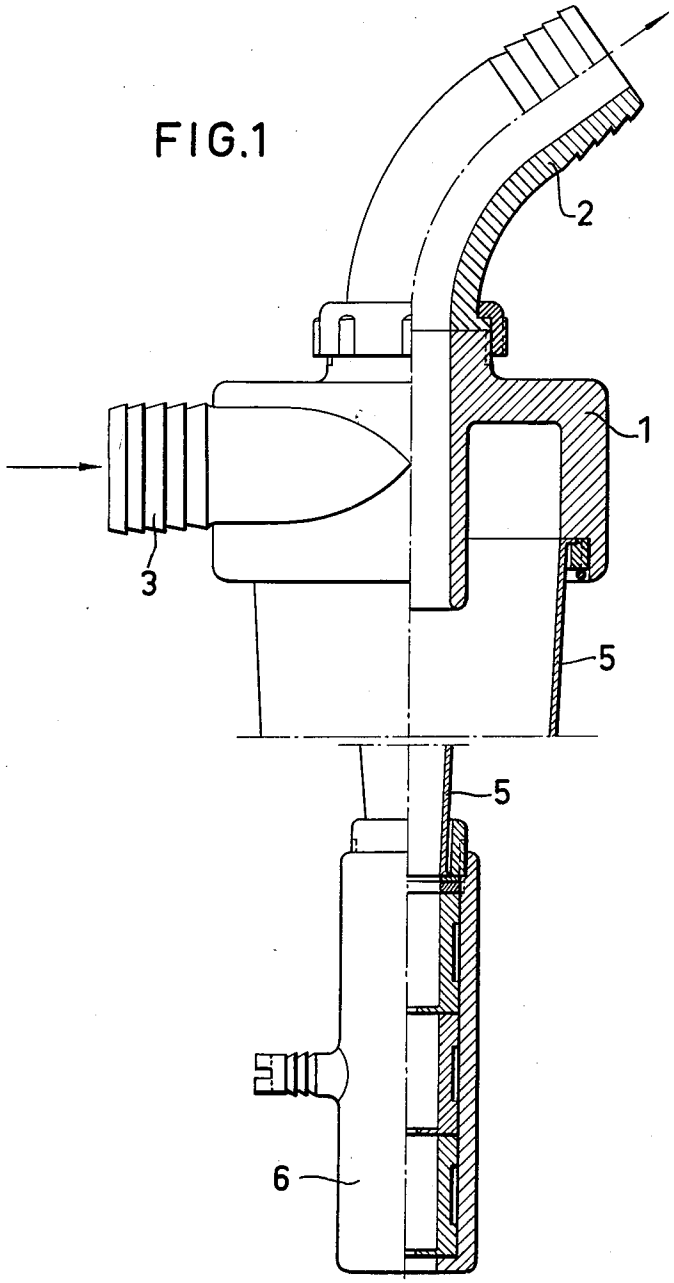
June 19, 1962 N. A. L. WIKDAHL 3,039,608

