



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : D01H X	A2	(11) International Publication Number: WO 91/07530 (43) International Publication Date: 30 May 1991 (30.05.91)
(21) International Application Number: PCT/US90/06208 (22) International Filing Date: 1 November 1990 (01.11.90) (30) Priority data: 433,167 8 November 1989 (08.11.89) US (71) Applicant: FIBERWEB NORTH AMERICA, INC. [US/US]; 545 N. Pleasantburg Drive, Greenville, SC 29607 (US). (72) Inventors: ZELDIN, Leon, M. ; 111 Shefford Ct., Greer, SC 29650 (US). LAMKIN, Ronald, E. ; 33812 S.E. 27 St., Washougal, WA 98671 (US). WERNER, Joseph, E. ; Route 2, Box 11, Gray Court, SC 29645 (US).		(74) Agents: PATTERSON, Herbert, W. et al.; Finnegan, Henderson, Farabow, Garrett & Dunner, 1300 I Street, N.W., Washington, DC 20005-3315 (US). (81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent). Published <i>Without international search report and to be republished upon receipt of that report.</i>
(54) Title: METHOD AND APPARATUS FOR PROVIDING UNIFORMLY DISTRIBUTED FILAMENTS FROM A SPUN FILAMENT BUNDLE AND SPUNBONDED FABRIC OBTAINED THEREFROM (57) Abstract A method and apparatus for providing uniformly distributed filaments from a spun filament bundle and a process for forming spunbonded fabric having superior uniformity and a favorable ratio between machine and cross direction tensile strengths. The apparatus includes a fiber transfer tube and a pair of adjustable deflector plates. The deflector plates form a channel having a tapering width for transporting the filaments in a stream of high velocity air. The apparatus may also include an electrostatic charging means for applying an electrostatic charge to each individual filament after it exits the channel. The method for providing uniformly distributed filaments includes a first stage of separating the filament bundle by the high velocity stream of air and may also include a second stage of electrostatically charging the filaments to achieve a uniform filament separation. The process for forming spunbonded fabric enables a fabric to be produced having a machine direction to cross direction tensile strength ratio less than about 1.5.		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FI	Finland	ML	Mali
AU	Australia	FR	France	MN	Mongolia
BB	Barbados	GA	Gabon	MR	Mauritania
BE	Belgium	GB	United Kingdom	MW	Malawi
BF	Burkina Faso	GN	Guinea	NL	Netherlands
BG	Bulgaria	GR	Greece	NO	Norway
BJ	Benin	HU	Hungary	PL	Poland
BR	Brazil	IT	Italy	RO	Romania
CA	Canada	JP	Japan	SD	Sudan
CF	Central African Republic	KP	Democratic People's Republic of Korea	SE	Sweden
CG	Congo	KR	Republic of Korea	SN	Senegal
CH	Switzerland	LI	Liechtenstein	SU	Soviet Union
CI	Côte d'Ivoire	LK	Sri Lanka	TD	Chad
CM	Cameroon	LU	Luxembourg	TC	Togo
DE	Germany	MC	Monaco	US	United States of America
DK	Denmark	MG	Madagascar		
ES	Spain				

METHOD AND APPARATUS FOR PROVIDING UNIFORMLY DISTRIBUTED
FILAMENTS FROM A SPUN FILAMENT BUNDLE AND SPUNBONDED FABRIC OBTAINED
THEREFROM

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for providing uniformly distributed filaments from a spun filament bundle. The invention also relates to a process for forming spunbonded nonwoven webs having superior web uniformity and a favorable ratio between machine and cross direction tensile strengths, and the fabric formed by such process.

Nonwoven fabrics can be made from spun filaments by passing freshly extruded filaments on a stream of air through a plurality of filament distribution devices to transport the filaments onto a moving conveyor screen or belt where a nonwoven web is formed as the conveyor moves past the filament distribution devices. The nonwoven web can then be bonded, utilizing any one of a variety of known methods, to produce an integrated web or fabric.

To obtain nonwoven webs of high quality, it is important that the filaments being supplied to the moving conveyor be separated from each other so that they can be uniformly distributed onto the moving conveyor. It is known in the prior art that transporting the spun filaments by a stream of turbulent air will tend to separate the filaments from each other to a certain degree. It is also known that separation of spun filaments can be achieved by application of an electrostatic charge, i.e., a corona discharge, to the filaments prior to supplying the filaments onto the moving conveyor.

One of the problems encountered in forming a nonwoven web from spun filaments is achieving adequate filament separation so that the filaments can be uniformly distributed onto the conveyor.

1 If the filaments laid down to form the web stick together,
entangle with other filaments or are laid onto the nonwoven fabric
too close to other filaments, the web will have a nonuniform,
rope-like appearance which is unsightly and undesirable.

5 Another problem that is encountered in nonwoven web formation
is the interaction between adjacent filament distribution devices
which are normally provided in series to form a nonwoven web onto
the moving conveyor. These adjacent distribution devices may
adversely affect the uniform distribution of filaments because the
10 turbulent flow of air from each device tends to interfere with the
flow of air from adjacent devices.

Another problem that arises in utilizing an electrostatic
charge to enable filament separation in forming a nonwoven web is
providing the electrostatic charge uniformly to each individual
15 filament. If the electrostatic charge is applied to a bundle of
filaments, those filaments on the surface of the bundle will
receive a substantially greater charge than those filaments at the
interior of the bundle. This will result in a nonuniform
application of charge to the filaments and thus inadequate
20 spreading.

