(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 567 713 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
15.04.2009 Bulletin 2009/16

(21) Application number: **03780347.5**

(22) Date of filing: **05.12.2003**

(51) Int Cl.:
D21F 11/00 *(2006.01)*

(86) International application number:
PCT/GB2003/005298

(87) International publication number:
WO 2004/050990 (17.06.2004 Gazette 2004/25)

(54) A METHOD OF MANUFACTURING A FIBROUS SUBSTRATE INCORPORATING AN ELONGATE ELEMENT WITH A VARIABLE EDGE PROFILE

VERFAHREN ZUR HERSTELLUNG EINES FASERSTOFFSUBSTRATS MIT EINGEBETTETEM STREIFEN VARIABLER BREITE

PROCEDE DE FABRICATION DE SUBSTRAT FIBREUX INCORPORANT UN ELEMENT EFFILE A PROFIL D'ARETE VARIABLE

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **05.12.2002 GB 0228423**

(43) Date of publication of application:
31.08.2005 Bulletin 2005/35

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Description

[0001] This invention is directed to improvements in manufacturing substrates, such as paper, incorporating an elongate impermeable element and a substrate made therefrom.

[0002] It is generally known to include elongate elements in paper or other substrates, usually as a security feature. Such elements can be threads, strips or ribbons of, for example, plastics film, metal foil, metallised plastic, metal wire. These elongate elements are included in the thickness of the substrate to render imitation of documents produced therefrom more difficult. These elements help in the verification of the documents as they render the view of the documents in reflected light different from that in transmitted light. To increase the security provided by the inclusion of such an elongate element, it is also known to endow the element itself with one or more verifiable properties over and above its presence or absence. Such additional properties include magnetic properties, electrical conductivities, the ability to absorb x-rays, fluorescence, optically variable effects and thermochromic behaviour.

[0003] As a further security feature, it has been found to be particularly advantageous to provide windows in one side of the surface of the substrate, which expose such elongate elements at spaced locations. Examples of methods of manufacturing paper incorporating security elements with or without windows are described below. It should be noted that references to "windowed thread paper" include windowed paper incorporating any elongate security element.

[0004] EP-A-0059056 describes a method of manufacture of windowed thread paper on a cylinder mould paper-making machine. The technique involves embossing the cylinder mould cover to form raised regions and bringing an impermeable elongate security element into contact with the raised regions of the mould cover, prior to the contact entry point into a vat of aqueous paper stock. Where the impermeable security element makes intimate contact with the raised regions of the embossing, no fibre deposition can occur. After the paper is fully formed and couched from the cylinder mould cover, water is extracted from the wet fibre mat and the paper is passed through a drying process. In the finished paper the contact points are present as exposed regions which ultimately form windows, visible in reflected light, on one side of the paper, which is most often used as banknote paper.

[0005] As the exposed regions of the elongate element can be used to display indicia or overt security features, it is considered to be an advantage in some applications to expose as big a surface area of the element as possible. Thus attempts have been made to wholly and partially embed elements which are wider than the more frequently used elements, which fall in the range of 0.5mm to 2.00mm.

[0006] Whilst the above-mentioned method has been commercially extremely successful, difficulties have been found in incorporating wider security elements as the impermeable nature of the security elements block the flow of liquid through the mesh and the point where it lies, thereby interfering with the deposition of fibres. Where the security element is wider than the typical length of the paper fibres used, the fibres are unable to bridge the security element, which therefore becomes exposed in pin holes or defects on the opposite side of the paper to the windows.

[0007] EP-A-0070172 proposes an alternative method of making paper having an elongate security element embedded therein, providing elements which have regions of permeability and regions of impermeability. This method enables much wider element to be embedded in paper. When incorporated into paper on a cylinder mould making machine, the permeable regions are embedded in the thickness of the paper and the less permeable regions are exposed at one surface thereof. This method can be used for elongate elements having a width from 0.5mm to the full width of the sheet, which could be 5000mm.

