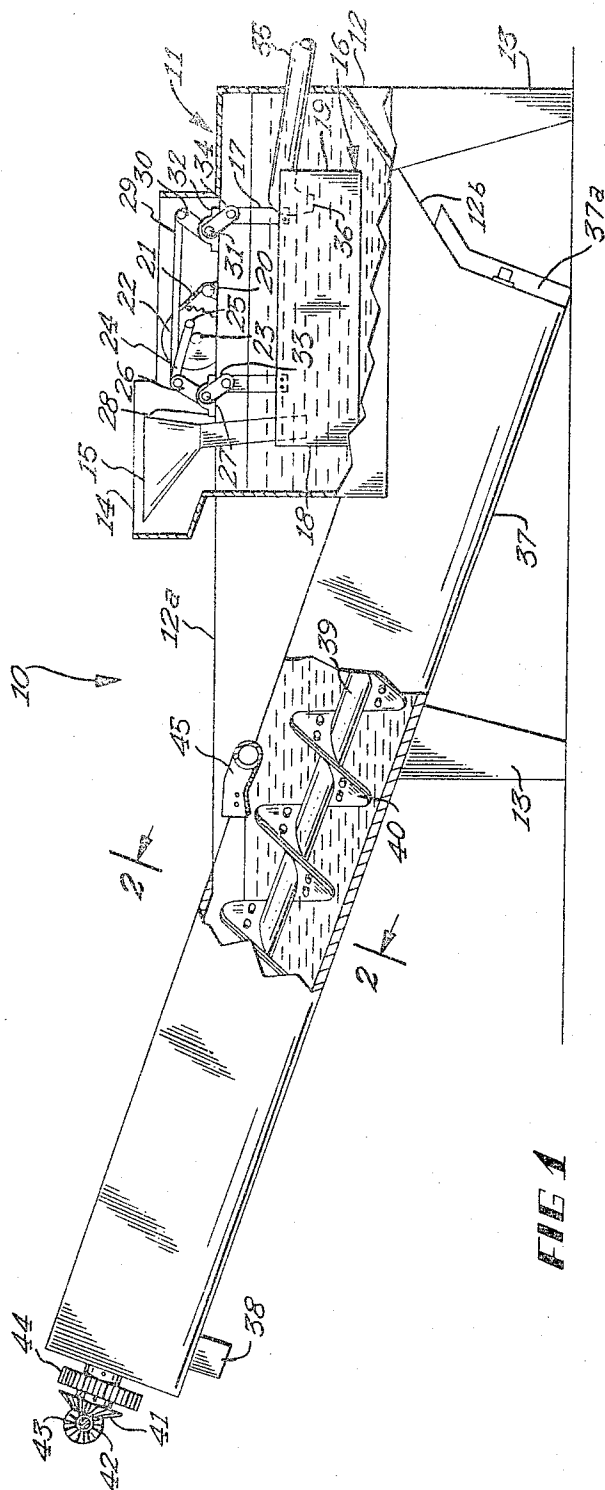
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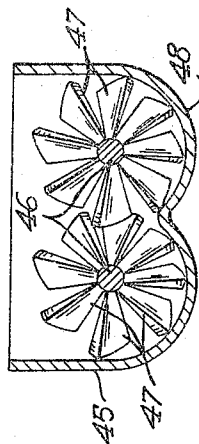
3,357,555

MATERIAL CLEANING APPARATUS

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FILE 2



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MATERIAL CLEANING APPARATUS
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This invention relates to apparatus for cleaning particulate material such as gravel, ore or the like.

An object of this invention is to provide a single unit for removing deleterious matter from particulate material such as gravel, ore or the like, in which the material is introduced into a tank having a submerged type oscillating screen structure therein operable to cause the lighter weight foreign matter to be removed from the particulate material, the latter being directed to a scrubber mechanism comprising a part of the unit and wherein the particulate material is subjected to a scrubbing action to remove clay and other foreign adhesion matter from the particulate material.

