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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
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Act. 444 RESPUESTAREQUE Folios: 123

Señor
SUPERINTENDENTE DE INDUSTRIA Y COMERCIO
SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
Ciudad

REFERENCIA:	**Expediente No. 15-261438**
TÍTULO:	**"PROCEDIMIENTO PARA PROPORCIONAR UNA CARACTERÍSTICA DE SEGURDIAD A UN DOCUMENTO DE SEGURIDAD Y EL DOCUMENTO DE SEGURIDAD"**
SOLICITANTE:	**FÁBRICA NACIONAL DE MONEDA Y TIMBRE – REAL CASA DE LA MODENA**
TRÁMITE:	**RESPUESTA A REQUERIMIENTO DE FORMA OFICIO N°13932**

JAIME EDUARDO DELGADO VILLEGAS, en mi condición de apoderado de la sociedad **FÁBRICA NACIONAL DE MONEDA Y TIMBRE – REAL CASA DE LA MODENA,** dentro del término legal y luego de haber solicitado prórroga para dar respuesta al oficio de la referencia, presento respuesta a la acción oficial notificada mediante el oficio No. **13932 del 01 de diciembre de 2015**, en los siguientes términos:

Capítulo del PCT

- Debe aclarar si esta es una solicitud PCT Capítulo I o Capítulo II.

En respuesta a este requerimiento, nos permitimos aclarar que la presente solicitud es una solicitud capítulo II y se presenta nuevo petitorio donde se ha efectuado la precisión pertinente

Pago de tasas oficiales

- Teniendo en cuenta que el capítulo reivindicatorio presentado excede diez reivindicaciones, es necesario que el solicitante cancele la tasa establecida por

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cada reivindicación adicional presentada, de conformidad con lo dispuesto en la resolución de tasas vigente para la fecha de presentación de la solicitud, so pena de que no sean tenidas en cuenta dentro del presente trámite administrativo. En este caso particular quiero aclarar a su Despacho que se realizó solamente el pago de 6 reivindicaciones, debido a que junto con la solicitud se realizó y pago la modificación al capítulo reivindicatorio quedando en total 16 reivindicaciones.

Teniendo en cuenta lo anterior y debido a que junto con esta contestación se agrega una reivindicación, es decir el capítulo reivindicatorio ahora comprende 17 reivindicaciones me permito adjuntar el recibo de pago No. 16 -005082 por valor de $40.000 correspondiente a la 7 reivindicación adicional.

REIVINDICACIONES DE USO

- Las reivindicaciones 12 y 13 se refieren a un uso y por tanto, no son patentables.

Las reivindicaciones 12 y 13 han sido modificadas, en el caso de la reivindicación 12, se ha definido que dicho marcado (3) detectable es una característica de personalización. Esta modificación está soportada por la descripción, página 20, línea 28-33 y página 32, línea 19-29.

En el caso de la reivindicación 13, se ha definido que dicho marcado (3) una característica de identificación. Esta modificación está soportada por la descripción: página 32, línea 19-29.

Se ruega, por tanto, sea reconsiderada y retirada esta objeción.

REIVINDICACIONES

- La reivindicación 1 es visiblemente un proceso, pero no se caracteriza por una secuencia de etapas técnicas que trasforman una serie de materias primas en un nuevo producto o resultado de estas.

- Las reivindicaciones 1, 3, 10 y 13 incluyen los fragmentos: "de modo que altere

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dicho material (22), de modo que proporcione a dicho elemento (2) de seguridad..." (reiv. 1), "de modo que sublime sustancialmente al menos parte de dicho material (22), de modo que le proporcione a dicho elemento de seguridad dicho marcado (3) detectable" (reiv. 3), "es visible por transmisión, pero no por reflexión" (reiv. 10) y "para identificar un propietario del documento de (1) de seguridad" (reiv. 13) sugieren un resultado a alcanzar y no definen al producto y/o método, puesto que la reivindicación incluiría no sólo la solución propuesta por el solicitante, sino todas las alternativas presentes o futuras que lleguen a ese resultado. Se sugiere reemplazarlo por las características esenciales estructurales, que contribuyen a la obtención de ese efecto.

- La reivindicación 4 y 5 incluyen los fragmentos: "material conductor" y "material metálico", "partículas metálicas", que son términos generales. Se sugiere hacer la corrección necesaria especificando los materiales. Igualmente sucede con la reivindicación 6 donde se menciona que "el material sensible a la luz", lo cual es general y no define características de forma específica.

- Incluyen el término "al menos" es relativo por lo cual no permite distinguir la invención del estado de la técnica. Se sugiere sustituirlo por un término o rango concreto.

- Incluyen el término: "sustancialmente", que es impreciso, por lo cual no permite distinguir la invención del estado de la técnica. Se sugiere sustituirlo por un término preciso o un rango concreto.

- Incluyen la expresión: "preferentemente", precediendo una característica no es limitativo, porque hace opcional a la característica y no limita el alcance de la reivindicación. Se sugiere incluir las características opcionales o preferentes en una reivindicación dependiente.

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- La reivindicación 10 y 12 indican el uso que puede darse a los detectores magnéticos y al marcado detectable respectivamente, el cual no es una característica técnica que defina a la invención. Para el primero se sugiere eliminarlo o sustituirlo por un término tal como "por medio" y para el segundo retirarlo del pliego ya que no aporta una característica técnica particular adicional al procedimiento reclamado.

- La reivindicación 16 realiza una combinación de categorías de reivindicación, lo cual no es permitido. El documento que se reclama debe ser caracterizado por las características estructurales que posee.

En procura de superar las objeciones planteadas por ese Despacho y siguiendo las sugerencias del examinador, el solicitante presenta nuevo capítulo reivindicatorio que consta de 17 reivindicaciones y en el cual se han efectuado las siguientes modificaciones:

- La **reivindicación 1 ha sido modificada** para definir más claramente "la serie o sucesión de operaciones" del procedimiento de la invención por el cual partiendo de un documento de seguridad (=esa *materia sólida, liquida o gaseosa* que menciona Otero Lastres) que tiene unas características estructurales definidas (a saber: el documento (1) de seguridad tiene un sustrato (11) del documento, que es un sustrato de papel, y teniendo también el documento (1) de seguridad un elemento (2) de seguridad embebido en dicho sustrato (11) del documento, teniendo el elemento de seguridad un material (22) sensible a la luz láser), se proporciona un marcado detectable (=una característica de seguridad, que es *la cosa o resultado obtenido*, también según Otero Lastres) mediante la etapa de dirigir luz láser sobre el sustrato del documento alternado ese material sensible a la luz.

- Las **reivindicaciones 1, 3, 10 y 13** han sido objetadas por el Examinador por definir resultados a alcanzar y/o funcionalidades. Al respecto el solicitante ha modificado las reivindicaciones para más claramente definir en qué consiste cada etapa:

  - **Reiv. 1:** como se expuso en el punto anterior.

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- **Reiv. 3:** ahora define que la etapa de dirigir la luz láser sobre el sustrato del documento se realiza sublimando al menos parte del material sensible a la luz láser.
- **Reiv. 10:** se ha modificado según lo sugerido por el Examinador y ahora define que el marcado de seguridad detectable puede detectarse por medio de detectores magnéticos.
- **Reiv. 13:** ahora define que la etapa de dirigir la luz láser sobre el sustrato del documento se realiza sublimando al menos parte del material sensible a la luz láser.

Respecto al término *'visible por transmisión, pero no por reflexión'* el experto en la materia conoce la diferencia entre un marcado que es visible por transmisión, pero no lo es por reflexión, y sabe cómo obtener tal marcado. Véase, por ejemplo, la solicitud de patente europea publicada EP-2692539-A1 (de la cual se aporta traducción completa al castellano), en la que se explica cómo se consigue, mediante unos elementos celulósicos tratado térmicamente por láser (en forma de banda, tira o cinta), sean visibles por reflexión pero no por transmisión (cf. pár. [0025]). O véase también, por ej., la solicitud de patente británica publicada GB- 2433469-A, en la que también se muestra cómo incorporando una cinta de fibra con agujeros o perforaciones en un sustrato fibroso (tal como papel), éste sustrato tiene un aspecto diferente cuando se ve en reflexión que cuando se ve en transmisión (cf. pág. 1, lín. 3-11 y 17-22). Se aporta también copia del boletín nº 12, volumen 21 de diciembre de 2015 de noticias relacionadas con autenticación (*Volume 21 - No. 12, Authentication News, December 2015*), en cuya pág. 2, párrafo 2 se describe el efecto de visualización por reflexión (con un efecto) y por transmisión (con el efecto contrario) aplicado a marcas de agua en papel.

Adicionalmente, el solicitante desea indicar que las **características de tipo funcional** están explícitamente aceptadas en la Guía de Examen de Patentes de Colombia, en la sección 2.6.5.4 y también en la sección 2.6.5.15.

- **Reivindicación 4:** el solicitante desea indicar que los términos 'metálico' y 'conductor', si bien se trata de términos generales, esto no quiere decir que no sean aceptables pues tienen un significado claro y preciso, tal y como se puede apreciar en el diccionario de la RAE. Además, en la descripción (pág. 11, línea 1 a pág. 12, línea 22) queda claro su significado y lo que definen.

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En relación con esta objeción el solicitante hace alusión al ejemplo del punto 4.1.13, pág. 210 (Guía de Examen de Patentes), en el que se menciona '*un material permeable al vapor*'.

Respetuosamente se hace un llamado al examinador sobre el hecho que un término con un significado amplio no quiere decir que dicho término no se claro. Cualquier persona versada en la materia está en la capacidad de establecer si un

- **Reivindicación 5:** el solicitante desea indicar que la frase *'en el que dicho material está en forma de partículas metálicas'* es un término con una definición claro y aceptable: el material no está en cualquier forma, sino que está en forma de partículas, y no son unas partículas cualesquiera, sino que son partículas metálicas, es decir, hechas de metal (no de plástico). Además, en la descripción (pág. pág. 17, lín. 8-25) queda claro su significado.

  En relación con esta objeción el solicitante también desea señalar el ejemplo del punto 4.1.13, pág. 211 (Guía de Examen de Patentes), en el que se menciona explícitamente el término '*particulado*'.

- **Reivindicación 6:** el solicitante desea señalar que el término *'material sensible a la luz láser'* es un término que es claro y preciso, y que el experto en la materia sabe qué material es sensible a la luz láser y cuál no lo es.

  También se desea señalar el ejemplo del punto 5.2.2, pág. 228 (Guía de Examen de Patentes) en el que se usa la terminología *'sensible a'*.

- El Examinador objeta la expresión **'al menos'**. Respecto a esta objeción de falta de claridad, muy respetuosamente se indica al Examinador que se trata de expresiones claras:

  El término "al menos X" no consideramos que sea impreciso o que no permita una comparación con el estado de la técnica. Es un término amplio que significa lo mismo que la expresión "X o más", pero, aunque sea amplio, permite la comparación con el estado de la técnica por lo siguiente: un documento que divulgase cero, sería diferente de una reivindicación en la que se define 'al menos

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uno' (=uno o más); y un documento que divulgase uno, tres, diez o cien sería igual que esta reivindicación que define 'al menos uno'. Que una definición sea amplia, no significa que no sea clara, y que no pueda ser comparada con documentos del estado de la técnica.

De hecho, este tipo de términos son utilizados para señalar que al respecto de la característica o elemento a la que acompaña ese 'al menos' el solicitante no se quiere limitar.

Respecto a la sugerencia del Examinador de sustituirlo por un rango concreto:

- Imaginemos que lo limita definiendo 'de 1 a 10'; un tercero podría entonces reproducir su invención haciendo 11 ¡sin infringir! Esto constituiría un claro abuso y por eso esta terminología es muy utilizada, para cubrirse, y así no limitar características que realmente no son esenciales para la invención.
- Por otra parte, si ese rango 'de 1 a 10' no está claramente definido en la descripción, esa modificación no tendría soporte, por lo que habría ampliación de materia.

Sumado a lo anterior, consideramos importante señalar que, el término "al menos" aparece en multitud de patentes concedidas por diversas Oficinas, y ha sido aceptado por la Oficina de Colombia en patentes concedidas y tramitadas por este despacho tales como: No. 14-065.568 o No. 13-126.418.

- El Examinador objeta la expresión **'sustancialmente'**. Esta expresión ha sido eliminada.

- El Examinador objeta la expresión **'preferentemente'**. Respecto a esta expresión, el solicitante desea indicar que no causa confusión en la reivindicación 9 sino que expresa que es una característica meramente opcional, por lo que entonces es aceptable, según lo indicado en el punto 2.6.5.7 de la Guía de Examen de Patentes: "*Expresiones del tipo "preferentemente", "por ejemplo", "tal como", "en especial" precediendo una característica en una reivindicación,* ***se deben interpretar como no limitativos****, es decir, la característica es meramente opcional y no limita el alcance de la reivindicación (en particular al analizar novedad y nivel inventivo). Si causan confusión en la reivindicación, el examinador*

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debe requerir por falta de claridad y sugerir que las características opcionales, o preferentes se convierten en una reivindicación dependiente"

- **Reivindicaciones 10 y 12**: respecto a la reivindicación 10, el solicitante se remite a lo indicado anteriormente; e igualmente, como la reivindicación 12 ha sido modificada (cf. Punto 1.1 del presente escrito), esta objeción ya ha sido superada.

- **Reivindicación 16**: el solicitante ha modificado esta reivindicación para más claramente definir la característica estructural del elemento de seguridad.

Teniendo en cuenta las modificaciones realizadas en las reivindicaciones, así como la argumentación indicada en el presente escrito, se ruega sean reconsideradas y retiradas las objeciones emitidas por el Examinador.

En vista de las modificaciones efectuadas es evidente que los cambios efectuados cumplen con los lineamientos establecidos en el artículo 34 de la Decisión 486.

ANEXO

- Nuevo capítulo reivindicatorio modificado conforme a las precisiones indicadas en este memorial.
- Solicitud de patente europea publicada EP-2692539-A1 con su traducción.
- Solicitud de patente británica publicada GB- 2433469-A
- Boletín nº 12, volumen 21 de diciembre de 2015 de noticias relacionadas con autenticación (Volume 21 - No. 12, Authentication News, December 2015),

PETICIÓN

Basándonos en los argumentos expuestos, consideramos que la totalidad de las objeciones presentadas por el Examinador han sido superadas, y que el nuevo capítulo reivindicatorio cumple con el requisito de claridad. En consecuencia, solicito a esa Superintendencia proceder a estudiar la patentabilidad de la invención según el capítulo reivindicatorio adjunto a este memorial.

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Atentamente,

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*** Soporte del Pago ***

TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PAGO	VR.PAGO
CONSIGNACION	BANCO DE BOGOTA	062754387	758953742	21/01/2016	3.091.000.00

*** Conceptos Pagados ***

CANT.	RENTISTICO	CONCEPTO	Vr.UNDITARIO	Vr.CONCEPTO
1	50005-01-01 SOLICITUDES	1607 REIVINDICACION PATENTE UNITARIA ADICIONAL A LAS 10 INIC	40.000.00	40.000.00
				$40.000.00

SON: **CUARENTA MIL PESOS MONEDA CORRIENTE*

Responsable: _____
-*****-

Recibo de Caja Aplicado al Expediente No. Reivindic 15261438

REIVINDICACIONES

1. Procedimiento para proporcionar a un documento (1) de seguridad una característica de seguridad, comprendiendo dicho documento (1) de seguridad un sustrato (11) del documento, siendo dicho sustrato del documento un sustrato de papel, comprendiendo además dicho documento (1) de seguridad un elemento (2) de seguridad embebido en dicho sustrato (11) del documento, comprendiendo dicho elemento de seguridad un sustrato (21) del elemento, comprendiendo además dicho elemento de seguridad un material (22) sensible a la luz láser,

caracterizado porque el procedimiento comprende proporcionar a dicho elemento (2) de seguridad un marcado (3) detectable mediante la etapa de dirigir la luz (41) láser sobre el sustrato (11) del documento alterando dicho material (22) sensible a la luz láser.

2. Procedimiento de acuerdo con la reivindicación 1, en el que la etapa de dirigir la luz (41) láser sobre el sustrato (11) del documento comprende retirar al menos parte de dicho material (22), proporcionando a dicho elemento de seguridad dicho marcado (3) detectable.

3. Procedimiento de acuerdo con la reivindicación 2, en el que la etapa de dirigir la luz (41) láser sobre el sustrato (11) del documento comprende sublimar al menos parte de dicho material (22), proporcionando a dicho elemento de seguridad dicho marcado (3) detectable.

4. Procedimiento de acuerdo con la reivindicación 2 o 3, en el que dicho material (22) sensible a la luz láser es conductor y/o metálico.

5. Procedimiento de acuerdo con la reivindicación 4, en el que dicho material (22) sensible a la luz láser está en forma de partículas metálicas.

6. Procedimiento de acuerdo con cualquiera de las reivindicaciones anteriores, en el que dicho material (22) sensible a la luz láser está presente a modo de capa sobre el elemento (2) de seguridad.

7. Procedimiento de acuerdo con cualquiera de las reivindicaciones anteriores,

que además comprende la etapa de producir perforaciones en el material (22) y, de manera opcional, también en el sustrato (21) del elemento, tras la incorporación de dicho material sobre, o dentro de, dicho sustrato del elemento, antes del embebido del elemento (2) de seguridad en el sustrato (1) del documento.

8. Procedimiento de acuerdo con cualquiera de las reivindicaciones anteriores, en el que el elemento (2) de seguridad es una banda o un parche.

9. Procedimiento de acuerdo con cualquiera de las reivindicaciones anteriores, en el que el elemento (2) de seguridad comprende un sustrato de celulosa, preferentemente un sustrato de papel o celofán.

10. Procedimiento de acuerdo con cualquiera de las reivindicaciones anteriores, en el que dicho marcado (3) detectable es visible por transmisión, pero no por reflexión, y/o en el que dicho marcado de seguridad detectable puede detectarse por medio de detectores magnéticos.

11. Procedimiento de acuerdo con cualquiera de las reivindicaciones anteriores, en el que dicho marcado (3) detectable se realiza a registro con una característica del sustrato (11) del documento,

- tal como a registro con un marcado (5) sobre o dentro del sustrato del documento, tal como una marca impresa sobre el sustrato del documento o una marca de agua dentro del sustrato del documento, y/o
- tal como a registro con un lado (12, 13) del sustrato (11) del documento.

12. Procedimiento de acuerdo con cualquiera de las reivindicaciones anteriores, en el que dicho marcado (3) detectable es una característica de personalización.

13. Procedimiento de acuerdo con la reivindicación 12, en el que dicho marcado (3) detectable es una característica de identificación de un propietario del documento (1) de seguridad.

14. Procedimiento de acuerdo con cualquiera de las reivindicaciones anteriores, en el que la etapa de dirigir la luz (41) láser sobre el sustrato (11) del

documento comprende alterar dicho material (22) sensible a la luz láser proporcionando a dicho elemento (2) de seguridad un marcado (3) detectable, y sin afectar al sustrato (11) del documento.

15. Documento de seguridad, que comprende el sustrato (11) del documento, siendo dicho sustrato del documento un sustrato de papel, comprendiendo además dicho documento de seguridad un elemento (2) de seguridad embebido en dicho sustrato (11) del documento, comprendiendo dicho elemento (2) de seguridad un sustrato (21) del elemento en forma de banda o recorte de celulosa, caracterizado porque dicho sustrato (21) del elemento está provisto de un material (22) que es sensible a la luz láser, dispuesto de modo que dicho material se pueda sublimar con luz láser, de modo que proporcione a dicho elemento (2) de seguridad un marcado (3) detectable debido a la sublimación parcial de dicho material con la luz láser.

16. Documento de seguridad de acuerdo con la reivindicación 15, en el que el sustrato de papel comprende al menos dos capas (11A, 11B) de papel, estando dicho elemento (2) de seguridad embebido entre dichas dos capas (11A, 11B) de papel, donde dicho elemento (2) de seguridad está provisto del marcado (3) detectable mediante sublimación parcial del material (22) sensible a la luz láser con luz láser.

17. Documento de seguridad, obtenido u obtenible con un procedimiento de acuerdo con cualquiera de las reivindicaciones 1-14.

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(51) INT CL:
B42D 15/00 (2006.01) ***D21H 21/42*** (2006.01)

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B6A AC12 AC31 AC41 AC51 ATC
U1S S2271 S2272

(56) Documents Cited:
GB 1365876 A **EP 1602782 A2**
WO 2003/085193 A1 **US 5783275 A**
US 4462867 A **US 20050224203 A1**

(58) Field of Search:
UK CL (Edition X) **B6A, D1R, D2A**
INT CL **B42D, D21H, G07D**
Other: **EPODOC, WPI, TXTE.**

(54) Abstract Title: **Security substrate incorporating a fibrous apertured tape**

(57) The invention provides a security substrate (such as a paper) for use in a security document such as banknote, passport, or share certificate, and a method for its manufacture. Security is provided by the incorporation within a fibrous base substrate 10 of a fibrous tape 12 which includes at least one aperture 13 which is indistinct when the substrate is viewed by reflected light but is distinct when viewed in transmission. It is made indistinct by apparent blurring of the edges of the aperture(s) caused by deposition of fibres of the base substrate in region 14 (overlap area) around the perimeter of perforation 13 during the manufacturing/tape incorporation process. The manufacturing method may include a cylinder mould process to form the base substrate or the tape. The tape may be wholly embedded in the base substrate or partially embedded, with a surface exposed. The tape and/or base substrate may include additional security features.

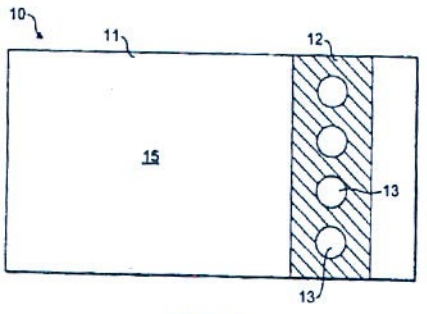


FIG. 1

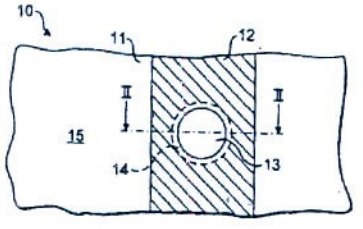


FIG. 2

GB 2 433 469 A

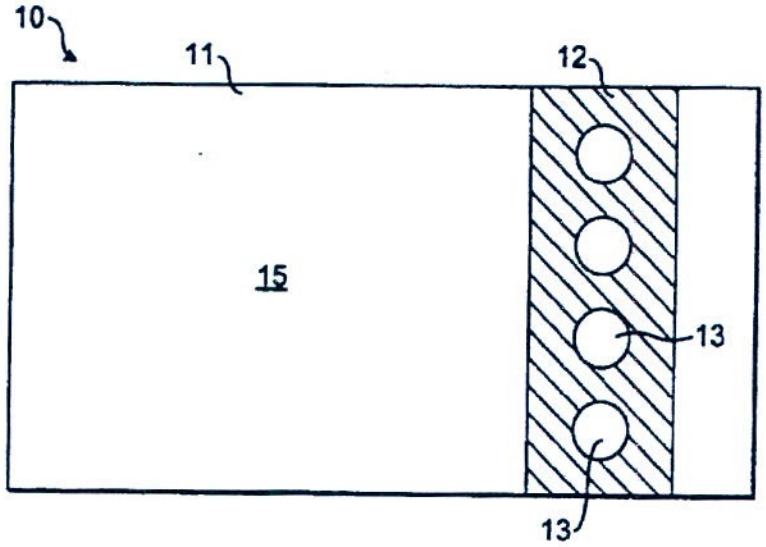


FIG. 1

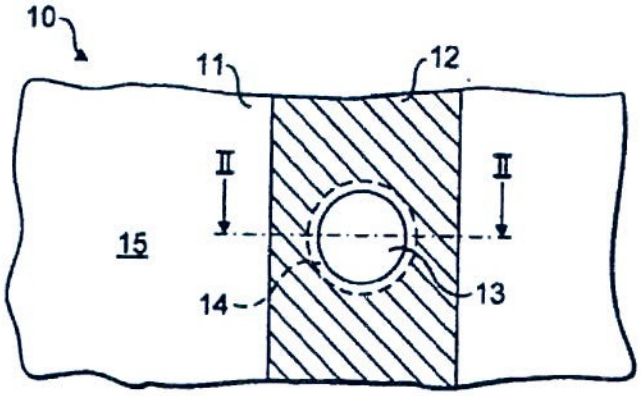


FIG. 2

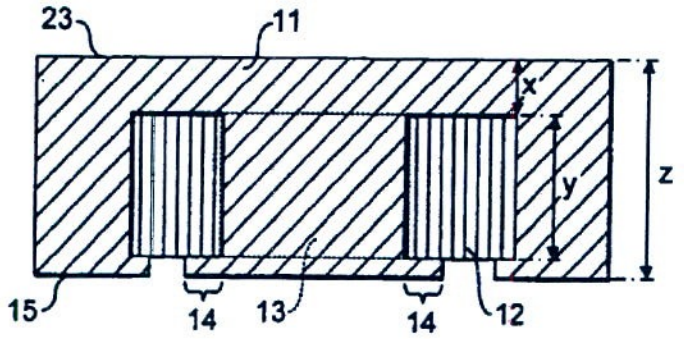


FIG. 3a

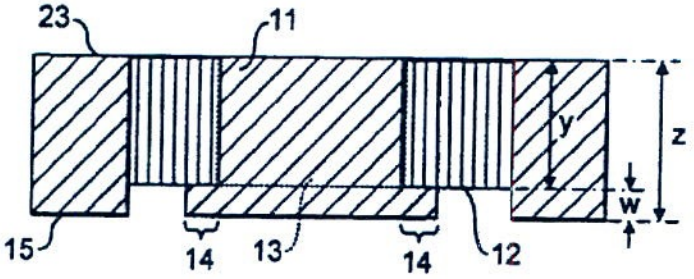


FIG. 3b

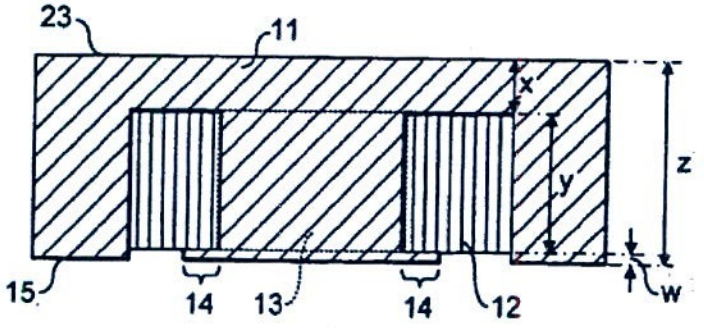


FIG. 3c

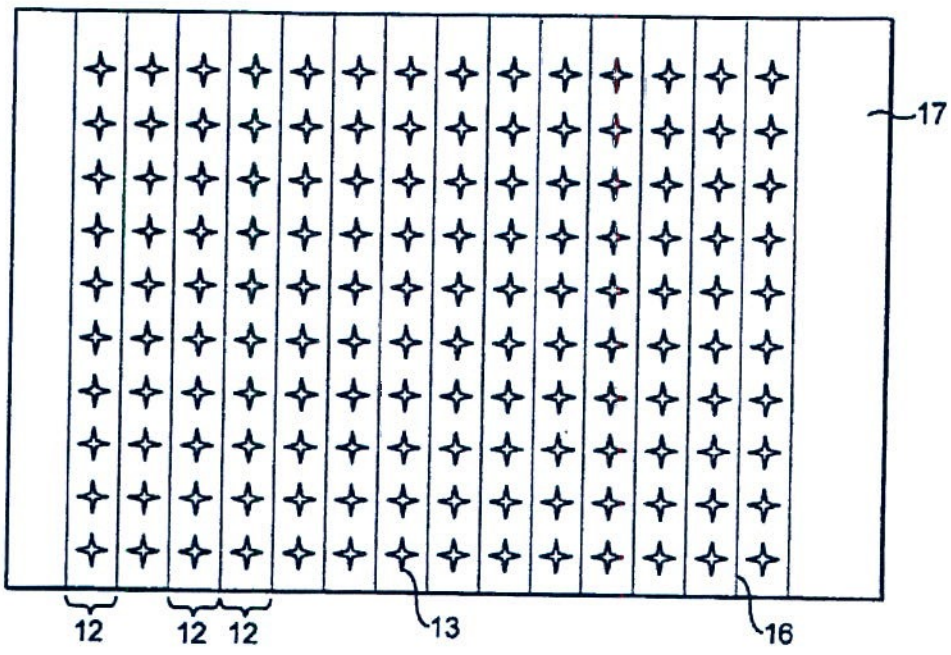


FIG. 4

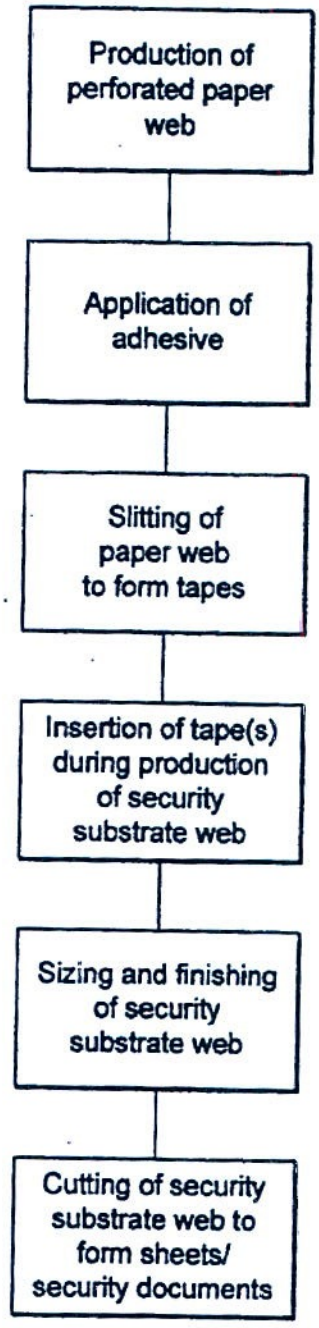

Production of perforated paper web
Application of adhesive
Slitting of paper web to form tapes
Insertion of tape(s) during production of security substrate web
Sizing and finishing of security substrate web
Cutting of security substrate web to form sheets/ security documents

