

[72] Inventors **Charles A. Brewster**
North Brunswick;
Charles H. Plummer, Princeton, N.J.
[21] Appl. No. **811,480**
[22] Filed **Mar. 28, 1969**
Division of Ser. No. 636,742, May 8, 1967,
Pat. No. 3,475,791.
[45] Patented **Apr. 20, 1971**
[73] Assignee **Johnson & Johnson**

[56] References Cited	
UNITED STATES PATENTS	
491,013	1/1893 Garraux
1,599,371	9/1926 Payzant
2,110,280	3/1938 Vieweg
2,450,511	10/1948 Harner et al.
2,676,363	4/1954 Plummer et al.
2,676,364	4/1954 Plummer et al.
2,711,381	6/1955 Novotny et al.
3,239,889	3/1966 Caughlin
	19/156.4
	19/156.3
	19/156.4
	19/156.3
	19/156.4
	19/156.4
	19/156.3X
	19/156.4

Primary Examiner—Evon C. Blunk
Assistant Examiner—W. Scott Carson
Attorneys—Robert L. Minier and Alexander T. Kardos

[54] **APPARATUS FOR COLLECTING WOODPULP FIBERS AS A UNIFORM LAYER**
3 Claims, 3 Drawing Figs.

[52] U.S. Cl. 302/59,
19/156.4, 302/11, 302/64
[51] Int. Cl. B65g 53/40
[50] Field of Search 19/88, 89,
156.3, 156.4; 302/17, 59, 64; 302/11

ABSTRACT: Apparatus for collecting woodpulp fibers as a uniform layer of loose fibrous material. The fibers are collected on a surface while removing the air from said fibers without disrupting the flow of said fibers or their formation on the collecting means.

