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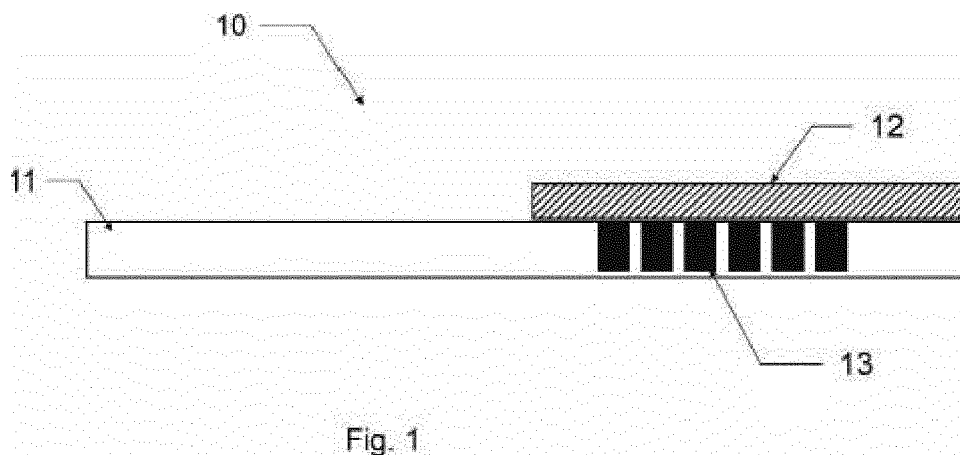
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(54) **A DOCUMENT SECURITY ELEMENT, A VALUE DOCUMENT WITH A SECURITY ELEMENT
AND A METHOD OF MANUFACTURING OF A VALUE DOCUMENT**

(57) The invention relates to a document security element comprising an image invisible in visible light, and visible in the infrared in the 700-1000 nm range, characterised in that it includes a layer of paper (11) susceptible to laser engraving, covered with a layer of paint (12) transparent in infrared radiation, wherein the layer of paper (11) comprises an engraving made by means of a laser beam pulse, performed after covering the layer of

paper (11) with the layer of paint (12). The invention also relates to a value document comprising a security element, especially a document constituting a banknote, certificate, visa, passport or an identity card, characterised in that it comprises an element securing the documents according to the invention and the method of manufacturing thereof.



Description**Field of the invention**

[0001] The object of the invention is an element securing a document with an image invisible in visible light, and visible in the infrared, and a value document, such as a banknote, certificate, visa, passport, identity card or other, comprising a security element. Furthermore, the object of the invention is also a method of manufacturing of such a value document.

Background of the invention

[0002] Value documents may comprise various security features, such as watermark, microprint, convex print, etc. However, new types of security features are still being introduced which allow them to be better protected against forgery.

[0003] For example, US Patent Application No. US2008088859A describes an invention relating to a value document, particularly a banknote, which has an individualising mark - in particular, constituting a number - created on the document in a contactless manner by means of a laser. The identification mark can be created on both sides of the value document by means of properly directed laser beams placed on one side of the document.

[0004] Canadian Patent Application No. CA2645578A presents a method for producing a data carrier in the form of e.g. a banknote that comprises an identifier in the form of patterns, letters, digits or an image. The identifier - in the solution being the object of the invention - is recognised visually or by means of appropriate devices designed for detecting security features. To apply the identifier onto the document, short laser pulses are used which modify the substance sensitive to the laser beam at a specific wavelength.

[0005] The aim of the invention was to develop methods for securing documents, alternative to those present in the prior art, which would ensure a higher level of document security, making forgery more difficult. The invention will allow for application of images invisible to the naked eye, as well as repeated personalised data, numbering or time stamps.

Essence of the invention

[0006] The essence of the invention is a document security element comprising an image invisible in visible light, and visible in the infrared in the 700-1000 nm range, characterised in that it includes a layer of paper susceptible to laser engraving, covered with a layer of paint transparent in infrared radiation, wherein the layer of paper comprises an engraving made using a laser beam pulse, performed after covering the layer of paper with the layer of paint.

