WASHING FIBERS WITH FALLING LIQUID FILM

Filed June 15, 1960

ALFRED REICHEL, EWALD DULFER

INVENTORS:

BY

Burgen, Kinlage & Gruen

ATTORNEYS
This invention relates to a process for the after-treatment of fibrous material with liquids. It is known to pass materials over suitable conveyor devices, for example perforated belts or perforated plate conveyors, and at the same time to wash or treat the materials by sprinkling with liquids. This method is in particular useful in the after-treatment of freshly spun fibers.

Some freshly spun fibers, which are not only washed and prepared during the after-treatment but are also freed from chemicals, still contain solvents as well and consequently are still soft and sensitive to pressure. Freshly spun cuprammonium-cellulose fibers from which the copper has not been removed are, for example, very sensitive to mechanical stressing. Thus, when a copper-containing cellulose fiber has been crushed, it is difficult to remove the copper from the places subjected to pressure. Moreover, during the after-treatment, the fibrous material shows a tendency to become tangled (tuft formation) and matted.

It has already been proposed to after-treat freshly spun fibrous material with liquids by sprinkling the liquids onto the fibrous material passing along on a sieve-like support. It is obvious that the washing process is not passed due to the comparatively violent action of the water or other washing liquid falling onto the fibrous material.

Another method heretofore used involves a pivoted baffle resting on the moving fibers in transverse direction to the path of travel. Through passage through troughs has the disadvantage that the perforations in the troughs are readily clogged by colloidal components contained in the liquid.

Thus, in accordance with one method used previously, a curtain of washing liquid is sprinkled downwardly in longitudinal direction to the moving path of the fibrous material. The material travels along an uneven path and is treated with the longitudinal curtain of liquid at one point as it travels upwardly in an inclined direction along its path. The sprinkled curtain of liquid merely flows in a random manner onto the fibrous material, and unfortunately the rebound effect of the liquid contacting the fibers is too great to render this method useful for after-treatment of soft, freshly spun fibers or fibers very sensitive to mechanical stresses or pressures. Moreover, undesired tangling and matting of the fibers cannot be avoided due to the comparatively violent action of the water or other washing liquid falling onto the fibrous material.

Another method heretofore used involves a pivoted baffle resting on the moving fibers in transverse direction to the path of travel. Along the outer edge of the baffle which rests or rides upon the moving fibers, a transverse nozzle means is situated through which a jet of treatment liquid may be sprayed onto the passing fibers. This jet action, however, causes a concomitant swirling up of the fibers which rest on the passing fibers, causing mechanical pressure and rubbing friction to be exerted thereon. Such mechanical stresses and pressures and violent liquid action are detrimental to sensitive or freshly spun fibers.

A further method involves the spraying of a treatment liquid into a trough, over a weir thereof and downwardly through a spout onto the textile to be treated. The liquid curtain passing from the spout randomly falls upon the cloth or textile. This method is neither particularly selective nor gentle with respect to the treatment of sensitive or freshly spun soft fibrous materials.

In another instance, a liquid curtain is sprinkled in transverse direction across material to be treated while the material moves along a horizontal path of travel. The liquid is directed onto the moving material from the edge of a horizontal surface maintained above and parallel to the horizontal path of the material. The sprinkling liquid curtain inherently changes its direction of flow by 90° from a path parallel to the longitudinally disposed material to a path normal with respect to the path of travel of the material.

These disadvantages are overcome in accordance with the invention by the use of a process for the after-treatment of fibrous material with liquids, wherein the fibrous material is passed through curtains of liquid in such a way that the curtains strike the fibrous material at an inclination and alternate curtains strike the material at different or opposite angles.

A particularly advantageous arrangement is that in which alternate liquid curtains impinge on the fibres at angles of approximately 30°–80° and 100°–150° relative to the direction of travel of the fibres.

The fibrous material can for example be passed beneath or past the curtains of liquid by means of a conveyor device for spools or skeins, by a perforated belt or perforated plate conveyor. The curtains are preferably brought so close to the fibrous material that they strike the fibrous material at the point at which movement in an angular direction given to them changes to a free falling movement. It is at this point that the horizontal velocity component of the curtains has its lowest value. The rebound effect of the liquid curtain is thus reduced to a minimum. The fibrous material is lifted from its support without any eddy formation since it is raised or suspended by the directed soft curtain of liquid. After the fibrous material has passed the line of the curtain of liquid it collapses onto its support without any tangling or matting owing to the discharge of the liquid. Due to the lifting of the fibrous material, the throughflow of the treatment liquid is assisted. A couching effect is produced by the collapsing of the fibres on the support. Both operations cause the best possible exchange effect without mechanical damage to the fibres.