FIG. 5

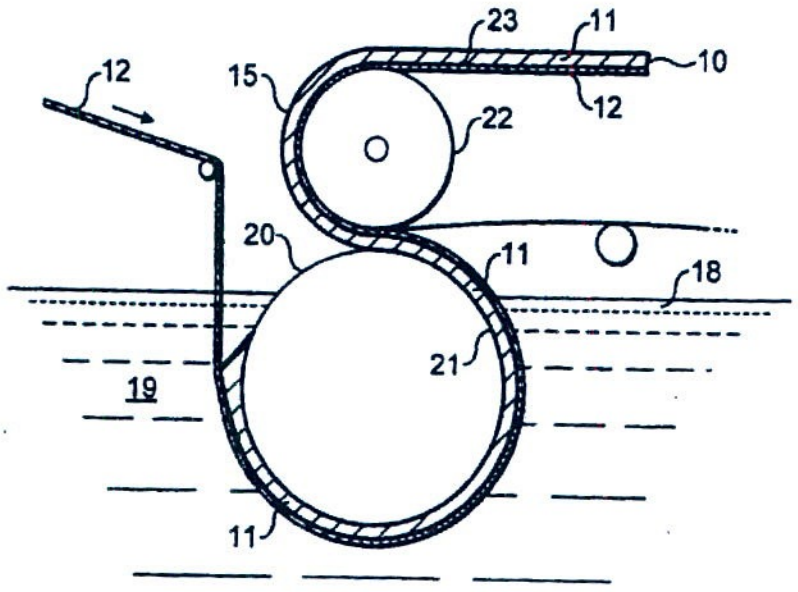


FIG. 6a

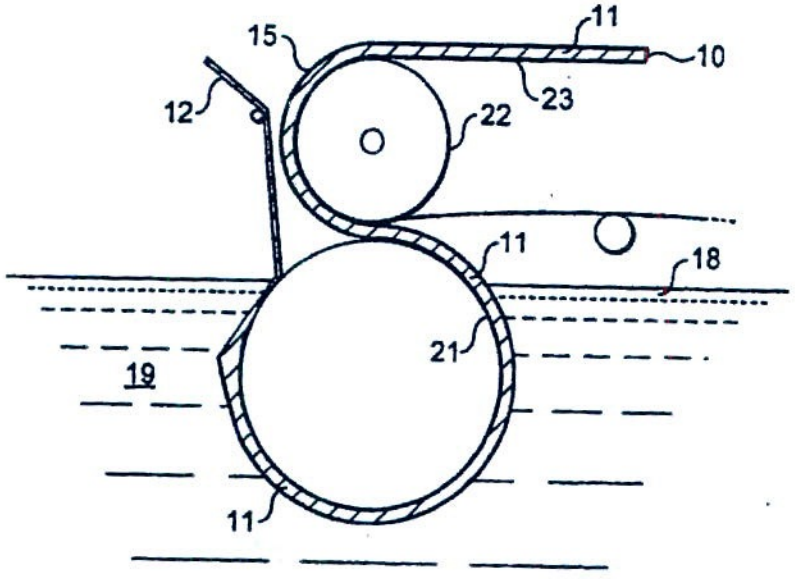


FIG. 6b

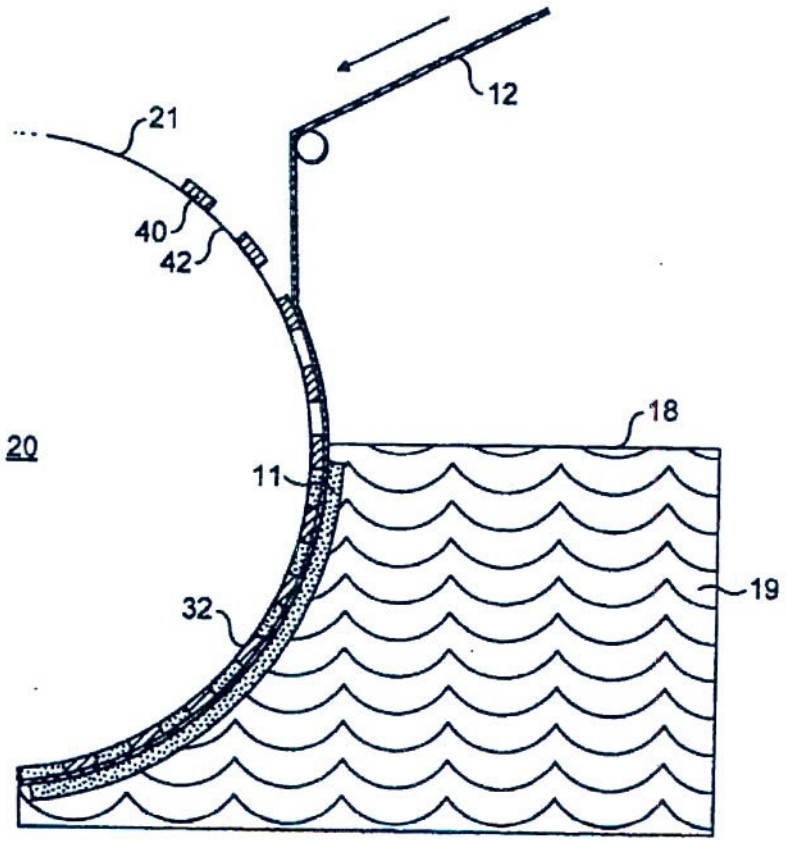


FIG. 6c

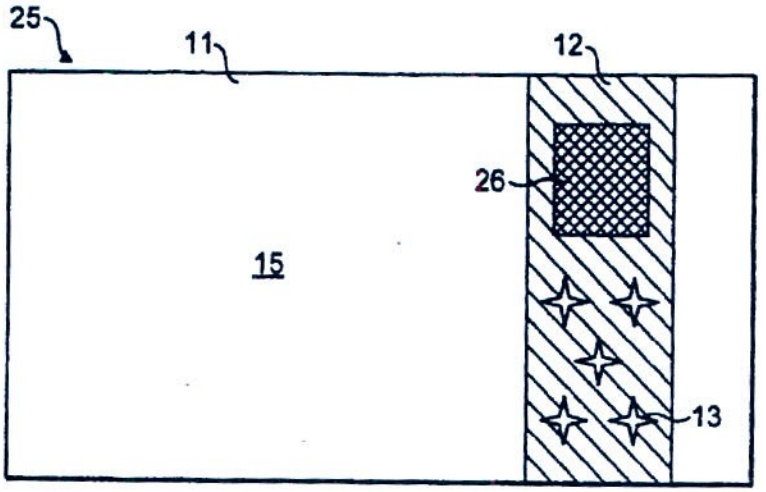


FIG. 7

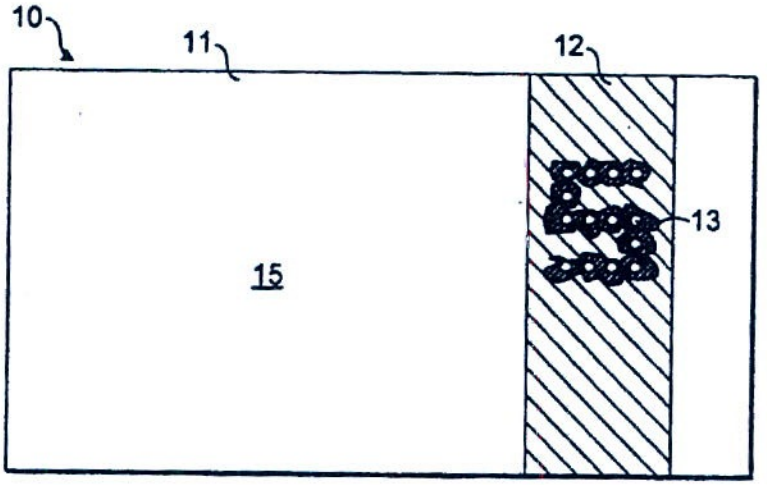


FIG. 8

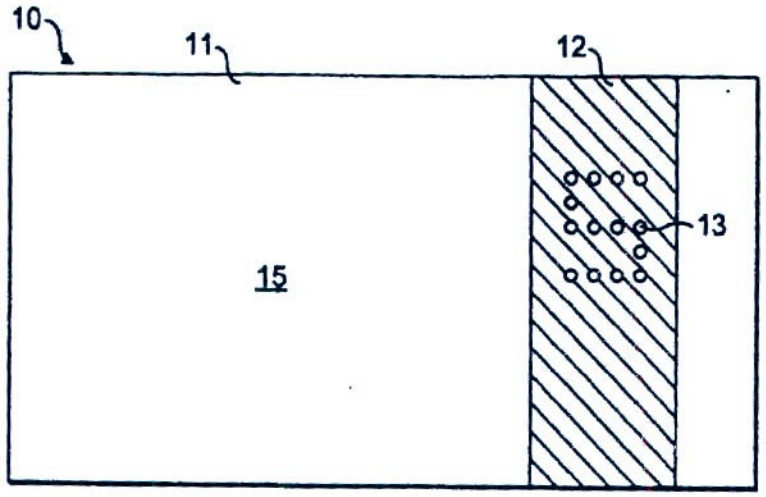


FIG. 9

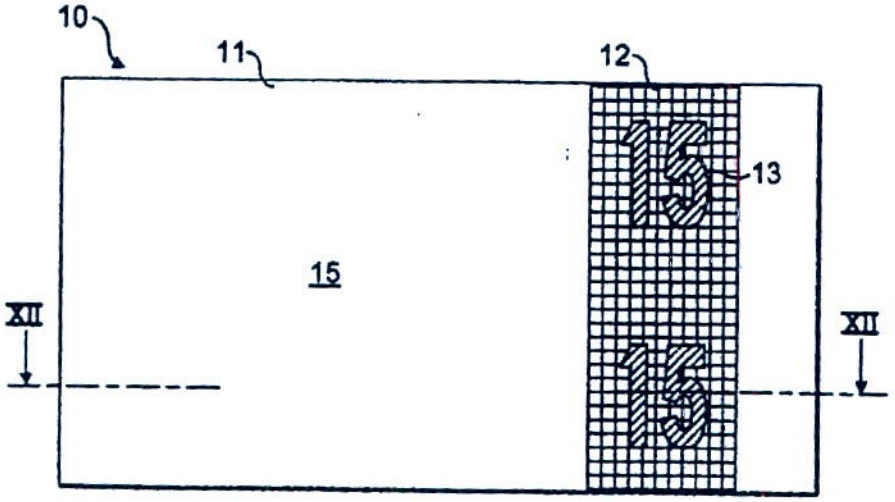


FIG. 10

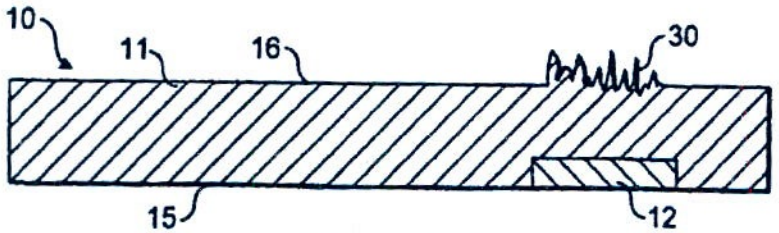


FIG. 11

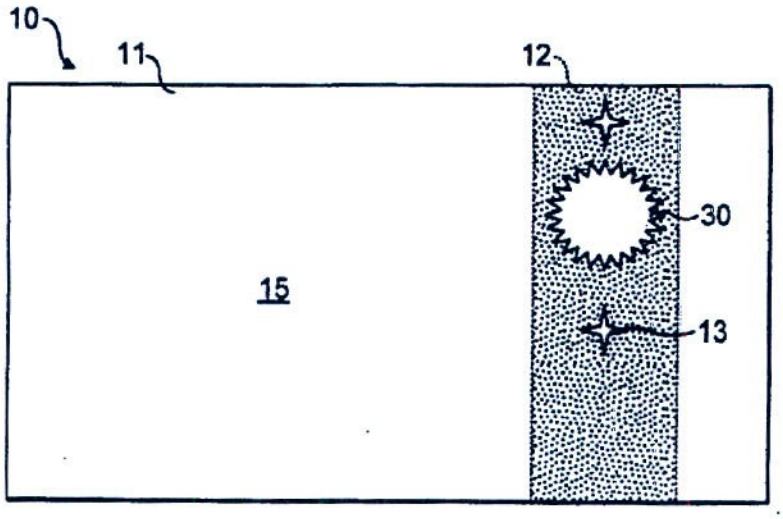


FIG. 12

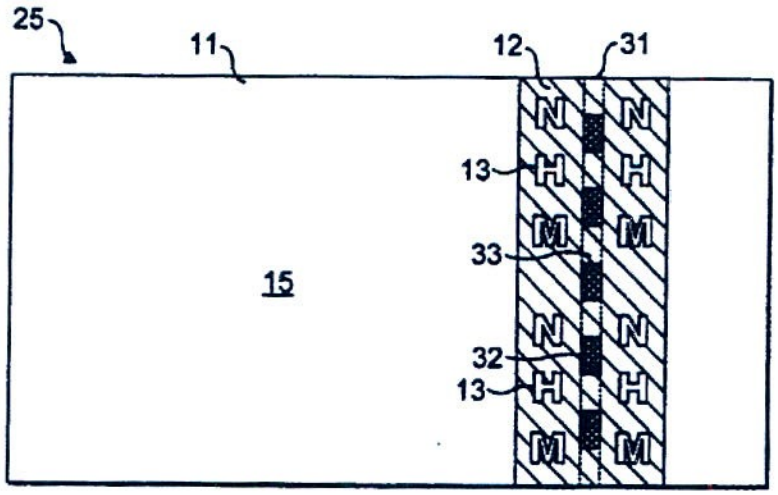


FIG. 13

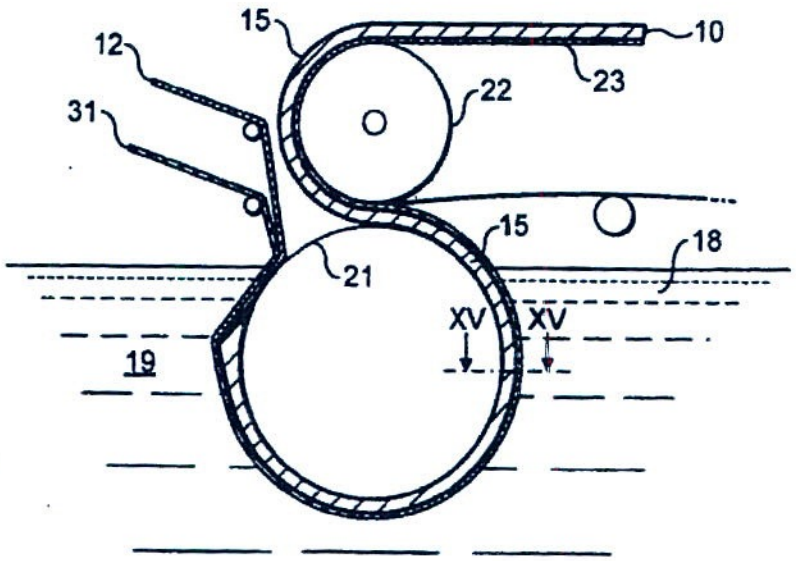


FIG. 14

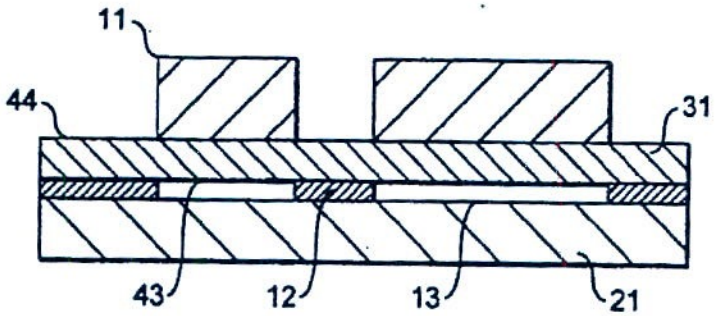


FIG. 15

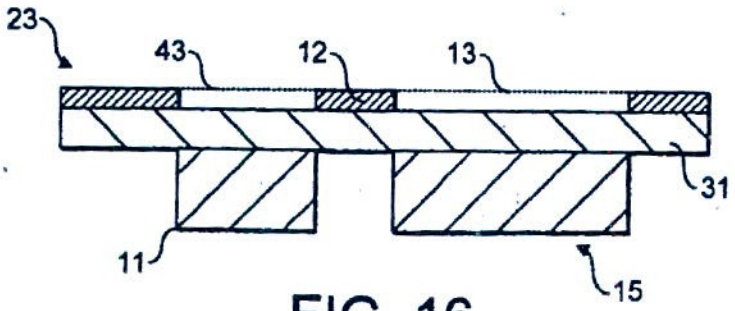


FIG. 16

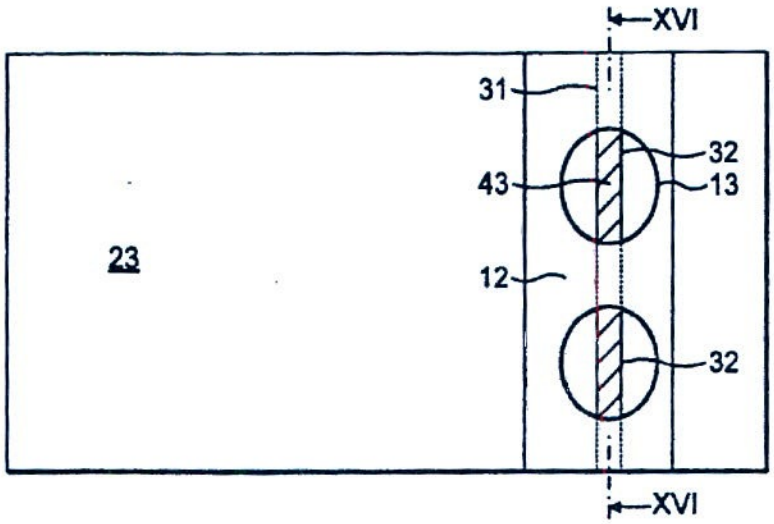


FIG. 17

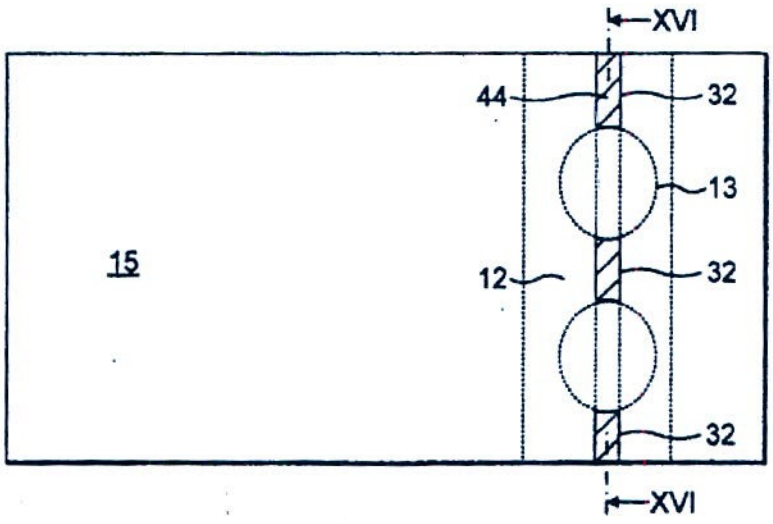


FIG. 18

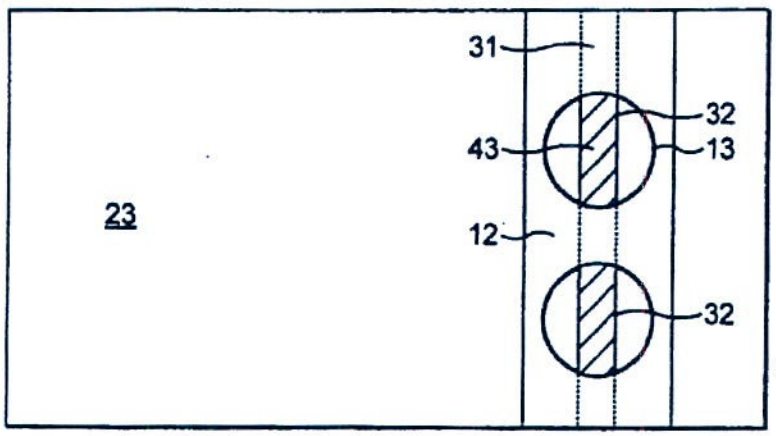


FIG. 19

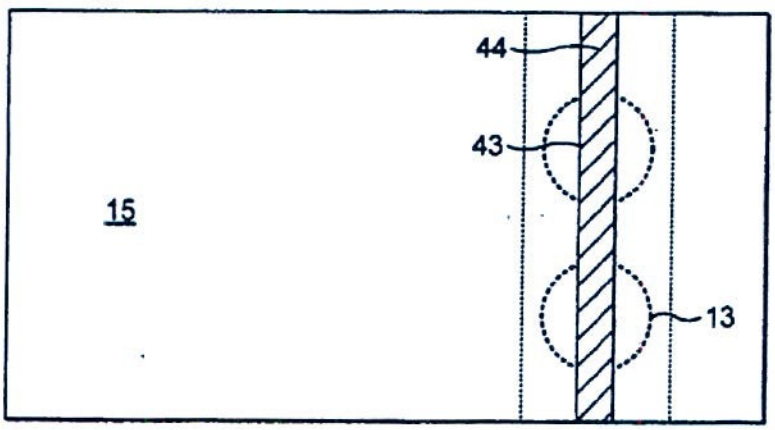


FIG. 20

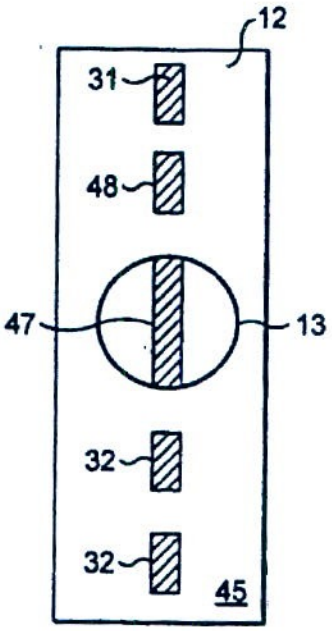


FIG. 21

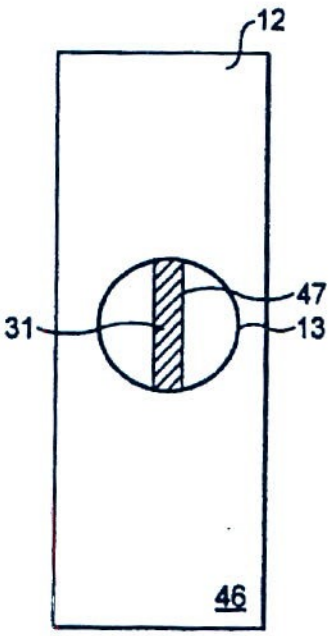


FIG. 22

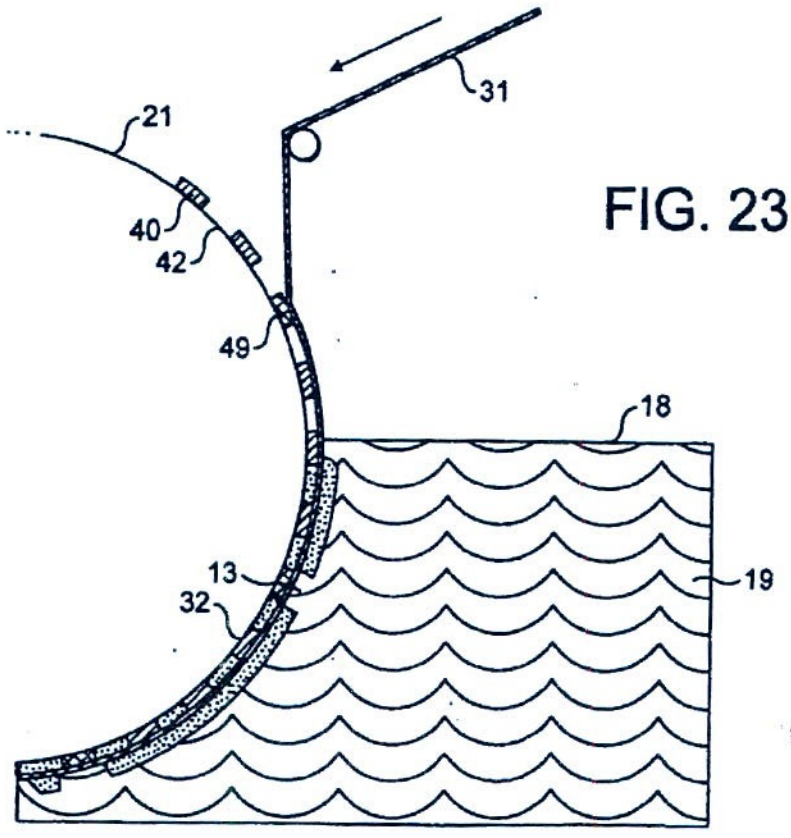


FIG. 23

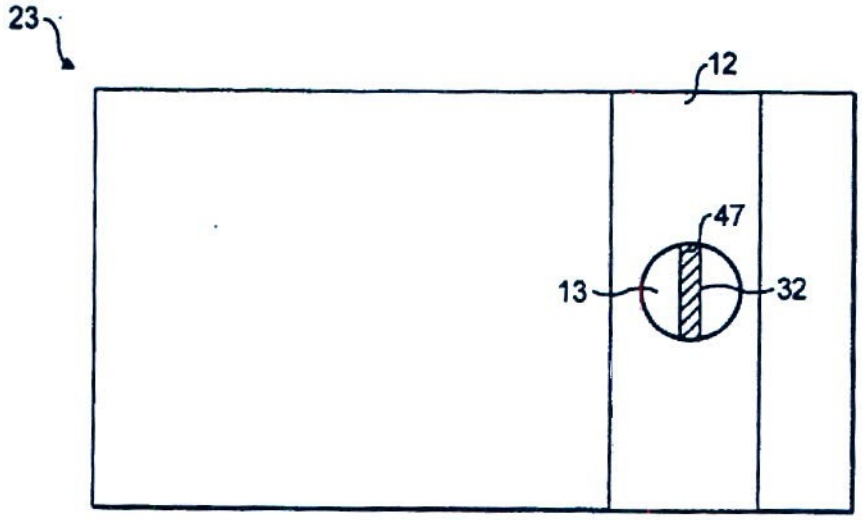


FIG. 24

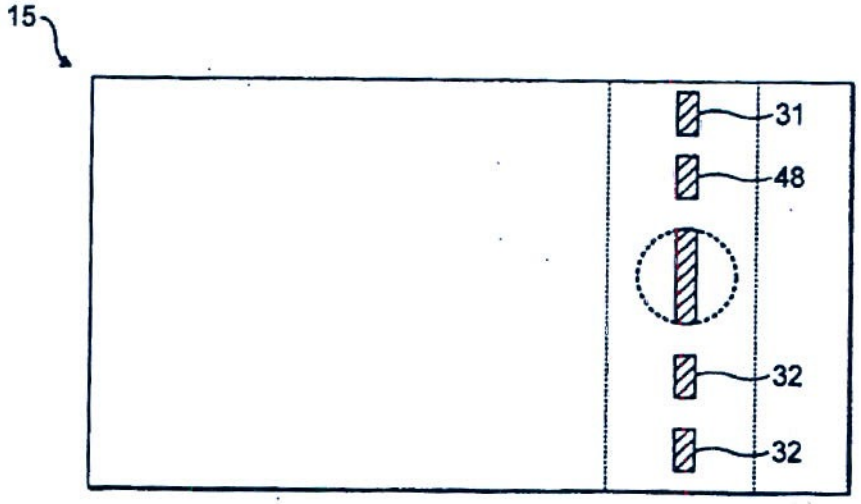


FIG. 25

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IMPROVEMENTS IN SECURITY SUBSTRATES

The present invention relates to improvements in security substrates having security features. More specifically the present invention relates to a fibrous substrate, such as paper, comprising an integral fibrous tape which has visible apertures in the form of holes and/or perforations. When the tape is incorporated into the base substrate it, and therefore the finished substrate, has a different appearance when viewed in reflection compared to its appearance when viewed in transmission.