[0007] The invention also includes a value document comprising a security element, in particular a document constituting a banknote, certificate, visa, passport or an identity card, characterised in that it comprises a document security element, described above in the essence of the invention, comprising an image invisible in visible light and visible in the infrared.

[0008] In addition, the solution according to the invention also relates to a method of manufacturing of a value document comprising an image invisible in visible light and visible in the infrared, characterised in that the layer of paper susceptible to laser engraving is covered with a layer of paint, wherein the paint is transparent in the infrared, and then the layer of paper susceptible to engraving is subjected to a laser beam pulse at a wavelength of 1064 nm at the place of paint application in such a manner that the layer of paint remains intact.

[0009] Preferably, the layer of paper susceptible to laser engraving is covered with the layer of paint in a printing process.

[0010] Also preferably, the colour and/or thickness of the paint by means of which the paper susceptible to engraving is covered provides adequate coverage of marked elements, i.e. such that the engraved element is not visible in daylight.

[0011] Preferably, the paint by means of which the paper susceptible to engraving is covered is a paint chosen from the following: steel-engraving, offset, screenprint or flexographic paints, and particularly preferably the thickness of the layer for the steel-engraving paint is between 40 μm and 60 μm , and for the screenprint paint it is between 15 μm and 20 μm , while for flexographic paint it is between 5 μm and 30 μm , and for the offset paint at least two of the partial optical densities measured for cyan, magenta, yellow colours are at least 0.8, or the partial optical density measured for black colour is at least 0.7.

[0012] Preferably, in the method according to the invention, the source of the laser beam is a Nd:YAG neodymium laser.

[0013] Also preferably, the power of the laser beam pulse ranges from $1.1 \cdot 10^{14}$ to $1.8 \cdot 10^{14}$ W/m², the beam speed ranges from 30 to 1000 mm/s, and the pulse frequency ranges from 700 to 15,000 Hz.

[0014] The object of the invention is presented in examples which do not limit its scope and in the drawing, in which:

Fig. 1 illustrates a cross-section of a document which is the object of the invention,

Fig. 2 illustrates an image visible in visible light,

Fig. 3 a-c illustrate images visible in the infrared at a wavelength greater than 700 nm on various types of value documents.

Embodiments

[0015] In an embodiment, value document 10, the cross-section of which is illustrated in Fig. 1, comprises a base layer of paper 11 made of cotton, cellulose and semi-cellulose. This layer is susceptible to engraving by means of a Nd:YAG laser beam with a wavelength of 1064 nm.

[0016] The paper susceptible to engraving of the embodiment comprises a paper substrate layer which is covered with a coating layer. The paper substrate layer comprises a laser pigment of tin dioxide doped with antimony oxide, and titanium white. In turn, the coating layer comprises a laser pigment of tin dioxide doped with antimony oxide. Both, paper in which the paper substrate layer was covered with the coating layer on one side only, and paper in which the paper substrate layer was covered with the coating layer on both sides were used. In the paper used, the laser pigment of tin dioxide doped with antimony oxide comprised from 95% to 99% by weight of tin dioxide (SnO_2) and from 1% to 5% by weight of antimony oxide (Sb_2O_3). This pigment allows for obtaining particularly legible and clear laser-engraved markings. The titanium white used was a rutile form of titanium dioxide (TiO_2). In turn, the paper substrate layer comprised conventional fibres and additives.

[0017] The paper substrate layer comprises 2.5-10%, preferably 5% by weight of laser pigment of tin dioxide doped with antimony oxide and from 2.5% to 10%, preferably 3.5% by weight of titanium white. The coating layer comprises 0.5-3%, preferably 2% by weight, of laser pigment of tin dioxide doped with antimony oxide.

[0018] A graphic layout is applied onto the base layer of paper 11 by means of typical printing techniques, such as, among others, offset, screenprint, steel-engraving or flexographic techniques. In the embodiment, an additional layer of paint 12 was applied onto a selected portion of the base layer 11 of the value document 10, which constitutes a pattern made with infrared-transparent paint, wherein various paints used in the above-mentioned printing techniques can be used. Various paint thicknesses were tested depending on the above-mentioned techniques, and the results are presented in Table 1.

