United States Patent [19]
Banks

[11] 3,755,856
[45] Sept. 4, 1973

[54] METHOD AND APPARATUS FOR THE FORMATION OF FIBER FLUFF

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[73] Assignee: Kimberly-Clark Corporation, Neenah, Wis.

[22] Filed: Apr. 23, 1971

[21] Appl. No.: 136,745

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 647,757, June 21, 1967, abandoned.

[52] U.S. Cl. 19/156.3
[51] Int. Cl. D01g 25/00
[58] Field of Search..... 19/88, 89, 155, 156–156.4, 19/205; 156/622

[56] References Cited

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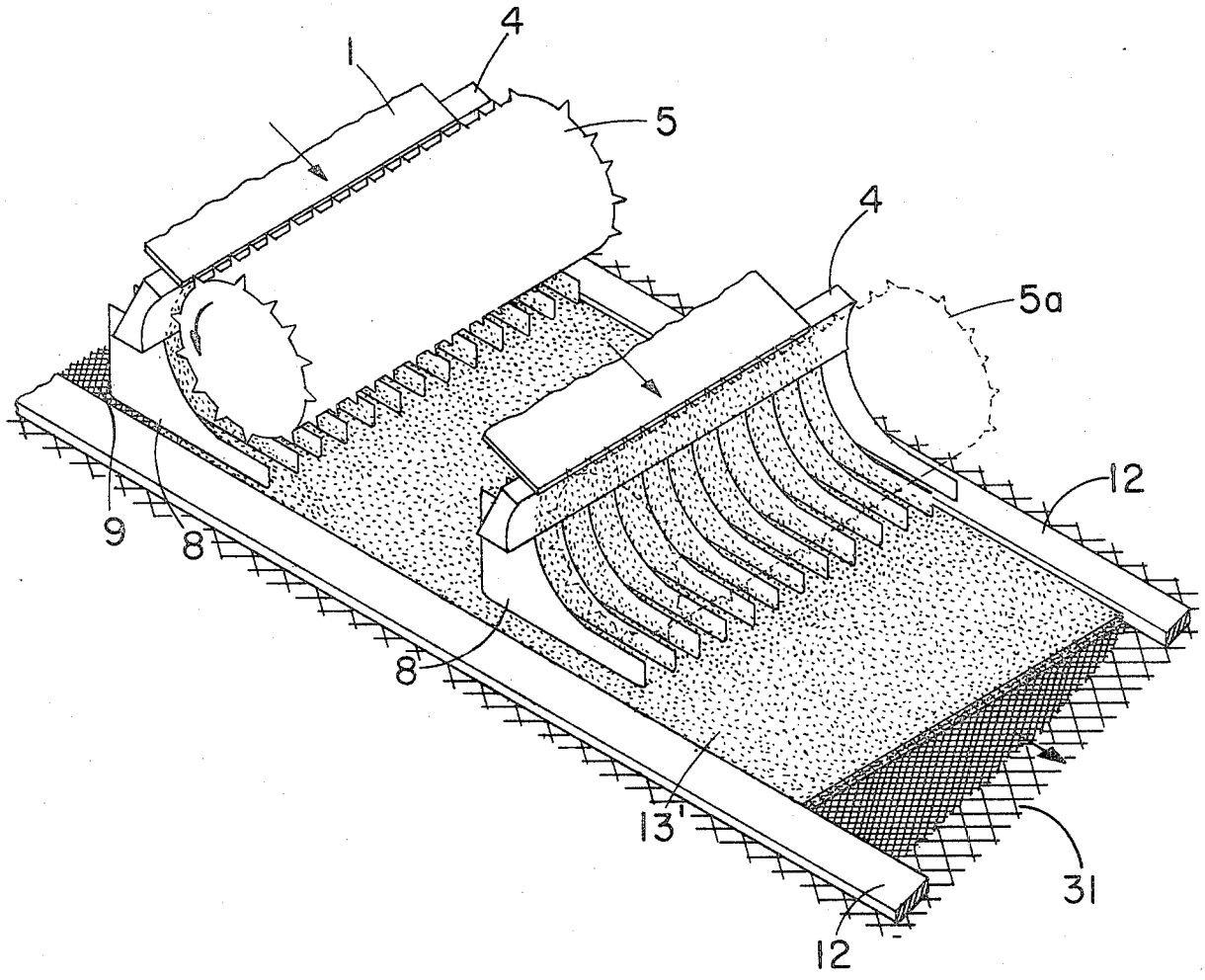
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Attorney—Daniel J. Hanlon, Jr., William D. Herrick and Raymond J. Miller

[57] ABSTRACT

Wood pulp fiber batts of uniform and controlled density are produced by picking fibers from compacted wood pulp and impelling the fibers to a receiving surface passing beneath a multiplicity of panel-like dividers disposed to provide a forming chamber for a unitary batt and to substantially prevent turbulent air currents from the formation zone.

