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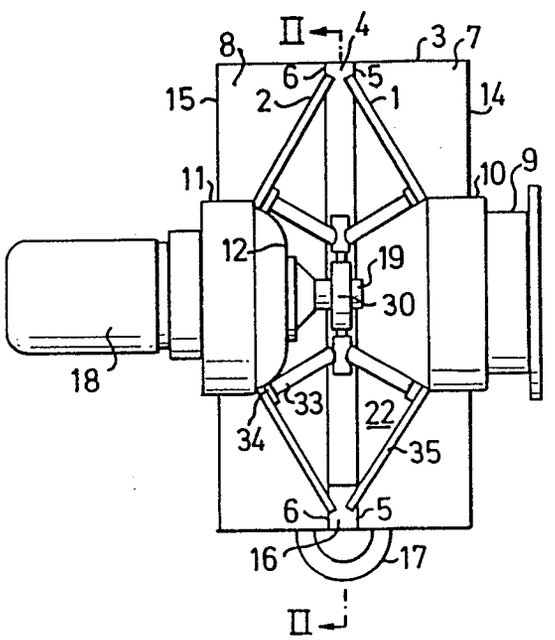
(54) Apparatus for fractionating fiber suspensions.

(57) The invention relates to an apparatus for fractionating fiber suspensions, said apparatus including a chamber (22) converging towards its periphery and formed by two annular fiber fractionating means (1, 2), preferably implemented as truncated cones, a collection trough (4) arranged concentric to and at the periphery of the chamber (22) for fibers retained by the fiber fractionating means (1, 2), and agitating means (20) departing from a centrally arranged shaft (19) and rotatable therewith, the means (20) having vanes (35) contiguous to the fiber fractionating means (1, 2), the vanes (35) having an engagement area coacting with the fiber fractionating means.



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APPARATUS FOR FRACTIONATING FIBER SUSPENSIONS

The present invention relates to an apparatus for fractionating aqueous fiber suspensions containing cellulose fibers, more specifically a fiber fractionating apparatus of the kind disclosed in the preamble to Claim 1.

In the present application and claims there is intended a division of an aqueous suspension of cellulose fibers into two fractions, of which the first contains fibers slushed up in water, which are substantially above a given size, and the second contains fibers substantially below a given size, the boundary between the fractions not being sharp but depending on the statistical character of the fractionating method.

Examples of such fiber fractionation are rough screening, fine screening and thickening. In rough screening the first fraction mainly contains larger fiber bundles, shives and larger particles, while the second fraction contains fibers of different sizes as well as fines. The reverse condition is obtained in thickening. The first fraction contains, generally speaking, all fibers except a portion of fines, while the second fraction only consists of liquid and fines.

The object of the present invention is to provide an apparatus for fiber fractionation in which the incoming fiber suspension is divided into two fractions.

Another object is to provide such fractionations as rough screening, fine screening and thickening with intermediate forms of fractioning of fibers in the same apparatus by merely changing the fractionating means.

The intended object is achieved with a fiber fraction apparatus which includes an annular chamber converging towards its periphery, formed by two annular elements preferably implemented as truncated cones, of which at least one is a fiber fractionating means; a collection trough arranged concentric with the chamber and at its periphery for fibers retained by the elements, from a centrally

arranged rotatable shaft and agitation means rotatable with the shaft, the agitation means having vanes extending in the collection trough and situated adjacent the fiber fractionating means, each vane having an engagement area engaging against the fiber fractionating means with which it coacts.

The essential features further characterizing the invention are apparent from the claims, and in the following different embodiments of the invention are described in conjunction with the accompanying drawing, on which

Fig. 1 is a section of an embodiment,

Fig. 2 is a cross section along the line II-II in Fig. 1,

Fig. 3 is an embodiment of the present agitation means, and

Figs. 4-7 illustrate contours of vanes used in the present invention.

