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(54) A strip for inclusion in a pulp during manufacture of a security paper

(57) A security fibre in the form of a small strip of paper (1; 51; 52) is suitable for incorporation into a paper product, for use in counterfeit protection. In example embodiments of the invention, the security fibre (1; 51; 52) comprises (i) a central region (2) made up of a plurality of different colours (21; 22; 23; 24), and (ii) a sacrificial margin (3; 31; 32; 33; 34) adjacent to the coloured region (2). The margin (3; 31; 32; 33; 34) includes a varnish. In example embodiments of the invention, the varnish alters the physical properties of the margin, for example by emitting light when illuminated with infra-red light, or by emitting light as a result of the anti-Stokes effect.

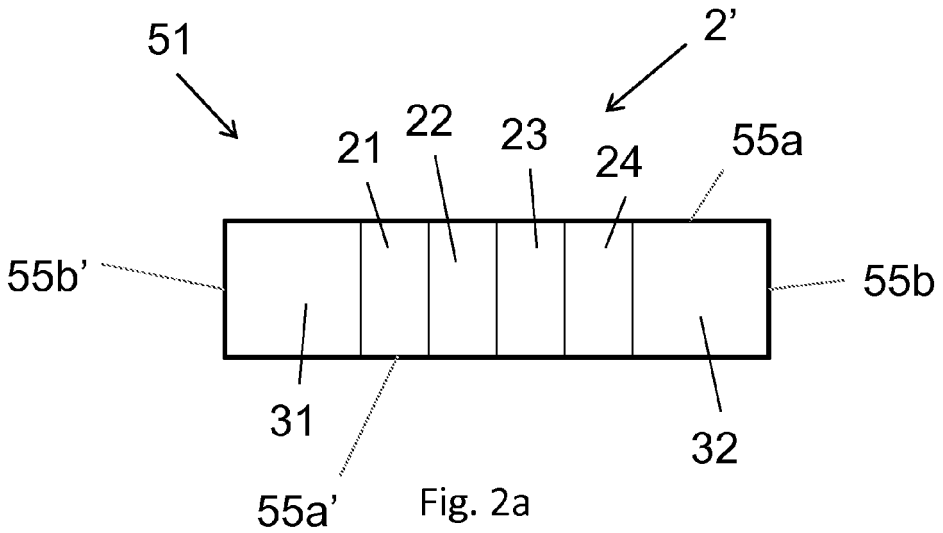

Fig. 2a

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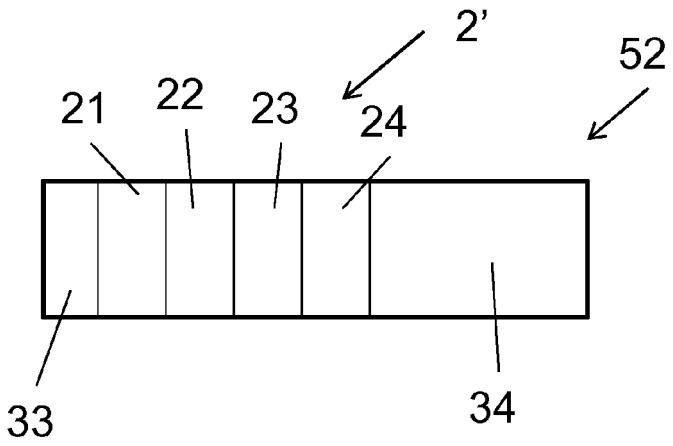


Fig. 2b

Description

[0001] The present invention relates to a strip for inclusion in a pulp during manufacture of a security paper, and to a method of manufacturing the strip, as well as to security paper including a plurality of the strips and a method of manufacturing the same. Such a strip is an example of a class of security features known as "security fibres", because they are incorporated into the security paper in the same way as are cellulose fibres, i.e. by inclusion in the pulp from which the paper is made. The invention relates in particular to a strip having a plurality of coloured fluorescent regions (for example stripes).

[0002] It is well known to provide security paper products, such as bank notes, cheques, passports, identity papers and fiduciary papers, with some form of counterfeit protection. The counterfeit protection measures may include watermarks, holograms, the provision of one or more metallic strips though the paper, the use of fluorescent particles and the use of optically variable inks and coatings. Problems with known counterfeit protection measures include the expense of some measures and the ease with which some measures can be overcome, for example by utilising methods including digital and laser printing, scanning, photography and xerography.

[0003] Security fibres are another example of a security feature that is incorporated into a security paper.

[0004] Paper is made from paper pulp, which contains cellulose fibres, for example wood, hemp, straw and cotton linters. A known security technique is to replace some of the cellulose fibres used to make a security paper with non-cellulose fibres, made from other materials, such as polyester, nylon and rayon, not usually used to make paper. A relatively small number of those non-cellulose fibres can be included in the paper pulp, along with a majority of cellulose fibres, which results in the security paper that is manufactured from the pulp having the non-cellulose fibres embedded within it and randomly distributed. The non-cellulose fibres can be dyed or coated, resulting in the paper including a random pattern of small coloured regions. The dye can be a fluorescent dye, so that the coloured random pattern is visible only under ultraviolet (UV) light.

[0005] Most prior-art non-cellulose fibres are indeed generally fibrous in shape - i.e. predominantly one-dimensional, rather than two-dimensional or sheet-like - like the cellulose fibres they replace. WO2004/025028A1 (D W Spinks (Embossing) Ltd) describes security features that are referred to as "fibres" because, like the non-cellulose fibres, they substitute for the cellulose fibres used in the manufacture of security paper, and because, in the manufactured paper, they give a visual impression that suggests that they are similar to such fibres. However, the paper fibres described in that document are small strips of paper, and are not fibrous in shape. (Note that, whilst cellulose fibres are used to make paper, they are not themselves made from paper).

