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CENTRIFUGE

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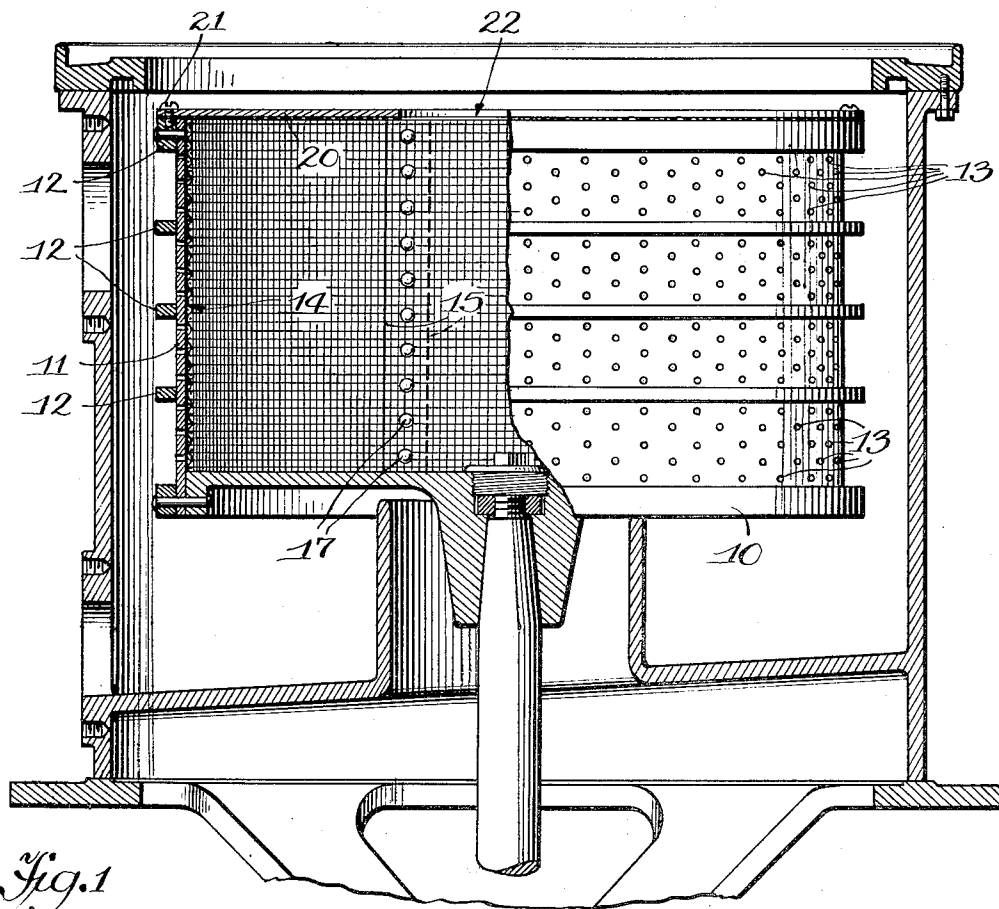


Fig. 1

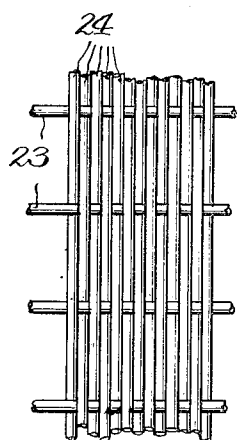
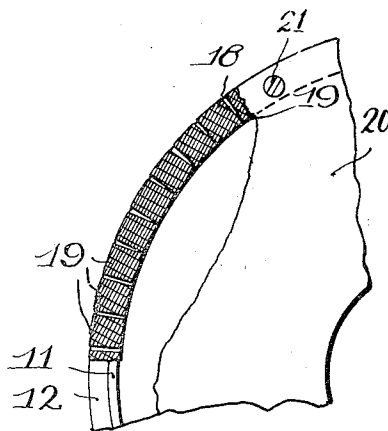


Fig. 2



Witness:
Chas. K. Trench

Inventors,
Walter F. Hoffman
Roy P. Hella
 By *W. Barclay Jones*, *Atty.*

UNITED STATES PATENT OFFICE

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CENTRIFUGE

Walter F. Hoffman and Roy P. Hella, Cloquet,
Minn., assignors to Cellovis, Inc., Chicago, Ill., a
corporation of Delaware

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5 Claims. (Cl. 210—76)

The present invention relates to reactive treatments of cellulose. It has particular reference to the esterification by nitration of short fibers of cellulose, such as wood fibers. Although wood fibers are classified generally into long fibers and short fibers, we do not refer in this invention to these subdivisions of wood fibers, but aim to distinguish between the fibers of natural cotton cellulose and the fibers of chemically prepared wood cellulose.