METHOD AND APPARATUS FOR SEPARATING FIBROUS SUSPENSIONS IN HYDROCYCLONES

Filed May 8, 1959 3 Sheets-Sheet 1

FIG.1



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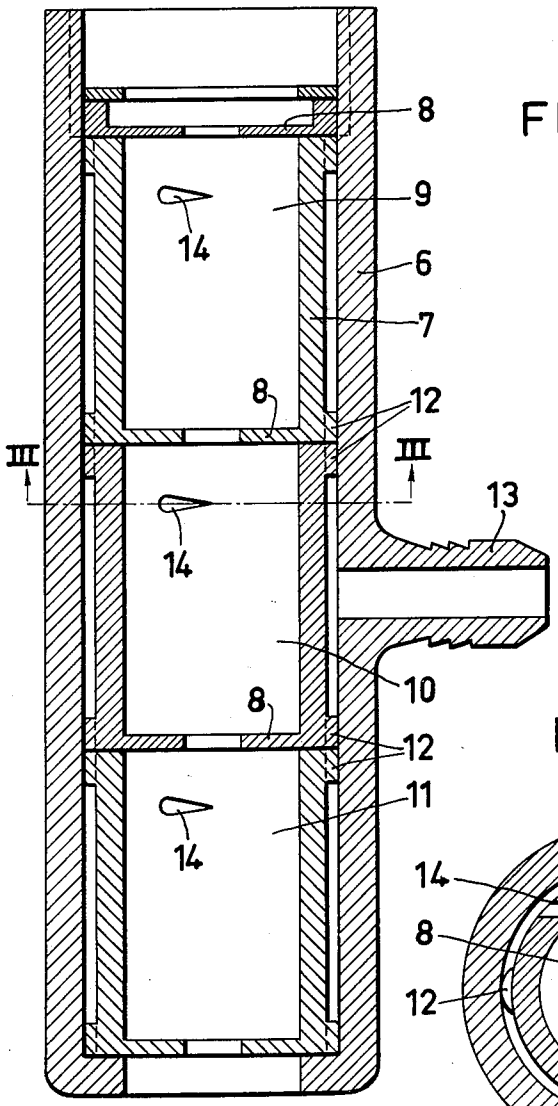
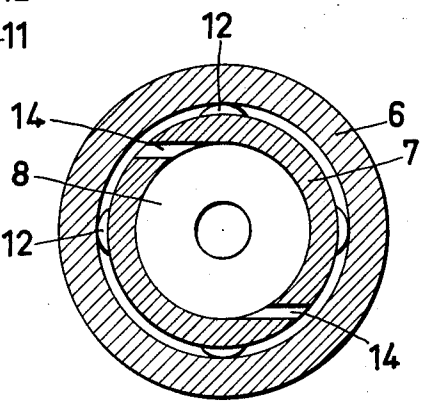


FIG. 2

FIG. 3



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METHOD AND APPARATUS FOR SEPARATING FIBROUS SUSPENSIONS IN HYDROCYCLONES

Filed May 8, 1959 3 Sheets-Sheet 3

FIG. 4

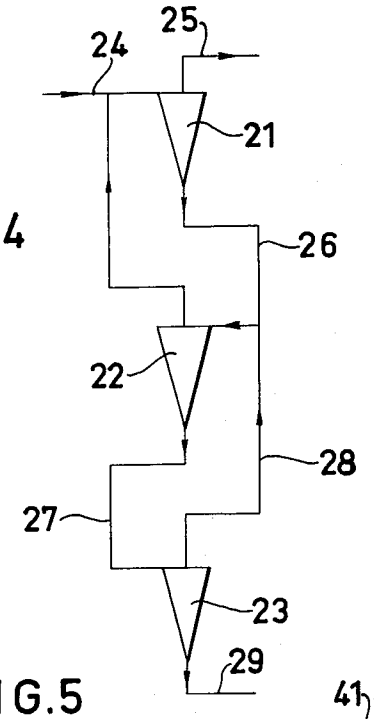
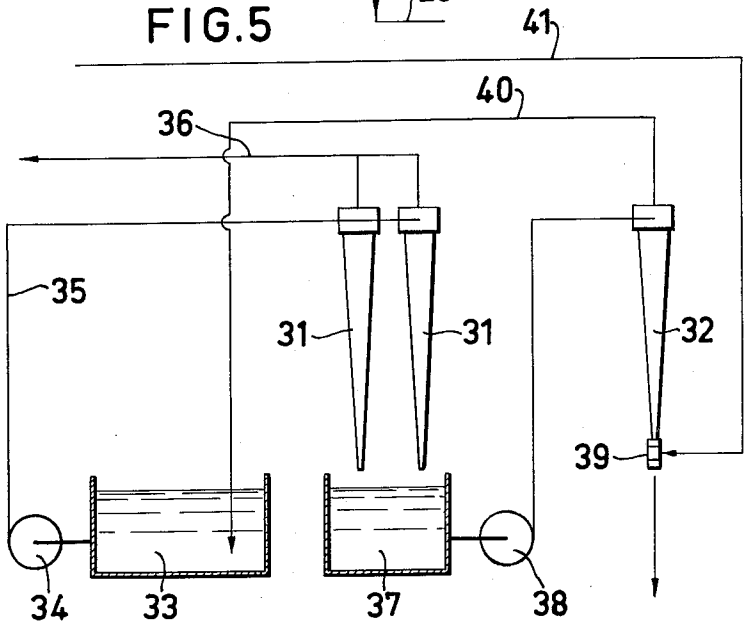


