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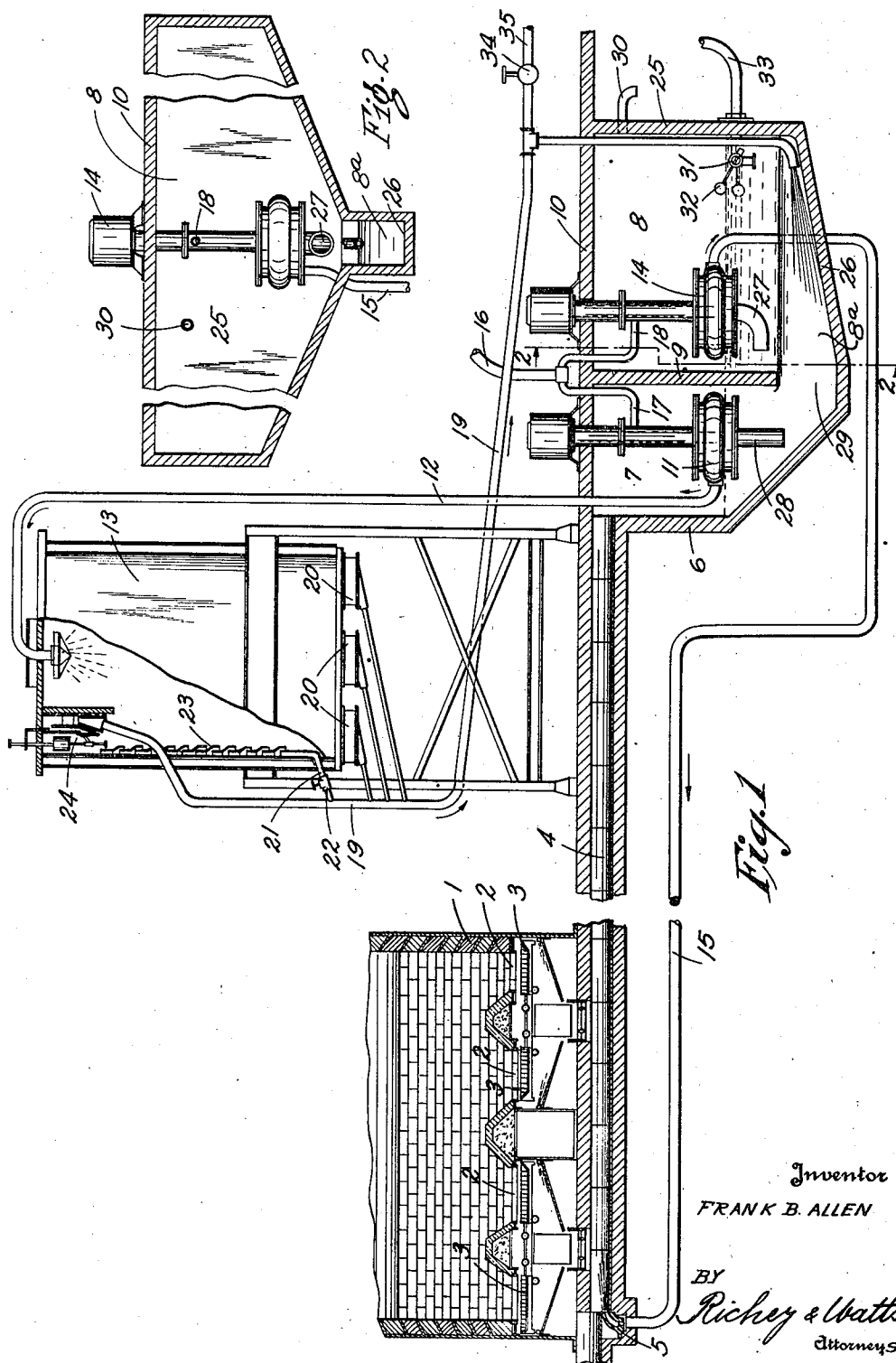
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1,990,446

