Sept. 27, 1955 H. HARDINGE 2,718,966

HYDRAULIC CLASSIFICATION METHOD AND APPARATUS

Filed Jan. 26, 1951 4 Sheets-Sheet 1

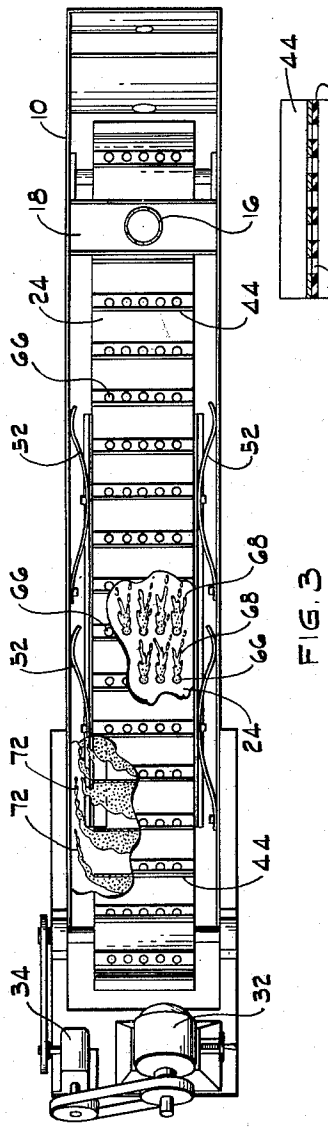


FIG. 3

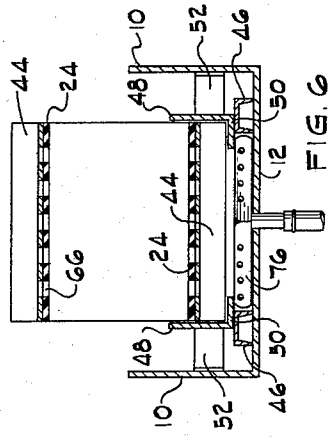


FIG. 6

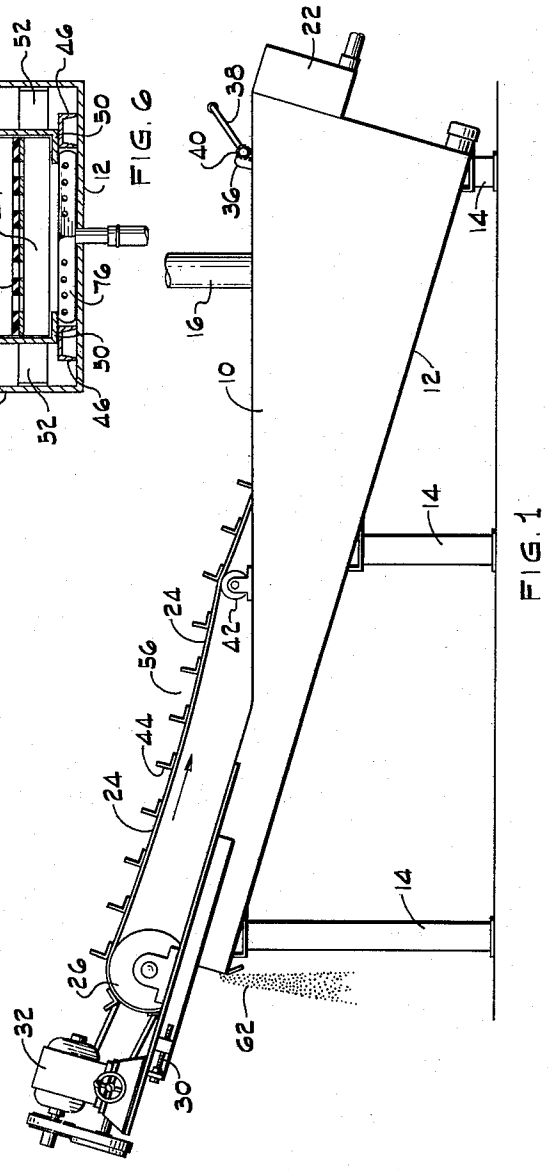


FIG. 1

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HYDRAULIC CLASSIFICATION METHOD AND APPARATUS

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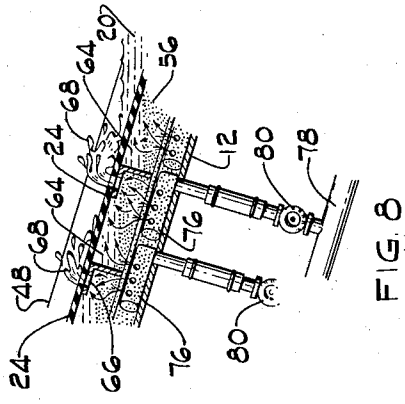


FIG. 8

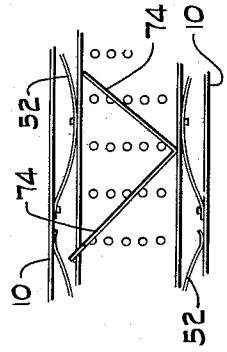


FIG. 9

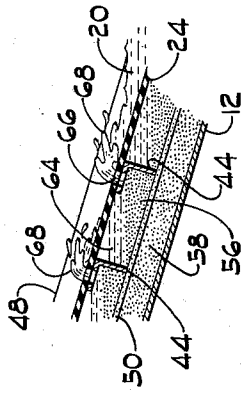


FIG. 7

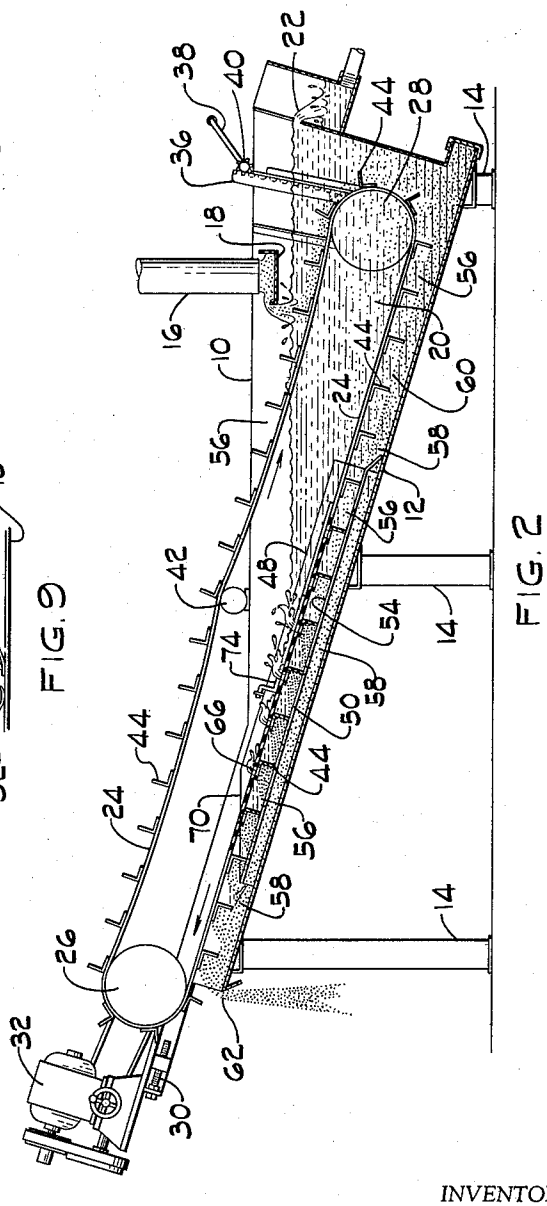


FIG. 2

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HYDRAULIC CLASSIFICATION METHOD AND APPARATUS

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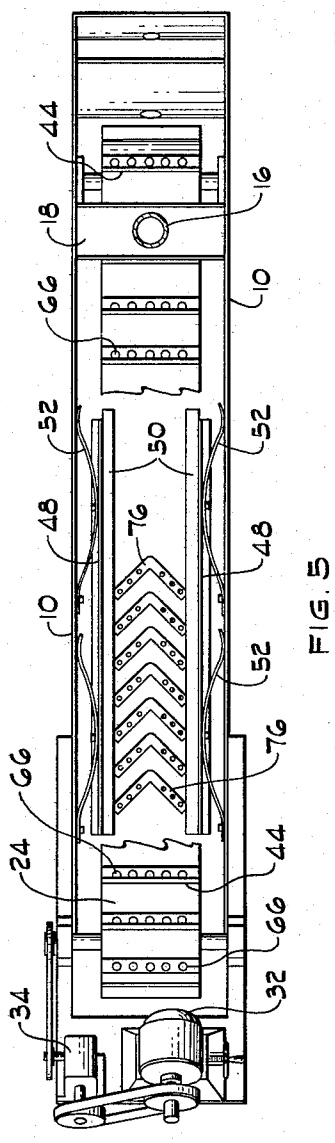


