

Web processing system and method for processing a web

Field of the invention

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The invention pertains to a web processing system and a method for processing a web, particularly for printing random patterns or layouts onto a continuous web of material.

Background of the invention

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Articles of value are usually protected by some sort of authenticity measures that are put into place by the manufacturer to prevent the forgery of such an article. For example, cigarette boxes may be tagged in way that allows to track its origin and to confirm its authenticity. Conventionally employed techniques involve methods of recording identification codes or the like on cardboard or paper using sophisticated printing techniques to tag the desired articles of value with a seal of genuineness. Those printing techniques are hard to reproduce for imitators or plagiarists since the techniques either involve specific knowledge about the manufacturing process or the use of hard to obtain materials.

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The document EP 1 125 758 A1 discloses a system for tagging sheets of paper with a random pattern, the system using a series of printing rollers that may apply phase shifted random patterns to one or both sides of the sheet.

25 Summary of the invention

One idea of the present invention is to provide a web processing system that is able to generate a patterned image on the web which patterned image is truly random or at least pseudo-random in nature.

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A first aspect of the present invention therefore relates to a processing system for a web, comprising a conveying mechanism configured to feed a continuous web of material along a conveying path in the processing system; a first printing cylinder having a first diameter and a first printing pattern, the first printing cylinder being arranged adjacent to the conveying path and configured to print a first image pattern on at least one surface of the continuous web; at least one second printing cylinder having a second diameter different from the first diameter and a second printing pattern, the second printing

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cylinder being arranged adjacent to the conveying path and configured to print a second image pattern on top of the first image pattern on the continuous web; and a system controller coupled to the conveying mechanism and configured to control the conveying mechanism according to at least one registration procedures, wherein the system
5 controller is configured to selectively disable at least one of the registration procedures when printing the first and second image patterns to print a final random image pattern on the at least one surface of the continuous web.

A second aspect of the present invention relates to a method for processing a web, the
10 method comprising conveying a continuous web of material along a conveying path in a processing system by a conveying mechanism; printing a first image pattern on at least one surface of the continuous web using a first printing cylinder having a first diameter and a first printing pattern; printing a second image pattern on top of the first image pattern on the continuous web using at least one second printing cylinder having a
15 second diameter different from the first diameter and a second printing pattern; and selectively disabling at least one registration procedure for the conveying mechanism when printing the first and second image patterns to print a final random image pattern on the at least one surface of the continuous web.

20 According to a third aspect of the invention, a web of material comprises a random pattern printed on a surface thereof, wherein the random pattern is obtained according to the method of the first aspect of the invention.

The dependent claims provide additional technical features of advantageous
25 embodiments and further improvements of the invention.

According to an embodiment of the processing system, the first printing pattern and/or the second printing pattern may be different.

30 According to another embodiment of the processing system, the registration procedures may comprise one or more of control of web conveying speed, control of lateral web alignment, control of conveying path length between the printing cylinders and control of web tension.

35 According to another embodiment of the processing system, the system controller may further be coupled to the first printing cylinder and the at least one second printing

cylinder and configured to drive the first printing cylinder and the at least one second printing cylinder at different rotational speed.

5 According to another embodiment of the processing system, the system controller may further be configured to drive the first printing cylinder and the at least one printing cylinder at the same tangential speed.

10 According to an embodiment of the method, the first image pattern and/or the second image pattern may comprise random image patterns.

According to another embodiment of the method, the first printing pattern and the second printing pattern may comprise different patterns.

15 According to another embodiment of the method, the registration procedures may comprise one or more of control of web conveying speed, control of lateral web alignment, control of conveying path length between the printing cylinders and control of web tension.

20 According to another embodiment of the method, the continuous web material may comprise one of cardboard, paper, cellulose, textile fabric, plastic, metal or a laminate combination thereof.

25 According to another embodiment of the method, the first printing cylinder and the at least one second printing cylinder may be driven at different rotational speed.

According to another embodiment of the method, the first printing cylinder and the at least one second printing cylinder may be driven at the same tangential speed.

30 According to another embodiment of the method, printing the first and second printing pattern may comprise transferring compositions comprising at least one of an ink, a varnish and a wax onto the at least one surface of the web.

35 The web according to the third aspect of the invention may in an embodiment include separation means adapted to allow separation of at least one sheet from the web, the at least one sheet comprising a portion of the printed random pattern. The separation means may comprise score lines, perforation lines or die cuts formed in the material of the web.

The web material according to the third aspect of the invention may in an embodiment comprise one of cardboard, paper, cellulose, textile fabric, plastic, metal or a laminate combination thereof.

- 5 A package comprising at least one part thereof made from a web may be manufactured using a web of material according to the third aspect of the invention.

The invention will be explained in greater detail with reference to exemplary embodiments depicted in the drawings as appended.

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Brief description of the drawings

The accompanying drawings are included to provide a further understanding of the present invention and are incorporated in and constitute a part of this specification.

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The drawings illustrate the embodiments of the present invention and together with the description serve to explain the principles of the invention. Other embodiments of the present invention and many of the intended advantages of the present invention will be readily appreciated as they become better understood by reference to the following detailed description. The elements of the drawings are not necessarily to scale relative to each other. Like reference numerals designate corresponding similar parts.

