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Jespersen

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[54] **APPARATUS FOR MAKING NONWOVEN FIBROUS WEBS**

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[52] **U.S. Cl.** **19/156.3**

[51] **Int. Cl.** **D01g 25/00**

[58] **Field of Search** 19/88, 89, 205, 155, 19/156, 156.4

[56] **References Cited**

UNITED STATES PATENTS

2,648,876	8/1953	Phillips et al.	19/156.3
2,890,497	6/1959	Langdon et al.	19/156.3 X
2,581,069	1/1952	Bertolet, Jr.	19/156.1
2,317,895	4/1943	Drill	19/155 X
3,501,813	3/1970	Lee et al.	19/156.3

FOREIGN PATENTS OR APPLICATIONS

1,396,985	3/1965	France	19/156.4

Primary Examiner—Dorsey Newton

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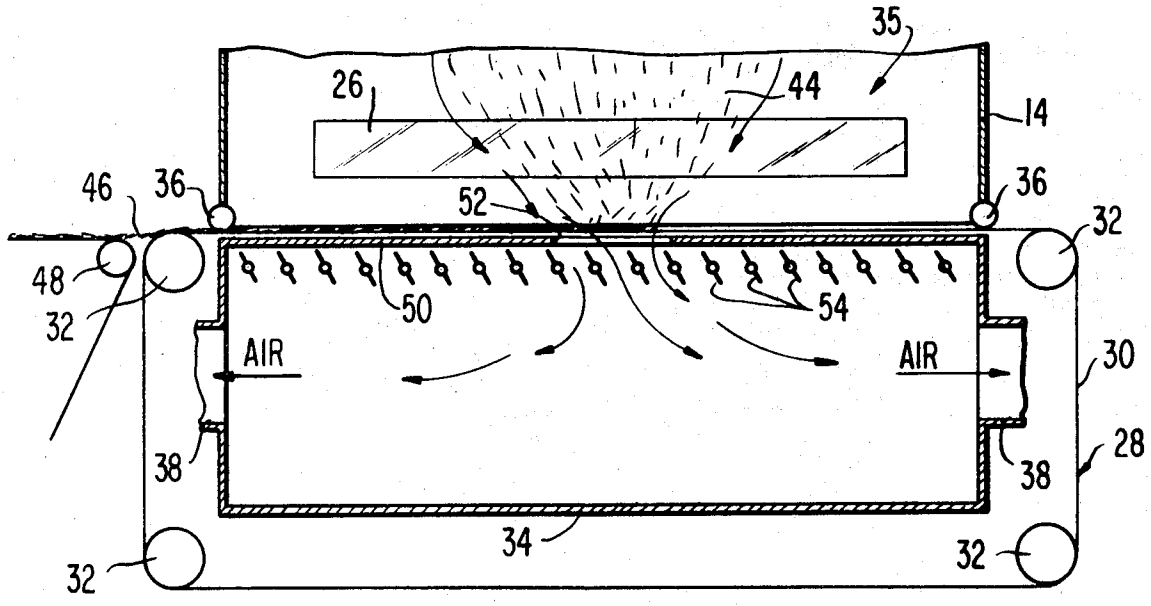
[57] **ABSTRACT**

An apparatus wherein a plurality of fibers are transported to and deposited on a foraminous conveyor by a flow of gas to form a nonwoven fibrous web. The passage of the flow through the conveyor is regulated by two independently operable, superposed means for selectively restricting such passage to control the deposition of the fibers on the conveyor and thereby control the thickness of the web.