7 Claims, 12 Drawing Figures



Patented Sept. 4, 1973

3,755,856

5 Sheets-Sheet 1

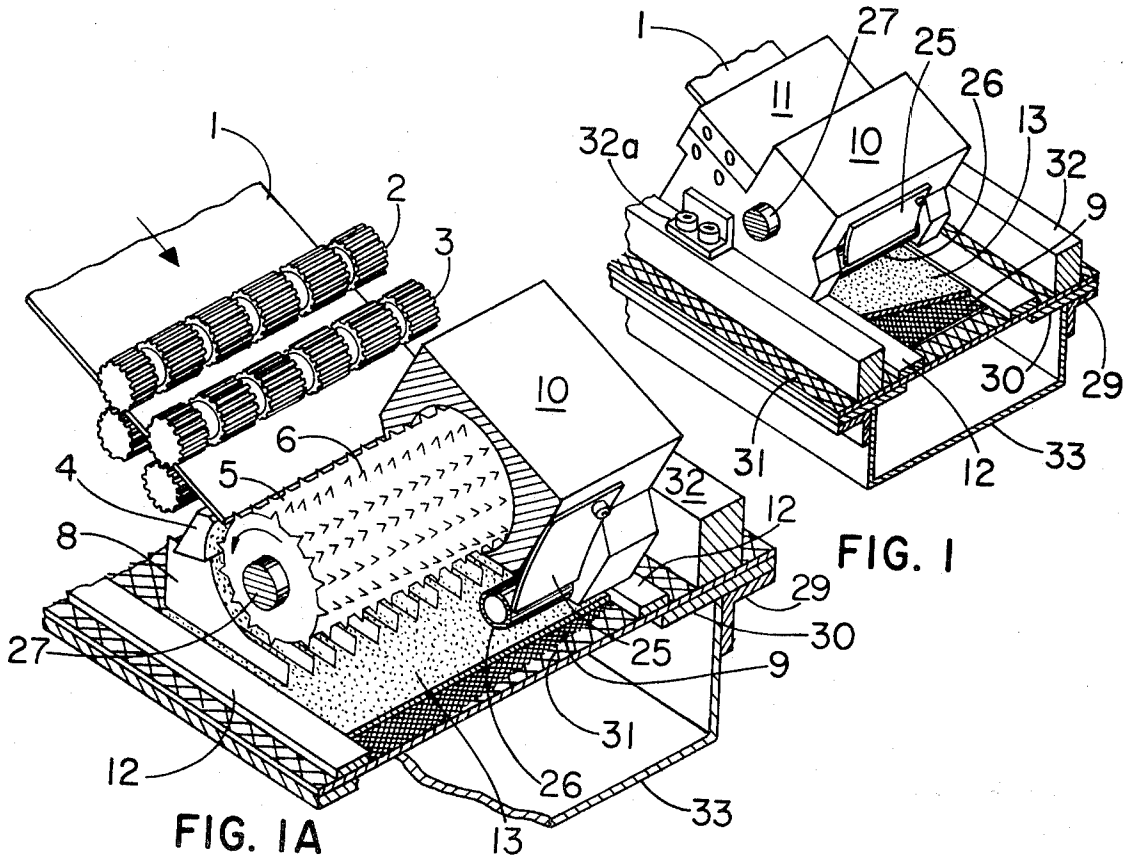


FIG. 1A

FIG. 1

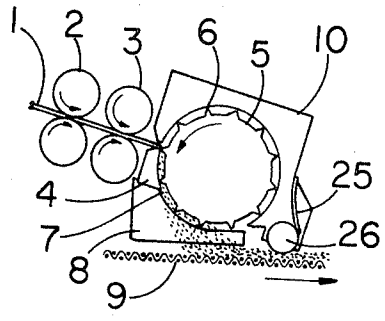


FIG. 2