A further problem in forming nonwoven webs by the use of a
pneumatic filament distribution device is the tendency of
individual filaments to become entangled with one another, thus
preventing the effective separation and spreading of the
25 filaments. Because of this tendency for filament entanglement,
lower air rates are often required, which means that fewer
filaments per device can be supplied to the conveyor and thus a

1 greater number of filament distribution devices are required to
form the nonwoven web.

A problem in forming nonwoven webs by the use of standard
tubular distribution devices is that the pattern or "footprints"
5 formed by the devices on the moving conveyor tend to become
elongated, due to aerodynamic effects created by the proximity of
adjacent devices, in the direction of conveyor movement (machine
direction) causing filaments to be oriented predominantly in that
direction. Nonwoven fabrics made by such processes thus tend to
10 be weak in the direction perpendicular to the conveyor (cross
direction) due to lack of orientation in that direction.

It is an object of the present invention to provide a device
and method for uniformly distributing filaments from a spun
filament bundle onto a moving conveyor.

15 It is another object of the invention to provide a filament
distribution device that allows a higher air flow rate to be
utilized without filament entanglement and thus a greater number
of filaments per device can be uniformly distributed onto a moving
conveyor.

20 It is also an object of the invention to provide a device and
method for pneumatically separating filaments from a spun filament
bundle while minimizing the amount of air that interferes with
adjacent devices.

It is another object of the invention to provide a device and
25 method for applying an electrostatic charge to separate filaments
from a spun filament bundle.

1 It is also an object of the invention to provide a device and
method for enabling an electrostatic charge to be uniformly
applied to substantially all the filaments from a spun filament
bundle.

5 It is a further object of the invention to provide a filament
distribution device having adjustable deflector plates which
enables different types of spun filament bundles to be uniformly
distributed onto a moving conveyor.

10 It is a further object of the invention to provide a filament
distribution device capable of adjustable orientation with respect
to the receiving conveyor to enable filament layers to be
distributed at varying angles onto the conveyor.

15 It is a further object of the invention to provide a process
for producing spunbonded nonwoven fabrics that have a machine
direction to cross direction tensile strength ratio less than
about 1.5.

20 It is a further object of the invention to provide a
spunbonded nonwoven fabric that has a uniform appearance and a
machine direction to cross direction tensile strength ratio less
than about 1.5.

25 Additional objects and advantages of the invention will be
set forth in the description which follows and in part will be
obvious from the description, or may be learned by practice of the
invention. The objects and advantages of the invention may be
realized and obtained by means of the instrumentalities and
combinations particularly pointed out in the appended claims.

SUMMARY OF THE INVENTION

1 The present invention provides an apparatus for providing
uniformly distributed filaments from a spun filament bundle. This
apparatus includes fiber transfer means for receiving and
5 pneumatically transporting spun filament bundles. First and
second deflector plates are attached to the fiber transfer means
and disposed in substantial face-to-face relation to each other.
The fiber transfer means includes an entrance and an exit. The
deflector plates extend beyond the exit of the fiber transfer
10 means to form a filament transfer channel between the first and
second deflector plates. The filament transfer channel has an
exit adjacent to an end of the second deflector plate. The first
deflector plate has a length extending beyond the exit of the
filament transfer channel. The filament transfer channel has a
15 width that tapers in the direction of filament flow from the fiber
transfer means exit to the exit of the filament transfer channel.
The apparatus may also further include electrostatic charging
means disposed beyond the filament transfer channel exit. The
electrostatic charging means include at least one charging pin for
20 uniformly applying an electrostatic charge to the filaments as
they exit the filament transfer channel.

 The present invention also provides a method for providing
uniformly distributed filaments from spun filament bundles. The
method includes transporting spun filament bundles pneumatically
25 through fiber transfer means to a filament transfer channel and
spreading and separating the spun filament bundles by directing
them in a current of air through the filament transfer channel to

1 form a thin layer of separated, spread filaments. The filament
transfer channel is defined by two deflector plates in substantial
face-to-face relation with each other. The deflector plates are
oriented so that the filament transfer channel has a tapered
5 width, with its greatest width at the exit of the fiber transfer
means and its narrowest width at the exit of the filament transfer
channel. The method may also further include applying a uniform
charge to the separated spread filaments after they exit the
filament transfer channel so that each filament is provided with
10 substantially the same amount of charge.

The present invention further provides a method for producing
a nonwoven spunbonded fabric having a machine direction to cross
direction tensile strength ratio less than about 1.5. The process
includes providing a plurality of the above described filament
15 distribution devices above a moving conveyor. The process also
includes extruding a thermoplastic polymeric material through a
plurality of spinnerettes to form a plurality of spun filament
bundles.

The process also includes transporting the plurality of spun
20 filament bundles through a plurality of the filament distribution
devices of this invention to form a plurality of thin layers of
separated filaments. The process further includes depositing the
separated filaments onto the moving conveyor at selected angles to
form a web followed by bonding the web to form a nonwoven
25 spunbonded fabric. The plurality of thin layers of separated
filaments are deposited onto the moving conveyors at angles
sufficient to enable the formation of a nonwoven spunbonded fabric

1 having a machine direction/cross direction tensile strength ratio
less than about 1.5.

The present invention further provides a nonwoven spunbonded
fabric having a uniform appearance and having a machine direction/
5 cross direction tensile strength ratio less than about 1.5.

The accompanying drawings, which are incorporated in and
constitute a part of the specification, together with the
description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

10 Figure 1 is a diagram illustrating one side view of the
apparatus of the invention.

Figure 2 is a diagram illustrating a side view of the
apparatus of the present invention rotated 90° relative to the
apparatus illustrated by Figure 1.

15 Figure 3 is a diagram illustrating an end view of the
apparatus of the present invention.

Figure 4 is a diagram illustrating a prior art process for
producing a nonwoven spunbonded web.

