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L. E. PENTÉN
METHOD AND MEANS FOR THE SEPARATION
OF FIBERS SUSPENDED IN A LIQUID

2,518,814

Filed Jan. 30, 1945

3 Sheets-Sheet 1

Fig. 1.

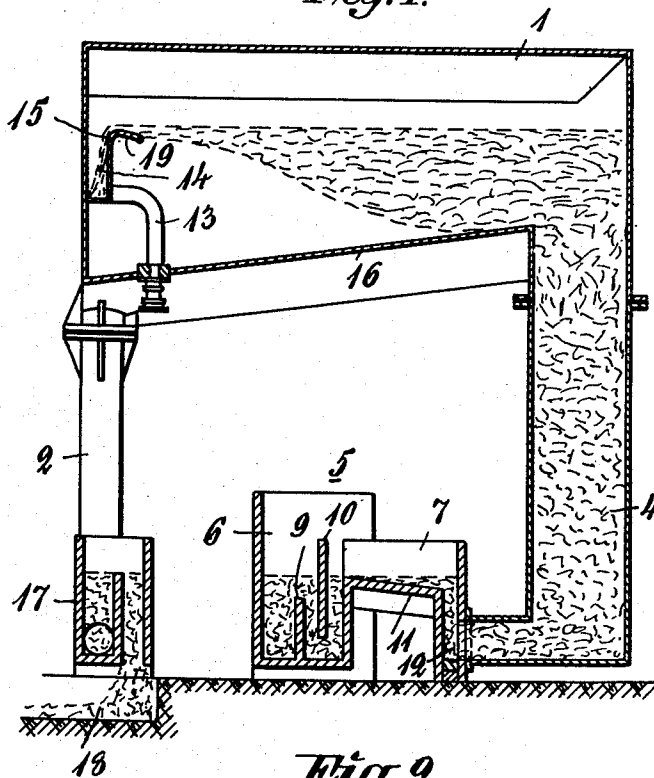


Fig. 1a.

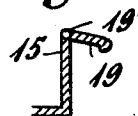
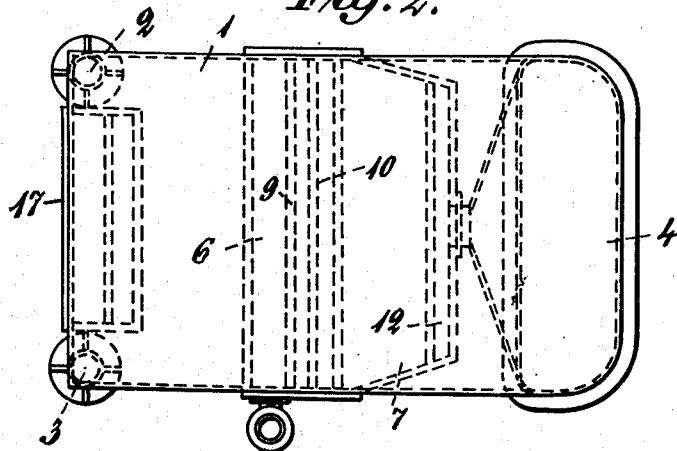


Fig. 2.



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3 Sheets-Sheet 2

Fig. 3.

