April 20, 1943. J. F. GEARY 2,316,783

COMPACTION SEPARATOR

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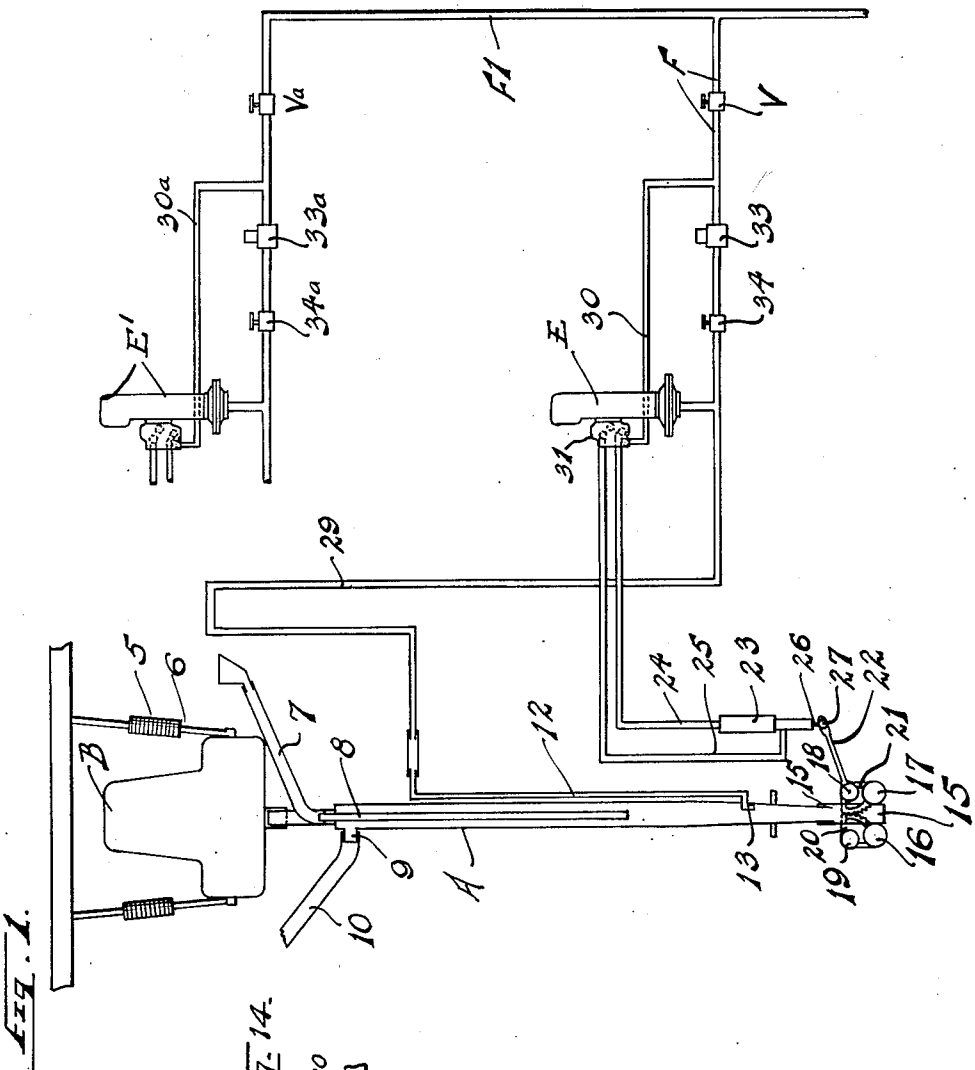
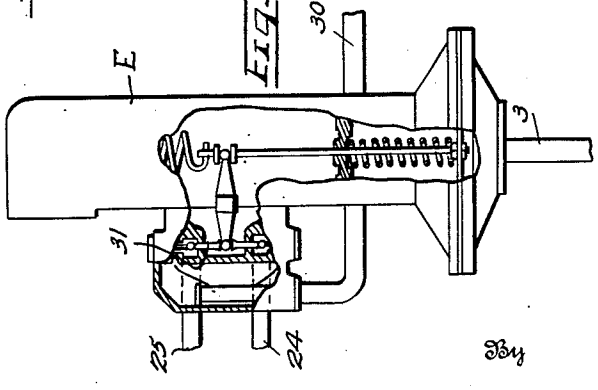


Fig. 1.