20 Figure 5 is a diagram illustrating one embodiment of the
process of the present invention for producing a nonwoven
spunbonded web.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the present preferred
embodiments of the invention, examples of which are illustrated in
25 the accompanying drawings.

In accordance with the present invention, there is provided
an apparatus for providing uniformly distributed filaments from a

1 spun filament bundle including fiber transfer means for receiving
and pneumatically transporting spun filament bundles and first and
second deflector plates attached to the fiber transfer means and
disposed in substantially face-to-face relation to each other. As
5 embodied in Figure 1, the apparatus 10 for providing uniformly
distributed filaments from a spun filament bundle includes fiber
transfer means shown in Figure 1 as fiber transfer tube 12. Spun
filament bundles freshly produced from extrusion devices (not
shown) are provided to a fiber transfer tube entrance 14 and are
10 transported by a high velocity stream of air through fiber
transfer tube 12 to fiber transfer tube exit 16.

First and second deflector plates 18 and 20, as shown by
Figs. 1 and 3, may be attached to fiber transfer tube 12 by a
holding bracket 29 attached to fiber transfer tube 12 by screws
15 31. Holding bracket 29 includes clevises 28 which engage with
pins 30 in first and second deflector plates 18 and 20 to allow
adjustable engagement of first and second deflector plates 18 and
20 to fiber transfer tube 12. In addition, first and second
deflector plates 18 and 20, as shown in Fig. 1, may include set
20 screws 26 which can be adjusted into contact with bracket 29 on
fiber transfer tube 12. Set screws 26 can be utilized to adjust
the angle of orientation of first and second deflector plates 18
and 20 relative to fiber transfer tube 12. First and second
deflector plates 18 and 20 may also be further secured in place by
25 extension springs 27, which enable easy access to the internal
surfaces of first and second deflector plates 18 and 20 for
cleaning.

1 In accordance with the invention, the first and second
deflector plates are disposed in substantial face-to-face relation
to each other and extend beyond the exit of the fiber transfer
means to form a filament transfer channel. The filament transfer
5 channel has an exit adjacent to an end of the second deflector
plate, with the first deflector plate having a length extending
beyond the exit of the filament transfer channel. As embodied by
Fig. 1, first deflector plate 18 and second deflector plate 20
extend beyond fiber transfer tube exit 16 to form filament
10 transfer channel 22. Filament transfer channel 22 has a filament
transfer channel exit 24 which is adjacent the end of second
deflector plate 20. First deflector plate 18 extends beyond
filament transfer channel exit 24.

15 In accordance with the invention, the filament transfer
channel has a width that tapers in the direction of filament flow
from the fiber transfer means exit to the exit of the filament
transfer channel. As embodied by Fig. 1, filament transfer
channel 22 tapers in the direction of filament flow from fiber
transfer tube exit 16 to filament transfer channel exit 24. The
20 tapered width of filament transfer channel 22 in the direction of
filament flow acts to direct the high velocity flow of air toward
filament transfer channel exit 24 to minimize turbulence which can
cause entanglement of individual filaments.

25 First and second deflector plates 18 and 20 are preferably
rectilinear in shape. First deflector plate 18 preferably has a
length ranging from 6 inches to 12 inches, a width ranging from
3 inches to 4 1/2 inches and a thickness ranging from 1/8 inch to

1 3/8 inch. Second deflector plate 20 preferably has a length
ranging from 4 inches to 8 inches, a width ranging from 3 inches
to 4.5 inches and a thickness ranging from 1/8 inch to 3/8 inch.
First and second deflector plates 18 and 20 should be made out of
5 a conductive material. One example of such a conductive material
is stainless steel. The internal surfaces of first and second
deflector plates 18 and 20 may also be coated with a wear
resistant material. Fiber transfer tube 12 preferably has an
inside diameter ranging from 3/8 inch to 5/8 inch and is
10 preferably composed of stainless steel.

The present inventors have found that the degree of filament
entanglement in the apparatus of the invention can be minimized,
and thus a maximum flow of air can be utilized without filament
entanglement, by adjusting the angle of orientation between first
15 and second deflector plates 18 and 20 to achieve optimum
performance. It has been found that first deflector plate 18
should be oriented at an angle ranging from -5° to $+14^{\circ}$ with
respect to a vertical plane. A positive angle as used herein
represents an angle with the vertical plane in the direction
20 towards the opposing deflector plate while a negative angle
denotes an angle between the plate and the vertical plane in the
direction away from the opposing deflector plate. It has been
found that second deflector plate 20 should preferably range from
 0° to $+18^{\circ}$ with respect to the vertical plane. A preferred
25 embodiment which has been found to achieve advantageous results is
first deflector plate 18 oriented $+7^{\circ}$ to the vertical plane and
second deflector plate 20 oriented $+7^{\circ}$ to the vertical plane

1 (shown by Fig. 1). A particularly preferred embodiment achieving
optimal results is first deflector plate 18 oriented parallel to
the vertical plane and second deflector plate 20 oriented + 14° to
the vertical plane. By adjusting the orientation of first and
5 second deflector plates 18 and 20, it may be possible with the
apparatus of the invention to transport up to 300 filaments per
tube to a moving conveyor without substantial filament
entanglement. This represents a substantial increase over the
prior art methods and results in the use of fewer devices and thus
10 increased process efficiency.

