PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :
B29C 47/34, 71/00, D04H 3/02

A1

(11) International Publication Number: **WO 92/20511**

(43) International Publication Date: 26 November 1992 (26.11.92)

(21) International Application Number: PCT/US91/03119

(22) International Filing Date: 10 May 1991 (10.05.91)

(71) Applicant: E.I. DU PONT DE NEMOURS AND COMPANY [US/US]; 1007 Market Street, Wilmington, DE 19898 (US).

(72) Inventors: FARR, Terry, James ; 122 Garwood Drive, Bear, DE 19701 (US). DEMPSEY, James, Joseph ; 12030 Wexwood Drive, Richmond, VA 23236 (US).

(74) Agents: SCHAEFFER, Andrew, L. et al.; E.I. du Pont de Nemours and Company, Legal/Patent Records Center, 1007 Market Street, Wilmington, DE 19898 (US).

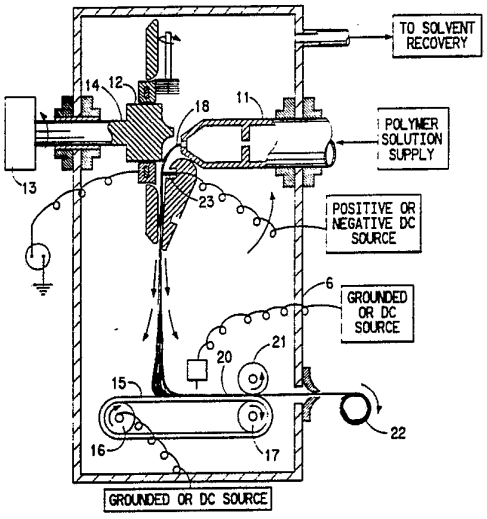
(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent).

Published
With international search report.

(54) Title: APPARATUS FOR FORMING THE EDGE OF FLASH SPUN WEBS

(57) Abstract

A combination of apparatus for forming a nonwoven fibrous sheet (20) having greater usable width, including a plurality of centrally located spinning packs and a plurality of edge spinning packs, each of which includes a spinning assembly (11) for spinning a fibrous strand (18), a rotating baffle (12) for receiving the strand and deflecting it downwardly while simultaneously spreading the strand and causing the spread strand to oscillate, and a motor (13) for rotating the baffle. A moving collection surface (15) is located below all of the spinning packs to collect the spread strands as they are deposited by the baffles. The baffles of the edge spinning packs are shaped so as to lay the spread strands down on the moving collection surface in a triangular swath with basis weight profile shape while the baffles of the centrally located spinning packs are shaped so as to lay the spread strands down on the moving collection surface in a trapezoidal swath basis weight profile shape. Preferably, each edge spinning pack cooperates with a product guide (73, 74) against which a portion of the spread strand from the edge spinning pack impinges and slides downwardly and off onto the moving collection surface.



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

Title

Apparatus for Forming the Edge of Flash Spun Webs

Field of the Invention

The present invention relates to a combination of apparatus for forming a nonwoven fibrous sheet having greater usable width than disclosed by the prior art. In particular, the present invention relates to a combination of apparatus for forming the edge of flash spun webs by (1) changing the swath throw and lay down pattern of the outer edge spinning positions so that a higher percentage of the edge swath contributes to usable sheet product and (2) reducing the effective width of the moving collection surface used for collecting the web in a sheet structure.

Background of the Invention

In the preparation of fibrous nonwoven sheets, various methods and apparatus have been developed for dispersing the filaments from a bundle into a wide band and for directing a strand by oscillating means in a programmed manner to various locations across the width of a moving collection surface. For example, U.S. Patent 2,736,676 (Frickert) discloses several methods for directing glass fibers by the use of wobble plates or by deflection from the perimeter of a cylinder rotating about an axis at an angle a few degrees from the longitudinal axis of symmetry.

In U.S. Patent 3,169,899 (Steuber), an apparatus is described for spreading and directing a strand of flash spun polymer in a flowing stream of solvent gas by utilizing the combined action of the hot expanding solvent gas and a curved, oscillating baffle. The curved baffle serves to spread the strand into a wide web. The oscillating motion imparted by the baffle directs the web to various areas across the width of a moving

collection belt. A randomly oriented fibrous nonwoven sheet is thereby obtained. The flash-spun strands, which are used in the sheet of Steuber, are prepared by flash-spinning from a solution of polymer in solvent under pressure and at a temperature far above the solution's atmospheric boiling point. When the solution passes from a spinning assembly to the surrounding atmosphere, the solvent evaporates almost instantly and forms a strand comprising a three-dimensional network of film-fibril elements. The strand has been termed a plexifilament and has been described in detail in U.S. Patent 3,081,519 (Blades et al.).

An apparatus for making a nonwoven fibrous sheet comprising a spinning assembly, a rotating baffle, electrostatic configurations for proper sheet dispersion, and a collection surface is described in U.S. Patents 3,497,918 (Pollock) and 4,666,395 (Shah). Commercial nonwoven polymer sheets (e.g., available from E. I. du Pont de Nemours and Company under the trademark "Tyvek®" are normally constructed of multiple swaths of trapezoidal basis weight profile shape that overlap across the width of the sheet. These types of sheets are disclosed and preferred by Pollock and Shah. However, along the edge of the sheet where there is less overlap (i.e., fewer swath layers at the sheet edges and thus lower mass), there is less usable sheet width due to thin spots left along the edge. This also results from the manner in which trapezoidal weight profile shapes stack at the edges of the sheet. This often results in a sheet having a maximum usable sheet width such that there is significant edge trim waste. For obvious reasons, it is desirable to reduce this edge trim waste loss.

Clearly, what is needed is an apparatus which maximizes usable sheet width by reducing the amount of edge trim waste. It is therefore an object of the

present invention to provide a combination of apparatus that does not have the deficiencies inherent in the prior art. Other objects and advantages of the present invention will become apparent to those skilled in the art upon reference to the drawings and detailed description of the invention which hereinafter follows.

Summary of the Invention

The present invention relates to an apparatus or combination of apparatus for forming nonwoven fibrous sheets from overlapping swaths of fibrous material. The resulting sheets have greater usable width for a given number of spinning packs.

The combination comprises a plurality of centrally located spinning packs and a plurality of edge spinning packs that are each fitted with a baffle which lays down fibrous material on a moving collection surface. The edge spinning packs are fitted with baffles that lay down a relatively narrow swath of fibrous material having a triangular basis weight profile shape. The edge spinning packs lay down fibrous material in cooperation with a product guide. The fibrous material in the outermost portion of the swath impinges upon and slides down the product guide and onto a moving collection surface. The centrally located spinning packs are fitted with baffles that lay down a relatively wide swath of fibrous material having a trapezoidal basis weight profile shape.

In particular, the combination comprises a plurality of centrally located spinning packs and a plurality of edge spinning packs each of which comprises a spinning assembly for spinning a fibrous strand in a generally horizontal path, a rotatable baffle for receiving the strand and deflecting it into a generally vertical plane downward while simultaneously spreading the strand and causing the spread strand to oscillate in

the generally horizontal plane, and means for rotating the baffle.