Fig. 14.



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COMPACTION SEPARATOR

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Fig. 2.

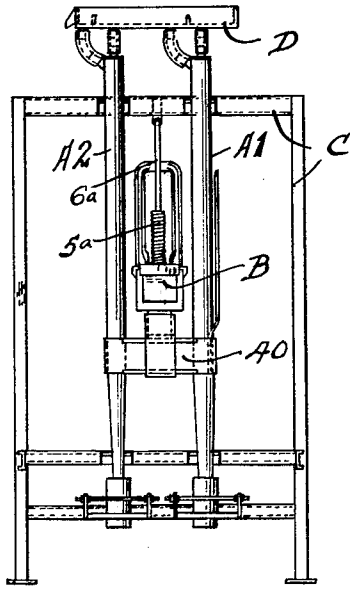


Fig. 3.

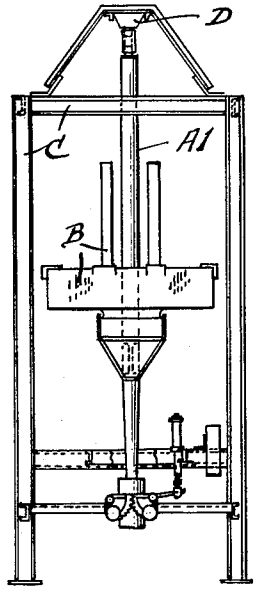


Fig. 5

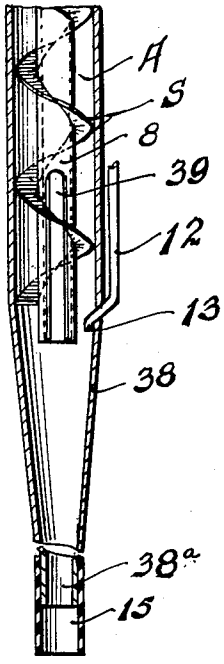
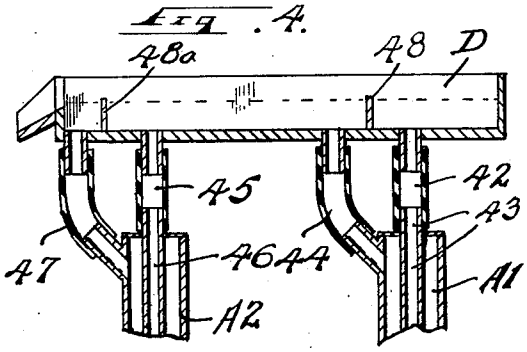


Fig. 4.