FIG. 5

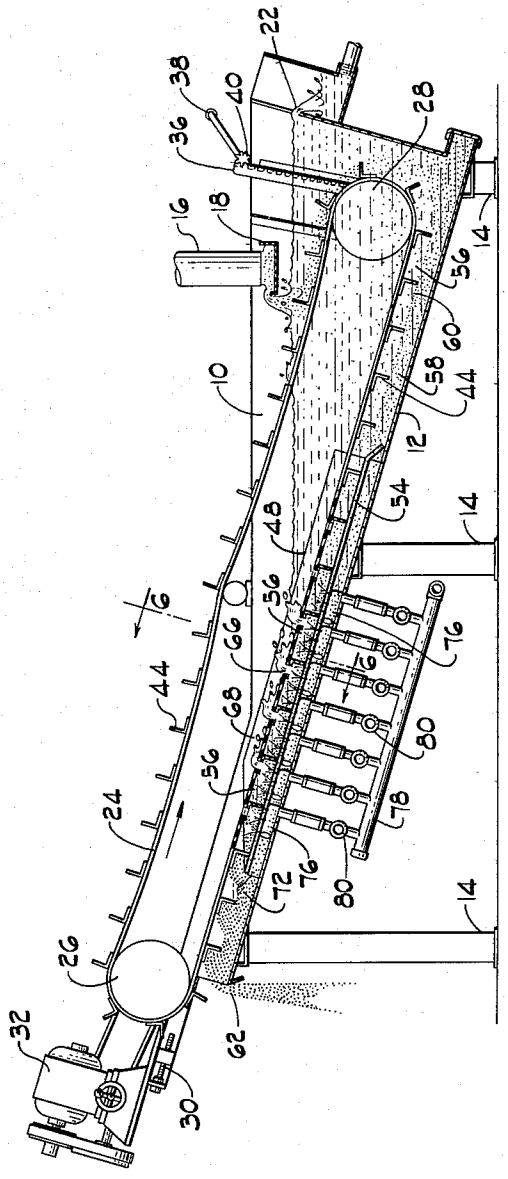


FIG. 4

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HYDRAULIC CLASSIFICATION METHOD AND APPARATUS

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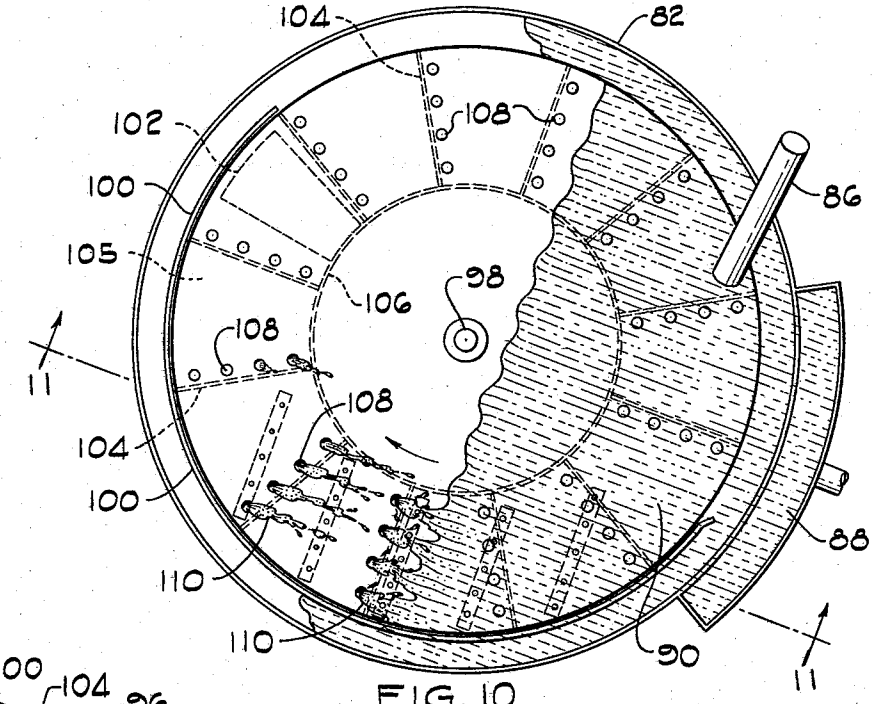


FIG. 10

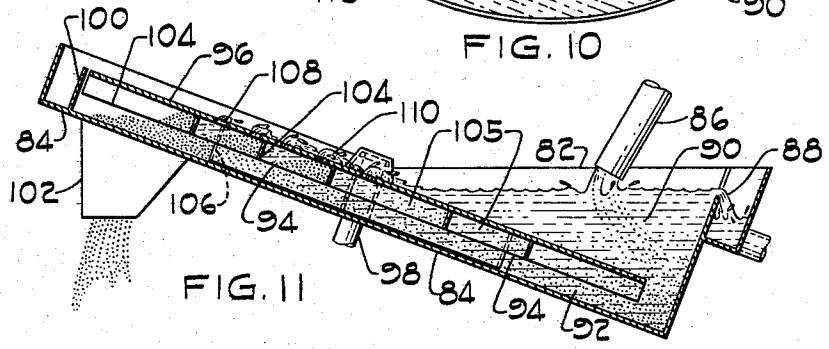


FIG. 11

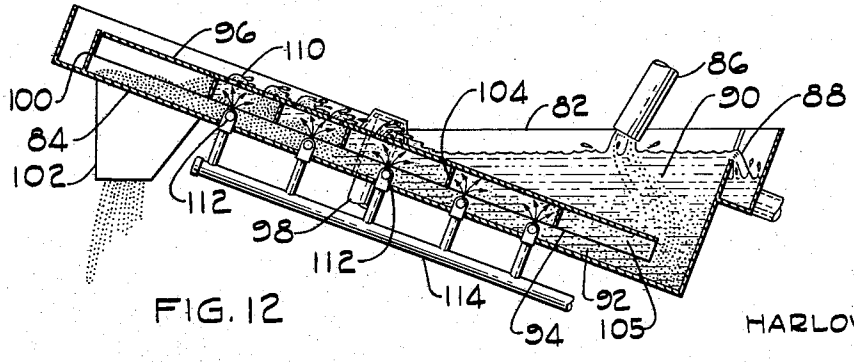


FIG. 12

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2,718,966

HYDRAULIC CLASSIFICATION METHOD AND APPARATUS

Harlowe Hardinge, York, Pa.

Application January 26, 1951, Serial No. 207,998

34 Claims. (Cl. 209—173)

The present invention relates to hydraulic mineral classification and apparatus and, more particularly, to a process and apparatus by which, for example, slimes and fines are removed from sands by employing novel hydraulic principles. The process and mechanism for achieving this objective pertain to treating a mixture of particles to be separated by feeding said mixture into a pool, separating the slimes and fines from the sands and removing the same by floating them from the pool while the sands are removed by mechanical means therefrom. The process is generally applicable to the separation of particles of various sizes from each other and pertains especially, but without restriction thereto, to the dressing of various kinds of ores.

Many attempts have been made to remove slimes and fines from sands by flushing or floating the same therefrom either with or without agitation and using sprays of various kinds, or using means to produce hindered settling. For example, in the standard types of belt, rake or spiral types of classifiers well known in the art today, mechanical devices scrape the sands from a settling pool up a board or incline above the pulp level. In so doing, the liquid drains off the pulp and down the board, returning to the pool level but, in so returning, this liquid which contains slimes and fines also tends to filter back through the oncoming sands inasmuch as the liquid in the oncoming sands meanwhile tends also to flow downward and form voids therein. Thus, liquid from a higher elevation flows downward over said sands and into these voids, thus re-entraining into said voids of the oncoming sands the slimes and fines in the liquid flowing from the higher elevation. This results in the oncoming sands not being as clean as they could be or would be if such re-entraining of slimes and fines therein did not occur.

Some of these attempts have further included the spraying of wash water directed upwardly from below a moving body of sand from which slimes and fines may at least partially have been separated by floating the same therefrom or otherwise but, by so flushing additional slimes and fines from the sands, the flushed slimes and fines were washed back onto and became re-entrained in oncoming sands, thereby increasing the slime and fine content thereof. Further, such flushing had the added disadvantage that the use of more than a nominal amount of wash water so liquified the sand mass on the drain board or other surface that it would not remain in a sufficiently dense mass to be held by the scrapers or elevating means and would tend to flow off like a liquid back into the pool. The result was that the solids or sands were not scraped up in sufficient quantities to supply the needs or make the operation economically feasible as far as sand handling capacity is concerned.

