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EUROPEAN PATENT APPLICATION

⑲ Application number: **81108092.8**

⑤ Int. Cl.³: **D 21 F 1/00**

⑳ Date of filing: **09.10.81**

⑳ Priority: **16.10.80 US 197551**

④ Date of publication of application:
05.05.82 Bulletin 82/18

⑧ Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

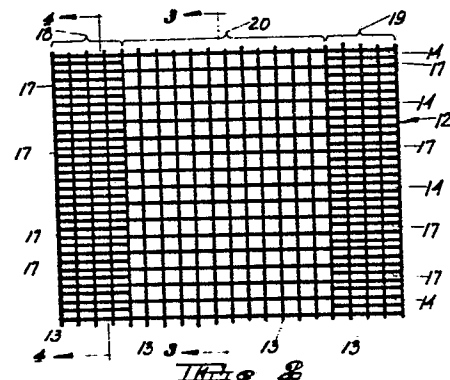
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⑤ Dryer fabric and method of making it.

⑤ A fluid-permeable, woven dryer fabric (12) for use in a paper making machine or the like having different permeabilities in different sections (18,19,20) across its width to control the moisture profile of a web being conveyed through the dryer section of the paper making machine. Additional cross-machine direction yarns (17) of different thicknesses are located in the dryer fabric (12) at selected positions across the dryer fabric in the cross-machine direction. The additional yarns of different thicknesses are introduced into the dryer fabric at selected positions in the cross-machine direction as part of the weaving process for the dryer fabric.



EP 0 050 766 A1

DRYER FABRIC AND METHOD OF MAKING IT

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TECHNICAL FIELD

5 The invention is directed to a fluid-permeable,
woven dryer fabric, and more particularly to such
a dryer fabric having different permeabilities in
different sections across its width by virtue of
Additional cross machine direction yarns which may
be of different thicknesses or bulk located at selected
10 positions across the dryer fabric in the cross machine
direction.

BACKGROUND ART

The usual papermaking machine has three primary
sections: a forming section, a press section and a
15 drying section. In the forming section, wet pulp
is deposited on the forming surface of a forming
fabric which is of the nature of a fluid-permeable
endless belt. Vacuum is applied to the underside of
of the forming fabric to withdraw moisture from the
20 pulp, causing the pulp to form a sheet on the forming
fabric. From the forming section, the sheet is
transferred to the press section and is conveyed by a
press fabric through a series of press rolls to further
remove water from the web. From the press section, the
25 web is then transferred to the dryer section where
it is passed about a series of heated dryer cylinders.
One or more dryer fabrics are employed to press the
moist web uniformly and successively against the
dryer cylinders to dry the web. As used herein and
30 in the claims, the term "papermaking machine" is to
be considered in a broad or generic sense, the
machine producing a paper or paper-like material such
as pulp, board, asbestos sheet or other similar
structures.

35 In the dryer section, the dryer cylinders are
internally heated by steam or the like. The cylinders

usually have imperforate surfaces for contacting the paper web. Other rolls, such as packet rolls may have surfaces which are perforated or slotted to permit the passage of heated air therethrough to increase the drying action on the web.

Several problems are encountered in the dryer section. First of all, it has been found that the surface temperature of the dryer cylinders may vary axially across the machine direction by as much as 40°F. This produces the distinct possibility that some portions of the web will be subjected to greater drying action than other portions of the web, resulting in a non-uniform moisture profile across the web.

A second problem results from the fact that moisture from the paper web tends to collect in enclosed areas or "pockets" in the dryer section. Usually more moisture accumulates in the central portions of the pockets than in those portions of the pockets lying nearer the lateral edges of the dryer section, the portions nearer the lateral edges of the drying section being more readily ventilated by the surrounding atmosphere.

Thus, by virtue of the variance in temperature across the cross machine direction or the dryer cylinders and moisture accumulated in pockets in the dryer section, the web generally will have a higher moisture content near its center, than at its edges. This is undesirable from the standpoint of quality control of the end product. Prior art workers have taken numerous steps to alleviate this problem. First of all, dryer fabrics have been devised which are fluid-permeable, such dryer fabrics having an open weave. An exemplary open weave dryer fabric is taught in U.S. Patent 2,180,054. Dryer fabrics in the form of nonwoven structures such as

needed felts and perforated plastic belts have also been used. To further alleviate the problem, various types of air jet apparatus or exhaust means have been provided to eliminate moisture build-up in the dryer pockets. Such devices are generally extremely complex and difficult to maintain, particularly in new dryer sections capable of handling webs having a width of the order of 400 inches.

Yet another approach to the provision of a more uniform moisture profile across the web is taught in U.S. Patent 3,867,766. According to the teachings of this reference, a fluid permeable dryer fabric is provided, the permeability of which varies at selected locations across its width. This is accomplished in several ways. In a first embodiment, the machine direction yarns in the edge regions of the dryer fabric are more closely spaced with respect to one another than in the center region of the dryer fabric. It is to be noted that the phrase "machine direction" used herein and in the claims refers to the direction of travel of the dryer fabric when mounted in the dryer section of the papermaking machine. The phrase "cross machine direction" refers to that direction transverse the dryer fabric and perpendicular to the direction of travel of the dryer fabric in the dryer section of the papermaking machine.

In another embodiment, U.S. Patent 3,867,766 teaches selectively varying the diameter of the machine direction yarns so that those yarns which lie in the area desired to be of reduced permeability have a diameter greater than those machine-direction yarns located in the more permeable sections of the dryer fabric. In a third embodiment, this reference teaches the utilization of machine direction yarns having a higher bulk construction near the lateral edges of the

dryer fabric. These yarns will tend to flatten and close off the effective open area between adjacent yarns, thus reducing the permeability of the dryer fabric near its edges. In a final embodiment, the
5 dryer fabric is selectively treated with greater amounts of resin or the like at its edges, than in its center, to reduce permeability at the edges thereof.

The various approaches taught in the above mentioned U.S. Patent 3,867,766, while effective, have
10 certain drawbacks. For example, when the frequency of machine direction yarns is increased at the edges of the dryer fabric, the edges tend to resist stretch to a greater extent and operate at a higher tension than the center of the dryer fabric. Furthermore, as the
15 machine direction yarns elongate and loose crimp, the cross machine direction yarns must accept crimp. However, the cross machine direction yarns are more difficult to bend as their ability to accept crimp is a function of the distance between the machine direction
20 yarns. As a result, it has been found that dryer fabrics of the type taught in U.S. Patent 3,867,766 demonstrate differences in machine direction physical characteristics across the width of the dryer fabric. These differences in machine direction physical characteristics between sections of differing end counts
25 present problems in achieving uniform flatness across the width of the dryer fabric and, similarly, can give rise to difficulties in running flat and wrinkle free in the dryer section of the papermaking machine.
30 Furthermore, it is generally accepted that higher operating tension in a dryer fabric gives rise to increased drying of the web. Therefore, dryer fabrics in which the edge portions have a higher frequency of machine direction yarns, to reduce the permeability and
35 thereby the drying rate of the edge portions of the fabric, suffer some counteracting effects of increased

drying of the web at the fabric edges due to their edges operating at a higher tension.