Another object of this invention is the provision of an apparatus for washing gravel and the like, wherein the gravel is first delivered to a submerged type stratifying device where the foreign lighter weight matter such as coal, shale and the like is stratified and separated from the gravel, and wherein an inclined elongate scrubbing device partially underlies the stratifying device for receiving gravel from the latter by action of gravity and which is operable to scrub and clean gravel, the stratifying device and scrubbing device forming a single unit which utilizes a single volume of water, the unit being of compact construction and during operation thereof minimizing the time required to handle and completely clean gravel for commercial usage.

A further object of this invention is to provide a single gravel cleaning unit of the class described wherein the gravel is discharged from the unit in a de-watered condition thus minimizing subsequent handling of the gravel material.

These and other objects and advantages of the invention will more fully appear from the following description made in connection with the accompanying drawing, wherein like character references refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a side elevational view of the apparatus with parts thereof broken away for clarity and other concealed parts thereof illustrated by dotted line configuration;

FIG. 2 is a cross sectional view taken approximately along line 2—2 of FIG. 1 and looking in the direction of the arrows; and

FIG. 3 is a view similar to FIG. 2 illustrating a modified form of the scrubber mechanism.

Referring now to the drawing and more specifically to FIG. 1 it will be seen that one embodiment of the material treatment or cleaning unit, designated generally by the reference numeral 10, is there shown. This cleaning unit 10 includes a gravity separator or stratifying device 11 of the submerged type and which is especially adaptable for use in cleaning gravel, ore and the like. The gravity separator device 11 includes a liquid-confining tank 12 which is provided with suitable supporting legs 13 and which is adapted to be substantially filled with water. The tank 13 is also provided with an inlet 14 having an in-feed hopper 15 therein for receiving material from a pre-washing plant and wherein the particulate material has been

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classified to predetermine the size. It is pointed out that the pre-washing and classifying plant does not remove the shale, coal and other light weight foreign deleterious material nor is the adhesive matter such as clay removed from the gravel.

In the embodiment shown, the gravity separator device 11 is provided with a stratifying and separating screen structure 16 which is mounted for shifting movement within the tank and which is suspended from the top of the tank by means of supporting arms 17. It will be seen that the screen structure 16 is substantially horizontally disposed in the tank and in the form shown the screen structure is of substantially rectangular configuration. This screen structure 16 has an oscillatory movement consisting of a combined vertical and longitudinal component.

The stratifying screen structure 16 is provided with an ingress end 18 which is positioned in close proximity to and receives the material from the in-feed hopper 15. During oscillating movement of the stratifying screen structure 16, the material is not only stratified into layers in accordance with the specific gravities of the material but the material is also moved along the screen structure towards an egress end 19 thereof. The heavy gravel or silicious material is discharged from the egress end of the screen structure while the stratified layer of lighter weight foreign material is removed from the tank by a siphoning mechanism to be described hereinbelow.

The means utilized for oscillating the stratifying screen structure 16 during operation of the gravity separator device comprises a pitman oscillating mechanism which is mounted on top of the tank 12 and which simultaneously oscillates the supporting arms 17. This mechanism includes a drive shaft having a drive pulley 20 keyed thereto for rotation therewith, the drive shaft being connected by suitable drive means such as a belt and pulley drive to a source of power such as a motor (not shown). The drive pulley 20 is connected by a suitable endless type drive chain 21 to a relatively large driven sprocket 22 which in turn is mounted or keyed to a driven shaft 23 which is journaled in suitable bearings mounted on the stratifying device 11.

The oscillator or pitman linkage is connected to the driven sprocket 22 and includes a drive link 24 having an eccentric connection 25 with the driven sprocket so that upon rotation of the sprocket the drive link 24 will be oscillated. The drive link 24 is pivotally connected to the upper end of a crank arm 26 which is secured to a rock shaft 27 journaled in suitable bearings 28 which are mounted on the tank 12.

It will be seen that one end of an elongate interconnecting link 29 is pivotally connected to the upper end of crank arm 26 while the other end of this interconnecting link is pivotally connected to the upper end of a second crank arm 30. The crank arm 30 is also fixedly connected to a rock shaft 31 journaled in suitable bearings 32 mounted on the tank 12 and it will be seen that the rock shafts 27 and 31 are disposed in substantially parallel relation with respect to each other. Opposite ends of the rock shaft 27 have lever arms 33 affixed thereto and these lever arms 33 have their lower ends respectively pivotally connected to the upper ends of a pair of supporting arms 17 adjacent one end of the stratifying screen structure 16. Opposite ends of the rock shaft 31 have a pair of lever arms 34 fixedly connected with the opposite ends thereof, these lever arms being pivotally connected at their lower-

most ends to the upper ends of the supporting arms 17 located at the other end of the stratifying screen structure 16.