FIG. 5



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United States Patent Office 3,039,608 Patented June 19, 1962

3,039,608

METHOD AND APPARATUS FOR SEPARATING FIBROUS SUSPENSIONS IN HYDROCYCLONES

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Filed May 8, 1959, Ser. No. 812,071
Claims priority, application Sweden May 8, 1958
6 Claims. (Cl. 209—211)

The present invention relates to a method of separating or fractionating fibrous suspensions, preferably suspensions of cellulose or wood pulp in hydrocyclones and to an apparatus for carrying out said method. Hydrocyclones are, as known, such devices which consist of a chamber having a circular cross section and at least one inlet and at least two outlets of which at least one is axially arranged. Said hydrocyclones are provided with means for imparting to the suspension introduced a rotary motion around the axis of the chamber and the chamber is shaped in such a way that a substantial part of the pressure energy supplied is transformed into rotary energy. A preferred embodiment of such a hydrocyclone comprises a conical chamber into which the suspension is introduced tangentially in the wider portion of the chamber whereby vertical movements arise causing the heavier or dynamically heavier particles (the coarser fraction) to leave the chamber through the apex. The lighter particles (the finer fraction) leave the chamber through a central outlet, the so-called overflow pipe.

In the cellulose and wood pulp industry the hydrocyclone plants are arranged in multiple steps, such as four or five steps. This means that the lighter fraction from one step except from the first step is returned to the inlet of a preceding step and that the heavier fraction from one step is introduced into the inlet of a following step. Generally, the secondary steps do not improve the total separating effect of the plant. They serve in the first place to reduce the fibre losses. For this reason the heavier fractions are pumped to a following step after dilution. Thus, diluting liquid and energy are supplied in order to reduce the fibre losses and to make the plant more effective.

Said multiple step hydrocyclones are very complicated as each step requires a pump and extensive pipe lines, motors, controlling means and so on. The pumps in the secondary steps are worn very much as in general the concentration of wearing particles increases for each step. Thus, a lot may be gained if the number of steps can be reduced.

The present invention relates to a method by which the above mentioned inconveniences may be removed and by which a better fibre fractionation or separation may be obtained.

Accordingly, the present invention broadly consists in causing the fibrous suspension to pass through two or more choking members on its way towards the outlet for the heavier fraction and in supplying liquid at a pressure of 0.5 to 3.0 atmosphere gauge between the choking in such a way that a cyclone action arises. The choking members are preferably made of an elastic material such as rubber. In this case the choking members may be expanded temporarily in order to prevent clogging. The liquid introduced may be given a rotary motion in the same direction as that of the suspension but may in some cases be given a direction opposite to that of the suspension. The liquid, such as water, may be supplied immediately after the choking members seen in the direction towards the outlet for the heavier fraction. The apertures of the choking members may have a different size so that the choking member situated nearest to the inlet for the suspension has a larger aperture than that of the following choking member.

The pressure of the liquid introduced between the choking members is preferably lower than that of the suspension supplied, and is preferably 0.1 to 3.4 kg./cm.^{2} lower, such as 0.5 to 2.0 kg./cm.^{2} lower. The liquid is supplied in general in a quantity of less than 50% of the suspension primarily supplied and preferably less than 20%.

