FIG. 1

FIG. 2

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VACUUM DRUM DRYER COMBINATION WITH FIBER GUIDING DEVICES

FIG. 3

FIG. 4

FIG. 5

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ABSTRACT OF THE DISCLOSURE

Vacuum drum dryer with series of side-by-side, rotating, air-permeable drums and stationary or movable fiber catching and guiding screen below one drum. Screen is curved to follow closely curvature of drum, and stationary screen has one free-hanging, weighted end.

This invention in general relates to improvements in vacuum drum dryers for drying fibers on rotating, foraminous vacuum drums. More specifically, the invention pertains to vacuum dryers of the aforementioned type wherein in a band or ribbon of a moist layer of loose fibers is dried as it is carried through the vacuum dryer by a series of foraminous rollers or drums, the improvement lying in the utilization of a foraminous air-permeable, screen-like guide for guiding moist fibers and catching those which tend to fall off the drum, usually the first drum.

In vacuum dryers for drying textile fibers such as cellulose fibers, a layer of moist, loose fibers is conducted alternately and successively around the upper and lower portions of successively arranged, side-by-side, rotating screen drums. The fiber layer is held on the screens of the respective drums by drawing a vacuum on the insides of the drums and thereby drawing into the rotating drums warm, drying air fed to the drying chamber. The warm air stream passes through the fiber layer and dries the fibers while holding them on the drum screens.

In known vacuum drum dryers, the loose fiber band or ribbon is continuously fed to the first drum by a belt-type conveyor or the like. It is discharged from the conveyor onto a cylindrical, rotating screen of the first drying drum at the lower, side portion thereof and carried thereby for about a half revolution. The partially dried ribbon or band of loose fibers is then picked up by a second rotating screen drum and conveyed across the upper half thereof, whereupon it is then transferred onto the lower half of the next drying drum and conveyed further through the dryer. This sequence may be repeated with one or more additional rotating, screen drums if additional residence time in the dryer is required to obtain the desired degree of drying.

A particular problem arises in adequately retaining the dryer, moist fibers against the lower half of the first vacuum drum. This fiber layer is still heavily laden with moisture. The moisture laden fibers are difficult to hold on the lower half of the rotating drum screen because of their weight and also because they tend to pack non-uniformly. The latter results in an erratic or uneven air flow through the moist layer with the result that, from time to time, portions of the fiber layer fall off the screen because the air flow through these portions is insufficient to hold them on the lower part of the screen against the force of gravity. Relatively large tufts of the moist, loose fiber layer may fall off from time to time. The finer fiber constituents, on the other hand, sometimes may fall off the layer without dropping to the bottom of the dryer and may be brought back to the layer by the air stream. If these finer fiber constituents are held by the turbulence of the air stream for any considerable period without being returned to the fiber layer, they may have a considerably longer residence time in the drying chamber than is the case for those fibers which are carried along with the layer from drum to drum. As a result, fibers of this character have a tendency to develop a darker color tone different from the general color tone of the dried product. If these darker fibers ultimately are redeposited on the fiber layer, the darker tone of such fibers reduces the quality of the fiber product.

It is an object of this invention to provide improvements in the vacuum drum drying of layers of moist, loose fibers by essentially eliminating the aforementioned problems.

Another object of the invention is to provide improvements in vacuum drum dryers by the utilization of special, air-permeable, fiber catching and guiding devices associated with an under surface of a drying drum which conveys the moist, loose layer of fibers on its lower side.

A further object of the invention is to provide a stationary, curved screen contiguous to the lower surface of a foraminous, rotating drum for guiding the moist, loose layer of fibers over a substantial portion of the bottom of the drum and for catching fibers or tufts thereof which fall off the drum.

Still another object of the invention is to provide an endless screen having a curved portion lying contiguous to the curved under surface of a rotating, foraminous vacuum drum, which curved surface moves at a linear speed substantially equal to the speed at which the fiber layer is conveyed across the lower portion of said drum.