[0008] EP-A-0229645 describes a method using two cylinder moulds to produce two separate plys of paper, with a security thread introduced in between the two layers. The option of incorporating holes in both layers by, for example, incorporating drainage restriction devices on the mould covers is disclosed in the specification. The resulting holes can be registered to produce windows on each side of the thread. This method has a major drawback in that the two cylinder moulds need to be exactly the same diameter and linked by a registration system which renders production of the paper extremely expensive. This document also fails to teach how to actually achieve registration.

[0009] Based on the desire to be able to display as much information or indicia as possible in the exposed regions, it has also been recognised that it would be highly advantageous to be able to expose the elongate element on both sides of the paper, or other substrate, in which it is embedded. EP-A-0059056 suggests that this could be achieved by using sufficiently large impervious projections on the cylinder mould. The disadvantage with the method described in this specification is that the holes produced by the drainage limiting devices need to be covered up and this means that rather wide threads have to be used, which increases the cost of the paper. Another disadvantage of this method is that the windows on each side necessarily coincide.

[0010] It is therefore an object of the present invention to provide an improved method of embedding an elongate element within a fibrous substrate such that the element is exposed at both sides of the substrate in an alternating or coincident manner.

[0011] The invention therefore provides a method of making a fibrous substrate comprising the steps of bringing an elongate flexible impermeable element into contact with window forming means provided on a moving

support surface, depositing fibres onto the support surface to form a fibrous substrate, the deposition of fibres being carried out in such a manner that as the fibres are deposited onto the support surface the elongate element is incorporated in the substrate, wherein a first set of windows are formed in one surface of the substrate at the point of contact of the element with the window forming means, in which windows the element is at least partially exposed, wherein the elongate element comprises a plurality of wide regions separated by narrow regions, the wide regions being of a width which obstructs the deposition of fibres on the said wide regions to form a second set of windows in an opposing surface of the substrate in which the elongate element is also at least partially exposed, the narrow regions being such as to allow fibres to be deposited thereover to cause the narrow regions to be covered by the opposing surface of the fibrous substrate away from the support surface.

[0012] The substrate made by the method according to the invention thus has two very carefully crafted sets of windows which are designed by the geometry of the thread and the window forming means. Thus carefully designed sets of windows can be used to maximise the usefulness of the area of the elongate element exposed, in a very different manner to allowing random flaws to develop on the back of the thread.

[0013] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Fig. 1 is a cross-sectional side elevation of a schematic of a paper-making vat for use in the method of manufacturing paper according to the present invention;

Figs. 2 to 4 are plan views of alternative elongate elements for use in the method of the present invention;

Figs. 5 and 6 are plan views of opposing sides of a sheet incorporating the elongate element of Figure 2; and

Fig. 7 is a magnified view of one window of the sheet of Fig. 6, in which the elongate element has a partial white coating.

[0014] The method of manufacturing a fibrous sheet, such as paper, according to the present invention is illustrated with reference to Figs. 1 and 2. The method can be implemented on a known papermaking machine, such as a cylinder mould machine or a fourdrinier machine. Although the following description refers to a cylinder mould cover, this can be replaced by the foraminous belt of a fourdrinier machine, such as is described in GB-A-2260772.

[0015] A porous support surface, for example in the form of a cylinder mould cover 10, is produced in a known way. The mould cover 10 has raised portions 12, formed by embossing, such as those described in EP-A-0059056. The raised portions 12 are spaced around the mould cover 10 and contact of a security thread therewith restricts the draining of the water content of the paper slurry through the mould cover 10 at the points of contact thereby preventing or reducing the deposition of fibres and defining the shape of the windows 17 formed in the final substrate. In this specification the term "window" includes a transparent or translucent region in the substrate of a predefined shape and occurrence. It should be noted that other window forming means for creating the windows may be used, such as electrotype, attached to the mould cover 10, which also directly prevents drainage and over which the thread is placed as shown in Figure 1.