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COMPACTION SEPARATOR

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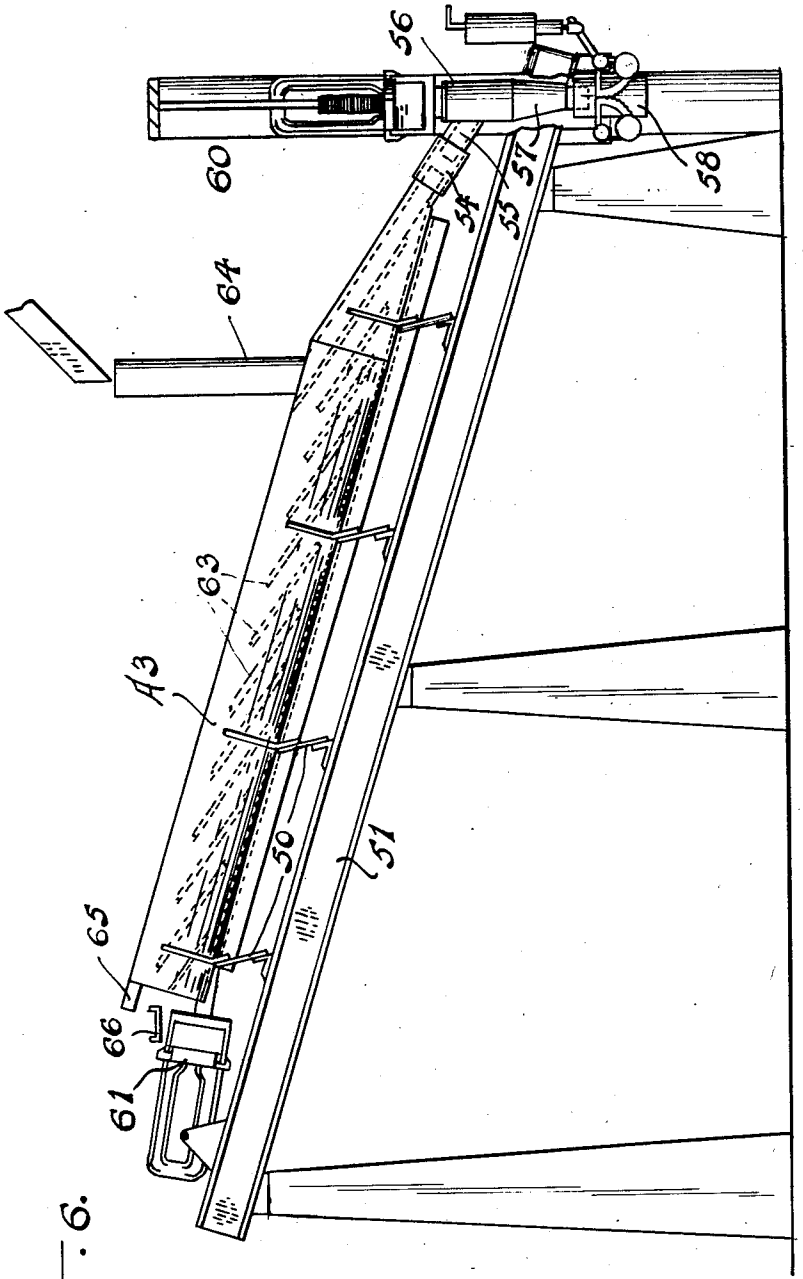


Fig. 6.

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COMPACTION SEPARATO R

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Fig. 7.