Cotton is the common form of cellulose which is nitrated, and its fibers are distinctive. Cotton fiber, such as linters, is nitrated with a mixture of sulphuric acid and nitric acid. Excess acid and the resultant treated fibers are quickly separated in a centrifuge. Although the chemistry of the process is or may be the same for nitrating suitable chemical wood pulp, which also is cellulose, it has been found there are many difficulties encountered by the mere substitution of wood pulp fibers for cotton fibers. The present invention aims to overcome these difficulties.

Cotton by nature easily mats into a fluff or ball, or whatever size or form of mat is permitted, in such a way that the mat is highly porous and absorbent. For the purpose of this invention it may be described as presenting open channels to its interior, so that esterifying acid may penetrate to the interior as a liquid flowing in the channel, as distinguished from diffusion of liquid through a mass of more compressed fibers or through capillary channels between or within fibers. In esterification, especially in nitration, particularly where the process is carried out in a relatively short time, it is essential that all the fibers be esterified and be uniformly esterified. Hence it is essential that the interior of fibrous balls or mats be quickly reached by acid. Where the exterior fibers of any such mass are effective to bar a flowing access of acid to the interior, the process of transfer through the obstructing exterior fibers may wholly or partly exhaust the active strength of the acid, and an incompletely esterified or an unesterified product is obtained on the interior. Although a large part, such as 95%, may be properly esterified, a slight residue of even slightly under-treated fibers, will manifest itself as undissolved or partially dissolved fibers, or as cloudiness in a solution of the mass. Because it is difficult to remove fibers or cloudiness from such solutions, it is important that uniform esterification be practiced.

Another difficulty experienced is the separation of fibers and spent acid after the esterification

process is completed. For cotton, a perforated basket may be employed in the centrifuge. This is a sufficient screen to quickly separate cotton fibers and nitrating acid, without significant loss of fiber, and without undue retention of acid. When chemical wood pulp, such as that prepared by shredding dried lap board, is used in the same type of centrifuge, there is an appreciable and economic loss of fiber through the perforations. There is also matting of the fiber into a sheet, or filter pad, over the holes in the basket, making it a very slow and difficult process to effect separation. Prolonged contact of the acid, even after the esterifying process is technically complete, may injure the product. It is otherwise important to hasten the separation because, as nitration is practiced commercially, one centrifuge may be used in rotation with several nitrating pots.

In attempting to overcome the clogging of centrifuges for nitration masses comprising concentrated acid mixtures and suspended fibers of esterified cellulose, numerous schemes have been tested. In the paper-making industry large masses of fiber, such as those blown from a digester, are drained of waste liquor, and washed by percolation, i. e., by providing drainer bottoms of perforated plates or tile. A considerable depth of liquor say over 10 feet, causes a high pressure on such drainer bottoms comparable to pressures in a centrifuge in action. While such perforated bottoms are suitable for the filtration of chemical wood pulp and waste cooking liquor, it has been found that they are not suitable for nitrated wood pulps suspended in waste nitrating acid. Perforated metal plates with specially designed perforations, based on past experience with pulp filtrations, were found to be unsatisfactory.

After numerous and various attempts to provide a suitable centrifuge basket it was discovered that the fibers from wood, compared to cotton linters, caused such a tight packing over perforated metal walls or sheets that filtration of acid through the pads over the holes further compacted the pads. Any dirt or residue in the nature of filterable material other than fiber, readily clogs the pad after it is formed. Prior to and during formation of the pad, many short fibers pass through the openings. By making the perforations smaller and more numerous, packing and clogging is increased. The fibers not only pack over the holes, but pack tightly against the metal walls between the holes so that no channel for flow exists at the interface of the fiber and the non-perforated areas of the wall.

By providing a fine wire screen between the nitrated fibers and the perforated wall of the ordinary centrifuge, we have been able to overcome all the difficulties above enumerated. The wire screen provides a uniform and a maximum filtering area so that nitrated fibers pack uniformly and uniformly resist flow therethrough, as distinguished from local packing and clogging with perforations. A uniform density of mat results, providing a uniform filtering area over the entire basket. The face of the screen against the basket wall provides channels for flow of filtered acid along the walls to outlets, such as perforation, in the walls.