The baffles, as viewed with their axes of rotation in the horizontal position, comprise integral bodies composed of a circular boss portion on a disc portion with a fillet portion extending around the boss portion. The centrally located spinning packs have baffles having fillet portions that intersect with the disc portion to form a generally concave surface and are adapted to form a swath having a trapezoidal basis weight profile shape when the spread strands are deposited on a moving collection surface located below the centrally located spinning packs. The edge spinning packs have baffles having fillet portions that intersect with the disc portion to form a generally convex surface and are adapted to form a swath having a triangular basis weight profile shape when the spread strands are deposited on the moving collection surface located below the edge spinning packs. The axis of rotation of the baffles is perpendicular to, and coincident with the centers of the top, circular edges of both the boss portion and the disc portion.

Additionally, the combination further comprises a product guide paralleling each edge of the moving collection surface. The product guides are adapted to minimize the width of the spread strand by contacting a portion of the spread strand being deflected by the baffles of the edge spinning packs and depositing such spread strand portion on the moving collection surface.

The edge baffle improves yield by reducing edge losses due to low basis weight. The product guides reduce the effective width of the moving collection surface used for collecting the spread strand in a sheet structure, eliminate the feathered edge of formed sheet to prevent wraps, and make taking edge trim easier.

It will be understood that the edge baffles can be used alone or in combination with the product guides. However, the best results are obtained when both are used together.

Brief Description of the Drawings

Fig. 1 is a diagrammatic elevation view of an apparatus for depositing plexifilamentary material to a moving collection belt and forming a nonwoven sheet. The apparatus includes a spinning assembly, a rotatable baffle, means for rotating the baffle, and collection means located below the baffle.

Figs. 2, 3 and 4 respectively are front, vertical section and plan views of the preferred trilobal baffle used in the centrally located spinning packs.

Figs. 5a-5d illustrate a baffle of the type shown in Figs. 2-4, the baffle being shown in the operating position as viewed from the spinning assembly. The four views illustrate the effect of the baffle or direction of spread strand travel as it rotates 90 degrees.

Fig. 5e shows the trapezoidal basis weight profile shape produced by the baffle shown in Fig. 4.

Figs. 6, 7 and 8 respectively are front, vertical section and plan views of the modified trilobal baffle used in the edge spinning packs.

Figs. 9a-9d illustrate a modified baffle of the type shown in Figs. 6-8, the baffle being shown in the operating position as viewed from the spinning assembly. The four views illustrate the effect of the baffle or direction of spread strand travel as it rotates 90 degrees.

Fig. 9e shows the triangular basis weight profile shape produced by the edge baffle shown in Fig. 8.

Fig. 10 is a schematic top view of the moving collection means and the edge product guides used in the present invention.

Fig. 11 is an end view of the moving collection means and the edge product guides used in the present invention.

Fig. 12 shows how the edges of the sheet are built up using the baffle shown in Fig. 4.

Figs. 13, 14 and 15 show how the sheet edge waste is minimized and usable sheet width is increased by using the baffle shown in Fig. 8 and/or the product guides shown in Figs. 10 and 11.

Detailed Description of the Preferred Embodiments

A combination of apparatus is used in the present invention to create a nonwoven sheet with greater usable width than with similar apparatus used in the past. A modified baffle is used in the edge spinning packs instead of the previously used standard pack baffle that is contained in the centrally located spinning packs. The modified baffle is similar to the standard pack baffle shown in Figs. 2-4 and described in U.S. Patents 3,497,918 (Pollock) and 4,666,395 (Shah), except that the lobes and fillet portion are shaped differently to provide a narrower swath having a triangular basis weight profile shape rather than a trapezoidal basis weight profile shape.

Referring now to Fig. 1, an apparatus of the present inventive combination is diagrammatically illustrated including a spinning assembly 11, a rotatable baffle 12, an electric motor 13 for rotating the baffle 12 through shaft 14, and a collection surface 15. As shown, collection surface 15 is preferably an endless belt set up to run around rolls 16 and 17. Strand 18, issuing from spinning assembly 11, is spread by baffle 12 and collected on belt (collection surface)

15 and combined with many other strands to form nonwoven sheet 20. Before the sheet 20 leaves belt 15, it is compacted by pressure exerted by roll 21, and the compacted sheet 22 is removed to storage or further processing. An electrostatic charging means 23 is provided to charge the spread web as it leaves baffle 12.

The standard trilobal rotary baffle used in the centrally located spinning packs is shown in Figs. 2-4. The baffle 12 is composed of a boss portion 30, a disc portion 31 and a fillet portion 32. In this embodiment, the boss portion 30 is a right cylinder standing on a planar disc portion 31. When the baffle is viewed with its axis of rotation 33 in the vertical position, as in Figs. 2 and 3, the axis is perpendicular to, and coincident with the centers of the top, circular edge 34 of the boss portion 30 and the top circular edge 35 of the disc portion 31.

Fillet portion 32 extends around boss portion 30, as shown in Fig. 4, and provides a sloped and contoured, generally concave, surface from the side 36 of boss portion 30 to the top flat surface 37 of disc portion 31. Fillet portion 32 includes preferably three radially disposed, equispaced lobes 38 which are the outermost part of the general contours of fillet portion 32. In practice, it has been determined that between one and twelve equispaced lobes 38 can be successfully used.

The upper surfaces 39 of the lobes 38 are slightly wedge-shaped, i.e., the surfaces are narrower near the boss portion 30 than they are near the disc portion 31. This can best be seen in Fig. 4. The edges of the wedges are indicated by lines 40; however, it should be understood that in actual construction all inflections in the surface of the fillet portion 32 are gradual. The reason for this will be apparent from the

description hereinafter of the manner of using the baffle.

The intersection of the fillet portion 32 with the side 36 of boss portion 30 forms a series of lines, one for each lobe hereinafter referred to as the boss intersection line (B.I.L.) below the top 34 of boss portion 30. The B.I.L. is identified in Fig. 2 by the numeral 41; as shown, the B.I.L. 41 is generally an S-shaped curve for each fillet portion 32.

The intersection of fillet portions 32 with the top surface 37 of disc portion 31 forms a series of lines, one for each fillet portion 32, hereinafter referred to as the disc intersection line (D.I.L.), inside the top, circular edge of the disc portion 31. The D.I.L. is identified in Fig. 4 by the numeral 42; as shown, the D.I.L. 42 is generally slightly concave between the individual lobes 38. The D.I.L. 42 can also form an equilateral triangle having rounded corners at the lobes 38.

Although the B.I.L. 41 and D.I.L. 42 are shown in the figures as distinct lines, it should be understood that in actual construction the fillet portion merges smoothly into the side 36 of boss portion 30 and the top surface 37 of disc portion 31. That is, there is no sharp inflection at either the B.I.L. or D.I.L.

Referring now to Fig 5a, it will be observed that when using the centrally located spinning baffle with this particular orientation, strand 18 impinges on the fillet portion at a point half-way between two lobes 38. The strand is spread and is deflected vertically downward, that is, the center line of the spread strand as it leaves the edge of the disc portion is vertical.