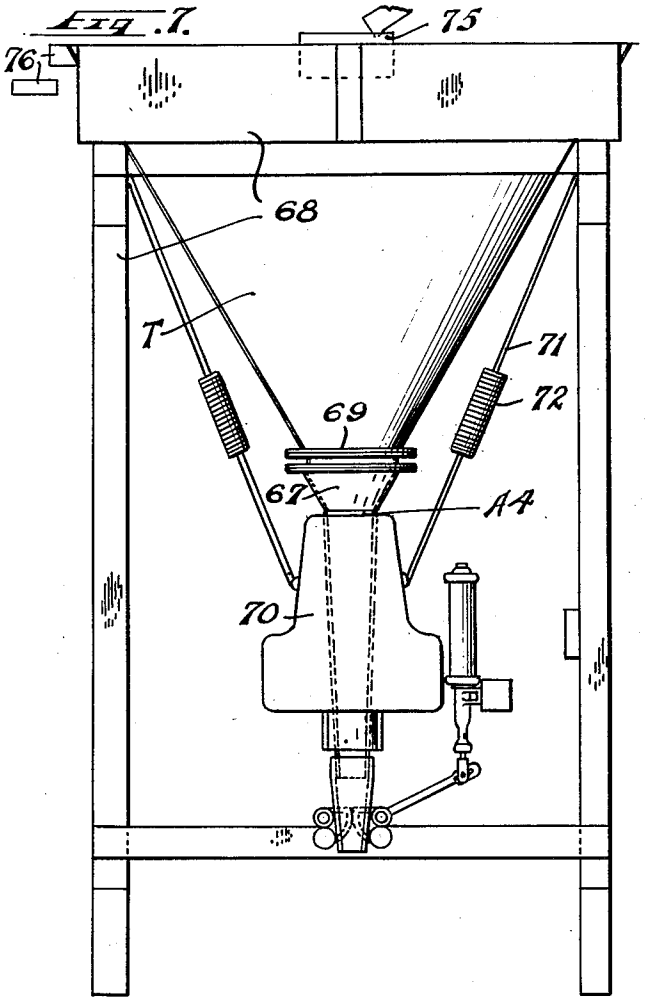


Fig. 8.

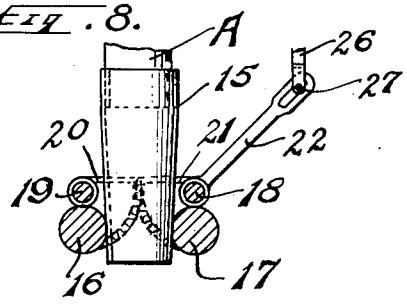
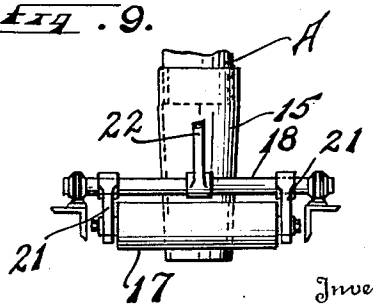


Fig. 9.



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COMPACTION SEPARATOR

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Fig. 10.

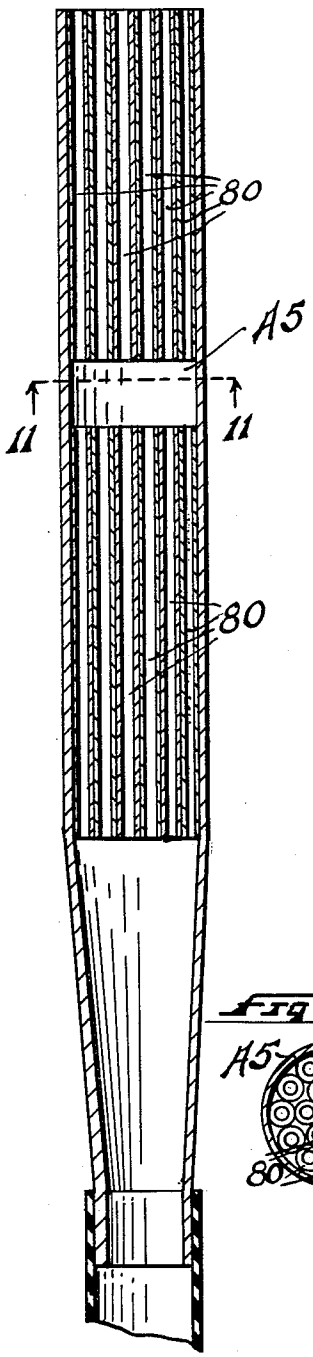


Fig. 11.

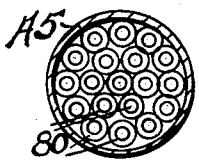


Fig. 13.