5 The use of one or more resin coatings on the dryer fabric to vary its permeability across its width has not proven very effective due to the difficulty of maintaining the resin coating throughout the life of the fabric. This is even more difficult to achieve in dryer fabrics made of monofilament yarns, due to the resistance of monofilament yarns to the
10 acceptance of resin coatings.

The present invention is based upon the discovery that if, in a woven dryer fabric, additional cross machine direction yarns, which may be of various thicknesses or bulk, are located in the fabric at
15 selected positions across the fabric, the permeability of the dryer fabric can be varied, by design, in different sections across its width. The additional cross machine direction yarns have little or no effect on the machine direction load bearing properties of the dryer
20 fabric. Thus, there will be no substantial differences in machine direction physical characteristics between the sections of the dryer fabric having different permeabilities. Furthermore, the present invention can be practiced in the manufacture of dryer fabrics made
25 substantially from monofilament yarns. The dryer fabrics of the present invention can also be pinseamed.

A well known problem encountered in the dryer section of a papermaking machine is frequently referred to as "edge flutter" in the web. This problem is
30 more severe at the web edges and tends to limit the speed at which the dryer section of the papermaking machine can be run. The dryer fabrics of the present invention provide much better control of edge flutter in the web and therefore permit the dryer section to
35 be run at higher speeds.

Another well known problem in the art is a malformation in the web edges known as "grainy edges" or "cockled edges" due to greater drying of the web at the edges and flutter. The dryer fabrics of the present invention tend to reduce or eliminate such malformations in the web edges.

Woven dryer fabrics are used in the dryer section of the papermaking machine in the form of endless belts. To this end, the dryer fabrics may be woven directly in the form of endless belts by endless weaving techniques well known in the art. In such an instance, the weft or filling yarns extend in the machine direction and the warp yarns extend in the cross machine direction. Alternatively, the dryer fabrics can be flat woven with their ends joined by well known means to form continuous belts. When the dryer fabrics are flat woven, the warp yarns extend in the machine direction and the weft or filling yarns extend in the cross machine direction. While the dryer fabrics of the present invention can be woven by either technique, for purposes of an exemplary showing the dryer fabrics will be described herein in terms of flat woven fabrics.

DISCLOSURE OF THE INVENTION

According to the invention there is provided a woven dryer fabric, for use in a papermaking machine or the like, having different permeabilities in different sections across its width to control the moisture profile of a web being conveyed through the dryer section of a papermaking machine. To achieve the different permeabilities in different sections of the dryer fabric, additional cross machine direction yarns, which may be of different thicknesses or bulk, are located in the dryer fabric at selected positions there-across in the cross machine direction.

In a first embodiment, the dryer fabric is woven utilizing any appropriate multi-layer weave and stuffer picks are introduced into the weave at edge sections of the dryer fabric. The stuffer picks extend from the dryer fabric edges inwardly in a cross machine direction for a predetermined distance toward the center of the fabric. This provides a dryer fabric having a central section of high permeability and edge sections of lesser permeability.

In a second embodiment, stuffer picks are introduced in the edge sections of the dryer fabric, as in the first embodiment. Additional stuffer picks of lesser diameter or less bulk are introduced into the center section of the dryer fabric, extending in the cross machine direction between opposed edge section stuffer picks. The resulting dryer fabric of this second embodiment differs from the first embodiment in that the center section of the dryer fabric has a somewhat reduced permeability, although the center section is still of greater permeability than the edge sections of the dryer fabric.

In a third embodiment, stuffer picks are again introduced at the edge portions of the dryer fabric. In this instance, however, alternate opposed pairs of stuffer picks at the edge sections are longer than the remaining edge stuffer picks. Again, additional stuffer picks of lesser diameter or less bulk are introduced into the dryer fabric extending between opposed edge stuffer picks. This provides a dryer fabric having edge sections containing the larger diameter stuffer picks, a center section containing the stuffer picks of less diameter or bulk and two intermediate sections containing alternate large diameter stuffer picks and stuffer picks of lesser

diameter or bulk. As a consequence, the dryer fabric has five sections across its width of differing permeabilities. The centermost section has the greatest permeability. To either side of the center section are sections of intermediate permeability and at the edges are sections of the least permeability.

A fourth embodiment of the present invention is identical to the third embodiment with the exception that the stuffer picks of lesser diameter or bulk are omitted. This again yields a five section dryer fabric with the centermost section having maximum permeability.

In all of the embodiments of the present invention the width of the sections of the dryer fabric of differing permeabilities does not constitute a limitation. The various sections can be made of any appropriate width depending upon the ultimate conditions of use of the dryer fabric, the material being dried, the axial temperature variance of the dryer rolls, and the like. Similarly, the nature of the yarns from which the dryer fabric is woven does not constitute a limitation. Spun yarns, monofilament yarns, multifilament yarns and combinations thereof can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a semi-diagrammatic representation of an exemplary dryer section of a papermaking machine.

Figure 2 is a fragmentary, semi-diagrammatic plan view of a first embodiment of dryer fabric of the present invention.

Figure 3 is a fragmentary, semi-diagrammatic cross sectional view taken along section line 3-3 of Figure 2.

Figure 4 is a fragmentary, semi-diagrammatic cross sectional view taken along section line 4-4 of Figure 2.

Figure 5 is a fragmentary, semi-diagrammatic plan view of a second embodiment of dryer fabric of the present invention.

5 Figure 6 is a fragmentary, semi-diagrammatic cross sectional view taken along section line 6-6 of Figure 5.

Figure 7 is a fragmentary semi-diagrammatic plan view of a third embodiment of the dryer fabric of the present invention.

10 Figure 8 is a fragmentary, semi-diagrammatic cross sectional view taken along section line 8-8 of Figure 7.

15 Figure 9 is a fragmentary, semi-diagrammatic plan view of a fourth embodiment of the dryer fabric of the present invention.

Figure 10 is a fragmentary, semi-daigrammatic cross sectional view taken along section line 10-10 of Figure 9.

BEST MODE OF CARRYING OUT THE INVENTION

20 Reference is first made to Figure 1 wherein an exemplary dryer section of a papermaking machine is shown. The dryer section is made up of an upper array of drying cylinders 1, 2 and 3 a lower array of drying cylinders 4 and 5. The drying cylinders 1 through
25 5 are heated by any appropriate means such as steam or the like. As indicated above, other rolls, such as rolls 9 and 11, may have imperforate surfaces, or perforated surfaces to permit the passage therethrough and through the web to be dried of heated air.

30 In Figure 1, a web to be dried is shown at 6. The web has an upper surface 6a and a lower surface 6b. The web is guided to and from the dryer section by guide rolls 7. As indicated above, the web 6 may be of any material normally made in a papermaking or paper-
35- making-like machine including paper, pulp, board, asbestos sheet or the like. It will be noted from

Figure 1 that the web travels through the dryer section in a senuous path, contacting each of the upper and lower dryer cylinders in order. It will further be noted that the upper surface 6a of web 6 is contacted by the cylinders 4 and 5 of the lower array, and the lower surface 6b of the web is contacted by cylinders 1, 2 and 3 of the upper array.