Table 1

Type of paint	Min. thickness of the paint layer [μm]	Max. thickness of the paint layer [μm]	Optimal thickness of the paint layer [μm]
Steel-engraving paint	10	60	40-60
Screenprint paint	10	40	15-20
Flexographic paint	5	30	5-30
Offset paint	at least two of the partial optical densities measured for cyan, magenta, yellow colours are at least 0.8, or the partial optical density measured for black colour is at least 0.7.		

[0019] After printing the additional layer 12 on the base layer of paper 11, the value document 10 was subjected to the process of laser engraving by means of a Nd:YAG neodymium laser with a wavelength of 1064 nm, which creates an image 13 in sepia or in shades of grey. Engraving by means of a laser beam was done in such a manner that the engraved image 13 was created under the additional layer 12 of infrared-transparent paint. The additional layer 12 of paint was not affected by the laser beam. The image 13 obtained in this manner was visible in the infrared at a wavelength above 700 nm, while the image was invisible in visible light.

[0020] In the embodiment, in order to apply the additional layer 12, steel-engraving, offset, screenprint or flexographic infrared-transparent paints were used with their colouring and/or thickness ensuring adequate coverage of the elements marked with the laser beam. Thanks to the use of covering colours and/or appropriate thickness of paint 12, the engraved image 13 is invisible in visible light (Fig. 2).

[0021] In visible light, on the value document 10 obtained by the method according to the invention, an image is visible which constitutes the additional layer 12 printed with paint, while the engraved image 13 remains hidden. When the value document 10 is placed in the infrared at a wavelength above 700 nm, then only the engraved image 13 which absorbs the infrared is visible.

[0022] It is possible to use the method that is the object of the invention to apply hidden images onto various types of

value documents. Hidden images can be, e.g., alphanumeric data or time stamps, bitmap pixel graphics and vector graphics.

[0023] An exemplary use of the method according to the invention is shown in Fig. 3a, where the value document 10 is a banknote and the hidden image 13 - visible in the infrared, made with the laser engraving technique - comprises the banknote's number. This number may constitute a repetition of traditional numbering of banknote made e.g. with a typographic technique. In turn, Fig. 3b shows a value document constituting a personalised secured document (e.g. ID card, visa or certificate), where the hidden image 13, visible in the infrared, comprises a photograph. By applying a repeated photograph of the document's holder with a technique other than in case of the main photograph visible in daylight, the level of personalisation security increases. In turn, Fig. 3c shows, for example, the value document 10 in the form of a passport, where a special code (e.g. time stamp) was applied with the laser engraving technique.

Claims

1. A document security element comprising an image invisible in visible light, and visible in the infrared in the 700-1000 nm range, **characterised in that** it includes a layer of paper (11) susceptible to laser engraving, covered with a layer of paint (12) transparent in infrared radiation, wherein the layer of paper (11) comprises an engraving made by means of a laser beam pulse, performed after covering the layer of paper (11) with the layer of paint (12).
2. A value document comprising a security element, especially a document constituting a banknote, certificate, visa, passport or an identity card, **characterised in that** it comprises the element securing the document comprising an image invisible in visible light and visible in the infrared, defined in claim 1.
3. A method of manufacturing of the value document defined in claim 2, **characterised in that** the layer of paper (11) susceptible to laser engraving is covered with the layer of paint (12), wherein this paint is transparent in the infrared, and then the layer of paper (11) susceptible to engraving is subjected to a laser beam pulse at a wavelength of 1064 nm at the place of paint application in such a manner that the layer of paint (12) remains intact.
4. The method according to claim 3, **characterised in that** the layer of paper (11) susceptible to laser engraving is covered with the layer of paint (12) in the printing process.
5. The method according to claims from 3 to 4, **characterised in that** the colouring and/or thickness of the paint by means of which the paper (11) susceptible to engraving is covered provides adequate coverage of marked elements.
6. The method according to claims from 3 to 5, **characterised in that** the paint by means of which the paper (11) susceptible to engraving is covered is a paint chosen from the following: steel-engraving, offset, screenprint or flexographic paints.
7. The method according to claim 6, **characterised in that** the thickness of the layer (12) for steel-engraving paint is between 40 μm and 60 μm .
8. The method according to claim 6, **characterised in that** the thickness of the layer (12) for screenprint paint is between 15 μm and 20 μm .
9. The method according to claim 6, **characterised in that** the thickness of the layer (12) for flexographic paint is between 5 μm and 30 μm .
10. The method according to claim 6, **characterised in that** in case of the applied layer (12) of offset paint, at least two of the partial optical densities measured for cyan, magenta, yellow colours are at least 0.8, or the partial optical density measured for black colour is at least 0.7.
11. The method according to claim 3, **characterised in that** the source of the laser beam is a Nd:YAG neodymium laser.
12. The method according to claim 3, **characterised in that** power of the laser beam pulse ranges from $1.1 \cdot 10^{14}$ to $1.8 \cdot 10^{14} \text{ W/m}^2$, the beam speed ranges from 30 to 1000 mm/s, and the pulse frequency ranges from 700 to 15,000 Hz.