[0006] Thus, security fibres in the form of small strips of paper, (for example, strips approximately 4mm x 0.3mm in size) can be added to the paper pulp during manufacture and become embedded in the sheets of security paper that are produced. The security fibres in the paper are often not distinguishable in daylight from the cellulose fibres in the paper, and remain unseen by the naked eye. However, when irradiated by ultra-violet light they become fluorescent and visible in the sheet of paper.

[0007] Fibres that fluoresce in a single colour are relatively easy and inexpensive to produce. However, counterfeiters have been able to use highlighter-type fluorescent marker pens to simulate mono-colour fibres in a sheet of paper. Invisible fluorescent inks are becoming widely available, and the ease of the counterfeiting process, making a few pen strokes on a sheet of paper, is reducing the effectiveness of single-colour fibres as a security device.

[0008] One solution is to make security fibres comprising different colour regions, which raises the difficulty and cost of producing counterfeit fibres. Such security fibres are described in detail in W02004/025028 A1. The "fibres" are intended for incorporation into paper products as a form of counterfeit protection. Each fibre has a plurality of regions on its front and rear, which under UV light fluoresce at different wavelengths, to give different colours in different regions. The regions may be in the form of stripes, or may be arranged in a pseudo-random pattern. The security fibres become much more difficult to simulate if the different colour regions are printed with a particular colour sequence, for example, the colours of a national flag.

[0009] Such security fibres are very small, for example, approximately 4mm x 0.3mm, as it has been found larger fibres or other larger types of security element are difficult to incorporate into the paper and are easily removed. Larger security fibres may be accidentally removed during the printing process, causing the paper to be rejected. This may be a particular problem when printing bank notes, which undergo several print processes using high pressure and high tack inks.

[0010] Note that strips that are classified as security fibres are different from the well-known security feature known as a security thread. Strips that are security fibres are much smaller than a security thread, and are scattered randomly in the pulp and hence in the security paper. Security threads are much larger, typically of a length comparable with the width or length of the security paper article in which they are incorporated (e.g. a banknote). Security threads typically have a specific orientation (i.e. usually parallel to a side of the security paper article). Also, a security paper article typically contains a larger number of security fibres (i.e. the small strips), for example more than 10, more than 20, more than 50 or more than 100, whereas a security paper article including a thread will typically include only a smaller number

of threads, for example fewer than 10, fewer than 5, 3, 2, or even only 1.

[0011] Producing such a small fibre with different colour regions, in particular different colour regions with distinct colour combinations in register with and in the same pattern as all of the other small fibres produced, is a highly difficult process. In the existing process, the pattern is printed on a large surface area of material and then small fibres are cut from the large surface area; however it is difficult to cut the fibres in perfect registration. Existing methods of high-volume cutting of material do not provide a means of registering the print with the cutter and many fibres are produced that do not have colours in register with each other. Existing methods do not allow the cutting to be controlled consistently within a tolerance between 0.125mm and 0.25mm which is believed to be the maximum tolerance for the colours in those fibres to appear to be equal in size and position.

[0012] The present invention seeks to mitigate or overcome one or more of the above-identified disadvantages associated with the prior art.

[0013] The invention provides, in a first aspect, a strip for incorporation in a pulp during manufacture of a security paper from the pulp, the strip having two opposing faces meeting each other at an edge or edges, at least one of the faces having an image having at least one fluorescent colour that is visible only under ultraviolet illumination, CHARACTERISED IN THAT the strip further comprises a margin, between the image and at least a portion of the edge or edges, that does not fluoresce under ultraviolet illumination, and in that the margin has a varnish.

[0014] It may be that only the margin has the varnish, and the part of the strip with the image does not. That may be particularly advantageous for example when the fibre includes a diagnostic reagent to detect contact with chemicals used in falsification of security papers; in that case, provision of the varnish in the margin only leaves the part of the strip bearing the image unvarnished, in order that access to the diagnostic reagent is not impeded. Provision of the varnish in the margin region only can nevertheless improve adhesion of the strip in the security paper.

[0015] Alternatively, the varnish may cover the whole of one or both faces of the strip.

[0016] The varnish in the margin may contain an adhesion promoter, which improves the adhesion of the strip in the security paper.

[0017] The varnish in the margin may contain an optical-property modifier, which alters an optical property, for example a spectroscopic property, of the varnish. The optical property modifier may for example cause the varnish to emit light of a first wavelength range when illuminate by light of a second, different and separate, wavelength range. It may be that the optical property modifier is a pigment or a dye. The pigment or dye may be a pigment or dye that emits light, which may be visible light, when illuminated with infra-red radiation (such a pigment or dye may be referred to as an IR up-converter). Advantageously, in that case, the pigment or dye does not emit visible light when illuminated with UV light (whether long- or short-wave UV). Especially when the varnish does not emit visible light under UV illumination, the IR response of the varnish can be a forensic verification feature, additional to that provided by the UV fluorescent image, in the security paper; when it emits light under IR illumination only, it provides a verification feature of which the counterfeiter is unlikely to be aware.

[0018] Use of a varnish containing an IR up-converter can provide another useful property. Security documents containing a UV security feature are normally made from paper that is 'optically dull' - i.e. paper that does not contain optical brightening agents (OBAs), which are used in papers to make them look whiter under visible light- because, otherwise, the UV fluorescence of the security feature is made less distinctive by the UV response of the OBAs. Because it is relatively unusual, making paper without OBAs adds to the cost of the paper used in security documents. When the strip has a varnish including an IR up-converter, the need for paper without OBAs is eliminated, as the strips are easily detectable even in papers with very high background fluorescence. Thus, advantageously, in some example embodiments of the present invention, the strips exhibit both fluorescence under UV light and emissions due to IR up-conversion, enabling use of the same kind of strip in both optically bright and optically dull security papers.