The dryer section of Figure 1 is of the type utilizing two dryer fabrics. A first dryer fabric 8 is shown passing about portions of the upper array of cylinders 1, 2 and 3. The dryer fabric is appropriately guided and tensioned by additional pocket rolls 9. The purpose of the upper dryer fabric 8 is to bear upon web 6 as it passes about cylinders 1, 2 and 3, bringing the underside 6b of the web into intimate contact with the cylinders 1, 2 and 3.

A lower dryer fabric 10 passes about portions of the cylinders 4 and 5 of the lower array and is appropriately tension and guided by pockets rolls 11. Again, the purpose of lower dryer fabric 10 is to press the web 6 against dryer cylinders 4 and 5, bringing the upper surface 6a of the web into intimate contact with dryer cylinders 4 and 5. It will be understood that the dryer fabrics 8 and 10 are substantially identical, except for length, and the teachings of the present invention are applicable to either the upper or the lower dryer fabrics.

A first embodiment of the present invention is illustrated in Figures 2, 3 and 4, wherein like parts have been given like index numerals. Reference is first made to Figures 2 and 3. The dryer fabrics of the present invention are woven of yarns and the yarns may be spun yarns, monofilament yarns, multifilament yarns or combinations thereof. As indicated

above, for purposes of an exemplary showing only, the dryer fabrics of the present invention will be described as flat woven.

5 It is a requirement of the present invention that the dryer fabrics be woven, utilizing a multi-layer
- weave. To this end, the embodiment of Figures 2, 3 and 4, generally indicated at 12, is shown in
diagrammatic fashion as being made of a simple duplex
weave. The warp or machine direction yarns are shown
10 at 13. The weft or filling yarns (cross machine
direction yarns) are arranged in two layers. The upper
filling yarns are indicated at 14 and the lower filling
yarns are shown at 15. Since the yarns 14 and 15 are
arranged in vertical pairs, only yarns 14 are visible
15 in Figure 2. Both layers of filling yarns are shown
in Figures 3 and 4.

It will be evident from the semi-diagrammatic
representation of the simple duplex weave in Figure 3
that a series of diamond-shaped openings occur
20 between the vertical pairs of filling yarns 14 and
15. These diamond-shaped openings are shown at 16.

In the embodiment of Figures 2 through 4, stuffer
picks are inserted in the diamond-shaped openings 16.
The stuffer picks are illustrated at 17 in Figure 4.
25 As is most clearly shown in Figures 2, the stuffer
picks 17 extend from the longitudinal edges of the
dryer fabric 12 for a predetermined distance toward
the center of the dryer fabric. It will be immediately
evident from Figure 2 that the dryer fabric 12 has
30 three sections or zones. Edge sections 18 and 19
contain the stuffer picks 17. A central section or
zone 20 is devoid of stuffer picks. As a result of
the presence of stuffer picks 17 in sections 18 and
19, these sections will have a fluid permeability
35 less than central section 20.

It will be understood by one skilled in the art that the width of sections 18, 19 and 20 does not constitute a limitation on the present invention. During the weaving process, sections 18, 19 and 20
5 may be tailored to have any desired width so that the dryer fabric 12 may have a cross machine direction permeability profile tailored to its particular end use. The width of sections 18, 19 and 20 will depend upon a number of factors such as the nature of the
10 material from which the web 6 is made, the desired moisture profile for the dried web, the temperature variance along the axial length of dryer cylinders 1 through 5 in the cross machine direction, the yarns from which the dryer fabric is made, the width of
15 the dryer fabric and the web 6, etc.

Figures 5 and 6 illustrate a second embodiment of the present invention. In this embodiment, the dryer fabric is generally indicated at 12a. Dryer fabric 12a is substantially identical to dryer fabric 12 of
20 Figures 2 through 4 and like parts have been given like index numerals. The dryer fabric 12a has warp or machine direction yarns 13, weft or filling yarns 14 and 15 in the cross machine direction and stuffer picks 17 extending inwardly from both longitudinal
25 sides of the dryer fabric. As a result, the dryer fabric 12a is again divided into two edge zones 18a, and 19a and a central zone 20a. The only difference between the dryer fabric 12a of Figures 5 and 6 and the dryer fabric 12 of Figures 2 through 4 lies in
30 the fact that additional stuffer picks are located in the central section or zone 20a. Each of the additional stuffer picks 21 extends the full width of the central section 20a and are in general alignment with the opposed edge stuffer picks 17 which
35 occupy the same diamond-shaped opening 16.

Figure 4 may be considered to be a longitudinal cross sectional view through either of the sections or zones 18a or 19a of Figure 5. Figure 6 is a longitudinal cross sectional view through the central zone 20a of Figure 5. It will be immediately apparent that the stuffer picks 21 are so selected as to have a smaller size or less bulk than stuffer picks 17. As a result, the dryer fabric 12a will differ from dryer fabric 12 in that the central zone or section 20a will have a somewhat lesser permeability than center section 20 of Figure 2, while still having a greater permeability than edge sections 18a and 19a. Again, the width of sections 18a, 19a and 20a can be varied, as described with respect to the embodiment of Figures 2 through 4.

A third embodiment of the present invention, generally indicated at 12b, is illustrated in Figures 7 and 8. For purposes of an exemplary illustration, the dryer fabric 12b is shown as being woven of a simple duplex weave. Warp or machine direction yarns are again shown at 13 and weft or filling yarns, extending in the cross machine direction, are again illustrated at 14.

As in the previous embodiments, stuffer picks are provided at the edge portions of the dryer fabric 12b. Stuffer picks similar to those of the previous embodiments are shown at 17. Fabric 12b differs from the previous embodiments in that alternate edge stuffer picks are longer, extending inwardly from the edge of the dryer fabric toward the center a greater distance. These stuffer picks are illustrated at 17a.

Dryer fabric 12b is also provided with stuffer picks of lesser diameter or bulk extending between the edge stuffer picks. Those intermediate stuffer picks

extending between edge stuffer picks 17 are identical to those illustrated in Figure 5 and are again given index numeral 21. Those intermediate stuffer picks extending between elongated stuffer picks 17a are, of course, shorter and are indicated by index numeral 21a.

As a result of this construction, it will be evident from Figure 7 that the dryer fabric 12b is divided into five zones or sections across its width (i.e. in the cross machine direction). First of all, there are the edgemoat sections 22 and 23. These sections are equivalent to edge sections 18 and 19 of Figure 2 and 18a and 19a of Figure 5. Therefore, the cross sectional view, Figure 4, can be considered to be illustrative of the longitudinal cross section of sections 22 and 23 of Figure 7, differing only in that alternate ones of the stuffer picks of Figure 4 would bear the index numeral 17a. These edgemoat sections or zones would have the least permeability.

The centermoat section 24 of dryer fabric 12b is substantially identical to the center section 20a of Figure 5, except that it is considerably narrower. The cross sectional view, Figure 6, can be considered to be illustrative of the cross section of center section 24 of Figure 7, with the exception that alternate ones of the stuffer picks of Figure 6 would be designated 21a. This is the section of dryer fabric 12b having the greatest permeability.