Other attempts have included the use of washing sprays directed from above onto a body of sand moving upward along an inclined path, for example, from a body of pulp in which slimes and fines are suspended at least temporarily but such sprays to a large extent defeated

the desired purpose thereof by actually directly re-entraining some of the slimes and fines into the voids in the sand from which they had already been removed such as by floating the same therefrom or otherwise.

The principal object of the present invention is to overcome these deficiencies of the aforementioned previous methods and mechanisms and provide a method whereby slimes and fines are hydraulically removed from sands or relatively coarser particles and, once liberated therefrom, re-entrainment of the slimes and fines within the sands is effectively prevented while the sands are mechanically removed from the pulp pool in relatively clean and drained condition.

An additional object of the invention is to embody, under some circumstances, in the foregoing method the use of wash water, whereby removal of slimes and fines from sands is enhanced by flushing and variable settling effects are also achieved but such flushing does not inhibit effective removal of the sands as in previous attempts referred to hereinabove.

Another additional object of the invention is to effect separation of fines from sands in a pulp thereof by withdrawing successive quantities of pulp progressively from a pool while flushing and/or decanting fines therefrom above a predetermined level in each quantity, and inhibiting the escape of liquid in said quantities from below said level until a desired amount of flushing and/or decanting has occurred, and thereafter residual liquid in said quantities is permitted to drain therefrom and all liquid and fines removed from sands in said quantities are returned to the pool without becoming re-entrained in succeeding quantities while being withdrawn from the pool, the separated sands being suitably mechanically collected after drained of said residual liquid and the fines being permitted to flow from the pool.

Still another object of the invention is to provide several embodiments of simple mechanism of a rugged nature requiring minimum power and operating on similar basic principles to achieve the foregoing methods.

A further object of the invention is to embody various adjustable features in the operating mechanism, whereby rates and degrees of separation of the slimes and fines from the sands may be varied.

A still further object of the invention is to so arrange the mechanism that it is kept free from the collection of solids where otherwise said solids would collect and prevent satisfactory operation of the mechanism employed; the arrangement also being such that liquid flowing from pocketed quantities of pulp withdrawn from the pulp pool discharges onto the emerging belt lap and effectively washes solids therefrom.

Details of the foreoging objects as well as other objects and details thereof will be apparent from the following specification and the accompanying drawings comprising a part thereof.

In the drawings:

Fig. 1 is a side elevation of one embodiment of mechanism by which the present invention may be practiced.

Fig. 2 is a side elevation of the mechanism illustrated in Fig. 1 but being shown principally in longitudinal section.

Fig. 3 is a top plan view of the mechanism shown in Figs. 1 and 2, some of the elements of said mechanism being broken away so as to illustrate details of other elements and functions thereof.

Fig. 4 is a view similar to Fig. 2 but showing another embodiment of mechanism by which the present invention may be practiced.

Fig. 5 is a top plan view of the embodiment of the invention shown in Fig. 4, some of the elements of said mechanism being broken away in this figure to illustrate details of other elements therein.

Fig. 6 is a transverse sectional view taken on the line 6—6 of Fig. 4.

Fig. 7 is an enlarged fragmentary sectional elevation illustrating a detail of one embodiment of the mechanism of the invention in operation.

Fig. 8 is a view similar to Fig. 7 but showing the corresponding operation of another embodiment of the invention.

Fig. 9 is a fragmentary plan view showing a detail of part of the mechanism comprising the invention.

Fig. 10 is a top plan view of still another embodiment of mechanism by which the present invention may be practiced.

Fig. 11 is a sectional elevation taken on the line 11—11 of Fig. 10.

Fig. 12 is a view similar to Fig. 11 but showing a still further embodiment of mechanism by which the invention may be practiced.

Reduced to its basic principles, the present invention provides several different mechanisms generally embodying similar elemental arrangements for achieving desired results obtainable by practicing the method comprising the present invention. These basic principles comprise introducing into a pool a liquid pulp of slimes, fines and sands which are to be treated to separate the sands or coarser particles from the slimes and fines by pocketing successive quantities of the pulp and moving the same progressively up a generally inclined path, permitting settling of the sands or coarser particles in said pocketed quantities while moved along said path in such manner as preferably to prevent any appreciable drainage of liquid from the lower portions of said pocketed quantities in which the sands settle, removing slimes and fines and excess liquid from the upper portions of said pocketed quantities by decanting the same from said pockets and returning the decanted material to the pool by flowing the same over oncoming quantities which are shielded from re-entrainment thereby, subsequently draining residual liquid from the settled sands in the lower portions of said pockets near the end of the path of movement, discharging relatively drained sands which are substantially free from slimes, fines, and excess liquid and floating the removed slimes, fines and liquid from a predetermined level in the pool.

The overall result of this operation is to limit the slimes and fines removed from the pool with the sands to those slimes and fines that are entrained in the sands at the outset when first pocketed in the pool and not drained off with the excess liquid, the so pocketed quantities of pulp containing slimes, fines and sands thereby not being augmented by filtering or entraining thereinto any additional slimes and fines or other material as is now possible in presently used processes described above and over which the present invention comprises a marked improvement. It is well known in the art that sands entrap slimes and fines where the flow of the latter is downward onto the sands and, in fact, this principle is used to a very large degree in filtering silt, slime and foreign matter from various types of industrial and municipal water wherein sand is used as the filtering media. It is this very action which the present invention effectively inhibits.

The present process can also be facilitated and rendered more efficient by subjecting the pocketed quantities of pulp to the action of wash water sprays directed upwardly against said pocketed quantities in such manner that undesirable back flow of the sands down the path of travel does not take place. The uprising currents of the wash water from the sprays tends to clean the sands more efficiently than when no sprays are used and, under some circumstances, the introduction of sprays produces a somewhat hindered settling effect in the pocketed quantities of pulp as they are elevated relative to the pulp pool. However, the addition of sprays of this nature primarily varies the degree of efficiency of separation and thereby comprises a further refinement of the above described invention wherein no sprays are used to achieve acceptable and desirable results.

The speed of movement of the pocketed quantities along the path thereof may also be varied to effect different settling rates of sands within the pockets and such settling rates may also further be varied by the use of the aforementioned sprays.

Several embodiments of mechanism generally incorporating similar basic principles have been devised for practicing the foregoing method and refinements thereof. One embodiment of mechanism is illustrated in Figs. 1 through 3 and 7 and in which a tank **10** is illustrated having a bottom **12** which is preferably inclined as illustrated in Figs. 1 and 2. The tank may be supported by any suitable structure such as standards **14** comprising part of a frame or otherwise. Liquid pulp containing slimes, fines and sands is introduced into the tank **10** through a feed launder **16**. Such introduction of pulp may also be facilitated by a baffle board or spreader **18** as shown in Fig. 2. Introduction of the pulp into the tank forms a pool **20** which will assume a pulp level as illustrated in Fig. 2. Slimes and fines float in the liquid in the pool **20** and are discharged through an overflow port **22**.

In this embodiment of mechanism, quantities of pulp are pocketed within the pool **20** by a mechanism comprising an endless belt **24** which, except as described hereinafter, is impervious to liquid such as rubberized canvas for example. The belt extends around and is supported by a pair of suitable rolls or pulleys **26** and **28**. Pulley **26** is rotatably mounted adjacent one end of the tank well above the pool level, said mounting means preferably including belt tightening means **30** in accordance with customary practice as illustrated in Figs. 1 and 2. The pulley **26** is also driven by any appropriate means such as a motor **32** and a speed reducer **34** which is preferably of the type that may be varied in order to change the speed of the pulley **26** or any other standard means of changing speeds between the motor and speed reducer may be employed. Suitable belts and chain drives illustrated in Figs. 1 through 3 operatively connect the motor, speed reducer, and a sprocket fixed to pulley **26**.

Pulley **28** is usually submerged within the pool **20** in normal operation of the mechanism and said pulley is preferably rotatably supported on a frame **36** which is movable more or less vertically so as to vary the position of pulley **28** relative to the bottom **12** of the tank **10**. Such movement of the frame **36** may be accomplished by any suitable means such as a hand crank **38** and a gear **40** connected thereto which meshes with a rack on frame **36**. One or more auxiliary supporting rolls **42**, rotatably supported relative to tank **10**, may be included to support the upper course of the belt **24** as shown in Figs. 1 and 2.

The belt **24** is provided with a plurality of pocket or compartment forming means such as a plurality of longitudinally separated scrapers or vanes **44**. In the specific illustration shown in Figs. 1 through 3, the vanes **44** comprise angle irons, one web of which comprises the scrapers or vanes **44** and the other web of which is secured to one surface of the belt **24** such as by bolts or rivets, not shown. The scrapers or vanes **44** are coextensive with the width of the belt **24**; that is, the ends of the scrapers or vanes are flush with the edges of belt **24**.

