Dec. 26, 1961 R. H. FRYKHULT 3,014,589

APPARATUS FOR DEWATERING SUSPENSIONS, SUCH AS FIBROUS PULP SUSPENSIONS

Filed May 23, 1958 2 Sheets-Sheet 1

FIG1

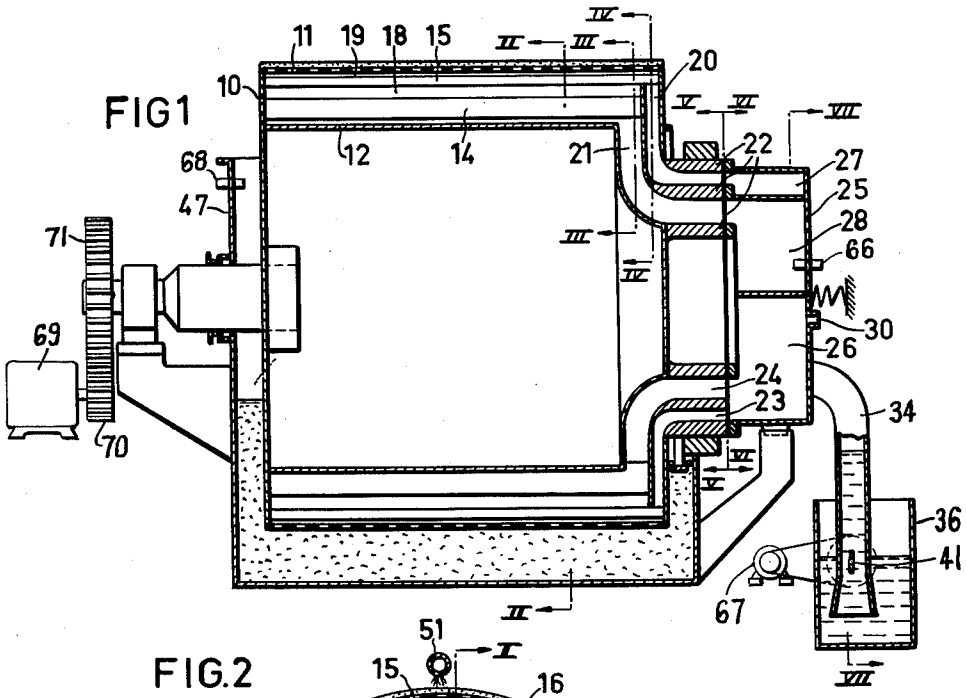
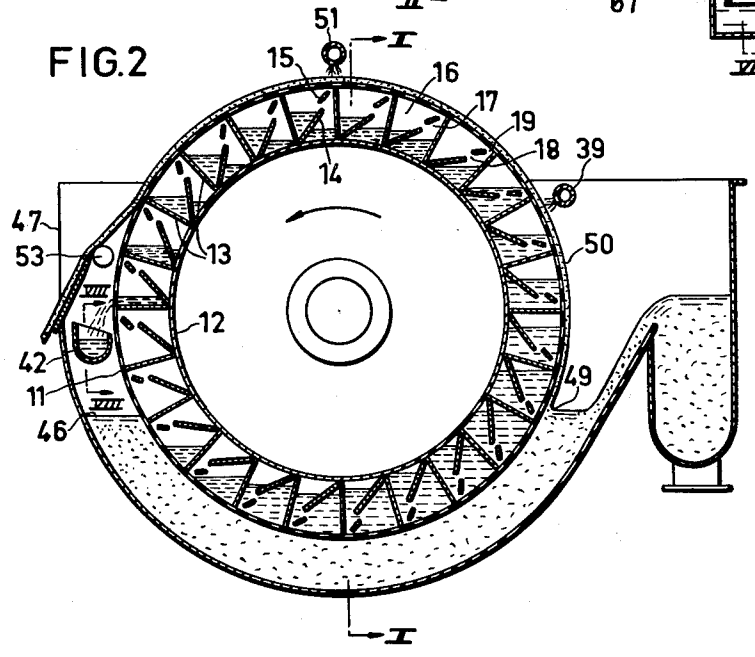