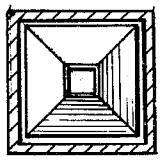
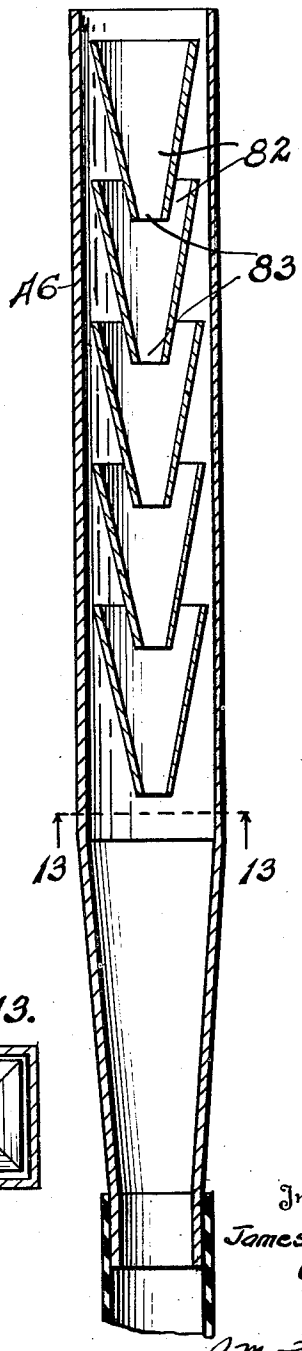


Fig. 12.



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UNITED STATES PATENT OFFICE

2,316,783

COMPACTION SEPARATOR

James F. Geary, Salt Lake City, Utah

Application August 14, 1939, Serial No. 290,048

2 Claims. (Cl. 210—57)

My invention relates to compaction separators for dehydrating, drying and de-watering devices, and its principal object is to provide a new and better method of, and apparatus for, separating solid particles from the liquids with which they are mixed. This process and apparatus is applicable to solid-liquid mixtures such as ore pulps, sugar pulps, paper pulps, etc.

A further object is to provide a new control device for compaction tubes which will automatically discharge the dried material from the bottom of the tube commensurately with the amount of dried materials accumulated therein.

A still further object is to provide a dehydrating tube preferably in vertical alignment but which may be mounted at any angle desired, and which may be used singly or in series.

A still further object is to provide a device for the treatment of solid-liquid mixtures which will be economical to install and use and highly efficient in its operation and which will produce a drier "cake" or solid product.

In many present day industrial processes such as ore dressing, beet sugar manufacturing, paper manufacturing, sewage disposal, etc., it is frequently necessary to separate the solids from the liquids with which they are mixed. As a general rule, particularly in ore dressing operations, this separation is effected in two different steps as is well known in the art, but with my process and apparatus this may be accomplished with the one device.

These objects I accomplish with the device illustrated in the accompanying drawings in which similar numerals and letters of reference indicate like parts throughout the several views and as described in the specification forming a part of this application and pointed out in the appended claims.

In the drawings in which I have shown my device:

Figure 1 is a diagrammatic view of the assembly of my device with the additional connection shown for use when multiple tubes are to be employed.

Figure 2 is a side elevation of a completed assembly where a continuous flow is to be utilized throughout co-acting tubes.

Figure 3 is an end view of Figure 2.

Figure 4 is an enlarged sectional view of the feed and discharge shown and used in Figures 2 and 3.

Figure 5 is a longitudinal diametrical section of the lower portion of one of the tubes, parts cut away.

Figure 6 is a side view of a tube mounted in a slanting position, showing the variation required when the tube is so mounted over that shown in Figures 1, 2, 3 and 4.

Figure 7 is a side elevation of a modified type of tube joined to and operating concentrically with a conical settling tank.

Figure 8 is an enlarged view showing the bars and their cooperative parts for controlling the flow of solid materials from the bottom of the tube.

Figure 9 is a side view of Figure 8.

Figure 10 is a vertical diammetrical section through a modified type of tube in which small individual tubes are set.

Figure 11 is a section on line 11—11 of Figure 10.

Figure 12 is a vertical section of another modified type of tube.

Figure 13 is a section on line 13—13 of Figure 12.

Figure 14 is a side view of a pressure controller.