The invention relates also to an apparatus for carrying out the above described method and said apparatus comprises a hydrocyclone which at the outlet for the heavier fraction is provided with a housing divided into at least two chambers which are separated by choking members and each chamber being provide with a tangential inlet for liquid.

The invention is more particularly described with reference to the accompanying drawings in which

FIG. 1 shows a longitudional section of a hydrocyclone,

FIG. 2 is a longitudinal section on a larger scale through the apex portion of the hydrocyclone,

FIG. 3 is a section along the line III—III of FIG 2,

FIG. 4 shows diagrammatically a conventional hydrocyclone plant, and

FIG. 5 is a hydrocyclone plant according to the present invention.

The hydrocyclone according to FIG. 1 comprises a lid **1** having an outlet **2**, the so-called overflow pipe, for the finer fraction, and inlet **3** for the suspension to be treated and a conical portion **5** having an outlet for the coarser fraction. The apex of the conical portion **5** is provided with a housing **6**, more specifically shown in FIG. 2. The housing **6** consists of a cylindrical casing in which another cylindrical casing **7** is situated. The casing **7** is divided into three chambers **9**, **10** and **11** by means of choking members **8**, and is kept at a distance from the inner wall of the outer casing by means of spacing elements **12**. Liquid may be supplied to the space between said casings by a tubular extension **13** of soft rubber having a central aperture. In the wall of the casing **7** there are provided aperatures **14** tangentially connected to the inner wall of the casing **7** in the neighborhood of the choking members **8**. The height of the chambers **9**, **10** and **11** shall be larger than the diameter of the chambers.

The suspension to be treated is introduced under pressure by means of the inlet **3** into the wider portion of the cyclone and is imparted a cyclone movement towards the apex of the cyclone. The coarser particles move downwards along the periphery towards the apex and the finer ascend in the vortex formed in the interior of the cyclone and leave through the overflow pipe **2**. The coarser particles pass into the chamber **9** and will there meet water supplied by the tubular extension **13** whereby a further separation of the coarser particles takes place due to the arising cyclone action. In the same manner a repeated fractionation occurs in the chambers **10** and **11**. In this way a further part of the finer fraction separated in the conical portion of the cyclone, which fraction has been further treated in the chambers **9**, **10**, **11**, is returned to the outlet **2** thus reducing the fibre losses.

In FIG. 4 is shown a conventional hydrocyclone plant which comprises three groups of hydrocyclones **21**, **22** and **23**. The suspension to be treated is introduced through a pipe **24** into the cyclone **21**. The resulting finer fraction is discharged through a pipe **25** and the coarser fraction through a pipe **26** and is introduced into the cyclone **22**. Therefrom the finer fraction is pumped through the pipe **24** to the cyclone **21**. The coarser fraction leaving the cyclone **22** is fed to the cyclone **23** through the pipe **27** and the finer fraction obtained in cyclone **23** is introduced into the cyclone **22** through a pipe **28**. The coarser fraction leaving the cyclone **23** is discharged through a pipe **29**.

The plant shown in FIG. 5 which is carried out according to the present invention, is with regard to the capacity

equivalent to the plant shown in FIG. 4. It comprises a set of hydrocyclones 31 in a first step and a set of hydrocyclones 32 in a second step. The suspension to be treated is fed from a vessel 33 via a pump 34 and a pipe 35 to the cyclones 31 and the finer fraction leaves through a pipe 36. The coarser fraction is fed to a vessel 37 and is introduced via a pump 38 into the hydrocyclones 32 made in accordance with the present invention, i.e. they are provided with a housing 39 containing three chambers connected to the apices of the cyclones. The finer fraction obtained is returned to the vessel 33 through a pipe 40. Water is introduced into the housing 39 through a pipe 41.