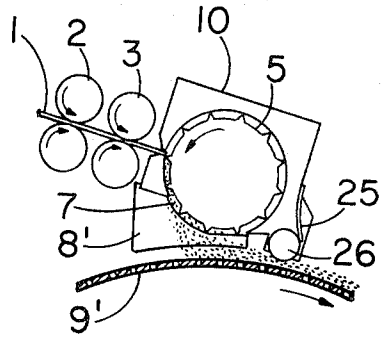


FIG. 3

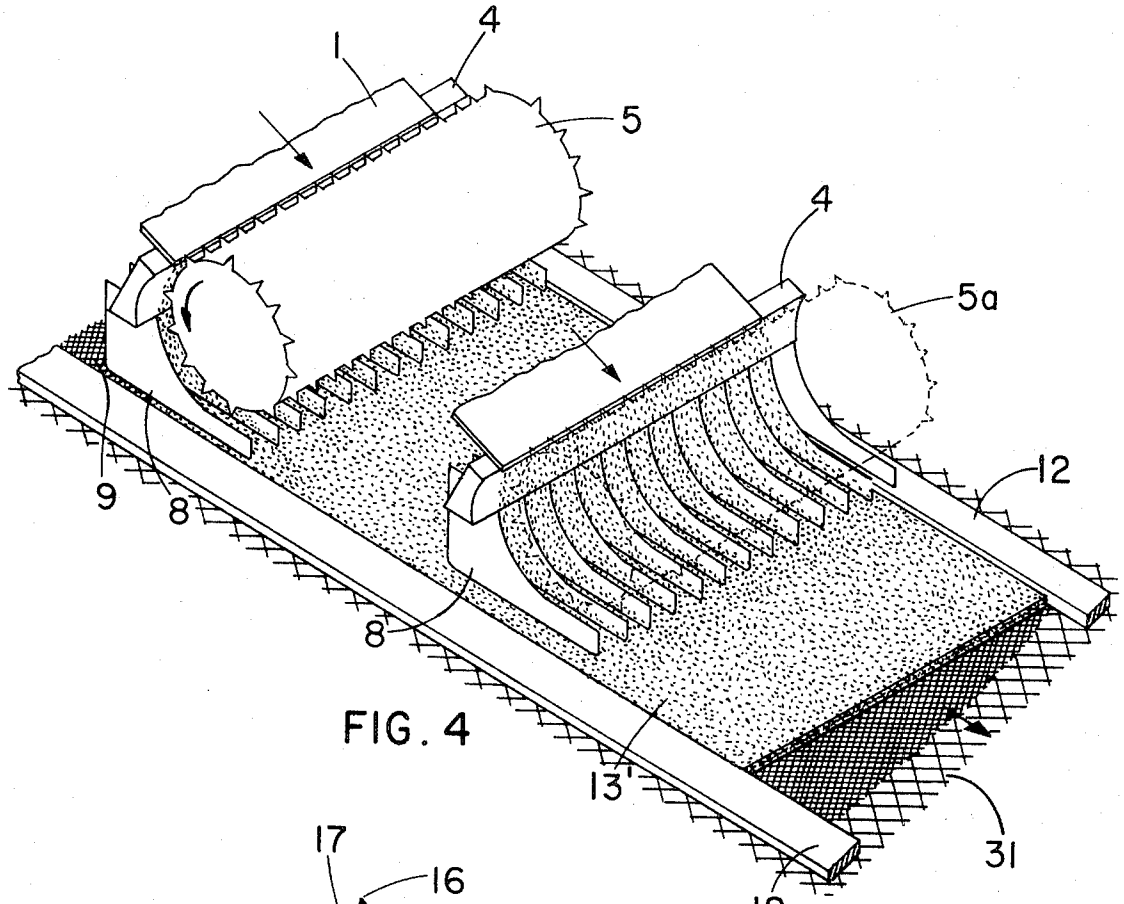


FIG. 4

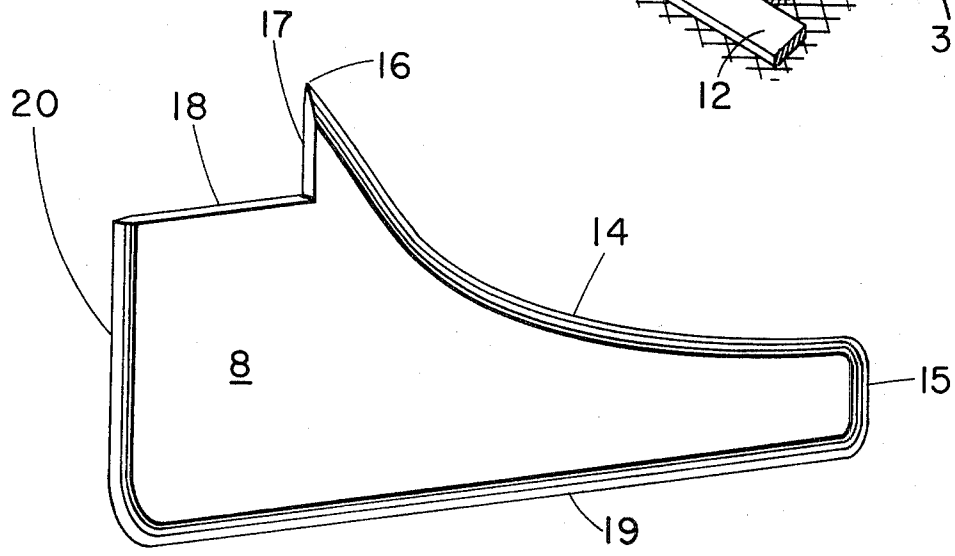


FIG. 5

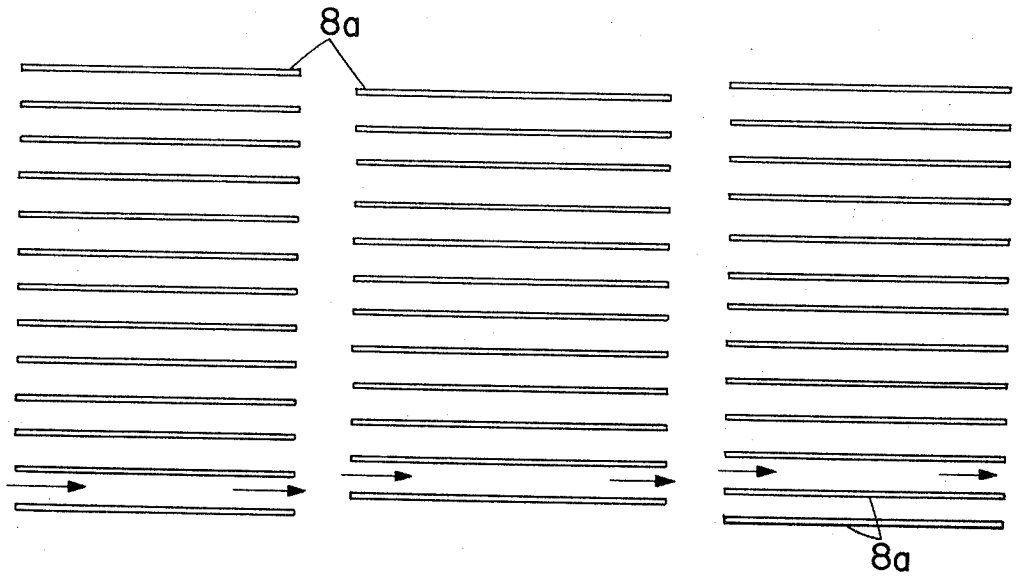