FIG.2



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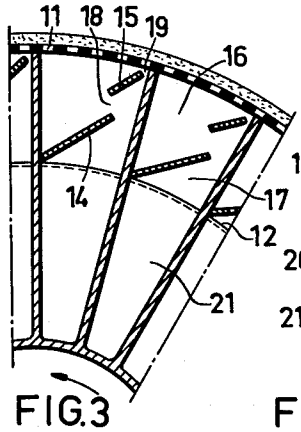


FIG.3

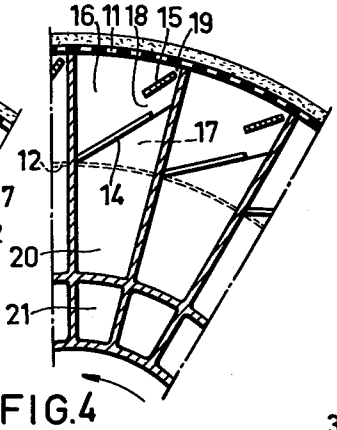


FIG.4

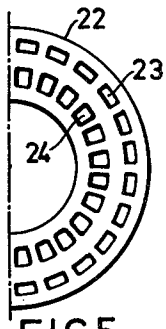


FIG.5

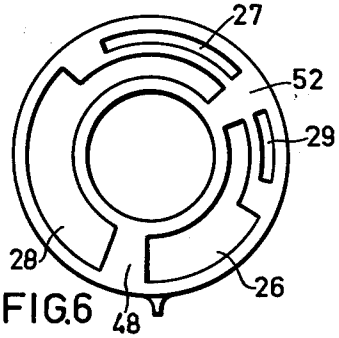


FIG.6

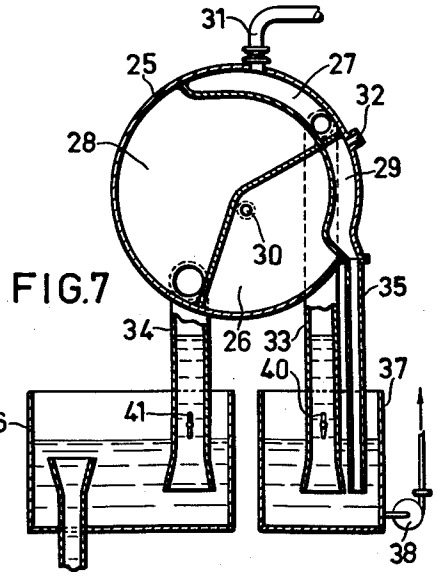


FIG.7

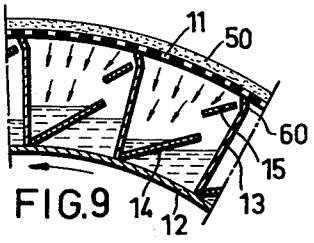


FIG.9

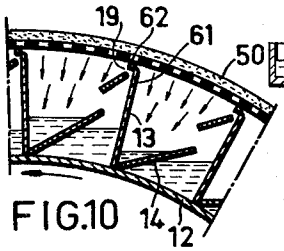


FIG.10

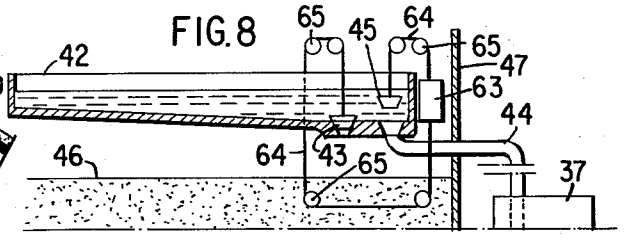


FIG.8

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APPARATUS FOR DEWATERING SUSPENSIONS, SUCH AS FIBROUS PULP SUSPENSIONS

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5 Claims. (Cl. 210—123)

The present invention relates to an apparatus for dewatering or draining suspensions, such as fibrous pulp suspensions. The apparatus, which in the first place might be defined as a fractionating filter for suspensions of cellulose pulp, comprises, at large, a rotatably mounted screening drum which is intended to operate partially immersed in the suspension and which consists of an outer shell, provided with screening openings, and of an inner shell without such openings and located at some distance from said outer shell, partitions being provided between said shells, said partitions extending in the longitudinal direction of the screening drum and dividing the interspace between the shells into cells, said cells communicating with at least one non-rotatable suction box, adapted to put certain cells under vacuum, depending upon the various positions occupied by the cells during the rotation of the drum.