The effectiveness is due to the screen, and is not due to the perforated character of the centrifuge basket described. The fact that the basket is perforated is immaterial. Other means might be provided for permitting acid to escape after it has passed through the screen. The perforated basket is merely exemplary of means rigidly to support the screen in a nonyielding position to form a balanced basket. It is the preferred means for the reason that ordinary nitrating centrifuges of commerce, and of accepted design, may be used for wood pulp by the addition of a screen lining on the interior thereof. Such screens are easily replaced without removal of the basket from its customary housing.

In using a screen, a metal wire screen of the so-called non-corrosive or acid-proof metals may be employed, although there is no need to limit the screen to such material. Any material which has a life in the acid encountered is suitable, which life is commensurate with initial and replacement costs. I have successfully employed nickel-chromium alloy which is 60% nickel, 13% chromium, 25% iron, and 2% manganese.

A basket weave wire cloth has been found most suitable. Such a cloth may be made of 14 warp strands per inch, each .014 inches in diameter. The shute or filling wires may be .011 inches in diameter, thus giving about 100 meshes per inch. Of course, the sizes of the wires and the spacing of the warp may be varied, and this may be determined somewhat by the character, such as stiffness, length and diameter, of the fiber used with the screen. In the centrifuge it is preferably used with the warp wires lying circumferentially.

Thus, the shute wires extend parallel with the axis of the basket and act as a grid over which the fibers must slide as there is slippage in rotation. A fiber moving endwise to the wall can thus have its end caught by a shute wire, which will result in fastening it so that it will be dragged, and its body will lie across the shute wires and parallel to the warp. With the wire arranged with the warp parallel to the axis, the elongated openings would be arcuate about the axis, and passage therethrough will be easier than where the elongation is directed as described. Where the basket is truly cylindrical as shown, or where it may be another form of revolution (geometrically speaking) the shute wires are substantially geometrical elements of the circular screen wall. The direction of the elongations of the openings are thus angular, and in a cylinder at right angles, to the plane of rotation.

Aspen wood pulp is one of the shortest of ordinary chemical wood fibers and we have found that the screen described is satisfactory for retaining and for filtering waste nitrating acid from nitrated aspen fibers. In such nitration we have used the process described in the application of

W. C. Wilson, Serial No. 119,995, filed July 1, 1926, which is a short-time nitration, where rapid removal of the acid from the pulp at the end of the nitrating reaction is desirable. Efficient removal is effected by the present invention so that little acid is wasted when the pulp product is removed and drowned in water. It is usually desirable to make a quick transfer of the whizzed fibers to water, and the wire screen of the present invention, when used herein as described, is in no way a detriment to the quick emptying of the centrifuge.

Fig. 1 represents a vertical cross-section of a common centrifuge embodying the present invention.

Fig. 2 is a detailed view of the preferred screen construction.

Fig. 3 is a fragmentary plan view of the top of the centrifuge basket showing one method for securing the screen.

The numeral 10 represents a type of centrifuge basket used in nitrating cotton. It has metal wall 11 supported by numerous rings designated 12. The wall may be perforated with $\frac{1}{8}$ inch holes 13 on 1 inch centers for nitrating cotton. Although such a basket may be used for centrifuging nitrated cotton, it is subject to the disadvantages above mentioned when used for separating nitrated wood pulp from nitrating acid. However, by placing a screen, such as resistant wire cloth of fine mesh, within the wall as a lining, the basket may be adapted for use with nitrated wood pulp. Numerous mechanical expedients may be resorted to to secure the screen in the basket.

A strip 14 of woven wire cloth such as that above described may be laid as a lining inside the basket. The ends 15 may be riveted together as at 17 or merely allowed to overlap. The edge is allowed to project above the basket and is cut at intervals 18 to the edge of the basket. The tabs 19 thus formed are bent over the top against the upper ring 12. An annular cover plate 20 is screwed at 21 to the ring 12 and this secures the screen in place. The cover plate projects inwardly of the basket and provides a smaller circular opening 22. Where a basket is 30 inches in diameter the opening 22 may be 20 inches in diameter. Such a basket may be 16 or 17 inches deep. However, these dimensions are not controlling, being herein given as illustrative. The warp wires 23 are shown running circumferentially about the basket, and the shute wires 24 are shown at right angles thereto lying adjacent each other in piled formation. In Fig. 2 the holes are behind wires and cannot be seen.