In accordance with a preferred embodiment of the invention,
the apparatus for providing uniformly distributed filaments from a
spun filament bundle also may include electrostatic charging means
disposed beyond the filament transfer channel exit. The
15 electrostatic charging means includes at least one charging pin
for uniformly applying an electrostatic charge to the filaments as
they exit the filament transfer channel. The electrostatic
charging means may function as an additional separation stage.
The electrostatic charging means, embodied herein as shown by
20 Figs. 1 and 2, may consist of a corona discharge assembly device
32 which preferably comprises a housing made of plexiglass.
Corona discharge assembly device 32 can be attached to second
deflector plate 20 by screws 38. Corona discharge assembly device
32 preferably includes at least one metal bar 36 each embedded
25 therein. It is preferred to utilize two metal bars 36. Metal
bars 36 each include a plurality of charging pins 34. Charging
pins 34 are preferably evenly spaced from one another in rows

1 perpendicular to the direction of the filament flow and are
preferably composed of sharpened monel. Metal bars 34 can be
attached to high voltage cables 40 for providing electrostatic
charge to charging pins 34. It may be advantageous to provide a
5 different voltage to each row of charging pins 34. The area
bounded by first and second deflector plates 18 and 20 beyond
filament transfer channel exit 24 is shown in Fig. 1 as
electrostatic charging area 42.

In accordance with the invention, a method is provided for
10 uniformly distributing filaments from spun filament bundles
including transporting spun filament bundles pneumatically through
fiber transfer means to a filament transfer channel and spreading
and separating the spun filament bundles by directing them in a
current of air through the tapered filament transfer channel to
15 form a thin layer of separated, spread filaments. The rate of air
flow through fiber transfer tube 12 preferably ranges between 15-
45 standard cubic feet per minute. The high velocity stream of
air flowing through fiber transfer tube 12 acts as an initial
separation stage to separate the individual filaments from the
20 spun filament bundle. Individual filaments which have been
separated to a certain degree by the flow of high velocity air
through filament transfer channel 22 exit filament transfer
channel 22 at filament transfer channel exit 24. Filament
transfer channel exit 24 should be wide enough to allow individual
25 filaments to exit filament transfer channel 22 without plugging
filament transfer channel exit 24, and should be narrow enough so
that bundles of filaments cannot exit, i.e., only substantially

1 individual layers of filaments should be allowed to pass from
filament transfer channel 22. It has been found by the inventors
that the optimum width of filament transfer channel 24 is
preferably 1/16"-3/16", with the most preferred width being
5 approximately 1/8 inch.

In accordance with a preferred embodiment of the invention, a
method is provided which may also include applying a uniform
charge to the separated, spread filaments after they exit the
filament transfer channel so that each filament is provided with
10 substantially the same amount of charge. The optimum width of
filament transfer channel 24 is selected so that a thin layer,
preferably a single layer, of individual filaments will enter
electrostatic charging area 42 whereby a uniform electrostatic
charge can be applied to each filament. If several layers of
15 filaments are allowed to exit at filament transfer channel exit
24, the application of electrostatic charge from charging pins 34
may only be effective in charging those filaments on the outside
of the bundle. Thus, the present invention enables a uniform
charge to be applied to the individual filaments in electrostatic
20 charging area 42.

As the filaments pass by charging pins 34 in electrostatic
charge area 42, a high voltage electrostatic charge between
charging pins 34 and conductive first deflector plate 18 is
provided to the air and to the filaments in electrostatic charging
25 area 42. This electrostatic charge causes adjacent filaments to
repel each other which insures that the filaments exiting the
electrostatic charge area 42 are separated and thus have a uniform

1 spread. In order to provide adequate charge to the filaments, it
is preferred that electric cables 40 provide an electrostatic
charge ranging from 15,000 - 40,000 V. A DC current supply is
normally used to supply the electrostatic charge and charging pins
5 34 should have either a positive or negative charge depending upon
the type of filaments. Fibers such as nylon and rayon should have
a positive charge. It is believed that fibers such as polyesters
and acrylics may have either a positive or negative charge.
Polypropylene fibers should have a negative charge.

10 As disclosed in Fig. 5, each apparatus 10 for providing
uniformly distributed filaments from a spun filament bundle can be
utilized in combination with a plurality of similar apparatuses
10, located in rows, to provide the filaments onto a conveyor 44
moving below the plurality of apparatuses 10 to form a nonwoven
15 web. The apparatuses 10 are vertically oriented and can be
located above the conveyor 44 in a plurality of rows. First and
second deflector plates 18 and 20 prevent the flow of high
velocity air from each apparatus 10 from interfering with the flow
of high velocity air from adjacent apparatuses.

20 As disclosed in Fig. 4, prior art processes for producing
nonwoven spunbonded fabric utilized a plurality of spinnerettes 50
to draw down continuous filaments to attenuators 52 and extension
tubes 54 which provide the filaments by high velocity air onto a
moving conveyor 56. The attenuators 52 and extension tubes 54 are
25 arranged side by side along the cross direction of the conveyor 56
and the flow of air from the attenuators 52 and extension tubes 54
forms a pattern or footprint 58 on conveyor 56. Footprints 58

1 overlap one another on conveyor 56 to enable the deposition of
filaments onto conveyor 56 to form a nonwoven web. Footprints 58
issued by prior art attenuators 52 and extension tubes 54 are
elongated in the machine direction due to aerodynamic effects from
5 adjacent devices which causes filaments to be oriented on conveyor
56 primarily in the machine direction (MD). Fabrics made from
such processes tend to be weak in the cross direction (CD) due to
the lack of filament orientation in that direction and thus the
tensile strength ratio of the machine direction to the cross
10 direction becomes very large.