3 Claims, 3 Drawing Figures



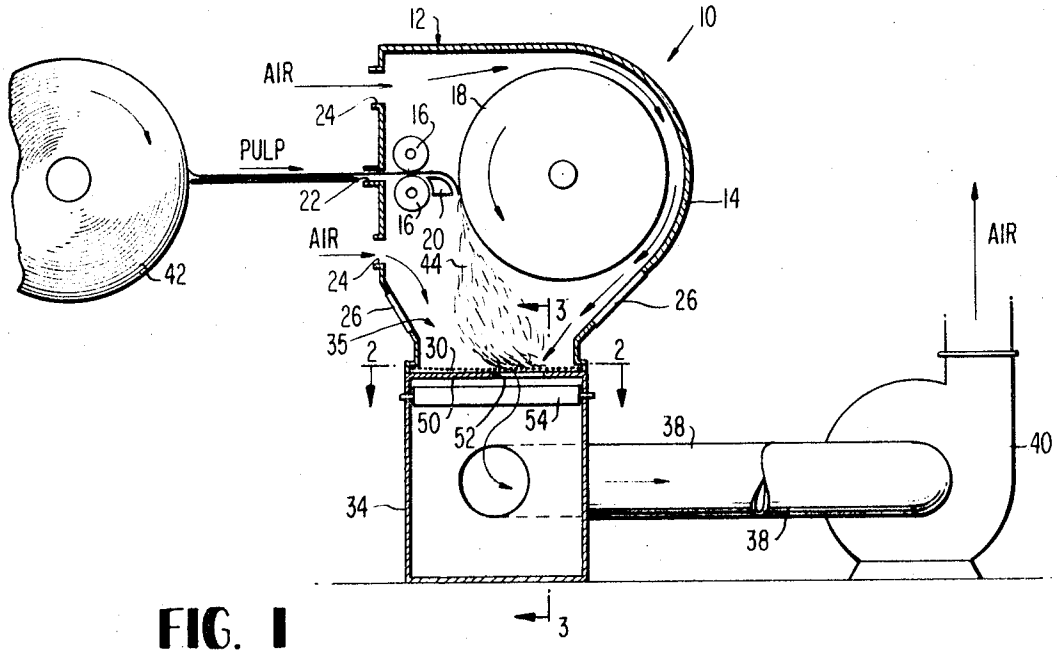
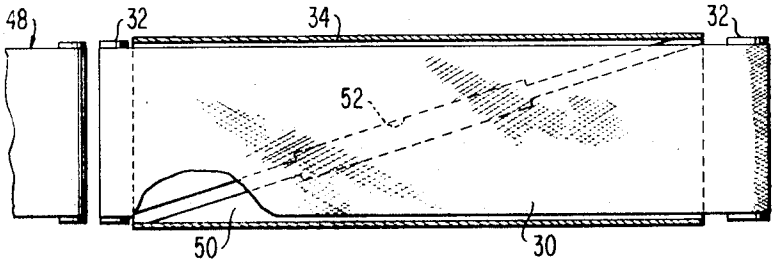


FIG. 1

FIG. 2



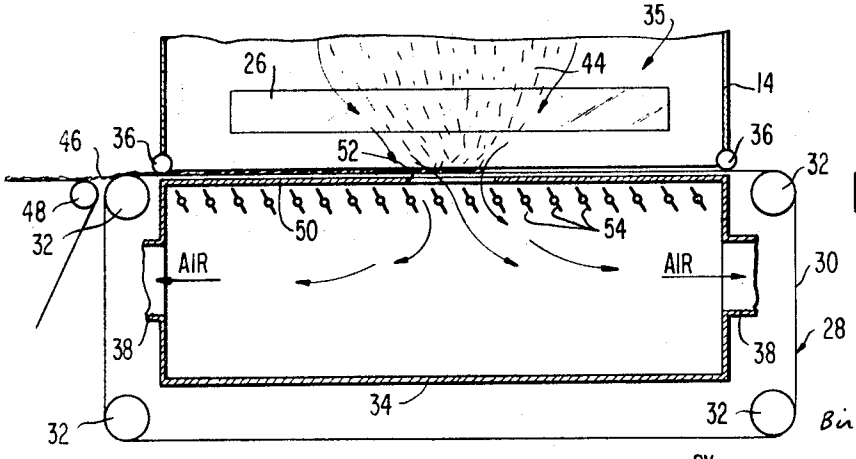


FIG. 3

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APPARATUS FOR MAKING NONWOVEN FIBROUS WEBS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to methods and apparatus for making nonwoven webs, and particularly to a method and apparatus for making a nonwoven fibrous web wherein the thickness of the web is accurately controlled, including desired transverse variations in thickness.