FIG. 6

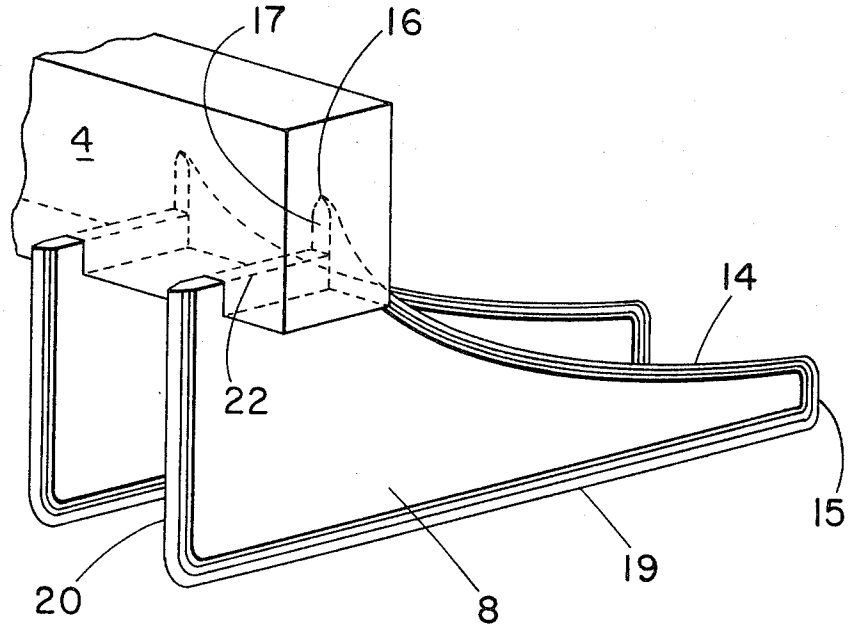


FIG. 7

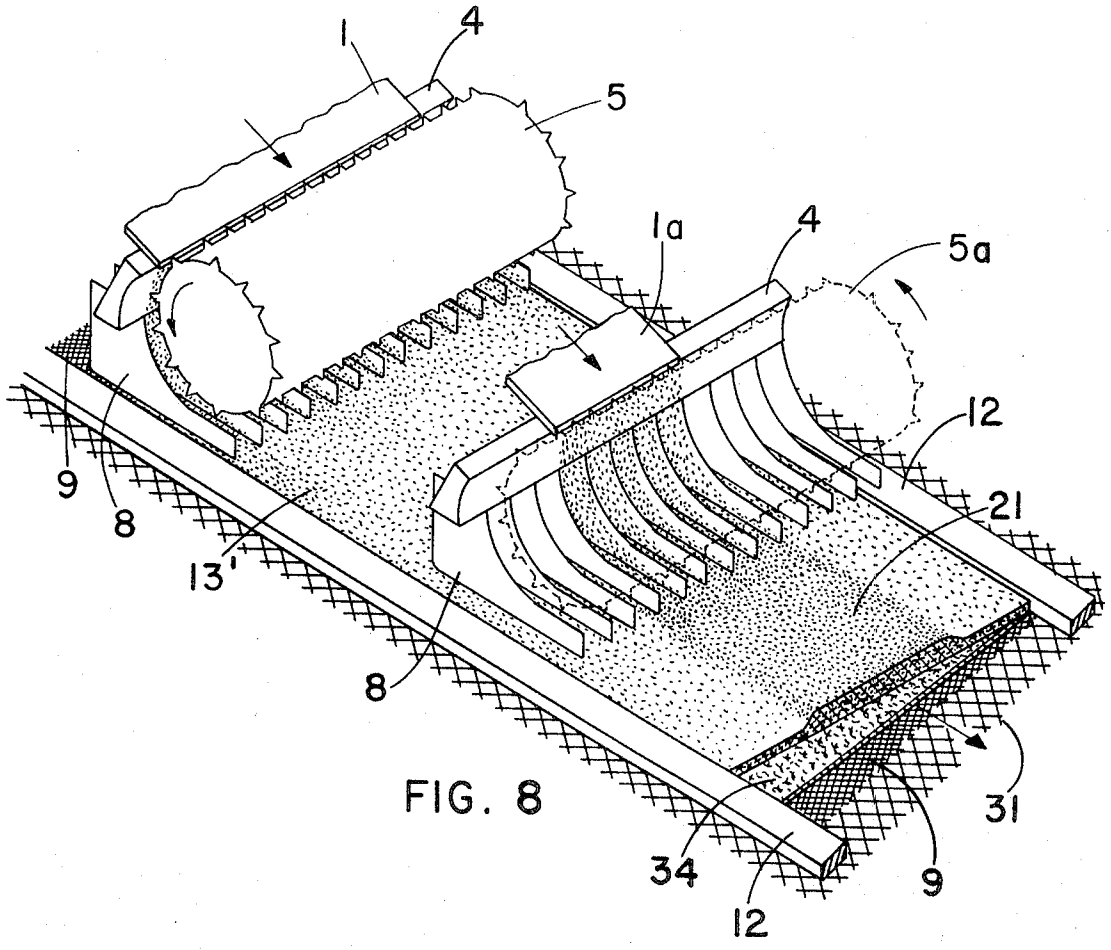

1
4
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1a
4
5a
12
21
9
8
13'
8
31
34
9
12