[0019] The optical property modifier may be a pigment or dye that emits light, which may be visible light, as a result of the anti-Stokes effect.

[0020] Advantageously, the margin acts to provide a margin of error when producing the fibre. The strip may be cut from a substrate, for example a sheet of paper, such that the cutting takes place in the margin. Some inaccuracy during the cutting process can thus be tolerated, as long as it does not affect the appearance of the image.

[0021] The strip is of a size suitable for incorporation in the pulp from which the security paper is formed. As discussed above, the strips may be referred to as fibres, as they effectively replace some of the cellulose fibres that form the paper pulp. Optionally, the strip is between 3.5mm and 9mm in length, and between 0.2mm and 6mm in width. Optionally, the security fibre is at most 5mm, 6mm, or 7mm long with a central region of at most 3mm, 4mm, or 5mm long, respectively. However, it is clear that the invention can be applied such that a longer or wider security fibre is produced, although excessively large fibres are undesirable, as they can "pick out" from the security paper. The dimensions of the coloured region and the margin or margins may be increased correspondingly proportionally.

[0022] The strip may be made of paper. Optionally, the paper has a basis weight of between 10 gsm and 75 gsm. Preferably, the paper has a basis weight of between 10 gsm and 35 gsm; according to American Paper Weights and Measures, tissue paper has a basis weight of between 10 gsm and 35 gsm, and thus the sheet may be a sheet of tissue

paper. Optionally, the paper has a wet tensile strength of at least 1 N/15mm, more preferably at least 3 N/15mm. Optionally, the paper has a wet tensile strength of less than 15 N/15mm, preferably less than 7 N/15mm. Optionally, the wet tensile strength of the paper including any print, varnishes, or other material which increases the wet tensile strength relative to that of the paper itself is at least 1 N/15mm, more preferably at least 3 N/15mm. Preferably, the wet tensile strength of the paper including any print, varnishes, or other material which increases the wet tensile strength relative to that of the paper itself is less than 15 N/15mm, preferably less than 7 N/15mm.

[0023] Optionally, the paper has a dry tensile strength of about 5 daN/30mm. Optionally, the paper has an opacity of up to 90% or more, or alternatively may be transparent.

[0024] Alternatively, the strip may be a non-paper strip.

[0025] The strip may be rectangular. The margin may extend at least partially, more preferably fully, along one or both of the short edges of the rectangle. The margin may extend at least partially, more preferably fully, along one or both of the long edges of the rectangle.

[0026] The image may be distinguishable by the naked eye only under ultra-violet light. Providing a central region that is visible only under ultra-violet light enables counterfeit protection which is not visible with the naked eye to be added to paper. The image may have at least one colour that is visible under visible light. It may be that at least part, or all, of the image changes colour when illuminated by visible light, on the one hand, and ultraviolet light, on the other hand.

[0027] It may be that the image is on both faces of the strip. The margin may be transparent.

[0028] The strip may comprise a transparent substrate, for example transparent paper. When using a transparent substrate, it may be that the image is formed on one side only of the substrate, but is visible through the substrate from the other side. The substrate may be made transparent by applying a varnish to it; thus, a varnish may be applied to the substrate, and then the image formed on top of the varnish.

[0029] The margin may completely surround the image. The margin may be, for example, 0.5mm to 2 mm, 3 mm or even 5mm wide.

[0030] Preferably, the image is located approximately at the centre of a rectangular strip, with the margin extending fully along each short edge of the strip.

[0031] The image may comprise a plurality of different colours under UV illumination, which may for example be coloured stripes. There may for example be two, three, four or more stripes in the image. The said stripes may include for example, any or all of the colours red, green, yellow, and blue. The stripes may be placed at approximately 1mm graduations. The stripes may appear in the same order, i.e. in a repeating pattern. Advantageously, the stripes appearing in the same order in a repeating pattern makes it more difficult to forge the strip. The image may be rectangular in shape. It may be that the image measures between 3mm and 5mm in length. It may be that the image measures 0.2mm to 1mm in width. The image may comprise a more complex pattern than stripes. For example, the image may comprise a two dimensional pattern. The image may be a representation of a flag, and/or a combination of numbers and/or letters or some other recognisable shape.

[0032] The invention provides, in a second aspect, a method of manufacturing a strip for incorporation into a pulp during manufacture of a security paper from the pulp, the method comprising the steps of

applying an ink to a substrate sheet to form a plurality of images, separate from each other, and each having at least one fluorescent colour that is visible only under ultraviolet radiation,

applying a varnish, that does not fluoresce under ultraviolet illumination, to the areas of the substrate sheet between the images, and

cutting the substrate sheet between adjacent images to create a plurality of strips, each strip having two opposing faces meeting at an edge and including at least one of the images upon at least one of the faces, and wherein the areas of the varnished substrate sheet between the images form in each strip a margin, between the image and at least a portion of the edge or edges, that does not fluoresce under ultraviolet illumination.

[0033] It may be that the varnish is also applied on top of the image or to the substrate sheet where the image is to be formed (i.e. so that it is underneath the image).

[0034] Advantageously, the margin increases, in comparison with a margin-less fibre, the margin of error permitted during the cutting process without the appearance of the images being affected.

[0035] The images may each comprise a series of rows that are coloured under UV illumination. Each image may comprise a plurality of such coloured areas arranged side-by-side. Each image may comprise a plurality of such coloured areas forming stripes.

[0036] The method may include the step of applying the ink by printing. The printing may comprise printing on one side of the substrate sheet and allowing the ink to soak through to the other side of the substrate sheet, to provide pigments on both the sides of the substrate.