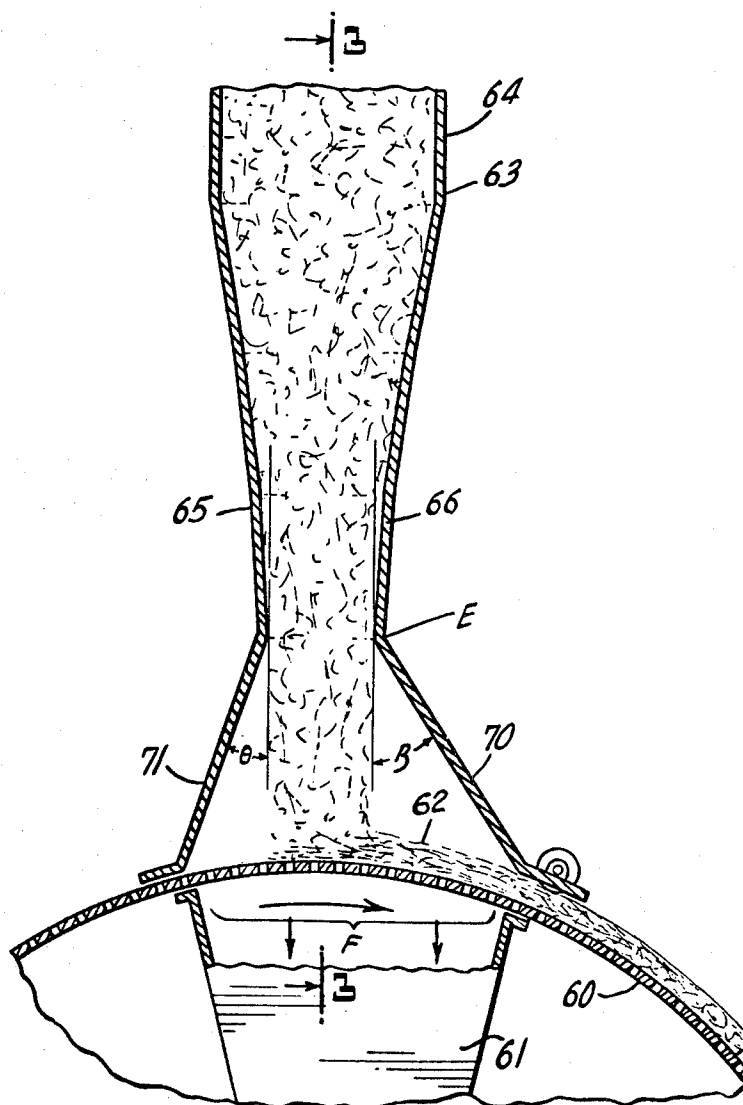
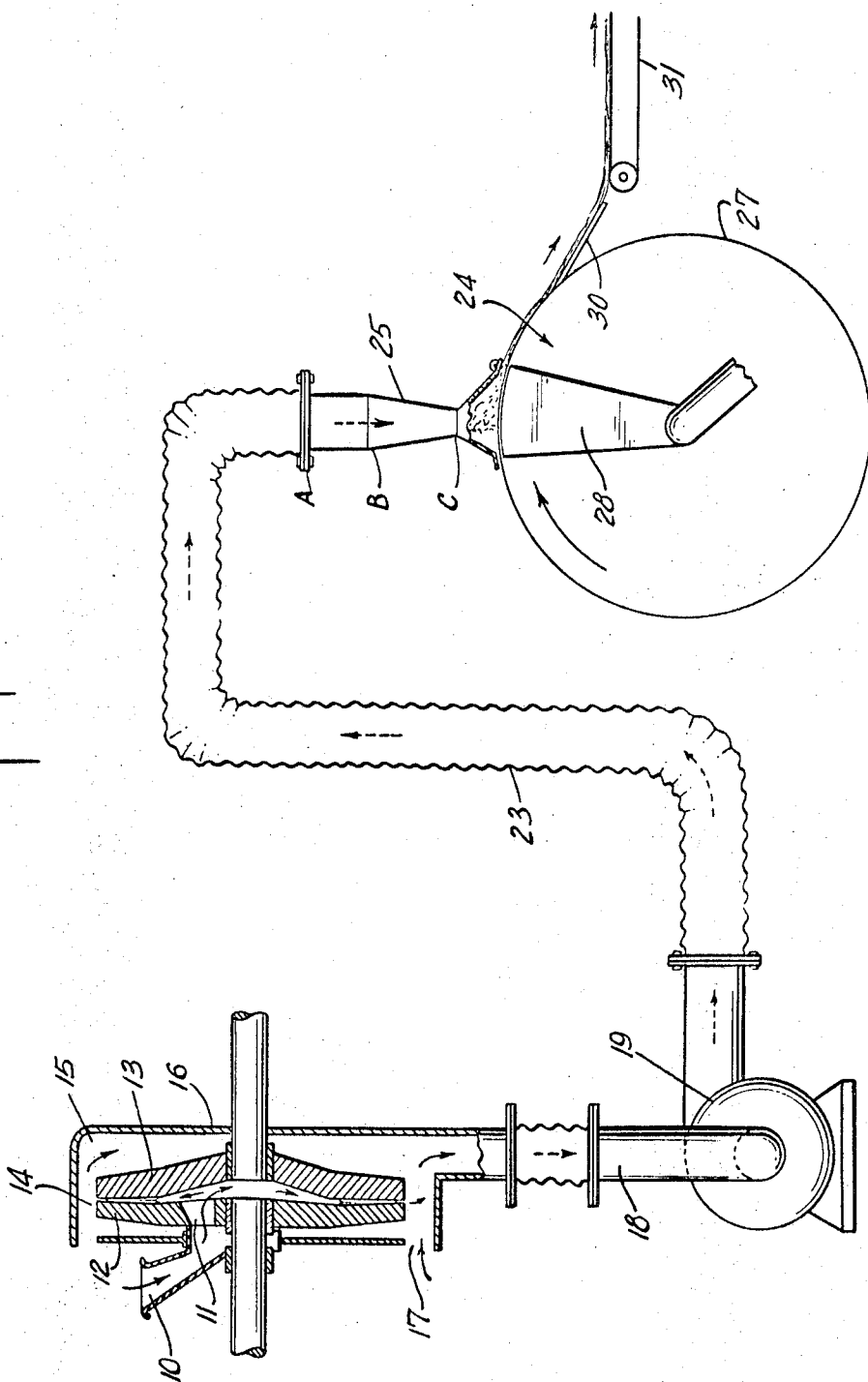


Fig. 1.