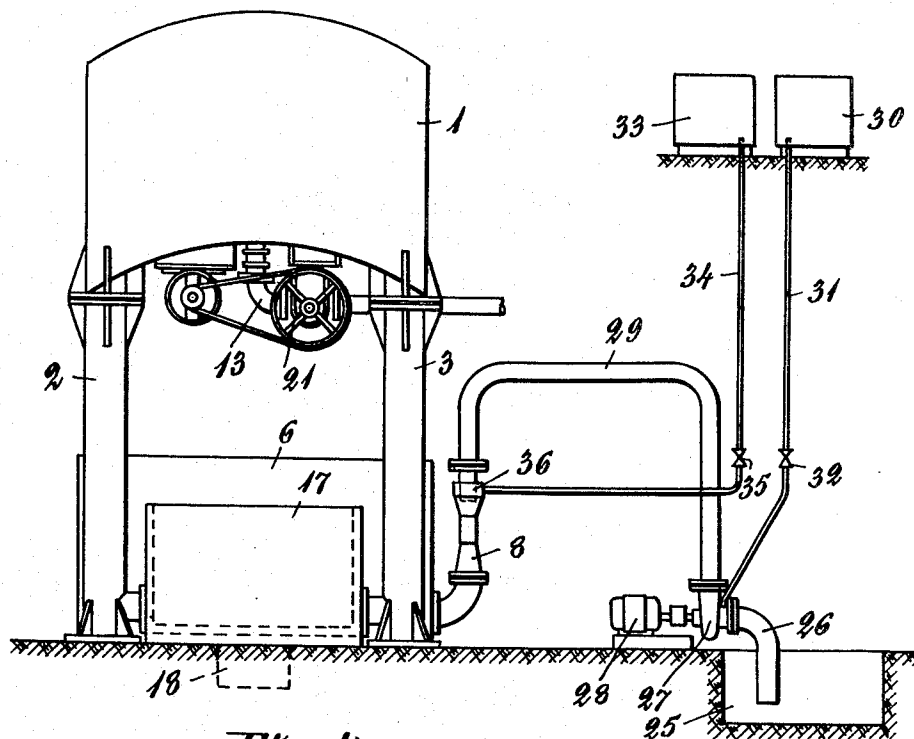


Fig. 4.

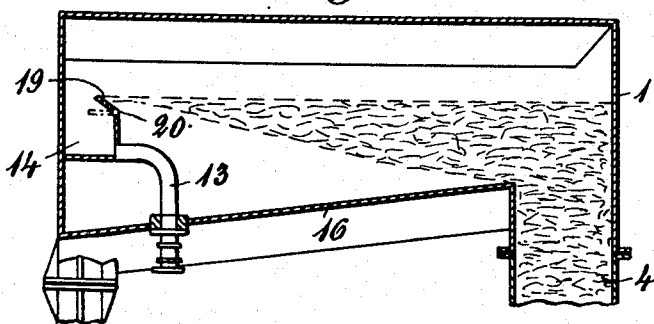
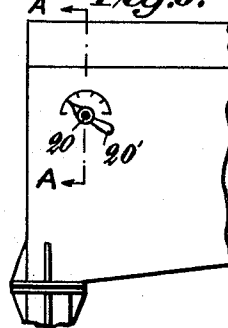


Fig. 5.



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3 Sheets-Sheet 3

Fig. 6.

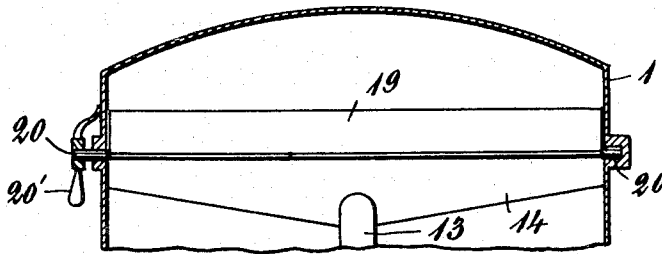


Fig. 7.

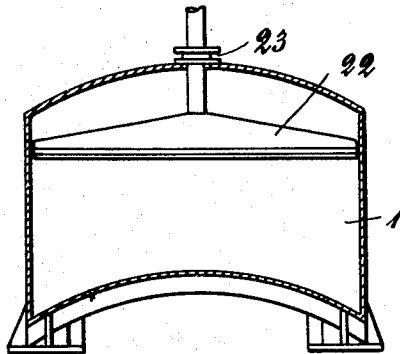
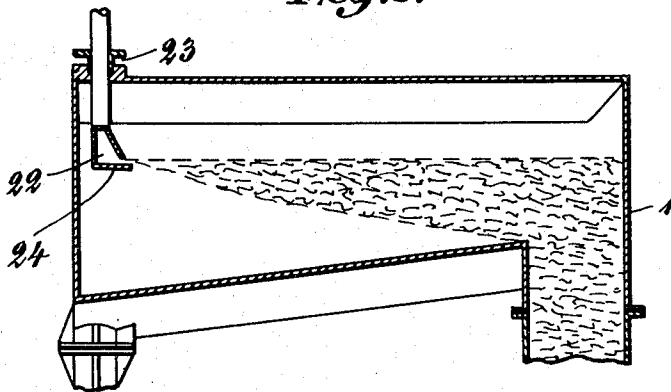


Fig. 8.