FIG. 8

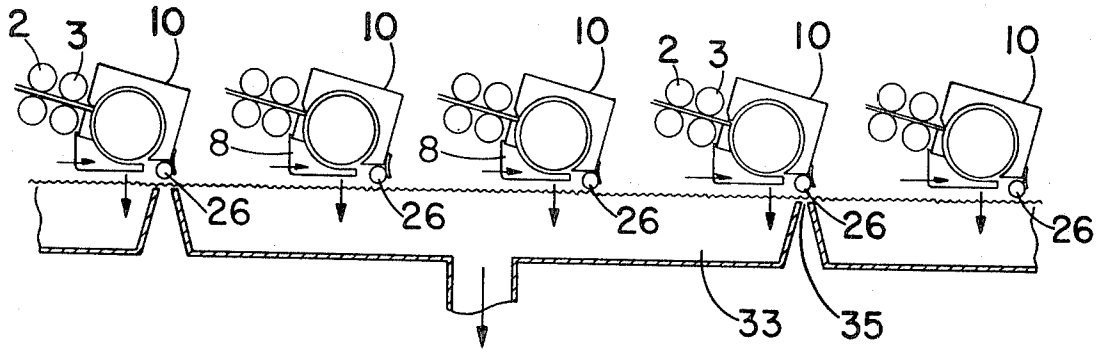

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FIG. 9

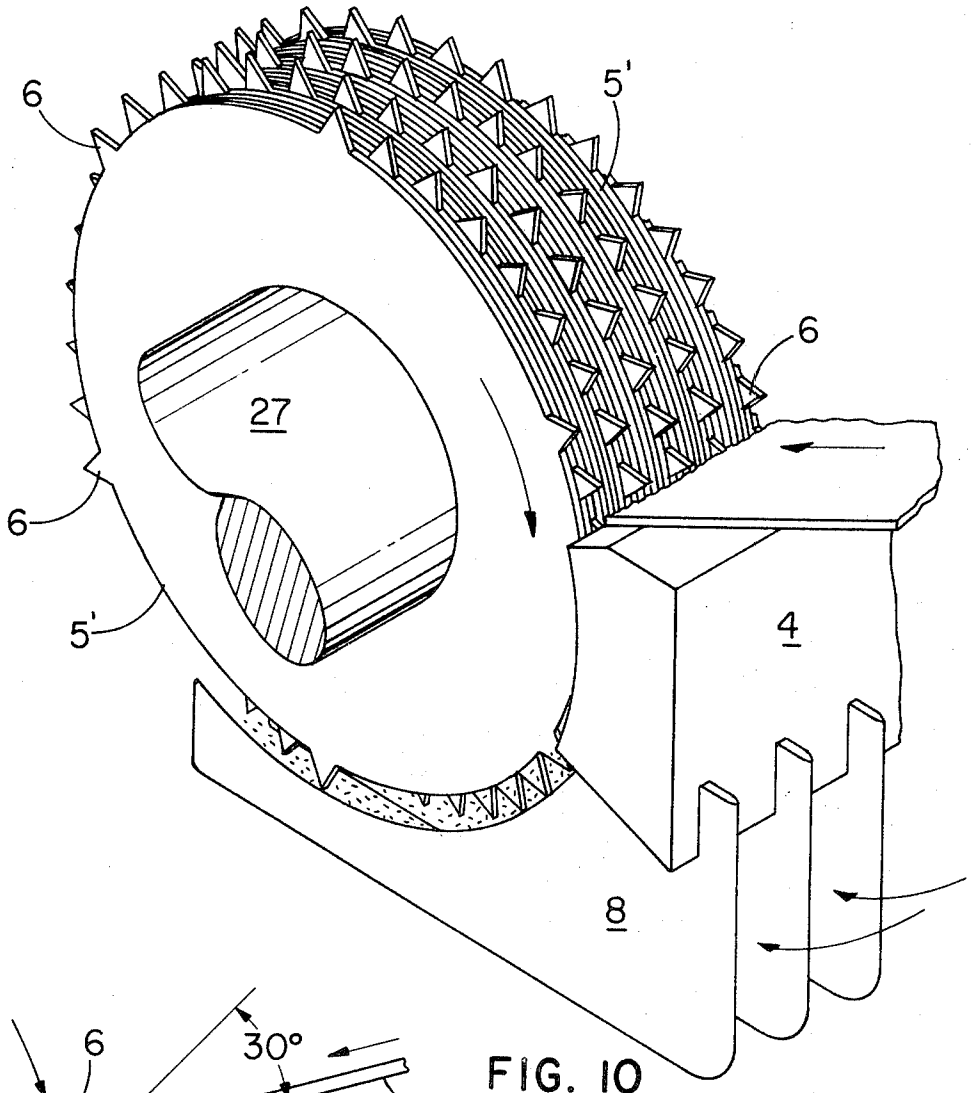


FIG. 10

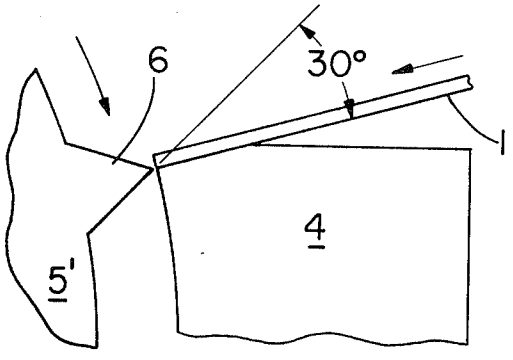


FIG. 11

METHOD AND APPARATUS FOR THE FORMATION OF FIBER FLUFF

This application is a continuation-in-part of my copending application Ser. No. 647,757 filed June 21, 1967, now abandoned, and assigned to the same assignee as the present application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to wood pulp fiber batts and to apparatus and methods for making substantially continuous lengths of such batts.

2. The Invention With Relation To The Prior Art

It is common practice to ship wood pulp in the form of compacted fibers. The fibers are pressed together while wet. Upon drying, the pressed fibers provide a hard, board-like material which withstands shipping conditions well and provides for reasonable economy in transportation. The fibers may be picked from such boards and dispersed for the making of fiber slurries or air formed sheets. I have found that, in the manufacture of air formed sheets, the disintegrator mechanism which picks the fibers should be disposed very closely to the fiber receiving member in order to provide adequate velocity to the fibers over the distance between the fiberizing area and a receiving surface and overcome electrostatic charge effects and consequent fiber clumping as the fibers move to the surface. While such principle is employed in the practice of the present invention, I have further found that some non-uniformity in the fiber batts may result from air currents including windage caused by the picker mechanism itself. I have now further provided an apparatus and method which still further minimizes the tendency toward non-uniformities in fluffy fibrous batt formation.