2. Description of the Prior Art

Various methods and apparatus are known for making nonwoven fibrous webs, including webs adapted to be used as absorbent pads. Exemplary of the prior art methods and apparatus of this general type are those disclosed in Bertolet U.S. Pat. No. 2,581,069, Anderberg et al., U.S. Pat. No. 3,032,836, Labino U.S. Pat. No. 3,114,939 and Nordstrand U.S. Pat. No. 3,423,796. The apparatus disclosed in these patents include means for pneumatically depositing a plurality of fibers on a foraminous conveyor and means for controlling the deposition of the fibers, such as a plurality of pivotally mounted vanes positioned adjacent the conveyor. While such vanes are useful for controlling the thickness of the webs, they do not provide sufficient control over the pneumatic deposition means to permit the formation of webs having desired transverse variations in thickness.

For some uses of nonwoven fibrous webs, it is desirable that the webs have transverse variations in thickness. For example, a web having a central portion of greater thickness than the marginal portions, is ideally suited for use as an absorbent pad in a disposable diaper.

SUMMARY OF THE INVENTION

The method and apparatus of the present invention provide an effective and efficient solution to the above-mentioned deficiency of the prior art methods and apparatus, and are ideally suited for making nonwoven fibrous webs adapted for use as absorbent pads. Basically described, the apparatus of the invention comprises; a chamber; a foraminous conveyor having a portion extending through the chamber; means for generating a flow of gas through the chamber, said chamber being operable to direct the flow through said conveyor portion; means for feeding a plurality of fibers into the flow so that the fibers are transported to and deposited on said conveyor portion by the flow to thereby form a web; and first and second independently operable, superposed means for adjustably restricting the passage of the flow through said conveyor portion to control the deposition of the fibers on said portion and thereby control the thickness of the web.

Generally described, the method of the invention comprises; directing a flow of gas through a foraminous conveyor; feeding a plurality of fibers into the flow so that the fibers are transported to and deposited on the conveyor by the flow to thereby form a web; and regulating the passage of the flow through the conveyor to control the deposition of the fibers thereon and thereby control the thickness of the web, said regulating including adjusting two independently operable, superposed means for restricting the passage of the flow through the conveyor.

One of the independently operable passage restricting means preferably comprises a plate positioned adjacent the conveyor and having an opening therein. The other independently operable passage restricting means preferably comprises a plurality of movably mounted vanes also positioned adjacent the conveyor. The size and shape of the opening in the plate and the attitude of the vanes may be adjusted independently to produce a web having accurately controlled thickness variations transversely of the web.

The conveyor preferably includes a wire mesh belt, and the gas flow generating means preferably comprises a conventional blower. The blower preferably is connected to a suction box and the conveyor and passage restricting means preferably extend across the upper end of such box.

The fiber feeding means preferably comprises a pin mill adapted to abrade a sheet of wood pulp. The pin mill preferably is mounted above the suction box so that the pin mill and suction box form a chamber through which an air flow generated by the blower passes. The chamber thus directs the flow through the conveyor and passage restricting means so that the wood fibers are transported to and deposited on the conveyor by the flow.

With the foregoing in mind, it is an object of the present invention to provide an improved method and apparatus for making nonwoven fibrous webs.

It is also an object of the invention to provide a method and apparatus for making nonwoven fibrous webs having controlled transverse variations in the thickness thereof.