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UNITED STATES PATENT OFFICE

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METHOD AND MEANS FOR THE SEPARATION
OF FIBERS SUSPENDED IN A LIQUID

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9 Claims. (Cl. 210-53)

1

The present invention refers to a method and an apparatus for the separation of fibres suspended in a liquid, particularly for the recovery of fibres out of liquids originating from the manufacture of paper, cellulose, wood pulp, pasteboard and the like. It is known for this purpose to mix air and flock-forming substances into the suspension liquid and to introduce the suspension into a liquid container, in which the fibres float upwardly and form flocks of fibres floating on the surface of the liquid, said fibre flocks being then separated by means of contrivances in the form of scrapers or suction means or the like movable across the surface of the liquid. Such separating means suffer from the drawback that they subject the floating fibre flocks to a stirring effect, which results in that these flocks are disintegrated, so that the fibres loosen themselves and sink down in the container, a comparatively great portion of the fibrous material being thus caused to escape with the purified water.

The present invention has for its object to obviate said disadvantages and is principally distinguished by the feature that the fibre pulp floating on top of the liquid is fed to an outlet arranged fixedly within the liquid container, solely through the influence of a liquid current flowing toward the outlet, and that the fibre pulp thus being fed is removed from the liquid container through a suction conduit opening at the outlet. Hereby the fibre flocks may be conveyed to the outlet in a quietly flowing stream and without disturbing movements in the liquid, the purification of the water being thus rendered more effective and the percentage of recovery becoming greater than in the previously known apparatus with mechanical feeding means or movable separating means.

It will be found suitable to have the separation of the fibres take place at the maintenance of a suitable pressure below atmospheric in the air space above the liquid level in the separating container, the separation of the fibre pulp being preferably effected by guiding the liquid current over an overflow arranged within the liquid container. The level of the liquid at the overflow may be simply controlled by a regulation of said pressure below atmospheric, for the purpose of providing a suitable concentration of the suspension flowing off over the overflow, and for the purpose of preventing damming up of the suspension in front of the overflow, so that the suspension flows forwards to the outlet in a uniform current. The fibre suspension escaping over the overflow is removed through the suction

2

conduit, which is connected for this purpose to a collecting pocket for the fibre pulp arranged adjacent to the overflow, the fibre suspension being then conveyed off together with the air separated in the container. The regulation of the pressure below atmospheric and thus of the level of the liquid in the container may then preferably be effected by a control of the quantity of fibre suspension and air escaping through the suction conduit through a control of the number of revolutions of the suction pump provided for this purpose. However, the regulation of the pressure may also be effected by sucking out a suitable quantity of air only from the container.

The invention will be described more closely hereinafter with reference to the accompanying drawings, which by way of example illustrate a selected form of embodiment of an apparatus for the recovery of fibres from liquids according to the invention. Figure 1 is a vertical section and Figure 2 a plan view of the apparatus. Fig. 1a is a detail view of a modified embodiment of the guide blade shown in Fig. 1. Figure 3 is a front view of the apparatus. Figure 4 is a vertical section through the upper portion of the apparatus, showing a modified embodiment of the overflow. Fig. 5 is a partial outside view of the embodiment of the apparatus as shown in Fig. 4. Fig. 6 is a vertical section in greater scale taken along the line A-A in Fig. 5 through the embodiment of the apparatus shown in Figs. 4 and 5. Fig. 7 is a transverse vertical section through the upper portion of the apparatus, showing a modified embodiment in which the overflow is replaced by a suction nozzle. Fig. 8 is a longitudinal vertical section through the embodiment shown in Fig. 7.