[0016] In a known manner, the cylinder mould cover 10 is rotated in a vat of fibrous stock 11 as illustrated in Figure 1, and fibres are continuously deposited thereon in a known manner to form a continuous web of substrate. The stock may comprise fibres of natural materials, such as cotton, synthetic fibres or a mixture of both. As the cylinder mould cover 10 rotates, a flexible elongate impermeable element 13, is brought into contact with the raised portions 12 of the cylinder mould cover 10 above the level of the stock, i.e. before any fibres have been deposited on the mould cover 10. As the mould cover 10 rotates, the elongate element 13 is introduced into the stock, and is partially embedded in the substrate as it forms. The fibres deposit in the valleys between raised portions 12 to form bridges 18, under which the element 13 is embedded, between the windows 17 formed at the point of contact between the element 13 and raised portions 12. The continuous fibrous substrate (or web) is moved along continuously as it is formed, its direction of travel being known as the "machine direction".

[0017] The elongate element 13 used in the present invention, however, differs from that used in EP-A-0059056 in that its width varies along its length having narrow regions 14 linking wider regions 15. The narrow regions 14 are sufficiently narrow not to interfere with fibre deposition and so are covered by fibres during the paper making process. They therefore preferably have a width of less than 3mm, and more preferably less than 2.00mm. The wider regions 15, on the other hand, are sufficiently large to interfere with fibre deposition as they are too wide to be bridged by the fibres, and they are therefore left exposed in a second set of windows 19 on the reverse side of the fibrous sheet to the windows 17 formed by the raised portions 12. It is well known that the selection of the fibre length is therefore important as the fibres must not be so long that they do bridge over the winder areas of the elongate element 13. Preferably the fibre length is roughly at least half the length of the width of the narrow parts of the elongate element. The wider regions 15 preferably have a width greater than 3mm and the narrow regions preferably have a width less than 2mm.

[0018] Overall, the grammage of the substrate produced is preferably less than 110gsm, and more preferably in the range of 80 to 110gsm.

[0019] The lengths of the wider regions 15 and the narrow regions 14 can be chosen to coincide with the lengths of the peaks of the raised portions 12 and the valleys between the raised portions 12 respectively, so that the windows 17,19 formed on each side of the substrate coincide, ie they are in full registration, forming an aperture in which the elongate element 13 can be seen from both sides of the sheet.

[0020] Alternatively, the aforementioned measurements can be selected so that the windows 17,19 on either side of the substrate are registered, but wholly offset so that the elongate element 13 is exposed at different points at each side of the substrate. As a further alternative the windows 17,19 on opposing sides of the substrate may be designed to be partially coincident with eachother.

[0021] In order for the elongate element 13 to be registered, a device will be required for controlling it's insertion.

[0022] As a further alternative, the windows 17,19 may be out of register in a random manner.

[0023] Thus, substrates made according to the present invention are advantageous in that it is possible to increase the exposure of the element 14, not just on one side of the substrate, but two sides, which means that it can be used to its best extent. This is important because these elements 13 can be expensive to provide.

[0024] It should also be noted that many current paper making method use paper making machines with a short former which creates a second paper layer which is merged with a first paper layer during the paper making production. The current method cannot use such machines as the second apply would effectively eliminate one of the sets of windows, unless the second ply is formed with apertures which overlie the exposed regions of the security element 14 in the first ply.

[0025] The elongate elements 13 are preferably made of clear polyethylene and are preferably die cut, and shaped to minimise wastage. As such the profiling should be such that the threads tesselate. Examples of some suitable profiles are shown in Figs. 2 to 4, although these are not restrictive. The wider regions 15 may, for example, have semi circular profiles.

[0026] As an alternative to die cutting the elongate elements 13, a standard constant width elongate element 14 (or thread) can be used to which a plurality of tabs, of a greater width than the element itself are adhered. The tabs can be applied to one or both sides of the element 14 by means of an adhesive. They may be applied by a stamping machine after the element 14 has been unwound and just before entry into the vat. The tabs may be of the same or a different material to that of the element 14. They may also bear the same, or different, features such as those described below. They may also be of a matching or contrasting colour. This means that the expense of slitting the element 14 in complex shapes can be avoided, and that existing technologies can be used.

[0027] Elongate security elements typically have a layer of adhesive, which help the embedment within the substrate. In the present invention it is important that a suitable adhesive is used which does not cause the fibres to adhere in the windowed regions but in the vat.

