Dec. 24, 1940. H. W. CASEY 2,226,337

DIALYZER

Filed Nov. 8, 1938

Fig. 1.

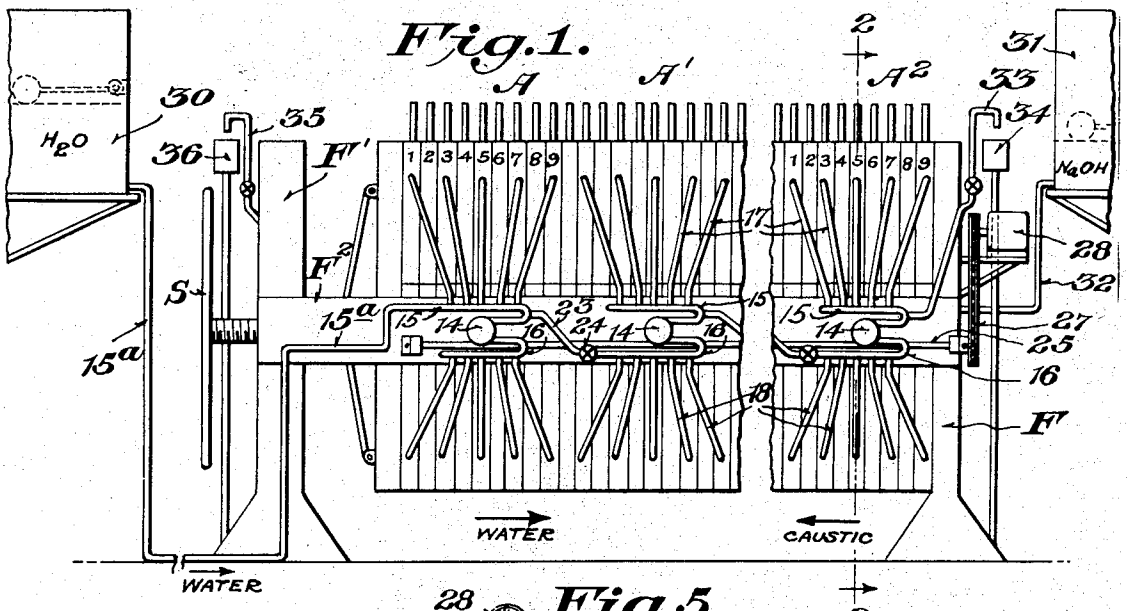


Fig. 5.

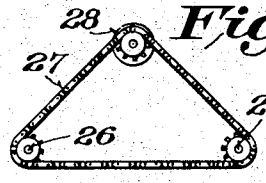


Fig. 2.

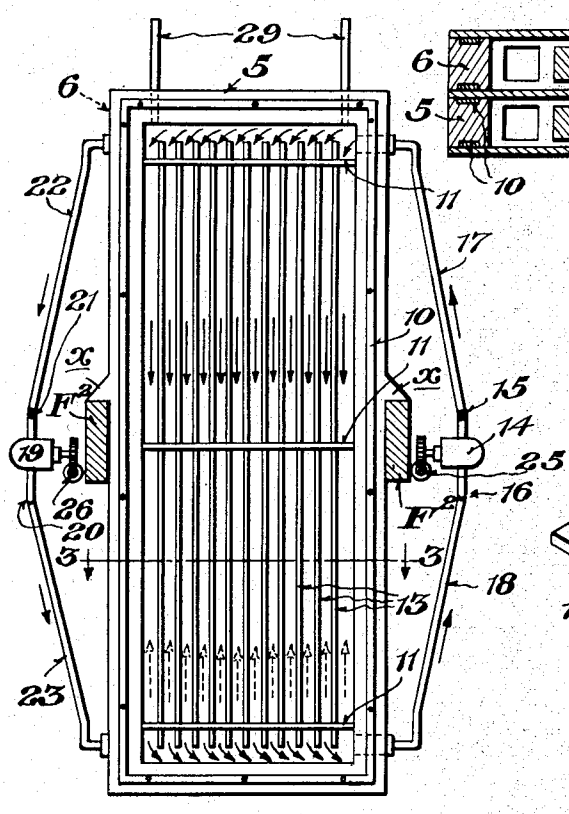


Fig. 3.