It is an additional object of the invention to provide a method and apparatus for making nonwoven fibrous webs in which a plurality of fibers are deposited on a foraminous conveyor by a flow of gas and in which the thickness of the web formed by such deposition is controlled by two independently operable, superposed means for restricting the passage of the flow through the conveyor.

These and other objects of the invention will be apparent upon a consideration of the following detailed description of the preferred embodiments thereof given in connection with the following drawings, wherein like reference numerals identify like elements throughout.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevational view, partially in section, of the apparatus of the invention;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1; and

FIG. 3 is a sectional view taken on line 3—3 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the apparatus of the invention is shown in the drawing, as designated by reference numeral **10**. Apparatus **10** includes a pin mill **12** comprising a housing **14**, and disposed within the housing, a pair of rotatably mounted feed rolls **16**, a rotatably mounted attrition roller **18** and a nose bar **20** positioned between the feed rolls and attrition roller. Feed rolls **16** and attrition roller **18** are rotatably driven by conventional drive mechanisms (not shown). A feed slot **22** is formed in the side of housing **14** adjacent feed rolls **16**. Also, a pair of openings **24** are formed in the

side of the housing to permit air to enter the housing for a purpose described below, and a pair of windows **26** are mounted on opposite sides of the lower portion of the housing through which the operation of mill **12** may be observed.

A conveyor **28** is mounted below mill **12** and includes a foraminous wire mesh belt **30** and a plurality of rotatably mounted guide rolls **32** about which belt **30** is trained. One of rolls **32** is rotatably driven by a conventional drive mechanism (not shown). The upper run of belt **30** extends across the open lower end of housing **14.**

A suction box **34** also is mounted below mill **12.** The upper run of belt **30** extends across the open upper end of suction box **34,** and the lower end of housing **14** is connected to the upper end of box **34** along the sides of the upper run of belt **30** so that the housing and suction box form a chamber **35** through which the upper run of the belt extends. If desired, a pair of resilient surfaced rollers **36** may be rotatably mounted on the lower end of housing **14** directly above and contacting belt **30** adjacent the entrance and egress of the belt to and from chamber **35.** Rollers **36** minimize the flow of air into chamber **35** through the openings provided therein at the juncture of the lower end of housing **14** and upper end of box **34** through which belt **30** extends, for reasons which will become apparent below.

A pair of conduits **38** are connected between the ends of suction box **34** and a conventional blower **40.** Blower **40** generates a flow of air through chamber **35** with air being drawn into housing **14** through openings **24** and out of suction box **34** through conduits **38.** As will be apparent, the flow moves downwardly from housing **14** and into suction box **34** through the upper run of belt **30.**

A rolled sheet **42** of wood pulp is rotatably supported adjacent housing **14.** Sheet **42** is fed into the housing through feed opening **22** and between feed rolls **16.** Rolls **16** feed the sheet across nose bar **20** and against the surface of attrition roller **18.** The attrition roller abrades sheet **42** into individual wood fibers **44** and urges the fibers downwardly into the flow of air through housing **14.** Fibers **44** are transported to the upper run of belt **30** and deposited thereon by the air flow, incident to movement of the flow from housing **14** into suction box **34.** The fibers thus form a nonwoven fibrous web **46** on the upper run of the belt. Web **46** is thereafter transported out of chamber **35** by belt **30** and deposited on the belt of a transfer conveyor **48.**

Apparatus **10** includes means for controlling the thickness of web **46,** and in particular for varying the thickness of the web transversely thereof. Such means comprise two independently operable, superposed means for adjustably restricting the passage of the air flow through the upper run of belt **30.** One of the passage restricting means comprises a plate **50** positioned beneath the upper run of the belt and having an opening **52** therein. The passage of the air flow though the portion of belt **30** adjacent plate **50** is thus restricted to the area of opening **52.**

The other passage restricting means comprises a plurality of movably mounted vanes **54** positioned below plate **50.** Vanes **54** preferably are pivotally mounted in the upper end of suction box **34** and extend transversely of belt **30.** Vanes **54** may be individually pivoted to differentially restrict the passage of the air flow through the adjacent portion of belt **30.**

Plate **50** and vanes **54** permit the thickness of web **46** to be accurately controlled, including variations in the thickness of the web transversely thereof. As mentioned above, this latter feature is particularly advantageous for making webs which are adapted to be used as absorbent pads.