As the baffle rotates (clockwise in this case), the spread strand begins to be deflected to the left. For this particular embodiment, the center line of the

spread strand as it leaves the disc is approximately perpendicular to the disc intersection line (D.I.L.) 42. Thus, one degree of rotation as the baffle turns from the position shown in Fig. 5a to that shown in Fig. 5b results in the center line being deflected about 1 degree from vertical. In general, the baffles must deflect the strand at a great enough angle such that a given minimum swath width and given basis weight profile shape result to meet the blendability needs of the product. At about 40 degrees rotation, strand 18 impinges on the point of maximum slope on the left slope of a lobe 38, as shown in Fig. 5b. At this degree of rotation, the center line of the spread strand is deflected approximately 35 degrees from the vertical, and this is the point of maximum deflection to the left for this particular embodiment.

As the baffle continues to turn, the strand 18 begins to impinge on the upper surface of a lobe 38 and the center line of the spread strand begins to shift back to vertical. When the baffle has rotated through about another 20 degrees (60 degrees from Fig. 5a), the strand 18 impinges upon the center of a lobe 38 and is again deflected vertically downward, as shown in Fig. 5c.

Upon further rotation of the baffle, the spread strand begins to impinge upon the right slope of the lobe 38, and the center line of the spread strand is diverted to the right. When the baffle has rotated about another 20 degrees (80 degrees from Fig. 5a) the spread strand center line is deflected approximately 35 degrees from the vertical, as shown in Fig. 5d, and this is the point of maximum deflection to the right for this particular embodiment.

As the baffle continues to turn through about another 40 degrees from the position shown in Fig. 5d (120 degrees from Fig. 5a) the spread strand center line

moves gradually back to the vertical until it again assumes the position illustrated in Fig. 5a.

From the above description, it will be apparent that 360 degrees rotation of this trilobal baffle produces three complete oscillation cycles of the spread strand. As noted above, the rotation of the baffle as shown in Figs. 5a-d results in a swath of trapezoidal basis weight profile shape (shown as 44 in Fig. 5e) when laid down on a moving collection surface. It is important to note that swath width as well as swath shape are important and both are influenced by the distance from the baffle to the collection surface. It will be understood that the contours of the baffle may vary greatly so long as a swath of trapezoidal basis weight profile shape is produced. Radically different geometries and contours of the fillet portion 32 can be used. Therefore it will be understood that the shapes and contours of the fillet portion 32 depicted in Figs. 2-4 are non-limiting and intended for purposes of illustration only.

Referring now to Figs. 6-8, a modified rotary baffle is shown as used in the edge spinning packs. The modified or edge baffle is similar in many respects to the centrally located spinning pack baffle except that certain contour changes have been made to produce a triangular basis weight profile shape rather than a trapezoidal basis weight profile shape when operated at the same distance to the collection surface as the centrally located spinning pack baffles. The major difference is that the intersection of the fillet portion 32 with the top surface 37 of the disc portion 31 (i.e., the D.I.L. 42') is generally convex between the individual lobes 38. In other words, the D.I.L. 42' bows out between each lobe 38 of the trilobal baffle. This is clearly seen in Fig. 8. It is the convex D.I.L.

42' that produces a narrower swath having a triangular basis weight profile shape.

Moreover, as noted above, although the B.I.L. 41 and D.I.L. 42' are shown in Figs. 6-8 as distinct lines, it should be understood that in actual construction the fillet portion merges smoothly into the side 36 of boss portion 30 and the top surface 37 of disc portion 31. That is, there is no sharp inflection at either the B.I.L. or D.I.L.

Referring now to Fig. 9a, it will be observed that when using the edge spinning baffle with this particular orientation, strand 18 impinges on the fillet portion at a point half-way between two lobes 38. The strand is spread and deflected vertically downward, that is, the center line of the spread strand as it leaves the edge of the disc portion is vertical. The rotation sequence set forth for Figs. 5a-5d is the same for Figs. 9a-9d. The spread strand produced by the edge spinning baffles is deflected at a smaller angle left and right than the centrally located spinning baffles. This results in creating the narrower, triangular shaped basis weight profile 45 as shown in Fig. 9e. (Dimension 59 in Fig. 9e is less than dimension 58 in Fig. 5e).

The edge baffle described above is preferably used in conjunction with an edge product guide which is depicted in Figs. 10 and 11. Referring now to Fig. 10, the spread strand collection means is shown generally at 70, comprising machine frames 71, 72, product guides 73 and 74 and the face of belt guide 75. Referring now to Fig. 11, belt guide 75, supports moving belt 76 upon which the spread strands are deposited. Product guides 73 and 74 are shown disposed at about a 30° angle from vertical. Product guides 73 and 74 are mounted on movable supports 77 and 78.

Besides the shape of the baffle in the edge spinning pack, the baffle speed and direction of

rotation and the amounts by which the spread strands are electrostatically charged can be varied to optimize the production of greater sheet width for different basis weights of nonwoven sheet which the invention is designed to produce. The baffles of the centrally located spinning packs all operate at the same speed, and while the baffles of the edge spinning packs can often be operated at the same speed as the baffles of the centrally located spinning packs, it will be understood that they can also be operated at a different speed or rotation direction. Due to its narrower swath width and resultant higher charge density, the electrostatic charge level applied to the strands from the edge spinning packs is generally lower (e.g., 60% to 100%, preferably 70% to 80% lower) than that of the charge level being applied to the strands from the centrally located spinning packs.

Generally, there are from 1 to 4 edge spinning packs applying strands along each edge of the sheet. The space between the edge spinning packs can be varied to control the size and shape of the final sheet being produced. For example, the edge spinning packs can be closely spaced for special effects on the edge of the sheet. Depending upon the circumstances, the edge spinning packs can be spaced from one pack centerline to the next, or from one half the next pack centerline. However, this is largely governed by the number of packs used and the type of sheet desired.

When the sheet is laid down on a moving belt, a product guide is preferably used to direct the outward deflection of the spread strand to the laydown belt along both edges. The surfaces of the product guides must have surfaces which have low friction and high dielectric strength so that charged strands will easily slide off. Polycarbonate has been found to be a preferred material for forming the product guide using

currently available commercial flash-spinning solvents. The surface placement of the product guide preferably ranges from vertical to 45 degrees from vertical. However, it should be noted that the product guide can be placed at an angle greater than 45 degrees from vertical, although it would not be as effective as the preferred range. Preferably, the product guides are long enough to allow the strands from one to four edge spinning packs being used to impinge on it and slide off onto the moving belt. The product guide is used to form a controlled straight edge of laid down strands thick enough so that fibrous material which is trimmed from the edge can be pneumatically conveyed as an unbroken tape. This minimizes the problems associated with handling strands having a feathered edge. The product guide's distance from the edge is adjustable in the cross machine direction over a distance of about 30 cm.

Figs. 12, 13, 14 and 15 show the improvement in usable sheet width and reduction in waste (edge trim) that result from use of the edge baffle and/or product guide. Fig. 12 (no edge baffle and no product guide) shows how the individual basis weight profile shapes from the centrally located spinning packs 44 stack up at the sheet edge, creating a given usable width 56 and an edge trim waste 52. Fig. 12 shows a composite representation of a five (5) layer sheet edge basis weight profile shape having a "usable width" significantly less than that of the full sheet width. Figs. 13 (no edge baffle but with a product guide) shows how the product guide modifies the full sheet profile, narrowing it by causing material 47 to be moved inward to create profile 48, and reducing edge trim waste 53 to less than 52 of Fig. 12. Usable sheet width in Fig. 13, 56, is approximately the same as that of Fig. 12. Fig. 14 (edge baffle but no product guide) shows the effect of the edge baffle to increase usable sheet width (57 >

56) and reduce waste trim 54 by greatly modifying and improving the sheet edge profile 49. Fig. 15 (edge baffle and product guide) shows the resultant edge profile improvement 51 when using both the product edge guide and the edge baffle. Note that usable width 57 is approximately the same as in Fig. 14, but edge trim waste 55 has been further reduced versus 54 of Fig. 14 and 53 of Fig. 13. In use, the inventive combination of edge baffles and product guides reduces edge losses by about 50% and increases usable sheet width by about 20 cm.