These and other objectives and advantages of the invention are achieved through the use of a stationary screen or an endless, moving screen located immediately below the fiber-conveying, under surface of one or more of the cylindrical, rotating screens of the vacuum dryer drums. Such rotating screens are usually the screens on the first drum, although the invention embraces combinations utilizing such stationary or endless screens in association with other drums if the problems as aforesaid are overcome by the utilization of such screens with drums other than the first drum. Briefly, these stationary or endless, moving screens have a curvature substantially corresponding to the curvature of the cylindrical screen of the drum and lie immediately adjacent the lower part of the cylindrical screens so that the fiber layer held on the cylindrical screens is either in actual contact or in approximate contact with the stationary or endless, moving screen. In these combinations, the stationary screen or the endless, moving screen functions as a fiber-catching or fiber-guiding component which holds the fibers against falling away from the vicinity of the moist, loose fiber layer on the rotating screen. The stationary screen or the endless, moving screen is a heat-resistant, non-corroding, air-permeable sheet or belt, preferably extending the width of the drying chamber and at least coextensive with the length of the cylindrical screen drying drum. The spacing between the cylindrical screen of the drying drum and the stationary screen or the endless, moving screen is such that when the moist, loose layer of fibers is held against the under surface of the rotating, cylindrical screen, the outer surface of the fiber layer touches or approximates touchingly the stationary screen or endless moving screen. The screen may be of the usual woven type, or it may be a mat type screen made of synthetic polymers such as polypropylene. The endless moving screen is used advantageously in the drying of fiber layers or fleeces having low cohesion such that the light brushing on the layer or fleece against the stationary screen would disturb the continuity of the fiber layer and cause it to jam between the stationary screen and the cylindrical screen of the drum.
Preferred embodiments of the invention are illustrated in the drawings wherein:

FIG. 1 is a diagrammatic, side elevation of the moist fiber layer feed conveyor, three rotating drums and a stationary screen below the first drum in a vacuum dryer;

FIG. 2 is a diagrammatic, side elevation similar to FIG. 1 but with an endless moving screen below the first drum;

FIG. 3 is a fragmentary, broken top plan view of the discharge end of the feed conveyor and the first drum with the fiber layer on the conveyor;

FIG. 4 is a perspective view of the stationary screen of FIG. 1; and

FIG. 5 is a perspective view of the endless, moving screen of FIG. 2.

Referring to the drawings, the vacuum dryer is of generally known construction comprising a conventional drying chamber (not shown) housing a series of rotating, side-by-side, cylindrical screen drums. A vacuum is drawn on alternating upper and lower parts of the drums in a manner so that the fiber layer is held on the respective screen for about one-half revolution and then is transferred to the next vacuum drum. Apparatus for supplying heated air to the chamber and for drawing the vacuums on the inside of the drums are well known, and hence need not be illustrated herein.

A belt conveyor 10 carries on its upper flight a band or ribbon 11 of wet, loose fibers to the side portion of the first vacuum drum 12. The drum 12 is also of well known construction and comprises essentially a frame supporting a cylindrical air permeable wall, e.g., screen 13, and an axle 14 on which the drum is slowly rotated by a conventional mechanical drive (not shown) about a horizontal axis. Vacuum drums 18 and 22 are of the same general construction.

A current of air, indicated by arrows 15, is constantly drawn through the lower half of drum 12 by maintaining a pressure inside drum 12 lower than the pressure on the outside thereof, i.e., by drawing a vacuum on the inside of drum 12. No vacuum effect is exerted on the upper half of drum 12 because the stationary, semi-cylindrical plate 16 blocks air flow through the upper half of the screen of drum 12 as it rotates.

The fiber layer portion 11a is conveyed on the underside of drum 12 to transfer point 17 where the drum 18, which is rotating at the same speed as, but in opposite direction to, the drum 12. At transfer point 17, the vacuum effect of drum 12 ceases and the vacuum effect on the upper half of drum 18 takes over, drawing the partially dried fiber layer onto the screen of drum 18. The fiber layer portion 11b is held on the upper half of drum 18 by the air current, indicated by arrows 19, until it reaches transfer point 21. The lower half of drum 18 is blocked off by the stationary, semi-cylindrical plate 20.

The fiber layer is transferred in the same manner as previously described onto the lower half of vacuum drum 22, which in the illustrated embodiments is the final drying stage. The layer portion 11c is held on the rotating cylindrical screen of drum 22 by air currents, indicated by arrows 23, while air currents are blocked from flowing through the upper half of drum 22 by stationary, semi-cylindrical screen 24. Drum 22 rotates at the same speed as, but in opposite direction to, drum 18.

FIGS. 1 and 4 illustrate an embodiment of a stationary screen 25 beneath first drum 12. One edge of screen 25 is supported on a fixed frame member, i.e., rod 26 extending under one side of the drum 12. The other edge of screen 25 is draped slidably over a fixed rod 27 lying under the other side edge of the drum 12. A small, as a weight plate, or gravity tensioning device, is held in an edge loop 32 of the overhanging segment 31.