The fiber fractionation apparatus according to Figs.1 and 2 has two stationary fractionating means 1,2 implemented as annular elements which are axially, laterally arranged relative each other and have the shape of the sweep of a truncated cone. The elements 1,2 are made in one piece and have perforations 23 in the form of round holes. They are adapted such that they have the concave sides facing towards each other and are each removably attached at their outer edges to the inner edge of an annular support element 5,6. The support elements 5,6 are axially laterally arranged and are connected with its outer edges to a surrounding cylindrical housing or casing 3. Together, the support elements 5,6 and the portion of the cylindrical housing 3 between them form an annular collection trough 4, which is open at the inner edge of the elements 5,6 towards a fiber fractionation chamber 22 which is disposed between the fiber fractionating means 1,2. The fiber fractionating means 1,2 are each removably attached to their respective portions of an inner, intermediate wall consisting of two cylindrical parts 10,11 concentric with the cylindrical casing, the parts 10,11 uniting the inner edges of the fiber fractionating

means 1,2, each to the respective end wall 14,15 of the casing 3. One cylindrical part 10 of the intermediate wall is on its side facing away from the chamber 22 provided with an inlet 9 for fiber suspension. The other cylindrical part 11 of the intermediate wall is provided on its side facing towards the chamber 22 with a wall 12 sealing against the chamber 22. There is a lead-through in the wall 12 for a rotatable shaft 19 which is driven by a motor 18 projecting into the room formed by the cylindrical portion 11 and the joining wall 12.

The rotatable shaft 19 carries two agitating means 20 which are rotatable with the shaft. The agitating means 20 (Fig. 1) are attached to the shaft with the aid of a sleeve 30, which is adjustable axially on the shaft 19 and non-rotatably connected to it with the aid of a screwed joint at the free end of the shaft. Two pins 31 project from the sleeve 30, a central body 32 being attached to each pin. The central body is rotatable about and displaceable along the pin 31 for adjusting the position of the agitating means 20. Two arms 33, directed towards each other, depart from the central body 32, a vane 35 being attached to each arm. Each vane has an orientation relative the fractionating means with which it coacts such that it engages with an engagement area 33 against the fiber fractionating means, substantially in the direction of the generatrix. The dimensions of the vane 35 in the direction of the generatrix are such that the vane projects into the collection trough 4, and during rotation of the shaft 19 has swept, after one complete revolution, over the entire fiber fractionating means with which it coacts.

Further to the collection trough 4, the apparatus has three separated spaces 22,7,8. The first space is the fiber fractionating chamber 22, which is defined by the inlet 9 and the area between the fiber fractionating means 1,2. The chamber 22 is open towards the trough 4 which close to its lowest point has an opening 16 with an outlet 17. The chamber 22 communicates via the openings of the fractionating

means 1,2 with two connection spaces 7,8. One space 7 is defined by the cylindrical casing 3, the end wall 14, the part 10 of the intermediate wall, the fractionating means 1 and the support element 5 which forms the right-hand side wall of the trough 4 in Fig. 1. The second collection space 8 is defined by the cylindrical casing 3, the end wall 15, the wall 12, the part 11 of the intermediate wall, the fractionating means 2 and the support element 6. A common outlet 13 is connected to the two collection spaces 7,8 but they may each be provided with an outlet.

The casing 3, as will be seen from Fig. 2, is made in two halves, one upper and one lower half, of which the upper is connected by means of hinges 21 or the like to the lower half and is thus raisable.

In accordance with the invention, the conical angle for the fractionating means 1,2 should lie within the interval 90° - 180° and preferably have a value of between 120° and 150°. It is particularly preferred that both of the fractionating means 1,2 have the same conical angle.

According to one embodiment, there is only one fractionating means, the other element being blank, i.e. it lacks perforations.

The fiber fractionating means 1,2 have perforations 23 in the form of holes or slots. The holes are preferably round holes which are cylindrical or conical, the wider part of the conical holes facing towards a reception space 7 or 8. The slots may also widen towards the reception space, or have parallel side walls. The size of the perforations depend on the size of particles it is desired to pass through the fiber fractionating means, and varies within wide limits. For thickening, at which only a part of the fines passes through the openings, the perforations have a diameter, or a least diameter if they are conical, of 0.2 - 1.5 mm, and with a perforated area, i.e. a quotient between the total area of the perforations and the total area of the fractionating means, of at least 50%. The upper limit is about 50% for practical reasons. When using slots, they have a

width of 0.1 - 0.5 mm. The open area is also in this case at least 30%. For screening, the openings have a diameter of 1 - 10 mm, or a width of 0.2 - 2 mm. The open area is between 5% and 30%.

