United States Patent [19]

Jacquelin et al.

[11] **3,770,126**

[45] **Nov. 6, 1973**

[54] **SYSTEM FOR SEPARATING FIBRES FROM A FIBROUS SUSPENSION**

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[22] Filed: **Jan. 2, 1973**

[21] Appl. No.: **320,462**

[52] **U.S. Cl.** **210/81,** 210/400
[51] **Int. Cl.** **B01d 23/24**
[58] **Field of Search** 209/76–78; 210/355, 356, 348, 159, 542, 81, 400

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Assistant Examiner—Gene A. Church
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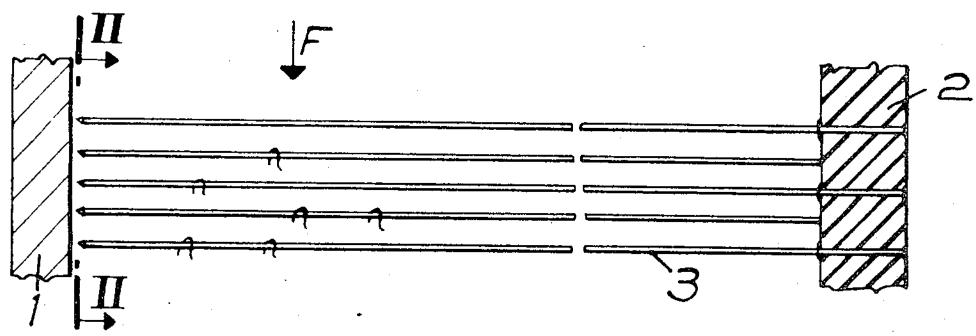
[57] **ABSTRACT**

A system for separating fibre from a fibrous suspension by contacting the suspension with a receptacle having needles extending therefrom on which the fibres are caused to engage and are removed from the suspension.