[0028] The elongate elements can contain a wide variety of known security features which may include the following:-

- a metallic layer, indicia or designs, which appear dark, when the substrate is viewed in transmitted light, compared to the lighter, partly light-transmitting, substrate. When viewed in reflected light, the shiny metallic parts will be clearly seen in the windows;

- de-metallised indicia or designs, which may comprise areas of substantially removed metal to take advantage of the transparency of the base film and provide a large area of transparent window;

- holographic designs, which may comprise areas of full metal and half-tone screens to provide partial transparency and/or no metal. Under certain viewing conditions, with no metal, a holographic image is still visible;

- front to back print registration, in which features are printed which would clearly exhibit Moiré patterns from both front and back if a counterfeit were attempted. Alternatively, such patterns could be produced on a transparent film prior to insertion of the element 13 into the paper as a security feature itself. The exact reproduction of such patterns are very difficult to mimic;

- luminescent, iridescent, thermochromic, liquid crystal or magnetic materials;

- designs or indicia created by printed inks.

[0029] Many other options are available and with such a large exposed area of the element 13 available, it is possible to combine many security or decorative features together on one element 13.

[0030] In one embodiment of the invention, the parts of the wider regions 15 which extend beyond the width of the narrow regions, i.e. the sections shaded at the left hand end of Figures 2, 3 and 4 and marked with reference numeral 16, may be coated on one side with a matt coating to match the colour of the substrate. This means that when the element 13 is viewed in reflected light through the windows 19 formed on the back of the substrate due to the wider regions 15, a constant width of the elongate element 13 will be seen, as shown in Figure 7. The wider regions 16 will not be visible as they blend in with the

surrounding substrate. They will, however, be visible in transmitted light as the opaque areas of the element 13 will be seen as dark areas within the lighter, partly light-transmitting, substrate.

[0031] As an alternative, the wider regions 15 may be of a colour which means that they are visible.

[0032] The substrate may, in addition to the variable profile elongate element described above, contain a second elongate element which is exposed in windows at the front of the substrate (as described in EP-A-0059056).

[0033] The substrate described above can be cut and printed to make all forms of documents, including security documents, such as banknotes, cheques, travellers cheques, identity cards, passports, bonds, security labels, stamps, vouchers etc.

Claims

1. A method of making a fibrous substrate comprising the steps of bringing an elongate flexible impermeable element (13) into contact with window forming means (12) provided on a moving support surface (10), depositing fibres onto the support surface (10) to form a fibrous substrate, the deposition of fibres being carried out in such a manner that as the fibres are deposited onto the support surface (10) the elongate element (13) is incorporated in the substrate wherein, a first set of windows (17) are formed in one surface of the substrate at the point of contact of the elongate element (13) with the window forming means (12), in which windows (19) the elongate element (13) is at least partially exposed, wherein the elongate element (13) comprises a plurality of wide regions (15) separated by narrow regions (14), the wide regions (15) being of a width which obstructs the deposition of fibres on the said wide regions (15) to form a second set of windows (19) in an opposing surface of the substrate in which the elongate element (13) is also at least partially exposed, the narrow regions (14) being such as to allow fibres to be deposited thereover to cause the narrow regions (14) to be covered by the opposing surface of the fibrous substrate away from the support surface (10).

2. A method as claimed in claim 1 wherein the first and second set of windows (17,19) on the opposing sides of the substrate are fully registered such that they are coincident with each other.

3. A method as claimed in claim 1 in which the windows (17,19) on the opposing sides of the substrate are registered such that they are not coincident with each other.

4. A method as claimed in claim 1 in which the windows (17,19) in the opposing sides of the substrate are not formed in register with each other.

5. A method as claimed in any one of the preceding claims in which the wide regions (15) of the element have a width of at least 3mm.

6. A method as claimed in any one of the preceding claims in which the narrow regions (14) have a width of less than 3mm.

7. A method as claimed in claim 6 in which the narrow regions (14) have a width of less than 2.0mm.

8. A method as claimed in any one of the preceding claims in which the edge profile of the elongate element (13) tesselates.

9. A method as claimed in any one of the preceding claims in which parts of the wider regions (15) which extend beyond a width of the narrow regions (14) are coated on one side with a matt coating to match a colour of the substrate.