[0037] The printing may comprise individually printing ink on one side of the substrate sheet and printing ink on the other side of the substrate sheet, to provide pigments on both sides of the substrate.

[0038] The substrate sheet may be a sheet of paper. Alternatively, the substrate may comprise a non-natural polymer or cellulose-based substrate.

[0039] Providing, on the one hand, the varnish in the margin and, on the other hand, an area of the strip having an image and optionally the varnish can affect the shape of the strip. For example, it may create a corrugation effect due to the raised level of the coloured regions once ink has been printed on the substrate to form the image, such that when one such piece of substrate is stacked on top of another such piece of substrate, the sheets fall into a natural alignment. Preferably, several sheets of substrate are stacked on top of each other and are cut simultaneously. The stack of sheets of substrate to be cut may be between 10mm and 20mm high. The natural alignment of the sheets of substrate, together with the cutting taking place within the margins, allows the cutting process to deviate, for example, by up to 1mm without any affect on the appearance of the image on each strip. The image may for example be, and appear to be, 4mm long and in the correct red, green, blue, and yellow proportion, despite the variance in the cutting of the strip. The cuts may produce a paper fibre with for example a length between 3.5mm and 9mm, and a width between 0.1 and 0.5mm.

[0040] The cuts may be made with a knife arranged to cut the substrate both in at least one margin and across a coloured region simultaneously. Preferably, the knife is arranged to cut the substrate with a single cut in order to produce the security fibres. Preferably, the knife comprises a crenellated blade.

[0041] The invention provides, in a third aspect, a method of manufacturing a paper product, the method comprising the steps of:

mixing one or more strips according to the first aspect of the invention or one or more strips manufactured using the method of the second aspect of the invention with slurry paper pulp such that the strips form a bond with cellulose fibres in the paper pulp; and
forming the mixture comprising the paper pulp and strips into a continuous web of paper.

[0042] The strips may be randomly distributed in the web of paper.

[0043] The invention provides, in a fourth aspect, a security paper product containing a plurality of strips as according to the first aspect of the invention or manufactured using the method of the second aspect of the invention.

[0044] Preferably, the strips are randomly distributed throughout the security paper product.

[0045] Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings of which:

Figure 1 is a schematic drawing of an example of a strip of paper printed according to an embodiment of the invention;
Figures 2a and 2b are a schematic drawing of an example of the security fibres according to an embodiment of the invention;
Figure 3 is a schematic view of an example security paper according to a embodiment of the invention, illuminated by (a) visible light; and (b) UV light;
Figure 4 is a flowchart showing steps in the manufacture of the example security fibre of Fig. 2;
Figure 5 is a flowchart showing steps in the manufacture of the example security paper of Fig. 3; and
Figure 6 is a schematic drawing of an example of a knife blade used to cut the security fibres.

[0046] Figure 1 shows a substrate 1, onto which three images in the form of three coloured regions 2 have been printed. The coloured regions 2 have been printed with inks containing pigments that fluoresce, so that their bright colours are visible only when viewed under ultra-violet light. The coloured regions 2 are generally rectangular in shape and are each made up of four different coloured fluorescent stripes, 21, 22, 23, and 24, printed side by side. The four different coloured stripes 21, 22, 23, and 24. The colours in this example are red, green, yellow, and blue. In one embodiment, the colours are visible when the substrate is illuminated with ultra-violet light having a wavelength of between 245nm and 365nm.

[0047] In this embodiment of the invention, the coloured regions 2 are visible on both sides of the substrate 1. In this case, the substrate 1 is a thin and porous paper and printing on a single side of the substrate 1 with an appropriate amount of ink results in the ink soaking through the substrate 1. (In an alternative embodiment, each side of the substrate 1 is printed individually, such that the coloured regions 2 on each side of the paper line up in register with each other.)

[0048] In between each adjacent pair of coloured regions 2, and separating the coloured regions 2 from each other, there is a separating region 3 (which will become a margin in the finished strip). The separating regions do not fluoresce under ultra-violet light. In the example shown in Fig. 1, the separating regions 3 are areas of the substrate 1 that have been coated with a varnish containing a pigment that emits visible light when illuminated with infra-red light.

[0049] The printing of the coloured regions 2 and the separation regions 3 being varnished creates a slight but significant corrugation effect. The corrugation effect can advantageously be used when stacking several sheets of similarly printed substrate 1, as it brings the sheets substrate 1 into natural alignment with each other. The cutting of the substrate 1 can then advantageously be performed with several sheets of substrate on top of each other, thus saving time and effort.

[0050] Figure 1 also shows, with dashed lines, the planned cut lines 4. In Figure 1, only the cut lines parallel to separating regions are shown, in order to best demonstrate the advantages of the invention.

[0051] Figure 6 shows the cutting outline of a knife which is designed to cut the substrate 1 in such a way that a single cutting step can produce rectangular security fibres. The knife comprises a blade with a crenellated cutting edge. The size of the crenulations corresponds to the size of the strips to be produced. The knife is brought down onto the stack of the sheets of substrate, thus cutting out a plurality of rectangular strips. The sections of the knife blade that are designed to cut along the cut lines 4 shown as parts 41, and the sections of the knife blade that cut across the coloured regions 2 are marked 42. The knife or the sheets of substrate is then moved (in the direction parallel to the length of each stripe 21, 22, 23, 24 i.e. up or down the page in Fig.1) and a further cut made, thus creating more strips.

[0052] Due to the separating regions 3 between the coloured regions 2, minor deviations of the cutting from the planned cut lines 4 can be tolerated without affecting the shape, size and appearance of the images, i.e. coloured regions 2.