The treatment of the fibrous material can also be repeated at short intervals by the process of the invention and in such a case different treatment liquids can if desired be used.

An apparatus for carrying out the process for the invention is shown in section in the accompanying diagrammatic drawing. The apparatus consists of a supply container a, a distributor pipe b, a perforated insert or screen c and overflow weirs d. The latter are connected to smooth flat guide surfaces e. On one side, one of these guide surfaces e is at an angle between 100 and 150° relative to this direction. The guide surfaces are provided with lateral flanges f at either side and at the bottom end with discharge edges g. The liquid curtains h strike fibrous material i which is guided by a perforated plate conveyor k beneath the curtains. The conveyor k is positioned on rollers for movement in the direction of the arrow. The complete apparatus is suspended from a support by means of screw connections l, which allow vertical adjustment of the apparatus, with respect to material i disposed on the conveyor k.

The operation of the apparatus is as follows:

By means of the perforated pipe b disposed along the bottom portion of container a, the treatment liquid is supplied from a source to the container a uniformly over its entire width adjacent to pipe b. The liquid
reaches the guide surfaces \( e \) by way of passing through the screen \( c \) and discharging over the overflow weirs \( d \). The overflow weirs \( d \) and the guide surfaces \( e \) are ground and glazed to provide a smooth surface, so that wetting tension causes the liquid to form a thin contiguous liquid film or sheet of washing liquid which is directed by the positioning of the guide surfaces in a vertically inclined path. The discharge edges \( g \) are disposed at such a distance from the fibrous material passing below that the discharging curtain of liquid \( h \) reaches the surface of and gently contacts the fibers at substantially the point where the direction of the current changes to a free-falling movement under gravity, i.e., at substantially the point of directional change of the liquid flow from angular to vertical direction. The material is raised or suspended at the points where the liquid strikes it, and collapses onto the support again after the liquid has drained away through the perforated conveyor \( k \). The latter is caused to move in the direction of the arrow together with the fibrous material beneath the curtains. The screw connections at the suspension \( l \) serve to adjust the level of the overflow weirs relative to the water level, striking material \( i \). The apparatus and process for the after-treatment of fibrous materials with a washing liquid is provided in accordance with the invention, wherein the fibers are substantially continuously passed across a substantially horizontal path of travel. A thin, contiguous sheet of washing liquid is guided down towards the fibers in a vertically inclined direction, the discharge edge \( g \) directed toward the fibers. The fibers are contacted with the liquid at substantially the point of directional change of the liquid from angular to vertical direction of flow so that the liquid is allowed to flow horizontally along the fibers whereby the apparent cross-sectional thickness of the composite fibers is increased. Thus, the liquid may be guided in a vertically inclined direction at an angle of from 30 to 80° relative to the plane of movement of the fibers.

The layer of fibrous material \( I \) is indicated by vertical lines to illustrate the alternate increase and decrease in apparent cross-sectional thickness of the composite fibers. The apparent increase in cross-sectional thickness of the material \( I \) occurs when the material is passed in the direction of the arrow beneath the curtain of washing liquid \( h \). Thus, the individual fibers are suspended or raised by the action of the washing liquid gently flowing into the composite fibers to effect the desired washing. Due to the raising of the fibers upon contact with the washing liquid, the washing liquid is able to pass through the loose material efficiently. A conching effect is produced on the conveyor by the collapsing of the composite fibers between curtains \( h \). The alternate raising and collapsing of the composite fibers in this manner leads to an optimum exchange effect and washing action while the fibrous material is treated under only the most carefully and delicate conditions. Thus, no pressure is exerted on the fibrous material since the same is wetted by the liquid curtain which runs down the inclined, smooth surfaces \( e \) and penetrates the fibrous material where the direction of the curtains changes to a free-falling movement, i.e., substantially at the point of directional change of the liquid from angular to vertical direction of flow. In accordance with the invention, due to the delicate water treatment, no application of pressure is involved which would cause a petting of the sensitive fibrous material, such as freshly spun copper-containing cellulose fibers.