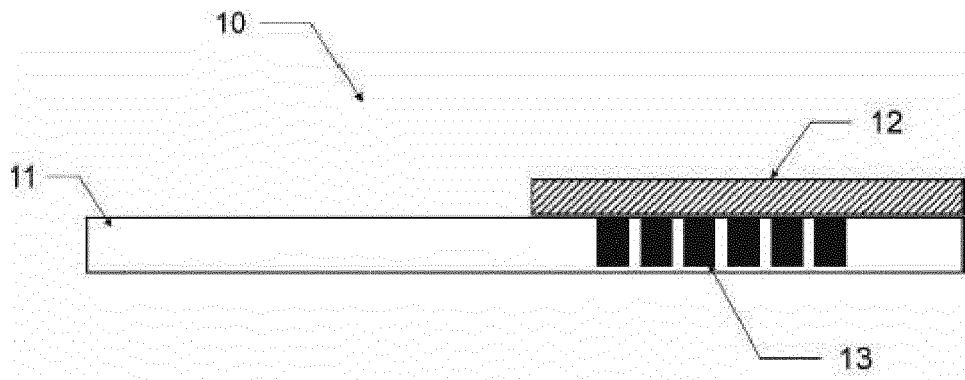


Image in visible light

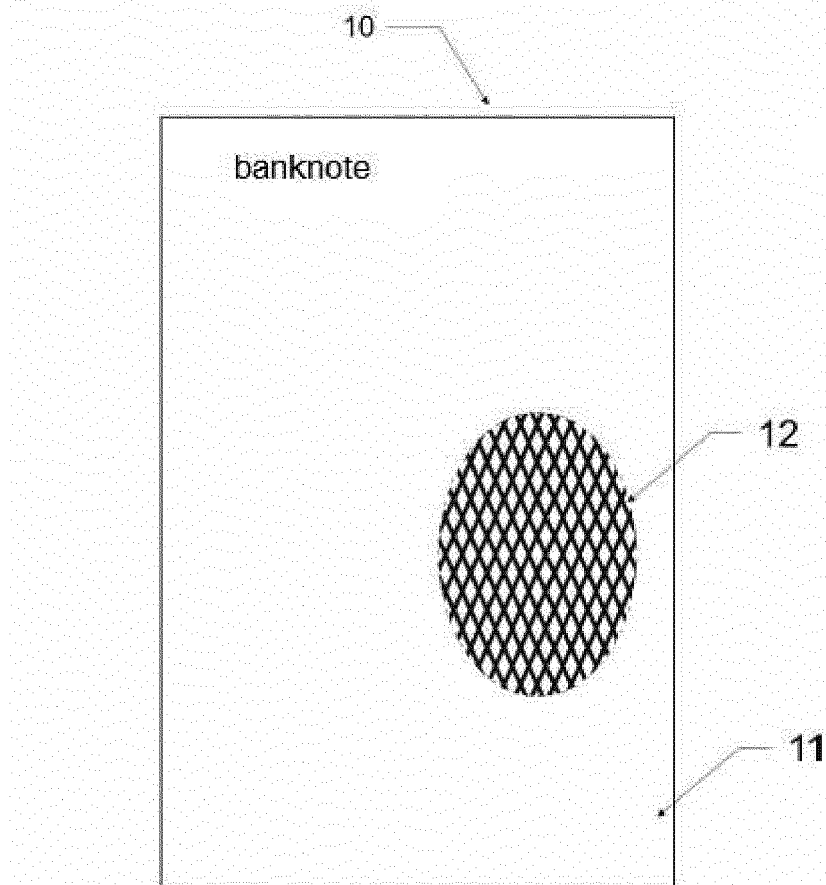


Image in the light of 1000 nm IR