INVENTORS:
 CHARLES A. BREWSTER
 CHARLES H. PLUMMER
 BY *Robert L. Jensen*
 ATTORNEY

Fig. 3.

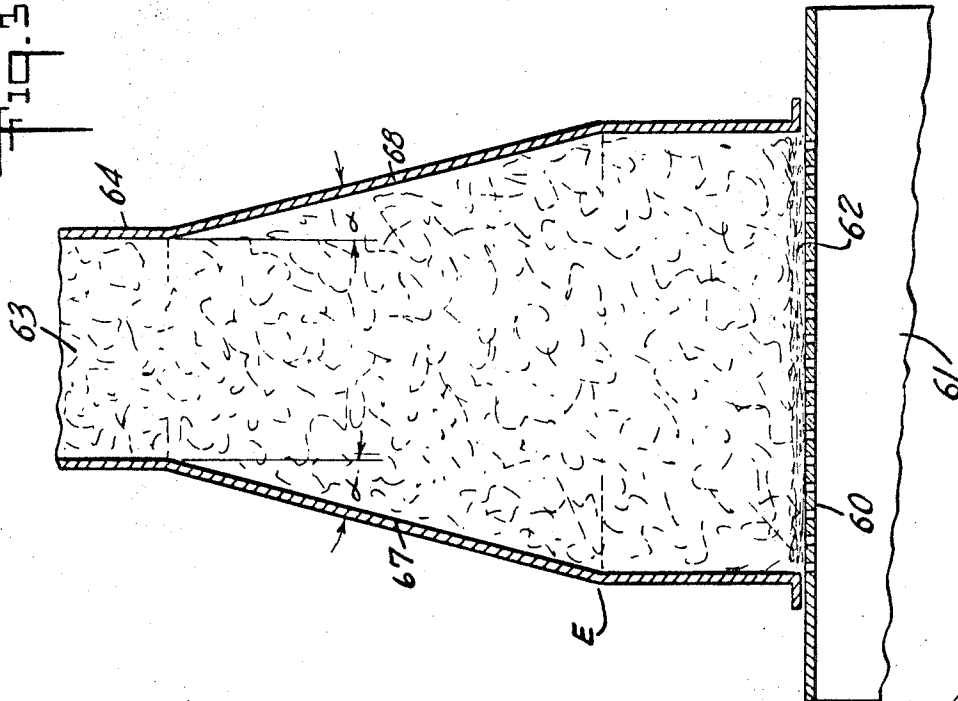
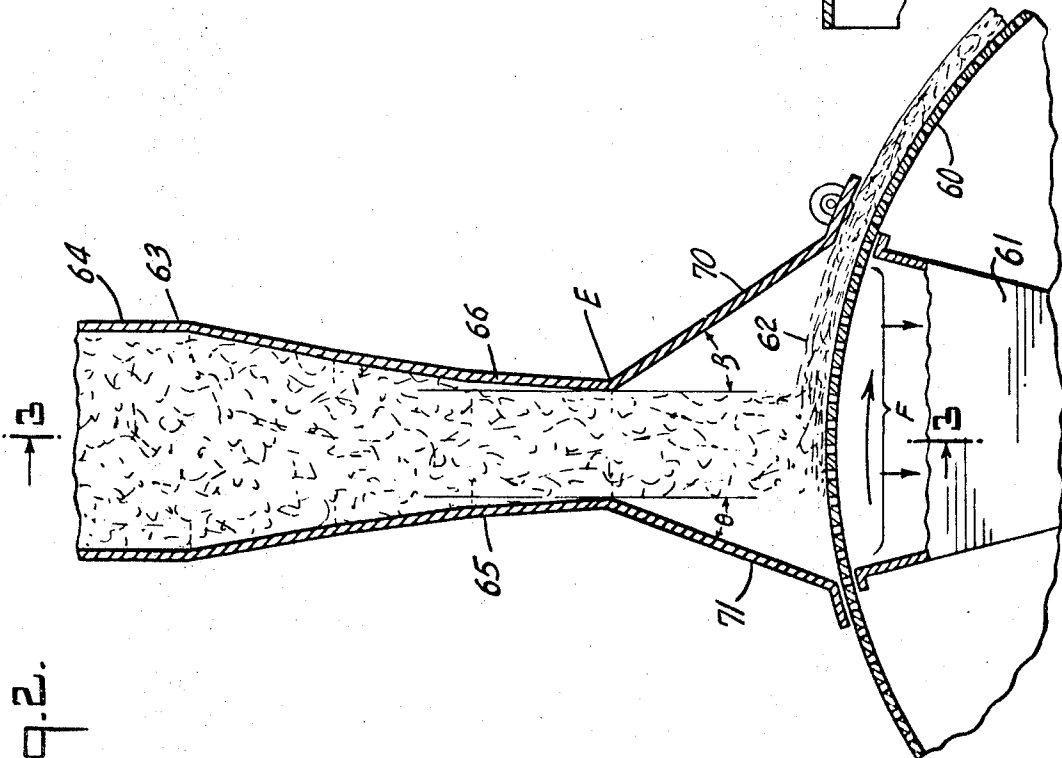