Hence, by the use of a thin, contiguous sheet of liquid, in accordance with the instant invention, a gentle washing action may be effected with respect to fibrous material, very sensitive to mechanical stressing, and which exhibits a tendency to become tangled and matted by the action of a washing liquid, without disrupting the fibers or causing the same to mat yet permitting the fibers to become buoyed up by the washing liquid. In this way efficient, thorough and gentle washing treatment of the fibers can take place.

In contrast to the conventional operations which tend to cause tangling and matting of the fibers, due to the normal force of the liquid flowing thereupon, in accordance with the instant invention, the gentle flow of the contiguous sheet advantageously merely passes into the fibers causing the buoyancy and suspension or raising of the same. This buoyant action of the liquid on a portion of the fibers such as, for example, the end portion of the fibers, causes the fibers to stand upright and lift in consequence of which the flow through the fibers of the treatment liquid is assisted.

Specifically, in accordance with the invention, since the overflow weirs \( d \) and the guide surfaces \( e \) are ground and glazed so that wetting tension causes the liquid to form a thin, liquid film, the contiguous liquid sheet is subject to friction and cohesion along its guided path down the incline. As a result, the point where the component changes from angular to vertical is rather short, and the velocity of the liquid would only substantially be that of free-fall from the discharge edge \( g \) less the air flow resistance of fall, with the result that the flow force would be practically negligible. Consequently, the liquid does not disrupt the fibers but instead effects a gentle and efficient washing action.

It should be noted that the gravitational component is the sheet being freely directed toward the same in a rather dense condition. However, by the action of the gentle, contiguous film of liquid, the fibers are raised, lifted, suspended or swelled, these terms all being synonymous to define this action, and the liquid is permitted to effect efficient and gentle washing of the fibers and to horizontally flow along the fiber path. It is this horizontal flow of the liquid which causes the fibrous material passing therealong on the conveyor to increase its apparent cross-sectional thickness a certain amount before reaching the point of contact with the liquid continuous sheet as well as after passing said point.

This application is a continuation-in-part application of copending U.S. application Serial No. 574,926 filed March 29, 1956, now abandoned.

We claim:

1. A process for the after treatment of freshly spun tender fibrous material with a washing liquid which comprises the cleaning of the fibers by washing the fibers with the liquid tenderness fibers across a substantially horizontal path of travel, guiding a thin contiguous sheet of washing liquid down toward the fibers in a vertically inclined direction, freely directing said sheet of liquid toward the fibers, contacting the fibers with the liquid at substantially the point of directional change of the liquid from angular to vertical direction of flow and flowing the liquid horizontally along the fibers increasing the apparent cross-sectional thickness of the composite fibers.

2. A process according to claim 1 wherein an additional thin contiguous sheet of washing liquid is guided toward the fibers in a vertically inclined direction opposite to the vertically inclined direction of the first mentioned thin contiguous sheet of washing liquid and spaced therefrom, said additional sheet of washing liquid being freely directed toward the fibers, said fibers being contacted with said additional sheet of washing liquid at substantially the point of mechanical damage of the said additional sheet of washing liquid from angular to vertical direction and allowing the said additional washing liquid to flow horizontally along the fibers increasing the apparent cross-sectional thickness of the composite fibers.

3. A process according to claim 1 wherein said liquid is guided in a vertically inclined direction at an angle of from 30 to 80° relative to the plane of movement of the fibers.
4. A process according to claim 1 wherein said fibers are freshly spun copper-containing cellulose fibers.

5. A process according to claim 1 wherein said liquid is guided in a vertically inclined direction opposed to the direction of movement of the fibers.

6. A process according to claim 5 wherein said liquid is guided in a vertically inclined direction at an angle of from 100 to 150° relative to the direction of movement of the fibers.

7. A process according to claim 1 wherein said liquid is guided in a vertically inclined direction toward the direction of movement of the fibers.

8. A process according to claim 7 wherein said liquid is guided in a vertically inclined direction at an angle of from 30 to 80° relative to the direction of movement of the fibers.

References Cited in the file of this patent

UNITED STATES PATENTS

426,875  Stiner  Apr. 29, 1890
1,593,252  Flour  July 20, 1926
1,659,926  Stocker  Feb. 21, 1928
2,065,189  Cox  Jan. 5, 1954

FOREIGN PATENTS

60,489  Denmark  Jan. 4, 1943
629,100  Great Britain  Sept. 17, 1949