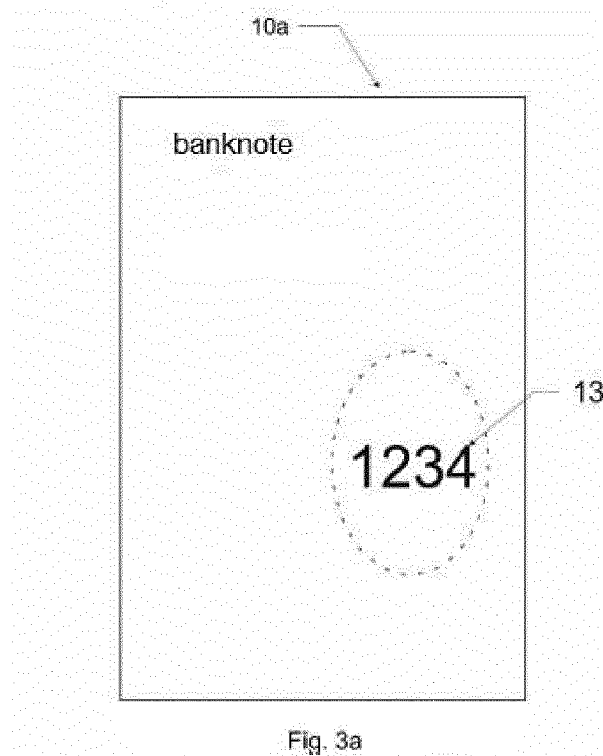
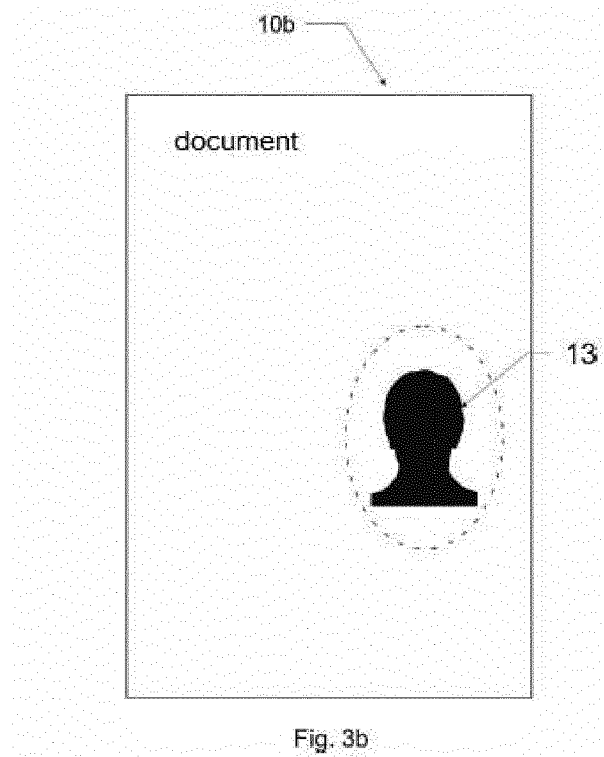
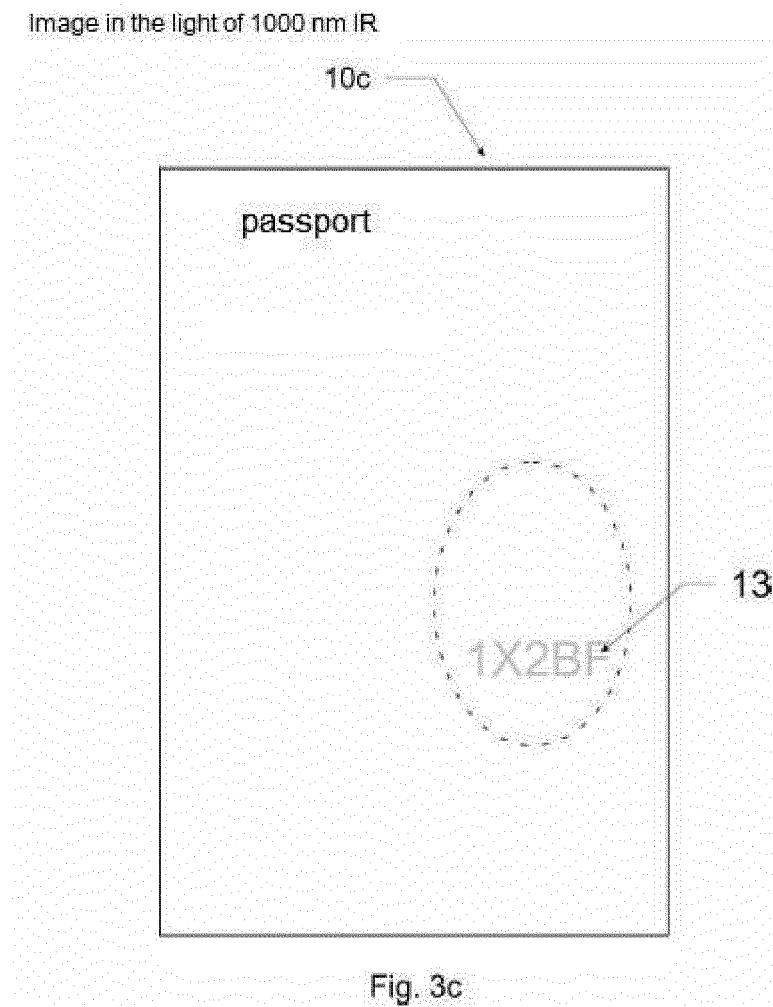