APPARATUS FOR SEPARATING LIQUIDS FROM SOLIDS

Filed Oct. 17, 1931

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

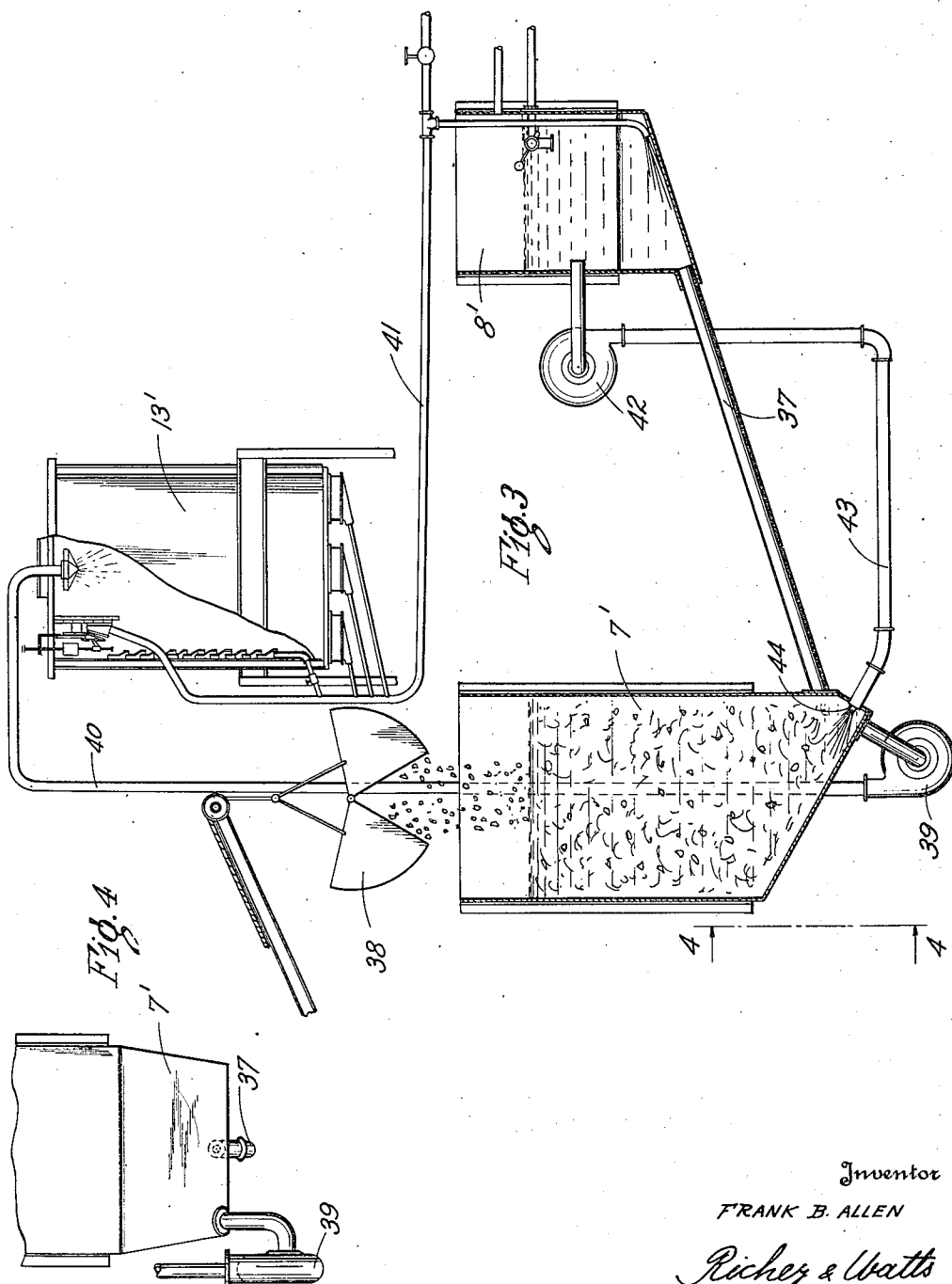


Fig. 4

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1,990,446

APPARATUS FOR SEPARATING LIQUIDS
FROM SOLIDS

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Application October 17, 1931, Serial No. 569,494

8 Claims. (Cl. 302—14)

This invention relates to an improved apparatus for handling mixtures of liquid and solid material, and more particularly to a method of and apparatus for handling the products of combustion from boiler furnaces and the like.