I accomplish the objectives of an improved fibrous batt of uniform and controlled density by positioning a forming chamber closely beneath the picker drum for the fibers and directing the picked or separated fibers through the chamber to a receiving surface. The forming chamber is constructed of a plurality of panels or blades extending in parallel relation longitudinally in the direction of batt formation and provided in a closely spaced array transversely of the equipment. The panels are supported below the equipment fiberizing bar and above the fiber receiving surface on which the batt is formed although in close proximity to the surface. The receiving surface, whether it be a temporary receiving surface in the nature of a backing for the fibers or as a perforate drum or screen, is subjected to a vacuum pressure to influence the retention of the fibers on the receiving surface. The fiberizing equipment and forming chamber are limitedly open to the atmosphere below the fiberizing bar and zone of picker drum operation.

The batts produced in accordance with the invention achieve good uniformity because the fiber velocity in the spacing between the fiberizing bar and receiving surface itself inhibits lateral fiber movement and also because the forming chamber further tends to eliminate lateral fiber movement and fiber clumping.

The invention will be more fully understood by reference to the following detailed description and accompanying drawings wherein:

FIG. 1 is a view in perspective of equipment useful in the practice of the invention;

FIG. 1A is a somewhat enlarged diagrammatic view in perspective with parts removed and others broken away of the arrangement of FIG. 1;

FIG. 2 is a side and schematic view of the structure of FIG. 1 with parts removed to particularly illustrate the mode of operation;

FIG. 3 is a view similar to that of FIG. 2 but with a modified structural arrangement;

FIG. 4 is a view in perspective like that of FIG. 1 but illustrating a further modification of the invention;

FIG. 5 is a view in perspective of an element of the forming chamber;

FIG. 6 illustrates in plan view and diagrammatically one layout arrangement of forming chambers in accordance with the invention for the production of multiply products;

FIG. 7 is a view in perspective illustrating in greater detail a structural arrangement of components of a forming chamber;

FIG. 8 is a view in perspective like that of FIGS. 1 and 4 illustrating a further modification of the arrangement of the invention;

FIG. 9 illustrates schematically an arrangement of the fiberizing devices for providing products in multiply form and including indicated associated vacuum hoods;

FIG. 10 is a much enlarged view in perspective showing an arrangement of primary components of a fiberizer and forming chamber; and

FIG. 11 is a detail view showing an angular disposition of the material to be fiberized with relation to the fiberizing device.

Referring to the drawings more particularly, the numeral 1 in FIGS. 1 and 1A designates a sheet of wood pulp moving in the direction indicated by the arrow. This sheet may be from a roll source or the supply may be in individual sheet form. Sheet 1 is directed (FIG. 1A) through a first set 2 of feed rolls comprising an upper and lower series of rolls which grip and move the relatively heavy sheet of wood pulp forwardly. A second set of feed rolls similar to the first is designated at 3 and serves to provide for minimum load on each roll set while yet providing positive movement of the sheet 1.

The sheet 1 is directed over a fiberizing bar designated at 4 endwise to a picking roll or drum indicated at 5. Picking drum 5 carries a considerable plurality of teeth 6 disposed in spiral relation about the drum. The picking drum and teeth operate on the projecting end of the sheet to work on and break up the pulp sheet into substantially individual fibers. The fiberizing bar 4 and the picking drum 5 extend the full width of a forming chamber which includes passage 7 (FIGS. 2 and 3). Passage 7 is formed between the picking roll 5 and a plurality of forming chamber dividers 8 in the form of thin panels or blades. The panels 8 are spaced relatively close together and extend across the width of the machine beneath the picking drum 5 in close proximity to the drum. The panels or dividers 8 are themselves supported from the fiberizing bar 4 as will be discussed more particularly hereinafter.

The picking drum 5 and its associated forming chamber dividers 8 are spaced immediately above a foraminous receiving surface, one type of which is indicated at 9 in FIG. 2. The teeth of the picker drum, that is, the apices of teeth 6, may approach the wire surface as closely as one-half inch, and such is desirable when the

forming chamber panels 8 are not utilized. The inclusion of panels permits greater latitude in the spacing of the drum and wire while yet achieving uniformity in the product. If the panels are not employed, generally a spacing of not more than about 1½ inches should be maintained between the drum or teeth apices and the receiving surface. The foraminous surface of FIG. 2, as illustrated, is a paper machine forming wire having a large number of perforations. Alternatively, the receiving surface may be an arcuate portion of a foraminous drum 9' in FIG. 3. In either event, the receiving surface 9 or 9' travels in the direction indicated by the arrow, and a vacuum pressure is exerted on the underside of the receiving surface to aid receipt on the surface of defiberized material directed downwardly in the channel 7 toward the receiving surface.

Extending the full axial length of the picker drum 5 and around the ends of the drum is a housing 10. This closeness of the housing 10 to the teeth 6 is effective to inhibit buildup of fibers in the form of fiber pockets or bundles and which might tend to fall onto a forming sheet and spoil sheet formation. Forwardly, the housing at its lower end, in known manner, carries a depending flexible member 25 which is adapted to engage sealing roll 26 and assist in closing off the forward end of the forming chamber to the entry of air. Laterally, the oppositely disposed guides 12 inhibit the flow of air to the forming chamber and define the width limits of the forming sheet 13 of pulp fibers.