The woven wire cloth having a basket weave is an example of a screen in which there are no perforations normal to the screen surface. The characteristic perforation is tortuous, requiring for direct normal passage through the screen, as occurs in a centrifuge lined with such a screen, a devious path around a wire, and otherwise requiring for a straight passage therethrough one which is angular to normal. Without limiting this invention to any particular theory in connection with the success of this wire cloth for wood pulp fibers, it is believed that there is relation of the character of opening in a centrifuge to the character of fiber.

By the term "basket-woven" as applied to wire or cloth it is intended to indicate that the warp strands are spaced and that the shute or filler strands are piled and are adjacent to each other

and cross in contact with each other in the spaces between the warp strands.

The mass of openings provided by such a basket-woven wire cloth as illustrated is in a checkered-like arrangement, and the communication into the wall of the centrifuge from the interior of the basket is resultingly at an angle to the radius of the plane of rotation, and is directly blocked in the line of said radius.

10 Cotton fiber is in diameter larger, stiffer, and more kinky than chemical wood fibers. The latter are more straight as they grow in nature, finer, and after chemical liberation, are more flexible. In flowing in a streaming suspending
15 liquid, they tend to move endwise in straightened form to a greater extent than cotton fibers. This enables a mass of them to flow through openings in a centrifuge which ordinarily will retain a mass of cotton fibers. Particular note
20 should be made that this invention deals with the properties of a mass of fibers, rather than the properties of an individual fiber, that the nitrated fibers, rather than the original fibers are concerned, and that a waste acid mixture is the suspending medium, and not water. It is
25 possible that several fibers jam together in a perforation and form a pad. This would be less likely to occur in a punched or drilled hole in a basket or in a sheet. The small wire obstructions between openings no doubt aid in catching and holding fibers looped about the wire.

Although the improvement appears simple, it is marked in results and has shown itself an important factor in economy, that is, in preventing loss of material and loss of time; that the adoption has caused success, where impractical results were obtained in devices used for cotton
35 linters.

It is pointed out that heretofore in the use of chemical wood pulp for nitrations, free fibers have not been employed. It has been a practice to use tissue sheets, torn or cut into small pieces, which maintain the felted character during nitration and in separation do not exhibit in centrifugal separation the difficulties here described
45 when nitrated chemical wood pulp in free fibrous form is suspended in the residual acid of nitration.

In the accompanying claims we aim to include such modifications and departures from the invention as will appear to those skilled in the art, and which fall within the scope of the appended claims.

We claim:

55 1. A centrifuge comprising a rotary basket having a circular wall of basket woven wire

cloth arranged with the shute or filling wires lying substantially in planes passing through the axis of rotation of the basket, said cloth having spaced warp strands extending substantially circumferentially of the basket in the
5 plane of rotation and having shute strands lying in contact with each other in piled formation and woven alternately above and below the warp strands.

2. In a centrifuge a basket having numerous
10 minute perforations in the wall and a wall surface presenting a fine grid structure extending generally in the direction of the axis, and means crossing each opening in the grid structure forming elongated axially directed grid openings
15 whereby suspended fibers moving endwise in liquid in the basket during rotation may be caught at the end by said grid, and be turned to lie across the grid.

3. A centrifuge comprising a rotary basket
20 having a circular wall of basket woven wire cloth arranged with the shute or filling wires lying at a substantial angle to and generally cross-wise of the plane of rotation of the basket, said cloth having spaced warp strands extending substantially circumferentially of the basket in the
25 plane of rotation and having shute strands lying in contact with each other in piled formation and woven alternately above and below the warp strands.

4. A centrifuge comprising a rotary basket
30 having a circular wall provided on its inside surface with a mass of small elongated perforations arranged in checkered-like positions over substantially the entire area of the filtering zone
35 of said wall, the direction of elongation being angular to and generally crosswise of the plane of rotation, said openings providing communication into said wall surface only at an angle to a radius in said plane of rotation.

5. In a centrifuge a basket having means permitting the escape of liquid from the basket in centrifugal action of the basket, and filtering means providing an inner filtering surface having a fine grid structure extending generally in
45 the direction of the axis and having means crossing each opening in the grid structure forming elongated axially directed grid openings, whereby suspended fibers moving endwise in liquid in the basket during rotation may be caught by
50 said grid and be turned to lie across the grid, said liquid passing through said filtering means for escapement from the basket.

WALTER F. HOFFMAN. 55
ROY P. HELLA.