In certain cases the hydrocyclones according to the invention may have an inferior separating capacity than conventional cyclones. In such cases excellent results are obtained if conventional hydrocyclones are used in the first step and the coarser fraction from said step is introducted into a second step using hydrocyclones in accordance with the present invention as disclosed in FIG. 5.

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

1. A method of separating or fractionating fibrous suspensions in a hydrocyclone chamber having a circular cross section comprising, the step of: introducing a suspension tangentially under pressure into the hydrocyclone chamber to form a vortex, dividing the suspension in the vortex into a lighter ascending fraction and a heavier apex fraction, discharging each of the lighter and heavier fractions through individual axially aligned outlets, further treating the heavier fraction by constricting said heavier fraction from its individual axial outlet in at least two choking members, and passing a liquid under a pressure of 0.5 to 3.0 atmosphere gauge tangentially at a point intermediate the choking members to impart a cyclone action increasing the rotational speed of the heavier fraction.

2. A method according to claim 1 wherein the liquid is introduced between the choking members at a pressure which is 0.1 to 3.4 kg./cm.^{2} lower than the pressure of the fibrous suspension introduced.

3. A method according to claim 1 wherein the liquid is introduced immediately downstream from the choking members.

4. Apparatus for separating or fractionating fibrous suspensions comprising a hydrocyclone having an outlet for a heavier fraction, said outlet including a housing divided into at least two seperate chambers separated by choking members, each one of said chambers being provided with a tangential inlet for introducing liquid into the interior thereof during passage of the heavier fraction passing into said housing to impart a cyclone action increasing the rotational speed of the heavier fraction.

5. A method of separating fibrous material from solids intermingled therewith by means of a hydrocyclone assembly, said method comprising the steps of tangentially feeding under pressure a liquid suspension of said fibrous material and solids into a first chamber of said assembly to form in said chamber a spirally rotating flow in which liquid enriched with fibrous material flows centrally upwards and liquid enriched with solids flows peripherally downwards, directing the downward flow through a constriction into a second chamber of the assembly, feeding liquid under a pressure of 0.5 to 3.0 atmosphere tangentially into said second chamber to impart to the enriched liquid in said chamber a renewed spirally rotating flow in which liquid enriched with fibrous materials again flows centrally upwards and liquid enriched with solids again flows peripherally downwards, and discharging the liquid flows enriched with solids at the base of the hydrocyclone assembly and the liquid flows enriched with fibrous material at the top of the hydrocyclone assembly.

6. An installation for a multiple stage separation of fibrous material from solids intermingled therewith, said installation comprising a hydrocyclone including an elongated first housing of rotation of symmetric cross section, an inlet duct tangentially communicating with said first housing for feeding a pressure flow of a liquid suspension of fibrous material and solids into said first housing and to impart to said flow a spirally rotating motion within the first housing, a discharge duct connected to the top of said first housing to discharge therefrom liquid enriched with fibrous material, said hydrocyclone constituting the first separation stage, an elongated second housing of rotation of symmetric cross section disposed beneath said first housing coaxially therewith, one end of said second housing communicating with the base of said first housing to discharge therefrom liquid enriched with solids but still containing fibrous material into said second housing transverse partition walls dividing said second housing into several chambers, each of said partition walls including an orifice, said orifices and the communication between the first housing and the second housing of the hydrocyclone being disposed in alignment, an inlet duct tangentially communicating with each of said second housing chambers for tangentially feeding liquid under pressure into the respective chamber to impart spirally rotating motions to the liquid in the chambers, and a discharge duct communicating with the base of the lowermost chamber to discharge therefrom liquid enriched with solids and substantially liberated from fibrous material, each of said chambers constituting a further separation stage.

References Cited in the file of this patent

UNITED STATES PATENTS

2,252,581	Saint Jacques	Aug. 12, 1941
2,590,691	Fontein	Mar. 25, 1952
2,794,832	Rietema	June 4, 1957