When using the described apparatus, the fiber suspension is supplied through the inlet 9 and is distributed in the inner chamber 22 defined by the fractionating means 1,2. The shaft 19 with the agitating means 20 rotates in this chamber, the vanes 35 engaging with their engaging surface 36 against the fractionating means with which they coact, and during their movement prevent fibers and agglomerates, retained by the fractionating means, from fastening on said means. The heavier fraction of the incoming material, which has not passed through the openings 23 of the fiber fractionating means, is fed out to the collection trough 4, where it leaves the apparatus through the opening 16 and outlet 17. The finer fraction of the incoming material is caused to pass through the openings 23 of the fractionating means 1,2 into the collection spaces 7,8. The latter fraction leaves the collection space 7,8 via the common outlet 13.

Fig. 3 illustrates another embodiment of the agitating means 20 and its attachment to the shaft 19. The arms 33, carrying the vanes 35 via attachment means 34, depart from a central body 29. This body is thrust into a sleeve 28 which is rigidly attached to a sleeve 27. In the same way as the sleeve 30, the sleeve 27 is settable axially and non-rotatably connected to the shaft 19. The central body 29 is locked in a desired position with the aid of a nut 26 on the sleeve 28.

The vane 35 consists of a plastic material with a small coefficient of friction, e.g. plastics, and is fixed to the arm 33 via the fixing means 34 in the part closest to the shaft 19. Since the vane is only attached at one end and due to its plasticity, it can bear yieldingly against the fiber fractionating means during the rotation of the agitation means 20. The vane 35 has a dimension in the direction of the generatrix such that it extends into the collection trough 4. It thereby reduces or eliminates the edge effect resulting in

plugging up of the perforations nearest to the trough. The cross section of the vane in the direction of the generatrix is preferably constant.

Implementations of the vane 35 in profile, i.e. in cross section at right angle to the direction of the generatrix, are illustrated in Figs. 4 - 7. The arrow P illustrates the direction of movement of the vane. The part of the vane 35 engaging against the fiber fractionating means is denoted by 36 and relates to the engagement area. The engagement area 36 has small dimension in the direction of movement of the vane in relation to the total dimension of the vane in the same direction, and is farthest forward on the vane. The art of the vane facing towards the fibre suspension may have or more discernable areas. The first area, which is connected to the engagement area, is denoted by 37. The angle between the area 36 and 37 is a right angle or preferably acute, e.g. 90^{o} - 40^{o}. The area 37 can be flat, convex or concave. The part of the vane facing towards the fiber suspension can have any of the shapes illustrated in Figs. 1 - 4. What is essential is that the vane has a shape such that it is urged against the fiber fractionating means by the suspension it collides with on rotation of the agitating means 20.

Behind the engagement surface 36, seen in the direction of movement of the vane, there is an area 38 at a distance from the fractionating means and facing towards it. The distance between the area 38 and the fiber fractionating means is 5% - 20% of the total dimension of the vane in its direction of rotation. The area between the area 36 and the area 38 has small extension as seen in the direction of rotation of the vane.

The rear side of the vane, between the area 38 and the portion of the vane facting towards the fiber suspension, has also importance for the ability of the vane to keep the fractionating means clear. This is preferably a flat area 40, and the angle between it and the area 38 is a right angle or obtuse angle, e.g. 90^{o} - 135^{o}.

The fiber fractionating apparatus described hereinbe-

fore and illustrated in the drawing is of course only to be regarded as an embodiment of the invention. Other embodiments within the scope of the main claim are therefore also conceivable. It is thus not necessary that the shaft of the apparatus is horizontal, as illustrated in the drawing. The shaft may also have another orientation in space. It is of course possible to use any conical angle for the fiber fractionating means within the scope of Claim 1, Neither is it necessary that the conical angle of the fractionating means is constant along the entire length of the generatrix. On the contrary, it is sufficient that the angle between the geometric axis of the fractionating means and an optionally selected tangential plane to the fractionating means is within the preferred interval of 45^{o} - 90^{o} and particularly has a value between 60^{o} and 75^{o}, which corresponds to a conical angle of 90^{o} - 180^{o} and 120^{o} - 150^{o}, respectively. This thus signifies that the generatrix of the fractionating means may also consist of a completely or partially curved line.

Finally it should be pointed out that the agitating means may have merely one arm, on which the vane engaging against the fiber fractionating means is attached. Furthermore, the arm or arms may be attached directly to the shaft 19 or via a sleeve axially adjustable on the shaft. The arms may also be adapted resiliently, so that the vanes are urged harder against the fractionating means for increasing the revolutionary rate of the shaft 19.