Image in the light of 1000 nm IR







EUROPEAN SEARCH REPORT

Application Number
EP 18 18 4788

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 98/22291 A2 (EASTMAN CHEM CO [US]; CYR MICHAEL JOHN [US]; KRUTAK JAMES JOHN SR [US]) 28 May 1998 (1998-05-28) * figure 4 *	1-3	INV. B42D25/41 B42D25/378
A	WO 03/056507 A1 (DIGIMARC ID SYSTEMS LLC [US]; JONES ROBERT [US]) 10 July 2003 (2003-07-10) * figure 5 *	1	
A	US 2015/306887 A1 (WAUMANS BART [BE] ET AL) 29 October 2015 (2015-10-29) * figure 2 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B42D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 October 2018	Examiner Langbroek, Arjen
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			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 18 4788

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9822291 A2	28-05-1998	AU 5249798 A	10-06-1998
		DE 69718826 D1	06-03-2003
		DE 69718826 T2	07-08-2003
		EP 0988150 A2	29-03-2000
		JP 2001504406 A	03-04-2001
		WO 9822291 A2	28-05-1998

WO 03056507 A1	10-07-2003	AT 555911 T	15-05-2012
		AU 2002364746 A1	15-07-2003
		CA 2470600 A1	10-07-2003
		EP 1459246 A1	22-09-2004
		HK 1069467 A1	16-05-2013
		US 2003234292 A1	25-12-2003
		WO 03056507 A1	10-07-2003

US 2015306887 A1	29-10-2015	NONE	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2008088859 A [0003]
- CA 2645578 A [0004]