The new apparatus is characterized substantially in that each cell is divided into at least two chambers extending substantially along the entire length of the cells, said chambers within each cell communicating with each other through a slot or the like, extending longitudinally of the cell, each of said chambers having a discharge duct of its own, each such duct communicating with said suction box.

The longitudinal slot of each cell is formed between two longitudinal metal beams or similar members, one of which is positioned after the other relative to the direction of rotation of the drum, and said one beam also being positioned further out than the other beam in the radial direction of the drum. The two chambers of each cell may communicate with each other also through a further slot or the like, situated between the outermost beam, in the radial direction of the drum, and the adjacent wall of the cell.

A preferred embodiment of the filter according to the invention will be described below in detail, reference being had to the accompanying, diagrammatic drawings.

In the drawings:

FIGURE 1 is a longitudinal sectional view of the filter on the line I—I of FIGURE 2.

FIGURE 2 is a transverse sectional view of the filter on the line II—II of FIGURE 1.

FIGURE 3 is a transverse sectional view of part of the screening drum on the line III—III of FIGURE 1.

FIGURE 4 also is a transverse sectional view of part of the screening drum on the line IV—IV of FIGURE 1.

FIGURE 5 is an end elevational view of part of the outlet section of the drum on the line V—V of FIGURE 1.

FIGURE 6 is an end elevational view of the drum contacting portion of the suction box on the line VI—VI of FIGURE 1.

FIGURE 7 is a transverse sectional view of the suction box on the line VII—VII of FIGURE 1.

FIGURE 8 is a longitudinal sectional view, on the line VIII—VIII of FIGURE 2, of a trough for receiving filtrate.

FIGURES 9 and 10, finally, each shows a transverse sectional view of a somewhat modified type of a cell when in one of its highest positions during the rotation of the drum.

Referring to the drawings 10 indicates the rotatably mounted screening drum, which is provided with an outer, perforated shell 11, which preferably is covered with screening cloth. Inside said outer shell and at some distance away from the same there is provided an inner shell 12, which has no perforations. By means of partitions 13, extending longitudinally of the drum, the space between the two shells 11, 12 is divided into a number of suction cells. By means of longitudinal metal beams, bars or similar members 14, 15 each suction cell is divided into two chambers, one outer chamber (when viewed in the radial direction of the drum) or fore chamber 16 (relative to the direction of rotation of the drum) and also one inner chamber (when viewed in the radial direction of the drum) or rear chamber 17 (relative to the direction of rotation of the drum). The two beams or bars 14, 15 are so positioned relatively to one another that between them there is left a slot 18 extending along the entire lengths of the beams or bars. Moreover the beam or bar 15 may be arranged in such a way that between the same and the adjacent wall of the cell there is a slot or a row of openings 19. Both the slot 18 and the slot or row of openings 19 allow liquid to pass therethrough from one chamber of the cell to the other. Said two beams may be replaced by one single beam, preferably extending about diagonally of the cell. In that case a slot or the like may be provided at the top between the upper edge of the beam and the corresponding wall of the cell, said edge being located at some distance away from said corresponding wall of the cell. From each cell there extend at least two discharge ducts, i.e. at least one discharge duct 20 from the outer chamber 16 of the cell and at least one discharge duct 21 from the inner chamber 17 of the cell. At one end of the screening drum 10 there is provided an outlet section 22, through which extend ducts or openings 23, 24, each of said ducts or openings connecting its discharge duct 20, 21 from the chambers of the cells with a non-rotatable suction box 25. The suction box has four chambers 26, 27, 28 and 29. The chamber 26 is free of vacuum and, through the opening 30, it can be connected directly with the atmosphere. The chambers 27 and 28 are chambers adapted to be put under vacuum when the apparatus is in operation, the chamber 27 being adapted to be connected to a vacuum pump (not shown) through a line 31, in case it should prove desirable to improve the vacuum in the cell chambers of the screening drum. The chamber 29, finally, is a chamber which is adapted to be connected to the atmosphere through an opening 32. To each of the chambers 27, 28 and 29 there is connected a discharge pipe 33, 34 and 35, respectively. 36 indicates a tank for receiving filtrate from the inner cell chambers 17, and 37 is a tank for receiving filtrate from the outer cell chambers 16. 38 indicates a pump, which usually is adapted to pump filtrate from the tank 37 to a tube 39 for spraying washing liquid (FIG. 2). The trough 42 for receiving filtrate, shown in FIG. 8 and also to be found in FIG. 2 in its place outside the screening drum, is of a length which is at least equal to the working width of the filter. In the trough 42 there is a drain valve 43 and, in a line 44 extending from said trough 42 to the tank 37 (or to the chamber 29 of the suction box) there is a control valve 45. During operation of the filter the valve 43 is to be kept shut and the valve 45 is to be held open. When starting the apparatus, or otherwise, when the pulp level 46 in the trough 47 (FIG. 2) ascends above the trough 42, the valve 43 should be held open and the valve 45 be kept shut in order to prevent the pulp suspension from flowing to the filtrate tank 37. Automatic opening and shutting of said two valves may be obtained by providing a float 63. Numeral 64 designates a wire connecting the