The apparatus consists of an upper separating container 1 supported at the one end thereof by two tubular standards 2, 3, and at the other end thereof by a vertical drum 4 opening at the top into the rear end of the separating container 1 and serving as an inlet passage for the fibre suspension. Connected to the lower end of the drum 4 is a mixing apparatus 5 comprising an open mixing vessel 6 and a likewise open separating vessel 7. The liquid containing the fibres is supplied to a container indicated at 25 and withdrawn therefrom through a pipe 26 by means of a pump 27 driven by a motor 28 which pump, through pipes 29 and 8, introduced the liquid into the mixing vessel 6. Additional substances, so-called flocculating substances by means of which the fibres tend to unite so as to form flocks, are added to and mixed with the

3

liquid on its path from container 25 to the mixing vessel 6. Suitable flocculating substances are sulphate of aluminium ($\text{Al}_2(\text{SO}_4)_3$) used in combination with a fully saponified resin glue or animal glue. In the embodiment shown in Fig. 3 the resin or animal glue is introduced by gravity flow into the path of flow of the liquid from a source of supply 30 which over a pipe 31 communicates with the interior liquid path of pump 27. A control valve 32 is inserted at an intermediate point of pipe 31 to permit regulation of the amount of resin or animal glue added. The sulphate of aluminium is introduced by gravity flow into the path of flow of the liquid from a source of supply 33 which over a pipe 34 communicates with pipe 8. A control valve 35 is inserted at an intermediate point of pipe 43 to permit regulation of the amount of sulphate of aluminium added. Before the liquid enters the mixing vessel 6, it has been mixed in known manner with air by the suction of air into the conduit 8 by means of an ejector 36. When the liquid passes through the vessel 6, it is compelled by partitions 9, 10 to flow in a zig-zag path, so that the liquid is intimately mixed with the air and the admixtures. From the vessel 6, the liquid passes through the vessel 7, within which it is spread over a comparatively large surface while flowing over an inclined bottom 11 to a channel 12, from which the liquid flows into the lower portion of the drum 4. The raising of the liquid to a suitable level in the separating container 1 is effected by the maintenance of a pressure less than the atmospheric pressure in the air space above the surface of the liquid in the container 1. To this end, said air space is connected through a conduit 13 to a motor-driven suction pump 21, Figure 3, preferably a centrifugal pump, the number of revolutions of which is regulated so that a pressure below atmospheric suited for the proper functioning of the apparatus is maintained in the air space of the separating container. Said suction conduit 13 opens into the lower portion of a collecting pocket 14 located adjacent to the fore end of the separating container and extending over the whole width of the container. The inner wall of said collecting pocket forms an overflow 15 at the upper portion thereof, said overflow extending over the whole width of the separating container, and over which the fibres separated from the liquid and floating on top of the same escape to the pocket 14, whence they are conveyed through the suction conduit 13. To facilitate the flowing off of the water, the bottom 16 of the separating container is inclined toward the outlet side, and is arcuate in the manner appearing from Figure 3, the pipes 2, 3 being connected to the bottom adjacent to the side walls of the separating container.

As the vessels 6, 7 and 17 are at the top in open communication with the atmosphere, the liquid columns in the pipes 2, 3 on the one hand and in the drum 4 on the other hand will substantially balance each other. By the pumping of liquid through the pipe 8 in a suitably adapted quantity per unit of time, the liquid is caused to flow in the separating container 1 at the rear end of the latter and to flow through the container in a horizontal direction toward the outlet end, whence the purified liquid escapes through the pipes 2, 3 and a receptacle 17, which is open at the top, to an outlet 18. Through the influence of the air and flocculating substances mixed into the liquid the fibres float up to the top of

4

the liquid in the separating container, where they unite with each other and form fibre flocks floating on top of the liquid, said flocks being entrained by the liquid current flowing toward the outlet end. By a regulation of the pressure below atmospheric in the separating container, the level of the liquid is kept somewhat higher than the level of the overflow 15. By reason of this, the upper liquid layer will flow, together with the fibre flocks floating therein, over the overflow 15 so as to be separated from the remaining liquid. To facilitate the movement of the fibre pulp over the overflow, the latter is provided with an inclined guide blade 19 projecting underneath the fibre layer, said guide blade preventing the flocks from sticking to the overflow. Because of this arrangement separated fibres flow in a continuous stream over the overflow. If desired, the guide blade 19 may be swivable about a horizontal axis 19' at the upper edge of the overflow, as shown in detail in Figure 1a, so that the front edge thereof may, by a turning movement about said axis, be adjusted to various depths below the liquid surface and the fibre layer.