In accordance with the invention, a method is provided for
producing a nonwoven spunbonded fabric having a machine direction
to cross direction tensile strength ratio less than about 1.5.
The method includes providing a plurality of the apparatuses of
15 the invention above a moving conveyor, extruding a thermoplastic
polymeric material through a plurality of spinnerettes to form a
plurality of spun filament bundles, transporting the plurality of
spun filament bundles through a plurality of the apparatuses of
the invention to form a plurality of thin layers of separated
20 filaments, depositing the separated filaments onto the moving
conveyor at selected angles, and bonding the filament web to form
a nonwoven spunbonded fabric. The plurality of thin layers of
separated filaments are deposited onto the moving conveyor at
angles sufficient to enable the formation of a nonwoven spunbonded
25 fabric having a MD/CD tensile strength ratio less than about 1.5.

As embodied by Fig. 5, a plurality of the apparatuses 10 of
the invention are provided above a moving conveyor 44 which may be

1 a belt or a wire. Each apparatus 10 is attached to fiber transfer
means 12 as described earlier herein. Fiber transfer means 12
preferably is a fiber transfer tube. The plurality of fiber
transfer tubes are attached to spinnerettes (not shown) which
5 receive extruded thermoplastic polymeric material from extruders
(not shown). The spinnerettes convert the extruded polymer into
spun filament bundles. These spun filament bundles are then
transported by high velocity air through the apparatuses 10 of the
invention as described earlier herein. Apparatuses 10 separate
10 the spun filament bundles into individual filaments and they exit
apparatuses 10 as thin layers of separated filaments. These thin
layers of separated filaments are deposited onto moving conveyor
44 in patterns or footprints 60. Footprints 60 are in the shape
of elongated ellipses with the long diameter of the ellipse
15 corresponding to the length of filament transfer channels of
apparatuses 10. Utilizing a plurality of apparatuses 10 arranged
side by side in a plurality of rows enables a wide nonwoven
spunbonded web to be formed by overlapping footprints 60 on moving
conveyor 44.

20 Footprints 60 can be formed on moving conveyor 44 at various
angles between the long axis of the ellipse and the cross
direction. This angle is shown by θ in Fig. 5. By rotating
apparatus 10 about fiber transfer means 12 as described earlier
herein, it is possible to orient the elliptical footprint 60 onto
25 moving conveyor 44 at any angle. By altering the angle of
deposition of footprints 60 onto moving conveyor 44, a nonwoven
spunbonded web can be formed that, after bonding, can produce a

1 spunbonded fabric having a machine direction to cross direction
tensile strength ratio of less than about 1.5. A fabric having
such a ratio is desirable in that it has a substantially uniform
strength throughout, while maintaining sufficient strength in the
5 machine direction to retain machinability.

Two rows of footprints 60 formed by 2 rows of apparatuses 10
are illustrated in Fig. 5. However, it may be preferable to
utilize more than 2 rows of apparatuses 10. Apparatuses 10 may be
oriented so that each row of footprints 60 is oriented in the same
10 direction or they may be oriented so that adjacent rows are
oriented perpendicular to each other. In Fig. 5, angle θ is 45°
and the rows are oriented perpendicular to one another. It is to
be understood that footprints 60 can be oriented at various angles
 θ ranging from 0° to approximately 75° . At angles θ greater
15 than 75° , the machine direction to cross direction tensile
strength ratio becomes too high. Moving conveyor 44 may make a
single pass under apparatuses 10 and collect a single layer of
filaments or may make a number of passes to collect multiple
layers in forming the web. Following deposition of the nonwoven
20 spunbonded web onto moving conveyor 44, the web can be bonded by
means known in the art to form a nonwoven spunbonded fabric.

In accordance with the invention, a nonwoven spunbonded
fabric is provided having a uniform appearance and having a
machine direction to cross direction tensile strength ratio less
25 than about 1.5. This fabric can be utilized as a liner for
diapers or sanitary napkins.

The following working Example is provided to illustrate the present invention and some of its advantages. The Example is representative only and is in no way limitative of the invention.

EXAMPLE

A nonwoven spunbonded fabric of filament grade polypropylene resin was produced by a process utilizing 6 spinnerettes, with 7 filament distribution apparatuses of the invention per spinnerette. Filaments from the filament distribution apparatuses were deposited onto a foraminous conveyor to form a web that was 92.7 inches wide. The web was formed by one pass of the conveyor under the filament distribution apparatuses. The filament distribution apparatuses were located in two rows. The rows were 13" apart and each apparatus was 4 1/4" from adjacent apparatuses.

Each apparatus included two deflector plates of stainless steel having a thickness of 3/8" and a width of 3 1/2". The short deflector plate was 6" long and was oriented at +14° while the long deflector plate was 8" long and was oriented at 0°. The fiber transfer tube had an inside diameter of 1/2" and was stainless steel. The width of the filament distribution channel exit was 1/8". The voltage applied to the filaments by the electrostatic charging means was 30,000 volts.

The nonwoven spunbonded web was subsequently bonded by a calender between two heated rolls, one having a smooth surface and the other having point engraving with 18% bond area to form a fabric having a basis weight of .70 oz./sq.yd. The fabric had a

tensile strength in the machine direction of 4.5 lbs./in. and a tensile strength in the cross direction of 4.2 lbs./in. The ratio of machine direction to cross direction tensile strength was 1.07.

Although the present invention has been described in connection with the preferred embodiments, it is understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention. Such modifications are considered to be within the purview and scope of the invention and the appended claims.

WHAT IS CLAIMED IS:

1. An apparatus for providing uniformly distributed filaments from a spun filament bundle, comprising:

fiber transfer means for receiving and pneumatically transporting spun filament bundles, said fiber transfer means including an entrance and an exit; and

first and second deflector plates attached to said fiber transfer means and disposed in substantial face-to-face relation to each other, said deflector plates extending beyond the exit of said fiber transfer means to form a filament transfer channel between said first and second deflector plates, said filament transfer channel having an exit adjacent to an end of said second deflector plate and the first deflector plate having a length extending beyond said exit of said filament transfer channel, said filament transfer channel having a width that tapers in the direction of filament flow from the fiber transfer means exit to the exit of the filament transfer channel.