It will therefore be seen that when the driven sprocket 22 is revolved, the screen structure will be oscillated and this oscillation will have both the vertical and longitudinal components of movement. It is pointed out, however, that in the event that the screen structure 16 is slightly inclined from the ingress end towards the egress end, the linkage may be constructed to produce a reciprocating rectilinear movement in the screen structure.

During the oscillatory movement of the stratifying screen structure 16, the material supplied thereto will move along the screen structure from the ingress end thereof towards the egress end and the material will be stratified into layers in accordance with the specific gravity of the particular material. The heavier gravel or silicious material will move along the surface of the screen structure in a bed of predetermined thickness while the lighter weight material will form a layer above the heavier material or silicious material and this lighter weight foreign material is picked up and discharged through overflow tube 35.

The inlet end of the overflow tube 35 comprises a housing 36 which is semi-circular in shape and communicates with the overflow tube 35. The lower end of this housing 36 has an opening therein extending transversely substantially across the width of the stratifying screen structure 16 adjacent the egress end thereof and disposed in spaced relation above the screen structure and above the layer or bed of heavy silicious or gravel material being moved longitudinally along the screen structure. This overflow tube 35 and housing thereof is similar in structure to that disclosed in my United States Letters Patent No. 2,824,644, and serves to remove the lighter weight material such as coal, shale and the like from the tank.

As the water flows into the elongated opening of the housing 36 and passes in close proximity with and through the layer of stratified lightweight material so that the water entrains these lightweight suspended materials and carries them out of the tank. The heavier materials spill over the egress end of the screen structure and fall by action of gravity into a scrubbing device wherein the adhesive materials such as clay are removed from the gravel.

In many conventional treatment plants wherein gravel, ore and the like are washed for commercial usage, the gravel or light material is first treated to remove the deleterious lighter weight materials such as coal, shale and the like, but this particular apparatus is ineffective in removing clay or other adhesive material from the gravel. It is therefore necessary to convey the gravel from the gravity type separator or other apparatus used to remove the lighter weight deleterious material from the gravel to a scrubber apparatus. Not only do each of these machines or apparatus occupy a relatively large space in such treatment plants but the initial installation cost, maintenance and operation of these separate machines is quite costly. For example, the material discharged from the machine used to remove the lightweight material such as coal, shale and the like ordinarily involves the loss of considerable amounts of water as the gravel material is discharged from such a machine. Further this gravel material must thereafter be conveyed by suitable conveying equipment to the next treatment apparatus so that the general cleaning treatment is not only interrupted but requires extensive amounts of water.

The cleaning unit 10, however, permits the gravel, ore or the like to be cleaned and ready for commercial usage in a single cleaning operation. To this end, it will be seen that the side walls 12a of the tank 12 converge downwardly and an elongate generally inclined trough structure 37 has its upper edges throughout a portion of its length rigidly or integrally formed with the lower portions of the side walls 12a.

The tank 12 has a bottom wall portion 12b which is inclined downwardly from adjacent the egress end of the stratifying screen structure 16 and is joined with the lowermost end 37a of the trough structure 37. This inclined bottom wall portion 12b defines a surface for directing the gravel discharged from the egress end of the stratifying screen structure and directs the gravel by action of gravity to the lowermost end or inlet portion of the trough structure 37. The trough structure 37, as best seen in FIG. 1, is connected throughout a major portion of its length to the tank structure and cooperates therewith to form a single water containing receptacle. Thus the trough structure and tank 12 actually constitute parts of a container or receptacle for containing a single volume of water.

The upper end of the trough structure 37 has a discharge outlet or chute 38 communicating with the interior thereof and through which the cleaned gravel, ore or the like is discharged. In cross section, the trough structure is preferably shaped, as best seen in FIGS. 2 and 3, to define a pair of arcuate halves which are joined along the vertical longitudinal center line plane of the trough structure.