[0053] The substrate 1 from which the strips are produced in this example embodiment of the invention is a tissue or thin paper without optical brighteners. The optimum paper is a high porosity, high wet strength tissue paper with a nominal basis weight of 25 grams per square metre.

[0054] Strips in accordance with the present invention could for example be manufactured using paper having the properties listed below. These properties have been developed with the intention of providing a fibre that works well, but are only one example. Other papers could be used.

Properties	**Units**	Minimum	Maximum	Average
Substance	g/m^2	15	45	24.8
Lemm Capillary Climb md	mm	16	17	16.6
Wet Tensile Strength	N/15mm	4.5	5.9	5.14
Bulk	Cm^3/g	2.4	2.5	2.46
High Porosity	$1/mn/100cm^2$	24	31.2	27.9
Humidity pH of aqueous extract	%	4.9	7.0	6.8

[0055] In addition, the target Bensten porosity (defined by ISO standard 5636/3) is 1500ml/mm, the minimum Bensten values is 700 ml/mm.

[0056] As described, for the embodiment of the invention as shown in Figure 1, four different colour stripes are printed in the coloured regions 2. Suitable products for the printing process have been developed from commercially available pigments. Each of the red, green, yellow, and blue prints has a Blue Wool lightfastness of 3, an excitation wavelength in the region of 365nm and good chemical resistance.

[0057] Figure 2a shows a paper strip 51 which has been cut out in accordance with the planned cut lines 4 (and also in the direction perpendicular to the cut lines 4 as described above, such that a thin, approximately rectangular strip has been produced).

[0058] The security fibre 51 is in the form of a strip comprising two opposing faces meeting at four edges 55a, 55b, 55a', 55b'. In this example, the coloured regions 2 on the substrate 1 have formed on both faces of the strip a central coloured region 2' including the pattern of four different colours. The separating regions 3 in the substrate 1 have formed approximately equal margins 31, 32 between the image (coloured region 2) and the edges, in particular the short edges 55b', 55b of the strip, in this example. The varnish applied to separating regions 3 in the substrate is retained in margins 31, 32 in the fibre 51, providing the margins 31, 32 with altered optical properties.

[0059] The security fibre 51 is approximately 5mm x 0.3mm, the coloured region being approximately 3mm long. The coloured central region 2' is approximately in the centre of the paper fibre 51. The margins 31 and 32 are approximately 1mm long each. Figure 2b shows a security fibre 52, with approximately the same dimensions as the security fibre 51, which has been cut out with a deviation from the planned cut lines 4 due to the cutting machine tolerances. The coloured central region 2' is located towards the left hand side of the paper fibre 52 as seen on the figure. The coloured central region 2' is located between two margins 33 and 34, although the margin 33 is smaller than the margin 34. However, despite the inaccuracy of the cutting process, when viewed under ultra-violet light, the coloured central region 2' in security fibre 51 and security fibre 52 will appear to be identical.

[0060] The fibres 51, 52 are incorporated into paper pulp used to manufacture a security paper, in this example a banknote 50 (Fig. 3). Under visible light (Fig. 3(a)), the fibres 51, 52 are unremarkable, blending in with other, cellulose, fibres that make up the paper of the banknote 50. However, under long-wavelength UV light, the fibres 51, 52 fluoresce, forming a random pattern of multicolour markings in the banknote 50 (shown schematically for ease of illustration by the dotted pattern in Fig. 3(b)). Thus a UV light is used for a check of the validity of the security paper, e.g. in a shop, or by a bank teller.

[0061] Fibres 51, 52 are manufactured by the process shown in Fig. 4. Paper is drawn from a roll in a paper store 60 and passed to a printing machine 70. Printing machine 70 includes ink reservoirs 80 (a) to (e), which contain four inks containing pigments that fluorescent in different colours when illuminated with UV light, and also the varnish. The printing machine prints regions 21, 22, 23, 24 onto the paper to form multiple images across the paper substrate 1. The varnish is then applied to the separating regions 3 between the coloured regions. The printed paper substrate passes to cutting machine 90, where it is cut into strips, i.e. fibres 51, 52. The cut fibres 51, 52 are deposited into a bin 100 for transport to a paper mill.

[0062] At the paper mill, the banknote of Fig. 3 is manufactured by the method shown in Fig 5. Security fibres 51, 52, produced by the method of Fig. 4, are drawn from store 110 and mixed with water and conventional cellulose fibres (from a second store 120) to form a pulp 130. A paper making machine 140 manufactures paper from pulp 130 using conventional methods. At step 150, further processing of the paper takes place, including printing of standard images and the like. The manufactured and printed paper is then cut (step 160) to form the paper product 170, in this case, banknotes.

[0063] Thus, paper products in accordance with the present invention are made by including strips according to the invention in the slurry paper pulp. The strips of the present invention bond with the cellulose fibres in the paper pulp, and when the pulp is formed into a continuous web of paper, the strips in the pulp become an integral part of the web or sheet of paper. The coloured regions of the strips can only be seen under ultra-violet light, thereby providing a security feature that cannot be seen in normal light conditions. When illuminated with infra-red light, the varnish in the margins 31,32,33,34 emits visible light, providing a further security check.

[0064] Where in the foregoing description, integers or elements are mentioned which have known, obvious or foreseeable equivalents, then such equivalents are herein incorporated as if individually set forth. For example, the substrate may be a non-natural polymer or cellulose-based material. The coloured region may comprise a more complex pattern than stripes, for example, a two-dimensional pattern or a combination of numbers and/or letters. The coloured region may be a representation of a flag or other recognisable image.

[0065] Reference should be made to the claims for determining the true scope of the present invention, which should be construed so as to encompass any such equivalents. It will also be appreciated by the reader that integers or features of the invention that are described as preferable, advantageous, convenient or the like are optional and do not limit the scope of the independent claims.