Finally, dryer fabric 12b has two intermediate zones or sections 25 and 26. In these zones, stuffer picks 17a and 21 alternate. The longitudinal cross section of section 25 is shown in Figure 8. It will be understood that Figure 8 is also illustrative of the longitudinal cross section of section 26. Thus,

in these sections 25 and 26 there are alternate large diameter stuffer picks and stuffer picks of lesser diameter or less bulk, yielding a permeability between that of section 24 on the one hand and sections 22 and 23 on the other. As a result, dryer fabric 12b has a high permeability center section 24, medium permeability intermediate sections 25 and 26 and lesser permeability edge sections 22 and 23.

Figures 9 and 10 illustrate a fourth embodiment of the present invention wherein the dryer fabric is designated generally at 12c. Dryer fabric 12c is identical to dryer fabric 12b of Figures 7 and 8, with the sole exception that the stuffer picks 21 and 21a of lesser diameter or less bulk have been omitted. In Figures 9 and 10, like parts have been given the same index numerals as in Figure 7 and 8.

Once again, dryer fabric 12c is a five zone or section fabric. Thus, fabric 12c has edge zones 22 and 23 identical to edge zones 22 and 23 of fabric 12b of Figure 7. Fabric 12c has a central zone 24a, the same width as zone 24 of Figure 7, but with the lesser diameter or lesser bulk stuffer picks 21 and 21a omitted. In a similar fashion, the intermediate zones 25a and 26a of dryer fabric 12c differ from the intermediate zones 25 and 26 of dryer fabric 12b only in that the lesser diameter or lesser bulk picks 21 have been omitted.

As a result of these differences, dryer fabric 12c will have the same permeability at its edges, as does dryer fabric 12b. The central zone 24a of dryer fabric 12c will have the maximum permeability, and therefore a permeability greater than the central zone 24 of dryer fabric 12b. Figure 10 is a diagrammatic cross sectional view illustrating the longitudinal section of zone 25a of dryer fabric 12c. It

will be understood that Figure 10 can also be considered to be illustrative of the longitudinal section of intermediate zone 26a of Figure 9. Since the lesser diameter or lesser bulk picks 21 are omitted in sections 25a and 26a, these sections will have a lesser permeability than center section 24a, but a greater permeability than the intermediate sections 25 and 26 of dryer fabric 12b.

The four embodiments described above are exemplary only of the manner in which the teachings of the present invention can be employed to produce dryer fabrics having zones of different permeabilities across its width (i.e., in the cross machine direction). While all of the embodiments, for purposes of an exemplary showing, have been illustrated in the form of a dryer fabric made up in a simple duplex weave, it will be understood that any appropriate multi-layer weave can be used which will enable the introduction of stuffer picks. By varying the nature of the stuffer picks and their locations, a large variety of dryer fabrics of differing permeabilities across their widths can be achieved.

Since, in accordance with the teachings of the present invention, the frequency of the warp or machine direction yarns is uniform and has not been altered across the fabric width, significant differences in load bearing characteristics across the width of the dryer fabrics have not been introduced. It is recommended that the stuffer picks not be harder or stiffer and more rigid than the base picks.

In dryer fabrics of the type taught in the above mentioned U.S. Patent 3,867,766, it has been found that the load bearing properties or stretch characteristics of the edge sections and the center section can differ in a proportion as high as 1:3.5. The

dryer fabrics of the present invention demonstrate much more nearly uniform load bearing properties or stretch characteristics of the various zones across their widths.

5

EXAMPLE I

A dryer fabric of the type illustrated in Figure 5 was made, utilizing a simple duplex weave. The warp or machine direction yarns 13 were 20 mil monofilament synthetic yarns at a frequency of 52
10 yarns per inch. Both polyester and nylon yarns were used, arranged in alternate groups of four across the width of the dryer fabric.

The filling or cross machine direction yarns 14 and 15 were 20 mil monofilament polyester yarns.
15 The outer stuffer picks 17 were 0.7 cotton count yarns spun of polyester staple fibers. The center stuffer picks 21 were 4/4 cotton count yarns spun of polyester staple fibers. The overall pick frequency was 41 per inch, including the stuffer picks.

20 The dryer fabric had a width of approximately 275 inches, the outer zones 18a and 19a being approximately 40 inches wide and the central zone 20a being approximately 195 inches wide. The dryer fabric was heat set in a conventional manner to heat
25 stabilize the fabric and to achieve the final desired dimensions.

The permeabilities of the sections 18a, 19a and 20a were tested utilizing a standard Frazier air permeability tester, yielding the permeability values
30 in cubic feet per minute per square foot of fabric at a pressure drop of 0.5 inches of water. The sections or zones 18a and 19a demonstrated a permeability of approximately 90 cubic feet per minute, while the central section 20a demonstrated a
35 permeability of approximately 180 cubic feet per minute.

Samples from sections 18a, 19a and 20a were subjected to a standard stretch test at 0.65% elongation in the machine direction. Under these circumstances, the edge sections 18a and 19a demonstrated a force of 9.7 pounds per inch of width while the center sections 20a demonstrated a force of 7.3 pounds per inch of width. Thus, the difference in load bearing properties between the edge sections 18a and 19a and the center section 20a was in the proportion of 1:1.3. Thus, it can be seen that the various sections of the fabric demonstrated very nearly the same load bearing characteristics.

EXAMPLE II

A second dryer fabric of the type illustrated in Figure 9 was manufactured, utilizing a simple duplex weave. The warp or machine direction yarns 13 were 3,250 denier continuous multifilament polyester yarns arranged at a frequency of 32 ends per inch. The filling or cross machine direction yarns (including the stuffer picks) were 100% fiberglass continuous multifilament yarns arranged at a frequency of 36 picks per inch in the edge sections 22 and 23, 30 picks per inch in the intermediate sections 25a and 26a and 24 picks per inch in the central section 24a. When subjected to the permeability tests described with respect to Example I, the edge regions 22 and 23 demonstrated a permeability of 100 cubic feet per minute, the intermediate sections 25a and 26a demonstrated a permeability of 275 cubic feet per minute, while the central section 24a demonstrated a permeability of 400 cubic feet per minute.

The dryer fabric of this example had an approximate of width of 280 inches, the edge sections 22 and 23 being approximately 44 inches, the intermediate

sections 25a and 26a being approximately 38 inches and the center section 24a being approximately 116 inches. The dryer fabric was resin treated to enhance the stability of the fabric and was heat set
5 in a conventional manner to heat stabilize the fabric and to bring it to the final required dimensions.

Samples of the five sections 22, 23, 25a, 26a and 24a were subjected to a standard stretch test, as explained in Example I above. At 1.3% elongation in
10 the machine direction, the edge sections 22 and 23 demonstrated a force of 8.75 pounds per inch of width. The intermediate sections 25a and 26a demonstrated a force of 7.6 pounds inch of width and the center section 24a demonstrated a force of 8 pounds per
15 inch of width. Again, it will be noted that the machine direction load bearing characteristics were very much more uniform than those of the prior art, being in a ratio of 1:1.5 between the highest and the lowest.