Among the objects of my invention are: the provision of a handling system for mixtures of liquids and solids in which the liquid may be continuously circulated through the system and used over and over again without unnecessary waste; the provision of ash handling equipment with which ashes from boiler furnaces and the like may be carried to a place of disposal in a hydraulic conveyor system and then practically completely separated from water used in the conveyor so that the water may again be circulated through the jets and pipes of the conveyor system without harmful wear thereon; the provision of a method for handling mixtures of liquids and solids which requires a minimum of power and which is particularly economical of water; the provision of a liquid conveyor ash handling system in which the pumps are in a large measure protected from the abrasive action of the ash.

The above and other objects of my invention will appear from the following description of my improved method and a preferred form of apparatus adapted to carry out the method, reference being had to the accompanying drawings, in which—

Fig. 1 is a vertical section through the bottom of a boiler furnace and my improved apparatus for handling the ashes discharged therefrom.

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

Fig. 3 illustrates a modified form of my material handling apparatus.

Fig. 4 is a view taken on line 4—4 of Fig. 3.

The furnace bottom 1 may be of any type. The particular form illustrated has a plurality of bottom discharge openings 2 which are adapted to be closed by gates 3. When these gates 3 are opened the ashes, which have collected within the furnace bottom 1, will be fed into the hydraulic conveyor conduit 4. The nozzle 5, disposed at one end of the conduit 4, is adapted to discharge water into the conduit 4 under pressure in the direction indicated. This flow of water will carry the ashes discharged into the conduit from the furnace along until the mixture of water and ash is discharged into the collecting tank 6.

The tank 6 is divided into two compartments 7 and 8 by the baffle wall 9 which extends downwardly from the cover 10 of the tank. The bottom of the compartment 8 is formed with a sloping trough 8a having its greatest depth adjacent the wall 9. This trough opens into the compartment 7 and provides a communicating passage between the compartments 7 and 8, for reasons which will be explained later.

A vertical centrifugal pump 11 is disposed with-

in the compartment 7 and is adapted to pick up the mixture of water and ashes which is discharged into the compartment 7 through the conduit 4 and force it upwardly through the pipe 12 into the separating tank 13.

A second vertical type centrifugal pump 14 is disposed within the compartment 8. This pump has its inlet opening 27 just above the top of the trough portion 8a and takes the relatively clean water which enters the compartment 8 and pumps it back through the pipe 15 and the jet 5 into the hydraulic conveyor conduit 4. Both of the pumps 11 and 14 are preferably of the general type disclosed in my co-pending United States patent application, Serial No. 368,289, filed June 14, 1929. In this type of pump the clearance spaces between the impeller and the casing are positively flushed with clear flushing water. This clear flushing water may be supplied to the pumps 11 and 14 from any suitable source through the pipe 16. As seen in the drawings the pipe 16 is divided into two branches, one branch 17 leading to the pump 11, and the other branch 18 leading to the pump 14.

The main discharge pipe 19 from the separating tank 13 is adapted to continuously carry away the clear overflow water from the tank 13, the leakage water which escapes around the bottom gates 20 of the tank 13, and the water which is discharged through the pipe 21 when the valve 22 is open to completely drain the tank 13 through the louvre system indicated at 23.

The overflow control mechanism generally indicated at 24 is adapted to prevent the discharge of the floating solid materials with the overflow water and the louvre system 23 prevents the discharge of ash into the pipe 19 when the tank is being completely emptied of water prior to the opening of the gates 20 and the removal of the ashes collected in the tank.

The pipe 19 extends downwardly into the tank 6 adjacent the wall 25 thereof and is bent at its lower end so that its discharge is directed along the sloping bottom wall of the trough 8a. The intake pipe 27 of the pump 14 is preferably located so that any water discharged from pipe 19 must reverse direction to enter it, while the intake pipe 28 of the pump 11 preferably is positioned so that water flowing from compartment 8 to compartment 7 need not abruptly change direction as it enters pipe 28.