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.

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.

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 and windows are formed in the surface of the paper. 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 regions of the security element which are exposed in the windows are visible in reflected light on one side of the paper, which is commonly used for mainly banknotes.

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.

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.

EP-A-1630285 describes an alternative method for manufacturing a paper substrate incorporating an elongate impermeable element which is exposed in windows in both surfaces of the substrate. This method involves a modification to the cylinder mould papermachine with the requirement of an additional moving belt under the conventional cylinder mould. Such a modification is non-ideal and increases the cost and complexity of the process.

GB2397582 describes a further alternative method for manufacturing a paper substrate incorporating an elongate impermeable element which is exposed in windows on both

surfaces of the substrate. In this method the security element comprises a plurality of wide regions separated by narrow regions, the wide regions being of a width which obstruct the deposition of fibres. The elongate element is brought into contact with a cylinder mould cover having window forming means such that the narrow regions form windows in the conventional manner as in EP-A-0059056 and the wide regions, by virtue of obstructing deposition, form windows in the opposing surface. The main limitation with this method is that the profile of the elongate element has to be tessellated. This tessellated profile increases the expense for producing the elongate element as single elements have to be produced using die-stamping or laser cutting rather than simply slitting from a wide web.

The use of perforations in secure documents is known in the prior art. WO97/18092 describes a security document having a pattern of fine perforations that are visible when the document is viewed in transmitted light, whilst they are invisible when viewed in reflected light. In this and other prior art examples the whole document is perforated typically in a final processing step such as mechanical punching or laser cutting.

It is therefore an object of the present invention to provide an improved security substrate wherein apertures, such as perforations or holes, are formed in a first fibrous tape which is then integrated into the main fibrous substrate such that the final substrate has a different appearance when viewed in reflection compared to its appearance when viewed in transmission.

The invention therefore comprises a security substrate and a fibrous tape incorporated therewith, said fibrous tape having at least one aperture wherein the shape of the at least one aperture is indistinct when the substrate is viewed in reflected light, but is distinct when the substrate is viewed in transmitted light.

Preferably fibres from the base substrate form inside the at least one aperture and form a fibrous layer on the surface of the tape around a perimeter of the aperture. The fibres thereby disguise the perimeter.

The invention also provides a method of forming a security substrate comprising the steps of forming a fibrous tape, said fibrous tape having at least one aperture therein, forming a fibrous base substrate and integrating the fibrous tape in the base substrate during the formation of the base substrate.

It is a further object of the present invention to provide an improved method of manufacturing fibrous security substrates which enable the incorporation of an elongate impermeable element which is exposed at windows in both surfaces of the fibrous security substrate.

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

Figure 1 is a plan view of a security substrate according to the present invention;

Figure 2 is a plan view of a small section of the substrate of Figure 1;

Figure 3a is a cross-section of the fibrous substrate of Figure 2 on the line II-II;

Figures 3b and 3c are equivalent cross-sections to that of Figure 3a for alternative embodiments of the substrate;

Figure 4 is a plan view of a web of substrate from which the fibrous tapes for the security substrate of Figure 1 are formed;

Figure 5 is a flow chart illustrating the steps of the preferred method of manufacturing the substrate of Figure 1;

Figures 6a, 6b and 6c are schematic representations of parts of a cylinder mould machines for use in the manufacture of the substrate of Figure 1;

Figure 7 is a plan view of an alternative security substrate to that of Figure 1;

Figure 8 is a plan view of a further alternative security substrate viewed in reflected light;

Figure 9 is a plan view of the security substrate of Figure 8 viewed in transmitted light;

Figure 10 is a plan view of a further alternative security substrate according to the invention;

Figure 11 is a cross-sectional side elevation of a further alternative security substrate according to the invention;

Figures 12 and 13 are plan views of further alternative security substrates according to the present invention.

Figure 14 is a schematic representation of parts of a cylinder mould machine for use in the manufacture of a further embodiment of the substrate of the present invention;

Figure 15 is cross sectional side elevation of a portion of the cylinder mould cover of the machine of Figure 14 on the line XV-XV;

Figure 16 is a cross sectional side elevation of a portion of a web of substrate produced on the machine of Figure 14 on the line XVI-XVI of Figures 17 and 18;

Figures 17 and 18 are plan views of the front and back of a security substrate of Figure 16;

Figures 19 and 20 are plan views of the front and back of an alternative substrate to that of Figure 16;

Figures 21 and 22 are front and rear elevations of a portion of tape for use in the substrate of the present invention;

Figure 23 is a cross sectional side elevation of a section of the cylinder mould cover of the paper machine used to produce the tape of Figures 21 and 22; and

Figures 24 and 25 are plan views of the front and back of another alternative embodiment of a security substrate.

The security substrate 10 of the present invention comprises a fibrous base substrate 11 into which is integrated a fibrous tape 12, in which at least one aperture 13, in the form of one or more perforations and/or holes, has first been formed such that the fibres from the base substrate 11 interact with the aperture(s) 13.

Figure 1 illustrates a fibrous substrate 10 according to the present invention comprising an integrated fibrous tape 12 where the tape 12 is exposed at one of the surfaces 15 of the finished substrate 10. The tape 12 comprises an array of apertures 13 in the form of perforations which have been filled by fibres of the base substrate 11.

Figure 2 is an enlarged view of one of the perforations 13 showing how the fibres from the base substrate 11 extend beyond the perforation 13 of tape 12 and partially cover the surface of the tape 12 in the region 14 around the perimeter of the perforation 13.

Figure 3a illustrates a cross-section of the section of the fibrous substrate 10 shown in Figure 2. It is the interaction of the fibres of the base substrate 11 with the perforations 13 in the tape 12, characterised by the overlap area 14, that provides the unique optically variable effect.

The fact that the fibres from the base substrate 11 slightly overlap the tape 12 means that, when viewed in reflection, the perforations 13 in the tape 12 are not distinct or clearly defined. Thus any image or identifying information formed by the perforations 13 in the tape 12 is blurred and not easily resolved with the naked eye. However on viewing in transmission, the perforations 13 are distinct and clearly defined along with any associated image or identifying information.

In the preferred method of producing the present invention, as illustrated in Figures 4 to 6, a first fibrous web 17 is produced comprising a number of tapes 12 aligned in parallel strips. The apertures 13 can be introduced into the tapes 12 during the papermaking process by preventing fibre deposition in localised areas by blinding or sealing the cylinder mould cover. Alternatively the tapes 12 can be perforated in a subsequent secondary process, for example by laser cutting or mechanical punching.

An optional adhesive coating can be applied to the first web 17 using a conventional size bath in which the web 17 is submerged in an adhesive resin. A conventional size press can also be used comprising of a pair of rolls, into the nip of which an adhesive is applied through which the dry or partially dry web is passed. Alternatively the adhesive may be applied to the first paper web 17, using conventional coating methods such as gravure coating. An alternative to using an adhesive coating is to add thermosoftening fibres to the furnish of the paper tapes 12 such that on heat activation during the drying of the base substrate 11 the fibres from the tape 12 fuse to the base

substrate 11. The first fibrous web 17 is then slit along either side of the rows of apertures 13 along slitting lines 16 to produce a plurality of tapes 12.

The base substrate 11 and tape 12 are preferably made from cotton-based paper stock, but alternatively wood based pulp or synthetic fibres or a mix of natural and synthetic fibres can be used. Preferably the tape 12 is a low permeable fibrous tape and is produced using a cylinder mould paper machine to enable complex security features to be incorporated, although other papermaking processes could be used such as the Fourdrinier process. The permeability of a fibrous tape 12 can be adjusted by varying the mesh size of the cylinder mould cover 21. A conventional banknote low permeable paper substrate containing complex security features such as a watermark and a partially embedded polymeric security element would be formed on a fine mesh with a typical mesh size being 70 (warps per inch) by 48 (wefts per inch) (70/48). Tapes 12 of varying permeability may be employed in the current invention with the only requirement being that the final perforated tape 12 has sufficient handling strength to be integrated into the base substrate 11. For the purpose of this invention a low permeable fibrous tape 12 is one which when placed against a paper forming mesh (for e.g. a cylinder mould cover) restricts drainage and inhibits fibre deposition. Typically the fibrous paper tape 12 suitable for use in the current invention will have a Bendtsen porosity in the range 0 to 100mls/min.

If the tape 12 is not used to carry complex security features requiring a low permeability (for example 0 to100

mls/min Bendtsen porosity), then it is possible to use a more permeable tape 12. A permeable tape 12 can be produced by using a cylinder mould cover 21 with a coarse mesh size, for example a typical mesh size would be 20 (warps per inch) by 20 (wefts per inch) 20/20. Paper produced from a coarse mesh comprises a plurality of discrete areas having a lower fibre density than the rest of the web. Water can easily pass through the areas of lower fibre density resulting in a low permeable substrate. An added advantage of using a coarse mesh is that the tape 12 will have a very obvious wire mark, which is readily apparent when the final sheet is viewed in transmission thus providing additional security and aesthetic benefits. If a distinct wire mesh is not required, then permeable paper can be produced by using fibres especially selected and treated to give a paper with a high permeability.

Other methods may be used to make high permeability paper including the use of electrotypes to produce small regions of reduced grammage paper. Another method is to apply waterjets through a cylinder rotating on the formed, but still wet, paper mat. The cylinder is partially blinded by a patterned stencil. Where the pattern is open, water passes through the cylinder and displaces the paper fibres causing low, or even zero, grammage regions that are more porous than the adjacent regions. Such methods could result in specific regions of the tape 12 having high permeability compared to other parts of the tape 12.

A web of the base substrate 11 is preferably produced using a cylinder-mould process, as shown in Figure 6a. A cylinder-mould papermachine comprises a vat 18 containing a

suspension of paper fibres 19 in which dips the major portion of a cylinder 20 arranged on a horizontal axis. The surface of the cylinder 20 comprises a cylinder mould cover 21 formed from a wire mesh. Liquid is drawn through the mesh as the cylinder 20 is rotated causing paper fibres 19 to deposit on the mesh and form a web of the fibrous substrate 11 that is couched from the cylinder 20 by a couch roll 22 and conveyed away.

The above-mentioned optically variable effect of the present invention arises because fibres 19 from the base substrate 11 are not completely constrained to the apertures 13 in the tape and overlap the tape 12 forming a fibrous surface layer around the perimeter of the apertures 13. The degree and pattern of overlap is unique to each aperture 13 but the result is to blur the appearance of the original apertures 13 in reflected light. The presence of the overlapping fibres can be identified with the naked eye and provides an additional security benefit. The position at which the tape 12 contacts the cylinder mould 20 during the manufacture of the base substrate 11 controls the formation of the fibrous surface layer around the perimeter of the apertures 13 in the tape 12.

In a preferred embodiment the tape 12 is fed into the vat 18 at a point such that the cylinder mould cover 21 has already acquired a substantial coating of fibres 19 before the tape 12 makes contact, as shown in Figure 6a. In the case of a low permeable tape once the tape 12 has made contact with the formed substrate 11 little or no further fibres 19 deposit over the tape 12, however fibres 19 continue to deposit adjacent to the tape 12 and also fill up

the perforations 13 within the tape 12 resulting in the tape 12 being exposed on the back surface 15 of the security substrate 10. The back surface 15 is the one facing away from the cylinder mould cover 21 during formation of the substrate 10. The front surface 23 is the one which is facing the cylinder mould cover 21.

Referring to Figure 3a, the thickness (y) of the tape 12 is preferably between 20-70% of the thickness (z) of the base substrate 11 and more preferably between 40-70% of the thickness (z) of the base substrate 11. The thickness (x) in Figure 3a is the thickness of fibres of the base substrate 11 that have been deposited on the cylinder mould cover 21 before the tape 12 contacts the cylinder mould cover 21. The thickness (x) is preferably between 20-70% of the thickness (z) base substrate and more preferably between 30-50% of the thickness (z) of the base substrate 11. In order for fibres 19 to fill the perforations 13 in the tape 12 and overlap the tape 12 forming a fibrous surface layer around the perimeter of the perforations 13, the point at which the tape 12 contacts the mould cover 21 is controlled such that the combined thickness (x) of the fibres and the tape thickness (y) is preferably less than the final thickness (z) of the base substrate 11.

The incorporation of the tape 12 in the base substrate 11 as described in relation to Figure 6a is such that there is a substantial coating of fibres 19 on the front surface 16 of the tape 12 which improves the durability of the final security substrate 10.

In an alternative embodiment a low permeable fibrous tape 12 is brought into contact with the cylinder mould cover 21 before it enters the vat 18 as shown in Figure 6b. As in the previous embodiment the fibres 19 from the base substrate 11 fill up the perforations 13 within the tape 12 and overlap the tape 12 forming a fibrous layer on the surface of the tape 12 around the perimeter of the perforations 13. The difference in this embodiment is that there is, in addition to the tape 12 being exposed on the back surface 15 of the security substrate 10, negligible fibre coverage on the opposite front surface 23 resulting in the tape 12 being exposed on both sides of the security substrate 10. In this embodiment, and with reference to Figure 3a, the thickness (x) is approximately equal to zero.

In an alternative embodiment illustrated in Figure 6c a low permeable fibrous tape 12, comprising one or more perforations 13, is incorporated into the base substrate 11 in the same manner as that described for elongate elements in EP-A-00059056. The technique involves embossing the cylinder mould cover 21 to form raised regions 40 and bringing the tape 12 into contact with the raised regions 40 of the mould cover 21, prior to the contact entry point into a vat of aqueous paper stock 19. Where the low permeable tape 12 makes intimate contact with the raised regions 40 of the embossing, no fibre deposition can occur and windows 32 are formed in the front surface 23 of the base substrate 11. After the finished substrate 10 is fully formed and couched from the cylinder mould cover 21, water is extracted from the wet fibre mat and the finished substrate 10 is passed through a drying process. In the finished substrate 10 the regions of the tape 12 which are exposed in the windows 32

are visible in reflected light when viewed from the front surface 23 of the substrate 10.

Figure 3b illustrates an equivalent cross-section to that shown in Figure 3a of a region of the finished substrate 10 where a perforation 13 in the tape 12 was in contact with a raised region 40 on the cylinder mould 21. In this case the fibres 19 from the base substrate 11 fill up the perforation 13 within the tape 12 and overlap the tape 12 forming a fibrous layer of thickness (w) on the surface of the tape 12 around the perimeter of the perforations 13. In the raised regions the tape 12 contacts the cylinder mould cover 21 before entering the vat and is therefore exposed on both sides of the security substrate 10, and with reference to Figure 3a, the thickness (x) is approximately equal to zero.

Figure 3c shows the equivalent cross-section to Figure 3b for the case where a perforation 13 in the tape 12 is coincident with gap 42 between two raised regions 40 on the cylinder mould cover. The fibres 19 which form underneath the tape 12 inhibit the drainage through the perforation 13 such that the thickness (w) of the overlapping surface layer is reduced compared to the case where the perforations 13 are in contact with the raised regions 40.

The difference in the thickness (w) of the overlapping surface layer, illustrated in Figures 3b and 3c, results in the appearance of the perforation 13 in the tape 12 varying depending on whether it coincides with a raised region 40 on the cylinder mould cover 21 during its incorporation into

the base substrate 11. When the back surface 15 of the substrate 10 is viewed in reflection the aperture/ perforation 13 is more disguised and less readily apparent in the regions originally in contact with the raised regions 40 of the cylinder mould cover 21 compared to the regions that were coincident with the gaps 42 between the raised regions 40. This provides an additional optically variable effect, when viewed in reflection, that increases the difficulty for a potential counterfeiter. In one embodiment the tape 12 may comprise a large aperture which both partly coincides with the raised regions 40 and gaps 42 on the cylinder mould cover 21. In this case the appearance of a single aperture in reflection will vary across its length.

An additional paper layer may be applied to the back surface 15 of the security substrate 10 to cover the exposed back surface of the tape 12. The additional layer can be applied by a separate lamination process or produced parallel to the production of the main substrate on a short former and brought together in the wet section of the paper machine. When the security substrate 10 is viewed in reflection the additional paper layer will further disguise the presence of the perforations 13 in the paper tape 12.

There is no width restriction to the tape 12 of the present invention, but preferably the width of the tape 12 is in the range 5-50mm and more preferably 10-30mm.

The at least one aperture 13 of the tape 12 of the present invention may comprise a variety of forms. The tape 12 may comprise one large aperture 13 shaped in the form of an identifying image or an array of smaller perforations 13

arranged to form an identifying image. The only size requirement of the apertures/ perforations/holes is that they are visible to the naked eye. Preferably the mean diameter of the apertures 13 would fall in the range 1-50mm and more preferably 5-30mm.

As mentioned above, the apertures 13 may be formed during the papermaking process of the tape 12. WO-A-0039391 describes a method of making single ply paper with fibre free regions by blinding one or more selected areas of a cylinder mould cover, and then depositing a layer of paper fibres onto the cylinder mould cover around the blinded areas. The blinded areas are impermeable which substantially prevents the deposition of fibres. A similar method is described in WO-A-03054297. The blinded areas can be created by attaching a suitably shaped metallic or polymeric element to the cylinder mould cover.

Alternatively the aperture(s) 13 can be created by perforating the tape 12 once it has been fully formed and prior to incorporating it into the base substrate 11. Examples of suitable methods for perforating the tape 12 include stamping, die-cutting, grinding, laser cutting, and water jet cutting.

It is not essential for the tapes 12 to have a linear edge and the edge of the tape 12 could have a curved or geometric pattern cut e.g by a laser.

Experimental work has shown that where the edge of the tape 12 has a thinner fibrous layer than the main body of the tape 12 a higher level of adhesion to the base substrate

11 is observed than for a tape 12 with a uniform thickness. This is because when the tape 12 is rewetted on insertion into the vat 18 during the production of the base substrate 11, the fibres in the thin fibrous layer of the tape 12 have an increased freedom of movement compared to a thicker layer and can entangle and bond more efficiently with the fibres of the base substrate 11.

A preferred method of manufacturing a tape 12 with a thin fibrous edge is to attach continuous thin wires circumferentially around the cylinder mould cover 21 to mark the edge of each tape 12. The wire will result in a significant decrease in drainage and fibre deposition forming a light line in the substrate along the edge of each tape 12. The substrate is significantly thinner along these lines 16 and can be torn by a suitable roller and rewind arrangement. The tearing action, as opposed to a slitting action, results in a frayed fibrous edge which further enhances the bonding of the tape edge into the base substrate 11.

In a further embodiment the tape 12 can be given different aesthetic properties to the base substrate 11. For example the tape 12 could be formed from red coloured fibres resulting in a coloured perforated tape 12. Alternatively the tape 12 could have a higher or lower opacity than the base substrate 11. In yet a further example the tape 12 could be fully or partly formed from phosphorescent or fluorescent fibres. In alternative embodiments the tape 12 may be coloured by a conventional printing process prior to insertion into the base substrate 11. A conventional

printing process enables a design to be applied to the tape 12 rather than an all-over colouring.

In addition to the patterned array of apertures or perforations 13, the tape 12 may comprise additional security features using the same methods as for a normal banknote substrate. Such features may include multitonal watermarks, single tone watermarks commonly known as electrotypes, polymeric elongated elements including embedded and partially embedded threads and fibres, silks or planchettes with associated functional properties. The functional properties can include UV excitable fluorescent or phosphorescent emissions, magnetic properties and IR excitable visible emissions.

Multitonal watermarks can be formed in the tape 12 by embossing the wire mesh of the cylinder mould cover 21 attached to the cylinder mould 20. When the cover 21 is embossed with a detailed image, the fibres 19 deposit with a lesser or greater thickness on the raised and depressed elements of the embossing to form a fully three-dimensional watermark in the paper. An alternative security feature is a single tone light element, commonly known as an electrotype watermark. This is created by attaching a metallic electrotype or a polymeric sealing compounds to the cylinder mould cover 21, resulting in a significant decrease in drainage and fibre deposition forming a light mark in the paper.

In a further embodiment of the present invention the tape 12 may comprise an elongated security element or thread. The inclusion of elongate elements or security

threads into security paper is well known and has been widely described within patent literature. Such threads may be wholly or partially embedded in the tape 12. It is usual to refer to partially embedded threads as being windowed, as the thread surfaces at regular intervals on the substrate surface like a series of windows. A number of methods for producing security papers with so-called windowed threads have been described one of which is described in EP-A-59056. Paper is still regularly produced by the method described within EP-A-0059056 and sold commercially under the trade name Stardust®.

In a further embodiment of the present invention a fibrous tape 12 has an elongate element partially embedded therein and at least one discrete aperture extending through the fibrous tape 12 exposing at least a part of the elongate element, wherein at least one edge of the elongate element is exposed in the aperture(s) 13. A method for producing such a paper web, with an elongate element exposed in an aperture, is disclosed in WO-A-04001130.

A further advantage of the proposed invention is that the production of the tape 12 is solely concerned with the generation of the security features. This allows fibres of a specific type or characteristic to be used in order to optimise the security feature. This is particularly useful for a perforated or holed tape 12 incorporating a watermark where short fibres lead to improved watermark definition. However short fibres result in degradation in strength and durability but the proposed method enables the fibres in the base substrate 11 to be optimised for strength and durability. It is well-known in the papermaking art that the

doublefold and tensile strength properties are generally improved by the addition of longer fibres or synthetic fibres and therefore for example the strength of the base substrate 11 could be optimised by using synthetic PVOH fibres as described in EP-A-873448B1. The resultant final substrate will contain a higher quality security feature and exhibit a higher strength and durability compared to when the security feature is incorporated into the substrate during the production of the final document.

The tape 12 may go undergo a number of optional processing steps prior to being incorporated into the base substrate 11. In order to provide additional security, images may be printed onto the tape 12 using conventional security printing techniques such as gravure, screen printing, litho, intaglio etc. The surface of the tape 12 could be modified by embossing or applying tactile inks such that in the final document the tape 12 can be identified by touch.

In order to ensure that the tape 12 is fully bonded to the base substrate 11, a heat sealable or water soluble adhesive can be applied to one or both sides of the tape 12 by standard coating or printing processes. In the preferred embodiment where the tape 12 is to be incorporated into the base substrate 11 such that it surfaces on the back surface 15 of the finished security substrate 10, the adhesive may be applied only over the edge of the tape 12 on the side that surfaces to adhere the fibres from the base substrate 11 that overlap the edge of the tape 12.

An additional benefit of the apertures 13 in a low permeable tape 12 is that it increases the adhesion of the tape 12 to the base substrate 11 due to the fact there are substrate fibres present on both sides of the tape 12. Without the apertures 13 the fibres from the base substrate 11 would only be attached to one surface of the tape 12, i.e. the surface that is not exposed on the back 23 of the security substrate 10. However with the apertures 13 present, the fibres from the base substrate 11 fill the apertures 13 and become attached to the tape 12 on the opposite side of the tape 12. A preferred embodiment to enhance adhesion between a low permeable tape 12 and a fibrous base substrate 11 comprises a series of apertures along one or both long edges of the tape 12 (Figure 13). Alternatively there could be a series of apertures along the middle of the tape (Figure 1), or an array of apertures covering the whole surface of the tape 12. Experimental work has shown that the adhesion of the tape 12 to the base substrate 11 is optimised if the apertures are of a size in the range 0.5 - 2mm wide by 0.5 to 4mm long and the space between the apertures is in the range 1 - 3mm.

In addition to the incorporation of the tape 12 the base substrate 11 may also comprise traditional banknote security features for example multitonal watermarks, single tone watermarks, embedded or partially embedded polymeric threads and fibres, silks or planchettes with associated functional properties. The functional properties can include UV excitable fluorescent or phosphorescent emissions, magnetic properties and IR excitable visible emissions. The security features are incorporated using conventional techniques in the same manner as described for the tape 12.

Optionally the position of the tape 12 is registered to security features in the base substrate 11. The holes or perforations 13 in the tape 12 could be registered to the security features on the base substrate 11 such as watermarks, or electrotypes. For example the tape 12 could be positioned directly under the watermark or adjacent to a watermark such that the image observed due to the holes or perforations is linked to or completes the image of the watermark.

Figures 7 to 13 show a number of alternative embodiments of the present invention. Figure 7 shows an example of a security substrate 10 of the present invention comprising a low permeable paper tape 12 in which the tape 12 comprises a first security feature provided by a plurality of apertures 13 in the shape of stars, which provide identifying information, and a further security feature in the form of a traditional multi-tonal watermark 26. As described above, the fibres from the base substrate 11 are viewed through the apertures 13 in the tape 12. In one embodiment the tape 12, is made from a different coloured furnish to the base substrate 11. For example if the base substrate 11 is substantially white and the tape 12 is a shade of blue, then on viewing the base substrate 11 in reflection, from the exposed tape 12 side, a blue strip will be observed comprising white stars. However because the white fibres from the base substrate 11, fill the star-shaped apertures 13 of the tape 12 and form a surface layer around the perimeter of the apertures 13 the edge of the stars are not distinct and appear blurred and poorly defined when viewed in reflection. The fact that the presence of the

white fibres around each star can be identified with the naked eye against the blue background of the tape provides an additional security benefit. A counterfeiter simply printing white stars on a blue background cannot replicate this blurred fibrous edge. In contrast on viewing the document in transmission a sharp image of the stars can be clearly seen against the background of the coloured tape 12. The fact that the tape 12 is of a different colour to the base substrate 11 provides additional security and substantially increases the contrast for the patterned apertures 13 when viewed in transmissive light. Alternatively the tape 12 can be made from the same colour furnish as the base substrate 11 but differ in another visible characteristic such as opacity or density and in this case the identifying information formed from the outline of the perforations 13 will be virtually invisible in reflected light but easily distinguishable in transmitted light.

In a further embodiment illustrated in Figures 8 and 9, the low permeable paper tape 12 comprises an array of small circular perforations 13 arranged to form the numeral 5. In this example a paper tape 12 is made from a paper furnish with a lower opacity than the base substrate 11. The perforations 13 are formed during the paper making process for the tape 12 by blinding the cylinder mould cover on which the paper fibres are deposited. The patterned paper tape 12 is subsequently incorporated into the base substrate 11 as described above. The fibres from the base substrate 11 form in the perforations 13 of the tape 12 and slightly overlap the perimeter of the perforations 13 such that when viewed in reflection the perforated regions are not distinct

or clearly defined and a virtually imperceptible "blurred" image of the number 5 is present (Figure 8). However on viewing in transmission the presence of the tape 12 is immediately noticeable due to the difference in opacity with the base substrate 11 and the perforations 13 of the tape 12 are distinct and clearly defined within the tape 12 as sharp circles defining the numeral 5 (Figure 9).

Figure 10 shows an example of a security substrate 10 comprising a permeable tape 12, preferably of paper, produced by using a coarse wire mesh. The tape 12 is made from substantially the same furnish as the base substrate 11 and is therefore difficult to see in reflection, but in transmission the tape 12 is characterised by an obvious wire mark which clearly distinguishes it from the base substrate 11. In addition holes 13 in the shape of numerals "1" and "5" have been produced in the tape 12, prior to its incorporation into the base substrate 11, by laser cutting. As with previous examples the identifying information provided by the holes 13 is not clearly resolved in reflected light, but is sharp and easily apparent in transmitted light.

In an alternative embodiment of a security substrate 10 comprising a permeable tape 12, the permeable tape 12 is impregnated with a transparentising resin or varnish. The varnish can be applied during the production of the tape 12 or as a separate printing or coating process. The transparentising of permeable paper sheet by impregnation with a resin is well known in the prior art, see for example US-A-2021141, GB-A-1489084, US-A-5118526 and US-A-4513056. The paper tape 12 is then perforated in the form of an

identifying image and incorporated into the base substrate 11 as described with reference to Figure 6a. The impregnated resin reduces the permeability of the paper tape 12 such that when incorporated in to the substrate 11 very few fibres deposit over the tape 12, however the fibres 19 continue to deposit adjacent to the tape 12 and fill the perforations 13 in the tape 12 and overlap the tape 12 forming a fibrous surface layer around the perimeter of the perforations 13. The perforations 13 in the tape 12 thus appear indistinct in reflected light, but sharp and easily apparent in transmitted light. Furthermore in this embodiment the paper tape 12 appears lighter than the base substrate 11 because of the transparentising effect of the impregnated resin.

Figure 11 shows a cross-section of a security substrate 10 comprising a perforated low permeable tape 12 which is of a different colour to the base substrate 11. For example the base substrate 11 is white and the tape 12 is blue. The base substrate 11 comprises a traditional multitonal watermark 30 characterised by a region of irregular thickness in the top surface of the substrate 11. The tape 12 is registered in the cross direction with the watermark 30 such that it is positioned directly under and surfaces on the opposite side of the substrate 11 to the watermark 30. When viewed in transmission the colour of the tape 12 highlights the watermark 30 and draws the eye of the authenticator to the watermark 30. Security is further enhanced by the fact that the position and content of the perforations 13 correlate with the design of the watermark 30 or alternatively the design of the perforations 13 can complete the image of the watermark 30. In this example the watermark 30 is in the

form of a large star and the perforations 13 are in the form of small stars positioned above and below the watermark (Figure 12).