18 Claims, 6 Drawing Figures



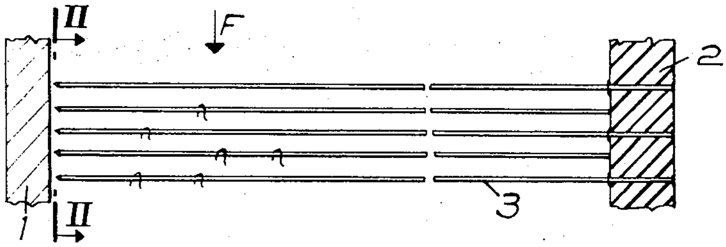


FIG.1

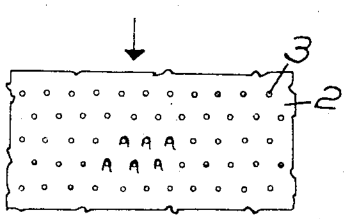


FIG.2

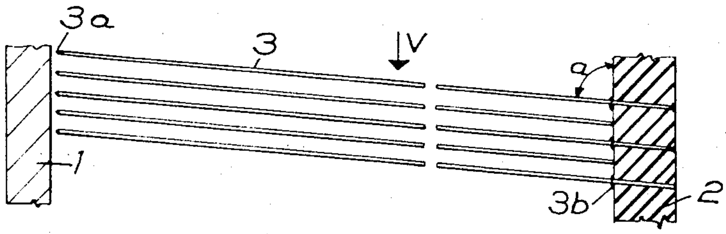


FIG.3

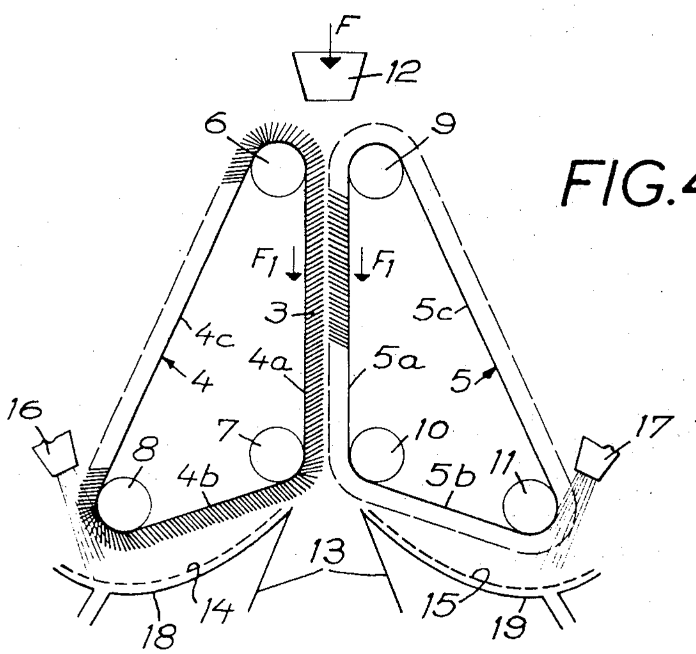


FIG.4

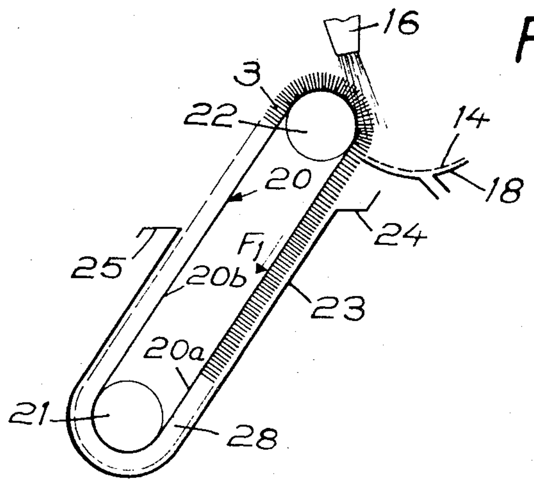

16
3
22
14
20
18
24
25
F1
20b
23
20a
21
28

FIG.5

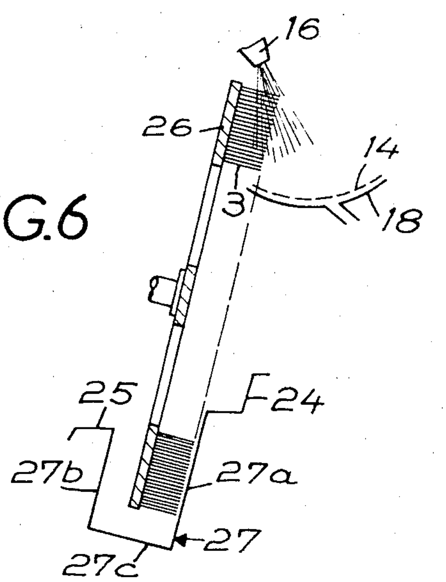

16
26
14
3
18
25
24
27b
27a
27
27c

FIG.6

SYSTEM FOR SEPARATING FIBRES FROM A FIBROUS SUSPENSION

The present invention refers to a method and device enabling the long fibres in a fibrous suspension to be separated from the other constituents.

Certain known filtration and classification devices employ members with gauged orifices such a filter cloths or perforated plates defining holes, slits or the like, these members being arranged across the suspension as it flows. The disadvantages of these known devices are the following:

— if the orifices are sufficiently small to hold back the majority of the fibres, these rapidly accumulate over the said orifices and the filtration then taking place through the fibres is accompanied by a considerable retention of fine and colloidal products with the fibres; such as phenomenon can lead to choking and in any case cause considerable load losses;

— on the other hand, if the orifices are larger a considerably quantity of long fibres escapes being trapped.

In order to obtain a greater selectivity with these known devices, one is led to dilute the suspension containing fine and colloidal products considerably, but then the output of the installation remains poor both as regards the quantity of long fibres recovered per unit of time and surface and as regards the energy expended.

Furthermore the fibres retained are intermingled and firmly tangled with the filtration member so that it is particularly difficult to extract them from it.

The method in accordance with the invention enables these disadvantages to be corrected and at the same time the long fibres to be easily, rapidly and automatically taken off as they are trapped.

In accordance with the invention the method consists

— in immersing in the suspension relatively fine needles the diameter of which is much smaller than the length of the fibres to be retained;

— to cause a relative motion between the suspension and the needles so that the long fibres straddle the latter;

— to bring the said needles out of the suspension and to make the fibres retained slide along these needles so that they fall off the ends.

The present invention also has as its object a device putting this method into effect and for this purpose comprising at least one movable support which circulates over one portion of its path into an enclosure fed with suspension and over the remainder of its path opposite a receptacle for the long fibres, this movable support being furnished with needles extending in an overhang.