20 Modifications may be made in the invention without departing from the spirit of it.

25

WHAT IS CLAIMED IS:

1. A woven dryer fabric for use in a papermaking machine, said dryer fabric being woven of machine direction and cross machine direction yarns in a multi-layer weave, said machine direction yarns being evenly spaced along the width of said dryer fabric, additional cross machine direction yarns being located in said dryer fabric at selected positions across the width of said dryer fabric to produce longitudinally extending zones in said dryer fabric across the width thereof of different fluid permeabilities.

2. The structure claimed in claim 1 wherein said machine direction yarns, said cross machine direction yarns and said additional cross machine direction yarns are chosen from the class consisting of monofilament yarns, multifilament yarns, spun yarns and combinations thereof.

3. The structure claimed in claim 1 wherein said additional yarns are of a softness and stiffness up to that of said cross machine direction yarns.

4. The structure claimed in claim 1 including first and second groups of said additional cross machine direction yarns, the yarns, of said first group being so located in said dryer fabric as to extend from one longitudinal edge thereof toward the center thereof a predetermined distance, said second group of yarns being so located in said dryer fabric as to extend from the other longitudinal edge thereof toward the center thereof a predetermined distance, the yarns of each of said groups being of the same length, said dryer fabric having two edge zones of lesser fluid permeability and a center zone therebetween of greater fluid permeability.

5 5. The structure claimed in claim 1 including
first and second groups of said additional cross
machine direction yarns, the yarns of said first
group being so located in said dryer fabric as to
10 extend from one longitudinal edge thereof toward the
center thereof, said yarns of said second group being
so located in said dryer fabric as to extend from the
other longitudinal edge thereof toward the center
thereof, alternate ones of the yarns of each of said
15 first and second groups thereof being longer than
the remaining yarns of that group, in each of said
first and second groups said alternate longer yarns
being of the same length and said remaining yarns
being of the same length, said dryer fabric having
two edge zones of lesser fluid permeability, a center
zone of higher fluid permeability and two intermediate
zones of intermediate fluid permeability.

20 6. The structure claimed in claim 4 including
a third group of said additional cross machine direction
yarns, said yarns of said third group being so located
in said dryer fabric as to extend between said yarns
of said first and second groups.

25 7. The structure claimed in claim 5 including
a third group of said additional cross machine
direction yarns, said yarns of said third group being
so located in said dryer fabric as to extend between
said yarns of said first and second groups of yarns.

30 8. The structure claimed in claim 6 wherein said
yarns of said third group having a diameter less than
said yarns of said first and second groups.

 9. The structure claimed in claim 6 wherein
stuffer yarns of said third group are of less bulk
than said yarns of said first and second groups.

10. The structure claimed in claim 7 wherein said yarns of said third group having a diameter less than said yarns of said first and second groups.

5 11. The structure claimed in claim 7 wherein said yarns of said third group are of less bulk than said yarns of said first and second groups.

10 12. A method of making a dryer fabric for use in a papermaking machine including the steps of weaving said dryer fabric of machine direction and cross machine direction yarns in a multi-layer weave with said machine direction yarns being evenly spaced along the width of said dryer fabric, and introducing additional cross machine direction yarns in said dryer fabric at selected positions across the width
15 of said dryer fabric to produce longitudinally extending zones in said dryer fabric across the width thereof of different fluid permeabilities.

20 13. The method claimed in claim 12 wherein said machine direction yarns, said cross machine direction yarns and said additional cross machine direction yarns are chosen from the class consisting of monofilament yarns, multifilament yarns, spun yarns and combinations thereof.

25 14. The method claimed in claim 12 wherein said additional cross machine direction yarns are of a softness and stiffness up to that of said cross machine direction yarns.

30 15. The method claimed in claim 12 including the steps of introducing a first group of said additional cross machine direction yarns into said dryer fabric such that they extend from one longitudinal edge thereof toward the center thereof a predetermined distance and introducing into said dryer fabric a second group of said additional cross machine direction
35 yarns such that they extend from the other lateral edge thereof toward the center thereof a predetermined

distance, the yarns of each of said groups being of the same length whereby to provide a dryer fabric having two edge zones of lesser fluid permeability and a center zone therebetween of greater fluid permeability.

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16. The method claimed in claim 12 including the steps of introducing a first group of said additional cross machine direction yarns into said dryer fabric such that they extend from one longitudinal edge thereof toward the center thereof and introducing into said dryer fabric a second group of said additional cross machine direction yarns such that they extend from the other lateral edge thereof toward the center thereof, alternate ones of the yarns of each of said first and second groups thereof being longer than the remaining yarns of that group, in each of said first and second groups said alternate longer yarns being of the same length and said remaining yarns being of the same length, whereby to provide a dryer fabric having two edge zones of lesser fluid permeability, a center zone of higher fluid permeability and two intermediate zones of intermediate fluid permeability.

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17. The method claimed in claim 15 including the step of introducing into said dryer fabric a third group of said additional cross machine direction yarns such that they extend between said yarns of said first and second groups.

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18. The method claimed in claim 16 including the step of introducing into said dryer fabric a third group of said additional cross machine direction yarns such that they extend between said yarns of said first and second groups.