Fig. 2.



INVENTORS:
CHARLES A. BREWSTER
CHARLES H. PLUMMER
BY

Robert S. Plummer

ATTORNEY

APPARATUS FOR COLLECTING WOODPULP FIBERS AS A UNIFORM LAYER

This application is a division of application Ser. No. 636,742, filed May 8, 1967 now U.S. Pat. No. 3,475,791.

This invention relates to separating pulpboard into individualized fibers utilizing disc refiners or attrition mills and collecting the fibers on a screen or a similar foraminous material while dissipating the air so as not to disrupt the fibers and obtain a uniform distribution of the individualized fibers.

Two of the main advantages of woodpulp fibers are their very high absorbent characteristics and their low cost. Some of the main disadvantages of such fibers are that they are quite short, quite difficult to work with and process, readily tend to mat or cling to themselves forming hard knobs or balls and if wet processed form thin, paperlike rather than fabriclike sheets.

Because of their high absorbency, woodpulp fibers have long been formed as loose fibrous masses or batts to be used as absorbent media, however, in most all instances these batts are covered by paper wadding, lightweight fabrics or similar materials to stabilize the woodpulp and prevent it from linting or dusting. The cover on the batt allows the batt not to be as uniform as if the cover were not present and hence some balling or felting of the fibers can be tolerated. Also, because of their low cost, woodpulp fibers would appear to have great advantage as the basic component of a fabric, however, most of the woodpulp fiber today is processed in water or other liquids which produces a paper product which lacks drapeability, softness, and the required hand for many uses. It has been believed that if woodpulp fibers could be processed in the absence of excess water so that they would maintain softness, bulk, drapeability, and other desirable properties, there would be many more end uses for the woodpulp fibers.

The original woodpulp board of compressed woodpulp fibers has a moisture content by weight of from about 3 to 6 percent. In processing such woodpulp fibers in accordance with the present invention a maximum of about 10 percent by weight additional moisture is added to the woodpulp fibers. The total moisture content of the fibers during the entire processing is maintained at less than about 16 percent and usually more than 3 percent. The preferred moisture content of the fibers is from about 12 to 15 percent by weight. The low moisture contents cause static problems, increase fire hazard, increase fiber breakage, etc. The high moisture contents, above about 20 to 30 percent, make the fibers hard to separate, and once separated increase the possibility of fiber agglomeration and the formation of balls of fibers.