This device may likewise comprise at least one nozzle for distribution of a fluid under pressure, directed towards the receptacle for long fibres across the path of the movable support.

In accordance with a particularly advantageous embodiment the enclosure containing the suspension consists of a tank two walls of which are parallel with and separated from the immersed portion of the movable support whilst the other two walls are located near the edges of this portion in order to define a duct for the circulation of the suspension and the channelling of the needles, this duct being fed at one end from a transfer volume arranged in the tank above the level of a weir provided at the end for the exhaust of the treated suspension.

The receptacle for long fibres is a member having gauged orifices such as a filter cloth or a perforated plate located straight below the place at which the tips of the needles in the portion of the movable support leaving the enclosure circulate at a level lower than that of the roots of these needles and into the volume of action of the nozzle or nozzles for distribution of the fluid under pressure.

Various other characteristics and advantages of the invention will moreover be evident from the detailed description which follows.

Embodiments of the object of the invention are shown by way of nonrestrictive example in the drawing attached.

In the drawing:

— FIG. 1 is a partial diagrammatic section illustrating a first way of performing the method of the invention,

— FIG. 2 is a partial elevation taken along the line II—II in FIG. 1,

— FIG. 3 is a view similar to FIG. 1 emphasizing a second way of performing the method.

— FIG. 4 is a diagrammatic view showing a first embodiment of the device in accordance with the invention,

— FIG. 5 is a diagram similar to that of FIG. 4 showing a second embodiment of the device.

— FIG. 6 is a diagram similar to that of FIG. 4 relating to a third embodiment of the device.

The suspension to be treated generally contains in a liquid, fibres of various lengths mixed with fine products as well as with colloidial products. It is a question of separating in this undiluted suspension the fibres having a length sufficient to be reusable.

As is clearly evident from FIG. 1, the suspension flows in the direction of the arrow F between two walls 1 and 2 one of which is furnished with needles 3 extending across the flow up to the proximity of the other wall.

These needles 3 are intended to intercept the fibres moved by the flowing suspension and to retain them. They must therefore be sufficiently fine and long for fibres having a length greater than the predetermined limit to be able to straddle them and stop there in this condition; moreover the distribution of these needles in tiers must be judiciously selected so that any fibres escaping from one needle can be collected by one of the later needles in the manner indicated above.

For example, if it is a question of retaining any fibres having a length over 1 mm, the needles can have a diameter of 0.2 mm and for instance, a length of about 28 mm; further, the needles in the same tier can be 1.5 mm apart, the successive tiers being stepped at 2 mm and the needles of one tier being arranged in a diamond pattern relative to those of the adjoining tier (FIG. 2).

Two of the essential phases of the method are thus found, which consist in immersing in the suspension relatively fine needles the diameter of which is much smaller than the length of the fibres to be retained, and in causing a relative motion between the suspension and the needles so that the long fibres thus moved are intercepted by the latter, straddle them, and are in this way retained.

It is not sufficient that these two phases be put into effect; it is also necessary that the fibres intercepted and retained should be extracted as this proceeds. For this reason the method likewise consists in bringing the needles out of the suspension and making the fibres that they have retained slide along so that they fall off the ends of said needles.

For this reason the needles must be integral at their roots with only one wall 2 and their opposite ends must be free; they cannot in consequence be integral with the wall 1 though remaining near the latter.

Consequently the needles must be manufactured of a material sufficiently rigid for them not to deform under the action of the suspension in motion, the thrust of which is exerted not only on their own section but also on the fibres loading them, or in any case only to deform to a small degree compatible with the geometry of the device.

The needles 3 may be as shown in FIG. 1, perpendicular to the wall 2. They may also, as is emphased in FIG. 3, be inclined relative to this wall so that their tips *3a* are located upstream of their roots *3b* if the relative velocity V between the suspension and this wall is considered, which velocity may result from the flow of the suspension along the fixed wall or from the movement of the wall in a stationary suspension or even from the flow of the suspension along a moving wall. The angle of inclination "*a*" of the needles may lie between 30° and 90°.

In the flow the various velocity gradients of the fluid cause rotation of the fibres in suspension. When a fibre in the course of its motion encounters a rigid needle it has the tendency to stop there adopting an "astride" attitude. The trapping thus obtained is the more effective the smaller the diameter of the needles relative to the length of the fibre and the more flexible the fibre. It is important to note that the fibres retained by the needles are washed by the fluid and thus separated from the fine products which accompany them.