10. A method as claimed in any one of the preceding claims in which the elongate element (13) has a metallic or magnetic track which runs along the middle thereof.

11. A method as claimed in any one of the preceding claims in which the elongate element (13) includes a security feature.

12. A method as claimed in any one of the preceding claims in which the substrate is paper.

13. A method as claimed in any one of the preceding claims in which the support surface (10) is a cylinder mould of a cylinder mould papermaking machine.

14. A method as claimed in any one of claims 1 to 10 in which the support surface (10) is the foraminous belt of a fourdinier papermaking machine.

15. A method as claimed in any one of the preceding claims in which the wider regions (15) of the elongate element (13) are formed separately as tabs which are applied to a thread having a constant width corresponding to the width of the narrow regions (14).

16. A method as claimed in claim 13 in which the tabs are applied to one or both sides of the thread.

17. A method as claimed in any one of the preceding claims further comprising an additional elongate element (13) exposed in windows (17,19) in the one surface of the substrate, but not on the opposing surface.

Patentansprüche

1. Verfahren zur Herstellung eines Fasersubstrats, umfassend die Schritte von:

   - in-Kontakt-Bringen eines länglichen, flexiblen, impermeablen Elements (13) mit Fenster bildenden Mitteln (12), welche auf einer sich bewegenden Unterstützungsfläche (10) bereitgestellt sind,
   - Ablagern von Fasern auf der Unterstützungsfläche (10), um ein Fasersubstrat zu bilden,

   wobei das Ablagern der Fasern auf eine solche Weise ausgeführt wird, dass, wenn die Fasern auf der Unterstützungsfläche (10) abgelagert werden, das längliche Element (13) in dem Substrat aufgenommen wird,
   wobei ein erster Satz von Fenstern (17) in einer Fläche des Substrats an dem Kontaktpunkt des länglichen Elements (13) mit den Fenster bildenden Mitteln (12) gebildet wird, in welchen Fenstern (19) das längliche Element (13) wenigstens teilweise freiliegend ist, wobei das längliche Element (13) eine Mehrzahl von breiten Bereichen (15) umfasst, die durch schmale Bereiche (14) voneinander getrennt sind, wobei die breiten Bereiche (15) von einer Breite sind, die das Ablagern von Fasern an den breiten Bereichen (15) hemmt, um einen zweiten Satz von Fenstern (19) in einer entgegengesetzten Fläche des Substrates zu bilden, in welcher das längliche Element (13) ebenfalls wenigstens teilweise freiliegend ist, wobei die engen Bereiche (14) derart sind, dass sie es Fasern (14) ermöglichen, durch die entgegengesetzte Fläche des Fasersubstrats weg von der Unterstützungsfläche (10) bedeckt zu werden.

2. Verfahren nach Anspruch 1, wobei der erste und der zweite Satz von Fenstern (17, 19) auf den entgegengesetzten Seiten des Substrats vollständig in Konturendeckung gebracht sind, so dass sie deckungsgleich miteinander sind.

3. Verfahren nach Anspruch 1, wobei die Fenster (17, 19) auf den entgegengesetzten Seiten des Substrates so in Konturendeckung gebracht sind, dass sie nicht dekkungsgleich miteinander sind.

4. Verfahren nach Anspruch 1, wobei die Fenster (17, 19) in den entgegengesetzten Seiten des Substrates nicht in Konturendeckung miteinander gebildet sind.

5. Verfahren nach einem der vorhergehenden Ansprüche, wobei die breiten Bereiche (15) des Elements eine Breite von wenigstens 3 mm aufweise.

6. Verfahren nach einem der vorhergehenden Ansprüche, wobei die schmalen Bereiche (14) eine Breite von weniger als 3 mm aufweisen.

7. Verfahren nach Anspruch 6, wobei die schmalen Bereiche (14) eine Breite von weniger als 2,0 mm aufweisen.

8. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Kantenprofil des länglichen Elements (13) tesselliert.