In addition to the fibres falling down into the pocket 14, the air separated from the suspension in the container 1 will also escape through the suction conduit 13. By a control of the number of revolutions of the pump 21 connected to the suction conduit 13, the pressure below atmospheric in the separating container may be regulated, so that the surface of the liquid obtains a level over the overflow insuring complete separation of the fibres from the liquid. By such a control of the pressure and of the liquid level, the concentration of the fibre suspension escaping through the suction conduit 13 may also be regulated, inasmuch as a higher pressure and a correspondingly lower liquid level give a higher concentration, and vice versa. The flow of the liquid flowing through the separating container may be varied by varying the quantity per unit of time of the fibrous liquid supplied through the pipe 8.

Figures 4, 5 and 6 show a modified construction of the overflow to render possible a control of the level of the overflow. To this end, the shaft 20 at the guide blade 19 is pivotally arranged so as to permit the guide blade of being swung about a horizontal axis. With the aid of a handle 20' provided on the shaft 20 of the blade outside the separating container, the guide blade may be adjusted to different positions of inclination, as indicated by chain-dotted lines, the level of the overflow being altered at the same time by the overflow edge of the guide blade being correspondingly raised or lowered. This provides for a further possibility to vary the relative levels of the liquid surface and of the overflow either separately or in combination with a pressure regulation. If desired, the guide blade may be adapted to be raised and lowered periodically, in a manner such that the fibre layer floating on top of the liquid is periodically dammed up, the transfer of the fibre pulp to the pocket 14 then also taking place periodically each time the guide blade is lowered. Hereby, a certain compression of the fibre pulp will be obtained in front of the guide blade, so that it will afterwards be transferred to the outlet pocket in a more concentrated condition.

According to another modified construction shown in Figures 7 and 8 the overflow may be omitted, the suction means being then formed as a suction nozzle 22 extending over the whole

5

width of the separating container 1, said nozzle being fixedly and vertically adjustable arranged by means of a stuffing box 23 adjacent to the outlet end of the liquid container so as to open immediately adjacent to the liquid surface, the fibre pulp being thus sucked up directly from the surface of the liquid through the suction nozzle. The suction nozzle is preferably arranged in such manner that its lower edge 24 forms an inclined guide blade projecting underneath the fibre layer, said guide blade being similar to the guide blade 19 in Figure 1 adapted to catch the fibre flocks floating toward the nozzle. This ensures that the fibre layer can float in a continuous uniform stream to the point of the outlet without any impediments, and that it is separated from the surface of the liquid, without individual fibres working loose from the fibre flocks and escaping to the water outlet. The vertical adjustability of the suction nozzle serves to control the liquid level in the container. When a suction nozzle is brought into use, the separation of the fibres need not necessarily take place under vacuum in the separating container, provided the level of the liquid be maintained approximately constant by a suitable control of the supply of the water to the separating container and of the draining of the water therefrom.

I claim:

1. Apparatus for separating fibres suspended in a liquid comprising a closed settling tank, a drum connected with one end of the tank constituting an inlet for fibre suspension, an outlet in said tank at its opposite end for clarified liquid, the liquid flowing through the tank from the inlet to the outlet without disturbance by moving transport means, a stationary overflow for the removal of the upper fibre containing layer of the liquid to be cleared and arranged adjacent the outlet, and a suction pipe connected with said tank at a point below said overflow for withdrawing air from the tank to cause the introduction of fibre suspension into the tank through said inlet and to maintain the level of the liquid in predetermined relation to the overflow.

2. Apparatus as claimed in claim 1 wherein said air suction pipe is arranged to carry off the upper layer of liquid passing said overflow.

3. Apparatus as claimed in claim 1 provided with a pocket for receiving separated fibres passing said overflow, said air suction pipe communicating with said pocket for withdrawing liquid and fibre together with air.

4. Apparatus as claimed in claim 1 wherein said overflow is constituted by an upwardly inclined guide blade for facilitating separation of the fibre layer.