Although particular embodiments of the present invention have been described in the foregoing description, it will be understood by those skilled in the art that the invention is capable of numerous modifications, substitutions and rearrangements without departing from the spirit or essential attributes of the invention. Reference should be made to the appended claims, rather than to the foregoing specification, as indicating the scope of the invention.

Claims:

1. An apparatus for forming a nonwoven fibrous sheet having greater usable width for a given number of spinning packs which comprises a plurality of centrally located spinning packs and a plurality of edge spinning packs, each of which comprises a spinning assembly for spinning a fibrous strand in a generally horizontal path, a rotatable baffle for receiving the strand and deflecting it into a generally vertical plane downward while simultaneously spreading the strand and causing the spread strand to oscillate in the generally vertical plane and means for rotating the baffle, the baffles as viewed with their axes of rotation in the vertical position, being integral bodies composed of a circular boss portion on a disc portion with a fillet portion extending around the boss portion, the centrally located spinning pack baffles having fillet portions that intersect with the disc portion to form a generally concave surface and adapted to form a swath having a trapezoidal basis weight profile shape when the spread strands are deposited on a moving collection surface located below the centrally located spinning packs and the edge spinning pack baffles having fillet portions that intersect with the disc portion to form a generally convex surface and adapted to form a swath having a triangular basis weight profile shape when the spread strands are deposited on the moving collection surface located below the edge spinning packs, the axis of rotation of the baffles being perpendicular to, and coincident with the centers of the top, circular edges of both the boss portion and the disc portion.

2. The apparatus of claim 1 wherein both the centrally located spinning packs and the edge spinning packs are adapted to electrostatically charge the spread

strands and the charging strength of the edge spinning packs is from 60 to 100% of the charging strength of the centrally located spinning packs.

3. The combination of claim 1 wherein there are from 1 to 4 edge spinning packs located along each edge of the plurality of centrally located spinning packs.

4. A combination of apparatus for forming a nonwoven fibrous sheet having greater usable width for a given number of spinning packs which comprises a plurality of centrally located spinning packs and a plurality of edge spinning packs, each of which comprises a spinning assembly for spinning a fibrous strand in a generally horizontal path, a rotatable baffle for receiving the strand and deflecting it into a generally vertical plane downward while simultaneously spreading the strand and causing the spread strand to oscillate in the generally vertical plane and means for rotating the baffle, the baffles as viewed with their axes of rotation in the vertical position, being integral bodies composed of a circular boss portion on a disc portion with a fillet portion extending around the boss portion, the centrally located spinning pack baffles having fillet portions that intersect with the disc portion to form a generally concave surface and adapted to form a swath having a trapezoidal basis weight profile shape when the spread strands are deposited on a moving collection surface located below the centrally located spinning packs and the edge spinning pack baffles having fillet portions that intersect with the disc portion to form a generally convex surface and adapted to form a swath having a triangular basis weight profile shape when the spread strands are deposited on the moving collection surface located below the edge spinning packs, the axis of rotation of the baffles being perpendicular to, and coincident with the centers of the top, circular edges

of both the boss portion and the disc portion, and a plurality of product guides paralleling each edge of the moving collection surface and adapted to minimize the width of the spread strand by contacting a portion of the spread strand being deflected by the baffles of the edge spinning packs and depositing such spread strand portion on the moving collection surface.

5. The combination of claim 4 wherein both the centrally located spinning packs and the edge spinning packs are adapted to electrostatically charge the spread strands and the charging strength of the edge spinning packs is from 60 to 100% of the charging strength of the centrally located spinning packs.

6. The combination of claim 4 wherein there are from 1 to 4 edge spinning packs located along each edge of the plurality of centrally located spinning packs.

7. The combination of claim 4 wherein the product guides are formed of a dielectric material.

8. The combination of claim 4 wherein the product guides are formed of polycarbonate.

9. The combination of claim 4 wherein the product guides are disposed between vertical and 45° from vertical sloping inwardly toward the edge spinning packs.