Further, if the needles are inclined as shown in FIG. 3, the fluid current has the effect of moving these fibres along the needles to accumulate them against the roots of the latter and thus to clean the said needles constantly in order to preserve their efficacy vis-a-vis long fibres and to eliminate the occurrence of any phenomenon of retention of other constituents in the suspension.

Withdrawal of the fibres retained by the needles may be performed periodically if the device putting into effect the method described above is fixed, or else continuously if this device is movable as is evident from the various embodiments described below.

According to a first embodiment of the device as shown in FIG. 4, the needles 3 are carried by two continuous flexible belts 4 and 5 arranged on three rollers 6 to 8 and 9 to 11 respectively. One of the rollers (6 for the belt 4 and 9 for the belt 5, for example) is the driver for making the corresponding belt circulate in the direction of the arrow F1 and at least one of these rollers is of tensioner type. In addition, the rollers 6 and 9, 7 and 10 are spaced so that the spans *4a* and *5a* of the belts extending between them are parallel and that the tips of the needles on these spans are only a little way apart.

These spans *4a* and *5a* forming movable supports for the needles constitute two of the opposite walls of an enclosure in which flows the suspension, for example, in same the direction as the needles move (arrows F and F1), in which case the velocity of flow of the suspension must be higher than the velocity of movement of the belts; the two other walls of the enclosure may consist of fixed panels extending close to the edges of the spans *4a* and *5a*.

At the one end of the enclosure defined by the spans *4a* and *5a* the susepsnion is distributed by a throat 12, whilst at the opposite end the susepnsion from which the long fibres have been extracted is channelled by deflectors 13 towards an exhaust circuit.

Opposite the spans *4b* and *5b* of the belts 4 and 5 screens 14 and 15 are arranged, intended to receive the fibres retained by the needles 3 in the treatment enclosure and which have the tendency to escape from the said needles by simple sliding under the combined effects of gravity and the centrifugal force in the bends in the belts located at right angles with the rollers 7 and 8, 10 and 11.

In order to perfect the cleaning of the needles the device also includes nozzles 16 and 17 for distribution of a fluid under pressure, such as water; these nozzles are pointed onto the arrays of needles, tangentially with the rollers 8 and 11 and towards the screens 14 and 15 which are extended up to these points. The fluid distributed under pressure causes sliding of the fibres which are still on the needles, along the latter up to their ends whence they fall onto the screens 14 and 15; the fibres thus detached from the needles accumulate on these screens whilst the water is collected under the said screens in pans 18 and 19 furnished with discharge piping.

Consequently the needles carried by the spans *4c* and *5c* of the belts, extending between the pulleys 8, 6 and 11, 9 are clear of fibres and perfectly cleaned, so that they reach the treatment enclosure *4a*, *5a* perfectly ready to collect fibres from the suspension. Further, the fibres collected on the screens 14 and 15 are washed in the best possible conditions and ready for reuse.

According to the second embodiment illustrated in FIG. 5 the device comprises only one single continuous flexible belt 20 supporting an array of needles 3 and arranged on two rollers 21 and 22 one of which is the driver. This belt is immersed in its lower portion in a tank 23 the opposite walls and the bottom of which are appropriately spaced from the tips of the needles 3, the sidewalls of the said tank being located very close to the edges of the belt.

The wall of the tank 23 parallel with the descending span *20a* of the belt is surmounted by a transfer volume 24 in which the susepnsion to be treated is distributed; on the other hand the wall of the tank parallel with the rising span *20b* of the belt is extended by a weir 25 located at a level lower than that of the volume 24, these two walls of the tank and the belt 20 defining a treatment enclosure 28 having the form of a curved U-channel. Thus the susepnsion circulates in this channel 28 from the volume 24 round to the weir 25 and the movable needles take out the long fibres during their passage through this suspension.

This device of FIG. 5 includes as in the previous case a nozzle 16 for distribution of a fluid under pressure, a screen 14 for recovery of the long fibres and a liquid exhaust pan 18. But in this embodiment as FIG. 5 the nozzle, screen and pan are located in the portion of the belt 20 and the needle array 3 out of the liquid in the vicinity of the upper roller 22.