In Figure 13 the security substrate 10 comprises a perforated low permeable tape 12, which contains a partially embedded security element in the form of a thread 31 that is exposed in windows 32. The tape 12 is incorporated into the base substrate 11 as described with reference to Figure 6a with the tape 12 oriented such that the exposed windows face away from the mould cover. As the tape 12 surfaces on the back surface 15 of the substrate 10 the windows 32 are not covered by the fibres of the base substrate 11 and the optical characteristics of a traditional windowed thread are maintained.

The tape 12 in Figure 13 is of a different colour to the base substrate 11. When the substrate 10 is viewed in reflection, from the same side as the surfacing tape 12, a coloured stripe is observed in the middle of which is a windowing polymeric thread 31. In reflection the perforations 13 in the form of the letters "NHM" are blurred and difficult to resolve, but when viewed in transmission the thread 31 is observed as a uniform dark strip and the perforations 13 become readily apparent. The colour of the tape 12 provides additional security as well as attracting the attention of the general public to the security thread 31.

In a further embodiment (not illustrated) the perforated tape 12 incorporates a partially embedded polymeric thread 31 which is registered in the cross

direction to a security feature in the base substrate 11. For example the tape 12 in Figure 13 could be positioned directly under a multitonal watermark 30 in the base substrate 11. In this case security can be further enhanced by correlating the design of the watermark 30 with either the design of the perforations 13, shape of the windows 32 or the optical information displayed in the windows 32. For example the polymeric thread 31 could be used to display a holographic design such that the hologram observed in the windows 32 is of the same design as the watermark 30. On viewing the substrate 10 in reflection from the side of the exposed tape 12 a series of windows 32 will be observed with a repeating holographic image, and when viewed in transmission a watermark 30 of the same image will be observed directly behind the windowed thread 31 providing the authenticator with a clear link between the two security features.

In a further embodiment of the present invention the tape 12, made from a low permeable paper, comprising one or more apertures 13 is incorporated into the base substrate 11 in combination with a conventional elongate impermeable element 31 such that the elongate impermeable element 31 contacts the cylinder mould cover 21 through the apertures 13 in the tape 12 and thereby the regions 43 of the elongate impermeable element 31 coincident with the apertures 13 in the tape 12 surface on the front side 23 of the finished substrate 10 in windows 32. The regions 44 of the elongate polymeric element 31 not coincident with the apertures 13 in the tape and positioned on the surface of the tape 12 away from the mould cover 21 will surface on the back side 15 of the base substrate 11 as no fibres will deposit over the low

permeable paper tape 12. In this manner the elongate impermeable element 31 is exposed in one or more windows 32 on both the front and backside 23,15 of the finished substrate 10.

Figures 14 to 18 illustrate one embodiment of the proposed invention which enables the incorporation of an elongate impermeable element 31 such that it is exposed at windows 32 in both surfaces 23,15 of the finished substrate 10. A fibrous tape 12 made from a low permeable paper comprises a series of apertures 13 positioned along the tape 12. The apertures 13 may be formed during the paper making process for the tape 12 by blinding the cylinder mould cover 21 on which the paper fibres 19 are deposited. Alternatively the apertures may be formed by perforating the tape 12 once it has been fully formed and prior to incorporating it into the base substrate 11. Examples of suitable methods for perforating the tape 12 include stamping, die-cutting, grinding and laser cutting, water jet cutting and laser cutting.

The tape 12 is incorporated into the base substrate 11 as shown in Figure 14. In this example the tape 12 and the base substrate 11 are made from the same furnish. The tape 12 is combined with an elongate impermeable element 31 immediately before the tape 12 contacts the cylinder mould 20. The elongate impermeable element 31 and tape 12 are brought together such that the elongate element 31 contacts the tape 12 on the side of the tape 12 away from the cylinder mould cover 21. The elongate impermeable element 31 is positioned such that it lies across one or more of the apertures 13 in the tape 12. The combined structure is then

brought into contact with the cylinder mould cover 21 (Figure 15) prior to the cylinder mould 20 entering the liquid in the vat 18 with the result that the tape 12 is exposed on the front surface 23 of the finished security substrate 10 (Figure 16). Furthermore the regions 43 of the elongate impermeable element 31 lying across the apertures 13 in the tape also contacts the cylinder mould cover 21 and likewise are exposed on the front surface 23 of the finished security substrate 10. In the case of a well consolidated low permeable tape 12 the restricted drainage results in few or no fibres 19 being deposited on the back surface 15 of the tape 12, although fibres 19 will continue to accumulate adjacent to the tape 12, with the result that the tape 12 is substantially exposed on the back surface 15 of the finished security substrate 10. Fibres forming the base substrate will continue to form in the apertures 13 in the tape 12 and overlap the tape 12 forming a fibrous layer on the surface of the tape 12 around the perimeter of the apertures 13.

If the elongate impermeable element 31 is sufficiently narrow not to interfere with fibre deposition then fibres 19 will also form over regions 43 of the impermeable elongate element 31 such that it is only exposed on the front side of the final substrate 10. This results in the elongate impermeable element 31 being exposed in alternate windows 32 on the front and back 23,15 of the finished substrate 10 as shown in Figure 17 (front) and Figure 18 (back). In order to allow fibre deposition the impermeable elongate element 31 will preferably have a width less than 3mm, and more preferably less than 2mm.

Alternatively if the elongate element 31 is sufficiently large to interfere with fibre deposition as it is too wide to be bridged by the fibres, regions 43 of the impermeable element 31 will be exposed on both the front and back surface 23,15 of the final substrate 11 (Figures 19 and 20). In this case the impermeable elongate element 31 preferably has a width greater than 3mm and even more preferably greater than 6mm.

For the embodiments with reference to Figures 14 to 20 the tape 12 and the elongate impermeable element 31 may be delivered into the papermachine in a number of ways. In one method the tape 12 and the elongate impermeable element 31 will be delivered on separate rolls with guide reels being used to ensure they are brought into contact at the correct point. Alternatively the tape 12 and the elongate impermeable element 31 may be brought into contact in a separate step prior to the papermaking process and delivered into the papermachine from the same roll. Although not essential an adhesive layer can be used to bond the tape 12 to the elongate impermeable element 31, this adhesive bond could be formed prior to entry into the papermachine, for example using an adhesive lamination process, or during the papermaking process using a moisture or heat activated adhesive.

In a preferred embodiment the elongate impermeable element 31 is incorporated into the fibrous tape 12 during its fabrication. This can be achieved using the method of making fibrous substrates described in WO-A-04001130. The tape 12, illustrated in Figures 21 and 22 viewed from the front surface 45 and back surface 46, comprises a partially

embedded elongate impermeable element 31 and one or more holes 13 which expose both surfaces of regions 47 of the elongate impermeable element 31. The tape 12 also comprises traditional windows 32, as described in EP-A-0059056, in which only one surface of regions 48 of the security element 31 are exposed.

The method of manufacturing the low permeable tape 12 illustrated in Figures 21 and 22 is shown in Figure 23. A porous support surface, for example in the form of a cylinder mould cover 21, is produced in a known way. The mould cover 21 has a plurality of drainage restriction regions 49. These can, for example, be provided by fixing a blinding material to the cylinder mould cover 21. The blinding material is typically a metal which is welded; to the cylinder mould cover 21. Other suitable blind materials are wax, polymer or any other material which can be securely attached to the cylinder mould cover 21 to prevent drainage of water from the fibrous stock 19 and hence fibre deposition. These drainage restriction regions 49 define the shape of the holes 13 formed in the tape 12.

The cylinder mould cover 21 also comprises embossed raised regions 40 which are used to generate the conventional windows 32. The elongate impermeable element 31 is brought into contact with both the raised regions 40 and drainage restriction regions 49 on the mould cover 21 prior to the contact entry point into a vat of aqueous paper stock 19. Where the elongate impermeable element 31 makes intimate contact with the raised regions 40 of the embossing, no fibre deposition can occur and windows 32 are formed in the front surface 45 of the paper tape 12 that was in contact

with the mould cover 21. Assuming the impermeable elongate element 31 is not sufficiently wide to prevent fibre deposition, fibres will be deposited over the impermeable element 31 in contact with the raised regions 40 such that it will not be exposed on the back surface 45 of the paper tape 12. In the drainage restriction regions 49 there is little or no covering of fibres. However in the gaps 42, which are flat freely draining regions, full fibre coverage is obtained. Thus when the substrate used to form the paper tape 12 is removed from the cylinder mould 21 the elongate impermeable element 31 is exposed from both sides of the tape 12 in the holes 13 corresponding to the drainage restriction regions 49 and exposed from one surface of the paper tape 12 in the windows 32 corresponding to the raised embossed regions 40. In the regions between the windows 32 and the holes the elongate element 31 is wholly embedded within the tape 12.

The low permeable tape 12, illustrated in Figures 21 and 22, is then incorporated into the base substrate 11 as described with reference to Figure 6b, prior to the cylinder mould 20 entering the liquid in the vat 18, with the conventional windows 32 facing away from the mould cover 21. The tape 12 is exposed on the front surface 23 of the finished security substrate 10. Furthermore the regions 47 of the elongate element 31 lying across the holes 13 in the tape 12 also contacts the cylinder mould 20 and likewise are exposed on the front surface 23 of the finished security substrate 10 (Figure 24). If the elongate impermeable element 31 is sufficiently narrow not to interfere with fibre deposition then fibres 19 will also from over regions 47 of the impermeable elongate element 40 such that it is

only exposed on the front side 23 of the final substrate 10. Fibres forming the base substrate 11 will continue to form in the holes 13 in the tape 12. As the tape 12 is of low permeability it is also exposed on the back surface 15 of the finished security substrate 10 and therefore the conventional windows 32 are not covered by the fibres of the base substrate 11 and therefore regions 48 of the elongate impermeable element 31 are exposed on the back surface 15 (Figure 25).

The method, for the incorporation of an elongate impermeable element 31 into a base substrate 11 such that it windows on both surfaces 15,23 described in the various embodiments in Figures 14 to 24, allows total control of the degree and position of exposure of the elongate impermeable element 31 within the security substrate 10. For example the elongate impermeable element 31 can be exposed on both surfaces 15,23 of the final substrate 10 in an alternating manner (Figures 15 to 18), or coincident manner (Figure 19), or where the elongate impermeable element 31 can be exposed in a plurality of windows 32 on one surface and only a single window 13 on the second surface (Figures 24 and 25).

Thus, substrates 10 made according to the present invention are advantageous in that the apertures 13 in the paper tape 12 provides a security feature that is indistinct when the substrate 10 is viewed in reflected light but is distinct when the substrate 10 is viewed in transmitted light. Furthermore the aperture 13 has a second function which is to increase the exposure of the impermeable elongate element 31, not just on one but both surfaces of the substrate, which means that it can be used to its best

extent. This is important because such elongate impermeable elements can be expensive to provide.

The elongate impermeable elements 31 are preferably made of clear polyester although other materials may be used, such as polyethylene or polypropylene, and may have a constant or variable width. The elongate impermeable elements typically have a layer of adhesive, which help the embedment within the tape and/or final substrate.

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 or diffractive designs, which may comprise areas of full metal and half-tone screens to provide partial transparency and/or no metal;

- 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 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;

- dichroic materials which can have different colours when viewed in transmission and refection, for example as described in GB-A-1552853. These materials are particularly useful where the windows on the front and back of the substrate coincide to form an aperture (as shown in Figure 16);

- thin film interference devices, as described in EP-A-227423 or liquid crystal polymer films or liquid crystal pigmented inks, such as described in EP-A-435029 or EP-A-863815.

The elongate impermeable elements may be oriented, which means that each side of the element may carry different information, materials or optical effects. Examples include:-

- holographic or diffractive materials on a first side of the element, with a thin film interference device on a second side;

- liquid crystal film over a black or dark background on a first side and plain metal on a second side;

- different coloured metals on each side, e.g. aluminium on the first side and another metal on the second side. Alternatively one or more coloured transparent lacquers over a metal layer could be used to create a variety of colours;

- a magnetic micrometallised thread, such as described in GB-A-2375078;

- repeating indicia or security features located in either window or bridge regions on one or both sides of the substrate.

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

Following the incorporation of the paper tape 12, the security substrate 10 undergoes further standard security printing processes to create a secure document, including one or all of the following; wet or dry lithographic printing, intaglio printing, letterpress printing,

flexographic printing, screen printing, and/or gravure printing. The printed designs are preferably printed both on the substrate 11 and the exposed regions of the paper tape 12. The printed images can subsequently be correlated and registered to images and designs produced by the apertures 13 in the paper tape 12.

The printed image on the exposed regions of the paper tape can be designed such that when the secure substrate 10 is viewed in reflection the printed image disguises the presence of the apertures 13 in the paper tape 12.

The disguising pattern can either be an integrated design or a stand-alone discreet design. The disguising pattern can either be regular or irregular and may consist of one or more of lines, dots, squares, or other small shapes. Preferred designs are those which contain distinctive images or patterns. Other preferred designs are those which have an additional distinct visual element, e.g. indicia within the disguising pattern.

It is also of benefit if the disguising pattern contains distinctive images or patterns itself. This is because of perceptual organisation when the eye views an image, whereby the brain tends to process images on the basis of grouping and, for example, will not clearly perceive the identifying image below.

The security substrate 10 of the present invention is particularly suitable for many types of security documents, include passport, banknotes, tickets of value and authenticity, share certificates and the like.

CLAIMS:

1. A security substrate comprising a fibrous base substrate and a fibrous tape incorporated therewith, said fibrous tape having at least one aperture wherein the shape of the at least one aperture is indistinct when the security substrate is viewed in reflected light, but is distinct when the security substrate is viewed in transmitted light.

2. A security substrate as claimed in claim 1 in which fibres of the base substrate form a fibrous layer on the surface of the tape around a perimeter of the aperture.

3. A security substrate as claimed in claim 1 or claim 2 in which the at least one aperture comprises a plurality of apertures in the fibrous tape.

4. A security substrate as claimed in any one of the preceding claims in which the fibrous tape incorporates a security feature.

5. A security substrate as claimed in claim 4 in which the security feature is a watermark.

6. A security substrate as claimed in claim 4 in which the security feature is a security element comprising an impermeable plastic substrate.

7. A security substrate as claimed in any one of the preceding claims in which the fibrous tape has a low permeability in the range of 0 to 100 mls/mins Bentdsen porosity.

8. A security substrate as claimed in any one of the preceding claims in which the at least one aperture in the fibrous tape provides identifying information.

9. A security substrate as claimed in any one of the preceding claims in which the at least one aperture in the fibrous tape is of a size visible to the naked eye.

10. A security substrate as claimed in any one of the preceding claims in which the at least one aperture in the fibrous tape has a width in the range 1mm to 50mm.

11. A security substrate as claimed in claim 10 in which the at least one aperture in the fibrous tape has a width in the range of 5mm to 30mm.

12. A security substrate as claimed in any one of the preceding claims in which the fibrous tape has a linear edge.

13. A security substrate as claimed in any one of claims 1 to 11 in which the fibrous tape has a non-linear edge.

14. A security substrate as claimed in any one of the preceding claims in which edges of the fibrous tape are thinner than the main body of the tape.

15. A security substrate as claimed in any one of the preceding claims in which the fibrous tape has the same

visual appearance as that of the base substrate in reflected light.

16. A security substrate as claimed in anyone of claims 1 to 14 in which the fibrous tape has a different colour to that of the base substrate in reflected light.

17. A security substrate as claimed in any one of preceding claims in which the fibrous tape has a different opacity from that of the base substrate.

18. A security substrate as claimed in any one of the preceding claims in which the fibrous tape is wholly or partially formed from phosphorescent or fluorescent fibres.

19. A security substrate as claimed in any one of the preceding claims in which the base substrate incorporates one or more security features.

20. A security substrate as claimed in claim 19 in which the one or more security features in the base substrate comprise watermarks, security elements and the like.

21. A security substrate as claimed in any one of claims 19 to 20 in which the at least one aperture is registered to a security feature in/on the base substrate.

22. A security substrate as claimed in any one of claims 6 to 21 in which the at least one aperture exposes both sides of at least one portion of a security element being a security feature of the fibrous tape or of the base substrate.

23. A security substrate as claimed in any one of claims 6 to 22 in which the tape further comprises windows in which only one surface of at least one portion of a security element being a security feature of the fibrous tape or of the base substrate is exposed.

24. A security substrate as claimed in any one of claims 6 to 23 in which a security element being a security feature of the fibrous tape or of the base substrate includes more security features.

25. A security substrate as claimed in any one of the preceding claims in which the thickness of the fibrous tape lies in the range of 20 to 70% of the thickness of the base substrate.

26. A security substrate as claimed in claim 25 in which the thickness of the fibrous tape lies in the range of 40 to 70% of the thickness of the base substrate.

27. A security substrate as claimed in any one of the preceding claims in which the depth of fibres covering one side of the fibrous tape lies in the range of 20 to 70% of the thickness of the substrate.

28. A security substrate as claimed in claim 27 in which the depth of fibres covering the one side of the fibrous tape lies in the range of 30 to 50% of the thickness of the base substrate.

29. A security substrate as claimed in claim 27 or claim 28in which the combined thickness of the fibres covering the one side of the fibrous tape and the tape thickness is less than the thickness of the base substrate.

30. A security document made from the security substrate of any one of the preceding claims.

31. A security document as claimed in claim 30 comprising a banknote, document of value, share certificate, passport or the like.

32. A method of forming a security substrate as claimed in any one of the claims 1 to 29 comprising the steps of forming a fibrous tape having at least one aperture therein, forming a fibrous base substrate and integrating the fibrous tape in the base substrate during the formation of the base substrate.

33. A method as claimed in claim 32 in which the base substrate and/or fibrous tape are formed on a cylinder mould papermaking machine.

34. A method as claimed in claim 33 in which the fibrous tape is brought into contact with a cylinder mould cover of the cylinder mould machine after a layer of fibres has already been deposited on the cylinder mould cover.

35. A method as claimed in claim 33 in which the fibrous tape is brought into contact with a cylinder mould cover of the cylinder mould machine mould before a layer of fibres has been deposited.

36. A method as claimed in claim 32 in which the fibrous tape and/or base substrate are formed on a Fourdrinier paper making machine.

37. A method as claimed in any one of claims 32 to 36 in which at least one aperture is formed during the manufacturing of the tape.

38. A method as claimed in any one of claims 32 to 36 in at least one aperture is created after the tape has been fully formed and prior to incorporating into the base substrates.

39. A method as claimed in any one of claims 32 to 38 in which a plurality of tapes are formed from a web of tape substrate, a plurality of wires being attached to a support surface on which the tape substrate is being formed to decrease drainage and fibre deposition and form a light line defining edges of the tapes such the tapes are separable from each other by a tearing action along these lines, said tapes having a frayed fibrous edge.

40. A method as claimed in any one of claims 32 to 39 further comprising the step of incorporating a security element into the base substrate adjacent the tape.

41. A method as claimed in claim 40 in which the tape includes at least one aperture through which the security element contacts a support surface of a papermaking machine during the formation of the base substrate.

42. A method as claimed in claim 40 or claim 41 in which the tape and security element are combined prior to incorporation in the base substrate.

43. A method as claimed in any one of claims 40 to 42 in which the tape and security element are bonded prior to incorporation within the base substrate.

44. A method as claimed in any one of claims 40 to 43 in which the security element is incorporated into the fibrous tape during its fabrication said tape including at least one hole which exposes both sides of at least one portion of the security element.

45. A method as claimed in claim 44 in which the tape further comprises windows in which only one surface of at least one portion of the security element is exposed.

46. A method as claimed in any one of claims 40 to 45 in which the security element includes more security features.

47. A security substrate formed by any one of the method claims 32 to 46.

48. A security document made from a security substrate of claim 47.

49. A security document as claimed in claim 48 comprising a banknote, document of value, share certificate, passport or the like.

50. A security substrate substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

51. A method manufacturing a security substrate substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

UK Intellectual Property Office

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Application No: GB0625089.8 **Examiner:** Richard Pannett

Claims searched: 1-51 **Date of search:** 17 April 2007

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A		GB 1365876 A (PORTALS LTD) See: page 1 lines 60-86.
A		EP 1602782 A2 (BANQUE DE FRANCE) See: abstract; figures 1-5. See also WPI Abstract Accession number 2006-012557 [02].
A		WO 03/085193 A1 (OESTERREICHISCHE BANKNOTEN) See: abstract; page 7 lines 25-33; page 8 lines 21-32; figures 1-8. See also WPI Abstract Accession number 2003-853841 [79].
A		US 2005/0224203 A1 (GIESECKE & DEVRIENT) See: abstract; paragraphs [0006], [0022], [0026], [0029]; figures 9, 11.
A		US 5783275 A (GIESECKE & DEVRIENT) See: abstract; column 5 line 58 to column 6 line 50; figures 6-13.
A		US 4462867 A (PORTALS LTD) See: abstract; column 2 line 42 to column 3 line 12; column 6 lines 27-50; figures 4A, 4B, 6.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

B6A; D1R; D2A

Worldwide search of patent documents classified in the following areas of the IPC

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The following online and other databases have been used in the preparation of this search report

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(54) Laser heat-treated cellulose element, security paper comprising said element, security document comprising said paper and method for embedding a cellulose element in a security paper

(57) The present invention relates to a laser heat-treated cellulose element, security paper comprising said element, security document comprising said paper and method for embedding a cellulose element in a security paper, wherein the cellulose element has a laminar configuration and comprises plant fibers and at least one laser heat-treated area (2, 3, 4), wherein the plant fibers located in said heat-treated area are degraded due to said heat treatment.

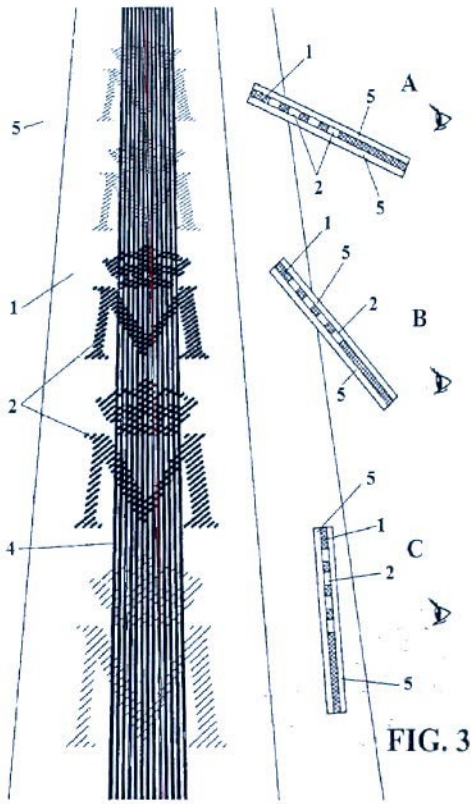


FIG. 3

EP 2 692 539 A1

Description

Technical Field of the Invention

[0001] The present invention can be applied in the security document industry, and more specifically in the area of visual recognition security elements intended for verifying the authenticity of security documents.

Background of the Invention

[0002] Security documents incorporating both through holes and watermarks obtained from thickness differences due to the accumulation of a different amount of cellulose fibers when producing the document are known in the area of security documents incorporating visual security elements today.

[0003] In the first case, for example, international application number WO-9718092-A1 describes a security document in which perforations have been made by means of a laser beam generating a pattern recognizable formed by holes such that the presence of the holes can be easily detected by the eye without needing magnification systems, while at the same time being hardly observable by reflection without optic aids for observation.

[0004] International application number WO-9526274-A1 likewise describes a carrier containing patterns that can be readily recognized by the human eye formed by holes created by a laser beam and they can also be perceived with the naked eye or they may have shapes or irregularities that are so minor that special apparatuses verifying that the hole was made with laser technology and not with conventional mechanical methods are required.

[0005] International application number WO-2006099971-A1 in turn describes producing paper with a plurality of plies where at least one of them is paper and where in each of said plies there can be holes that can overlap one another when the successive plies of paper are overlain both during processes for producing paper in simultaneous plies and in processes for rolling previously produced paper webs. The technology used for making these holes is based on incorporating electrotypes in the wire fabric of the paper machine, these holes being completely perceivable due to the transmission of light.

[0006] On the other hand, in the second case, i.e., in the case of watermarks, there are patent applications, such as for example European patent application number EP-0549384-A1, which describes the technique of producing single-tone watermarks, usually known as electrotypes, which generate on one face of the paper a reduced amount of cellulose fibers present as the result of the inability to deposit said fibers in specific pre-established areas during the process of producing the paper, as there are impermeable parts placed in the wire fabric that prevent the deposition thereof. These watermarks are uniform, i.e., they have a single tone, and are visible by transparency with the naked eye but unperceivable by reflection.

[0007] Multitone watermarks which are generated by means of different depositions of cellulose fibers depending on the variable deformation in heights and depths generated in the wire fabric of the paper machine are also known.

[0008] In any case, producing these security documents with visually noticeable elements involves making perforations in the document as such, with the subsequent acceleration in the deterioration of the document that it entails, in addition to the need to often surface treat the security paper for its protection, which has limitations when they are observed by reflection, or including a watermark, with the subsequent limitations and making the process more expensive all entailed by the foregoing.

[0009] On the other hand, Spanish patent application number 200500563 relates to a security strip, a security paper incorporating said strip and a security document and banknote incorporating said paper. Said document describes a security strip which is formed by a cellulose carrier web formed by plant fibers to which security elements are added for visual observation, said elements including, for example, dyes or expandable agents such as those described in Spanish patent application number 200400256. According to the invention described in Spanish patent application number 200500563, the cellulose strip is fixed between the plies of a paper substrate in the wet area of the paper machine such that bonds form between the cellulose fibers of the outer faces of the strip and the cellulose fibers of the substrate.

Description of the Invention

[0010] A first aspect of the present invention relates to a laser heat-treated cellulose element, which allows obtaining a visually noticeable security element which can be embedded in a security paper, which allows obtaining surprising visual effects relating to their observation either by transparency or by reflection, all in an economical and simple manner.

[0011] The cellulose element proposed by the invention has a laminar configuration and comprises plant fibers, i.e., it consists of paper.

[0012] According to the invention, the security cellulose element comprises at least one laser heat-treated area in which the plant fibers located in said heat-treated area are degraded due to said heat treatment.

[0013] According to a preferred embodiment, the cellulose element is in the form of a web, strip or band, these terms

being considered as equivalents.

[0014] The possibility that the heat-treated area consists of through holes, the effects of which will be described below, is contemplated.

[0015] The possibility that the degradation of the heat-treated area consists of non-through holes, the effects of which will be described below, is also contemplated.

[0016] The possibility that the degradation of the heat-treated area consists of burning only the plant fibers located superficially on the security cellulose element, the effects of which will be described below, is also contemplated.

[0017] A second aspect of the invention relates to a security paper comprising at least one substrate in which at least one cellulose element such as that described above is embedded, where said at least one substrate has enough opacity to prevent the passage of light such that the amount of light going through the assembly formed by substrate and security cellulose element is similar when the light goes through the heat-treated area and when it goes through the non heat-treated area.

[0018] It is understood that substrate is a term equivalent to base paper.

[0019] A third aspect of the invention relates to a security document comprising a security paper corresponding to the second aspect of the invention.

[0020] Security paper is understood as that paper which is ready to be printed or processed such that a security document, an identification document or a valuable document are obtained. The term security document or item refers to that which has particular features assuring its origin and, therefore, its authenticity. These security documents or items include all those used by public administrations and their public agencies, as well as those used in the private sector, when they circulate massively between citizens and businesses, and they contain means or devices for identification, authentication or anti-counterfeiting, commonly referred to as security elements.

[0021] Finally, a fourth aspect of the invention relates to a method for embedding a security cellulose element, like that corresponding to the first aspect of the invention, in a security paper like that corresponding to the second aspect of the invention.

[0022] According to the invention, the method comprises inserting the security cellulose element during a wet forming phase for forming the substrate or sheet of paper and after separating said formed sheet of paper from a wire mesh constituting a paper sheet forming apparatus.

[0023] As can be seen in view of the data relating to wet tensile strength provided below in the preferred embodiment of the invention, the cellulose element can be dispersed or broken down in water, so unlike a security thread, the cellulose element cannot be inserted according to the known methods for embedding a security thread in the substrate at the beginning of the forming process for forming said substrate or sheet of paper. Until now, there has been no method whereby a cellulose element, i.e., also consisting of paper, is embedded in a paper substrate.

[0024] The present invention allows providing a cellulose strip with visually noticeable security features, unlike the strip described in Spanish patent application number P200500563, without requiring the use of any additional type of material such as dyes, fibrils, expandable agents, but said features are formed when certain cellulose fibers which are thermally engraved by means of a laser light source degrade in a localized and controlled manner. Depending on the type and features of the laser beam, the heat increase produced can cause alterations in the color of the cellulose fibers by marking the paper from the surface burning thereof or cutting with perforation in the paper after complete burning of the cellulose fibers of the engraved area. Both the color changes and the holes generated and the combination of both effects in areas close to one another produce surprising and unexpected visual effects depending on specific designs of the areas to be degraded when the security strip is embedded in the paper according to the technique described in P200500563.

[0025] In the case of areas with holes, visual observation with the naked eye and with magnifying means only by reflection and not by transmission can be achieved when the sample of paper with the embedded strip is placed between the observer and a source of light.