Means are also provided for scrubbing the gravel material while this gravel material is moved upwardly through the trough structure 37 so that adhesive material adhering to the gravel will be removed. In the embodiment shown, this means comprises a pair of elongate shafts 39 which are disposed in substantially side-by-side parallel relation and each shaft extending throughout the length of the trough structure and projecting outwardly from the respective end walls thereof. Each shaft 39 has a continuous helicoid blade 40 affixed thereto, the blades being disposed in overlapping relation, as best seen in FIG. 2. It is also pointed out that in some instances the scrubber means will comprise a single bladed shaft or auger mechanism which cooperates with the trough 37 to very effectively scrub the gravel material as it is moved upwardly through the trough structure from the lower end thereof to the upper end. If a single bladed shaft is used, this auger or screw type scrubber conveyor cooperates with the inner surface of the trough structure to not only move the gravel material upwardly through the trough, but to produce a scrubbing action whereby any adhesive material adhering to the gravel will be removed. Similarly, a pair of such auger or screw type scrubber conveyors, if utilized, as illustrated in FIGS. 1 and 2, will cooperate with each other and with the trough structure to clean and convey the gravel material as it is moved through the trough structure.

The upper end of one of the shafts 39 has a driven beveled gear or pinion 41 affixed thereto for rotation therewith and this pinion meshes with the drive pinion 42 affixed to a drive shaft 43 which is drivingly connected to a suitable source of power. The driven shaft 39 drivingly engages the other shaft 39 by means of meshing gears 44 which are respectively keyed to the shafts 39. It will therefore be seen that the drive pinion 42 through its meshing relation with the driven pinion 41 and the gears 44 provides a suitable drive connection with the power source for the auger or screw type scrubbers.

Means are also provided for removing the suspended clay material from the trough structure and this means includes an overflow tube device 45 similar in arrangement and construction to the overflow tube device 35. It will be appreciated, of course, that the inlet end of the housing of the overflow tube 45, which is only shown in part, will be of smaller size since the cross sectional width of the trough structure 37 is substantially smaller than the cross sectional width of the tank 12. It will also be noted that the overflow tube device 45 is substantially spaced from the screen structure 16 and in no way affects the operation thereof. The gravel or ore material being scrubbed will always fall towards the bottom wall of the trough structure while the dislodged clay material will be

suspended in the water and removed by the overflow tube device 45. It will be noted that the upper portion of the trough structure 37 and the screw type scrubbers therein project above the water level so that the gravel material is actually de-watered when it is discharged through the discharge tube 38.

Referring now to FIG. 3 it will be seen that a different embodiment of the scrubbers are shown wherein it is desirable to obtain a more thorough scrubbing action. To this end, it will be seen that the embodiment illustrated in FIG. 3 discloses a trough structure 48 of identical construction and configuration with the trough structure 37. A pair of elongate shafts 46 are disposed in side-by-side relation in the trough structure 48 and each projects through opposite ends of the trough structure. The shafts 46 have scrubber elements in the form of staggered paddle blades 47 rather than the helicoid blades of the embodiment of FIGS. 1 and 2. These paddle elements are arranged longitudinally and in staggered relation with respect to shafts 46 and produce a more thorough scrubbing action than the helicoid blades. It is to be understood that the trough structure 48 in the embodiment illustrated in FIG. 3 is related to the tank 12 in the identical manner to that of the trough structure 37. Therefore when it is desirable to obtain a highly thorough scrubbing effect on the gravel, the paddle type scrubber mechanism is utilized and in the event that a moderate scrubbing action is desired, the helicoid or auger type scrubber mechanism will be used. It is also pointed out that under certain conditions, a single paddle type scrubber conveyor may be used instead of a pair of such scrubber conveyors and the paddles thereof will cooperate with the trough structure 48 to not only clean the gravel material but to remove the adhesive material which adheres to the gravel material as the same is moved through the trough structure.

During operation of the cleaning unit 10, and especially if the unit is used in a gravel cleaning operation, the gravel will be supplied by suitable conveyor means to the in-feed hopper 15. The gravel will be delivered from a washer plant which subjects the gravel to a mild washing and which screens or sizes the gravel to the desired predetermined size. This gravel material will, however, include or have associated therewith deleterious matter such as shale, coal and other lightweight material as well as adhesive material such as clay, clay balls and the like.