To insure continuous operation of my system I have provided a float controlled make-up water valve 31. Any suitable type of valve may be used and the control float 32 is adjusted so that the valve will be opened when the water level in compartment 8 of the tank 6 falls to a point just above the top of the intake opening of the pump 14. When this occurs make-up water from the supply line 33 will be discharged into the com-

partment 8 until the water level rises to a predetermined amount and the float 32 closes the valve 31. An overflow connection 30 is provided preferably at an elevation somewhat below the bottom of the conduit 4.

It should be noted that the cubic capacity of the tank 6 between the level of the overflow 30 and the pump inlet 27 of pump 14 should preferably be substantially as great or greater than the cubic capacity of the tank 13 when filled to the overflow level. This provision is made so that after tank 6 has been filled initially the pumps may be started and tank 13 can be filled to its overflow level without the addition of any make-up water to the system. As soon as tank 13 begins to overflow water will return to tank 6 as rapidly as taken therefrom and the system will not be flooded. Thus, by making the tank 6 large enough to hold all of the water which is normally used in my recirculating system, the necessity of adding make-up water each time the system is started is eliminated. A branch discharge conduit 35 is provided with a control valve 34. If corrosives become too highly concentrated in the circulating solution valve 34 may be opened diverting a certain amount of the fluid as required. As this liquid is drawn off valve 32 will open and fresh clean water will make up the amount withdrawn and the system will be maintained in proper balance.

Assuming that the pumps 11 and 14 are operating and that ash is being discharged into the conduit 4 from the furnace bottom 1, the operation of my apparatus is as follows:

The mixture of water and ash is carried along through the conduit 4 and discharged into the compartment 7 of the tank 6. This mixture is picked up through the inlet pipe 28 of the pump 7 and is pumped up through the pipe 12 and discharged into the top of the separating tank 13. The tank 13 separates the solid materials from the water and relatively clean water is discharged therefrom by gravity flow through the pipe 19. As the bottom opening of the pipe 19 is directed along the bottom wall 26 of the trough 8a, clean water will be directed along this bottom wall and its force, in the direction of the opening 29, between the compartments 7 and 8, will tend to prevent the mixture of water and ash, which enters the compartment 7, from passing through the opening 29 into the compartment 8. The pump 14, will, therefore, be working in the compartment 8, which is filled with relatively clean water and will take the clean water which flows into the compartment 8 by gravity from the separating tank 13, and pump it back through the pipe 15 and the nozzle 5 into the conduit 4 where it again picks up the ash discharged through the furnace bottom and carries it along into the compartment 7.

Pump 11 preferably discharges more than pump 14. Thus, water continuously goes to tank 13 and (after it is filled to overflow) returns to compartment 8 then is taken from compartment 8 by pump 14. It is thus evident that as compartments 8 and 7 intercommunicate there will be a continuous flow of water from compartment 8 to compartment 7 through the opening 29. Any fine material carried back from the overflow of tank 13 is continuously urged by gravity and the sloping bottom wall 26 and by the above described current through the opening 29, to re-enter the pump 11 and go to the separating tank 13 and not to re-enter pump 14 and thus continue to recirculate.

It will be seen from the above description that a continuous circulation of the water used in my ash handling system is obtained as the water flows through the conduit 4 into the compartment 7, from the compartment 7 up into the separating tank 13 where it is separated from the ashes which it has picked up in the conduit 4. From the tank 13 the water then passes down through the pipe 19 into the clear water compartment 8 of the tank 6, where part of it is picked up by the pump 14 and again forced back through the nozzle 5 into the conveyor conduit 4, the balance passing through the opening 29 into compartment 7 again. The clean auxiliary flushing water which is supplied to the pumps 11 and 14 through the pipe 16 enters the main mass of circulating water and serves to make up any losses which may occur from any leakage, evaporation, and the water carried away with the ashes discharged from the separating tank 13. An overflow outlet 30 is provided for the collecting tank 6 so that, if the water added through the pipe 16 be more than enough to make up the leakage losses, or if for any other reason the water level rises too high in the tank 6, the extra water will pass out through the overflow 30 and will not back up into the conduit 4.