FIG.1

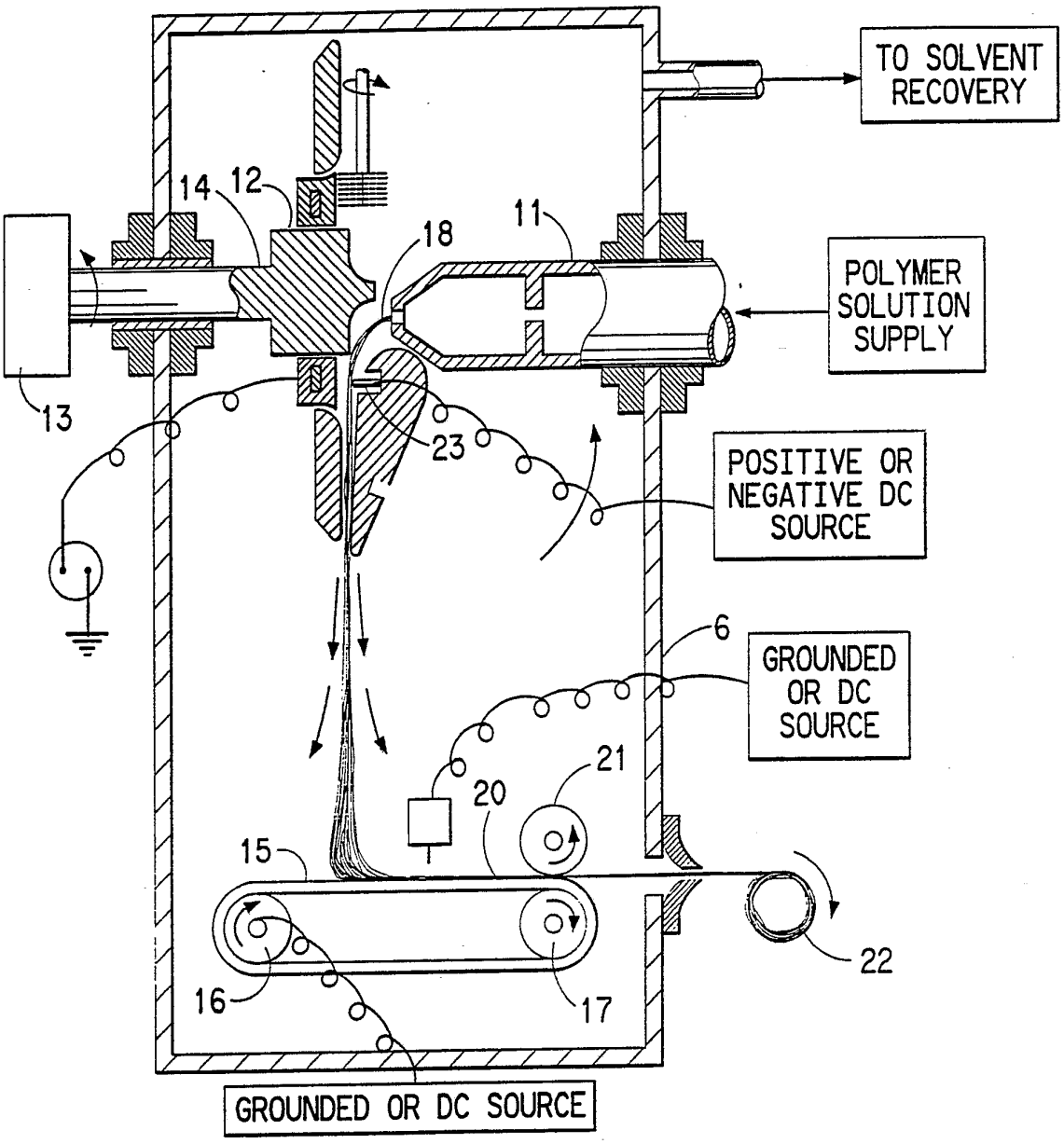

TO SOLVENT RECOVERY
POLYMER SOLUTION SUPPLY
POSITIVE OR NEGATIVE DC SOURCE
GROUNDED OR DC SOURCE
GROUNDED OR DC SOURCE
11
12
13
14
15
16
17
18
20
21
22
23
6