[0026] In the case of color changes, a visual effect equivalent to that of a conventional watermark but without the generation of thickness differences typical of this security element is achieved, having the advantage that since it remains inside the substrate it is less susceptible to deterioration than the watermark due to the handling of the security document with which said substrate is produced.

[0027] In the case of the combination of both effects, there is a high contrast between light and dark areas of the area engraved by the laser beam which is much better than that obtained by conventional multitone watermarks.

[0028] The object to be patented is the laser heat-treated cellulose strip, the method of inserting the security strip in the paper substrate during its formation in the wet area of the paper machine, the security paper containing the security strip embedded therein and the security document produced with said security paper.

[0029] The possibility that the cellulose element comprises expandable agents selectively distributed in the pulp or on the surface forming a figure or legend is contemplated, such that when heat and pressure are applied during the phase for producing the security paper containing said cellulose element, said expandable agents expand such that the surface of the cellulose element has a curved and continuous embossment, according to the distribution of the expandable

agents, being recognizable both by sight and by touch. It is also contemplated that the cellulose element comprises any of the security elements described in Spanish patent application number 200500536, including dyes, or any other addition of security elements to the cellulose element itself in combination with the laser treatment thereof.

[0030] Therefore, the invention consists of thermally degrading in specific and located points or areas of a strip of paper made up of cellulose fibers of a plant origin with a laser beam to obtain perforations in said paper when the burning is complete and affects the entire thickness of the engraved area of paper or color changes when the burning is partial and only affects the surface of the engraved area. In summary, the perforations generate areas of through holes throughout the entire thickness of the strip of paper whereas in the color changes, the laser beam does not go through the paper. The non-through holes, i.e., the perforation having certain thickness, generate a tone or color change on the surface of the non-perforated area.

[0031] When the cellulose strip is embedded completely between the plies of a substrate such as that formed by security paper covering the holes in the strip on both faces, due to the opacity of the substrate, greater than 90%, compared to the opacity of the strip, usually around 40%, the phenomenon is inverted in relation to what occurs when the strip is not embedded and the areas with holes or the pattern generated by the assembly thereof are no longer visible by transparency. In other words, the substrate has enough capacity to prevent the passage of light such that the amount of light going through the assembly of the substrate and the strip is similar both when the light passes through the area of holes and through the area without holes. Furthermore, the holes are visible by reflection due to the uneven dispersion of the light when it goes through the substrate and strip with or without holes.

[0032] In the case of color changes, a multitone visual effect is achieved depending on the degree of heat engraving of the laser beam on the cellulose fibers of the surface of the strip which, prior to that engraving, has been treated on the surface of the opposite face by a protective ply, for example by means of printing, sizing or coating systems for the purpose of reaching sufficient mechanical strength so that the unwinding tension and subsequent embedding are still possible without the strip breaking.

[0033] Points or areas with more or less burned area depth which will acquire different yellowish, brownish or black tones will be obtained with the laser heat engraving or marking. This multitone feature can reproduce the visual sensation of conventional watermarks.

[0034] In a conventional watermark generated from a wire fabric of a paper machine, the different fibrous accumulation caused by protrusions or grooves made on said fabric will lead to lighter or darker tones, respectively, but always the color of the paper pulp which in turn will depend on the combination of colorants chosen to provide the generated paper with the desired color. In other words, conventional watermarks always have the same color as the paper containing them but varying the degree of whiteness depending on the existing multitones.

[0035] In contrast, the strip with the image generated by controlled heat degradation has no increase in fiber accumulation, but rather a chemical alteration of the heat-degraded fibers takes place. This is the first difference in relation to conventional multitone watermarks.

[0036] On the other hand, when introducing the strip with the areas containing the aforementioned color changes, the image formed has a different color than the substrate containing it which allows establishing a second difference with respect to conventional watermarks.

[0037] Finally, when the image is generated in the strip and the strip is arranged within the substrate, a greater level of protection against abrasion or wear is achieved, which is the third difference in relation to conventional watermarks.

[0038] In the case of combining both effects (holes and color changes), there is a high contrast between light areas (holes) and dark areas (multitones due to a different degree of heat engraving) of the area in which the laser beam has been applied which is much greater than that obtained by conventional multitone watermarks, although when the strip is introduced in the substrate, the lightest areas corresponding to the holes will no longer be visible by transparency and the complete image with all the holes (which are now seen as dark) and superficially burned areas (multitone) will be obtained when it is viewed by reflection, generating a type of image having a configuration that is different from those known until now.

Description of the Drawings

[0039] To complement the description that is being made and for the purpose of aiding to better understand the features of the invention according to a preferred practical embodiment thereof, a set of drawings is attached as an integral part of said description where the following has been depicted with an illustrative and non-limiting character:

Figure 1 shows a schematic view of the heat-treated cellulose element according to the first aspect of the invention, in which making a motif by means of through holes, as well as the visual behavior of the cellulose element according to different inclinations (A, B, C) can be seen, reflection phenomena for approximate angles of observation less than 30° in view A and between 30°-60° in view B having been depicted in views A and B, whereas the transparency phenomenon between approximately 60°-120° has been depicted in view C.

Figure 2 shows a schematic view like that of Figure 1, in which the cellulose element is embedded in a paper substrate and the visual behavior of the assembly according to different angles of inclination of the observer (A, B, C) can be seen.

Figure 3 shows a schematic view like that of Figure 2, in which the cellulose element is additionally subjected to heat treatment producing the color and shape of dark parallel lines of the same tone; multitones have not been depicted so as to not complicate the visual interpretation of the drawings.

Figure 4 shows a cross-section of the cellulose element in which all the possible effects created by means of laser heat treatment, i.e., through hole, non-through hole and burning only the plant fibers located superficially, have been depicted, in the case of the non-through hole, how certain discoloration of the cellulose fibers takes place can be seen.

Figure 5 shows a schematic perspective view of equipment in which the method for embedding a cellulose element in a security paper according to the fourth aspect of the invention can be carried out, where several webs of the cellulose element are unwound from the reels containing them, being directed from the inside towards the point of overlapping of the two plies of paper generated by each cylindrical sheet forming apparatus.

Preferred Embodiment of the Invention

[0040] In view of the discussed figures, how the production of different visual effects is adjusted by combining the following parameters can be seen in one of the possible embodiments of the invention, according to experimental results:

1.- PARAMETERS OF THE CELLULOSE ELEMENT (1)

[0041]

Parameter	Effect produced	Possible range	Preferred range
Width	Embedding capacity	5 -100 mm	10 - 35 mm
Thickness	Embedding capacity	33 - 66 microns	44 - 55 microns
Bendtsen porosity (x4 sheets)	Capillarity	> 2000 ml/min	> 2500 ml/min
Grammage	Embedding capacity	15 - 30 g/m^2	20 - 25 g/m2
Dry tensile strength	Prevent breaking while embedding	SL: 20 - 35 N/15 mm ST: 8 - 25 N/15 mm	SL: 25 - 30 N/15 mm ST: 10 - 20 N/15 mm
Wet tensile strength	Prevent breaking while embedding	SL: 0 - 5 N/15 mm	SL: 0 - 2 N/15 mm
Opacity	Visibility of the optic effect	30% - 60%	35% - 45%

2.- PARAMETERS OF THE GRAPHIC DESIGN TO BE DEGRADED IN THE CELLULOSE ELEMENT (1)

[0042]

Parameter	Effect produced	Possible range	Preferred range
Geometry of the discoloring	Visual by reflection	Unlimited	Continuous areas in the form of lines, dots or speckles
Geometry of the holes	Visual by reflection	Polygons, circles, ovals, lines	Lines, circles
Distances between holes	Generation of an optical illusion	0.1 - 1.0 mm	0.1 - 0.2 mm
Perforated width	Generation of an optical illusion	0.1 - 10 mm	0.2- 1 mm

3.- PARAMETERS OF THE LASER AND THE ADJUSTMENT THEREOF FOR DEGRADATION

[0043]

Parameter	Effect produced	Possible range	Preferred range
Laser source	Heat degradation of the strip	Nd:YAG; Ho:YAG; Er:YAG; Tm:YAG; Organic colorant; Excimer; CO_2	Nd:YAG; CO_2
Wavelength	Heat degradation of the strip	100 - 11000 nm	9000 - 11000 nm
Type of head	Heat degradation rate	Fixed, Galvanometer	Galvanometer
Axes of the head	Heat degradation rate	2-3	2-3
Pulse power	Scope of the heat degradation	100 - 2000 W	125 - 250 W
Spot diameter	Geometry of the heat degradation	2 - 50 mm	2-5 mm

[0044] With respect to the manner of integrating the cellulose element into the substrate (5), the indications provided in Spanish patent application number 200500563 are followed, but considering the parameters of integration and of the substrate (5) provided in the following tables.

4.- PARAMETERS OF THE SUBSTRATE (5)

[0045]

Parameter	Effect produced	Possible range	Preferred range
Thickness	Embedding capacity	84 - 144 microns	102 - 108 microns
Bendtsen porosity (x4 sheets)	Capillarity	5 - 50 ml/min	10 - 35 ml/min
Grammage	Embedding capacity	70 - 150 g/m^2	85 - 100 g/m^2
Dry tensile strength	Prevent breaking while forming the sheet and winding the substrate itself	SL: 45 - 135 N/15 mm ST: 30 - 75 N/15 mm	SL: 75 - 120 N/15 mm ST: 45 - 65 N/15 mm
Wet tensile strength	Prevent breaking while forming the sheet and winding the substrate itself	SL: 15 - 65 N/15 mm ST: 7 - 35 N/15 mm	SL: 30 - 45 N/15 mm ST: 15 - 30 N/15 mm
Plies	Embedding capacity	2 - 4	2
Production rate	Embedding tension	40 - 100 m/min	45 - 55 m/min
Opacity	Visibility of the optic effect	85% - 99%	92% - 96%

5.- PARAMETERS OF INSERTION OF THE CELLULOSE ELEMENT (1) IN THE SUBSTRATE (5)

[0046]

Parameter	Effect produced	Possible range	Preferred range
Distance to the surface of the substrate	Pulling the strip through the substrate	<15mm	5 - 8 mm
Initial air pressure	Driving the strip towards the substrate	1.50 - 2.00 bar	1.70 - 1.80 bar
Air pressure	Keeping the strip embedded while producing the substrate	0.2 - 0.5 bar	0.25 - 0. 35 bar

Embodiments:

A. CUTTING OR PERFORATING:

[0047] Burning with perforation by means of through holes (2) having the geometry of lines generating the optical illusion of the figure corresponding to the emblem of the Fábrica Nacional de Moneda y Timbre (National Mint and Stamp Factory), as depicted in Figures 1 to 3, was carried out on a cellulose element (1) 18 mm wide, 22 g/m^2 in grammage, 48 microns thick, with a Bendtsen porosity of 2600 ml/min (x4 sheets), a dry tensile strength of 28 N/15 mm in the longitudinal direction (SL) and 17 N/15 mm in the transverse direction (ST), and a wet tensile strength of 0.2 N/15 mm in the longitudinal direction, the value of which is the same in the transverse direction. The lines had a perforated width of 0.15 mm and a distance between them of 0.1 mm.

[0048] The burning was performed with a CO_2 laser source with a wavelength of 10000 nm and a power of 150 W, through a 3-axis galvanometer head and a spot diameter of 2 mm.

[0049] The cellulose element (1) generated by these means obtained an observation by transparency and by reflection corresponding to the desired graphic design.

[0050] This cellulose element (1) was subsequently embedded between the two plies of a cotton paper substrate (5) when both plies are coming out of their corresponding sheet forming apparatuses (7) of the paper machine and a final substrate of 87 g/m^2, 106 microns thick, with 94% opacity was obtained at a production rate of 48 m/min.

[0051] To achieve the correct embedding of the cellulose element (1) a device for unwinding the reel containing the cellulose element (1) in the form of strip driving said strip with air at a pressure of 1.75 bar was used to place the cellulose strip (1) at a distance of up to 8 mm from one of the two plies of the substrate (5). Once the strip (1) is adhered between the two plies of paper as a result of the capillarity and fluid transfer phenomena of the cellulose pulp, the tension of the cellulose strip (1) was maintained at the same unwinding rate as the production rate of the substrate and with a supply air pressure of 0.3 bar.

[0052] In summary, the method according to the invention as illustrated in Figure 5 comprises inserting the security cellulose element (1) during a wet forming phase (6) for forming the substrate (5) and after separating said formed sheet of paper from a wire mesh constituting a paper sheet forming apparatus (7).

[0053] After producing the paper substrate (5) with the embedded strip (1), it was found that the optical illusion of the desired image was no longer visible by transparency but only by reflection on one of the faces of the substrate.

[0054] To illustrate the effects achieved with the invention, Figure 1 shows a schematic view of the heat-treated cellulose element (1) according to the first aspect of the invention, in which the making of a motif by means of through holes (2), as well the visual behavior of the cellulose element according to different inclinations can be seen.

[0055] In all of Figures 1 to 3, each of the three views A, B and C depicts a common phenomenon, phenomena of reflection for approximate angles of observation less than 30° in view A and between 30°-60° in view B having been depicted in views A and B, whereas the transparency phenomenon between approximately 60°-120° has been depicted in view C.

[0056] On the other hand, Figure 2 shows a schematic view like that of Figure 1, in which the cellulose element (1) is embedded in a paper substrate (5).

B. MARKING OR DISCOLORING

[0057] A protective ply is provided on a cellulose strip (1) 25 mm wide, 22 g/m^2 in grammage, 48 microns thick, with a Bendtsen porosity of 2600 ml/min (x4 sheets), a dry tensile strength of 28 N/15 mm in the longitudinal direction and 17 N/15 mm in the transverse direction, and a wet tensile strength of 0.2 N/15 mm in the longitudinal direction by means of a rotogravure printing process on one of its faces for the purpose of reaching sufficient mechanical strength so that after heat engraving, the unwinding tension and subsequent embedding are still possible without the strip breaking.

[0058] Then discoloration is performed by means of burned surface plant fibers (4) or by means of non-through holes (3), as can be seen in Figure 4, on the untreated face with the protective ply having a geometry of speckles generating irregular shapes enclosed in rectangular areas.

[0059] The marking or discoloring is done with a CO_2 laser source with a wavelength of 10000 nm and a power of 120 W, through a 3-axis galvanometer head and a spot diameter of 2 mm.

[0060] The cellulose strip (1) generated by these means obtains observation by transparency and by reflection corresponding to the desired random design.

[0061] This cellulose strip (1) was subsequently embedded between the two plies of a cotton paper substrate (5) when both plies are coming out of their corresponding sheet forming apparatuses (7) of the paper machine and a final substrate of 87 g/m^2, 106 microns thick, with 94% opacity was obtained at a production rate of 48 m/min, as schematically depicted in the process carried out in the equipment illustrated in Figure 5.

[0062] To achieve the correct embedding of the cellulose strip (1) a device for unwinding the reel containing the strip

(1) driving said strip (1) with air at a pressure of 1.75 bar was used to place the cellulose strip (1) at a distance of up to 8 mm from one of the two plies of the substrate (5). Once the strip (1) is adhered between the two plies of paper as a result of the capillarity and fluid transfer phenomena of the cellulose pulp, the tension of the cellulose strip (1) was maintained at the same unwinding rate as the production rate of the substrate (5) and with a supply air pressure of 0.3 bar.

[0063] After producing the paper substrate (5) with the embedded strip (1) it is found that the marked areas are visible both by reflection and by transparency.

[0064] For the purpose of illustrating the foregoing, Figure 3 shows a schematic view like that of Figure 2, in which the cellulose element (1) is additionally subjected to heat treatment producing the color and shape of dark parallel lines of the same tone; multitones have not been depicted so as to not complicate the visual interpretation of the drawings, as discussed above; the phenomena depicted in each of the views A, B and C correspond with said same views of Figures 1 and 2.

[0065] In view of this description and set of drawings, the person skilled in the art will understand that the embodiments of the invention that have been described can be combined in many ways within the object of the invention. The invention has been described according to some preferred embodiments thereof, but for the person skilled in the art it will be evident that many variations can be introduced in said embodiments preferred without exceeding the object of the claimed invention.

Claims

1. Laser heat-treated cellulose element, having a laminar configuration and comprising plant fibers, **characterized in that** said security cellulose element (1) comprises at least one laser heat-treated area (2, 3, 4), wherein the plant fibers located in said heat-treated area are degraded due to said heat treatment.

2. Cellulose element according to claim 1, wherein the degradation of the heat-treated area consists of through holes (2).

3. Cellulose element according to any of the preceding claims, wherein the degradation of the heat-treated area consists of non-through holes (3).

4. Cellulose element according to any of the preceding claims, wherein the degradation of the heat-treated area consists of burning only the plant fibers located superficially on the security cellulose element, such that the cellulose element (1) has burned surface plant fibers (4).

5. Cellulose element according to any of the preceding claims, the thickness of which is between 44-55 microns, has a grammage between 20-25 g/m^2 and opacity between 35%-45%.

6. Security paper comprising at least one substrate (5), wherein at least one cellulose element (1) according to any of claims 1 to 5 is embedded, where said at least one substrate (5) has enough opacity to prevent the passage of light such that the amount of light going through the assembly formed by substrate (5) and security cellulose element (1) is similar when the light goes through the heat-treated area (2, 3, 4) and when it goes through the non heat-treated area.

7. Security paper according to claim 6, wherein the substrate (5) has a thickness between 102-108 microns, a grammage between 85-100 g/m^2 and opacity between 92%-96%.

8. Security document comprising a paper according to any of claims 6 and 7.

9. Method for embedding a security cellulose element (1) according to any of claims 1 to 5 in a security paper according to any of claims 6 and 7, **characterized in that** it comprises inserting said security cellulose element (1) during a wet forming phase (6) for forming the substrate (5) and after separating said formed sheet of paper from a wire mesh constituting a paper sheet forming apparatus (7).

10. Method according to claim 9, wherein the distance between through holes (2) in the cellulose element (1) is 0.1-0-2 mm and the perforated width is 0.2-1 mm.

11. Method according to any of claims 9 and 10, wherein the laser wavelength is 9000-11000 nm, with a galvanometer head, wherein the pulse power is 125-250 W, with a spot diameter of 2-5 mm.

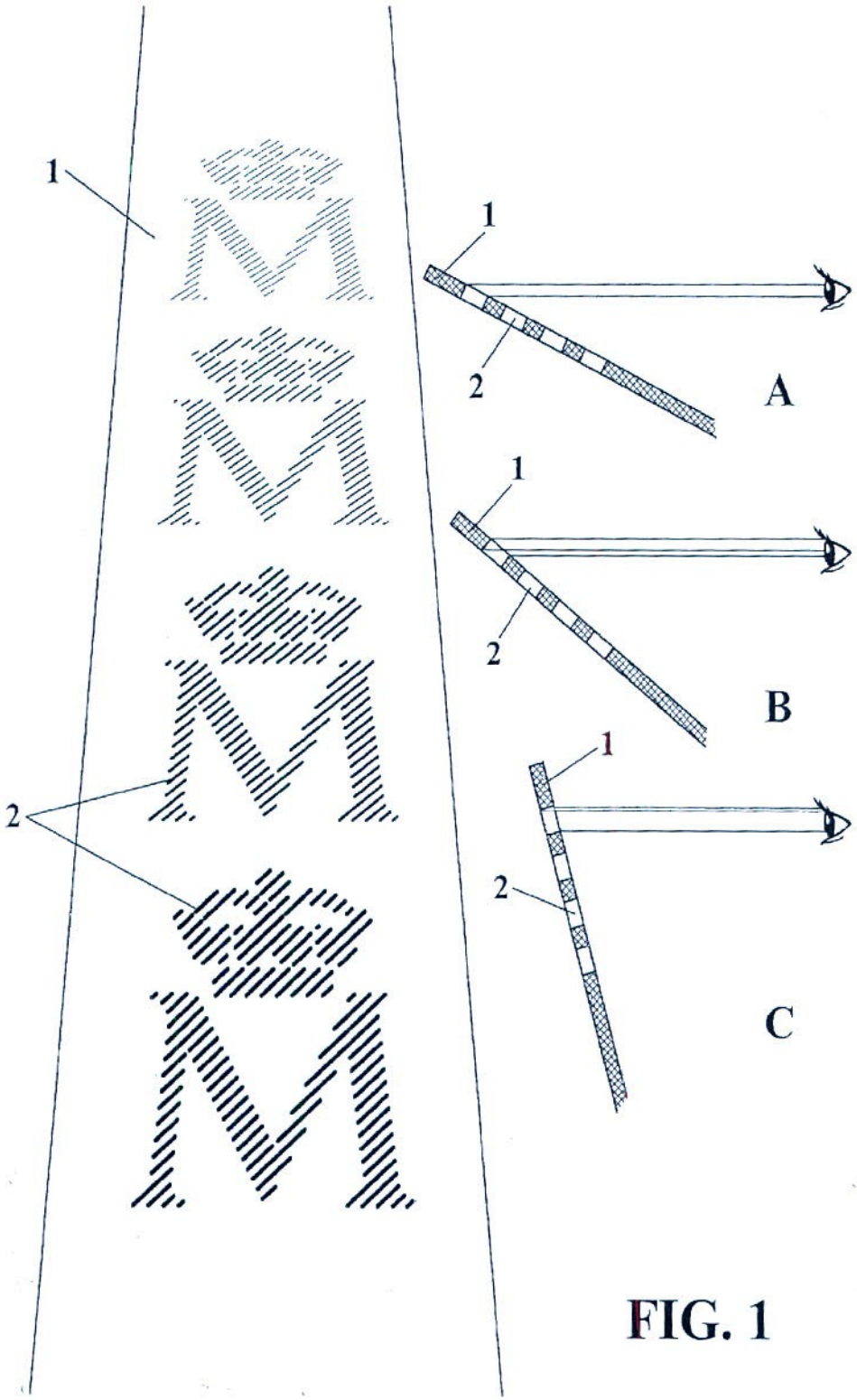


FIG. 1

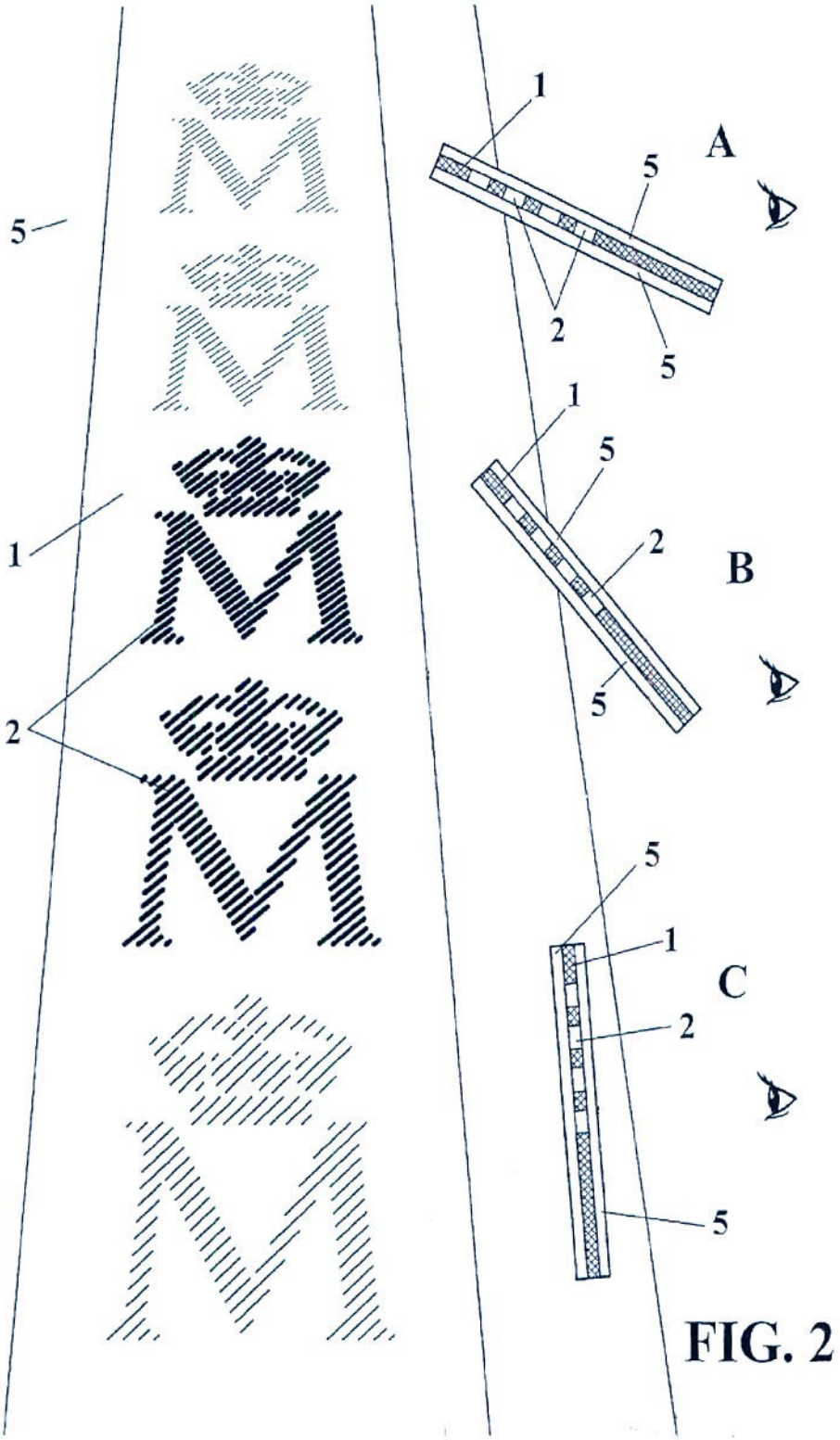


FIG. 2

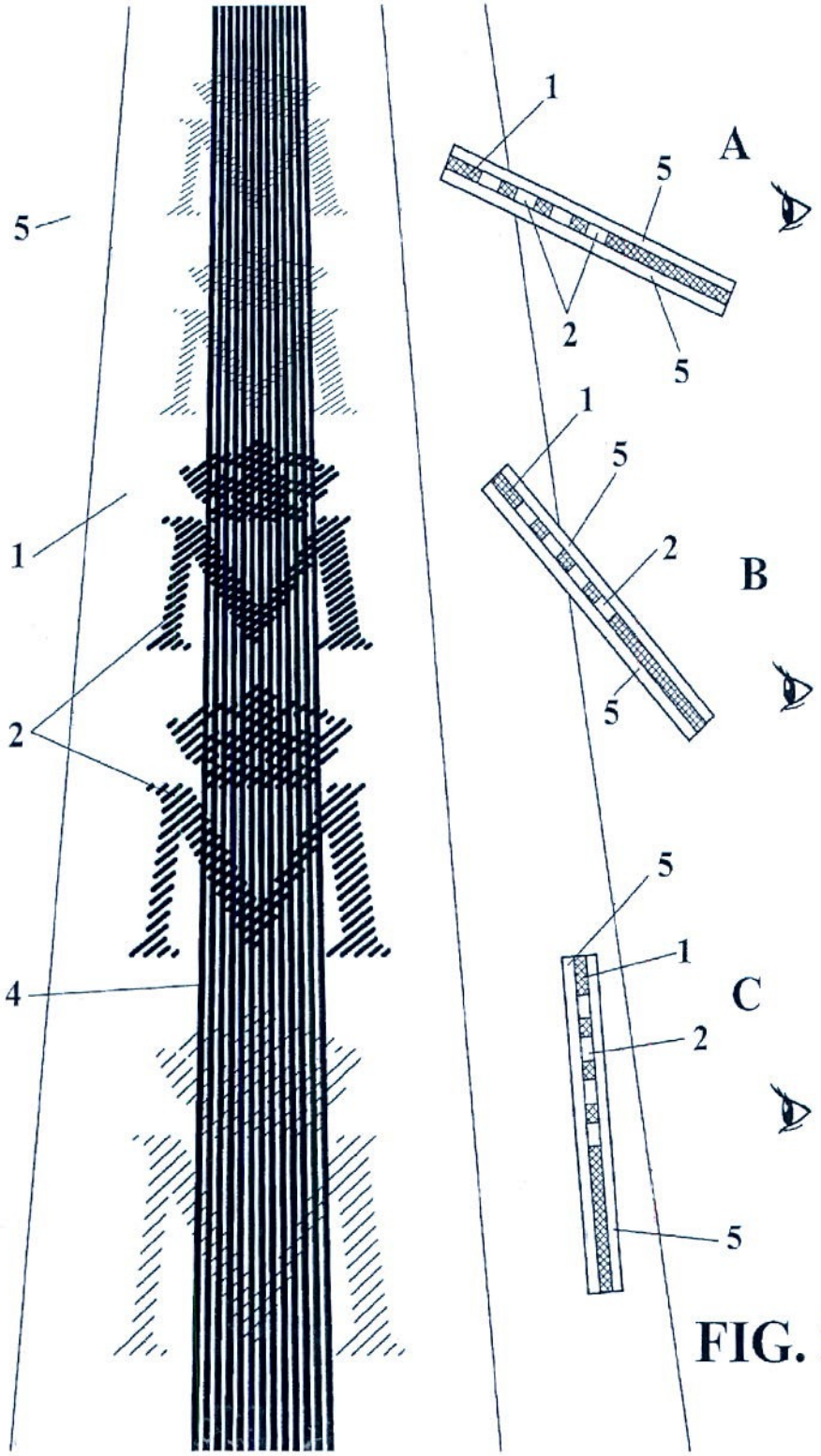


FIG. 3

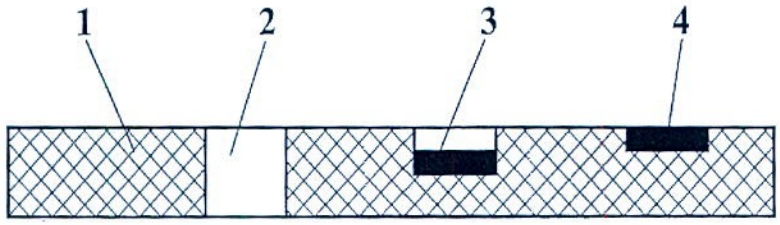


FIG. 4

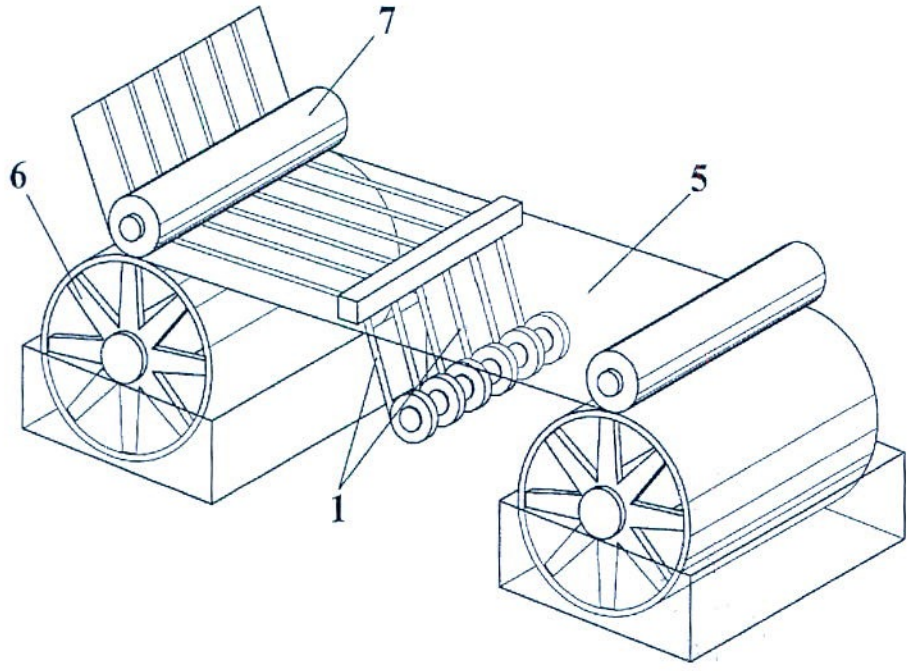


FIG. 5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 12 38 2309

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 2 433 469 A (RUE DE INT LTD [GB]) 27 June 2007 (2007-06-27) * Abstract; page 17, lines 17-24; figures 1-4,7-10 *	1-11	INV. B42D15/00 B41M5/24 D21H21/48
X	US 2011/056638 A1 (ROSSET HENRI [FR]) 10 March 2011 (2011-03-10) * Abstract; paragraphs [0142], [0157], [0271]; figures 4-12 *	1-11	
X	EP 0 070 172 A1 (PORTALS LTD [GB]) 19 January 1983 (1983-01-19) * paragraphs [0013] - [0021] *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)