CLAIMS

1. Apparatus for fractionating fiber suspension including a chamber (22) converging towards its periperhy, which is formed by two annular elements (1,2) preferably formed as truncated cones, of which at least the first is a fiber fractionating means, a collection trough (4) concentric with and disposed at the periphery of the chamber (22) for fibers retained by the elements (1,2), agitating means (20) departing from a centrally arranged shaft (19) and rotatable therewith, which has vanes (35) adjoining the fiber fractionating means (1,2), characterized in that the vanes have an area (36) engaging against the coacting fiber fractionating means.

2. Apparatus as claimed in Claim 1, characterized in that each agitating means (20) has at least one but preferably two vanes, each engaging against its fiber fractionating means (1,2) substantially in the direction of the generatrix and sweeping over the entire fiber fractionating means during a complete revolution, and that its vanes extend into the collection trough (4).

3. Apparatus as claimed in Claim 1 or 2, characterized in that the dimension of the engagement area (36) in the direction of rotation of the vane (35) is short in relation to the total dimension of the vane in its direction of rotation.

4. Apparatus as claimed in any one of Claims 1 - 3, characterized in that the engagement area (36) is farthest forward on the vane (35) in relation to the direction of rotation of the vane.

5. Apparatus as claimed in any one of Claims 1 - 4, characterized in that the vane (35) has an area (38) facing towards the fiber fractionating means and situated behind the engagement area (36) in relation to the direction of rotation of the vane, the area (38) being at a distance from the fiber fractionating means, and in that the distance is 5% - 20% of the dimension of the vane (35) in the direction of rotation of the vane.

6. Apparatus as claimed in any one of Claims 1 - 5, characterized in that the rear side of the vane forms an angle of 90° - 135° with the fiber fractionating means.

7. Apparatus as claimed in any one of Claims 1 - 6, characterized in that the front edge of the vane forms an angle of 90° - 40° with the engagement area (36).

8. Apparatus as claimed in any one of Claims 1 - 7, characterized in that each vane (35) has at least one flat area (37,39) and/or an area (41) with continuous curvature, which forms an acute angle with the plane of the engagement area (36) and when the vane (35) rotates collides with the suspension, whereby the vane is urged harder and harder towards the fractionating means with which it coacts for increasing revolutionary rate.

9. Apparatus as claimed in any one of Claims 1 - 8, characterized in that the vane comprises a plastic material with small coefficient of friction.

10. Apparatus as claimed in any one of Claims 1 - 9, characterized in that each vane (35) is resiliently arranged relative the shaft (19).

11. Apparatus as claimed in any one of Claims 1 - 10, characterized in that the fiber fractionating means (1,2) are provided with holes or slots with an open area of at most 30%.

12. Apparatus as claimed in any one of Claims 1 - 10, characterized in that the fiber fractionating means (1,2) are provided with holes or slots with an open area of 20% - 50%.

13. Apparatus as claimed in any one of Claims 5 - 12, characterized in that the flat rear side (40) of the vane (35) forms an angle with the plane of the engagement area (36) of 90° - 150°, preferably 90° - 135°.

14. Apparatus as claimed in any one of Claims 1 - 13, characterized in that each agitating means (20) includes a central body (32) attachable to the shaft (19) and at least one but preferably two arms (33) arranged on the central body (32) with an attachment means (34) for a vane (35) on each arm (33).

15. Apparatus as claimed in any one of Claims 1 - 13, characterized in that each agitating means (20) has at least one arm (33) attachable directly or indirectly on the shaft (19) with an attachment means (34) for a vane (35).