Claims

1. A strip for incorporation in a pulp during manufacture of a security paper from the pulp, the strip having two opposing faces meeting each other at an edge or edges, at least one of the faces having an image having at least one fluorescent colour that is visible only under ultraviolet illumination, **CHARACTERISED IN THAT** the strip further comprises a margin, between the image and at least a portion of the edge or edges, that does not fluoresce under ultraviolet illumination, and **in that** the margin has a varnish.

2. A strip as claimed in claim 1, in which the varnish in the margin contains an adhesion promoter, which improves the adhesion of the strip in the paper.

3. A strip as claimed in claim 1 or claim 2, in which the varnish in the margin contains an optical-property modifier.

4. A strip as claimed in claim 3, in which the optical-property modifier is a pigment or dye that emits light when illuminated with infra-red radiation.

5. A strip as claimed in claim 3 or claim 4, in which the optical-property modifier is a pigment or dye that emits light as a result of the anti-Stokes effect.

6. A strip as claimed in any preceding claim that is between 3.5mm and 9mm in length, and between 0.2mm and 6mm in width.

7. A strip as claimed in any preceding claim, which is a paper strip.

8. A strip as claimed in any preceding claim, which is rectangular.

9. A strip as claimed in claim 8, in which the margin extends at least partially along the short edges of the rectangle and/or at least partially along the long edges of the rectangle.

10. A strip as claimed in any preceding claim, in which the image is distinguishable by the naked eye only under ultraviolet light.

11. A method of manufacturing a strip for incorporation into a pulp during manufacture of a security paper from the pulp, the method comprising the steps of
applying an ink to a substrate sheet to form a plurality of images, separate from each other, and each having at least one fluorescent colour that is visible only under ultraviolet radiation,
applying a varnish, that does not fluoresce under ultraviolet illumination, to the areas of the substrate sheet between the images, and
cutting the substrate sheet between adjacent images to create a plurality of strips, each strip having two opposing faces meeting at an edge and including at least one of the images upon at least one of the faces, and wherein the areas of the varnished substrate sheet between the images form in each strip a margin, between the image and at least a portion of the edge or edges, that does not fluoresce under ultraviolet illumination.

12. A method of manufacturing a paper product, the method comprising the steps of:

mixing one or more strips according to the first aspect of the invention or one or more strips manufactured using the method of the second aspect of the invention with slurry paper pulp such that the strips form a hydrogen bond with cellulose fibres in the paper pulp; and
forming the paper pulp and strips mix into a continuous web of paper.

13. A security paper product containing a plurality of strips as according to the first aspect of the invention or manufactured using the method of the second aspect of the invention.