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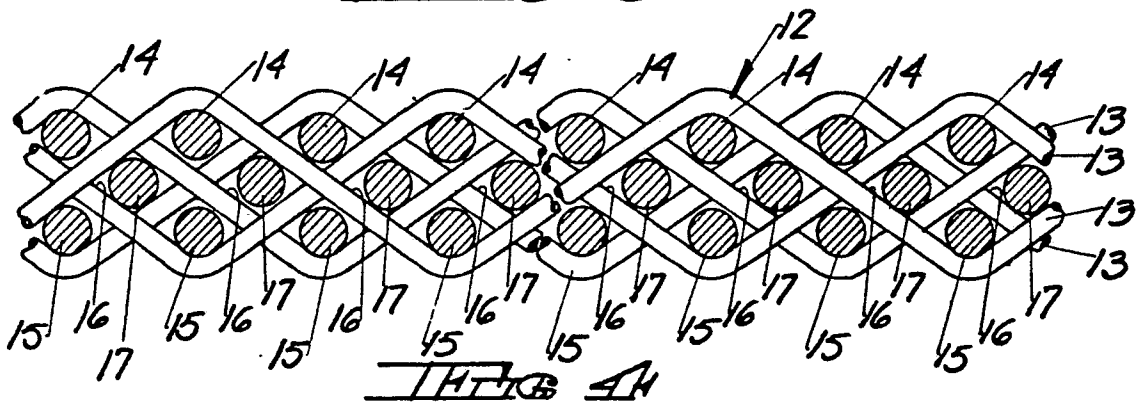
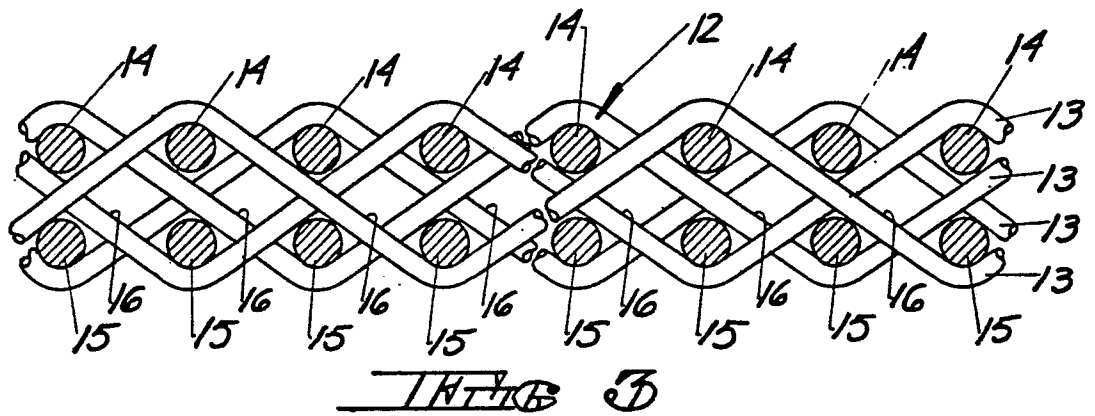
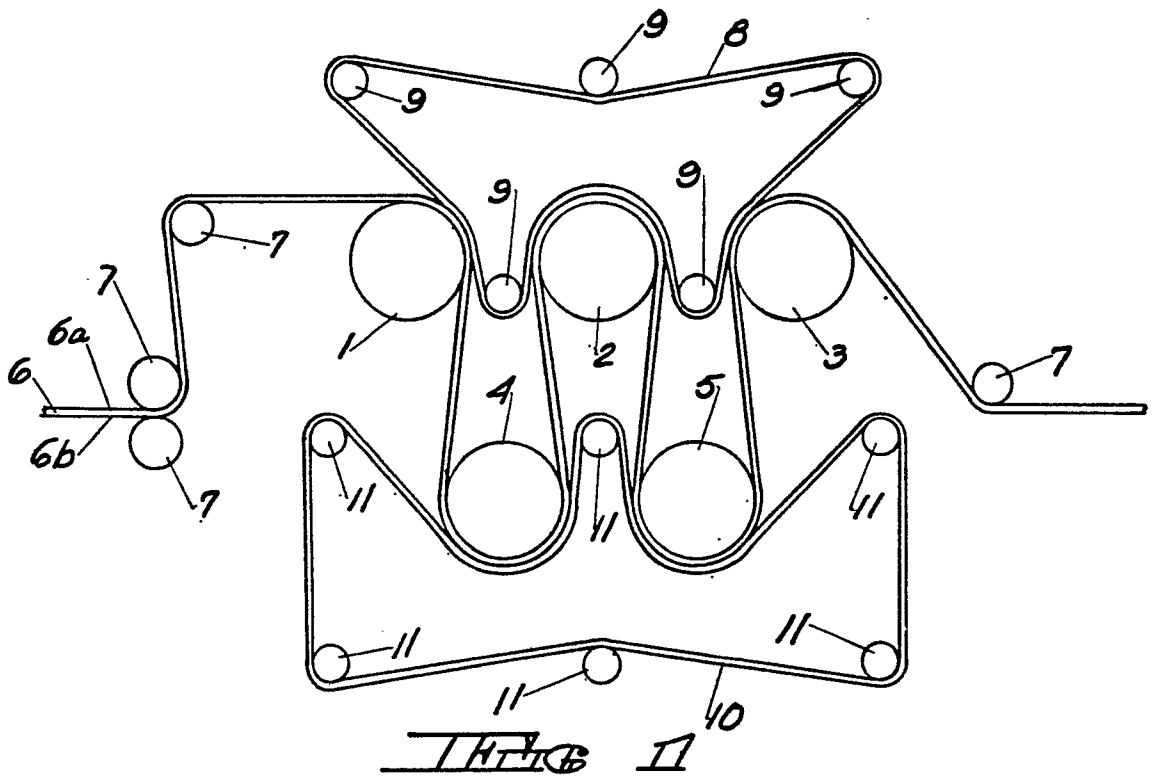
19. The method claimed in claim 17 wherein said yarns of said third group having a diameter less than said yarns of said first and second groups.

5 20. The method claimed in claim 17 wherein said yarns of said third group are of less bulk than said yarns of said first and second groups.

21. The method claimed in claim 18 wherein said yarns of said third group having a diameter less than said yarns of said first and second groups.