According to the third embodiment shown diagrammatically in FIG. 3, the movable support for the needles consists no longer of a continuous flexible belt but of a rotating disc **26**. In this case the disc is immersed at its lower part in a tank **27** one of the sidewalls **27***a* of which, surmounted by the transfer volume **24**, is located very close to the tips of the needles whilst the other sidewall **27***b* extended by the weir **25** is spaced wider from the disc **26**, as also is the curved bottom **27***c* of this tank to enable flow of the suspension after its passage across the needles. The upper portion of the disc **26** and the corresponding needles cooperate as in the previous case with a nozzle **16**, a screen **14** and a pan **18**. But in order to facilitate the extraction of the fibres retained by the needles it is desirable that the latter be inclined with the point downwards, at least in the zone of intervention of the nozzle **16**; for this purpose the axis of rotation of the disc **26** may be inclined, the needles **3** carried by this disc being in that case parallel with the said axis, or else this axis of rotation may be horizontal, the needles in that case being inclined relative to the disc with their points directed towards this axis.

The method and the device of the invention may be employed in all cases in which separation of fibres which are long relative to the other constituents in a fibrous suspension must be obtained in an effective and economical manner.

Applications of particular interest may be the treatment of effluents from paper manufacture, the classification of preparations on the basis of old scrap paper, etc.

We claim:

1. A method of separating fibres of a fibrous suspension from the other constituents, comprising the steps of:

— immersing in the suspension relatively fine needles the diameter of which is much smaller than the length of the fibres to be separated;

— causing relative motion between the susepnsion and the needles so that the fibres to be separated straddle the latter;

— bringing the said needles out of the suspension and causing fibres retained thereon to slide along these needles so that they fall off the ends.

2. A method as in claim **1**, wherein the retained fibres are caused to slide by directing against the needles and towards their free ends, a jet of fluid under pressure.

3. A method as in claim **1**, wherein the retained fibres are caused to slide by inclining the needles downwards.

4. A method as in claim **2**, including directing against the needles and towards their free ends, a jet of fluid under pressure.

5. A device for separating fibres from a fibrous suspension, comprising at least one movable support which moves over one portion of its path into an enclosure, fed with fibrous suspension and over a second portion of its path opposite a receptacle for the fibres to be separated, this movable support being furnished with needles extending therefrom.

6. A device as in claim **5**, including also at least one nozzle for distribution of a fluid under pressure, directed towards the receptacle for fibres to be separated across the path of the movable support.

7. A device as in claim **5**, wherein the needles are arranged in a diamond pattern on the movable support.

8. A device in claim **5**, wherien the needles are attached at their roots to the movable support and are free at their opposite ends.

9. A device as in claim **8**, wherein the needles are perpendicular to the movable support.

10. A device as in claim **8**, wherein the needles are inclined so that their tips are located upstream of their roots.

11. A device as in claim **5**, wherein the movable support is a continuous belt.

12. A device as in claim **5**, wherein the movable support is a rotatable disc.

13. A device as in claim **11**, wherein the enclosure containing the suspension consists of a tank, two walls of which are parallel with and separated from the immersed portion of the movable support whilst the other two walls are located near the edges of this portion in order to define a duct for the circulation of the suspension and the channelling of the needles, the duct being fed at one end from a transfer volume arranged in the tank above the level of a weir provided at the end for the exhaust of the treated suspension.

14. A device as in claim **11**, wherein the enclosure containing the suspension is defined by the facing portions of two mobile supports mounted face to face and by two walls located close to the edges of these portions, this enclosure being open at its two ends for feeding in and exhanusting the suspension.

15. A device according to claim **22**, wherein the enclosure containing the susepnsion is defined by the facing portions of two mobile supports mounted face to face and by two walls located close to the edges of these portions, this enclosure being open at its two ends for feeding in and exhausting the suspension.

16. A device as in claim **12**, wherein the enclosure for containing the suspension is a tank in the shape of a sector of a cylinder centered on the rotatable disc.

17. A device as in claim **5**, wherein the receptacle for fibres is a member having gauged orifices such as a filter cloth or a perforated plate located straight below the place at which the tips of the needles in the portion of the movable support leaving the enclosure circulate at a level lower than that of the roots of these needles and into the volume of action of the nozzle or nozzles for distribution of the fluid under pressure.

18. A device as in claim **16**, wherein the enclosure for containing the suspension is a tank in the shape of a sector of a cylinder centered on the rotating disc.

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