As illustrated in Figs. 2 and 6, the tank **10** has suitable means therein to support the free edges of vanes **44** as they are moved by the lower course of belt **24** relative to the bottom **12** of the tank. In the specific illustrations herein, such guide means comprise, for example, a pair of spaced, parallel channels **46** shown in Fig. 6, said channels supporting a pair of separated confining angles or side plates **48** having inturned flanges **50** at the lower edges thereof and directly engaging the channels **46** as shown in Fig. 6. The side plates **48**, in the preferred embodiment of the invention, are held in position preferably by suitable resilient means such as coil or leaf springs **52** disposed between the side walls of tank **10** and the side

plates 48 as is clearly shown in Figs. 3 and 6. The side plates 48 are thus yieldably and preferably lightly held in slidable engagement with the edges of the lower course of belt 24 but the side plates are held against any substantial movement longitudinally. As clearly shown in Figs. 2 and 6, the end portions of the lower edges of vanes 44 slide along the upper surfaces of flanges 50 at least at the commencement of operation of the device and thereby the side plates 48 and vanes 44 are held closely together during movement of the vanes 44 and belt 24 along inclined path 54 which is described in greater detail hereinafter.

Upon commencing operation of the apparatus described hereinabove, the pool 20 is established in the tank 10 and movement of the belt 24 is instituted. The pool 20 will consist of a mixture of liquid, slimes, fines and sands in which the sands tend to settle toward the bottom of the pool and the slimes and fines tend to float in the liquid in the upper portion of the pool. The pulp being fed through launder 16 is introduced largely onto the upper course of belt 24 as shown in Fig. 2. The belt moves in the direction of the arrows shown in Figs. 1 and 2 and the separated vanes 44 cooperate with the belt 24 to define a series of successive pockets or compartments 56 defining spaces of prescribed volume and preferably of substantially fixed geometric form. When the belt 24 moves as aforesaid, the pockets or compartments 56 which are disposed lowermost in the pool 20 are inverted, as shown in Fig. 2, and engage so as at least partially to enclose and thereby entrap successive quantities of the heavier portion of the pulp in pool 20. Said heavier portion of the pulp, however, includes a considerable amount of slimes and fines suspended in a relatively fluid pulp. The quantities of pulp confined in inverted pockets 56 are moved upward from the lower portion of pool 20 until they reach the lower ends of side plates 48. When this occurs, the quantities of pulp in the pockets 56 are completely enclosed at all sides and top thereof.

Shortly after the operation of the apparatus is commenced as aforesaid, a floor or bed 58 of sands clogged with slimes and fines becomes formed and said bed becomes substantially impervious to the flow of any liquid therethrough. The upper surface 60 of said bed thereby comprises a relatively smooth surface which is slidably engaged by the free edges of vanes 44 depending from belt 24 and said surface 60 and bed 58 extends between channels 46 and flanges 50, from the lowest end of the belt up to the upper end of bottom 12 of the tank 10 adjacent the sands discharge 62. Thus, particularly when the pockets 56 move between sides plates 48, the quantities of pulp therein are confined at the ends and sides between the side plates 48, the vanes 44, at the top by belt 24 and at the bottom by surface 60. A head 64 is formed in the upper portion of each of said pockets 56 as shown in Fig. 7.

While the pulp is so confined in said pockets and moved upward from the pool 20 along path 54, defined by surface 60, the coarser particles of the pulp will settle into the lower portion of said pockets and slimes and fines will at least temporarily float within the liquid comprising head 64. Removal of the slimes, fines and excess liquid from the more or less settled coarser particles or sands takes place through discharge openings or ports 66 formed in belt 24 as shown in Figs. 2 and 7 under the pressure created by the inclined movement of said pockets while moving along guide flanges 50. Said inclined movement, in effect, results in a tilting of said pockets. In the embodiment of the invention shown in Figs. 1 through 3 and 7, the floating slimes, fines and excess liquid will be decanted through the discharge opening 66 and the head 64 will cause such discharge to take place relatively rapidly at first as the pockets 56 move above the liquid level of pool 20 as shown in Figs. 2 and 7. The openings 66, in the preferred embodiment of the invention, are positioned in one or more rows in belt 24 adjacent the lowermost vane 44 of each pocket 56 to establish a predetermined decanting level in each pocket adjacent the trailing end thereof. The sloping belt 24, which actually comprises the top of each pocket 56 is otherwise substantially impervious and thus, as the decanted liquid, slimes and fines 68 are discharged through the opening 66, they will flow down the upper surface of belt 24 and back into pool 20, said belt thus comprising a shielding means for the contents of each pocket. The invention thereby embodies what may be called an "over-drain" principle but, the impervious nature of belt 24 prevents such discharged liquid, slimes and fines from becoming re-entrained in oncoming quantities of pulp in the succeeding pockets 56, thus not burdening said oncoming quantities with additional slimes and fines.

Each pocket 56 is provided with at least one opening 66 but, in actual practice, one or more rows of such openings are found to be preferable as shown in Fig. 3 in order to provide relatively rapid but restricted decanting while the slimes and fines remain in suspension within the heads 64 within the pockets 56, such openings being of such total area that the pressure within the pockets exceeds the exterior pressure and thereby prevents inflow of material through said openings. Further, the slimes and fines discharged from advanced pockets along path 54 do not flow back into lower pockets through the opening 66 therein due to the higher velocity of fluid discharging through said lower openings 66 as a result of the greater unexpended head therein rising and preventing the fluid flowing down the belt 24 from draining back into the lower pockets 56.

The ideal action is to have the sand load in each pocket about level with the openings 66. If the pulp contains a relatively small amount of sand, this may not be possible unless the belt is moved slower than in average normal operation. Conversely, if the belt is moved too slowly while treating average or heavy sand content pulp, for example, sands may crowd into the openings 66 and more or less choke them, allowing only a part of the water and slimes to decant therethrough. If necessary, additional rows of openings 66 may be provided for each pocket but, in the preferred operation, varying of the belt speed is resorted to for achieving ideal operation.

As the pockets 56 move farther up the path 54 above the level of pool 20, decanting of liquid, slimes and fines from the pockets will gradually become substantially complete while the settled sands remain in the fluid in the lower portions of the pockets 56 below the level of the openings 66. The fluid in said pockets 56 below the level determined by openings 66 is inhibited from draining therefrom during its movement up the path 54 due to the confining nature of the pockets 54 described hereinabove and the manner in which the settled sands in the pockets 56 are slidably moved along the surface 60 of bed 58 which, as described above, is sufficiently impervious to the drainage of liquid therethrough. However, the upper ends of side plates 48 each terminate in an edge 70 which, in effect, comprises a wier preferably parallel to the liquid level in each pocket. The side plates 48, as described above, actually form two opposed sides of the pockets 56 and thus, when the contents of the pockets are moved above the edges 70 of the side plates, the confining effect of the side plates terminates and permits the residual liquid in the pockets 56 to decant over the edges 70 and drain down between the side plates 48 and the sides of the tank 10 as shown at 72 in Fig. 3 and into the pool 20.

It will be noted that the side plates 48 terminate a short distance from the sands discharge 62, whereby the residual liquid in the sands may drain therefrom while the vanes 44 continue to move the sands to the discharge 62. Also, during such last mentioned movement of the sands, some of the sands in each pocket 56

could decant or flow over the edges 70 of the side plates and become somewhat intermixed with up-coming sands below them as they reach the terminating ends of side plates 48. However, when the sands reach the edges 70 of the side plates, and are moved thereabove toward the discharge 62 outlet, most of the main slimes and fines have been drained therefrom and the amount of water and fines left to be drained is so very much less than at the lower end of path 54 that such on-coming sands will be subjected to only the slightest re-entrainment by liquid or minute quantities of slimes and fines therein as the quantities of sands are exposed at their sides as they move past the edges 70 of the side plates 48.

It will therefore be seen that the apparatus described hereinabove affords simple and highly effective means for separating slimes and fines from sands or coarser particles by decanting slimes and fines from said sands and coarser particles without permitting the slimes and fines decanted from higher quantities from becoming re-entrained in oncoming quantities as withdrawn from the pool. Further, the degree of settling within the pockets 56 may be varied and controlled by the speed in which the pockets are moved up the path 54. Such speed is variable as aforesaid by manipulating the variable speed drive arrangement or possibly by using changeable V-pulleys and belts between the motor and speed reducer 34. The slower the movement of the pockets 56, the greater the amount of settling which may take place therein while slimes and fines are being decanted therefrom and conversely, the faster the movement of the pockets the less will be the settling and, under the latter circumstances, only the coarser particles will be permitted to settle below the level in the pockets controlled by the opening 66.