2. The apparatus of claim 1, further comprising electrostatic charging means disposed beyond the filament transfer channel exit, said electrostatic charging means including at least one charging pin for uniformly applying an electrostatic charge to the filaments as they exit the filament transfer channel.

3. The apparatus of claim 1, wherein said fiber transfer means is a fiber transfer tube.

4. The apparatus of claim 1, wherein the deflector plates are rectilinear.

5. The apparatus of claim 2, wherein a plurality of charging pins are arranged in rows perpendicular to the direction of filament transport.
6. The apparatus of claim 2, wherein said charging pins have a positive charge.
7. The apparatus of claim 2, wherein said charging pins have a negative charge.
8. The apparatus of claim 3, wherein said deflector plates are pivotally attached to said fiber transfer tube to enable adjustable orientation of said deflector plates relative to one another.
9. The apparatus of claim 3, wherein said apparatus is rotatably attached to said fiber transfer tube to enable said apparatus to be adjustably rotated about said fiber transfer tube.
10. The apparatus of claim 2, wherein said electrostatic charging means further includes a plastic body attached to said second deflector plate, said plastic body having a plurality of metal bars imbedded therein containing said plurality of charging pins, said metal bars each being attached to a high voltage cable for providing electrostatic charge.
11. A method for providing uniformly distributed filaments from spun filament bundles comprising:

transporting spun filament bundles pneumatically through fiber transfer means to a filament transfer channel, said filament transfer channel being defined by two deflector plates in substantial face-to-face relation with each other, said deflector

plates being oriented so that said filament transfer channel has a tapering width, with its greatest width at the exit of said fiber transfer means and its narrowest width at the exit of said filament transfer channel; and

spreading and separating said spun filament bundles by directing them in a current of air through said tapered filament transfer channel to form a thin layer of separated, spread filaments.

12. The method of claim 11, further comprising applying a uniform charge to said separated, spread filaments after they exit said filament transfer channel so that each filament is provided with substantially the same amount of charge.

13. The method of claim 12, wherein the charge applied to said separated spread filaments is positive.

14. The method of claim 13, wherein the charge applied to said separated spread filaments is negative.

15. The method of claim 11, wherein said fiber transfer means is a fiber transfer tube.

16. The method of claim 11, wherein said filament transfer channels are capable of being adjustably rotated about said fiber transfer means.

17. A process for producing a nonwoven spunbonded fabric having a MD/CD tensile strength ratio less than about 1.5 comprising:

providing a plurality of the apparatuses of claim 9 above a moving conveyor;

extruding a thermoplastic polymeric material through a plurality of spinnerettes to form a plurality of spun filament bundles;

transporting the plurality of spun filament bundles through a plurality of the apparatuses of claim 9 to form a plurality of thin layers of separated filaments;

depositing the separated filaments onto the moving conveyor at selected angles to form a web; and

bonding the filament web to form a nonwoven spunbonded fabric; said plurality of thin layers of separated filaments being deposited onto the moving conveyor at angles sufficient to enable the formation of a nonwoven spunbonded fabric having a MD/CD tensile strength ratio less than about 1.5.

18. A nonwoven spunbonded fabric having a uniform appearance and having a MD/CD tensile strength ratio less than about 1.5 produced by the process of claim 17.