It will be understood that the capacities of pumps 11 and 14 may be made such that the system will operate in the most efficient manner. For example, if the flow through the conduit 4 consists of 150 gallons per minute of ashes and 1000 gallons per minute of water, and 50 gallons per minute of clear flushing water enters the system through the pipe 16, I would provide the pump 11 with a capacity of 1300 gallons per minute. Thus 1300 gallons per minute of water and ashes would be discharged into the tank 13. Of this 1300 gallons approximately 150 gallons are ashes discharged into the compartment 7 from the conduit 4.

Thus, there will be an average flow of approximately 1150 gallons per minute of relatively clean water back into the compartment 8 through the pipe 19. The pump 14 will be designed to have a capacity of 1000 gallons per minute to supply the necessary flow of water to the conduit 4 through the jet 5. This leaves a surplus of 150 gallons per minute entering the compartment 8 over that which is pumped out by the pump 14. This 150 gallons per minute of relatively clean water will pass through the opening 29 beneath the wall 9 into the compartment 7 and will be picked up by the pump 11 along with the 1150 gallons per minute of water and ashes which are discharged into the compartment 7 from the conduit 4.

It will be understood that the above illustration of the operation of my apparatus would be adapted for a particular set of operating conditions and that in practical use the apparatus would be designed and adjusted to accommodate the particular quantities of ash and water being handled.

In Figs. 3 and 4 I have illustrated a modified form of apparatus in which the compartments 7 and 8 are made in the form of separate tanks 7' and 8'. These tanks are connected by a pipe 37 which corresponds to the opening 29 in the apparatus of Fig. 1. The tank 13' may be of the same type as tank 13 and serves to separate the solid from the liquid material.

In operation of the apparatus shown in Figs. 3 and 4 the ash or other solid material is dumped into the tank 7' from the bucket 38. Any other means may, of course, be used to convey the

solid material to the tank 7' but it may be pointed out that the apparatus of Figs. 3 and 4 is particularly adapted to handle solid material such as furnace ash, which is removed from the furnace in a dry state rather than by a fluid conveyor such as is shown at 4 in the apparatus of Fig. 1. The tank 7' is normally filled with water and the pump 39 is adapted to pump the mixture of water and solid material through the pipe 40 into the separating tank 13'. This tank separates the solid material from the liquid and the liquid overflow passes through the pipe 41 to the tank 8'. The lower end of the pipe 41 is curved in the same manner as that of pipe 19 and is adapted to direct the relatively clean water down through the pipe 37 into the tank 7'. The pump 42 takes water from the tank 8' and forces it through the pipe 43 and the nozzle 44 into the lower part of the tank 7'. The nozzle 44 is so directed that the water pumped by the pump 42 will act to agitate the mixture in the tank 7' so that it may be readily pumped into the tank 13' by the pump 39. The theory of operation of the system shown in Figs. 3 and 4 is the same as that shown in Figs. 1 and 2, the main distinction being that the pump 42 of Fig. 3, which corresponds to the pump 14 of Fig. 1, pumps the clean water from tank 8' into the tank 7' as an agitating agent rather than pumping it through the fluid conveyor, as is done by the pump 14 in the apparatus of Fig. 1.

Although I have illustrated and described in some detail one embodiment of my invention, it will be understood by those skilled in the art that modifications and variations thereof may be made without departing from the spirit of my invention. I do not, therefore, limit myself to the exact form shown and described, but claim as my invention all embodiments thereof coming within the scope of the appended claims.

I claim:

1. In an ash handling system, a collecting tank having a baffle wall adapted to divide said tank into a mixture compartment and a clear water compartment, said wall having an opening adjacent the bottom of said tank, hydraulic conveyor means for conveying a mixture of water and ashes into said mixture compartment, a separating tank, means for pumping said mixture from said mixture compartment into said separating tank, a clear water pipe from said separating tank to said clear water compartment, the discharge end of said pipe being directed to create a flow of clear water through said opening, and means for pumping clear water from said clear water compartment to said hydraulic conveyor.