During the decanting of slimes and fines from the pockets back into the pool 20 the amount and force of the decanted fluid is usually sufficient to wash back any sands which tend to settle on the upper surface of that portion of the lower course of the belt 24 which is within the pool. However, a scraper 74, shown in Figs. 2 and 9, may be used, supported between the side plates 48. Located preferably at or near the pulp level, the scraper is slidably engaged by said lower course of the belt 24, whereby any solids on the belt are positively removed therefrom. Any suitable shape of scraper such as one in the form of a right angle may be used. Thus, the belt is kept clean and solids do not build up thereon to any appreciable extent so as to interfere with the passage of the belt around the drive pulley 26.

In order further to enhance the efficiency of operation of the classifier described hereinabove and wash the sands of the pulp to a higher degree, another embodiment or refinement of the invention utilizes sprays which direct wash water into the pockets from below the contents thereof. This embodiment is illustrated especially in Figs. 4 through 6 and 8. Apart from the sprays however, the structure of this embodiment of the invention is similar to that illustrated in Figs. 1 through 3 and 7 and described hereinabove. In said additional embodiment of the invention, and referring particularly to Fig. 4, a plurality of spray heads 76 are positioned adjacent the inclined bottom 12 of tank 10 and preferably below the surface 60 of the sand bed 58. The spray heads are provided with a plurality of apertures which direct spray water into the inverted pockets 56 containing quantities of pulp. Thus, the spray is directed through the surface 60 of the sand bed and enters the interior of the pockets 56 in the nature of replacement liquid to somewhat dilute the pulp contained therein and thereby quicken the settling action within said pockets 56. Such spray liquid also creates a head in the upper portion of each space or pocket even while said pockets are submerged within the pool.

The pockets 56 trap the pulp within the tank 10 in a zone wherein the pulp is of relatively high density and where the settling rates thereof are relatively slow. Thus, the addition of diluting water to the contents of the pockets 56 will of itself increase the settling rate of sands and coarser particles within said pockets 56 and thereby create a better demarkation between the sands and the slimes and fines which are to be separated therefrom. The latter have a slower settling rate and tend to remain at least temporarily suspended in the liquid within the pockets 56. Further, the use of a current of wash water or liquid directed upwardly through the sands within the pockets 56 from the bottom upwards tends to clean the sands of slimes and fines more effectively than where no such washing currents of water are used as the velocity of this water can be made to be considerably higher than the settling rates of the slimes and fines to be discharged from the sands. Further, such spray water, due to the head created thereby, will even induce discharge of fines from the spaces when submerged below the level of pool 20.

Thus, the slimes and fines are moved to the upper surface of the sand mass in each pocket and, especially as said pockets are moved above the pulp level of the pool, liquid containing said slimes and fines is caused to flow out of the discharge openings 66 of the pockets 56 at a greater velocity than if such sprays were not used and the slimes and fines are discharged merely by decanting as in the structure illustrated in Figs. 1 through 3 and 7. Moreover, as the pockets are elevated well above the pulp level, the application of additional wash water through these sprays referred to still further cleans the sands and additionally tends to inhibit any tendency for water to filter back through the sands in the event there is any tendency of leakage around the vanes and into adjacent pockets. The use of such sprays therefore results in a very clean product being obtained and quantities of wash water can be used far in excess of what is feasible in conventional classifiers without danger of the sands being washed back into the pool 20 inasmuch as the sands remain trapped in the pockets until released as they emerge above the edges 70 of the side plates 48.

It will be observed from Figs. 4 and 5 that the plurality of spray heads 76 cover a sufficient number of adjacent pockets 56 to flush and wash the sands to a desired extent. In the preferred aspect of this embodiment of the invention, a header 78 may be used commonly to supply wash water to all of the spray heads 76 and valves 80 are preferably positioned between the header 78 and the various spray heads 76 in order that the amount of spray water fed to each spray head 76 may be individually controlled and varied as desired. The spraying action may thereby be regulated to a very fine degree and highly selective settling may be achieved within the pockets 56.

As in the first described embodiment, the separated slimes and fines are flushed from the pockets 56 as well as being decanted therefrom, as shown to best advantage in Fig. 8 particularly, and the substantially impervious nature of the belt 24 affords shielding means which prevents re-entrainment of discharged slimes and fines into oncoming pockets in the same manner as described hereinabove in connection with said first mentioned embodiment.

In both of the above described embodiments of the invention, if it is found that suitable sealing action is not obtained between the ends of the vanes 44 and side plates 48, additional means such as flexible wiping means, not illustrated, may be added to the ends of said vanes to facilitate sealing the contents of the pockets against escape between the ends of the vanes and the side plates 48. Further, if desired, one or more rollers, not shown, may be mounted so as to engage the upper surface of the lower course of the belt 24 and thereby hold the free edges of the vanes 44 in sliding engagement with the surface 60 of said bed 58 and to prevent a build-up thereof by the

deposition of settled sands thereon in the event the pockets **56** become overfilled at times with settled sands.

The two embodiments of the invention described hereinabove utilize a flexible belt to form the pulp confining pockets or compartments. Another means may also be used to form similar pockets which are disposed in inverted position while confining quantities of pulp and are movable relative to a generally inclined surface within a tank containing pulp. One such additional means is illustrated in the embodiment of the invention shown in Fig. 10 wherein a tank **82**, which is circular in plan view, is provided with an inclined bottom **84**. A feed launder **86** introduces pulp to the tank and a liquid over-flow **88** is also arranged to permit the drainage of slimes and fines from the pool **90**. A bed **92** of compacted sand impregnated with slimes and fines will be formed similarly to the bed **58** of the foregoing embodiments and a surface **94** will be formed thereon corresponding to the surface **64** of said foregoing embodiments.

A substantially flat disk **96** is mounted upon and driven by a shaft **98** movable relative to the tank **82**. The tank **82** is also provided with a semi-circular wall **100** which is fixed to the bottom of the tank and the upper edge of the wall **100** conforms closely to the rim of the disk **96** from the vicinity of the liquid overflow **88** to the sands outlet **102** in the bottom of tank **82**.

Compartment or pocket forming means are provided on the disk **96** in the form of radially extending vanes **104**, the lower edges of which slide relative to the surface **94** of the sand bed **92** as the disk is rotated by a shaft **98**. Segment shaped pockets **105** are defined by the disk **96** and the vanes **104**, while the wall **100** comprises another side of each pocket and a circular wall **106** depending from disk **96** comprises another wall of each pocket. A row of discharge openings **108** are also formed in the disk **96** adjacent each vane **104** as shown in Figs. 10 and 11.

As the disk **96** is rotated in the direction of the arrow shown in Fig. 10, the lowermost pockets **105** in the pool **90** engage quantities of the denser pulp in the lower portion of the pool **90** and progressively move the same up the inclined path or surface **94** while the pulp is confined in the pockets **105** in the same manner as the pockets **56** confine and move pulp in the above described embodiments of the invention. Sands gradually settle to the lower portions of the pockets **105** while slimes and fines are decanted as indicated at **110** through the discharge openings **108**. The disk **96** is impervious except for the openings **108** and will therefore shield the contents of the pockets **104** from becoming re-entrained with the slimes and fines decanted from preceding pockets while said decanted material is flowing back to the pool **90**. The cleaned sands, upon reaching the outlet **102** are discharged by the vanes **104** pushing the same therethrough.

A further refinement of the embodiment shown in Figs. 10 and 11 is shown in Fig. 12 wherein spray heads **112** are provided for discharging wash water upwardly into the contents of the pockets **105**. The heads **112** may be supplied with wash water from a header **114** and the function of said header and spray heads is similar to corresponding elements in the above described embodiments illustrated in Figs. 1 through 9.

In the mechanism shown in Figs. 10 through 12, the slimes and fines decanted or flushed from the pockets **105** flow back into the pool **90** and are removed by the liquid overflow **88** while the washed sands are discharged through outlet **102** as aforesaid. Thus, the basic principles and functions of the arrangements shown in these figures are substantially the same as the basic principles and functions shown in the embodiments illustrated in Figs. 1 through 9.

From the foregoing it will be seen that the various embodiments illustrated in the drawings and described herein comprise several different forms of mechanisms for performing a process of separating slimes and fines from sands or coarser particles by using an "over-drain" principle for removing either decanted or flushed slimes and fines as separated from the sands and returned to the pulp pool without becoming re-entrained in quantities of pulp progresssively being removed from said pool while slimes and fines are being separated from the sands therein. Thus, once such slimes and fines are removed from sands being treated, they no longer interfere with or become entrained in other quantities of pulp while being treated by the apparatus. Further, the process includes a pocketing technique for progressively removing quantities of pulp up a generally inclined surface and while such quantities are being moved, settling of the sands to the lower portions of the quantities takes place while slimes and fines are decanted from above such settled sands but said sands nevertheless remain in a somewhat fluid condition due to the liquid therein being inhibited from escape until the desired quantities of slimes and fines have been decanted therefrom. Then the sands are drained of residual liquid prior to being discharged as relatively clean and drained sands. The process further contemplates increased efficiency in separating slimes and fines from the sands by using upwardly directed sprays to facilitate such separation and more effectively clean the sands as described hereinabove.