In the drawings, in Figure 1, I have shown the compaction tube as A, with an electrical vibrator B of any good commercial type now on the market mounted therewith and suspended from a support by springs 5 and rods 6. The inlet for feeding materials into the tube A is through a feed pipe 7 into a concentrically mounted pipe 8 within the tube A. This pipe 8 extends down to a position below the longitudinal center of the tube A. The discharge from the tube A is shown from the top of the closed tube and consists of a discharge pipe 9 with a flexible hose 10 to carry off the discharge of clear fluid or liquids.

Mounted along one side of the tube A is an air control conduit 12, which conduit has its lower end passed through the side wall of the tube A into the interior thereof with the open end 13 of the conduit 12 facing downwardly so that the flow of the material in the tube A in its downward travel will pass around the end 13, but when sufficient solids have been collected or compacted, in the tube, pressure will be increased around and on the open end 13 of the conduit 12, thus retarding the flow of air therethrough.

Onto the bottom end of the tube A, where it is constricted to a smaller diameter, I connect a flexible hose 15 and which hose is controlled by co-acting pressure-applying bars 16 and 17. Shafts 18 and 19 are mounted along each side of the hose 15 and carry spaced-apart pairs of meshing rack members 20 and 21 on each end thereof, said members 20 and 21 being segments of gears meshed together and a lever

22 attached as an integral part of the shaft 18, actuates the two gear segments. When the lever 22 is pressed downwardly by an external force, which will be hereinafter described, the two bars 16 and 17 will be drawn together, applying pressure to the sides of the hose 15 and closing the end of the hose, preventing materials from passing therethrough.

The lever 22 is controlled by a double-acting piston mounted within a control cylinder 23 with an air line 24 leading into the top end of the cylinder and another line 25 leading into the bottom end of the cylinder so that air may be applied either above or below the piston in the cylinder to force it in either direction as desired. The lever 22 is connected with the piston by a rod 26, being connected to or within an elongated slot in the free end of the lever 22 by a pin 27.

The control for the bars 16 and 17 is provided by connecting the top end of the tube 12 with an inverted U-tube 29, which is connected by a pipe 3 to a variable pressure controller E of any of the well known variable pressure types in which the pressure of a fluid will shift a lever to change the direction of flow of fluid pressure from one line to another which, upon variation of pressure, will shift the flow of the air from one port to another.

An air line F is provided from an exterior source of air pressure and a shut off valve V is mounted therein to be used when required in shutting down the operation of the device. An air line 30 extends from the high-pressure side of the valve 33 into the valve chamber 31 of the controller and the two air lines 24 and 25, which lead into the two ends of the cylinder 23, are also connected with the valve chamber 31.

The air from the pipe F is passed through a pressure reducing valve 33, a needle valve 34, and into the bottom end of the controller E, also into the U-tube 29.

As shown in Figure 1, for multiple connections, the air pipe F may be extended as F1 into a like control E', having the pressure reducing valve 33*a*, needle valve 34*a*, and pipe 30*a*, identical with those shown in the lower portion of the view.

The extended pipes which are shown severed on the one end of the controller E' will naturally be connected to like parts of another compaction tube A in a manner similar to that shown, and as many multiples of tubes may be mounted onto one line as desired or required, for the particular use to which the apparatus and process is being applied.

It will be obvious that any fluid may be used instead of air and accomplish the same result.

Figure 5, which is a partial sectional view of a modified tube A, shows the lower end of the tube as tapered at 38, with the inner tube 8 being provided with side discharge slots 39 along the sides near the lower end thereof. The lower end of the tube A is formed cylindrical at 38*a* and the rubber tube 15 is carried around this cylindrical portion 38*a*. It will be obvious that the length of the lower end of the tube must be sufficient to permit proper compaction of the materials below the end of the tube 8.

In some instances and in some cases, the tube 8 will be provided with a spiral flight or screw S formed therearound to act as a continuous baffle, thus aiding in reducing the solid content in material discharged from the tube.