9. Verfahren nach einem der vorhergehenden Ansprüche, wobei Teile des breiteren Bereichs (15), welche sich über eine Breite des schmalen Bereichs (14) hinaus erstrecken, an einer Seite mit einer matten Beschichtung beschichtet sind, um einer Farbe des Substrates zu entsprechen.

10. Verfahren nach einem der vorhergehenden Ansprüche, wobei das längliche Element (13) eine metallische oder magnetische Bahn aufweist, welche entlang der Mitte davon verläuft.

11. Verfahren nach einem der vorhergehenden Ansprüche, wobei das längliche Element (13) ein Sicherheitsmerkmal umfasst.

12. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Substrat Papier ist.

13. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Unterstützungsfläche (10) ein Rundsiebzylinder einer Rundsiebzylinder-Papier herstellungsmaschine ist.

14. Verfahren nach einem der Ansprüche 1 bis 10, wobei die Unterstützungsfläche (10) das punktierte Band einer Fourdrinier-Papierherstellungsmaschine ist.

15. Verfahren nach einem der vorhergehenden Ansprüche, wobei die breiteren Bereiche (15) des länglichen Elements (13) separat als Nasen gebildet sind, welche auf einen Strang angewendet werden, der eine konstante Breite aufweist, die der Breite der schmalen Bereiche (14) entspricht.

16. Verfahren nach Anspruch 13, wobei die Nasen auf eine oder auf beide Seiten des Strangs angewendet werden.

17. Verfahren nach einem der vorhergehenden Ansprüche, ferner umfassend ein zusätzliches längliches Element (13), welches in den Fenstern (17, 19) in der einen Fläche des Substrates, nicht aber an der entgegengesetzten Fläche, freiliegend ist.

Revendications

1. Procédé de réalisation d'un substrat fibreux comprenant les étapes qui consistent à amener un élément imperméable flexible et allongé (13) en contact avec un moyen (12) de formation de fenêtres situé sur une surface de support (10) en mouvement, à déposer des fibres sur la surface de support (10) pour former un substrat fibreux, le dépôt de fibres étant effectué d'une manière telle que, au moment où les fibres sont déposées sur la surface de support (10), l'élément allongé (13) est incorporé dans le substrat dans lequel un premier ensemble de fenêtres (17) sont formées dans une surface du substrat au point de contact de l'élément allongé (13) avec le moyen (12) de formation de fenêtres, fenêtres (19) dans lesquelles l'élément allongé (13) est au moins partiellement à découvert, dans lequel l'élément allongé (13) comporte de multiples régions larges (15) séparées par des régions étroites (14), les régions larges (15) étant d'une largeur qui fait obstacle au dépôt de fibres sur lesdites régions larges (15) pour former un second ensemble de fenêtres (19) dans une surface opposée du substrat dans lequel l'élément allongé (13) est également au moins partiellement à découvert, les régions étroites (14) étant telles qu'elles permettent à des fibres d'être déposées sur elles pour que les régions étroites (14) soient recouvertes par la surface opposée du substrat fibreux éloignée de la surface (10) de support.

2. Procédé selon la revendication 1, dans lequel les premier et second ensembles de fenêtres (17, 19) sur les cotés opposés du substrat sont complètement alignés de manière qu'ils coïncident entre eux.

3. Procédé selon la revendication 1, dans lequel les fenêtres (17, 19) sur les côtés opposés du substrat sont alignées de manière à ne pas coïncider entre elles.

4. Procédé selon la revendication 1, dans lequel les fenêtres (17, 19) dans les côtés opposés du substrat ne sont pas formées en alignement entre elles.

5. Procédé selon l'une quelconque des revendications précédentes, dans lequel les régions larges (15) de l'élément ont une largeur d'au moins 3 mm.

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel les régions étroites (14) ont une largeur de moins de 3 mm.

7. Procédé selon la revendication 6, dans lequel les régions étroites (14) ont une largeur de moins de 2,0 mm.

8. Procédé selon l'une quelconque des revendications précédentes, dans lequel le profil de bord de l'élément allongé (13) est en damier.