14. A security paper product as claimed in claim 13, containing an optical brightening agent.

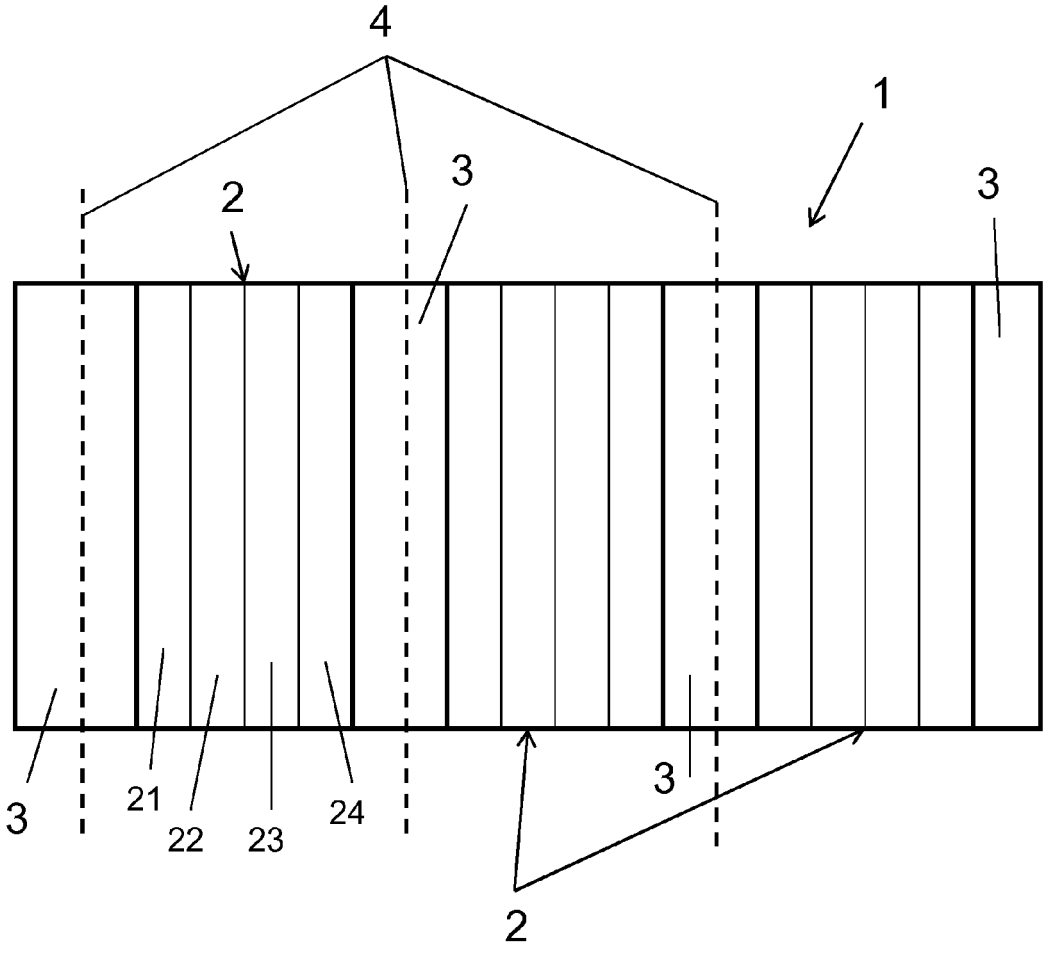


Fig. 1

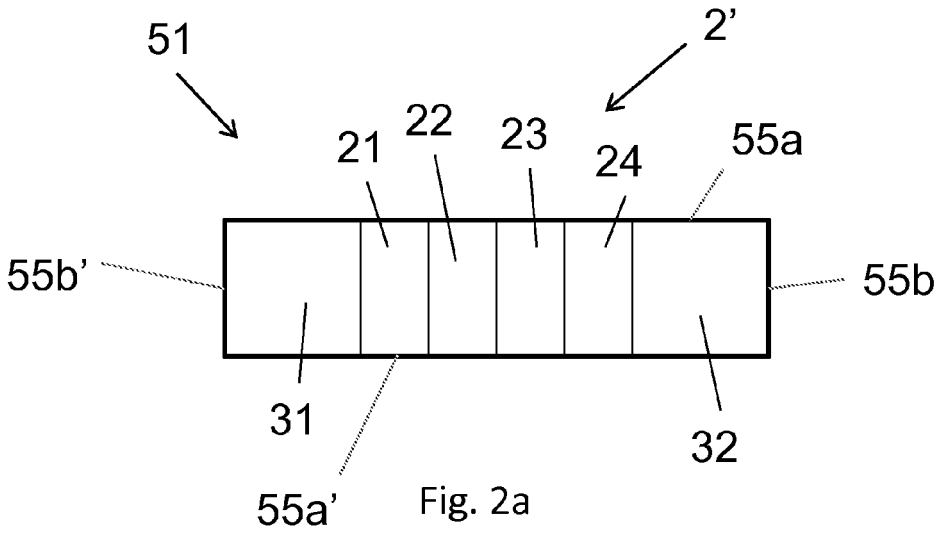


Fig. 2a

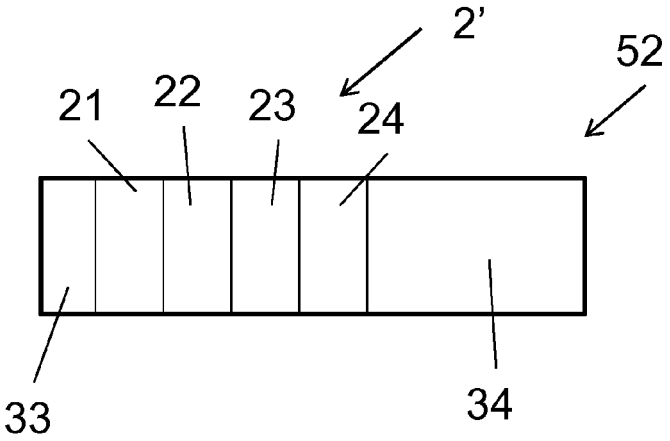
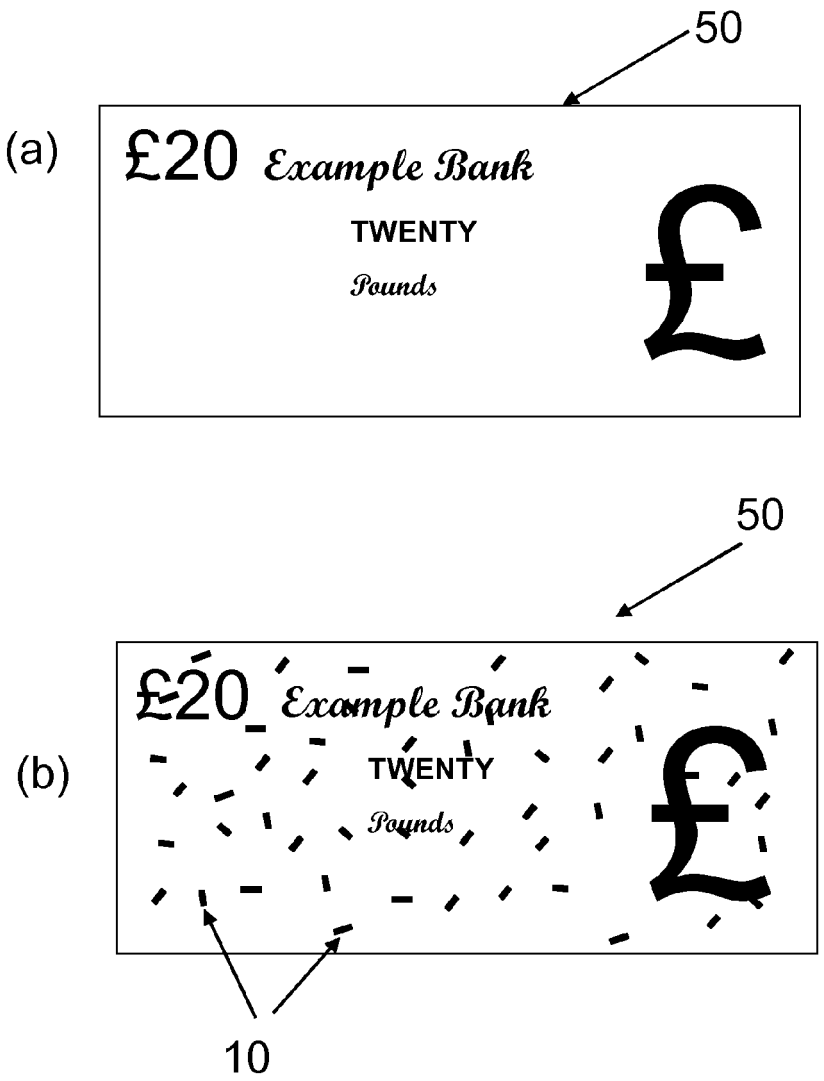