We have now discovered methods and apparatus for processing woodpulp fibers in air so that they may be collected in loose fibrous form. Our new method and apparatus substantially eliminates the breakage of fibers and very efficiently separates fibers and allows them to be collected in a uniform, loose fibrous layer with very few, if any, clumps or neps. Hence, our material may be bonded to maintain its loose, fibrous form and used as a fabric, or it may be adhered to gauze or similar material to provide strength and used as a fabric or it may be used by itself as an improved absorbent media.

In accordance with the present invention pieces of woodpulp board are air fed to the center of a pair of counter rotating discs and are forced outwardly between the discs to the outer perimeter thereof. The surface of the discs are so designed as to separate the pieces into individual fibers and the individualized fibers forced out from the peripheral edge of the discs both by the mechanical forces caused by the discs and the force of the air flow through the area between the discs. Substantially immediately on leaving the discs the individualized fibers are conveyed away from the discs at substantially right angles thereto by means of air and collected in an air stream. The fibers are maintained in a turbulent air stream and conveyed in this form to a collecting means. The fibers are substantially uniformly distributed throughout the air stream. The velocity of the air stream is reduced without substantially disrupting the path of the flow of fibers and the

fibers are substantially immediately collected on a collecting means while allowing the air to pass through said collecting means.

The collecting means generally comprises a foraminous surface such as a drum or conveyor to which the air-fiber mixture is directed with the air being allowed to pass through the openings in the collecting means and the fibers collected on the means. It is important that when conveying the fibers to the collecting means that the velocity be substantially constant and hence, the conveying means of a substantially constant cross section. Furthermore, because it is desired to maintain the fibers separated the concentration of fibers in the air stream should be quite low. The minimum amount of air required to maintain a pound of woodpulp fibers separated is about 150 cubic feet. It is preferred that from about 250 cubic feet to 350 cubic feet of air be used per pound of fiber. Much larger quantities of air may also be used though the more air used the more energy required to convey the pound of fibers and the less economical the system.

To form a batt of any thickness the amount of air which has to pass through the collecting means must be high and with a constant cross section conveying means there will not be sufficient open area in the collecting means to allow all of the air to readily pass through the deposit fibers. Instead the air will bounce off the collecting means and immediately disturb fiber distribution on the collecting means.

We have now discovered a method for continually collecting the fibers from the improved air-fiber stream by increasing the cross-sectional area of the conveying means without disturbing the fiber distribution. This is accomplished by conveying the air-fiber mixture in a duct having a rectangular cross section to a moving foraminous collecting means, and flaring or diverging the leading and trailing edges of the duct a total of from about 50° to 80° from their parallel planes. The leading edge must be flared from about 1.4 to 3.5 times as much as the trailing edge. The distance over which the leading and trailing edges are flared must be less than three times the distance between the leading and trailing edges at the point where they start to diverge. It is believed that the limitations previously described allow the inertia of fiber to maintain the fiber within the projected area of the cross-sectional area of the turbulent higher velocity conveying means until the fiber meets the collecting means and allows a portion of the air with substantially no fibers being dispersed therein, to pass both forwardly of and rearwardly of the area of the collecting means on which fibers are being deposited to pass therethrough without disruption of the fiber lay.

This of course is only a suspected theory. It may also be that placing a vacuum beneath the collecting means to hold the fibers in place when deposited the excess air is allowed to bounce into the expanded opening and be removed without fiber disruption provided the opening is constructed in accordance with the limitations previously given.

The large volume of air at relatively high velocity, it is believed, packs the fibers into the layer as the layer is being formed. The packing of the fibers causes interlocking of fibers forming a uniform, integral sheet which is readily handleable for further processing.