2. In a material handling system, the combination of a collecting tank having a baffle wall adapted to divide said tank into a mixture compartment and a clear water compartment, said wall having an opening adjacent the bottom of said tank, hydraulic means for mixing water and solid materials, a separating tank, means for pumping said mixture from said mixture compartment into said separating tank, a clear water pipe from said separating tank to said clear water compartment, the discharge end of said pipe being directed to create a flow of clear water through said opening, means for pumping clear water from said clear water compartment to said hydraulic conveyor, and means for supplying make-up water to the system.

3. In a material handling system, a collecting tank having a baffle wall adapted to divide said tank into a mixture compartment and a clear

water compartment, said wall having an opening adjacent the bottom of said tank, hydraulic conveyor means for conveying a mixture of water and solid materials into said mixture compartment, a separating tank, means for pumping said mixture from said mixture compartment into said separating tank, a clear water pipe from said separating tank to said clear water compartment and means for pumping clear water from said clear water compartment to said hydraulic conveyor, the relative capacity of said pumping means being such as to create a flow of clear water through said opening from said clear water compartment into said mixture compartment.

4. In a material handling system, a collecting tank having a baffle wall adapted to divide said tank into a mixture compartment and a clear water compartment, said wall having an opening adjacent the bottom of said tank, hydraulic conveyor means for conveying a mixture of water and solid materials into said mixture compartment, a separating tank, means for pumping said mixture from said mixture compartment into said separating tank, a clear water pipe from said separating tank to said clear water compartment and means for pumping water from said clear water compartment to said hydraulic conveyor, the capacity of said mixture pumping means being greater than that of said clear water pumping means.

5. In a material handling system, the combination of a mixture tank, a clear water tank, a conduit connecting said tanks, means for moving solid material into said mixture tank, means for mixing said solid materials with water in said mixing tank, a separating tank, means for pumping the mixture of water and solid materials from said mixture tank to said separating tank, means for returning clear water from said separating tank to said clear water tank, pumping means of less capacity than said mixture pumping means adapted to pump clear water from said clear water tank at high velocity into said mixture tank, said separating tank being of such capacity that it will return water to said clear water tank before the level of water therein has been reduced so that said clear water pumping means can no longer pump.

6. In a material handling system of the type described, the combination of walls defining a compartment for mixtures of liquids and solids, a separating tank, means for conveying a mixture of liquids and solids from said mixture compartment to said separating tank, walls defining a compartment for clear liquid, means for conveying clear liquid from said separating tank to said clear liquid compartment, fluid conducting connections between said clear liquid compartment and said mixture compartment whereby clear liquid may flow to said mixture compartment and means for discharging solid materials into said mixture compartment, said means for conveying clear liquid from the separating tank to the clear liquid compartment including a conduit having an outlet adapted to direct the clear liquid into the fluid conducting connections between the clear liquid compartment and the mixture compartment whereby clear liquid will flow through said fluid conducting connections into said mixture compartment.

7. In a material handling system, the combination of walls defining a compartment for mixtures of liquids and solids, a separating tank, means for conveying a mixture of liquids and solids from said mixture compartment to said

separating tank, walls defining a compartment for relatively clear liquid, means for conveying clear liquid from said separating tank to said clear liquid compartment, fluid conducting connections between said clear liquid compartment and said mixture compartment whereby clear liquid may flow into said mixture compartment, means including a fluid outlet directed into said fluid conducting connections for positively maintaining such a flow of clear liquid into said mixture compartment, and means for discharging solid materials into said mixture compartment.

8. In a material handling system, the combination of a mixture tank, a clear water tank, a conduit connecting said tanks, means for moving

solid material into said mixture tank, a separating tank, means for pumping a mixture of water and solid materials from said mixture tank to said separating tank, means for returning clear water from said separating tank to said clear water tank, pumping means of less capacity than said mixture pumping means adapted to pump clear water from said clear water tank at high velocity into said mixture tank, said separating tank being of such capacity that it will return water to said clear water tank before the level of water therein has been reduced so that said clear water pumping means can no longer pump.

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