9. Procédé selon l'une quelconque des revendications précédentes, dans lequel des parties des régions larges (15) qui s'étendent au-delà d'une largeur des régions étroites (14) sont revêtues sur un côté d'un revêtement mat pour une adaptation à une couleur du substrat.

10. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'élément allongé (13) est parcouru en son milieu par une piste métallique ou magnétique.

11. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'élément allongé (13) comprend un détail de sécurité.

12. Procédé selon l'une quelconque des revendications précédentes, dans lequel le substrat est en papier.

13. Procédé selon l'une quelconque des revendications précédentes, dans lequel la surface de support (10) est une forme ronde d'une machine à papier à forme ronde.

14. Procédé selon l'une quelconque des revendications 1 à 10, dans lequel la surface de support (10) est la bande poreuse d'une machine à papier à table plate.

15. Procédé selon l'une quelconque des revendications précédentes, dans lequel les régions larges (15) de l'élément allongé (13) sont formées séparément sous forme de languettes qui sont appliquées sur une bande (15) ayant une largeur constante correspondant à la largeur des régions étroites (14).

16. Procédé selon la revendication 13, dans lequel les languettes sont appliquées sur un côté ou les deux côtés de la bande.

17. Procédé selon l'une quelconque des revendications précédentes, comprenant en outre un élément allongé supplémentaire (13) mis à découvert dans des fenêtres (17, 19) dans la première surface du substrat, mais non sur la surface opposée.

FIG. 1.

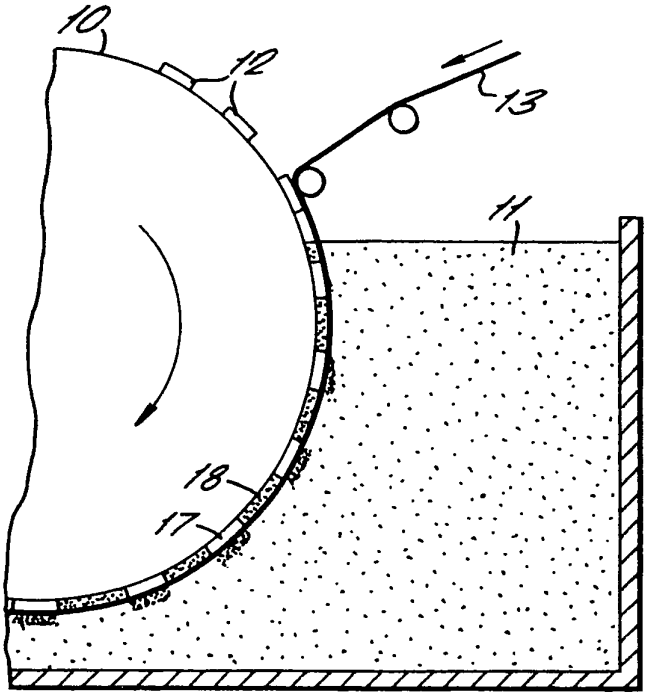


FIG. 2.

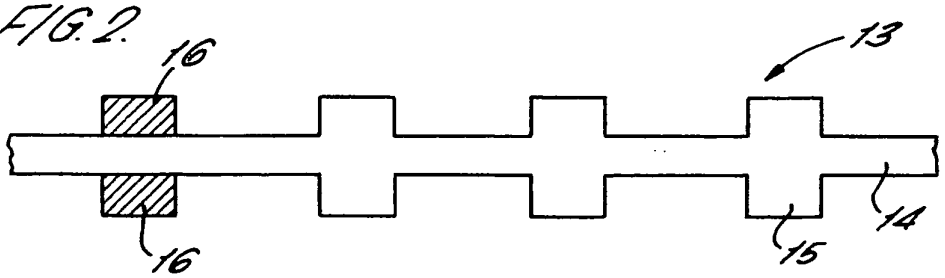


FIG. 3.