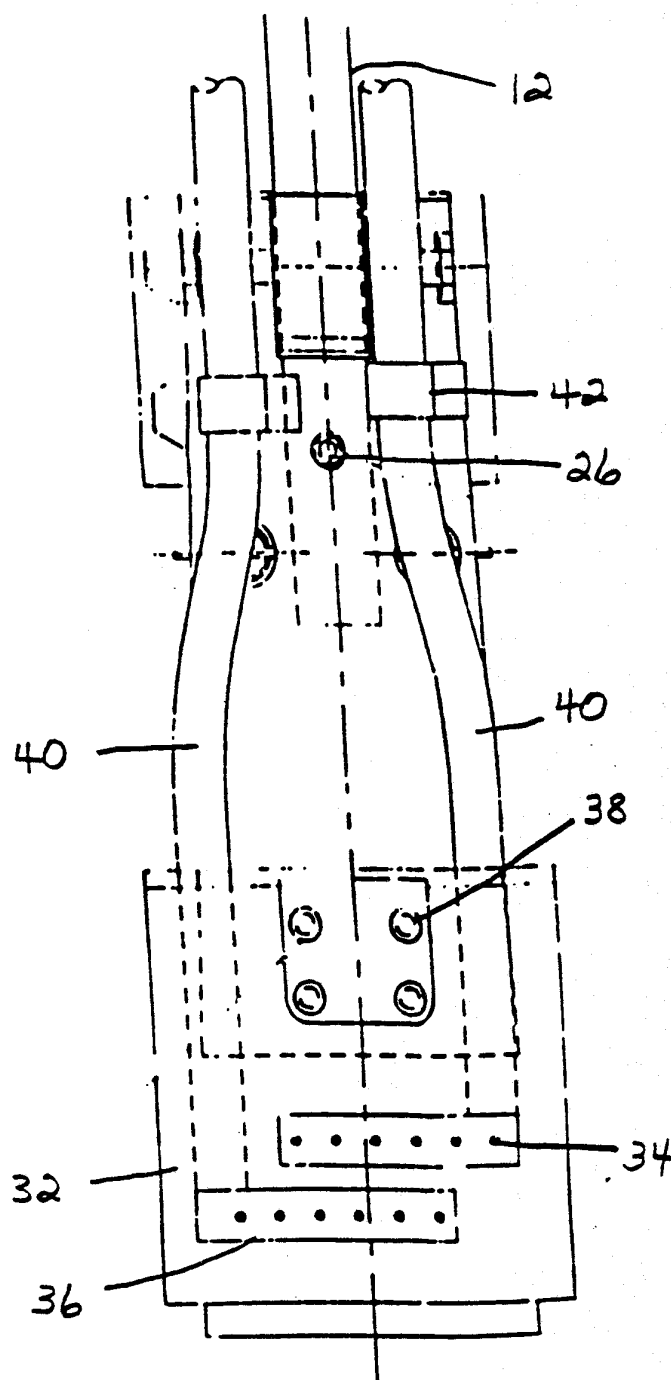


FIG. 2

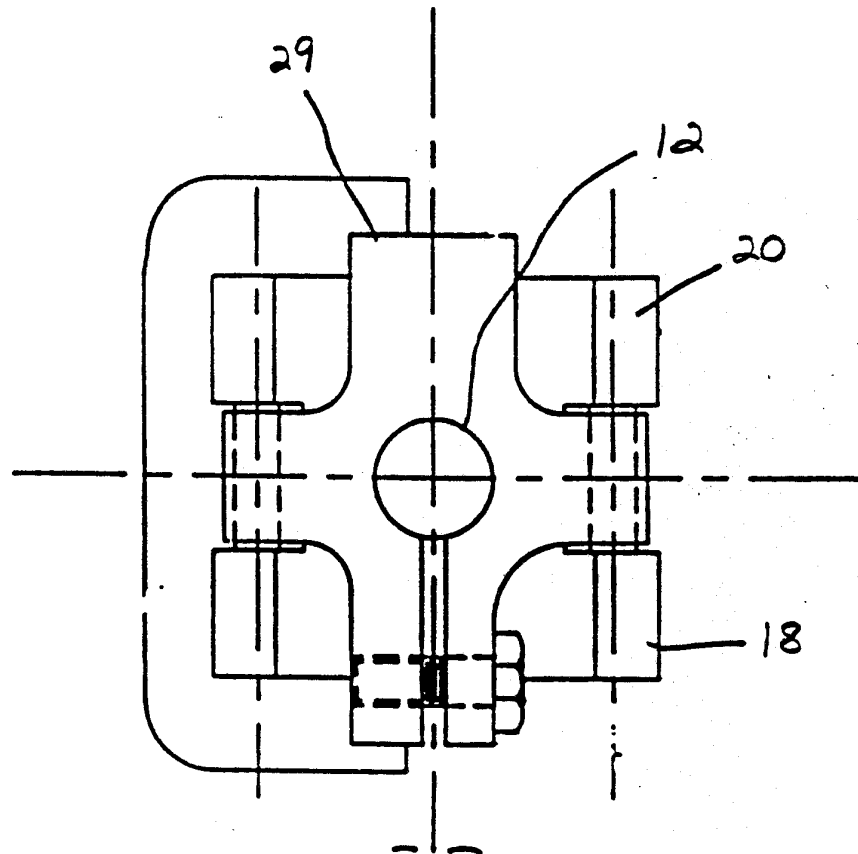


FIG. 3