B42D
D21H
B41M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 December 2012	Callan, Feargel

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 38 2309

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- WO 9718092 A1 **[0003]**
- WO 9526274 A1 **[0004]**
- WO 2006099971 A1 **[0005]**
- EP 0549384 A1 **[0006]**
- ES 200500563 **[0009] [0044]**
- ES 200400256 **[0009]**
- ES P200500563 **[0024]**
- ES 200500536 **[0029]**

ELEMENTO CELULÓSICO TRATADO TÉRMICAMENTE POR LÁSER, PAPEL DE SEGURIDAD QUE COMPRENDE DICHO ELEMENTO, DOCUMENTO DE SEGURIDAD QUE COMPRENDE DICHO PAPEL Y PROCEDIMIENTO PARA EMBEBER UN ELEMENTO CELULÓSICO EN UN PAPEL DE SEGURIDAD

DESCRIPCIÓN

CAMPO TÉCNICO DE LA INVENCIÓN

La presente invención tiene aplicación en la industria de los documentos de seguridad, y más concretamente en el ámbito de los elementos de seguridad de reconocimiento visual destinado a verificar la autenticidad de documentos de seguridad.

ANTECEDENTES DE LA INVENCIÓN

En la actualidad, en el ámbito de los documentos de seguridad que incorporan elementos de seguridad visuales, son conocidos documentos de seguridad que incorporan tanto orificios pasantes como marcas de agua obtenidas a partir de diferencias de espesor por acumulación de distinta cantidad de fibras celulósicas durante la obtención del documento.

En el primer caso, por ejemplo, la solicitud internacional n.º WO-9718092-A1 describe un documento de seguridad en el que se han realizado perforaciones mediante un rayo láser generando un patrón reconocible formado por agujeros de tal manera que la presencia de los agujeros puede ser detectada fácilmente por el ojo sin necesidad de sistemas de aumento, al tiempo que resulta muy difícilmente observable por reflexión sin ayudas ópticas para su apreciación.

Asimismo, la solicitud internacional n.º WO-9526274-A1 describe un soporte que contiene patrones reconocibles fácilmente por el ojo humano, formados por orificios creados por un rayo láser y que también puede ser percibidos a simple vista o con formas o irregularidades tan pequeñas que se precisa disponer de aparatos especiales que verifiquen que el orificio fue realizado con tecnología láser

y no con procedimientos mecánicos convencionales.

Por su parte, la solicitud internacional n.º WO-2006099971-A1 describe la fabricación de papel con una pluralidad de capas donde al menos una de ellas es de papel y donde en cada una de dichas capas pueden existir agujeros que pueden quedar superpuestos al superponer las sucesivas capas de papel tanto en procesos de fabricación de papel en capas simultáneas como en procesos de laminado de bandas de papel previamente fabricadas. La tecnología utilizada para la realización de estos agujeros está basada en la incorporación de electrotipos en la tela metálica de la máquina de papel, siendo estos agujeros totalmente perceptibles por transmisión de luz.

Por otro lado, en el segundo caso, esto es, en el caso de las marcas de agua, existen solicitudes de patente, como por ejemplo la solicitud de patente europea n.º EP-0549384-A1, que describen la técnica de fabricación de marcas de agua monotonales, habitualmente conocidas como electrotipos, que generan en una cara del papel una disminución de la cantidad de fibras celulósicas presentes como consecuencia de la imposibilidad de deposición de dichas fibras en determinadas zonas preestablecidas durante el proceso de fabricación del papel, al existir piezas impermeables colocadas en la tela metálica que impiden su deposición. Estas marcas de agua son uniformes, es decir, tienen un único tono, y son visibles por transparencia a simple vista pero imperceptibles por reflexión.

Del mismo modo es conocido el tipo de marcas de agua multitonales, las cuales son generadas mediante diferentes deposiciones de fibras celulósicas en función de la variable deformación en alturas y profundidades generadas en la tela metálica de la máquina de papel.

En cualquier caso, la obtención de estos documentos de seguridad con elementos apreciables visualmente implica la realización de perforaciones en el documento como tal, con la consiguiente aceleración en el deterioro del documento que ello conlleva, además de la necesidad en muchas ocasiones de tratar superficialmente el papel de seguridad para su protección, teniendo sus limitaciones a la hora de ser apreciados por reflexión, o bien la inclusión de marca de agua, con

las consiguientes limitaciones y encarecimiento del proceso que ello conlleva.

Por otra parte, la solicitud de patente española n.º 200500563 se refiere a una tira de seguridad, un papel de seguridad que incorpora dicha tira y una documento de seguridad y billete que incorporan dicho papel. Dicho documento describe una tira de seguridad que está formada por una banda de soporte celulósico formada por fibras vegetales a la cual se añaden elementos de seguridad para su apreciación visual, entre los cuales se encuentran, por ejemplo, pigmentos o agentes expandibles como los descritos en la solicitud de patente española n.º 200400256. De acuerdo con la invención descrita en la solicitud de patente española n.º 200500563, la tira celulósica se fija entre las capas de un sustrato de papel en la zona húmeda de la máquina de papel de manera que se producen enlaces entre las fibras celulósicas de las caras exteriores de la tira y las fibras celulósicas del sustrato.

DESCRIPCIÓN DE LA INVENCIÓN

Un primer aspecto de la presente invención se refiere a un elemento celulósico tratado térmicamente por láser, que permite obtener un elemento de seguridad apreciable visualmente que puede ser embebido en un papel de seguridad, permitiendo obtener efectos visuales sorprendentes relativos a su visualización ya sea por transparencia o por reflexión, todo ello de manera económica y sencilla.

El elemento celulósico que la invención propone tiene configuración laminar y comprende fibras vegetales, es decir, es de papel.

De acuerdo con la invención el elemento celulósico de seguridad comprende al menos una zona tratada térmicamente mediante láser en la que las fibras vegetales localizadas en dicha zona tratada térmicamente están degradadas por efecto de dicho tratamiento térmico.

De acuerdo con una realización preferente, el elemento celulósico se constituye como una banda, tira o cinta, considerándose estos términos como

equivalentes.

Se contempla la posibilidad de que la zona tratada térmicamente consista en orificios pasantes, cuyos efectos se describirán más adelante.

Asimismo se contempla la posibilidad de que la degradación de la zona tratada térmicamente consista en orificios no pasantes, cuyos efectos se describirán más adelante.

También se contempla la posibilidad de que la degradación de la zona tratada térmicamente consista en calcinar únicamente las fibras vegetales situadas superficialmente en el elemento celulósico de seguridad, cuyos efectos se describirán más adelante..

Un segundo aspecto de la invención se refiere a un papel de seguridad que comprende al menos un sustrato en el que se encuentra embebido al menos un elemento celulósico como el anteriormente descrito, donde dicho, al menos un, sustrato tiene opacidad suficiente para impedir el paso de la luz de forma que la cantidad de luz que llega a atravesar el conjunto formado por sustrato y elemento celulósico de seguridad es similar cuando la luz atraviesa la zona tratada térmicamente y cuando atraviesa la zona no tratada térmicamente.

Se entiende que sustrato es un término equivalente a papel base.

Un tercer aspecto de la invención se refiere a un documento de seguridad que comprende un papel de seguridad correspondiente al segundo aspecto de la invención.

Se entiende por papel de seguridad aquel que está listo para ser impreso o procesado de tal forma que se obtiene un documento de seguridad, de identificación o de valor. El término artículo o documento de seguridad se refiere a aquél que presenta unas características particulares que aseguran su origen y, por lo tanto, su autenticidad. Entre estos artículos o documentos de seguridad se encuentran todos aquellos utilizados por las administraciones públicas y sus

organismos públicos, así como los utilizados en el sector privado, cuando estos circulan de forma masiva entre el conjunto de ciudadanos y empresas, y que contiene medios o dispositivos de identificación, autentificación o antifalsificación, denominados comúnmente elementos de seguridad.

Por último, un cuarto aspecto de la invención se refiere a un procedimiento para embeber un elemento celulósico de seguridad, como el correspondiente con el primer aspecto de la invención, en un papel de seguridad como el correspondiente con el segundo aspecto de la invención.

De acuerdo con la invención, el procedimiento comprende insertar el elemento celulósico de seguridad durante una fase de formación húmeda del sustrato, u hoja de papel, y tras la separación de dicha hoja de papel formada de una malla metálica que constituye un formador de la hoja de papel.

El elemento celulósico, tal y como se puede comprobar a la vista de los datos relativos a su resistencia a la tracción en húmedo proporcionados más adelante en la realización preferente de la invención, es dispersable o disgregable en agua, por lo que a diferencia de un hilo de seguridad, no es posible su inserción de acuerdo con los procedimientos conocidos para embeber un hilo de seguridad en el sustrato, al principio del proceso de formación de dicho sustrato u hoja de papel. Hasta ahora, no existe ningún procedimiento mediante el cual se embeba en un sustrato de papel un elemento celulósico, es decir, igualmente de papel.

La presente invención permite dotar a una tira celulósica de características de seguridad apreciables visualmente, a diferencia de la tira descrita en la solicitud de patente española n.º P200500563 sin requerir la utilización de ningún tipo de material adicional como pigmentos, fibrillas, agentes expandibles, sino que dichas características se producen al degradar de forma localizada y controlada ciertas fibras de celulosa que son atacadas térmicamente mediante una fuente de luz láser. En función del tipo y características del rayo láser, el incremento térmico producido puede provocar alteraciones en la coloración de las fibras de celulosa por marcado del papel a partir de la calcinación superficial de las mismas o corte con perforación en el papel tras una calcinación total de las fibras de celulosa

del área atacada. Tanto los cambios de coloración como los orificios generados y la combinación de ambos efectos en zonas próximas entre si producen efectos visuales sorprendentes e inesperados en función de diseños específicos de las áreas a degradar cuando la tira de seguridad es embebida en el papel según la técnica descrita en P200500563.

En el caso de las áreas con orificios se puede obtener una apreciación visual a simple vista y con medios de aumento solo por reflexión y no por transmisión cuando se sitúa la muestra de papel con la tira embebida entre el observador y un foco de luz.

En el caso de los cambios de coloración se consigue un efecto visual equivalente al de la marca de agua convencional pero sin generarse las diferencias de espesor típicas de este elemento de seguridad teniendo la ventaja de que, al permanecer en el interior del sustrato es menos susceptible de ser deteriorada que la marca de agua por causa de la manipulación del documento de seguridad con el que esté fabricado dicho sustrato.

En el caso de la combinación de ambos efectos se produce un alto contraste entre zonas claras y oscuras de la zona atacada por el rayo láser que es muy superior al obtenido por las marcas de agua multitonales convencionales.

Se pretende patentar la tira celulósica tratada térmicamente con láser, el procedimiento de inserción de la tira de seguridad en el sustrato de papel durante su formación en la zona húmeda de la máquina de papel, el papel de seguridad que contiene embebida la tira de seguridad y el documento de seguridad fabricado con dicho papel de seguridad.

Se contempla la posibilidad de que el elemento celulósico comprenda agentes expandibles distribuidos de forma selectiva en masa o superficialmente conformando una figura o leyenda, de forma que cuando se aplica presión y calor en la fase de fabricación del papel de seguridad que contiene dicho elemento celulósico, se produce una expansión de dichos agentes expandibles, de forma que en la superficie del elemento celulósico se tiene un relieve curvado y continuo, de

acuerdo con la distribución efectuada de los agentes expandibles, siendo reconocibles tanto visualmente como al tacto. Asimismo, se contempla que el elemento celulósico comprenda cualquier de los elementos de seguridad descritos en la solicitud de patente española n.º 200500536, entre los que cabe mencionar pigmentos, o cualquier otra adición de elementos de seguridad al propio elemento celulósico, en combinación con el tratamiento láser del mismo.

Por lo tanto, la invención consiste en degradar térmicamente con un rayo láser en puntos o áreas concretas y localizadas de una tira de papel compuesto por fibras celulósicas de origen vegetal para obtener perforaciones en dicho papel cuando la calcinación es total y afecta a todo el espesor del área de papel atacada o cambios de color cuando la calcinación es parcial y afecta solo a la superficie del área atacada. En definitiva, las perforaciones provocan áreas de orificios pasantes en todo el espesor de la tira de papel mientras que en los cambios de coloración el rayo láser no atraviesa el papel. Los orificios no pasantes, es decir, la perforación de cierto espesor, genera un cambio de tonalidad o color en la superficie del área no perforada.

Cuando la tira celulósica se embebe completamente entre las capas de un sustrato como el constituido por papel de seguridad tapando por ambas caras los orificios existentes en la tira, por causas de la opacidad del sustrato, superior al 90%, en comparación con la opacidad de la tira, habitualmente en torno al 40%, el fenómeno se invierte en relación a lo que ocurre cuando la tira no está embebida y las áreas con orificios o el patrón generado por el conjunto de los mismos dejan de ser visibles por transparencia. Es decir el sustrato tiene una capacidad suficiente para impedir el paso de la luz de tal forma que la cantidad de luz que llega a atravesar el conjunto del sustrato y la tira es similar tanto cuando la luz pasa por la zona de orificios como por la zona sin orificios. Además los orificios son visibles por reflexión por causa de la desigual dispersión de la luz cuando esta atraviesa el sustrato y tira con orificios o sin orificios.

En el caso de los cambios de coloración se consigue un efecto visual multitonal en función del grado de ataque térmico del rayo láser sobre las fibras de celulosa de la superficie de la tira que previamente a ese ataque ha sido tratada en

la superficie de la cara opuesta por una capa de protección, por ejemplo mediante sistemas de impresión, encolado o estucado con el objetivo de alcanzar la resistencia mecánica suficiente para que la tensión de desbobinado y el embebido posterior siga siendo posible sin roturas de la tira.

Con el marcado o ataque térmico del láser se obtendrán puntos o zonas con mayor o menor profundidad de área calcinada que adquirirán distintos tonos amarillentos, parduzcos o negros. Esta multitonalidad puede reproducir la sensación visual de las marcas de agua convencionales.

En la marca de agua convencional generada a partir de una tela metálica de una máquina de papel, la distinta acumulación fibrosa producida por las protuberancias o hendiduras provocadas sobre dicha tela conducirá a tonos más claros o más oscuros respectivamente pero siempre del color de la pasta de papel que, a su vez, dependerá de la combinación de colorantes elegidos para dotar al papel generado del color deseado. Es decir las marcas de agua convencionales siempre tienen el mismo color que el papel que las contiene pero variando el grado de blancura en función del los multitonos existentes.

Por el contrario la tira con la imagen generada por degradación térmica controlada no tiene incremento de acumulación fibrosa sino que se produce una alteración química de las fibras degradadas por causa del calor. Esta es la primera diferencia en relación a las marcas de agua multitonales convencionales.

Por otra parte al introducir la tira con las áreas que contiene los cambios de color mencionados, la imagen formada tiene un color distinto que el del sustrato que la contiene lo cual permite establecer una segunda diferencia con respecto a las marcas de agua convencionales.

Por último, al encontrarse la imagen generada en la tira y esta quedar dispuesta en el interior del sustrato, se alcanza un mayor nivel de protección contra la abrasión o el desgaste, lo que constituye la tercera diferencia con relación a las marcas de agua convencionales.

En el caso de la combinación de ambos efectos (orificios y cambios de color) se produce un alto contraste entre zonas claras (orificios) y oscuras (multitonales por distinto grado de ataque térmico) de la zona en la que ha actuado por el rayo láser que es muy superior al obtenido por las marcas de agua multitonales convencionales si bien cuando se introduce la tira en el sustrato , las zonas más claras correspondientes a los orificios dejarán de ser visibles por transparencia y la imagen completa con la suma de orificios (que ahora se verán oscuros) y áreas calcinadas superficialmente (multitonales) se obtendrá al visualizarla por reflexión generando un tipo de imagen de diferente configuración a las conocidas hasta la fecha.

DESCRIPCIÓN DE LOS DIBUJOS

Para complementar la descripción que se está realizando y con objeto de ayudar a una mejor comprensión de las características del invento, de acuerdo con un ejemplo preferente de realización práctica del mismo, se acompaña como parte integrante de dicha descripción, un juego de dibujos en donde con carácter ilustrativo y no limitativo, se ha representado lo siguiente:

La figura 1.- Muestra una vista esquemática del elemento celulósico tratado térmicamente de acuerdo con el primer aspecto de la invención, en el que puede apreciarse la realización de un motivo mediante orificios pasantes, así como el comportamiento visual del elemento celulósico según diferentes inclinaciones (A, B, C); habiéndose representado en las vistas A y B fenómenos de reflexión para ángulos de observación aproximados menores a 30º en la vista A y entre 30º-60º en la vista B, mientras que en la vista C se ha representado el fenómeno de transparencia entre 60º-120º aproximadamente.

La figura 2.- Muestra una vista esquemática como la de la figura 1, en la que el elemento celulósico se encuentra embebido en un sustrato de papel y el comportamiento visual del conjunto según diferentes ángulos de inclinación del observador (A, B, C).

La figura 3.- Muestra una vista esquemática como la de la figura 2, en la

que adicionalmente el elemento celulósico tiene un tratamiento térmico que produce coloración e forma de líneas paralelas oscuras de un mismo tono; para no complicar la interpretación visual de las figuras no se ha representado multitonos.

La figura 4.- Muestra una sección transversal del elemento celulósico en el que se han representado todos los efectos posibles realizados mediante tratamiento térmico con láser, esto es, orificio pasante, orificio no pasante y calcinación únicamente de las fibras vegetales situadas superficialmente, en el caso del orificio no pasante, puede apreciarse cómo se produce asimismo cierta decoloración de las fibras celulósicas.

La figura 5.- Muestra una vista esquemática en perspectiva de un equipo en el que ejecutar el procedimiento para embeber un elemento celulósico en un papel de seguridad, de acuerdo con el cuarto aspecto de la invención, donde varias bandas del elemento celulósico se van desbobinando de las bobinas que las contienen, dirigiéndose por el interior hacia el punto de superposición de las dos capas de papel generadas por cada formador de hoja cilíndrico.

REALIZACIÓN PREFERENTE DE LA INVENCIÓN

A la vista de las figuras reseñadas puede observarse cómo en una de las posibles realizaciones de la invención, de acuerdo con resultados experimentales, la obtención de los distintos efectos visuales se ajusta con la combinación de los siguientes parámetros:

1.- PARÁMETROS DEL ELEMENTO CELULÓSICO (1)

Parámetro	Efecto producido	Intervalo posible	Intervalo preferente
Anchura	Capacidad de embebido	5 – 100 mm	10 – 35 mm
Espesor	Capacidad de embebido	33 – 66 micras	44 – 55 micras
Porosidad	Capilaridad	> 2000 ml/min	> 2500 ml/min

Bendtsen(x4hojas)			
Gramaje	Capacidad de embebido	15 – 30 g/m²	20 - 25 g/m²
Resistencia a la tracción en seco	Evitar roturas en el embebido	SL: 20 – 35 N/15mm ST: 8 – 25 N/15mm	SL: 25 – 30 N/15mm ST: 10 – 20 N/15mm
Resistencia a la tracción húmedo	Evitar roturas en el embebido	SL: 0 – 5 N/15mm	SL: 0 – 2 N/15mm
Opacidad	Visibilidad del efecto óptico	30% - 60%	35% - 45%

2.- PARÁMETROS DEL DISEÑO GRÁFICO A DEGRADAR EN EL ELEMENTO CELULÓSICO (1)

Parámetro	Efecto producido	Intervalo posible	Intervalo preferente
Geometría de las decoloraciones	Visual por reflexión	Ilimitado	Áreas continuas en forma de líneas, puntos o manchas
Geometría de los orificios	Visual por reflexión	Polígonos, círculos, óvalos rayas	Rayas, círculos
Distancias entre orificios	Generación de ilusión óptica	0,1 – 1,0 mm	0,1 – 0,2 mm
Anchura perforada	Generación de ilusión óptica	0,1 – 10 mm	0,2 – 1 mm

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3.- PARÁMETROS DEL LÁSER Y SU AJUSTE PARA LA DEGRADACIÓN

Parámetro	Efecto producido	Intervalo posible	Intervalo preferente

Fuente láser	Degradación térmica de la tira	Nd:YAG; Ho:YAG; Er:YAG; Tm:YAG; Colorante orgánico; Excimer; CO_2	Nd:YAG; CO_2
Longitud de onda	Degradación térmica de la tira	100 – 11000 nm	9000 – 11000 nm
Tipo de cabezal	Velocidad de degradación térmica	Fijo, Galvanométrico	Galvanométrico
Ejes del cabezal	Velocidad de degradación térmica	2 – 3	2 - 3
Potencia de las pulsaciones	Alcance de la degradación térmica	100 – 2000 W	125 – 250 W
Diámetro del spot	Geometría de la degradación térmica	2 – 50 mm	2 – 5 mm

Con respecto al modo de integración del elemento celulósico en el sustrato (5) se sigue lo indicado en la solicitud de patente española n.º 200500563, pero considerando los parámetros de integración y del sustrato (5) aportados en las tablas siguientes.

4.- PARÁMETROS DEL SUSTRATO (5)

Parámetro	Efecto producido	Intervalo posible	Intervalo preferente
Espesor	Capacidad de embebido	84 – 144 micras	102 – 108 micras

Porosidad Bendtsen(x4hojas)	Capilaridad	5 – 50 ml/min	10 – 35 ml/min
Gramaje	Capacidad de embebido	70 – 150 g/m²	85 – 100 g/m²
Resistencia a la tracción en seco	Evitar roturas durante la formación de hoja y bobinados del propio sustrato	SL: 45 – 135 N/15mm ST: 30 – 75 N/15mm	SL: 75 – 120 N/15mm ST: 45 – 65 N/15mm
Resistencia a la tracción húmedo	Evitar roturas durante la formación de hoja y bobinados del propio sustrato	SL: 15 – 65 N/15mm ST: 7 – 35 N/15mm	SL: 30 – 45 N/15mm ST: 15 – 30 N/15mm
Capas	Capacidad de embebido	2 – 4	2
Velocidad de fabricación	Tensión de embebido	40 – 100 m/min	45 – 55 m/min
Opacidad	Visibilidad del efecto óptico	85% - 99%	92% - 96%

5.- PARÁMETROS DE INSERCIÓN DEL ELEMENTO CELULÓSICO (1) EN EL SUSTRATO (5)

Parámetro	Efecto producido	Intervalo posible	Intervalo preferente
Distancia a la superficie del sustrato	Arrastre de la tira por el sustrato	< 15 mm	5 – 8 mm
Presión inicial del aire	Impulsión de la tira hacia el sustrato	1,50 – 2,00 bares	1,70 – 1,80 bares
Presión del aire	Mantenimiento de la tira embebida durante la fabricación del sustrato	0,2 – 0,5 bares	0,25 – 0, 35 bares

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EJEMPLOS DE REALIZACIÓN:

A. CORTE O PERFORACIÓN:

Sobre un elemento celulósico (1) de 18 mm de ancho, 22 g/m² de gramaje, 48 micras de espesor, 2600 ml/min de porosidad Bendtsen (x4 hojas), una resistencia a la tracción en seco de 28 N/15mm en sentido longitudinal (SL) y 17 N/15mm en sentido transversal (ST), y una resistencia a la tracción en húmedo de 0,2 N/15mm en sentido longitudinal, cuyo valor coincide igualmente en sentido transversal, se realizó una calcinación con perforación, mediante orificios pasantes (2),en geometría de rayas generando la ilusión óptica de la figura que corresponde al emblema de la Fábrica Nacional de Moneda y Timbre, tal y como se ha representado en las figuras 1 a 3. Las rayas tuvieron una anchura perforada de 0,15 mm y una distancia entre ellas de 0,1 mm.

La calcinación se realizó con una fuente láser de CO_2 con una longitud de onda de 10000 nm y una potencia de 150 W, a través de un cabezal galvanométrico de 3 ejes y un diámetro de spot de 2 mm.

El elemento celulósico (1) generado por estos medios obtuvo una visualización por transparencia y por reflexión correspondiente al diseño gráfico pretendido.

Posteriormente este elemento celulósico (1) se embebió entre las dos capas de un sustrato (5) de papel de algodón cuando ambas capas están saliendo de sus correspondientes formadores (7) de hoja de la máquina de papel y se obtuvo un sustrato final de 87 g/m², de 106 micras de espesor, con una opacidad del 94 % a una velocidad de fabricación de 48 m/min.

Para conseguir el correcto embebido del elemento celulósico (1) se usó un dispositivo de desbobinado del carrete que contenía el elemento celulósico (1) en forma de tira impulsando dicha tira con aire a presión de 1,75 bares para obtener un acercamiento de la tira celulósica (1) hasta 8 mm con respecto a una de las dos capas del sustrato (5). Una vez conseguida la adhesión de la tira (1) entre las dos

capas de papel gracias a los fenómenos de capilaridad y trasvase de fluidos de la pasta de celulosa, se mantuvo la tensión de la tira celulósica (1) a la misma velocidad de desbobinado que la velocidad de fabricación del sustrato y con una presión del aire de impulsión de 0,3 bares.

En definitiva, el procedimiento de acuerdo con la invención, tal y como se ilustra en la figura 5, comprende insertar el elemento celulósico (1) de seguridad durante una fase de formación húmeda (6) del sustrato (5) y tras la separación de dicha hoja de papel formada de una malla metálica que constituye un formador (7) de la hoja de papel.

Tras la fabricación del sustrato (5) de papel con la tira (1) embebida se comprobó como la ilusión óptica de la imagen pretendida ya no era visible por transparencia sino únicamente por reflexión en una de las caras del sustrato.

Para ilustrar los efectos conseguidos con la invención, en la figura 1 se ha representado una vista esquemática del elemento celulósico (1) tratado térmicamente de acuerdo con el primer aspecto de la invención, en el que puede apreciarse la realización de un motivo mediante orificios pasantes (2), así como el comportamiento visual del elemento celulósico según diferentes inclinaciones.