Figures 2, 3 and 4 show a multiple of two tubes A1 and A2, mounted in a framework C and actuated by the central vibrator B, mounted between them and suspended by cables 6*a* and springs 5*a*. A cross member 40 connects the two tubes and the vibrator to impart the motion to the two tubes.

Dual controls are naturally provided for the discharge end of the tubes and they are identical to those shown in the other views.

Each will be operated independently, as the time for compaction in the first tube may be less than that required in the second tube.

Over the top end of each tube there is a feed launder D, shown more clearly in Figure 4, and the material is fed into one end of this launder where it passes through the flexible tube 42 into the central tube 43 of the tube A1. The discharge of liquids from this tube is through the flexible tube 44 up into the launder D on the inside of a vertical dividing partition 48. This material passes then down through the tube 45 into the central tube 46 of the tube A2 and the discharge from this last tube is up through the flexible tube 47 into the end chamber of the launder and out through the overflow. The liquid material from the tube A1 is separated from the liquid from the tube A2 by the partition 48*a* and the tops of the two partitions in the launder are on a level slightly above the level of the overflow but both partitions are below the level of the side walls of the launder.

Figure 6 shows a modified form of the compaction tube A3 set on an angle and supported by yielding members shown as springs 50, which springs are supported from a slanting platform or framework 51. The lower end of the tube A3 is tapered and is connected with a flexible tube 54. This tube 54 is attached to an angle feed tube 55 on one side of a vertical compaction tube 56. The tube 56 is closed at the top and is a short form of the tube A of Figure 1. The lower end of the tube 56 is tapered at 57 with the end carrying a flexible closure tube 58. This tube is controlled in a manner identical to the other showings and further description thereof is not thought necessary. The same controls and air force being utilized as that shown in Figures 1 to 5 inclusive.

A vibrator 60 is attached to the top of the tube 56 to vibrate it in a manner similar to that shown in the other figures and an augmenting vibrator 61 is mounted on the framework 51 and is attached to the top end of the slanting tube A3. The two different motions are transmitted to this dual tube device.

The interior of the tube A3 is filled with slanting vanes or baffles shown by dotted lines 63 to aid in the settling of the solids in the tube A3.

A feed tube 64 is introduced into the top side of the lower end of the tube A3 to feed materials into the device and the top end of this tube must be above the liquid discharge level of the tube A3.

A discharge 65 permits the liquids to flow from the upper end of the tube A3 into a launder 66.

Figure 7 shows a very important modification of my tube attached to a conical settling tank T which tank is supported on a framework 68, and mounted above the compaction tube A4.

The vertical tube A4 is attached to the bottom end of the tank T by conical head 67 attached to a flexible connection 69 and vibrators 70 are

provided, supported from the framework 68 by cables 71 and springs 72.

These vibrators are attached to the vertical tube A4 to impart the necessary motion thereto. The lower end of the tube A4 is controlled in a manner identical with the other showings in this application and no mention need therefore be made of this control.

The material is fed into a central tube 75 in the top end of the conical tank T and the liquid discharge is from a launder 76 at one side of the tank T.

The conical chamber or tank T is for settling and thickening in one chamber from which the settled or thickened pulp then passes to the vibrator tube A4 where the final compaction takes place. This is also true of the tube A3 shown in Figure 6 as the first settling takes place in the tube A3 and the final compaction is in the tube 56. This type of double chamber makes it possible to more quickly settle out the solids and compact them in the compaction tube while the liquids more readily pass out of the top tube. The multiplicity of vanes 63 in Figure 6 provides greater surface for transmitting the vibrations to the entire mass being in closer contact with the solids lessening their distance from suspension surfaces and causing the liquids to pass out more readily and the solids to compact more quickly.

It will be possible to use this combination of a single conical settling tank where the material is settled and thickened in one chamber and a compaction where the compaction takes place in another chamber.