The forming chamber is open rearwardly below the fiberizer bar 4 and between the panels 8 to provide communication of atmospheric pressure air to the underside of the receiving surface. The forming chamber is otherwise suitably closed to the atmosphere. This communication with the atmosphere provides only a gentle movement of air toward the vacuum zone and is not a significant factor in fiber movement between the fiberizer bar and the wire 9. This is for the reason that in the practice of the invention the fibers are impelled at high velocity from the bar in the channel 7 to the wire and that the energy of the fibers is derived essentially from the high velocity impact of the picker drum teeth on the pulp sheet 1. This velocity is of such magnitude that the movement of the fibers laterally is inhibited and receipt of the fibers on the wire is accompanied by a tendency of the traveling fibers to, in effect, bounce, a condition which is minimized by the vacuum condition at the wire surface.

The feeding and fiberizing equipment and the wire 9 may be supported in any convenient manner. As illustrated in FIG. 1, angle irons 29 which may be mounted on framing (not shown) mount plates 30 and an expanded metal support 31 engages across the plates and is securely retained thereby. The support 31 is provided with spaced mounting blocks 32 which secure the housings 10,11 in position above wire 9. Retaining means 32a aid this purpose.

The laterally disposed forming chamber dividers or panels 8 have projecting ends which extend at least as far forwardly in the direction of receiving surface movement as the center of the picking drum 5 and preferably somewhat beyond. It is within the zone between the channel 7 and panel ends (FIGS. 2 and 3) that the defiberized material moves downwardly to be received on the surfaces 9 or 9' and form a fine fluff mat or batt 13.

As previously noted, a prior difficulty in the formation of wide width mats by air deposition of fibers has been the inability to procure mats of substantially uniform thickness over their width. This has been overcome in the present instance: first, by effecting the fiberizing action very closely to the receiving surface; and, second, by inhibiting the development adjacent the fiber receiving surface of air currents which would deleteriously influence the fiber deposition. For example, picking drum 5, since it rotates very closely to the forming chamber dividers, does not set up the damaging air currents which adversely influence fiber deposition at the receiving surface.

The panels themselves, for the purpose of minimizing air currents in the zone adjacent the receiving surface, have a surface 14 shaped to conform generally to the curvature of the drum 5. The surface 14 is very narrow and terminates in a forward vertically extending face 15 and a rearwardly disposed upper apex 16. A linear depending wall 17 extends from the apex 16 to the horizontally projecting land 18 which itself terminates in the rear face 20. The panel faces are, in effect, quite sharp edged designed to avoid or minimize fiber "hangup", that is, unwanted fiber retention.

The panel shown at 8 in FIG. 5 has a linear extending base 19 so that this latter surface conforms generally with a receiving surface as at 9 in FIG. 2. More suitably for use with a drum, the surface at 9 is provided with a slight curvature to conform it to the drum. Exact conformance with the drum or wire is not required but is beneficial to the attainment of uniform deposition of fiber in mat formation.

Referring now particularly to FIGS. 1 and 10, the drum 5 may be driven in the direction indicated by the arrow in any conventional manner, the picking drum having a shaft 27 for the purpose. Suitably, the drum is formed (FIG. 10) of a plurality of flat plates 5' fixed in side by side relation on the shaft. Each plate carries in peripherally spaced relation a plurality of the teeth 6. Teeth 6 may be aligned axially from plate to plate or may more suitably be in staggered or spiral relation as shown in FIG. 10 so that the incoming pulp sheet 1 is under substantially continuous contact by the teeth.

The teeth, I have found, may most suitably be shaped as triangles. Such configuration avoids any significant building of pitch or the like resulting from contact with the pulp sheet. The included angle of the tooth sides preferably is about 60°; a 90° included angle is very effective as to preventing pitch buildup but requires more power for the same action on the pulp. Teeth with included angles of up to 90° serve the purpose, however, and the nature of the pulp itself will have a bearing on the extent of nit formation, that is, the tendency of fibers to cluster. It is, of course, not necessary that the teeth be triangular and other shapes serve the purpose well.

The incoming pulp sheet may be subjected to the teeth over a relatively wide range of angular contact with the teeth. Preferably, the angle of contact is (FIG. 11) acute so that fibers tend to be both picked and wiped from the sheet. The teeth are intended to travel at relatively high speeds of about 4000 fpm and up and are selected in view of the density of the pulp undergoing the fiberizing action, higher tooth or drum speeds being more suitable at higher pulp sheet densities. At high speeds, the fibers removed from the sheet are carried by the force of the impact in the channel 7 and

forming chamber toward the wire 9 as already discussed. The velocity of the fibers due to the impact of the teeth is the controlling factor in fiber movement to the wire.

The fiberized material passes downwardly to the foraminous surface well within the limits of the length of the panel 8 (FIGS. 2 and 3). The deposited mat has a high degree of uniformity varying only about ± 2 percent in all directions in weight over a web having a substantially continuous length. This small variation has been found in trial widths of about 12½ and it is anticipated may be maintained substantially independent of the width. Such uniformity is attained by appropriately spacing the panels 8. Spacing at a distance of only about one inch apart and one-half inch above the fiber receiving surfaces is effective to provide communicating compartments of a width which is narrow relative to the width of the mat undergoing fiberization. Close proximity to the fiber receiving surface by the base of the panel 8 is desirable to prevent unwanted air flow between the chambers defined by the panels. Cross air flow is, in fact, essentially eliminated by the panels in the preferred practice of the invention.

Referring now to FIG. 4, the structural arrangement is similar to that of FIG. 1 except that a plurality of sheets are being fed individually to individual drums 5 and the fibers are directed to a common receiving surface. In this instance the panels associated with the forward drum 5*a* are offset slightly transversely of the equipment from the panels associated with the first drum 5. Also, the fiberizing drum or disintegrators of succeeding units may be spaced a greater distance from the fiber receiving member as may the panels to provide for clearance so that previously deposited fibers are not disturbed by a succeeding deposit.