valves 43 and 45 to the float 63 and 65, 65 are guide pulleys for the wire 64.

When the filter is started or when the supply of pulp suspension ceases or is reduced to such an extent that the level 46 sinks so far down that the drum 10 will not pick up a layer of pulp, atmospheric pressure prevails in the cells of the drum. In order that the pulp shall be picked up by the drum at the rotation thereof when there is no vacuum in the cells of the drum, the level 46 must be brought to a height considerably above the center of the drum. Upon rotation of the drum with atmospheric pressure prevailing in the cells and with a low level of suspension in the trough the consequence will, however, be that the pulp suspension becomes thickened (the filtrate will leave through the suction box 25 for the tanks 36 and 37), involving the risk of the drum getting stuck. In order to avoid a continuous attendance for the purpose of preventing the above mentioned drawback it is of advantage to equip the filtering apparatus as follows:

The discharge pipes 33 and 34 are provided with valves 40 and 41. By means of an impulse member 66 (connected to chamber 28 or to chamber 27 of the suction box 25) and a motor 67 or an electro-magnet said valves 40 and 41 are adapted to be shut upon cessation of the vacuum in the suction box. By means of another impulse member 68 and the motor 67 the valves 40 and 41 are opened when the level 46 of the pulp in the trough has reached a certain height. The valves 40 and 41 shall, of course, remain open until the vacuum in the suction box ceases for some reason or other. The motor 67 of FIGURE 1 is shown to only operate the valve 41. The same arrangement is also applicable to the valve 40, which also may be operated by the motor 67 or by a separate motor (not shown).

An alternative arrangement is as follows: Upon cessation of the vacuum in the chamber 28 or 27 of the suction box 25, the impulse member 66 is to stop a motor 69, and, when the level of the pulp in the trough has reached a certain height, the drum is again set into rotation by means of the impulse member 68 and the motor 69 via the toothed wheels 70 and 71. The drum shall, of course, be kept in rotation until the cessation of the vacuum in the suction box. (Electric lines are not shown in the drawings.)

The partitions 13 of the cells, which in FIGS. 1–4 are shown to be straight, may be modified as shown in FIGS. 9 and 10, for the purpose of preventing the flow of liquid from the outer chambers 16 of the cells to the inner chambers 17 of the cells.

According to FIG. 9 the outermost portion of each partition 13, i.e. the portion 60 located next to the outer shell of the screen, is along its whole length curved forwards, counting in the intended direction of rotation of the drum.

In FIG. 10 the partition 13 is shown to consist of two elements 61 and 62, the outermost element 62 (when counting in radial direction of the drum) being located a little distance ahead of the other element 61 (when counting in the intended direction of rotation of the drum) and/or having a somewhat larger extension in peripheral direction than that of the element 61. Of course the cross section of the element 62 may be varied from one case to another so that it may be of different geometrical shapes. For example, it may be square, rectangular or trapeziform. The present embodiment, in which each partition consists of two elements, is of a particular advantage in filters of the kind that need not entirely be made of acid-proof material, such as filters for washing out black liquor. In such filters it has proved of advantage that the perforated outer shell be made of acid-proof steel (of course the perforated shell may be replaced by a shell consisting of wound wire), whereas the remaining parts of the filters may be made of malleable iron. In that case, however, the perforated shell of acid-proof material will rest against partitions of malleable iron, which will result in increased corrosion. Of course also the partitions of the cells could be made of acid-proof material but this would involve a considerable increase of cost. Due to the fact that the element 62, as already mentioned, will prevent, in an effective manner, an undesired flow of liquid, at 19, it is possible to make this element, too, of acid-proof material, the quality of the screening drum being thereby increased with regard to the risk of corrosion. Thus, the major part of each partition 13, i.e. the element 61, could be made of malleable iron. In such a case the elements 61 and 62 should be united by welding.