In Figures 10 and 11 I have shown a modification of my device in which a multiplicity of small tubes 80 are set in a large tube A5. These small tubes are for the purpose of making it posible to more quickly compact certain solid materials which tend to compact into a springy, jelly-like mass rather than into a firm mass of granular particles. The multiplicity of tubes lessens the distance from a solid particle to a vibrating surface or from any given vibrating wall to the center of the solid mass, causing the vibration to be more directly applied and the solids to settle more quickly.

Figures 12 and 13 show another modification to the tube for the same purpose but in this showing the large tube A6 is shown provided with spaced apart small frusto-pyramidical tubes 82 mounted therein, each tube nested in relation to each other but spaced apart sufficient distance to cause the compaction of solids to occur at the narrow or apex end 83 of each tube 82 while the liquids may freely follow along the outside walls of the small tubes 82 thereby making quicker separation of the liquids from the solids.

This also provides a multiplicity of surfaces as do the types of devices shown in Figures 6 and 10. In each of these showings the multiplicity of surfaces used causes the pulp to break down more quickly by imparting the vibrations to them as more directly, that is, through a shorter distance, and providing greater vibrating area for the solids and liquids to contact.

The operation of my process and apparatus is as follows:

The material being treated is fed into the tube A through the feed pipe 7, passing down through the center pipe 8 into the lower portion of the tube A. The vibrations of the vibrator B cause the solids to settle into the lower portion of the tube A and the liquids so separated pass out through the top portion of the tube A through the tube 10. As the solids are compacted into the tube A they will build up around the end of the conduit opening 13, of the air conduit 12. Air or any suitable fluid is passed from the line F through the pressure reducing valve 33 and the needle valve 34 into the inverted U-tube 29 and into the conduit 12, passing out of the bottom end of the conduit 12 into the tube A. As the solids are compacted in the tube A this air meets more resistance as more solids are compacted until a predetermined force is required to force air through the conduit 12 into the tube A at which time the pressure controller B will be actuated by this increased pressure and the air from the line 30 will pass through the line 25 causing the piston in the cylinder 23 to move to its top end position which motion will be transmitted to the rod 26 and thence to the lever 22. This movement of the lever 22 will cause the two pressure applying bars 16 and 17 to be moved away from each other, opening the rubber hose 15, permitting solids to pass from the tube A until the pressure around the end 13 of the conduit 12 is decreased sufficiently to allow a freer passage of air therethrough, at which time the pressure controller B will again be actuated which will reverse the air in the valve chamber 31 causing air to pass through the line 24 moving the piston in the opposite direction, thereby reversing the action on the lever 22 and causing the rolls 16 and 17 to be moved together closing off the discharge from the tube A. This action will continue in alternating periods throughout the run of material through the tube A.

In the event that one separator will not collect all of the solids, those remaining in the liquid pasing off through the tube 10 may be passed through another like tube or a system such as shown in Figures 2 to 4, inclusive, may be employed and as many vertical tubes may be employed as desired or required for the given results.

Having thus described my invention, I desire to secure by Letters Patent and claim:

1. A device of the class described for separating liquids from solids comprising a compaction tube, a vibrator attached to said tube to vibrate the tube and contents, a feed pipe leading down into said compaction tube to introduce material therein, a flexible member on the bottom end of said compaction tube, valve means to control the flow of material through said flexible member, an air conduit leading into said compaction tube, with the end thereof near the lower end of said compaction tube, means to introduce air through said conduit into said compaction tube, fluid pressure means to actuate said valve, means operated by the air in said conduit as pressure therein varies to control the flow of fluid to said fluid pressure means, the pressure of the air in said conduit varying with the resistance offered by the solids in said compaction tube to the flow of air through said conduit into said tube.

2. A device as set out in claim 1 including means to mount a plurality of tubes in series with the discharge from one feeding into the inlet of the next tube.

JAMES F. GEARY.