Opening **52** may be of any desired shape and size to provide the desired fiber deposition pattern. The deposition pattern may be further controlled by individually adjusting the attitude of vanes **54.**

An example of the combined effects of plate **50** and vanes **54** is illustrated by the embodiment of the apparatus shown in the drawing. In this embodiment, opening **52** extends generally diagonally across plate **50** and is narrower at the ends thereof than at the central portion thereof. Thus, a greater volume of air is permitted to pass through the central portion of the opening than at the ends thereof. Consequently, a greater number of fibers **44** are deposited on the central portion of belt **30** as the belt passes over plate **50** than on the marginal portions of the belt, and the resulting web **46** will have a central portion of greater thickness than the marginal portions. This particular web configuration is well suited for use as an absorbent pad in a disposable diaper.

The deposition of fibers **44** may be further controlled by individually adjusting vanes **54.** In the embodiment of the apparatus shown in the drawing, the vanes are all adjusted to the same attitude so that the vanes do not differentially restrict the passage of the air flow through belt **30.** However, if a further reduction in the thickness of the marginal portions of web **46** is desired, the vanes which underlie the narrower portions of opening **52** may be partially closed to thereby further restrict the passage of the flow through the adjacent portions of belt **30.** Thus, a still greater number of fibers **44** will be deposited on the central portion of the belt and a lesser number will be deposited on the marginal portions of the belt. Other variations in the size and shape of opening **52** and the attitude of vanes **54** may be employed to provide other transverse variations in the thickness of web **46.**

The method of the invention will be apparent from the foregoing description of the apparatus thereof.

The method and apparatus of the invention are effective and economical for making nonwoven fibrous webs, and particularly webs having transverse thickness variations, and thus are ideally suited for making webs adapted to be used as absorbent pads.

While the foregoing constitutes a detailed description of the preferred embodiments of the method and apparatus of the invention it is recognized that various modifications thereof will occur to those skilled in the art. For example, while the preferred embodiment of the apparatus includes a pin mill specifically adapted for feeding a plurality of wood fibers onto belt **30,** other fiber feeding means as appropriate for the particular type of fibers desired may be employed. Thus, the invention is to be limited solely by the scope of the appended claims.

I claim:

1. An apparatus for making non-woven fibrous webs having transverse variations in thickness comprising:

a chamber;

a foraminous conveyor having a portion extending through said chamber;

means for generating a flow of gas through said chamber, said chamber being operable to direct said flow through said conveyor portion;

means for feeding a plurality of fibers into said flow so that the fibers are transported to and deposited on said conveyor portion by said flow to thereby form a non-woven web;

first means for restricting the passage of said gas flow through said conveyor portion comprising a plate positioned adjacent said conveyor portion on the downflow side thereof and having a generally diagonally extending opening thereacross for the passage of the gas flow therethrough, said diagonal opening is narrower at the ends thereof than the central portion thereof, thereby permitting a greater volume of gas to pass through the central portion of the opening than the ends thereof and

second means for restricting the passage of said gas flow through said conveyor portion comprising a plurality of movably mounted vanes superposed with respect to said plate.

2. An apparatus as recited in claim **1**, wherein each of said vanes is mounted for pivotal movement about an axis extending transversely of said conveyor portion, whereby the fiber deposition pattern may be further regulated by differentially adjusting the vanes.

3. An apparatus as recited in claim **1**, wherein said conveyor comprises a wire mesh belt.

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