The operation of the apparatus is as follows:

When the cells of the drum descend into the pulp suspension, at 46, they are empty. When the cells have gone below the surface of the suspension, filtrate will be pressed through the screening cloth into the cells and, due to the external hydrostatic overpressure, a layer of pulp will form on the surface of the screening cloth. The filtrate will enter the outer chambers 16 as well as the inner chambers 17 of the cells. When the openings 23 and 24 have passed the section 48 of the drum contacting portion (tightening member) of the suction box 25, the vacuum prevailing in the chamber 28 of the suction box will be transmitted to the cells of the drum through the conduits 20 and 21. The vacuum will cause further filtrate to be sucked through the screening cloth. The cells of the drum having left the pulp suspension, at 49, also air will be sucked through the layer of pulp 50 causing concentration of said layer. When the cells have reached the spray liquid tube 39, they have (through the discharge ducts 20 and 21 and also through the chamber 23 of the suction box) already been emptied to a certain extent to the tank 36 and the liquid remaining in the pocket formed between the beam or bar 15 and the perforated outer shell 11 will flow through the slot or row of openings 19 down into the inner chamber 17 of the cell. By means of the spray liquid tube 39 washing liquid is applied, such washing liquid displacing and replacing the liquid in the layer of pulp. Also some washing liquid will gradually be sucked through the layer of pulp. The position of spray liquid tube 39 is such that when the washing liquid begins being sucked into the cell, the beam or bar 14 and the beam or bar 15 have occupied a horizontal position. After that position the beam or bar 15 will act as a screen or shelter and will prevent the filtrate from flowing down into the inner chamber 17 of the cell. When the cells have arrived at another spray tube 51 for washing liquid (FIG. 2), located above the drum, fresh liquid is sprayed on. Such fresh liquid may consist of clean water and it will displace and replace the liquid present in the layer of pulp and gradually also some of the liquid applied through the tube 51 will be sucked into the outer chambers 16 of the cells. After the above-mentioned position, in which the partition beam 14 and the beam 15 were in their horizontal positions, the outer chambers 16 of the cells, through the conduits 20, are in connection with the chamber 27 of the suction box, the inner chambers 17 of the cells, through the conduits 21, still being in connection with the chamber 28 of the suction box.

The openings 23 and 24 having passed the section 52 of the drum contacting portion of the suction box, the outer chambers 16 of the cells will be in connection with the chamber 29 and the inner chambers 17 of the cells will be in connection with the chamber 26 of the suction box. The chamber 29 and the chamber 26 being both free of vacuum, the cells will then communicate directly with the atmosphere and the vacuum in the cells thus will cease, whereupon the layer of pulp can be removed from the drum 10 by means of a take-off roller 53. The cells having passed the take-off roller 53, the filtrate, if any, remaining in the outer chambers 16 of the cells will be turned out into the filtrate collecting trough 42. The filtrate will then flow through the line 44 to the tank 37 (or to the chamber 29) of the suction box.

The invention is not limited to the features shown and described above, but several changes may be devised. Thus, the discharge ducts 20 and 21 may be arranged in such a manner that, counting in the axial direction of a cell, they extend from the center of the cell or from some other optional place along the length of the cell in axial direction to the outlet section 22 instead of extending from the end of the cell, as shown. Then the discharge ducts preferably are in the shape of pipe lines of circular cross section.

Furthermore, the inner imperforate shell 12 could be made conical so as to cause the filtrate in the cells to flow faster to the inlets of the ducts. In that case the beams or bars 14 and 15 do not, of course, extend parallel with the perforated outer shell 11.

In filters having an exceptionally great working width two suction boxes may be provided, viz. one at each end of the drum. Except for the very operation the filter will then be the same at both ends.

Furthermore, the suction box may be placed at some other place than at the ends of the screening drum. It may even be placed inside the screening drum proper.

Another possible modification consists in omitting the discharge ducts 20, 21 and having the cells open directly into the outlet section 22, which will then extend along the whole cross section of the drum. Fundamentally, the suction box will be the same as before, but it will be larger.