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FIG.2

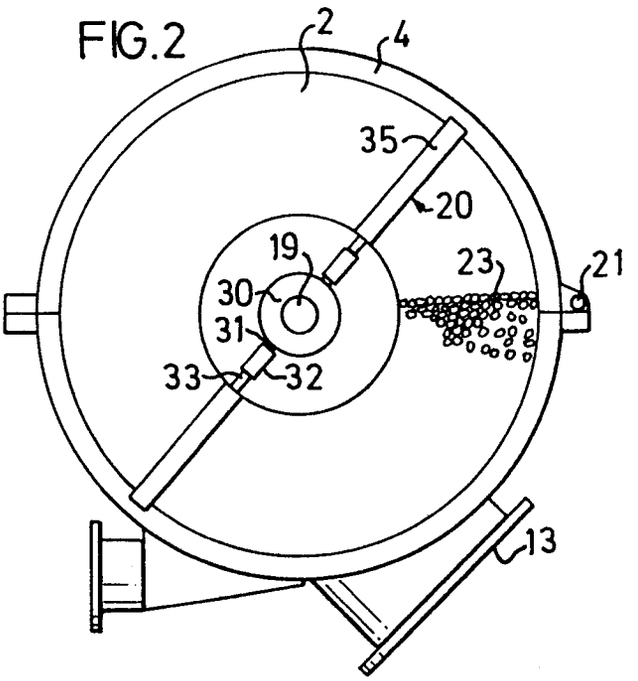
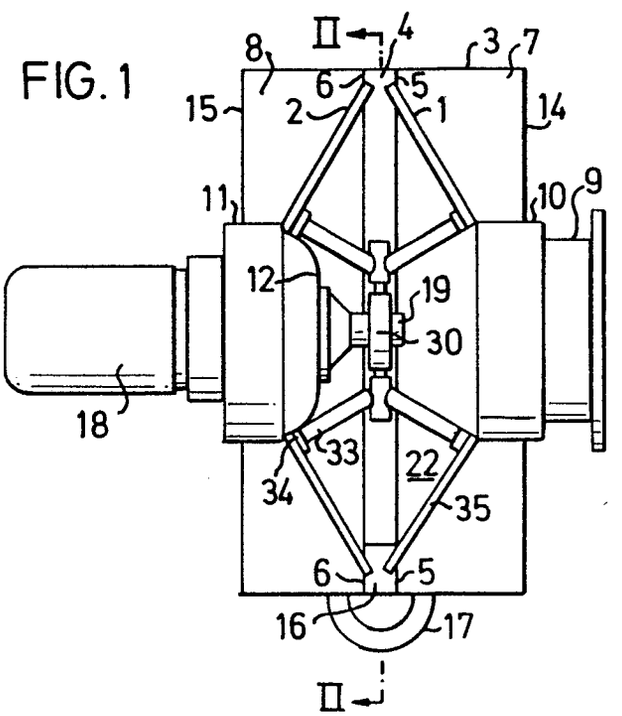


FIG.1



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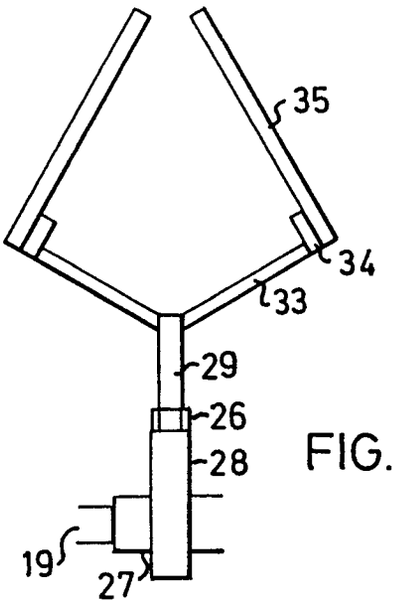

FIG. 3

FIG.4

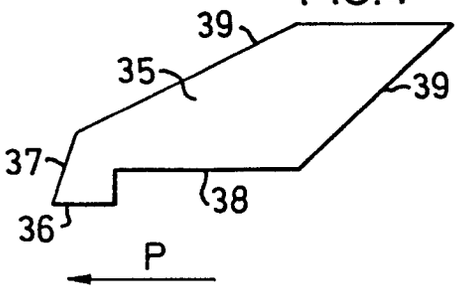

FIG.5

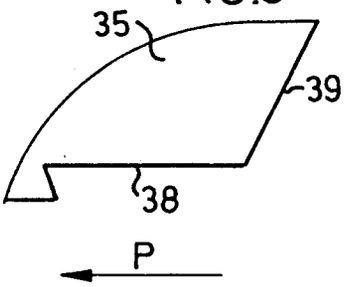

FIG.6

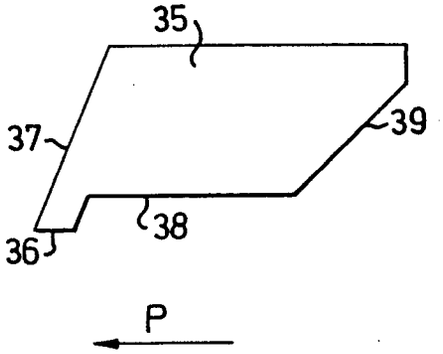

FIG.7