FIG.4

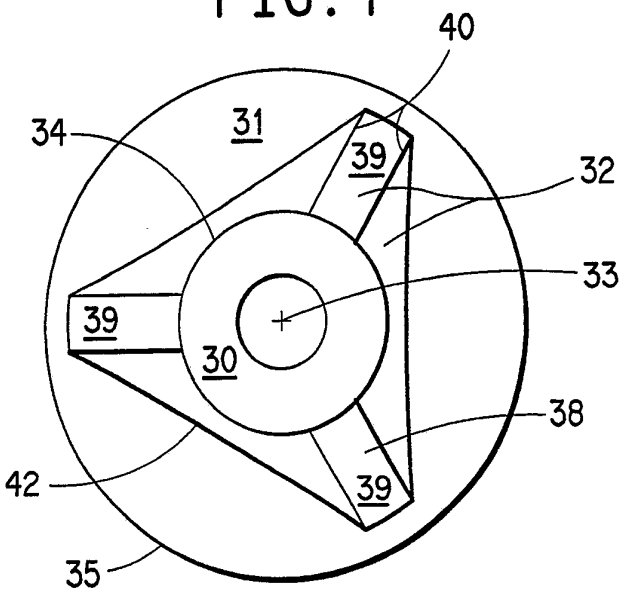


FIG.2

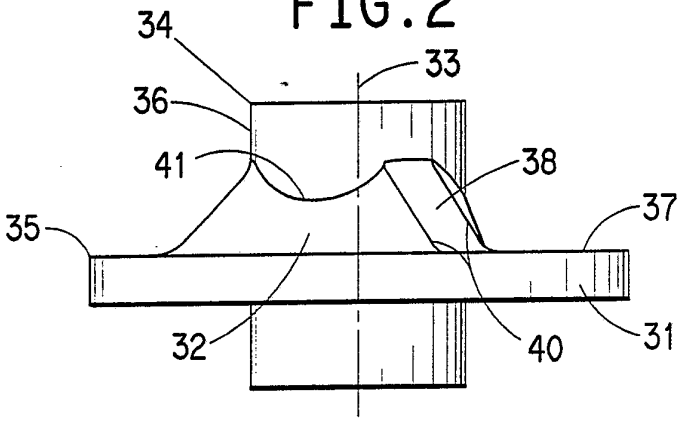


FIG.3

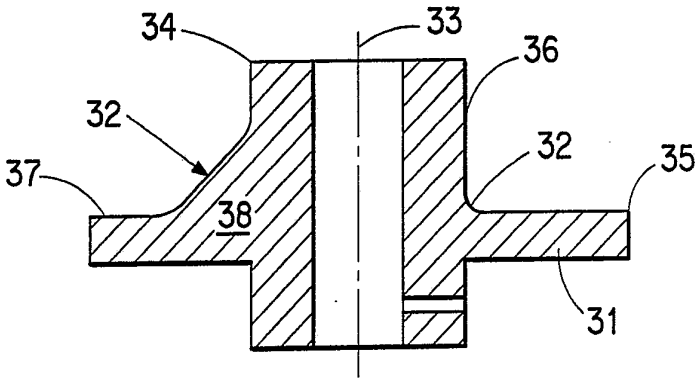


FIG.5a

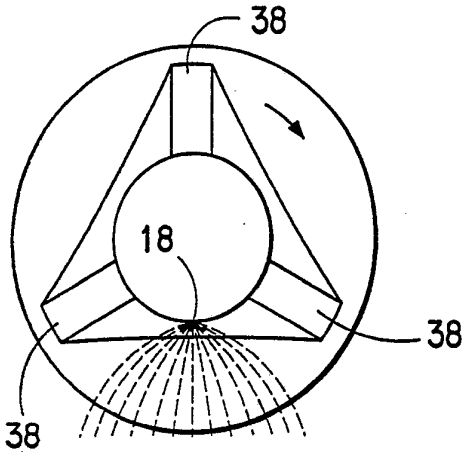


FIG.5b

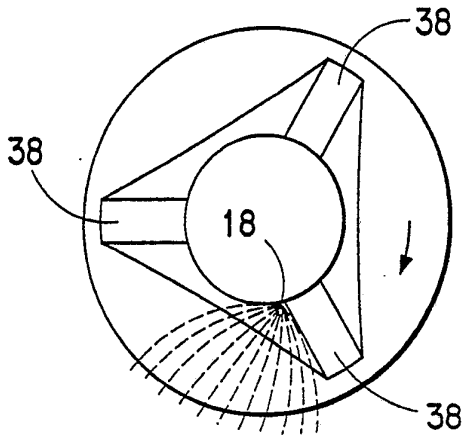


FIG.5c

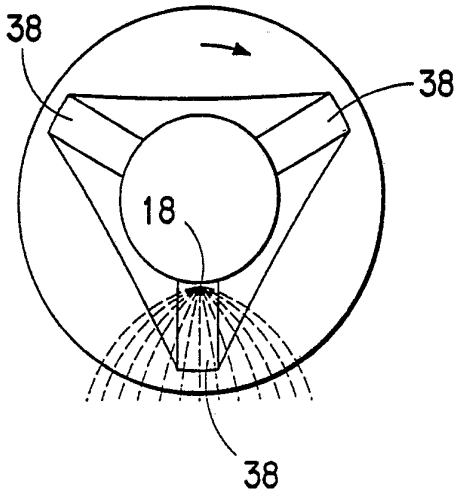


FIG.5d

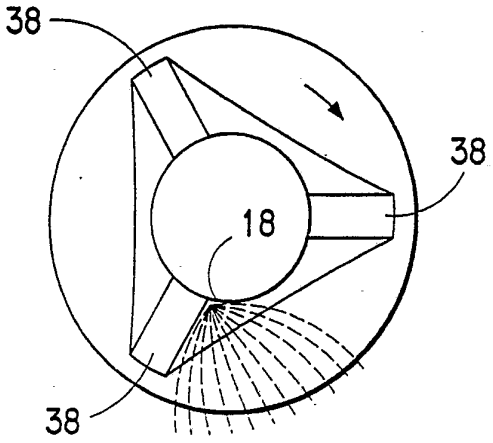


FIG.5e

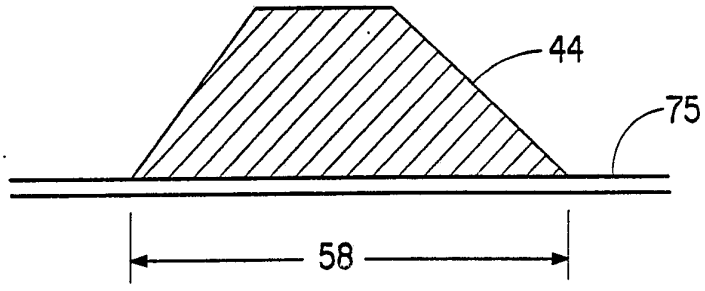


FIG.8

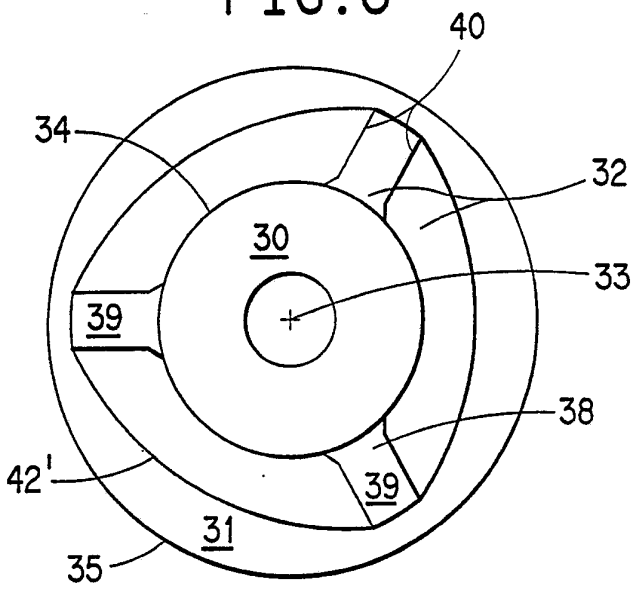


FIG.6

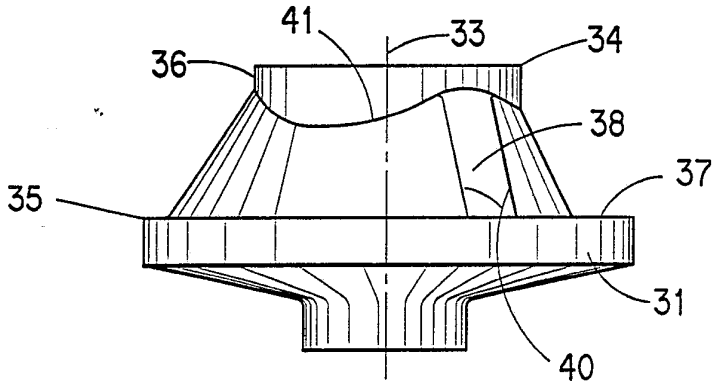


FIG.7

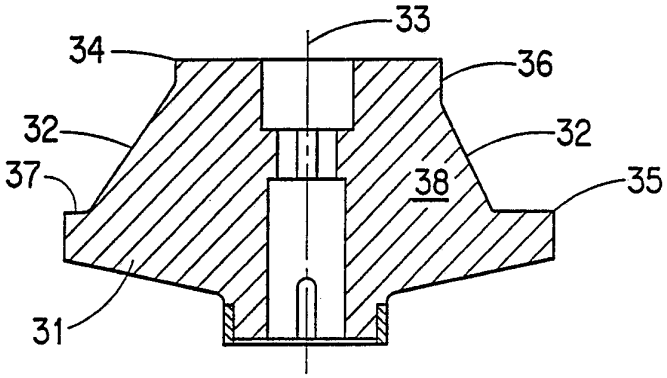


FIG.9a

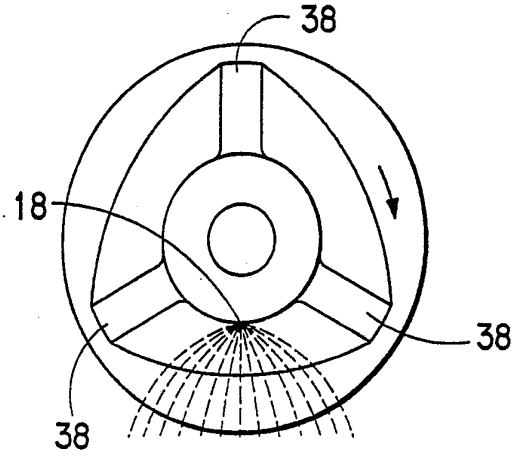


FIG.9b

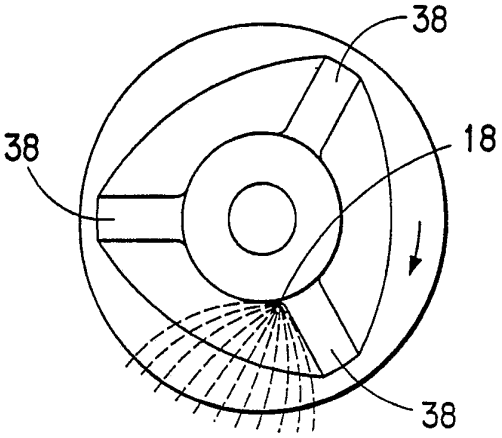


FIG.9c

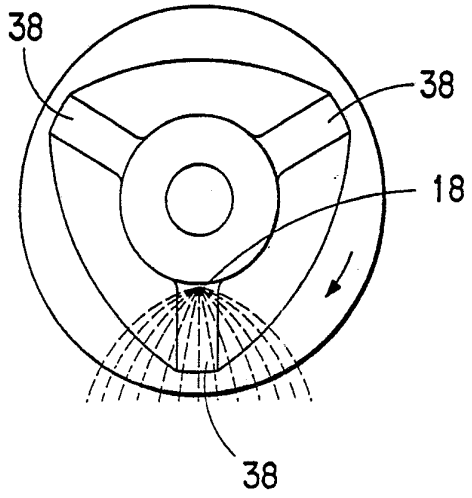


FIG.9d

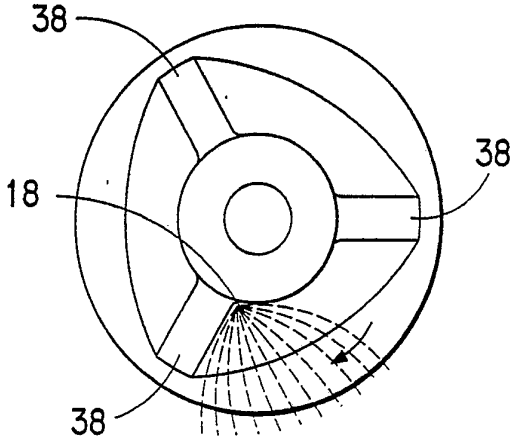


FIG.9e

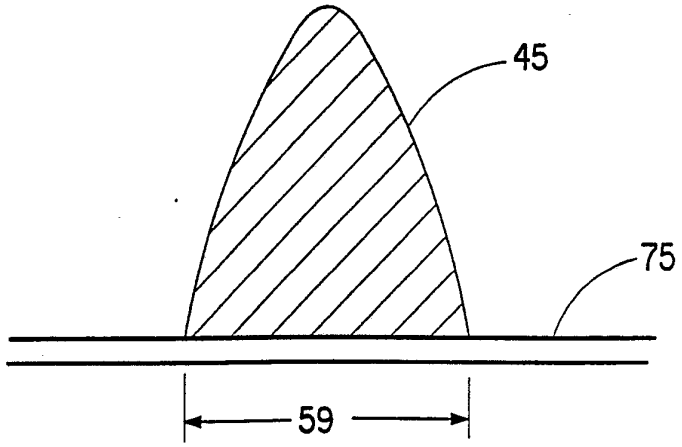