De manera común a las figuras 1 a 3, cada una de las tres vistas A, B y C representa un fenómeno común habiéndose representado en las vistas A y B fenómenos de reflexión para ángulos de observación aproximados menores a 30º en la vista A y entre 30º-60º en la vista B, mientras que en la vista C se ha representado el fenómeno de transparencia entre 60º-120º aproximadamente.

Por otra parte, en la figura 2 se ha representado una vista esquemática como la de la figura 1, en la que el elemento celulósico (1) se encuentra embebido en un sustrato (5) de papel.

B. MARCADO O DECOLORACIÓN

Sobre una tira celulósica (1) de 25 mm de ancho, 22 g/m^2 de gramaje,

48 micras de espesor, 2600 ml/min de porosidad Bendtsen (x4 hojas), una resistencia a la tracción en seco de 28 N/15mm en sentido longitudinal y 17 N/15mm en sentido transversal, y una resistencia a la tracción en húmedo de 0,2 N/15mm en sentido longitudinal, se aporta una capa de protección mediante un proceso de impresión en huecograbado sobre una de sus caras con el objetivo de alcanzar la resistencia mecánica suficiente para que, tras el ataque térmico, la tensión de desbobinado y el embebido posterior siga siendo posible sin roturas de la tira.

Posteriormente se realiza una decoloración, mediante fibras vegetales superficiales calcinadas (4) o bien mediante orificios no pasantes (3), tal y como se puede apreciar en las figuras 4, en la cara no tratada con la capa de protección en geometría de manchas generando formas irregulares encerradas en áreas rectangulares.

El marcado o decoloración se realiza con una fuente láser de CO_2 con una longitud de onda de 10000 nm y una potencia de 120 W, a través de un cabezal galvanométrico de 3 ejes y un diámetro de spot de 2 mm.

La tira celulósica (1) generada por estos medios obtiene una visualización por transparencia y por reflexión correspondiente al diseño aleatorio pretendido.

Posteriormente esta tira celulósica (1) se embebió entre las dos capas de un sustrato (5) de papel de algodón cuando ambas capas están saliendo de sus correspondientes formadores (7) de hoja de la máquina de papel y se obtuvo un sustrato final de 87 g/m², de 106 micras de espesor, con una opacidad del 94 % a una velocidad de fabricación de 48 m/min, tal y como se ha representado esquemáticamente en el proceso llevado a cabo en el equipo ilustrado en la figura 5.

Para conseguir el correcto embebido de la tira celulósica (1) se usó un dispositivo de desbobinado del carrete que contenía la tira (1) impulsando dicha tira (1) con aire a presión de 1,75 bares para obtener un acercamiento de la tira

celulósica (1) hasta 8 mm con respecto a una de las dos capas del sustrato (5). Una vez conseguida la adhesión de la tira (1) entre las dos capas de papel gracias a los fenómenos de capilaridad y trasvase de fluidos de la pasta de celulosa, se mantuvo la tensión de la tira celulósica (1) a la misma velocidad de desbobinado que la velocidad de fabricación del sustrato (5) y con una presión del aire de impulsión de 0,3 bares.

Tras la fabricación del sustrato (5) de papel con la tira (1) embebida se comprueba como las áreas marcadas son visibles tanto en por reflexión como por transparencia.

Con el objeto de ilustrar lo anterior, en la figura 3 se muestra una vista esquemática como la de la figura 2, en la que adicionalmente el elemento celulósico (1) tiene un tratamiento térmico que produce coloración e forma de líneas paralelas oscuras de un mismo tono; para no complicar la interpretación visual de las figuras no se ha representado multitonos, tal y como se ha comentado con anterioridad, los fenómenos representados en cada una de las vistas A, B y C se corresponden con dichas mismas vistas de las figuras 1 y 2.

A la vista de esta descripción y juego de figuras, el experto en la materia podrá entender que las realizaciones de la invención que se han descrito pueden ser combinadas de múltiples maneras dentro del objeto de la invención. La invención ha sido descrita según algunas realizaciones preferentes de la misma, pero para el experto en la materia resultará evidente que múltiples variaciones pueden ser introducidas en dichas realizaciones preferentes sin exceder el objeto de la invención reivindicada.

REIVINDICACIONES

1.- Elemento celulósico tratado térmicamente por láser, que tiene configuración laminar y comprende fibras vegetales,

caracterizado por que

dicho elemento celulósico (1) de seguridad comprende al menos una zona tratada térmicamente (2, 3, 4) mediante láser en la que las fibras vegetales localizadas en dicha zona tratada térmicamente están degradadas por efecto de dicho tratamiento térmico.

2.- Elemento celulósico según la reivindicación 1, en la que la degradación de la zona tratada térmicamente consiste en orificios pasantes (2).

3.- Elemento celulósico según cualquiera de las reivindicaciones anteriores, en la que la degradación de la zona tratada térmicamente consiste en orificios no pasantes (3).

4.- Elemento celulósico según cualquiera de las reivindicaciones anteriores, en la que la degradación de la zona tratada térmicamente consiste en calcinar únicamente las fibras vegetales situadas superficialmente en el elemento celulósico de seguridad, de forma que elemento celulósico (1) tiene fibras vegetales superficiales calcinadas (4).

5.- Elemento celulósico según cualquiera de las reivindicaciones anteriores, cuyo espesor se encuentra entre 44-55 micras, tiene gramaje entre 20-25 g/m^2 y opacidad entre 35%-45%.

6.- Papel de seguridad que comprende al menos un sustrato (5) en el que se encuentra embebido al menos un elemento celulósico (5) de acuerdo con cualquiera de las reivindicaciones 1 a 5, donde dicho, al menos un, sustrato (5) tiene opacidad suficiente para impedir el paso de la luz de forma que la cantidad de luz que llega a atravesar el conjunto formado por sustrato (5) y elemento celulósico (1) de seguridad es similar cuando la luz atraviesa la zona tratada térmicamente (2, 3, 4) y cuando atraviesa la zona no tratada térmicamente.

7.- Papel de seguridad según la reivindicación 6, en el que el sustrato (5) tiene espesor entre 102-108 micras, gramaje entre 85-100 g/m^2 y opacidad entre 92%-96%.

8.- Documento de seguridad que comprende un papel de acuerdo con cualquiera de las reivindicaciones 6 y 7.

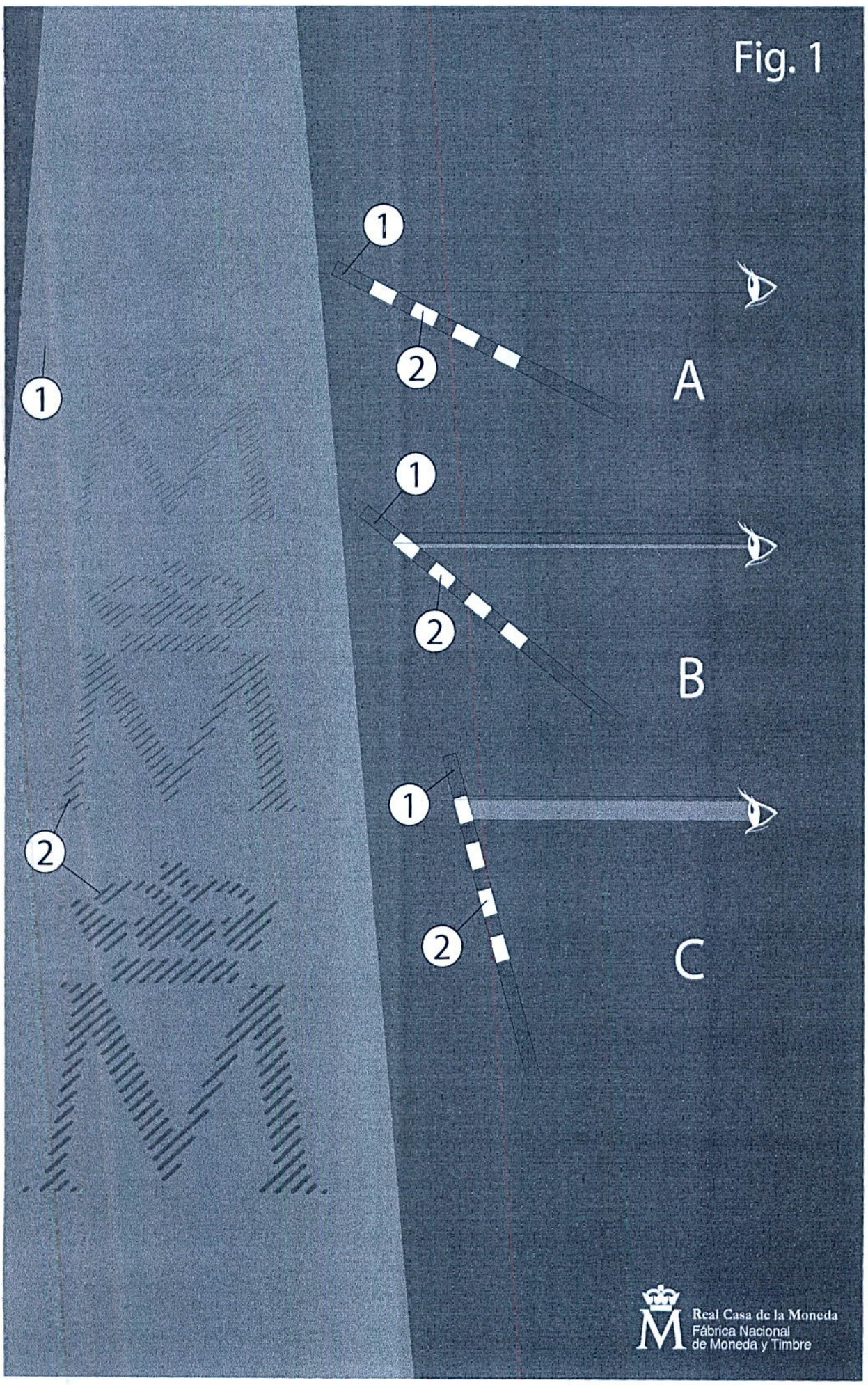
9.- Procedimiento para embeber un elemento celulósico (1) de seguridad de acuerdo con cualquiera de las reivindicaciones 1 a 5 en un papel de seguridad de acuerdo con cualquiera de las reivindicaciones 6 y 7, **caracterizado** por que comprende insertar dicho elemento celulósico (1) de seguridad durante una fase de formación húmeda (6) del sustrato (5) y tras la separación de dicha hoja de papel formada de una malla metálica que constituye un formador (7) de la hoja de papel.

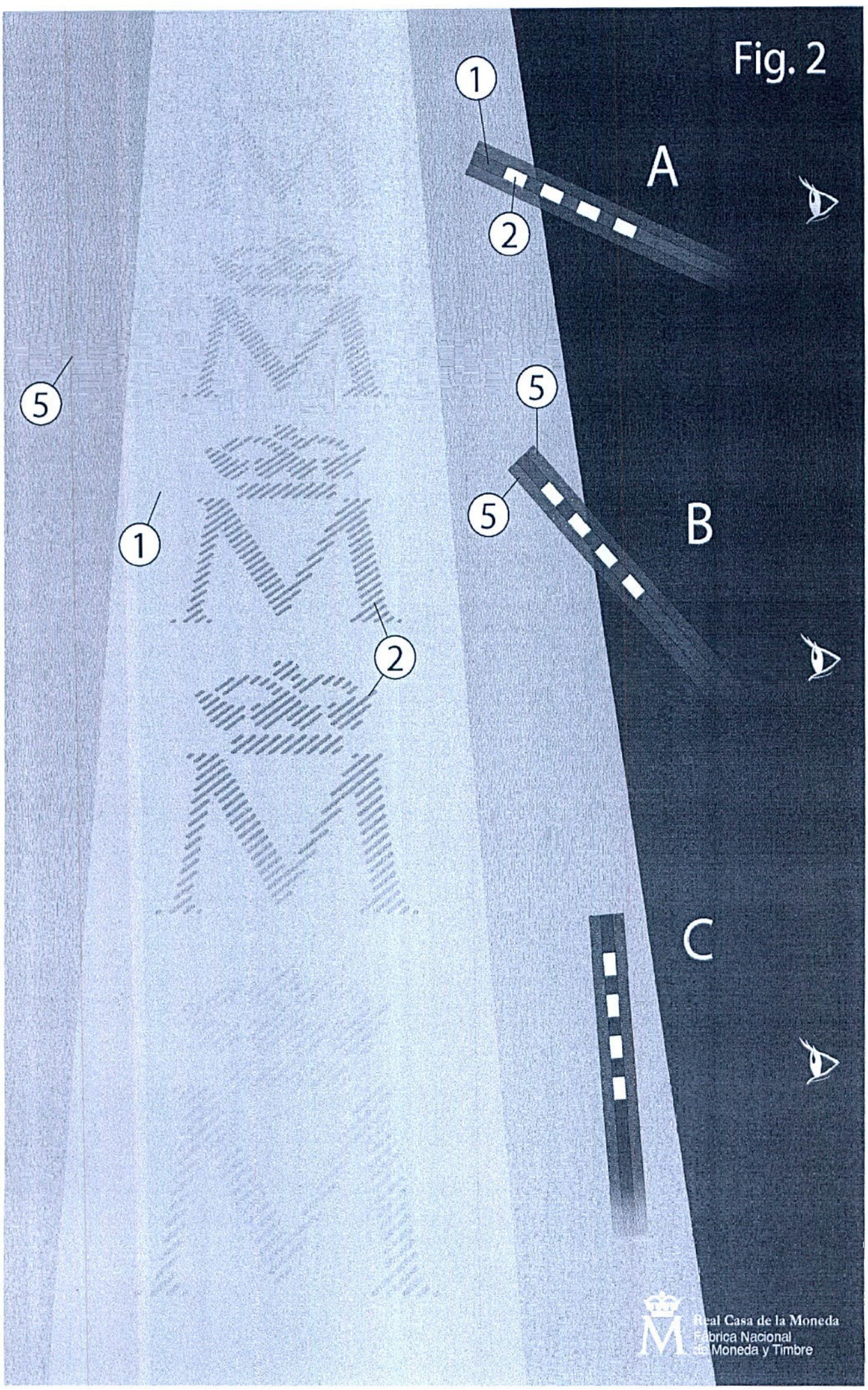
10.- Procedimiento según la reivindicación 9, en el que la distancia entre orificios pasantes (2) en el elemento celulósico (1) es de 0,1-0,2 mm y la anchura perforada es de 0,2-1 mm.

11.- Procedimiento según cualquiera de las reivindicaciones 9 y 10, en el que la longitud de onda del láser es de 9000–11000 nm, con cabezal galvanométrico, en el que la potencia de las pulsaciones es de 125-250 W, con un diámetro del spot de 2-5 mm.

RESUMEN

ELEMENTO CELULÓSICO TRATADO TÉRMICAMENTE POR LÁSER, PAPEL DE SEGURIDAD QUE COMPRENDE DICHO ELEMENTO, DOCUMENTO DE SEGURIDAD QUE COMPRENDE DICHO PAPEL Y PROCEDIMIENTO PARA EMBEBER UN ELEMENTO CELULÓSICO EN UN PAPEL DE SEGURIDAD, en el que el elemento celulósico tiene configuración laminar y comprende fibras vegetales y al menos una zona tratada térmicamente (2, 3, 4) mediante láser en la que las fibras vegetales localizadas en dicha zona tratada térmicamente están degradadas por efecto de dicho tratamiento térmico.


Fig. 1
1
2
A
1
2
B
1
2
C
Real Casa de la Moneda
Fábrica Nacional
de Moneda y Timbre


Fig. 2
1
2
A
5
5
5
1
2
B
C
Real Casa de la Moneda
Fábrica Nacional
de Moneda y Timbre

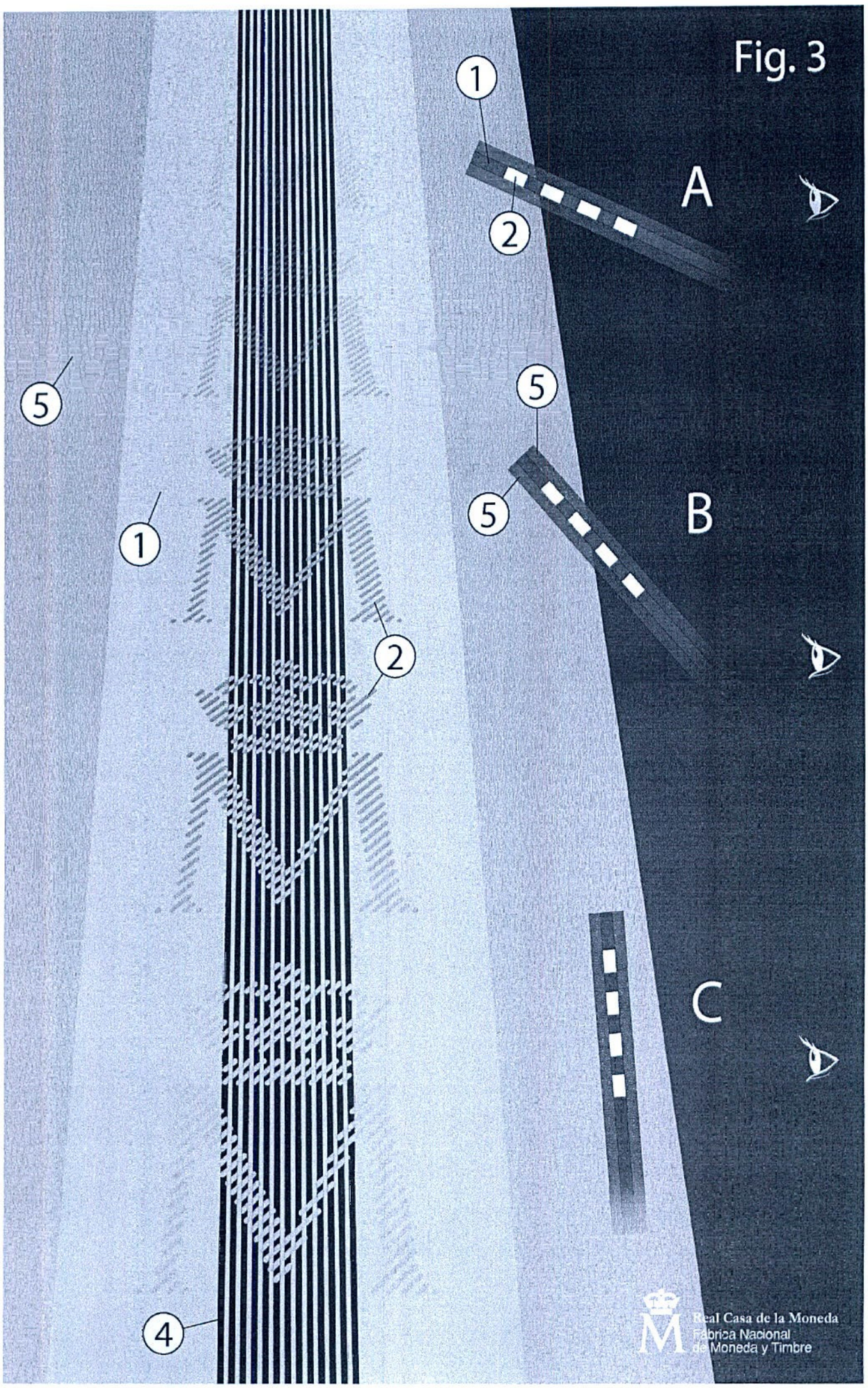

Fig. 3
1
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A
5
5
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C
4
Real Casa de la Moneda
Fábrica Nacional
de Moneda y Timbre

Fig. 4

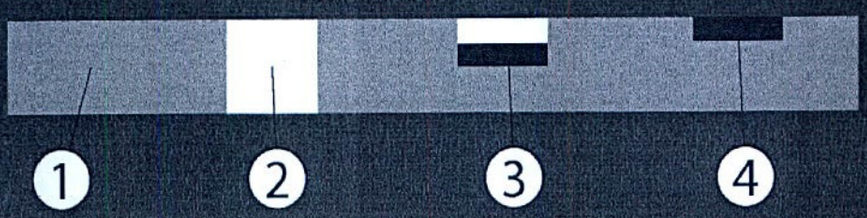
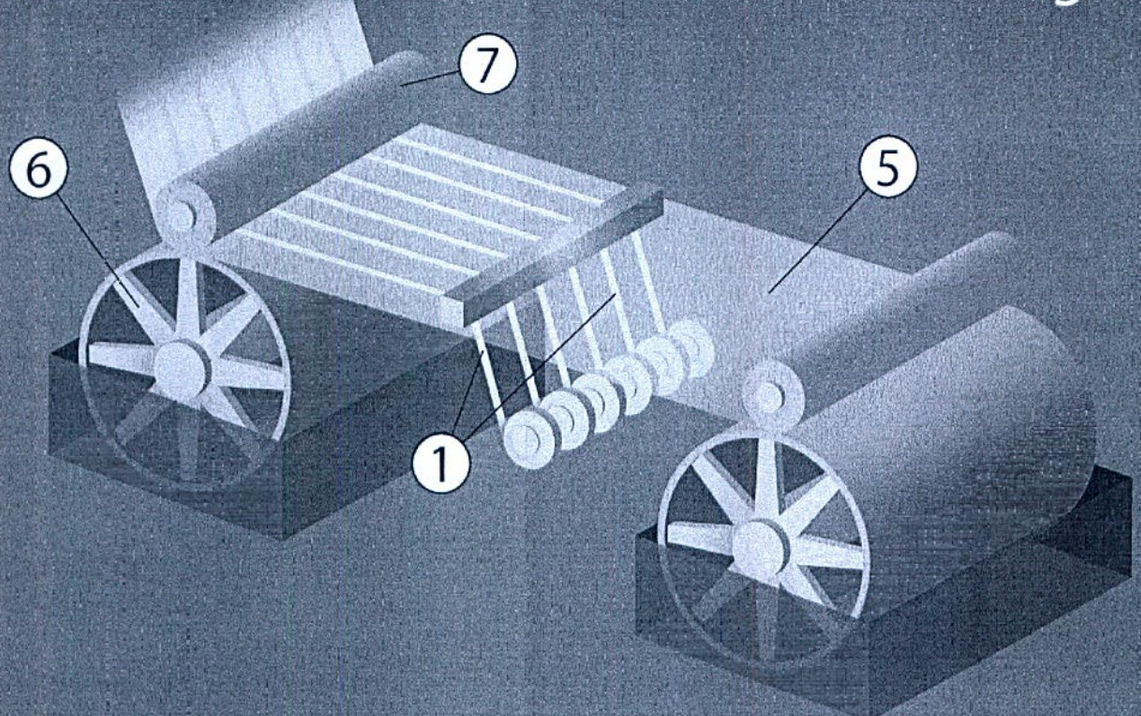


Fig. 5

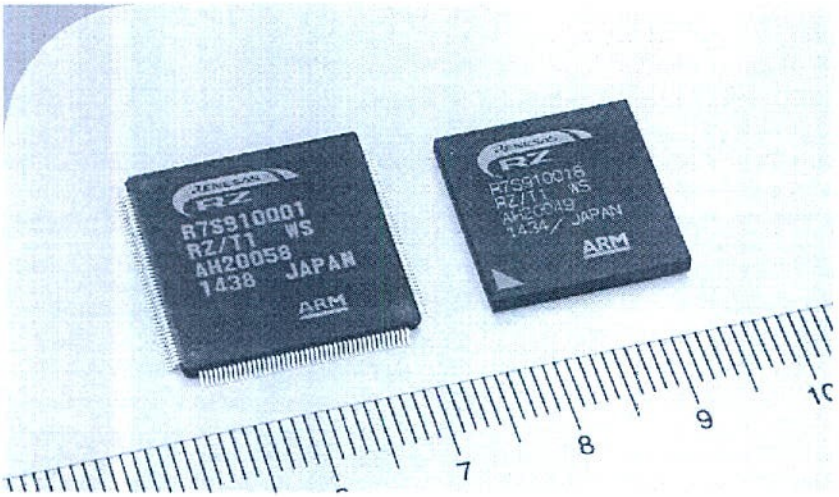


Real Casa de la Moneda
Fábrica Nacional
de Moneda y Timbre

RECONNAISSANCE
AUTHENTICATION NEWS®

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Renesas Electronics and G&D Collaborate



Renesas Electronics Europe, a provider of advanced semiconductor solutions, and Giesecke & Devrient (G&D), a leading international technology provider in the banknote, payment, secure communication and identity management sectors, have announced a collaboration on industrial security solutions and services.

Their first development focuses on an anti-counterfeiting solution for industrial products, which was demonstrated at the SPS IPC Drives in Nuremberg – Europe's leading exhibition for electrical automation.

The collaborative solution comprises Trusted Service Manager (TSM) technology from G&D and special chip activation technology within the Renesas *RZ/T* factory automation device. (TSM is defined as a role in an NFC mobile ecosystem, which acts as a neutral broker setting up business agreements and technical connections with various service providers in the ecosystem who wouldn't usually work together.)

'Together with G&D, we have found a methodology to prevent counterfeits,' stated Michael Hannawald, Vice President of Renesas' Industrial & Communications Business Group. 'Renesas will deliver protected devices to system manufacturers which are activated at the production line of the OEMs by our Trusted Service Manager provided by G&D. Renesas can now benefit from this TSM service expertise and system manufacturers can incorporate TSM-based security solutions into their products and service offerings,' he said.

G&D is a renowned provider of TSM services in the mobile world for SIM cards, Universal Integrated Circuit Cards (UICCs), and embedded secure elements.

There are two types of TSM – the secure element issuer TSM and the service provider TSM.

Continued on page 3 >

U-NICA and ACTILOR Become Two Separate Companies

The U-NICA Group, a Swiss-based security solutions provider, has undergone a reorganisation and strategic reorientation that has seen it divide into two separate entities.

One entity, continuing under the name U-NICA, will focus on physical and digital security solutions for products, brands and documents.

The other, the newly founded ACTILOR Group, will focus on unique pigments and nanotechnology for government security and life sciences. Both organisations come under the umbrella of U-NICA Holding, headed by company founder Alfred Rutz as the CEO.

U-NICA was established in 2004 by Rutz – previously with banknote paper manufacturer Landqart – with the objective of creating a company to develop and offer technologies covering the different requirements of authentication and track and trace from one source.

It is headquartered in Malans, Switzerland and has around 70 employees, five sites in Switzerland and Germany, and representative offices in Hong Kong and the US.

The security printing side of the business was originally focused on *actilor*®, a protein-based security ink developed for government security.

Continued on page 7 >

Today's Authentication Methods for Documents and Products

In this new monthly series of articles, *Authentication News*® will be taking a look at the characteristics and functions of the main groups of authentication features used on today's products and documents.

The series will cover both physical and digital features at all four levels of security (overt, semi-covert, covert and forensic).

We begin the series with an overview of one of the oldest, but still one of the most popular authentication devices in documents: the watermark.

Inside this Issue

1 Renesas Electronics and G&D Collaborate
1 U-NICA and ACTILOR Become Two Separate Companies
2 Today's Authentication Methods for Documents and Products – Part 1
3 A New Optical Reader
3 Tomorrow's Security Today at ODS
4 The Rise of Inspection Technology in a Variable Printing World
6 Digital Print on Offset Paper – the Learning Points
7 From the Archives

Part 1 – The Use of Watermarks in Printed Security Documents

Watermarks are the oldest optical authentication device in documents – there even exists an 'Archive of Papers and Watermarks in Greek Manuscripts' designed as a research tool for scholars.

However, it is generally accepted that watermarks were first introduced into paper on an industrial scale around 1282 in Fabriano, a small town in the Italian region of Marche. The town's high-quality papermaking skills led to its prosperity in the late Middle Ages and Renaissance era, as well as, from 1470, the establishment in nearby Foligno of one of the earliest printing centres in Italy. Today, the tradition of fine paper continues with Cartiere Miliani Fabriano (Fabriano), which is now part of Fedrigoni SPA.

A watermark, as the name implies, is a mark or pattern in paper created during the water-based papermaking process. It appears as various shades of light and dark in the structure of the paper when viewed by transmitted light (or when viewed by reflected light against a dark background). The variation in shade is caused by density variations in the paper.

First use in banknotes

The first recorded use of a watermark in banknotes is accredited to the Bank of England in 1697, three years after the Bank was established. When the Bank first opened, it issued handwritten receipts to repay a depositor with the amount deposited at the bank. These promissory notes were on standard paper with the security lying in the handwritten unique number, date, amount, name of the depositor and the signature of the cashier. However, it became apparent that depositors wished to exchange or utilise these promissory notes commercially, and so they had to be more secure.

In 1697, a watermark was incorporated into the hand-made sheets of paper used to produce the notes.

A looped border pattern was incorporated into a porous frame or mould, which was dipped into water containing dispersed cotton fibres. The water drained through the mould leaving behind the retained fibres as a sheet which, when removed and dried, formed the paper. Where the pattern was present in the mould, less fibres would be retained as it drained less quickly compared with the freer flowing areas. This resulted in a light watermark or pattern that could be seen in the sheet in transmitted light.