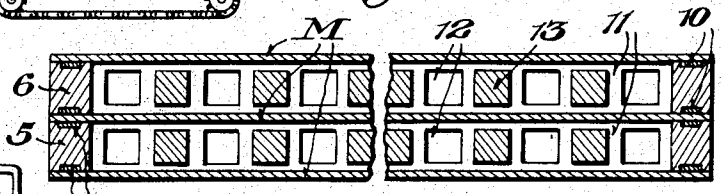
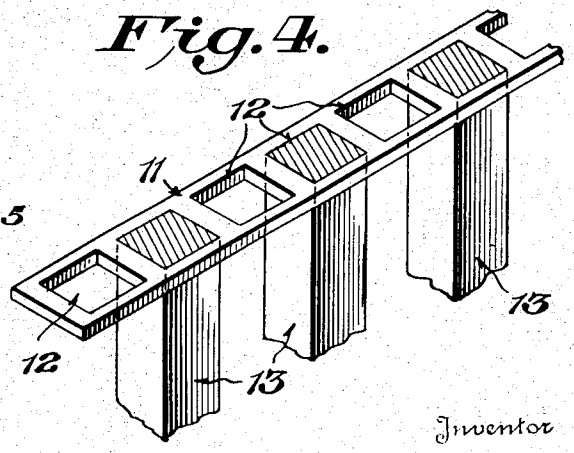


Fig. 4.



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DIALYZER

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Application November 8, 1938, Serial No. 239,594

4 Claims. (Cl. 210—8.5)

This invention relates to dialyzing apparatus for recovering sodium hydroxide or caustic soda from liquor used in connection with textile or other processes.

A primary object of the invention is to provide an apparatus comprising a unit which may be used in multiple to provide an apparatus of the desired capacity and wherein each unit provides for a positive circulation of the recovery water and the caustic thereby to increase the rate of osmosic filtration. In that connection the invention contemplates a unit comprising a plurality of frames so constructed as to provide alternate water and caustic cells, which cells are connected by suitable tubing with separate pumps for the water and caustic to circulate these two fluids in opposite directions in adjacent cells, and also provide for their recirculation as long as desired to increase osmosic efficiency. The pumps of the several units may be connected in series so that the water may be supplied at one end of the apparatus and the caustic at the other and caused to flow in opposite directions throughout the apparatus so that the caustic and water run counter to each other with respect to all of the units.

A further object of the invention is to provide a novel cell construction which assists in preventing the billowing of the membrane and also directs the fluid passing through the cell in such a manner as to effectively bring it into contact with a maximum area of the membrane.

With the above and other objects in view which will more readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination and arrangement of parts hereinafter more fully described, illustrated and claimed.

A preferred and practical embodiment of the invention is shown in the accompany drawing, in which:

Figure 1 is a side elevation of an apparatus constructed in accordance with the present invention.

Figure 2 is a vertical sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a transverse sectional view taken on the line 3—3 of Figure 1.

Figure 4 is a detail perspective view of one of the transverse fluid diffusing bars, used in the cells, and parts of the bars which assist in guiding the fluid through the cell as well as preventing the billowing of the membrane.

Figure 5 is a detail diagrammatic view illustrating the manner of operating the pump driving shafts at opposite sides of the apparatus.

The apparatus illustrated in the drawing includes a frame comprising a foot standard F and a head standard F' connected by longitudinal frame supporting bars F^2. The head standard F' also carries hand-wheel operated screw means S of suitable character for pressing the several frames of the various units together in operative relation toward the foot standard F.

The above described frame carries a plurality of dialyzing units A—A'—A^2, and of course, as many additional units as the capacity of the apparatus demands.

Each of the dialyzing units is of similar construction and therefore a description of one will suffice for all. Said units consist of a plurality of frames 1, 2, 3, 4, 5, 6, 7, 8 and 9. This number of frames is of course more or less arbitrary because the number may be increased or diminished, but in any event the frames 1, 3, 5, 7 and 9 are frames which provide water cells, while the frames 2, 4, 6 and 8 provide caustic cells.