As more clearly shown in FIG. 6, wherein the elements representing the panels are indicated at 8*a*, more than one set of panels may be offset from the initial group. For example, three sets may be disposed to provide, in effect, a great plurality of width-wise overlapping forming chambers, each of small widthwise dimension. The chambers, however, do communicate with each other, particularly in the transverse direction by virtue of the raised position (FIGS. 2 and 3) of the panels 8.

In another variation of the arrangement in accordance with the invention, the mat fed to the second, for example, of a series of picking drums may be more narrow than preceding or succeeding mats. Thus, as indicated at 1a in FIG. 8, the mat may be quite narrow and is fed centrally to the device to cause a deposition of a second mat 21 on a first mat 13', the second mat 21 being more narrow and derived from the pulp mat 1*a*. This provides for a controlled width of material of a contoured nature in the present instance more thick centrally than at the edges. Also, as illustrated in FIG. 8, the fiber deposition may be on a base sheet 34 of suitable nature to form a part of the final product, that is, tissue paper, film or the like.

A plurality of the fiberizing and forming chamber heads may be arranged in position to deposit very considerable thicknesses of fluff or to provide positioned thicknesses as in FIG. 8. As shown in FIG. 9, the vacuum boxes 33 then are preferably disposed so that the spacing 35 between boxes lies under the seal roll 26 to thus inhibit air loss. The arrows in FIG. 9 indicate the direction of air movement.

The positioning of the panels 8 closely adjacent the drums 5 is of major importance if the unwanted influence of air flow is to be avoided. Most suitably, the panels are supported by being pressed upwardly into slots 22 of the fiberizing bar 4, as most clearly illustrated in FIG. 7. The fiberizing bar 4 may be supported, of course, by any convenient means (not shown).

In specific application with the pulp sheet fed at a rate of about 20 fpm to the picker drum, the drum was driven at 5400 fpm. Each plate of the drum (FIG. 10) carried 6 teeth and the teeth were arranged spirally about the drum. The drum diameter was about 6 inches and the sheet was fed to the drum as illustrated in FIG. 11. The quality of the fluff deposited on the receiving surface was excellent, and the formed sheet varied in weight to the extent of only about ± 2 percent. The rate of feed of the pulp is dependent, for a specific fiber quality, on the nature of the material being fiberized. Very hard pulps have been successfully formed into fluffy batts at a feed rate of the pulp of 60 fpm while softer pulps have performed well at 120 fpm.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments thereof except as defined in the appended claims.

I claim:

1. In combination, in apparatus for forming a continuous layer of wood pulp fibers, roll picker means and a fiberizing bar for defiberizing to substantially individual fibers a mat of the wood pulp fibers, means for feeding a mat of the wood pulp fibers to the said bar and roll picker means, a forming chamber closely adjacent the periphery of and below the roll picker means, and a receiving surface communicating with said forming chamber, said forming chamber having a plurality of panels projecting longitudinally in the direction of the receiving surface in laterally spaced apart relation defining small compartments communicating the picker roll periphery and receiving surface, said panels inhibiting air flow between compartments and being disposed slightly above the receiving surface to provide a continuous laterally extending zone on the receiving surface for fiber deposition, the said forming chamber being open to the atmosphere below the fiberizing bar and the said receiving surface having communication with a vacuum chamber.

2. Apparatus as claimed in claim 1 and in which panels defining the forming chamber extend in the direction of the receiving surface beyond the picker roll center from rearwardly of the picker roll.

3. Apparatus as claimed in claim 1 and in which the panels are supported by and depend from the fiberizing bar and have a contour conforming to that of the picker roll and extend from the fiberizing bar beneath the picker forwardly of the picking roll center.

4. Apparatus for forming a continuous layer of wood pulp fibers from a mat of such fibers, said apparatus comprising a movable fiber receiving surface, a housing disposed above said fiber receiving surface for passage of the fiber receiving surface relative to the housing, roll picker means within the housing, a fiberizing bar, means for feeding a said mat of the fibers to said fiberizing bar and roll picker means so that said mat may be defiberized substantially individual fibers, a forming chamber between the receiving surface and roll picker means and having a plurality of panels extending longi-

tudinally with and above the receiving surface defining narrow compartments, said forming chamber having an opening to the atmosphere rearwardly of the compartments and below the fiberizing bar, and vacuum chamber means in communication with said opening through said receiving surface and said forming chamber.

5. Apparatus as claimed in claim **4** and in which a plurality of fiberizing bars and associated roll picker means are disposed in linear relation above a common receiving surface, and a forming chamber associated with each fiberizing bar-roll picker means combination, the panels of successive forming chambers being offset from each other laterally.

6. The method of forming a batt of pulp fibers which comprises forming in air a plurality of streams of substantially individual fibers with said streams in longitudinally spaced apart relation, directing the fiber streams toward a longitudinally moving common surface so that the fibers of the streams are superposed in layers on the said surface, limiting lateral movement of the fibers of each stream as it approaches the common surface by guiding each stream through a plurality of parallel disposed compartments and so that each stream is subdivided laterally, at least one compartment of one said plurality of compartments being disposed in slightly offset relation laterally to compartments of a subsequent plurality of parallel disposed compartments so that fibers of successive streams overlap laterally.

7. The method of forming a batt of pulp fibers which comprises forming in air a plurality of streams of substantially individual fibers with said streams in longitudinally spaced apart relation, directing the fiber streams toward a longitudinally moving common surface so that the fibers of the streams are superposed in layers on the said surface, limiting lateral movement of the fibers of each stream as it approaches the common surface by guiding each stream through a plurality of parallel disposed compartments and so that each stream is subdivided laterally, and forming initially one of said streams of said plurality of streams of a width which is significantly less than the width of at least one other of said streams so that a contoured batt is formed.

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