In the accompanying drawings and the following specification we have illustrated and described preferred designs of machines and modes of operation embodying our invention, but it is to be understood that our invention is not to be considered limited to the construction or operations disclosed except as determined by the scope of the appended claims. In the following drawings:

FIG. 1 is a diagrammatic showing, in elevation, of a preferred embodiment of fiber separating, converging and collecting apparatus suitable for carrying out the method of the present invention;

FIG. 2 is an enlarged cross-sectional view of the improved collecting portion of the apparatus of the present invention; and

FIG. 3 is a cross-sectional view taken along line 3-3 of FIG.

2.

Referring to FIG. 1 in the drawings there is shown apparatus for carrying out our improved process according to the invention. Pieces of woodpulp board, or woodpulp fibers in similar form, which are to be separated, are fed to the chute 10, through the opening 11 and between pair of counterr-
 5 rotating discs 12 and 13. Though it is preferred that the discs be counterrotating a combination of a stationary disc and a rotating disc may also be used. The force caused by the rotating discs forces the separated fibers out through and between the surfaces of the discs to the outer periphery 14 of the discs. The separated fibers are forced into the open space 15 enclosed by a shroud 16. The shroud has a circular opening 17 approximately in line with the outer circumference of the discs and the shroud is connected to the intake 18 of an air
 10 blower 19 for pulling a vacuum in the shroud. In operation, air is drawn through the circular opening in the shroud and directed perpendicular to the fibers being forced out from the rotating discs, and the fibers are drawn by suction into the intake of the fan or blower. The air-fiber mixture is blown by the blower to the depositing portion of the apparatus. The mixture is conveyed from the blower to the depositing section through corrugated-type duct work 23 which maintains the entire air-fiber stream in highly turbulent condition and prevents fiber agglomeration as the air-fiber mixture is being
 15 conveyed. The depositing section comprises a condensing mechanism 24 connected to the conveying duct work by suitable conduit 25 in accordance with the present invention. The condensing mechanism is a rotating perforated drum 27, which passes over stationary vacuum slot 28. The vacuum slot is in line with the conduit 25 and the drum rotates in the direction of the arrow shown.

The cross-sectional area of the duct is kept constant. At point A the cross-sectional area changes from a round configuration to a square configuration and is maintained constant to point B. At point B the configuration may be
 20 changed to point C in order to obtain the desired width of fiber lay. For example, two sides of the square conduit may be converged while the opposite sides are diverged in order to lay a wider sheet on the surface of the drum, however, when so doing the cross-sectional area of the conduit is maintained essentially constant. It is important that when changing cross-sectional areas the air velocity be kept at a minimum of 3,000 feet per minute.

At point C immediately adjacent the surface of the drum, the cross-sectional area is expanded in a specific manner to allow the air to expand and have sufficient area to pass through the drum without disturbing the fiber flow. In order to accomplish this the area must be expanded in the direction of rotation or direction of movement of the condensing means to a greater degree than in the opposite direction and it should preferably be at least expanded twice the amount in the direction of movement as it is in the direction opposed thereto. Furthermore, this expansion must be accomplished over a distance such that the expansion does not overcome fiber inertia and the fiber rather than being moved outwardly from its line of flow, has sufficient inertia to carry it approximately in a direct line to the condensing means. This distance should be 8 inches or less and preferably 6 inches or less.

The fibrous layer is removed from the condensing means by a doctor blade 30 and passed to a suitable conveyor means 31, to be processed as desired. Air may also be used to remove the fiber layer from the condensing means.

The velocity of the air-fiber dispersion may be from about 6,000 to 8,000 feet per minute so when presented to the condensing means, there is a considerable volume of air, which unless removed uniformly, will disrupt the fibrous layer as it is laid on the condensing means. Referring to FIGS. 2 and 3, there is shown our improved fiber laying apparatus. The fibers in sheet form of the desired width are collected on a perforated moving surface 60 which as a perforated drum or a perforated conveyor. Beneath the surface is a suction conduit 61 for collecting the air. The fibers filtered out by the surface are formed into a sheet 62. The thickness of the sheet will