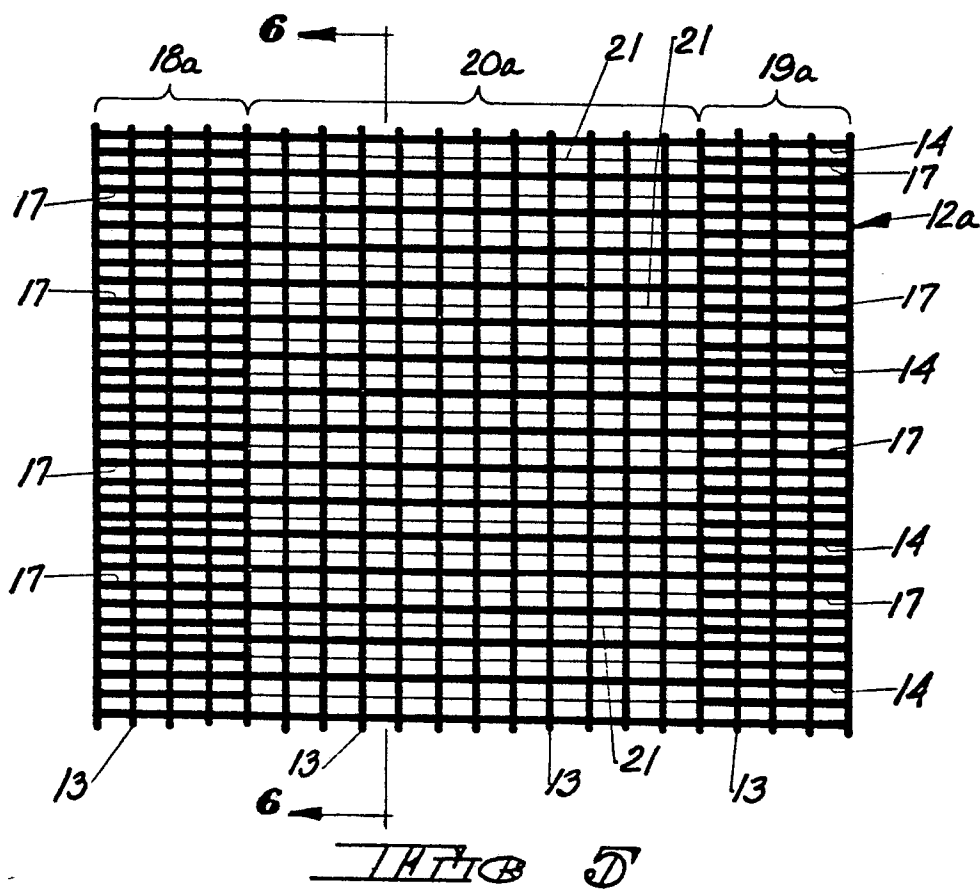
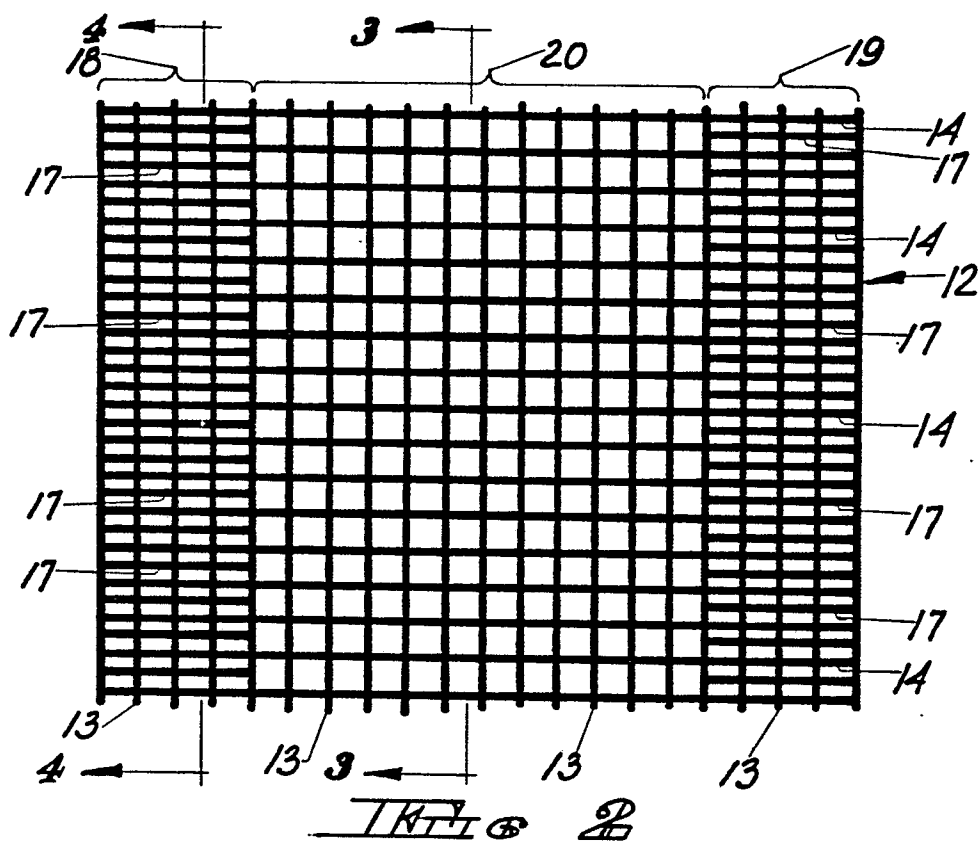
10 22. The method claimed in claim 18 wherein said yarns of said third group are of less bulk than said yarns of said first and second groups.