The gravel will be discharged from the in-feed hopper 15 upon the ingress end 18 of the screen structure 16 and the oscillator will oscillate the screen structure whereby the heavy silicious material will be moved in a bed of predetermined thickness along the screen structure towards the egress end. The lighter weight material because of its particular specific gravity will be stratified in a layer above the screen structure and will be removed by the overflow tube device 35. The heavier gravel material will spill over the end of the screen structure 16 at the egress end and will be directed downwardly by action of gravity into the lower or inlet portion of the trough structure 37.

The revolving movement of the scrubbers produces a scrubbing action so that the adhesive clay, clay balls and other deleterious matter will be removed from the gravel and will be ultimately removed by the overflow tube device 45 from the unit 10. The gravel will be conveyed upwardly by the scrubbers to the upper portion of the trough structure wherein the gravel is removed from the water and will be discharged through the discharge outlet or chute 38 in a de-watered condition.

It will therefore be seen that the unit 10 not only utilizes a single volume of water but the gravel, ore or other material treated is completely cleaned in a single operation and is ready for commercial usage as it is discharged from such machine. It is pointed out that in conventional cleaning apparatus, the gravel is not de-watered as it is discharged from the initial treatment apparatus such as the gravity separator wherein the coal, shale and other

lighter weight materials are removed. Thus in conventional operations, substantial amounts of water are lost as the gravel is transferred from one machine to another. The only loss of water from the unit 10 is that occasioned by the removal of the deleterious material by the overflow tube device or mechanism and no water is wasted during the operation of this unit. It has also been found that the installation cost, operating cost and space requirements for a single unit machine is obviously substantially less than the larger separate machines. It will also be noted that the unit 10 not permits the separation by stratifying and classifying action performed by the screen structure 16 but the scrubbers also separate the material from the gravel and the gravel is finally delivered from the unit in a de-watered condition wherein the gravel is separated from the water with a minimum loss of water.

It will therefore be seen that I have provided a novel cleaning unit which is not only of simple and inexpensive and compact construction and operation, but one which functions in a more efficient manner than heretofore known comparable devices.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of my invention.

What is claimed is:

1. Apparatus for cleaning particulate material, such as gravel or the like, said apparatus comprising,
 - a liquid-confining tank,
 - a generally horizontally oriented stratifying structure shiftably mounted in said tank below the liquid level therein,
 - oscillator mechanism connected to said stratifying structure for oscillating the same and causing mixed materials thereon to move from an ingress end of the stratifying structure towards an egress end thereof whereby to cause the lighter materials of the mixture to rise in a layer above the heavier materials, the latter being discharged over the egress end of the stratifying structure,
 - an overflow tube device extending into said tank and positioned adjacent the egress end of said stratifying structure for removing the lighter materials from the tank,
 - said tank having at least a portion thereof shaped to define an elongate inclined trough structure having the lower end portion thereof underlying said stratifying structure and receiving the heavier particulate material from the egress end of the stratifying structure, said trough structure having a discharge outlet at the upper end thereof located above the level of liquid within said tank,
 - a pair of elongate shafts having blades thereon positioned and closely confined within said trough structure, said blades on said shaft being disposed in overlapping relation with respect to each other and being disposed in close proximal relation with respect to the inner wall surfaces of said trough, said shafts being revolvable about their longitudinal axes and cooperating with each other and with said trough structure for scrubbing the heavier gravel material to remove mud and the like therefrom and for conveying the gravel from the lower end of the trough towards said outlet.
2. The apparatus as defined in claim 1 wherein each of said bladed shafts comprises an elongate auger having an elongate helical blade thereon.
3. The apparatus as defined in claim 1 and a second overflow tube device spaced from said first overflow tube device communicating with said trough structure below the water level thereof and receiving and removing suspended material from the trough structure.
4. The apparatus as defined in claim 1 wherein each of said bladed shafts has a plurality of paddle blades

affixed thereto and projecting radially outwardly therefrom, said paddle blades being arranged longitudinally of said shaft and in staggered relation with respect to each other.

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