In the foregoing descriptions and appended claims, it is to be understood that the terms slimes, fines and sands are used in the descriptive sense rather than in the substantive sense for purposes of distinguishing between sizes of particles within a mixture thereof. Also, these terms may embrace not only mineral matter but also organic matter where vegetable and other similar organic matter, for example, is to be removed from mineral matter as in the separation of sands from small particles and otherwise of plant life.

While the invention has been shown and illustrated in its several preferred embodiments, and has included certain details, it should be understood that the invention is not to be limited to the precise details herein illustrated and described since the same may be carried out in other ways falling within the scope of the invention as claimed.

I claim:

1. A method of separating relatively fine particles from relatively coarse particles contained in a pool of pulp mixture of the same and comprising the steps of confining a submerged prescribed volume of said pulp within said pool, introducing into the lower portion of said volume replacement fluid while permitting coarser particles to settle and be retained in said lower portion thereof, discharging liquid and fine particles from the upper portion of said quantity, and preventing re-entrainment of discharged liquid and fines into the coarser material retained in said volume by shielding said retained material from contact by discharged fine particles.

2. A method of separating relatively fine particles from relatively coarse particles contained in a pool of pulp mixture of the same and comprising the steps of confining a submerged prescribed volume of said pulp within said pool, creating a pressure head in said volume, and permitting said head to effect discharge of liquid and fines from the upper portion of said volume while coarser particles settle to the lower portion of said volume, and preventing re-entrainment of discharged liquid and fines into the coarser material retained in said volume by shielding said retained material from contact by discharged fine particles.

3. A method of separating fines and sands contained in a pulp and comprising the steps of confining separated quantities of said pulp within spaces of prescribed volume, withdrawing successive confined quantities of said pulp from a pool thereof along an inclined path terminating above said pool, spraying said confined quantities from below to facilitate separation of fines from the sands therein, decanting fines and liquid from above a predetermined level in said quantities, below the top of each

space as moved along said path sufficiently to afford a desired amount of decanting of fines and liquid therefrom while inhibiting the escape of liquid from the portions of said quantities below said predetermined level therein, and thereafter draining residual liquid from the portions of said quantities below said decanting level thereof and directing said drained liquids and decanted fines and liquid back into said pool.

4. A method of classifying particles of different sizes comprising the steps of feeding a pulp of said particles into a pool, progressively withdrawing quantities of said pulp from said pool within compartments confining said quantities from above and at the sides and ends thereof and moving the same along a path inclined upward from said pool, whereby said compartments are disposed higher at the leading end than at the trailing end during movement along said path, permitting settling of coarser particles in said quantities of pulp within said compartments as moved along said path, and as said compartments and quantities therein are moved above the liquid level of said pool decanting fines from the trailing end portions of said quantities at a position approximately at the upper level of the settled coarser particles in said compartments back into said pool, the head of the liquid containing fines in the uppermost portion of said compartments inducing such decanting of the fines contained therein, and preventing re-entrainment of discharged material into the pulp material retained in said compartments by shielding the contents of such compartments from contact by said discharged material.

5. A classifier comprising in combination, a tank to contain a pool of liquid pulp of sands having slimes and fines intermixed therein, mechanism movable relative to said tank and including means operable within said tank to segregate within the pool a quantity of said pulp within a space of substantially fixed geometric form and retain said quantity in said form while moving the same above the level of said pool and permit sands to settle to the lower portion of said form, means operable to effect a tilting of said form when above said pool level to retain sands in the bottom of the same while decanting liquid and fines from the upper portion thereof, and drainage inhibiting means of predetermined length positioned relative to said tank to cooperate with said segregating means and operable to prevent drainage of liquid from said settled sands until the end of said inhibiting means is reached prior to discharging said sands.

6. A classifier comprising in combination, a tank arranged to contain a pool of liquid pulp of sands containing slimes and fines to be separated therefrom; and compartment forming means associated with said tank and comprising a member movable relative to said tank, a series of spaced vanes projecting from one surface of said member and movable thereby while the free edges of said vanes slidably engage an inclined path defined by a surface within said tank during operation, said path extending from below the liquid level of said pool to a sands outlet above said pool level, spaced walls extending upward from said path and held against movement longitudinally of said path and slidably engaged by the ends of said vanes while moved along said path; said movable member during its movement being spaced above said path and substantially parallel thereto and operable to move the free edges of said vanes in wiping relationship along the surface defining said path to engage quantities of said pulp below the liquid level thereof of said pool and slidably move said quantities up said path while confined in compartments defined by said walls, vanes, member and path defining surface, and said movable member also having at least one opening therein positioned below the uppermost portions of said compartments and between each blade and operable to permit slimes and fines to be decanted therethrough as the pulp in said compartments is moved above the liquid level of said pool, whereby said slimes and fines flow back into said pool while said compartment defining means shield the contents of oncoming compartments from entrainment therewith.

7. A classifier for separating particles of different sizes comprising in combination, a tank arranged to contain a pool of pulp of said particles, and pulp moving mechanism mounted for movement within said tank and comprising an endless belt, a series of spaced transverse blades projecting from one surface thereof, said belt being disposed relative to said tank so that one course thereof moves up an inclined path from below the pool level to a sands outlet above the pool level, and side plates extending along and slidably engaged by the edges of said belt while moving along said path and cooperating with said belt and blades to form a series of adjoining inverted pockets arranged and operable to engage quantities of said pulp and move said quantities along said inclined path, said belt also having a limited number of openings positioned therein adjacent one blade to permit decanting of fines from the upper portions of said inverted pockets back into said pool and said belt otherwise being substantially impervious and operable to shield the particles in said pockets to prevent fines decanted from preceding pockets from becoming entrained therein.

8. A classifier for separating particles of different sizes comprising in combination, a tank arranged to contain a pool of pulp of said particles, and pulp moving mechanism mounted for movement within said tank and comprising an endless belt, a series of spaced transverse blades projecting from one surface thereof, said belt being disposed relative to said tank so that one course thereof moves up an inclined path from below the pool level to a sands outlet above the pool level, side plates extending along and slidably engaged by the edges of said belt while moving along said path and cooperating with said belt and blades to form a series of adjoining inverted pockets arranged and operable to engage quantities of said pulp and move said quantities along said inclined path, and means cooperating with said side plates to hold them in yieldable engagement with the edges of said belt, said belt also having a limited number of openings positioned therein adjacent each blade to permit decanting of fines from the upper portion of said inverted pockets back into said pool and onto the upper surface of said course of said belt and said belt otherwise being substantially impervious and operable to shield the particles in said pockets to prevent fines decanted from preceding pockets from becoming entrained therein.

9. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles, and pulp moving mechanism mounted for movement within said tank and comprising an endless belt, a series of spaced transverse blades projecting from one surface thereof, said belt being disposed relative to said tank so that one course thereof moves up an inclined path from below the pool level to a sands outlet above the pool level, side plates substantially parallel to said path adjacent and slidably engaged by the edges of said belt while moving along said path and cooperating with said belt and blades to form a series of adjoining inverted pockets arranged and operable to engage quantities of said pulp and move said quantities along said inclined path, openings positioned in said belt adjacent each blade to permit decanting of fines from the upper portions of said pockets back into said pool and said belt otherwise being substantially impervious and operable to shield the particles in said pockets to prevent fines decanted from preceding pockets from becoming entrained therein, and the upper ends of said side plates terminating a distance above the liquid level of said pool to form a weir from which additional liquid and fines may be decanted from said quantities prior to their reaching said sands outlet.

10. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles, and pulp moving mecha-

nism mounted for movement within said tank and comprising an endless belt, a series of spaced transverse blades projecting from one surface thereof, said belt being disposed relative to said tank so that one course thereof moves up an inclined path from below the pool level to a sands outlet above the pool level, side plates extending along and slidably engaged by the edges of said belt while moving along said path and cooperating with said belt and blades to form a series of adjoining inverted pockets arranged and operable to engage quantities of said pulp and move said quantities along said inclined path, said belt also having openings positioned therein adjacent said blades to permit decanting of fines from the upper portions of said pockets back into said pool and said belt otherwise being substantially impervious and operable to shield the particles in said pockets to prevent fines decanted from preceding pockets from becoming entrained therein, and adjustable means supporting one end of said course of said belt, whereby said end may be adjusted in a vertical direction to vary the position thereof relative to the bottom of said tank and the inclination of said course.