Fig. 2b

Figure 3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TWENTY
Pounds
£
50
(b)
£20 Example Bank
TWENTY
Pounds
£
10

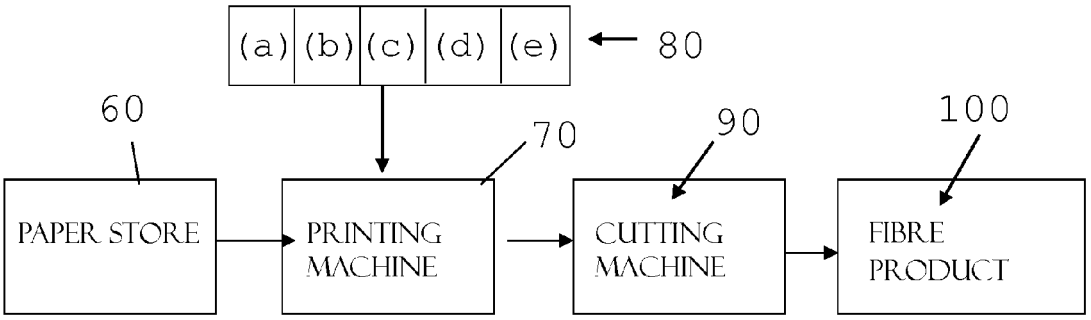

Figure 4

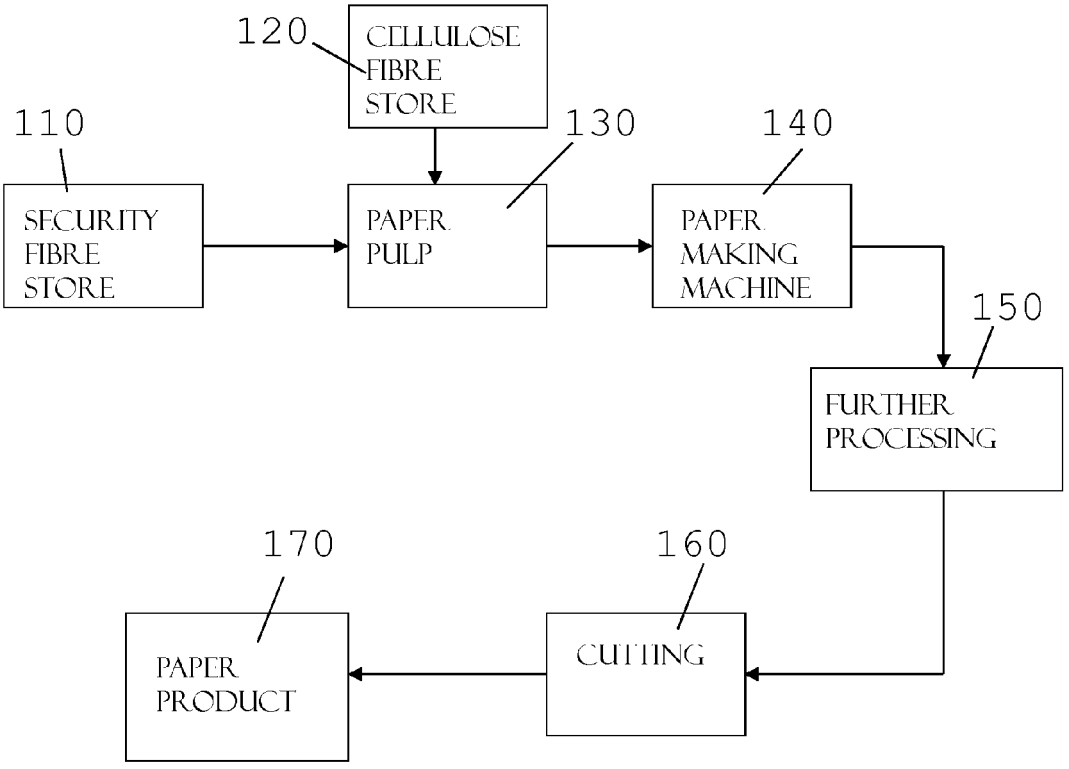

Figure 5

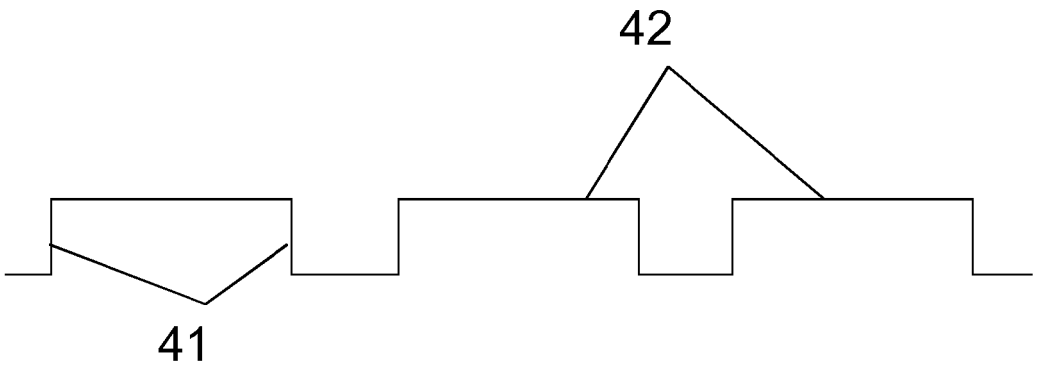

Fig. 6

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Place of search	Date of completion of the search	Examiner
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