4 / 5

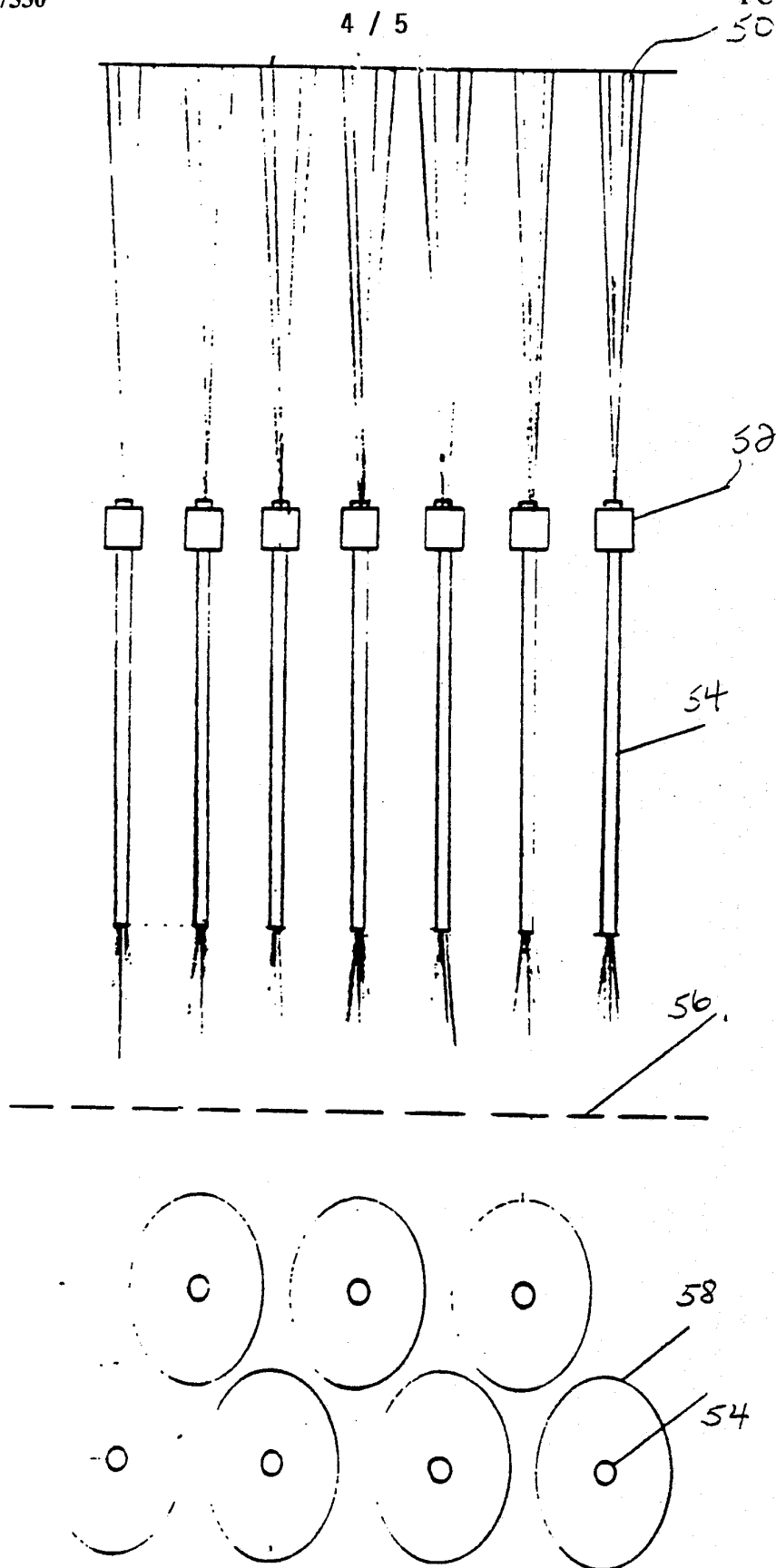


Fig. 4

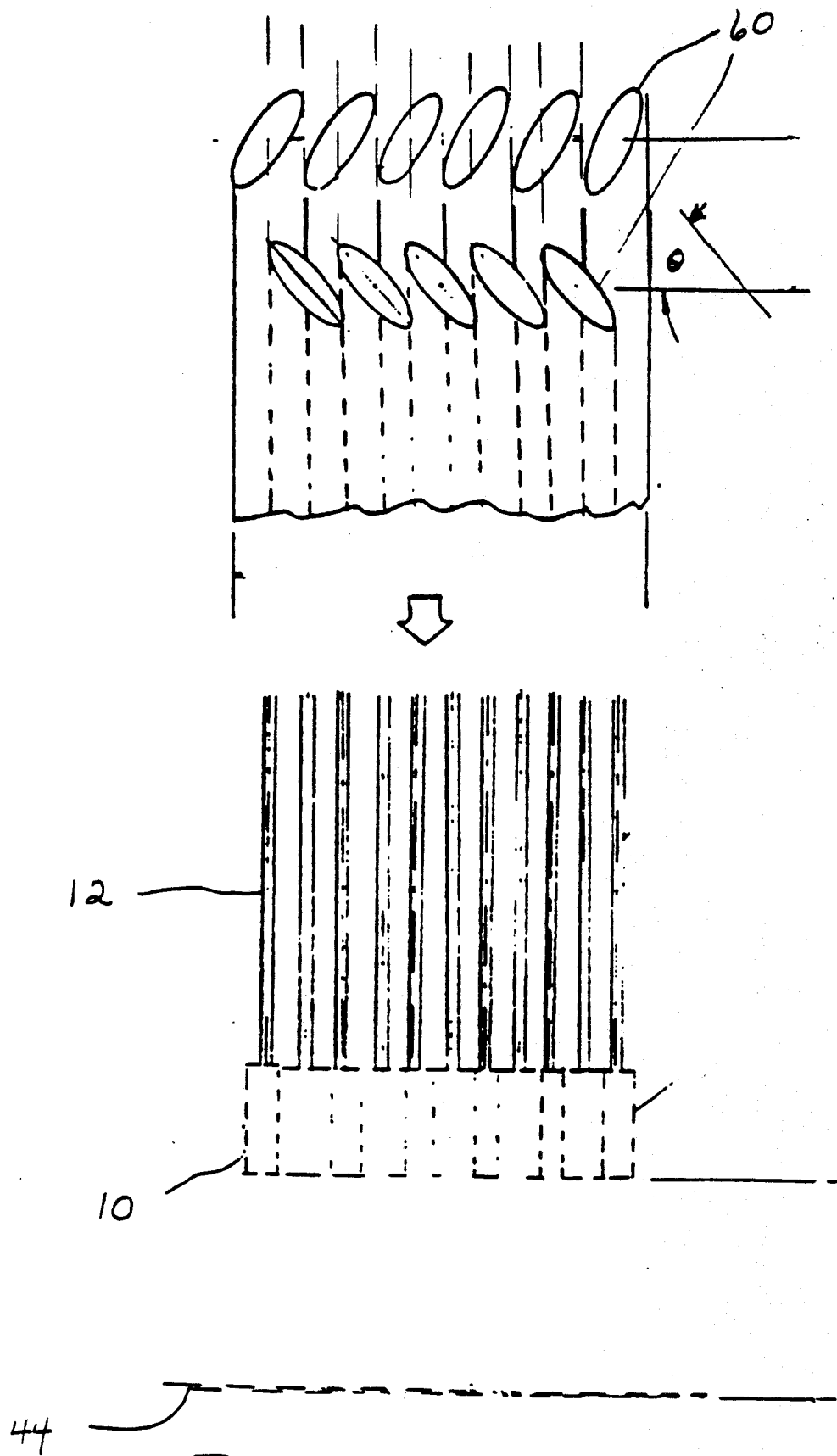


Fig. 5