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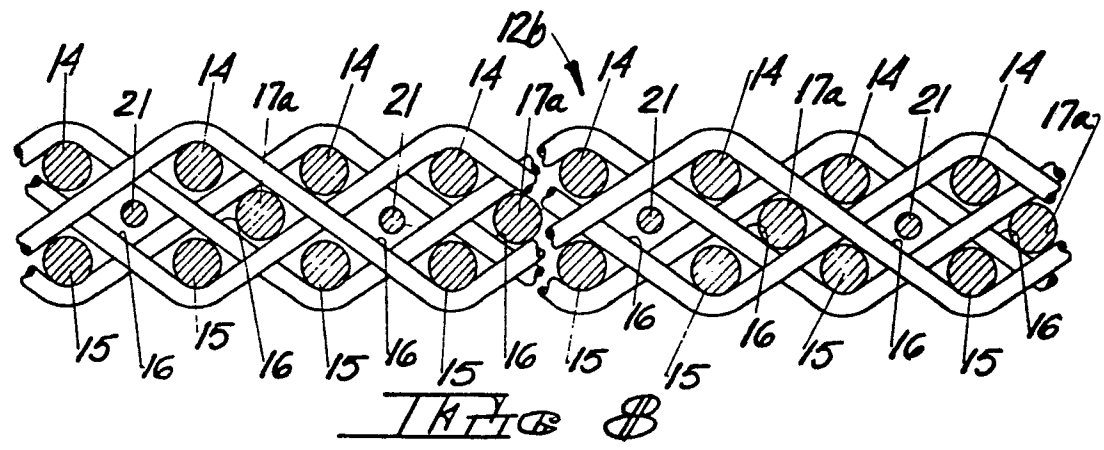
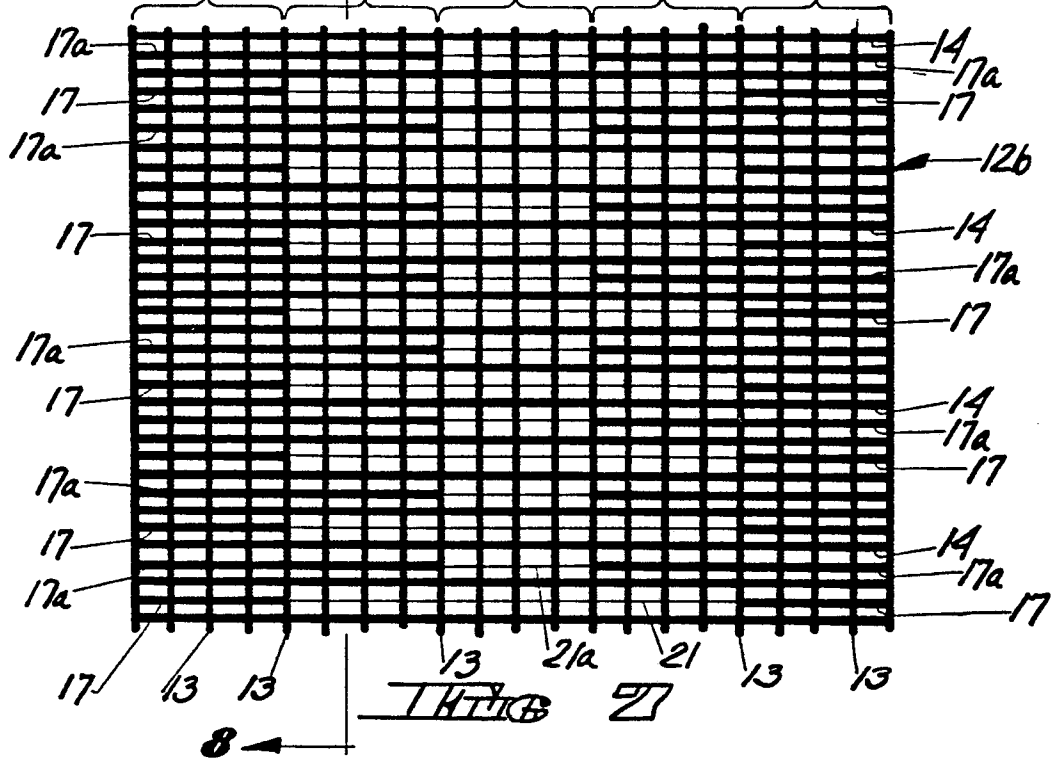
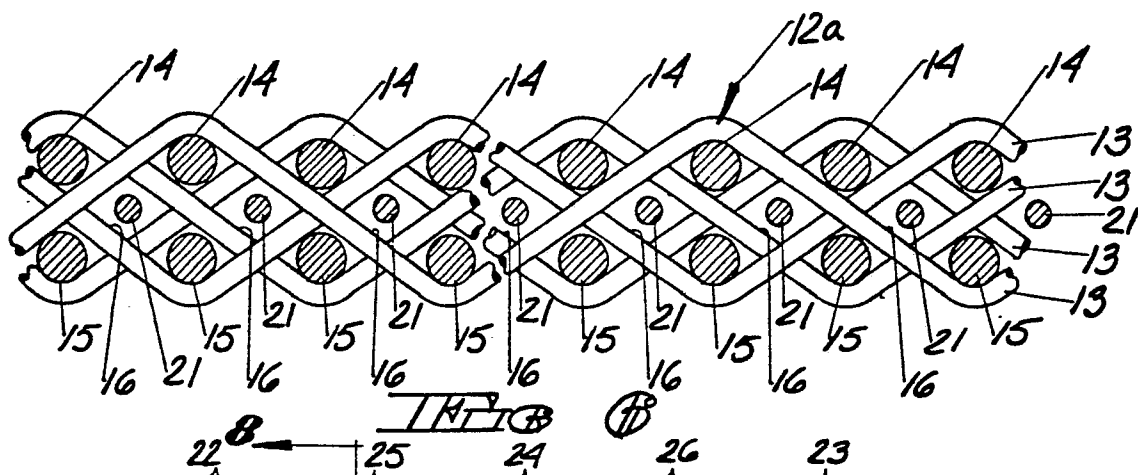
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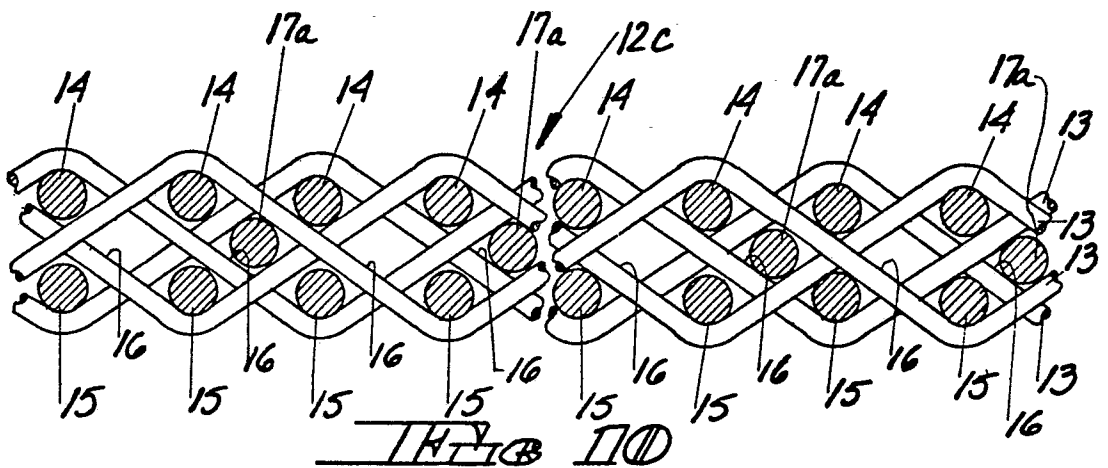
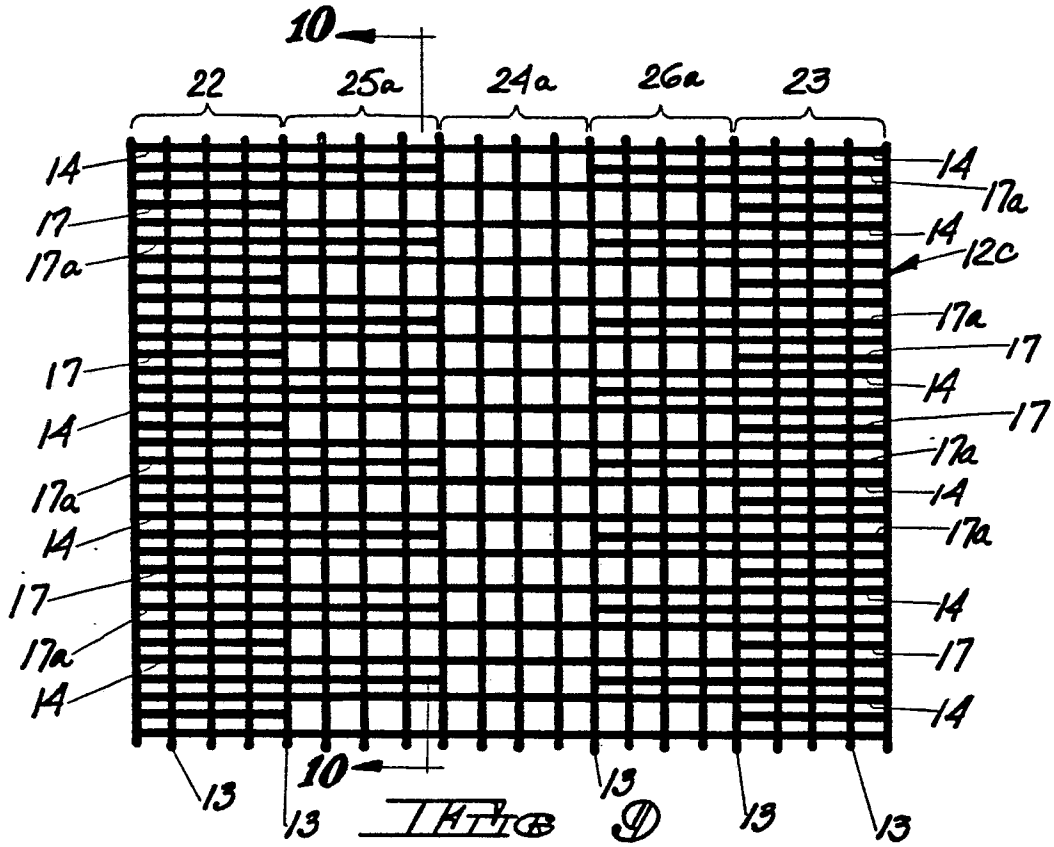


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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>FR - A - 2 024 388</u> (TAMPEREEN) * the whole patent * ---	1	D 21 F 1/00
A	<u>FR - A - 2 407 291</u> (J.W.I.) * the whole patent * ---	1	
D/A	<u>US - A - 3 867 766</u> (WAGNER) * the whole abstract * ---	1	
D/A	<u>US - A - 2 180 054</u> (HINDLE et al.) * the whole patent * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.3)
			D 21 F D 03 D
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons
			&: member of the same patent family, corresponding document
<input checked="" type="checkbox"/> The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		28.01.1982	DE RIJCK