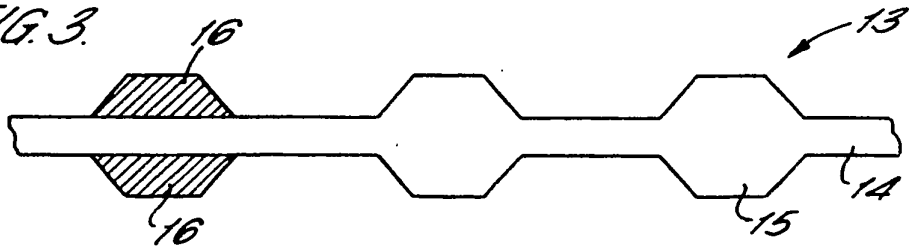


FIG. 4.

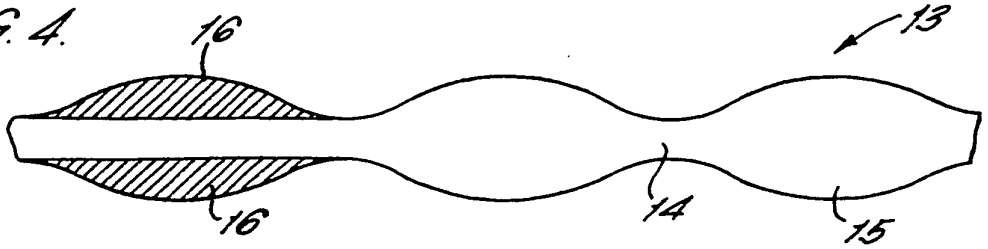


FIG. 5.

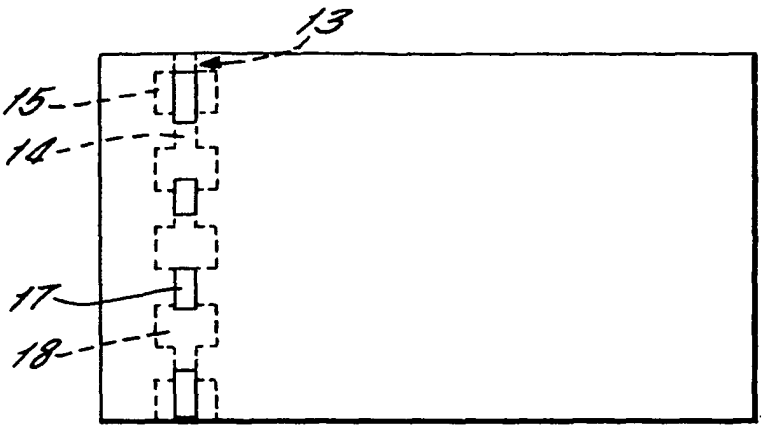


FIG. 6.

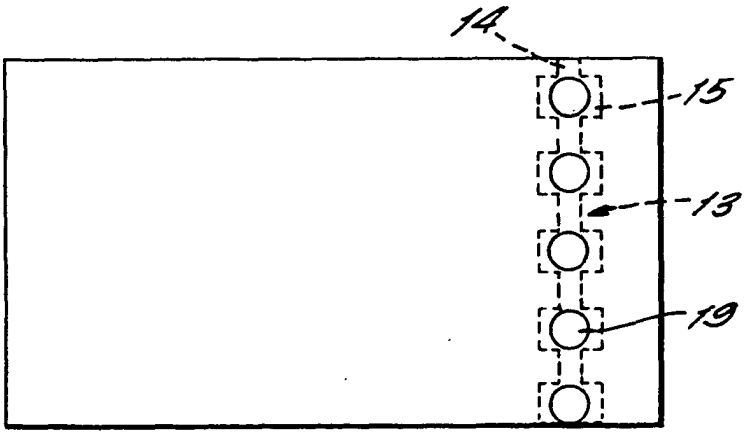
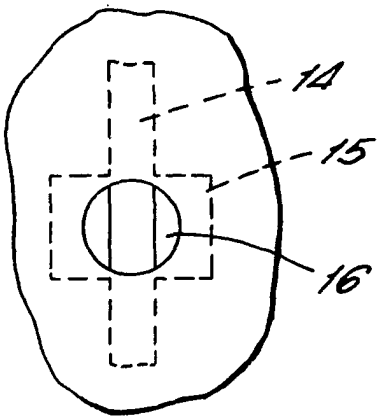


FIG. 7.



REFERENCES CITED IN THE DESCRIPTION

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