The construction of the individual cells may be best observed from Figures 2, 3 and 4. Referring first to Figure 2 it may be observed that the water cell 5 comprises a rectangular metallic frame having suitable rubber gaskets 10 on opposite sides thereof (Fig. 3) to cooperate with an adjacent caustic frame 6 which may or may not be provided with gaskets. The osmosic membrane M is clamped between adjacent frames to provide the desired cell structure. An interior grid work is provided within each of the cells and according to the illustration shown, the same preferably comprises upper, lower and intermediate transverse diffusing bars 11 which are provided with a plurality of spaced openings 12. Alternate openings receive the elongated fluid guiding bars 13, thus leaving intervening openings clear for the passage of fluid. In practice the diffusing bars 11 are approximately ⅜" wide and the bars or rods 13 are approximately ¼" square. The side edges of the diffusing bars 11 assist in clamping the membrane transversely at spaced points and the vertical fluid guiding bars 13, in addition to forming fluid guiding passages prevent the membrane from undue billowing, thus avoiding breakage or rupture during the operation of the device.

Referring further to Figures 1 and 2, more particularly the latter, it will be observed that the frames which comprise the cells are provided with laterally extending offset portions x which enable the frames to be supported on the longitudinal side frame members F2 of the apparatus. Also, it may be observed from Figure 2 that the frame 5 is provided at one side thereof with a water pump 14 which may be of any conventional type

and has pressure and suction manifolds 15 and 16 connected therewith. The pressure manifold 15 communicates with a plurality of pipes or tubes 17 leading to the upper end of the water frames and the suction manifold 16 communicates with a plurality of pipes or tubes 18 leading to the bottom of the water frames. It will thus be apparent from Figure 2, which shows one cell, that when the pump 14 is in operation water supplied from the connection 15ª (Fig. 1) will be forced upwardly through the tube 17 into the upper part of the water cell and will follow the course indicated by the arrows in Fig. 2. The water will then descend between the fluid guiding rods 13 and through the diffusing bars 11 to the bottom of the cell from whence it is picked up by the tube 18 and forced back into the suction manifold 16.

As will also be apparent from Figure 2 the caustic frame 6 which is located behind the water frame 5 is also provided with a pump 19 having a pressure manifold 20 at its lower side and a suction manifold 21 at its upper side. When the pump is in operation, caustic will be forced downwardly through the tube 23 to the bottom of the caustic cell 6 and will be caused to flow upwardly therein as indicated by the dotted arrows in Fig. 2. The ascending caustic will be sucked from the top of the cell 6 and back into the manifold 21 of the pump 19 through the tube 22. It will of course be understood that the pump 19 is common to all of the caustic cells in each unit and that a separate set of circulating tubes 22 and 23 is provided for each caustic cell.

The pumps 14 and 19, respectively, for water and caustic are the same at both sides of the apparatus. That is to say there is one pump for each unit. However, the respective pumps are so arranged that the flow of fluids in adjacent cells is in opposite directions. Moreover, it may be pointed out at this time that the arrangement of connections between the water pumps at one side of the apparatus and the caustic pumps at the other side are the same. However, as between the several units arranged in series the flow of caustic is countered by the flow of water inasmuch as the water is fed in at one end of the apparatus and caustic is supplied at the other.

Referring to Figure 1 it will be observed that each of the water pumps 14 having the manifolds 15 and 16, is placed in communication with a preceding pump by a transfer connection 23, the said connection leading from the pressure manifold 15 of one pump means to the suction manifold 16 of an adjoining pump means. A suitable regulating valve 24 may be interposed in the transfer connection so as to regulate the volume of flow in the several cells. Or, on the other hand the valve 24 may be manipulated so as to cause any selected pump to re-circulate its fluid medium within an individual unit for the desired length of time.

All of the water pumps 14 are operated by a common shaft 25 (Fig. 2) and likewise all of the caustic pumps 19 are operated by a common shaft 26 (at the opposite side of the machine shown in Fig. 1). The shafts 25 and 26 are driven through a sprocket chain 27 or its equivalent powered by a suitable motor 28 located adjacent the foot standard F of the apparatus. It will thus be understood that all of the pumps (both 14 and 19) are simultaneously driven during the operation of the apparatus.

Each of the frames 1—9 inclusive of each unit is provided with vent tubes 29 at their upper sides. The purpose of these tubes is to prevent air pockets occurring in the cells, and, as will be seen from Figure 1 the water supply 30, which is connected with the manifold 15 of the first water pump 14 by the connection 15ª, is provided with suitable float means to maintain the level of the water substantially in line with the upper ends of the vent tubes 29. At the opposite end of the apparatus the caustic supply 31 is provided with float means for maintaining the level of caustic substantially in line with the top of the frame forming the caustic cells. Caustic is supplied through the piping connection 32 to the pressure manifold of the first caustic pump 19 on the side of the machine opposite the water pumps.