FIG.10

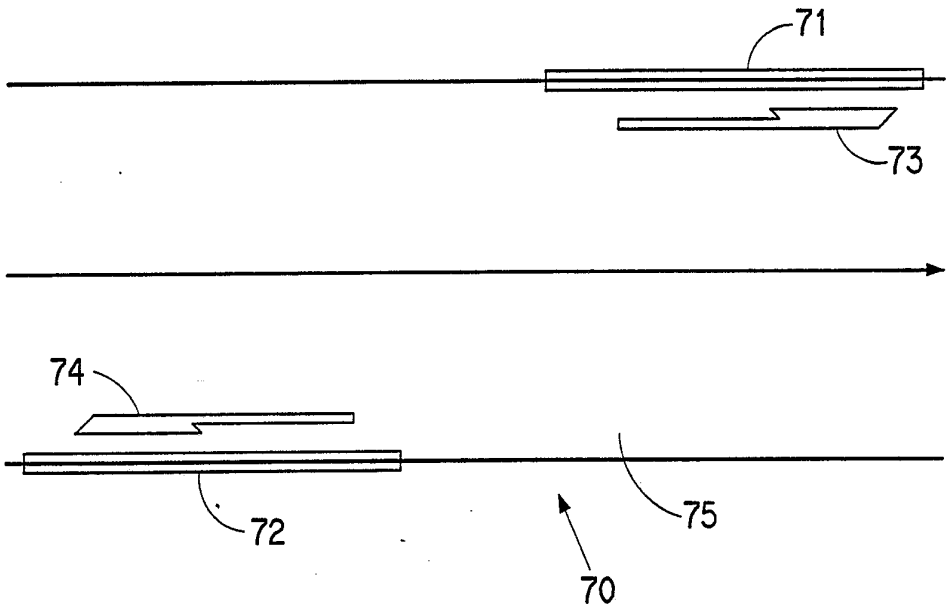


FIG.11

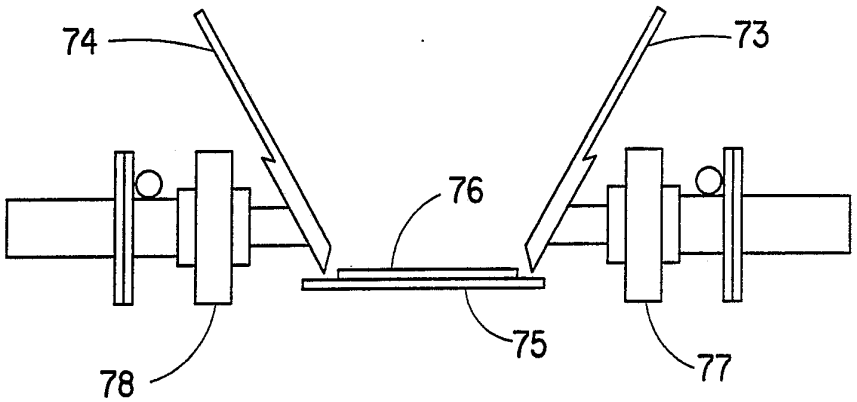


FIG. 13

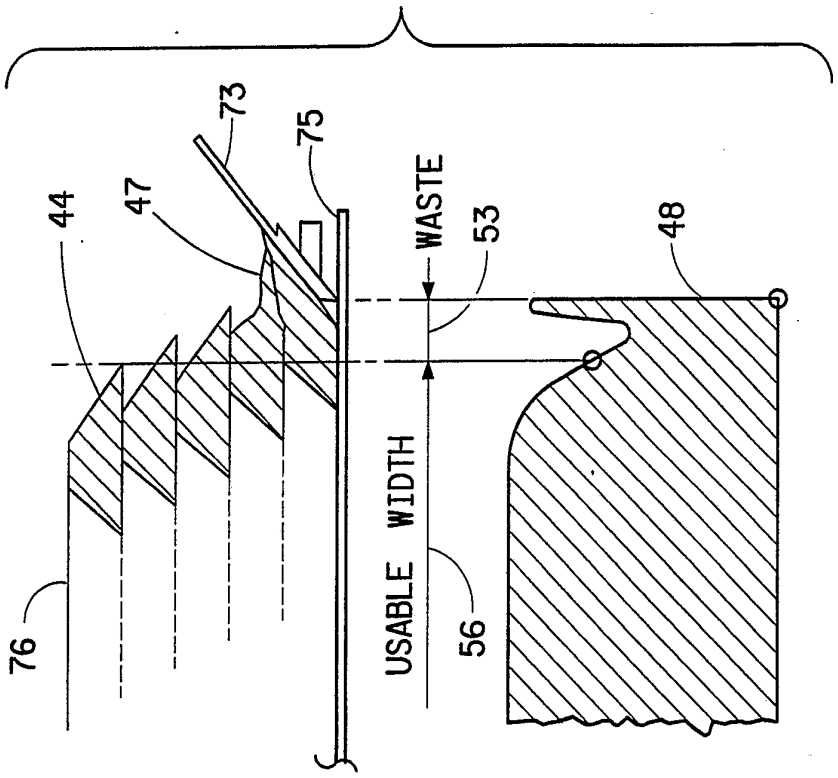

73
75
44
47
WASTE
53
48
USABLE WIDTH
56
76

FIG. 12

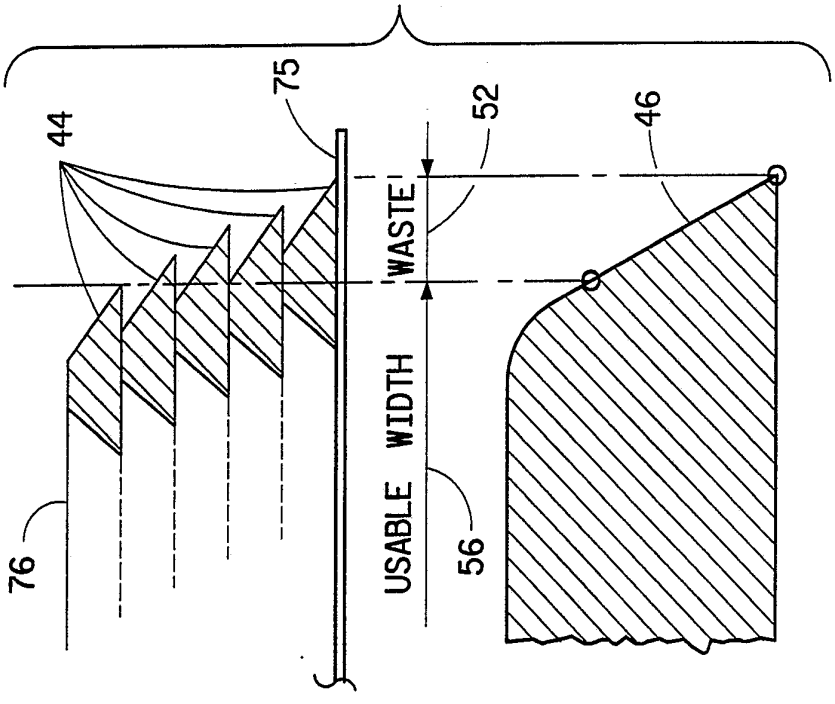

75
44
52
46
WASTE
USABLE WIDTH
56
76

FIG. 15

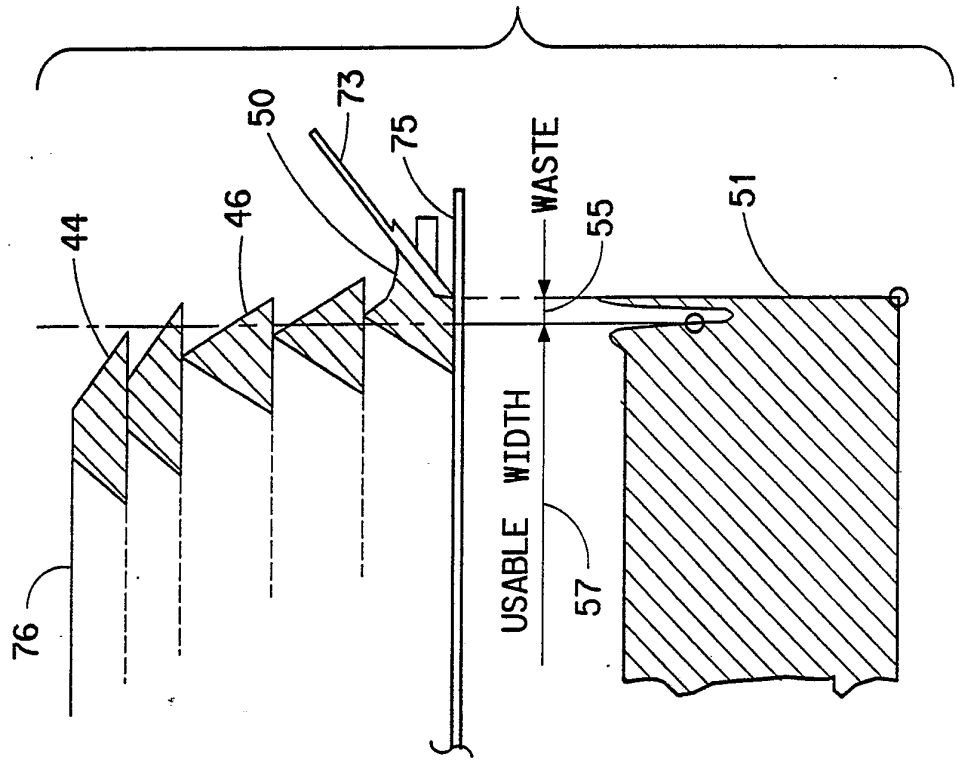
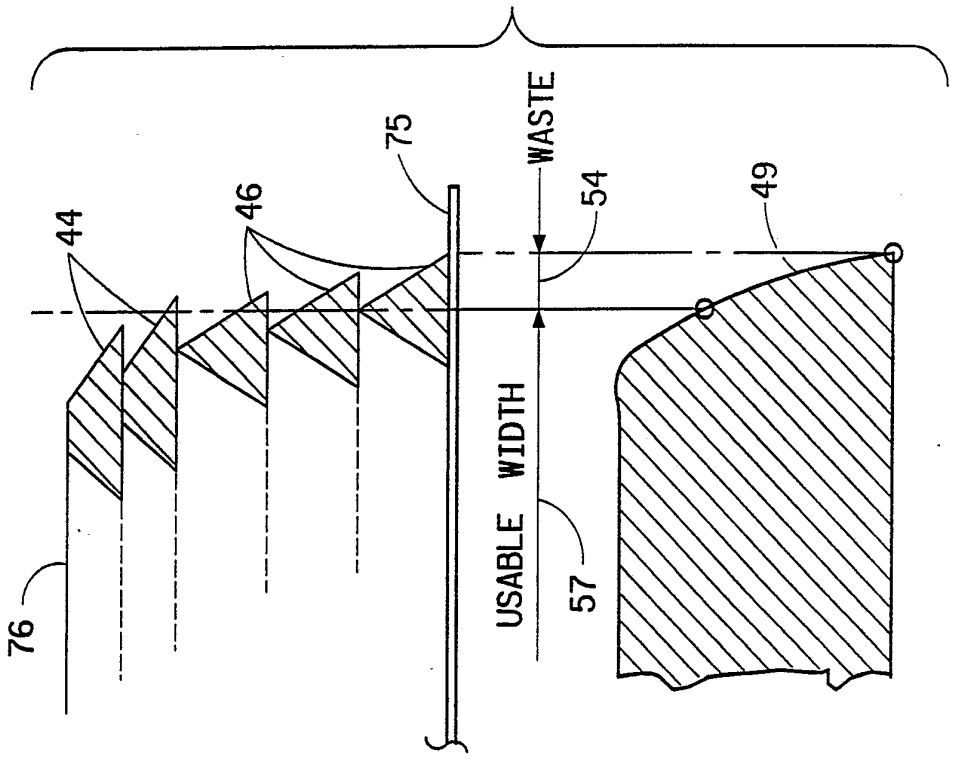

44
46
50
73
75
WASTE
55
51
76
USABLE WIDTH
57

FIG. 14


44
46
75
WASTE
54
49
76
USABLE WIDTH
57

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/03119

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): B29C 47/34, 71/00; D04H 3/02
U.S. CL.: 425/66,72.2, 174.8E 19/296 264/24

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	19/296,299 26/22, 24, 168, 204, 205 425/66, 72.2, 83.1, 174.8E, 377, 382.3

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	US, A, 2,736,676 (FRICKERT, JR.) 28 February 1956, See line 65 of column 2 to line 15 of column 3.	
A	US, A, 3,387,326 (HOLLBERG ET AL.) 11 June 1968, See column 3 lines 34-68.	
A	US, A, 3,497,918 (POLLOCK, JR., ET AL.) 03 March 1970, See line 10 of column 3 to line 13 of column 5.	
A	US, A, 3,593,074 (ISAKOFF) 13 July 1971, See line 40 of column 2 to line 41 of column 3.	
A	US, A, 4,334,340 (REBA) 15 June 1982, See abstract.	
A	US, A, 4,537,733 (FARAGO) 27 August 1985, See abstract.	
A	US, A, 4,666,395 (SHAH) 19 May 1991, See column 4, lines 9-56.	

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
11 JUNE 1991	19 JUL 1991
International Searching Authority	**Signature of Authorized Officer**
ISA/US	KHANH P. NGUYEN