The screen wires or filaments 29 are heat resistant and corrosion resistant, e.g., metal wires or synthetic plastic polymer filaments such as polypropylene, which has desirable slip qualities. The weighting of the overhanging segment 31 by rod 28 provides just sufficient tension to keep the draped, arcuate segment 30 in light brushing contact with the fiber layer portion 11a as it passes across segment 30 on the screen 13 of the rotating drum 12. The air currents passing through screen 25 tend to draw screen segment 30 toward the drum 12 and hence help to keep it in light brushing contact with the fiber layer portion 11a as the latter moves thereon. The curvature of the lower portion of the cylindrical wall 13 of drum 12 is closely spaced relationship thereto. The part or segment 30 is, in effect, an air permeable sheet maintained in light brushing contact with the fiber layer.

When the wet, fiber layer 11a is so thick and/or so heavy so that air currents are inadequate to effectively hold the fiber layer on the underside of drum 12, or when the fiber layer has the aforesaid described cohesiveness, the moving screen embodiment of FIGS. 2 and 5 may be used to greater advantage. The endless, moving screen 36 is a band of screen material of the same character as the screen material 29 of stationary screen 25. It travels at a speed so that the velocity of the curved, upper segment 37 is equal to the peripheral speed of drum 12.

Rollers or drums 33 and 34, one of which is driven by a mechanical drive (not shown) and screen-band-tensioning roller 35 carry the endless screen 36. The curved segment 37 presses fiber layer portion 11a against cylindrical screen 13 of drum 12 as the layer is carried along the underside of drum 12. The pressure may be adjusted to any desired pressure, which preferably is a relatively light pressure to avoid undue compacting of the moist fiber layer. Excessive compacting of the fiber layer can reduce seriously its permeability to flow of the air currents through the layer, thereby decreasing drying efficiency.

Thus, fibrous material loosened and dropped from the fiber layer on the drying drum is caught by the stationary screen or moving screen. The current of drying air which is flowing continuously through the stationary or moving screen, the lower part of the rotating cylindrical screen, and the layer of loose, matted fibers therebetween, lifts the fallen fibers or tufts thereof back into the moving fiber layer on the cylindrical screen. In order to avoid jamming of the fiber layer between the respective screens, the contact of the stationary screen with the fiber layer held by the air current on the drum surface (cylindrical screen) should, as nearly as possible, be not much more than light brushing contact, that is, essentially tangential contact. With the aid of a weight attached to the hanging free edge of the stationary screen, the curve portion of the screen can be tensioned so that the curvature portion 11a is pressed lightly against the outer side of the moving, fiber layer.

The fiber layer, held by the suction effect on the drum surface, slides lightly over the stationary screen without the fibers or tufts falling completely away from the fiber layer or be held unduly in the turbulent air.

In cases of relatively heavy fiber loadings for the vacuum dryer and consequently increased thickness of the fiber layer on the drums and also in cases of low cohesion of the fiber types to be dried, it may be of advantage to use an endless moving screen as previously described.

The invention is hereby claimed as follows:

1. In a vacuum drum dryer embodying a series of side-by-side, rotating air-permeable drums for conveying a band of loose, moist fibers while drying said layer by air currents drawn into the respective drums through the band of fibers, the improvement comprising the combination of a drum rotatable about a horizontal axis, a drum having a cylindrical, air permeable wall, means for drawing air currents through the lower portion of said drum as it rotates to hold against said air-permeable wall a layer of moist, loose fibers while said layer is conveyed by said lower portion, and a fiber-capturing and fiber guiding member below said lower portion and embodying an air-permeable, curved part which has a curvature substantially following the curvature of said
lower portion of said air-permeable wall in closely spaced relationship thereto, a stationary frame member beneath one side of said drum and supporting one edge of said sheet, a second frame member beneath the other side of said drum, the opposite edge of said sheet being slidably draped thereover with said curved part draped between said frame members, and means acting on said opposite edge to hold said curved part in light, brushing contact with said fiber layer on said lower portion.

2. The improvement as claimed in claim 1 wherein said fast-mentioned means comprises a downwardly hanging portion of said opposite edge, and weighting means secured to said downwardly hanging portion to lightly tension said curved part.

3. The improvement as claimed in claim 1 wherein said sheet comprises an air-permeable sheet of polypropylene filaments.

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