depend upon the speed of the surface and the concentration of the fibers in the dispersion. The duct work 63 feeding the surface is kept at a substantially constant cross-sectional area. This cross-sectional area 64 is generally circular or square and is expanded in one direction and contracted in the other direction to form a lay of the desired width while maintaining the cross-sectional area uniform. For example, if a 6 inch square duct 64 is being used opposite sides 65 and 66 are converged while the other sides 67 and 68 are diverged in such a manner as to maintain a constant cross section until the width of the lay is 12 inches wide, if this is the width of the desired fiber sheet, and the other dimension would be 3 inches. In diverging the sides it is important that they be diverged at a total angle 2α of less than 20° and preferably less than 15° to prevent turbulence and conglomeration of the fibers. The sides should be diverged an equivalent amount so that each side diverges from the vertical from about 7° to 10° , angle α .

Once the desired cross-sectional configuration is obtained as at E and within 8 inches of the condensing surface the front and rear surfaces 70 and 71 respectively are expanded to provide for a larger area for removal of air. The front surface should be expanded at least twice the degree that the back surface is expanded. This expansion allows the air to expand and be removed over entire area F of the condensing means while the inertia of the fiber causes the fiber to continue in its same motion and be deposited uniformly.

As shown in FIG. 2 the front angle B should be less than 55° and preferably less than 45° , whereas, the rear angle θ should be less than 30° and preferably less than 20° . The distance from the start of the expansion B to the condensing means must be less than 8 inches and should be approximately 6 inches. The rear wall of the transition chamber should be expanded from about 15° to 25° from the vertical in a negative direction, whereas, the front wall should be expanded from about 35° to 55° in a positive direction from the vertical, the total expansion should be less than 80° in order to obtain the advantages of the present invention. If there is not sufficient open area for the air to be removed while the fibers are being filtered the fibrous lay will be greatly disrupted. If too great an area is provided the velocity of the air-fiber mixture is reduced and the fibers will tend to agglomerate and form nonuniform areas in the layer.

For the sake of clarity certain standard items have been omitted from the drawings; e.g., the necessary blower for producing a vacuum in the conduit or slot 28, the various standard vacuum seals required throughout the apparatus to prevent blowout of fibers, etc.

Although the invention has been described in specific detail and with certain structural characteristics, the same should not be construed as limited thereby, nor to the specific details mentioned therein, but to include various other equivalent constructions as set forth in the claims appended hereto. It is understood that any suitable changes, modifications, and variations may be made without departing from the spirit and scope of the invention.

We claim:

1. In apparatus for collecting a loose layer of short fibers on a moving surface, from a dispersion of said fibers in air being conveyed through a substantially constant cross-sectional ductwork at substantially constant velocity, said fibers having a length of one-fourth inch or less, and said moving surface being permeable and allowing the air to pass through the surface while the fibers are collected upon the surface to form a uniform layer of fibers, the improvement comprising; a transition piece extending from said ductwork into close proximity with said moving surface, said transition piece having a rectangular cross section of increasing cross sectional area, two opposed sides of said piece being substantially parallel and vertically aligned with the sides of said moving surface while the other two opposed sides diverge from each other at a total angle of 50° to 80° , said other two sides forming a leading edge and a trailing edge extending across

5

the width of said moving surface, said side terminating in said leading edge diverging from the center plane of said transition piece, which is substantially perpendicular to said moving surface, about 1.4 to 3.5 times as much as said side terminating in said trailing edge diverges from said center plane.

2. Apparatus according to claim 1 wherein the distance over which the cross-sectional area of the transition piece increases is less than 8 inches.

6

3. Apparatus according to claim 1 wherein the leading edge of the transition piece is diverged from about 35° to 55° towards the direction of movement of the surface and the trailing edge is diverged from about 15° to 25° away from the direction of the movement of the surface and the distance over which the cross-sectional area of the transition piece increases is less than 8 inches.

10

15

20

25

30

35

40

45

50

55

60

65

70

75