5. Apparatus for separating fibres suspended in a liquid comprising means for feeding the fibre containing liquid from a source of supply, liquid conveying means comprising means for admixing to the liquid flocculating substances and air, a hermetically closed settling tank having a bottom inlet at one end thereof, a vertical drum portion in communication at its lower end with the said liquid conveying means and at its upper end with the said bottom inlet at the one end of the tank, the tank being provided at the opposite end thereof and above the level of the said bottom inlet with an outlet for an accumulated surface layer of fibre flocks on the liquid quiescently flowing through the tank, the said outlet comprising a pocket extending over sub-

6

stantially the whole width of the tank and having an inner wall portion provided along its upper margin with a guide blade having a horizontally disposed upper edge swingable about a horizontal axis to form a movable extension of said inner wall portion and over the upper edge of which the said accumulated surface layer of fibre flocks is separated from the underlying substantially fibre-free liquid, a suction pump, a suction pipe communicating at its one end with the bottom of the said pocket and connected at its other end with said suction pump for discharging the separated fibre flocks to the outside of the apparatus, and outlet openings for the substantially fibre-free liquid in the bottom of the tank at the outlet end thereof.

6. Apparatus for separating and recovering fibres from a suspension of fibres in liquid including a closed separating tank having a bottom inlet at one end and a liquid discharge outlet at its opposite end, liquid feed means communicating with said inlet, including means for introducing a flocculating agent into the liquid, suction applying means including a stationary fibre receiving chamber disposed within said tank adjacent the outlet end thereof and a conduit communicating with said chamber and extending exteriorly of said tank, said suction applying means reducing the pressure within said tank to control the liquid level therein and to produce a non-turbulent stream flowing from said inlet toward said outlet, the fibres rising to the surface of the liquid in the tank, and said chamber having one wall extending transversely of said tank and the stream to separate the floating fibres from the liquid, the fibres discharging through said conduit and the said liquid discharge outlet of said tank communicating with the tank below said chamber.

7. A method of separating and separately recovering fibres from a suspension of cellulosic fibres in a liquid, comprising introducing a fibre suspension in liquid admixed with air and a flocculating substance into the bottom of a closed separating zone, withdrawing air from said zone in an area spaced from the area through which the mixture enters the zone to reduce the pressure within said zone below atmospheric pressure and to produce a non-turbulent stream flowing quiescently toward the withdrawal area, the quiescent non-turbulent flow of the stream permitting the suspended fibres to float up to the surface of the liquid in the form of flocks to form a surface layer of fibre flocks, the thickness of which depends on the amount of fibres suspended in the liquid, regulating the withdrawal of air from the zone in accordance with the thickness of the surface layer to vary the concentration of the recovered fibres, and horizontally dividing the stream throughout substantially the entire width thereof immediately subjacent the floating layer to separate the fibre flocks from the liquid, removing the separated flocks and separately discharging the fibre free liquid at an area below the area of removal of the flocks.

8. A method as defined in and by claim 7, further consisting in that the upper liquid layer containing said flocks is withdrawn together with the air.

9. A method of separating cellulosic fibres suspended in a liquid, consisting of introducing a fibre suspension admixed with air and flocculating substances into the bottom of a hermetically closed separating zone at the one end thereof, withdrawing air through an outlet at the end

of the zone opposite the inlet end thereof to reduce the pressure in the tank below atmospheric pressure and thereby induce the liquid to rise to a predetermined level within the settling tank and to flow in a quiescently flowing stream undisturbed by mechanical transport means from the inlet end of the tank toward said outlet, the quiescent flow of the liquid permitting the suspended fibres to float up to the surface of the liquid in the form of flocks to form a surface layer of fibre flocks the thickness of which depends on the amount of fibres suspended in the liquid, regulating the withdrawal of air from the settling tank in accordance with the thickness of the said surface layer of fibre flocks thereby to adjust the level of the liquid and horizontally dividing the stream to separate the surface layer of fibre flocks from the underlying substantially fibre-free liquid and discharging the fibre-free liquid from the zone below the said fibre outlet.

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