Also, the outlet section 22 of the drum and the drum contacting surfaces of the suction box, which in the drawings are shown to be plane, may be made conical.

With the new apparatus it is possible not only to separate the filtrate into two fractions but it is possible also to obtain such a separation of material that filtrates of different strength and/or temperatures may be separated from each other. Thereby it will be possible, with the new filter, to save chemicals and/or heat.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Apparatus for dewatering a suspension of fibrous material in a liquid comprising a stationary main trough adapted to contain a body of said suspension, a screening drum rotatably mounted in said trough in position to be partially immersed in said body of suspension, said screening drum comprising a perforate outer cylindrical shell and an imperforate inner cylindrical shell spaced apart from and concentric with said outer cylindrical shell, radially and longitudinally extending imperforate partitions between said inner and outer shells dividing the annular space between said shells into a plurality of longitudinally extending cells, a first imperforate bar in each cell extending outwardly and rearwardly from a forward inner corner thereof partially dividing the cell into inner and outer longitudinally extending chambers, a second imperforate bar in each cell spaced apart from the outer edge of said first bar and extending outwardly toward the perforate outer cylindrical shell and completing the division of the cell into said inner and outer longitudinally extending chambers, the space between said first and second bars defining a first slot connecting said two chambers, a wall closing one end of said drum, means for rotating said drum, a plate mounted on the other end of said drum, said plate having inner and outer circular, concentric rings of openings, a conduit connecting each outer chamber with one of said outer ring of openings, a conduit connecting each inner chamber with one of said inner ring of openings, a stationary suction box positioned adjacent to said plate, said suction box having at least two suction chambers one of which is positioned to communicate with at least one opening in said outer ring and the other of which is positioned to communicate with at least one opening in said inner ring when the chambers connected to said openings are above the level of said body of suspension in said trough, a pair of filtrate tanks and a conduit connecting each of said suction chambers with one of said filtrate tanks.

2. Apparatus as defined in claim 1 in which the peripheral edge of said second imperforate bar is spaced apart from the perforate outer cylindrical shell of said drum thereby defining at least one other opening connecting the two chambers in each cell and in which the outer edge portion of each of said partitions is curved forwardly in the direction of rotation of said drum.

3. Apparatus as defined in claim 1 comprising a second trough within said main trough and positioned adjacent to said drum on the descending side thereof and below the level of the axis thereof and above the normal level of said body of suspension in said main trough, a drain valve in said second trough, a conduit connecting said second trough with one of said filtrate tanks, a control valve in said conduit and means responsive to the level of said body of suspension for opening said drain valve and closing said control valve when the level of said body ascends above the level of said second trough.

4. Apparatus as defined in claim 1 in which the inner edge of said second bar is advanced in the direction of rotation of said drum with respect to the outer edge of said first bar.

5. Apparatus for dewatering a suspension of fibrous material in a liquid comprising a stationary main trough adapted to contain a body of said suspension, a screening drum rotatably mounted in said trough in position to be partially immersed in said body of suspension, said screening drum comprising a perforate outer cylindrical shell and an imperforate inner cylindrical shell spaced apart from and concentric with said outer cylindrical shell, radially and longitudinally extending imperforate partitions between said inner and outer shells dividing the annular space between said shells into a plurality of longitudinally extending cells, dividing means in each cell extending substantially diagonally of the cell between a forward inner corner of the cell and a rear outer corner thereof, dividing the cell into inner and outer longitudinally extending chambers, the peripheral portion of said dividing means being spaced apart from the outer cylindrical shell of said drum thereby defining at least one slot connecting the two chambers in each cell, a wall closing one end of said drum, means for rotating said drum, a plate mounted on the other end of said drum, said plate having inner and outer circular, concentric rings of openings, a conduit connecting each outer chamber with one of said outer ring of openings, a conduit connecting each inner chamber with one of said inner ring of openings, a stationary suction box positioned adjacent to said plate, said suction box having at least two suction chambers one of which is positioned to communicate with at least one opening in said outer ring and the other of which is positioned to communicate with at least one opening in said inner ring when the chambers connected to said openings are above the level of said body of suspension in said trough, a pair of filtrate tanks, a conduit connecting each of said suction chambers with one of said filtrate tanks.

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