11. A classifier comprising in combination, a tank arranged to receive a liquid pulp of sands containing slimes and fines to be separated therefrom, a disk rotatably disposed in a plane at an angle to the liquid level of said pool and a portion of said disk normally being disposed in said pool, spaced compartment forming means depending from said disk and operable successively to engage quantities of said pulp and elevate said quantities up an inclined path substantially parallel to said disk and extending from below the liquid level of said pool to a position above said liquid level, discharge ports within said disk communicating with the trailing portions of each of said compartments therein and operable to permit slimes and fines to be decanted from the upper portions of said compartments back into said pool while said compartments retain sands therein as moved up said inclined path to a sands discharge at the end of said path, said disk otherwise being impervious and operable to shield the contents of said compartments from slimes and fines discharged from foregoing compartments from becoming entrained therein.

12. A classifier comprising in combination, a tank arranged to receive a liquid pulp of sands containing slimes and fines to be separated therefrom, a disk rotatably disposed in a plane at an angle to the liquid level of said pool and a portion of said disk normally being disposed in said pool, spaced vanes depending from said disk and extending substantially radially relative to the axis of said disk, said vanes and disk defining compartments operable successively to engage quantities of said pulp and elevate said quantities up an inclined path from below the liquid level of said pool to a position above said liquid level, curved plates fixed relative to said tank and respectively cooperable with the opposite ends of said vanes to confine said quantities of pulp within said compartments during movement thereof, discharge ports within said disk and at least one thereof communicating with the trailing portions of each of said compartments and operable to permit slimes and fines to be decanted from the upper portions of said compartments back into said pool while said compartments retain sands therein as moved up said inclined path to a sands discharge at the end of said path, said disk otherwise being impervious and operable to shield the contents of said compartments from slimes and fines discharged from foregoing compartments from becoming entrained therein.

13. A classifier comprising in combination, a tank arranged to receive a liquid pulp of sands containing slimes and fines to be separated therefrom, a disk rotatably disposed in a plane at an angle to the liquid level of said pool and a portion of said disk normally being disposed in said pool, spaced compartment forming means depending from said disk and operable successively to engage quantities of said pulp and elevate said quantities up an inclined path from below the liquid level of said pool to a position above said liquid level, spray means operable to discharge wash water upwardly into said compartments as moved up said path to facilitate separation of fines from said sands in said compartments, discharge ports within said disk communicating with the trailing portions of each of said compartments therein and operable to permit slimes and fines to be discharged from the upper portions of said compartments back into said pool while said compartments retain sands therein as said compartments are moved up said inclined path to a sands discharge at the end of said path, said disk being otherwise impervious and operable to shield the contents of said compartments from slimes and fines discharged from foregoing compartment from becoming entrained therein.

14. A method of classifying particles of different sizes contained in a pool of pulp material and comprising the steps of confining a quantity of said pulp material within a space of prescribed volume, moving said confined quantity relative to said pool, and discharging from said space at a level below the top thereof a portion of said quantity containing fines and liquid during such movement and preventing re-entrainment of discharged material into the pulp material retained in said space by shielding the contents of said space from contact by the discharged material.

15. A method of classifying particles of different sizes contained in a pool of pulp material and comprising the steps of confining separated quantities of said pulp material within spaces of prescribed volume, moving said confined separated quantities in succession relative to said pool, and discharging from said spaces at a level below the tops thereof a portion of the quantities therein containing fines and liquid during such movement and preventing re-entrainment of discharged material into the pulp material retained in said spaces by shielding the contents of said spaces from contact by said discharged material.

16. A method of classifying particles of different sizes contained in a pool of pulp material and comprising the steps of confining a quantity of said pulp material within a space of prescribed volume, moving said confined quantity up an inclined path relative to said pool and while being moved discharging fine material and liquid in said space therefrom at a level below the top of said space under pressure created by such inclined movement of said quantity to separate said fine material from the coarser material particles therein and preventing re-entrainment of any discharged material into said coarser material retained in said space by shielding the contents of said space from contact by discharged fine material.

17. A method of classifying particles of different sizes of material comprising the steps of feeding a pulp of said material into a pool, confining separated quantities of said material within spaces of prescribed volume, progressively withdrawing said quantities of said material from said pool along a rising path, and as said quantities are moved above the liquid level of said pool discharging from said spaces fines and liquid from a level below the top of each space under pressure created by the inclined movement of said spaces to separate said fines from the coarser particles in said quantities and preventing re-entrainment of discharged material into the pulp material retained in said spaces by shielding the retained material in said spaces from contact with said discharged liquid and fines.

18. A method of classifying particles of material of different sizes contained in a pool of pulp thereof and comprising the steps of segregating from said pool a volume of said pulp of substantially fixed geometric form, retaining said particles and liquid in said form and elevating said volume above the level of said pool, tilting said volume to permit settling of the coarser mate-

rial in the bottom thereof and establish a hydraulic head in the upper portion thereof, decanting liquid and fine material from the upper portion of said volume at a level below the top thereof while preventing re-entrainment of decanted material into the coarser particles retained in said volume by shielding the retained material in said volume from contact by said decanted material.

19. A method of classifying particles of different sizes contained in a pool of pulp and comprising the steps of successively segregating from said pool volumes of said pulp of substantially fixed geometric forms, retaining said particles and liquid in said forms and progressively withdrawing the same from said pool, and when said volumes are above the liquid level of said pool tilting said forms to retain the coarser particles in the bottom of said volumes, and decanting the upper portions thereof back into said pool from a level below the uppermost part of said geometric forms and preventing reentrainment of any of said decanted material into the coarser material retained in said forms by shielding the contents of said spaces from contact by said decanted material.

20. A method of separating fines and sands contained in a pulp and comprising the steps of confining separated quantities of said pulp within spaces of prescribed volume, withdrawing said confined quantities of said pulp successively from a pool thereof along an inclined path terminating above said pool, decanting liquid and fines from a level below the top of each space as said quantities are moved above the level of said pool, inhibiting the escape of liquid from the portions of said quantities below said level in each space while moving said quantities for a predetermined distance along said path to afford a desired amount of decanting of fines and liquid therefrom, and thereafter draining residual liquid from the portions of said quantities below said decanting level thereof.

21. A method of classifying particles of different sizes in a pool containing a pulp mixture thereof and comprising the steps of confining separated quantities of said pulp within spaces of prescribed volume, successively removing said confined quantities of said pulp from said pool along a surface defining a path inclined upward from said pool while said quantities are in close slidable engagement with said surface to inhibit drainage of liquid from the portions of said quantities below a predetermined level therein below the top of each space, and as said quantities are moved above the surface of said pool permitting settling of coarser particles into the portions of said quantities below said level in each space and decanting fines and liquid from the portions of said quantities above said predetermined level in each space so as to separate the fines and liquid from said settled coarser particles and flowing said decanted fines and liquid back into the pool, preventing re-entrainment of any decanted material into the pulp material retained in said confined quantities by shielding succeeding quantities of pulp from said decanted fines and liquids, and finally draining from the coarser particles below said predetermined level in each space the residual liquid contained therein and returning said residual liquid to the pool without appreciable contact thereof with the contents of succeeding quantities moving up said path.

22. A method of classifying particles of different sizes comprising the steps of feeding a pulp of said particles into a pool, confining separated quantities of said pulp within spaces of prescribed volume, progressively withdrawing said successive quantities of pulp from said pool and moving the same along an inclined path, subjecting the pulp within said spaces to spray applied in a direction effectively to implement the separation of the fines from the coarser particles of said pulp therein, discharging the separated fines from said quantities from a level below the top of each space into the pool, and preventing re-entrainment of discharged material into the pulp material retained in said spaces by shielding the contents of said spaces from contact by said discharged material.

23. A method of classifying particles of different sizes comprising the steps of feeding a pulp of said particles into a pool, progressively withdrawing successive quantities of said pulp from said pool while confined within spaces of prescribed volume, moving the same along an inclined surface, subjecting the pulp within said pockets to wash spray injected into the bottoms of said spaces effectively to implement the separation of the fines from the coarser particles in the pulp within said spaces, and discharging upwardly from said spaces the fines therein from a level below the top of each space, and preventing re-entrainment of discharged material into the pulp material retained in said spaces by shielding the contents of said spaces from contact by said discharged material.

24. A classifier for separating particles of different sizes comprising in combination, a tank arranged to contain a pool of pulp of said particles, pulp engaging and moving mechanism operable within said tank and including a series of pulp confining compartments of predetermined volume arranged to engage and segregate successive quantities of pulp, and means operable to move said compartments upward along a generally inclined path extending from below the pool surface to a sands outlet above said pool surface, said compartments each having an opening therein substantially below the top of the compartment and operable to permit decanting of fines and liquid from the upper portions of said confined quantities through said opening therein and said compartments otherwise being impervious above the level in which said opening is disposed in each compartment except for incidental leakage, thereby shielding the confined pulp within said compartments from contact by fines and liquid discharged from preceding quantities.

25. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles, pulp moving mechanism embodying a series of pockets each having a space of prescribed volume and mounted for movement within said tank and constructed and arranged successively to engage quantities of said pulp and move said quantities progressively from below the pool level to a sands outlet above the pool level, and guide means for said mechanism inclined upwardly toward said sands outlet, said pockets having openings positioned substantially below the upper portions of said pockets during such movement to permit decanting of pulp from the upper portions of quantities in said pockets under pressure created by said inclined movement, said pockets otherwise being impervious above the level in which said opening is disposed in each pocket except for incidental leakage, whereby the confined pulp within said pockets is shielded from contact by fines and liquid discharged from preceding pockets.

26. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles, pulp moving mechanism mounted for movement within said tank and comprising means forming separated pockets each having a space of prescribed volume and constructed and arranged to engage quantities of said pulp and move said quantities progressively up a path from below the pool level to a sands outlet, and a spray positioned relative to said path so as to be operable to engage the quantities of pulp in said pockets to discharge replacement liquid into said pockets to flush fines from the coarser particles in said pulp confined within said pockets, said pockets each having at least one opening therein positioned below the uppermost portions of said pockets during such movement and operable to permit discharge therethrough of fines from the pulp quantities in said pockets under pressure created therein by said spray, said pockets otherwise being impervious above the level in which said opening is disposed in each pocket except for incidental leakage, whereby the confined pulp within said pockets is shielded from contact by fines and liquid discharged from preceding pockets.

27. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles, surface means within said tank defining a path inclined upwardly toward a sands outlet, pulp moving mechanism comprising means forming an endless series of pockets each defining a space of prescribed volume and mounted for movement within said tank and constructed and arranged successively to slide relative to said surface and to confine quantities of said pulp within said pockets and move said quantities progressively up said inclined path from below the pool level to said sands outlet above the pool level, means fixed relative to said tank and operable relative to said pockets while moving along said path to inhibit drainage of liquid from larger particles settled in the lower portion of said pockets, said pockets each having at least one opening disposed at a level substantially below the top of each pocket and operable to permit decanting of fines from above the larger settled particles in said pockets and under pressure created from said inclined movement of said pockets, said pockets otherwise being impervious above the level in which said opening is disposed in each pocket except for incidental leakage, whereby the confined pulp within said pockets is shielded from contact by fines and liquid discharged from preceding pockets, and means operable relative to said pockets to permit draining of residual liquid from said larger particles as said pockets approach said sands outlet.

28. A classifier comprising in combination, a tank arranged to receive a liquid pulp of sands having slimes and fines intermixed therein, mechanism movable within said tank and including a series of means operable to confine successive quantities of said pulp and guided to move said quantities along a rising path from below the liquid level in the tank to a sands outlet above said level while sands settle to the lower portion of each quantity, said means each having at least one opening therein at a level substantially below the top of the confined quantity therein and operable to permit the discharge of liquid and fines from the upper portion of said quantity therein as it is moved along said path and said means otherwise being impervious except for incidental leakage and operable to shield the pulp confined therein from re-entrainment of discharged material, and drainage inhibiting means fixed relative to said tank and cooperable with said confining means as the same move above the pool level a predetermined distance to prevent the draining of liquid from the settled sands in the lower portions of said confined quantities, said inhibiting means terminating a distance from said sands outlet to permit drainage from said settled sands prior to the same reaching the outlet therefor.

29. A classifier comprising in combination, a tank to receive a liquid pulp such as sands having slimes and fines intermixed therein, mechanism movable relative to said tank and including means constructed and operable to segregate successive quantites of said pulp within spaces of substantially fixed geometric form and retaining said quantities in said form while being moved along a path from below the liquid level in said tank while sands settle to the lower portion of each quantity, said segregating means being constructed to permit discharge of slimes and fines from a level above the bottoms of said geometric forms, means associated with said pulp moving means and arranged to inhibit escape of liquid from said lower portions of said quantities while being moved along said path, means operable to effect a tilting of said spaces to permit discharge of slimes and fines from the upper portions of said quantities therein while moving through a portion of said path, and spray means positioned to engage said quantities as said quantities move through said portion of said path and operable to flush fines and slimes from the sands in said quantities, said inhibiting means terminating a distance from the end of the path of movement of said quantities, whereby residual liquid within said lower portions of said quantities may drain therefrom.

30. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles, and pulp moving mechanism mounted for movement within said tank and comprising an endless belt having a series of pocket forming means constructed and arranged to segregate successive quantities of said pulp within spaces of prescribed volume and move said quantities progressively up an inclined path from below the pool level to a sands outlet above the pool level, said pockets being inverted while moving along said path, and a limited number of openings positioned in said belt adjacent each pocket forming means defining the trailing end of each pocket to permit decanting of fines from the upper portions of said pockets under pressure created by said inclined movement thereof back into said pool, said belt otherwise being impervious and operable to shield the particles in said pockets to prevent fines decanted from preceding pockets from becoming entrained therein.

31. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles, pulp moving mechanism mounted for movement within said tank and comprising an arrangement having a series of means to form adjoining pockets and said pockets being constructed and arranged while in inverted position relative to said tank to engage successive quantities of said pulp of substantially fixed geometric form and move said quantities progressively up an inclined path from below the pool level to a sands outlet above the pool level and the tops of said pockets being inclined and having openings positioned therein below the uppermost portions thereof and adjacent the trailing ends of the pockets to permit decanting of fines from the upper portions of said pockets back into said pool under pressure created by said inclined movement thereof, said means otherwise being impervious except for incidental leakage and operable to shield the particles in said pockets to prevent fines decanted from preceding pockets from becoming entrained therein.

32. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles and having an inclined surface therein, and mechanism associated with said tank and comprising means forming a successive series of adjacent compartments mounted for movement relative to said surface in said tank and constructed and arranged to engage successive quantities of said pulp and move said quantities progressively up said surface from below the pool level to a sands outlet above the pool level, each compartment having a top and sides depending therefrom and said top being inclined to the horizontal during such movement and having an opening therein spaced below the uppermost portion thereof and adjacent the trailing portion of each compartment only, whereby a head of pulp is formed in each compartment to permit sands therein to settle to the lower portion of the compartment and fines floating in the liquid in the upper portion of said compartment are induced by said head to flow through said opening back over oncoming compartments into said pool, the upper portions of the tops of said compartments being otherwise impervious to shield the contents of said compartments during such decanting from preceding compartments and prevent fines decanted from becoming entrained in said contents retained in said compartments.

33. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles and having an inclined surface therein, mechanism associated with said tank and comprising means forming a successive series of adjacent compartments mounted for movement relative to said surface in said tank and constructed and arranged to engage successive quantities of said pulp and move said quantities progressively up said surface from below

the pool level to a sands outlet above the pool level, said compartments having tops and sides depending therefrom and said tops being inclined during such movement and having openings therein spaced below the uppermost portions thereof and adjacent the trailing portion of each compartment only, whereby a head of pulp is contained in each compartment and during such movement thereof sands settle to the lower portion of each compartment and fines floating in the liquid in the upper portions of said compartments are induced by said head therein to flow through said openings back over oncoming compartments into said pool, the upper portions of the tops of said compartments being otherwise impervious to shield the contents thereof during such decanting from preceding compartments and prevent fines decanted therefrom from becoming entrained in said contents retained in said compartments, and spray means operable to discharge into the lower portions of said compartments as moved along said surface thereby to implement the separation and decanting of fines from the sands therein.

34. A classifier for separating particles of different sizes comprising in combination a tank arranged to contain a pool of pulp of said particles and having an inclined surface therein, and mechanism associated with said tank and comprising means forming a successive series of adjacent compartments mounted for movement relative to said surface in said tank and constructed and arranged to engage successive quantities of said pulp and move said quantities progressively up said surface from below the pool level to a sands outlet above the pool level, said compartments having tops and sides depending therefrom and said tops being inclined during such movement and

having openings therein spaced below the upermost portions thereof and adjacent the trailing portion of each compartment, said tops otherwise being substantially impervious, means cooperating with said compartments and operable to inhibit drainage of liquid from said compartments below the level of said openings during movement of the compartments along said surface, whereby a head of pulp is contained in each compartment during such movement and sands settle to the lower portion of each compartment and fines floating in the liquid in the upper portion of each compartment are induced by said head therein to decant through said openings back over oncoming compartments into said pool, the impervious upper portions of the tops of the said compartments being arranged to shield the contents retained in said compartments from becoming entrained with fines decanted from preceding compartments.

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