Until the introduction of papermaking machines in 1799, watermarks continued to be incorporated by hand, generally by the use of wire strips retained above the porous mesh to create the designs.

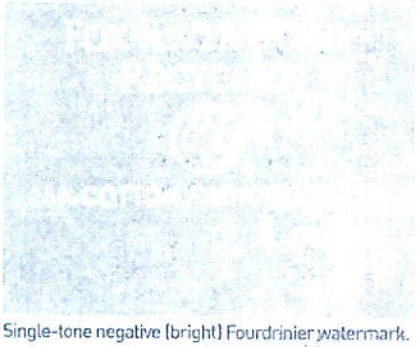
Fourdrinier and dandy roll process

In 1779, Louis-Nicolas Robert, a Frenchman, was granted a patent for a continuous paper machine.

This invention was to be later developed and improved by Fourdrinier brothers in England, who patented their machine in 1806. This machine was more efficient and could make a wide variety of paper sizes very quickly. However, the invention cost so much it caused the Fourdriniers to go bankrupt and due to the difficulty to protect the patent, the new system spread quickly.

In 1826, John Marshall introduced the dandy roll to the Fourdrinier-type continuous machine. This made watermarks in the paper by impressing a water-coated metal stamp (the dandy roll) onto the paper during manufacturing. This development revolutionised the process of watermarking paper and the principles of both Fourdrinier and Marshall still apply today.

Continued on page 5 >



Single-tone negative (bright) Fourdrinier watermark.



Example of a dandy roll for single-tone watermark on Fourdrinier machine.

A New Optical Reader – The Next Step in Item-Level Security?

TruTag Technologies, the developer of edible product security solutions, recently unveiled an enhancement to its spectral taggant technology with the launch of a new high-performance hand-held reader at the 2015 Active and Intelligent Packaging Industry Association (AIPIA) World Congress in Utrecht, Holland.



An example of the TruTag Model 4100 hand-held optical taggant reader.

For high-volume, high-value items (such as pharmaceuticals, industrial parts and electronic components), the ideal solution for an 'on-item' security solution will be microscopic, edible, and safe for food and human contact. It should also enable the end-user to verify product origin, lot number, and distribution history – provided it can be read and authenticated.

As a solution to this problem, TruTag Technologies has developed its *Model 4100* hand-held optical reader, which uses satellite imaging technology to ensure secure product authentication.

The solution is powered by a cloud-connected, solid-state imaging and processing engine, and can authenticate – in just a few seconds – medicines, electronic components, industrial parts, packaged goods and other items marked with silica-based *TruTag® microtags*.

According to TruTag, easy-to-use item-level decoding technologies like the Model 4100 are the next frontier in the continuing war on counterfeiting. Such technologies are invisible to the naked eye, but very visible with the right imaging and processing tool, and are applied directly to the product itself, not just its packaging.

www.trutagtech.com

G&D Collaborate *(Continued)*

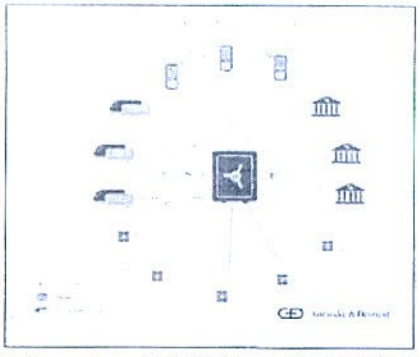
The former manages secure element lifecycles and security domains for service providers, while the latter manages the service provider's application provisioning to the service element and its application lifecycles.

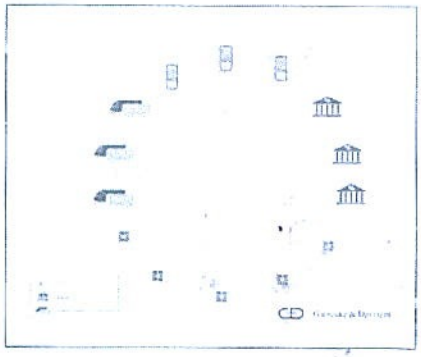
'We look forward to working with Renesas since the jointly developed solutions are a big leap toward real-time security on the chip level, which will benefit industrial facilities,' said Axel Deininger, Head of the Enterprise Security/OEM division in the Mobile Security business unit at G&D.

'For the first time, we are demonstrating a TSM service from our certified TSM hubs around the world, combined with semiconductors with embedded anti-counterfeiting technologies. This cooperation with Renesas allows us to address the emerging challenges of the connected industry', said Deininger.

www.gi-de.com

www.renesas.eu





NFC ecosystem with TSM (left) and without TSM (right).

Tomorrow's Security Today at ODS

Reconnaissance's *Optical Document Security*™ conference, the well-established event that covers the latest developments in optical technologies for document security, will take place 10-12 February 2016, in San Francisco, California.

This event brings leading researchers and developers together with security document issuers and printers to share the latest in optical technologies for securing documents. Because of its unique place as a specialist forum, researchers and start-up companies have used the event for the first presentations on several then-new – but now established – security products – something that will again happen in February.

While new products are important, so are developments of established products and processes. The 2016 programme includes presentations that also cover these developments.

Sessions cover the field

The titles of each conference session reveal the scope of the event. The opening session is titled simply 'Banknotes', with the opening paper, presented by Hans de Heij of De Nederlandsche Bank, covering the vital topics of human perception and user interface with security features. This is followed by papers from Banco de México and De La Rue, on their new image analysis software and lenticular device, respectively.

'Print & Printing', the second session, shows that there is still scope for innovative optical methods in these stages in the production of security documents. Topics include papers from Louisenthal and KBA-NotaSys, on optically variable structures and coatings, and intaglio quality measurement, respectively.

The University of South Dakota, a first-time speaker at ODS, will also be presenting its work on covert RGB upconverting inks.

Thursday afternoon is devoted to a session titled 'New Approaches to OVDs', which demonstrates the level of innovation and invention that continues in this field.

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The Rise of Inspection Technology in a Variable Printing World

Remember when the only quality control a printer was expected to perform included checking colour variation and print registration? And when the only additional elements a security printer was expected to check were static covert and overt security features?

This has now all changed with the advent of digital printing, where today's printer has also become responsible for ensuring the integrity of any variable data carried on the printed item.

This article describes how print inspection technologies have evolved to assist printers to meet these new responsibilities, and in particular refers to a recent case study involving Lake Image Systems (a leading provider of vision-based print inspection systems) and its client, a global security printer.

In the era before variable digital printing, a print inspection system would involve checking that, for example, every single print repeat in a continuous web was the same in every way. Detection of colour variation, print registration, streaks and hickies (the effect that occurs when a speck of dust or debris creates an imperfection in the printing), were at the heart of a successful print run, where defects were identified and removed later in the process.

In their simplest form, these systems presented a static image for the operator to view throughout the job, and make a subjective decision on print quality. As print speeds increased, however, human judgement could no longer be relied upon – and intelligent systems evolved to perform automatic measurement and verification functions, providing a more objective control of print quality.

The arrival of continually variable content has added another level of complexity that is not suited to traditional inspection methods. Most security-printed items today carry a myriad of variable data information, in the form of human- and machine-readable codes such as serial numbers and barcodes. These are often critical for track and trace and authentication purposes and demand 100% readability and integrity. This means that security printers are now expected to be experts in variable data printing.

Crucial to this expertise is not only the quality of the equipment used to print the codes but the inline inspection systems used to verify that the data carried in (or accessed via) the codes is readable, unique and complete. Failure to guarantee this can result in serious operational and security issues further downstream.

As a result, inspection technology has evolved to combine traditional print quality inspection with a whole new range of challenges. These challenges include blocked inkjets, out of sync print engines, database errors, and IT failings.

A case in point

One of Lake Image Systems' largest security printing clients had a challenge related to the inspection and validation of a new authentication label, which incorporated a unique identifier printed in UV fluorescent ink.

The client's modular and narrow web presses enabled complex, multiple-layered printing – using specialised substrates and a variety of security print processes to add specific overt and covert features to each label. With the press running in excess of 30 metres per minute, an inkjet print head system digitally added a unique identifier number to each label, using a specially formulated UV fluorescent ink.

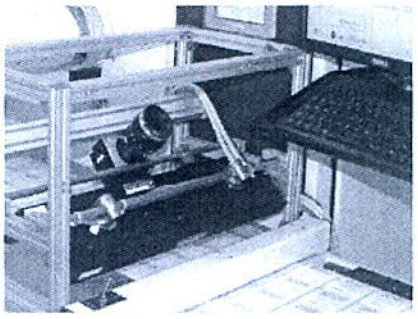
To maintain the high quality standards required, a small subset of the label print run was periodically manually inspected for readability and validated against the original data file by the client's QC department – a difficult task not made any easier by the small font size of the unique identifier. This inspection method was consequently falling short of requirements, by engendering increased production costs and introducing potential business risks.

The client therefore concluded that an automated system was needed that could inspect the UV fluorescent codes on all labels – and not just a subset – during the printing process, in order to mitigate potential risks.

This is where Lake Image Systems came in.

Following an internal process review, the client opted for a high-speed, camera-based OCR (optical character recognition) inspection system that could be integrated within its existing workflow.

The chosen system consisted of an 8,000 pixel resolution linescan camera (a camera with a single row of pixel sensors, as opposed to a matrix sensor formation). The camera was mounted inline on the label press and incorporated with a finely tuned UV LED light source to capture an image of each label and its fluorescent printed code.



Lake Image's high-performance linescan camera.

Lake Image's *Discovery MultiScan* software was then deployed to extract the unique identifier, inspect it and grade it for readability. The software matched the unique identifier against the original data file to ensure all codes were correct and created a log of any unreadable, duplicate and missing codes.

The client's QC team was able to view each label flagged as an 'error' using Lake Image's *MultiScan RollReview* – an offline label roll inspection system. The system showed an image of the suspect label, the inspection result and the expected data, enabling an operator to review the error and generate a label reprint file. This was an important step to maintain overall label job integrity and to keep reject rates to a minimum.

The client's investment in this system delivered benefits for the production team and for the business as a whole. 'Throughput has more than doubled, enabling us to meet tight delivery timescales,' commented a spokesperson on behalf of the client. 'At the same time, we have raised the production efficiency for this application by removing the need to do manual inspection, improving our overall bottom line'.

This case study demonstrates that inspection is a crucial part of the equation for the successful implementation of a digital print and finishing environment. However, as Martin Keats, Managing Director of Lake Image Systems observed, inspection is 'too often considered as an afterthought, once the budget has been spent and the risks have been discovered; yet its impact on bottom line profitability can be immense'.

Keats added: 'The print industry is now at a point where inspection functionality, performance and implementation provides an essential supporting role for the more glamorous printing technology. As such, it should feature as a critical element of every digital printing and finishing project if printers are to succeed in the digital world'.

www.lakeimage.com

Today's Authentication Methods *(Continued)*

In the Fourdrinier process, the pulp is fed through a sluice onto a specially woven metal or plastic fabric mesh conveyor belt (referred to as a wire) from a head tank, and the deposited slurry forms a continuous paper web. After the forming section, the web continues to have water removed until it reaches the dandy roll – a light roller covered by a screen, which can be embossed with a pattern or design.

The dandy roller compresses the web fibres – the greater the pressure, the thinner and brighter the lines on the paper (while the thicker areas block and absorb the light and appear darker). Fourdrinier watermarks are limited in the viewable number of tones and their contrast – a single- or two-tone watermark is the norm.

Cylinder mould-made process

This process was first used in 1848 and unlike hand-made paper, where the mould is flat, the cylinder mould-made process incorporates a slowly rotating cylinder mould, which picks up the paper stock from the vat. The stock is refined so the fibres are opened up for improved bonding.

The cylinder – whose surface is covered by the forming wire mesh to which watermarking elements have been precisely welded – is partially submerged in the vat full of stock. The cylinder rotates, water flows through the mesh and through the watermark mould, which has various levels of porosity according to the design of the mould. The pulp accumulates on the wire surface forming a fibre mat, which is removed by its transfer to a travelling felt belt moving along the paper machine.

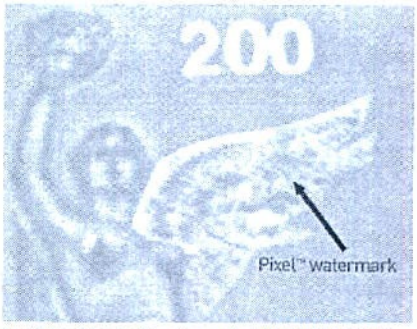
Excess water is removed in the press section and the web is then heat-dried before passing through a size bath, after which it is again dried. It then passes through a conditioning chamber to ensure all the paper has the same humidity, and calendared through hot steel cylinders to obtain the requisite smoothness. At the end of the machine, the paper web is wound on to a reel prior to conversion to sheets.

Cylinder mould-made watermarks are the closest that machine production can come to the fine quality of hand-made mould watermarks. The quality of the watermark is dependent primarily on the mould, which will normally be made by a highly skilled tradesman, either by the traditional method using wax and a cutting tool or more commonly now by computer-controlled engraving.

But the fibre length and refined state of the stock also play a critical part in the quality. As a general rule, the shorter the fibre length the more multi-tonal the watermark, but the weaker the paper.

For maximum security, many favour a multi-tonal portrait watermark to match the person printed on the banknote. First, there is a highly recognisable image to compare the watermark with, and second, the watermark will be more difficult to copy.

Often banknote watermarks will have a highlight or electrotype watermark of the denomination next to the main watermark image – this makes it easier to verify and more secure.

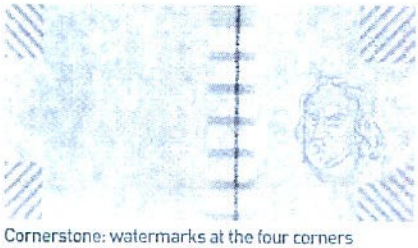


Multi-tonal portrait watermark with Pixel highlight wing and electrotype denomination.

Another highlight watermark feature is the *Pixel*™ watermark developed by ArjoWiggins Security and first used in the Mexico 200 pesos note. Pixel watermarks are used to create a light feature (wing) in the actual watermark, and there is an electrotype (200) denomination.

Watermarks for durability

Not all watermarks are for security purposes. De La Rue patented a system to strengthen the most vulnerable parts of banknotes – the corners and edges – by utilising deep grooved watermarks. The technology was named *Cornerstone*® and *Edgestone*®. Cornerstone is often used on its own but both can be employed together. In a field test by the Bank of England on its £5 note, Cornerstone increased the life of banknotes by 8%.



Cornerstone: watermarks at the four corners strengthen paper and increase banknote life.

Polymer banknotes

Polymer banknotes do not have watermarks as such, but *Guardian*® – Innovia's polymer substrate – does have a similar feature called a 'shadow image'. Working like a cotton substrate watermark, it is viewed in transmitted light where a positive image is seen, and in reflected light where there is a very diffuse negative image.

There are a number of hybrid substrates containing polymers as well as cotton, which have watermarks, or features providing a similar function to watermarks. The two best known of these are Giesecke & Devrient's *Hybrid*™ and Landqart's *Duranote*™.

Counterfeits

Although counterfeits of both Fourdrinier and mould-made watermarks exist, the multi-tonal, mould-made watermarks provide the most difficult challenge to counterfeiters. The most common method of counterfeiting involves printing in some form, such as screen, offset or colour photocopying, using white ink or oils, to provide a transparent effect.

Generally these counterfeits can be fairly easily detected, although some need careful examination and, if the interrogator is not familiar with the genuine watermark, he can be deceived. However, a side-by-side comparison with the genuine watermark almost always immediately reveals the counterfeit.

US currency watermarks are not as multi-tonal as mould-made watermarks that are generally used in banknotes. The US uses flax (with long fibres) as well as cotton in its substrate, and uses a watermark process unique to Crane & Co its paper suppliers. Criminals preferred to clean the ink off low denomination US banknotes and use the paper to reprint a higher denomination, rather than try to counterfeit the paper.

To counter this, the Federal Reserve replaced the portrait watermark with large denomination numerals as watermarks in the low denomination notes so that higher denominations on low denomination paper would be obvious.

Summary

In virtually all research on banknote and document security features involving the public, it is the watermark that is the most recalled, recognised and used. This is, perhaps, not surprising considering watermarks even pre-date security printing.

But whereas other security features come and go, the watermark is the most ever-present, known and looked-for authenticating feature. This speaks volumes about its enduring quality, in particular for banknotes, as a critically important, secure document authenticating feature.

Digital Print on Offset Paper – the Learning Points

By Alan Hodgson, Printing Consultant

High-speed digital printing is now making inroads into commercial print. In order to make progress in this area these printing presses need to be compatible with standard offset paper stock. The purpose of this article is to outline the innovations that were required to make this happen, highlighting the areas where this knowledge can be used in the production of secure documents on paper substrates.

The technology innovations required to make digital presses compatible with offset paper are presented at technical meetings, such as the Digital Printing conference that took place in Portland, Oregon in September (see AN October 2015). The significant challenge has been to ensure this compatibility at the speeds required to challenge smaller offset lithography presses. The opportunity for secure document production is that many of the learning points are transferrable to the type of substrates used in the production of paper-based items such as passports and visas.

The challenge posed by offset paper

High-speed presses were initially introduced for transactional printing for applications such as financial statements, and therefore were initially offered for plain paper substrates using high-speed inkjet with water-based inks. However, commercial printing uses a much wider range of paper substrates and an important one amongst these is coated offset paper. The problems that unfold here are that offset paper is really not designed with digital printing in mind, particularly with inkjet.

An overview of the technologies utilised in high-speed inkjet presses was presented in a previous article (see AN November 2015). It was shown that the combination of high speed and high image quality was not an easy demand to fulfil with inkjet technology. Aqueous inks on plain papers fundamentally dry through liquid absorption into the pores of the paper. Smoother papers are capable of higher print quality but tend to take longer to absorb the ink. As a result, inkjet tends to have increasing problems with image quality and image smear (smudging) on these types of papers.

Solutions are emerging for these issues and these initiatives are moving the right way for the printing of secure documents. While secure documents may not be using coated papers, such products have a reduced ink absorption capacity so these issues remain of interest to us.

Water-based inkjet inks

One of the key learning points that is emerging from this challenge is a reinforcement of an early lesson from inkjet printing. It is of critical importance to treat an inkjet printing implementation as a system. In the case of a secure document this means that the ink, paper and printer settings must all be designed together.

Consider two different ink/paper combinations. A dye-based aqueous ink that effectively wets a highly porous paper will be touch-dry very quickly but can suffer from bleed, low optical density and poor gamut. The other extreme would be a pigment-based aqueous ink on a substrate of lower porosity such as offset paper. This combination can show great print quality when measured as optical density and gamut but suffers from print-to-print offset and low smudge resistance.

This latter combination is important in the personalisation of secure paper documents such as passports and visas, as pigment black inks are used almost exclusively to ensure IR machine readability. Some of the work on pigment ink selection currently being published as a result of this offset paper initiative could be of significant value in the personalisation of secure documents.

This work has also highlighted some image quality issues around a phenomenon known as coalescence. This is where the rate of penetration of the inkjet drops into the paper is slow enough for them to flow on the paper surface and coalesce into random patterns. This leads to a further reduction in the rate of drying and smudge resistance, reduced image quality in portraits due to mottle and lack of definition in text and barcodes. Coalescence is sometimes seen as an issue in secure document production but, as shown by this offset paper initiative, careful choice of the ink/paper/drying conditions can go a long way to mitigate this.

Inkjet inks without water

There are a number of alternatives to water-based inkjet inks, based on oils and organic solvents. These have some interesting characteristics for secure documents but the liquids still need to be removed somehow after printing.

Drying is all about liquid removal. An interesting approach to this is to have no liquid to remove in the first place. The obvious established solution in this regard is to use UV cure inkjet inks. But at the highest print speeds, ink mobility before curing can cause print quality issues too.

A novel solution to this problem appears with the UV cure system in the *Konica Minolta KM-1*. This B2-size sheet-fed inkjet press uses heated inkjet print heads to lower the viscosity of the ink in order to make the fluid printable. When the droplets land on the paper they cool rapidly with a consequent increase in viscosity, effectively immobilising the printed dots before subsequent UV curing.

This is a similar ink transmission system to that used by Xerox in their solid ink devices, implemented on a production scale in their *CiPress* printers. These use a wax-based ink that is kept molten in a heated inkjet head and solidifies on contact with the paper. The printers then use a subsequent heat/pressure treatment to increase ink adhesion and surface flatness.

The challenge with these systems for secure documents is ensuring tamper-proof ink adhesion, as they can exhibit reduced penetration into the paper, resulting in a potential susceptibility to physical alteration.

Alternatives to inkjet

Inkjet is not the only potential solution for high-speed digital printing onto such papers. Liquid toner technology as found in the *Xeikon Trillium* and *HP Indigo* systems is also a viable alternative. It is not a technology found in smaller units such as desktop printers as the fluid management and printing control systems are not easy to scale down. However, the technology does work for high-speed digital production machines.

Liquid toner technology is in place in secure document production. However, it does have challenges similar to the non-aqueous inks described above.

Conclusion – gathering the learning points

The challenges faced by introducing coated offset papers into high-speed presses are similar to those found in inkjet printing low porosity papers in secure documents. They have placed emphasis on the critical importance of treating any inkjet printing implementation as a system. In the case of a secure document this means that the ink, paper and printing parameters must all be designed together.

There are alternative technologies to water-based inkjet and some of these are already established in secure documents on a larger production scale. UV cure inkjet and liquid toner printing fall into this category and innovations are still appearing in these. Further technologies such as wax-based printing also exist and are worthy of consideration for some applications.

U-NICA and ACTILOR *(Continued)*

But, as Alfred Rutz explains, 'The great potential of this product, its increasing market demand from key clients, and the necessary focused market development led to the entrepreneurial decision to carry out reorganisation'.

Hence the formation of a new company of the same name.

Actilor is an organic printing ink, based on a special protein extracted from the 'purple membrane' of a micro-organism called *Halobacterium salinarum*, which creates a distinct colour change when exposed to light.

This can be reversible, or the colour change can be fixed by exposing the ink to a laser, thus allowing a specific code or other design to be written to the colour-shift patch.

Actilor can be applied to banknotes, passports, visas, and other security documents, and can be verified with the naked eye. It provides other functions too, such as the option for optical data storage. A further expansion of this field and an increase in production capacity is intended for the future.

Expanding into life sciences

In addition, says the company, the Actilor protein provides enormous potential for further applications in the field of life sciences, including cosmetics and medicines. 'Which is why we decided to expand the business areas and further develop its various opportunities within the framework of a company of its own, specialising in biotechnology solutions, headed by new company management,' Rutz commented.

This new management is headed by Hertor Bauer (Commercial Division) and Samuel Schindler (Operations).

The other business areas of the U-NICA Group – which are mostly involved with physical and digital security technologies that are incorporated into the product or its packaging, rather than added on as labels – are unaffected by the reorganisation. 'In these fields we will continue to focus our concentration on sales, cooperation agreements and our customer projects with renowned, internationally active companies, in order to extend our global security solutions for the various branches over different business areas, and to give our customers complete solutions coming from one source,' said Rutz.

Both corporate groups are planning for substantial expansion of global sales activities in 2016 in order to move ahead with this development.

www.u-nica.com

www.actilor.com

From the Archives

10 years ago...

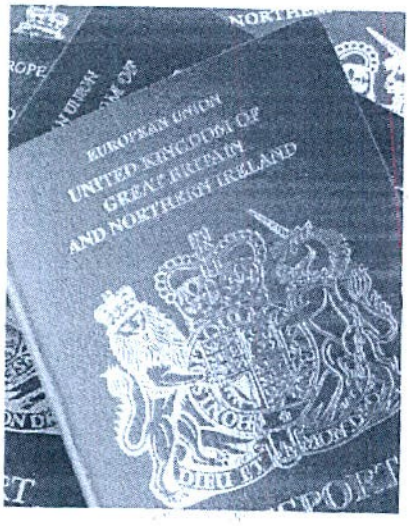
UK Passport Printer Up for Sale

Authentication News® reported that UK passport printer Security Printing Systems (SPS) was up for sale by its owners authentos, with a price tag of £150 million. SPS was acquired in 2001 by authentos, which was set up by venture capitalist APAX the previous year as the holding company for its acquisition of the state-owned German banknote and security printer Bundesdruckerei. Bundesdruckerei was subsequently sold back to a consortium of German banks for the sum of €1. It was understood SPS was being sold to pay off authentos' remaining debts.

Based in Oldham, UK, SPS printed UK passports, as well as giro cheques and other government security documents. It was originally part of the HMSO (Her Majesty's Stationery Office), being spun out as a separate company when the government-owned security printer was privatised in the mid-1990s.

NM Rothschild was reported to have been appointed to handle the sale of SPS. The news of the sale was a surprise, since the company was positioning itself through Bundesdruckerei International Services division squarely in the ID and biometrics markets. The acquisition of SPS was seen as a strategic move into the international markets that the company was looking to supply.

Later in 2006, 3M acquired SPS in a move to expand its secure document and issuance platform. In 2009 SPS lost a major passport contract and, in 2014, 3M announced its closure.



20 years ago...

New System for Green Card

Authentication News® reported that the US Immigration and Naturalisation Service (INS), an agency of the Justice Department, had appointed Information Spectrum Inc, of Annandale, VA as prime contractor to design and implement a new card issuing system to combat counterfeit cards used by illegal immigrants.

The contract was worth $275 million over three years. Information Spectrum in turn contracted Lasertechnics, a subsidiary of Sandia Imaging Systems, to provide high-speed card printers and consumables for the new fraud-resistant ID card programme.

The INS issued several different types of authorisation and ID documents to immigrants. Approximately 750,000 Employment Authorisation Documents (EADS) were issued annually to aliens who were granted temporary permission to work in the US; around 200,000 Border Crossing Cards were also issued annually to Mexicans and Canadians who were frequent border crossers, and 1.3 million Alien Registration Cards (Green Cards) were issued to legal permanent residents.

The new system issued documents, including the famous Green Card – the much sought after resident-alien status in the USA – in the form of PVC photo-ID cards with holographic laminate. Card production was expected to begin early in 1996, starting with EADS, followed by Border Crossing and Green Cards.

Sandia supplied up to 14 of its *Model 7R* printers that utilised dye sublimation to personalise PVC cards with digitised colour photos, fingerprints, signature and other features. These included holographic laminates, and the INS considered the use of holomagnetic stripes on its cards. The printing speed of two tandem 7R systems was over 300 an hour.

The new system electronically received complete card production information on aliens applying for US credentials. It then produced the card for mailing, including printing and sealing the envelope. The INS looked to install the new card printing system at four operating sites, the first being its Nebraska Service Centre in Lincoln. An online back-up system was also maintained in the Washington, DC area.

Tomorrow's Security Today at ODS *(Continued)*

Sectago, a young company giving its first CDS paper, reveals its mask-less lithography method to make continuous motion DOVID security features, while three papers in this session – by Toppan Printing, Surys (the new name for Hologram Industries) and the Reserve Bank of Australia – provide updates on optical security techniques which exploit surface plasmon resonance.

Opalux provides an update on how it is converting its opalescent materials into useable printing pigments, while the CSEM offers information on its embeddable sub-wavelength gratings, and IMT RAS explains its new control software for e-beam, dot-matrix and direct-writing systems.

The session closes with two papers on nano-optic technologies (from Nano Tech Security and Simon Frazer University).

And that's just the first day!

Friday morning sees a session on 'Combination Features' followed by a session on 'Smartphone Authentication' – both of which are certainly development areas.

The first features a paper from Zhongchao Special Security Tech Co, the first at ODS from this subsidiary of China Banknote Printing and Minting Corp, in which it unveils its work on interferential thin films.

The 'Smartphone Authentication' session opens with a paper from Raymond Wong, now at Hong Kong Polytechnic University but formerly with the HK Police, who explores the potential for a virtual ID document.

Newcomer Alise Devices explains its *LILIAC* transmissive security feature, then Goznak shows its smartphone-based method for analysing banknote images, with Orell Füssli closing the session with a paper on its *Blue Light* watermarking method for smartphone examination.

The final session of ODS 2016 covers the all-important topic of 'Authentication & Examination'. Another newcomer, ASE Optics explores the use of plastic optics as authentication tools, then Regula gives details of its equipment for examination and authenticity of secure holograms.

This is followed by another paper on the topic of image analysis, from a research group comprising KBA-NotaSys, Wincor Nixdorf and InIT which is working towards a low-cost analysis system.

The final paper of the conference has the European Central Bank describing its experiments in the use of infra-red image capture to screen for latent fingerprints on suspect banknotes.

What about the next big thing?

As is traditional at ODS, the two-day conference is preceded by the half-day 'Short Course on Optically Variable Devices'. This year, the course is given by Dr David Tidmarsh and Dr Mark Deakes of Reconnaissance, who between them are experienced in OVDs for banknotes, payment cards, tax stamps, brand protection and ID documents. While delivering the necessary foundation information for those new to OVDs, they promise a stimulating exploration of the latest techniques and consideration of what might become 'the next big thing'!

An always-popular and well-attended component of ODS is the conference dinner and table-top exhibit, which takes place on Thursday evening. This allows delegates to look at and examine the new developments that presenters describe in their papers, as well as other new optical security features from non-presenting organisations.

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