In operation water supplied from the source 30 is conveyed to the pressure manifold 15 of the first water pump 14 and circulated in each of the water frames 1, 3, 5, 7 and 9 in the manner described. After water has been circulated in the first unit A it is transferred to the pump 14 of the unit A′ through the transfer connection 23 where the same water cycle is repeated in unit A′. This action occurs in the water frames of all subsequent units in the series. The water which reclaims the caustic, or in other words, reclaimed solution, is conveyed by the pipe 33 to a recovery trap 34 located at the end of the apparatus opposite the source of water supply 30.

On the other hand caustic supplied from the source 31 through the pipe 32 is supplied to the pressure manifold 20 of the first caustic pump 19, associated, for example, with the unit A^2, to thus pump caustic into the caustic frames 8, 6, 4 and 2 which form the caustic cells of the unit A^2. The caustic is circulated in each of the caustic cells, as previously described, and is transferred by a connection corresponding to connection 23 with the pump 19 of the unit A′ where circulation of caustic is repeated. This same action takes place in unit A and waste liquor is then conveyed from the machine through the waste line 35 and waste trap 36.

From the foregoing it will be apparent that the present apparatus provides for circulating water and caustic in opposite directions in adjacent cells of each unit. The effect of pump circulation in each unit is to thoroughly agitate both the water and the caustic so as to promote quick and efficient osmosic action. The water and caustic in each unit is then transferred to a succeeding unit in the line to further complete the osmosic action, and this series of operations is repeated until the highest or desired percentage of recovery is obtained. Apparatus in accordance with the present invention has not only a high fluid capacity which enables it to handle large volumes of both water and caustic but at the same time provides for the highest possible percentage of caustic recovery. Thus, the present apparatus has considerable economic advantages and because of its simplicity of construction has manufacturing advantages which will be readily apparent to those skilled in the art.

I claim:

1. In a dialyzing apparatus, a series of dialyzer units, each unit including a plurality of alternately arranged water and caustic cells, means for recirculating water and caustic in said cells, said means comprising a water manifold for each unit including a pump and water connections communicating respectively with the upper and lower portions of each water cell, and a caustic manifold for each unit including a pump and caustic connections communicating respectively with the upper and lower portions of each

caustic cell, said pumps in the water and caustic manifolds circulating water and caustic in opposite directions in the adjacent cells of each unit, and transfer pipes for conveying water and caustic from the said water and caustic manifold of each unit to the related manifold of an adjacent unit.

2. In a dialyzing apparatus, a series of dialyzer units, each including a plurality of alternately arranged water and caustic cells, a water pump for each unit having a plurality of individual pipes leading to the upper and lower portion of each water cell, a caustic pump for each unit having a plurality of individual pipes leading to the upper and lower portion of each caustic cell, transfer pipes connecting each water pump, other transfer pipes connecting each caustic pump, and a valve in each of the transfer pipes for controlling the recirculation of fluid in the individual cells of each unit and the flow between adjacent units.

3. In a dialyzing apparatus, a plurality of dialyzer units, each including, juxtaposed water and caustic frames having membranes therebetween forming alternate water and caustic cells, a pump at one side of each unit including a pressure manifold having separate pipe connections with the upper sides of the water frames and also including a suction manifold having separate pipe connections with the lower sides of the water frames, a caustic pump at the other side of the unit and including a pressure manifold having separate pipe connections with the lower side of the caustic frames and also including a suction manifold having separate pipe connections with the upper side of the caustic frames, said pumps positively circulating water and caustic in opposite directions in alternate cells, and means for separately transferring water and caustic from one unit of cells to an adjacent unit.

4. In a dialyzing apparatus, a plurality of dialyzer units arranged in a progressive series, each unit including groups of frames having membranes therebetween and forming alternate water and caustic cells, separate caustic and water pumps at opposite sides of each unit and each having pressure and suction pipe connections with each water and caustic cell, a source of caustic supply at one end of the apparatus, a source of water supply at the other end of the apparatus, valved transfer connections between all of the caustic pumps at one side of the units to establish communication between the source of caustic supply and all of the caustic cells of the units to transfer caustic from one unit to the next for recirculation, valved transfer connections between all of the water pumps at the other side of the units to establish communication between the source of water supply and all of the water cells of the units, means for operating the caustic pumps and the water pumps to cause the flow of caustic and water in opposite directions throughout the apparatus, means for collecting reclaimed caustic, and means for conveying waste from the apparatus.

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