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Fig. 1 shows a schematical illustration of a processing system in isometric view according to one embodiment of the invention.

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Fig. 2 schematically illustrates a portion of a base web according to a further embodiment of the invention.

Fig. 3 depicts a functional block diagram of stages in a method for processing a web according to yet another embodiment of the invention.

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Detailed description of the embodiments

Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations may be substituted for the specific embodiments shown and described without departing from the scope and spirit of the present invention. Generally,

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this application is intended to cover any adaptations or variations of the specific embodiments discussed herein. In particular, specific features, characteristics and properties of different embodiments as discussed hereinbelow may be combined, if not explicitly indicated otherwise.

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Generally, this application is intended to cover any adaptations or variations of the specific embodiments discussed herein. In the present invention, reference is made to printing machines and printing systems. Such printing apparatuses are generally intended to comprise any combination or structural arrangement of units, modules and registers that are able to convey a web to be processed along a conveying path within the apparatus. Moreover, the printing apparatuses may comprise any components that are adapted to imprint, stamp or presswork patterns, images, text or coloured areas onto one or both sides of the web being processed. The printing apparatus may comprise one or more of laser beam devices, developing devices, transfer devices, fixation devices, cutting devices, folding devices and similar conventionally known components in gravure and offset printing.

Fig. 1 schematically illustrates a processing system 100. The processing system 100 may particularly be configured to process and produce printed webs Wp of material, the web Wp comprising material such as cardboard, paper, cellulose, textile fabric, plastic, metal or a laminate combination thereof. The processing system 100 generally comprises a plurality of processing stages 12 that are equipped with rollers or feed units, generally denoted with the reference sign 10 in Fig. 1. The rollers 10 form part of a conveying mechanism 11 that is configured to feed a continuous web W of material along a conveying path in the processing system 100.

Fig. 2 illustrates a functional view of a processing system for processing webs W and may be seen as conceptual depiction of the processing system 100 in Fig. 1. The web W may be input to the processing system at a system input 8, conveyed through the various processing stages 12 and output as printed web Wp at a system output 9. Among other not specifically indicated processing units and modules, the processing system 100 comprises a first printing cylinder 1 having a first diameter d1 and a first printing pattern formed thereon. The first printing cylinder 1 is arranged adjacent to the conveying path and configured to print a first image pattern, i.e. a printed image of the printing pattern of the first printing cylinder, on at least one surface of the continuous web W. In Fig. 1 and 2 the first printing cylinder 1 is configured to print the first image pattern on the bottom

surface of the web W running between the first printing cylinder 1 and a corresponding pressure roller 4.

5 The processing system 100 further comprises at least one second printing cylinder 2 having a second diameter d2 different from the first diameter d1 and a second printing pattern formed thereon. For example, the second diameter d2 may be larger than the first diameter d1. The second printing cylinder 2 is arranged in series with the first printing cylinder 1 and may be arranged downstream of the first printing cylinder 1 in the conveying path of the web W. The second printing cylinder 2 is likewise arranged adjacent
10 to the conveying path and is configured to print a second image pattern, i.e. a printed image of the second printing pattern of the second printing cylinder, on top of the first image pattern on the continuous web W. To that end, the second printing cylinder 2 may be configured to print the second image pattern on the bottom surface of the web W running between the second printing cylinder 2 and a corresponding pressure roller 5.

15 As shown in Fig. 1, there may be a third printing cylinder 3 downstream of the second printing cylinder 2, the third printing cylinder 3 having a diameter different from the diameter of the first and/or second printing cylinder 1 and 2, and preferably a third printing pattern formed thereon. A corresponding pressure roller 6 may be provided in
20 order to have the third printing cylinder 3 print a third image pattern, i.e. a printed image of the third printing pattern of the third printing cylinder, on a surface of the web W running between the third printing cylinder 3 and the pressure roller 6. Generally, the number of printing cylinders 1, 2 and 3 is not limited to two or three, but may instead be any desired number greater than two.

25 The first printing pattern and/or the second printing pattern may be printed on the web W as image patterns or layouts, for example as ornamental designs or lines, dots or geometrical shapes in various colours and/or line thickness. The first printing pattern and the second printing pattern may for example be different patterns providing a final image
30 pattern made of an overlapping of the first and second image patterns on the web W, i.e. the different printing cylinders 1, 2 and 3 print different image patterns on top of each other. The printing cylinders 1, 2 and 3 may be configured to transfer compositions in liquid form onto the at least one surface of the web W, such as ink, varnish or wax. Once transferred to the surface of the web W, the processing system 100 may comprise a drying
35 module downstream of each of the printing cylinders 1, 2 and 3 that is configured to dry the compositions in liquid form printed on the web W.

The processing system 100 further comprises a system controller 7 which is coupled to the conveying mechanism 11 and the printing cylinders 1, 2 and 3. The system controller 7 is on one hand responsible for control of the printing cylinders 1, 2 and 3. For example, the system controller 7 may be configured to drive the printing cylinders 1, 2 and 3 at different rotational speed. Depending on the diameters d_1 and d_2 of the printing cylinders 1, 2 and 3 the system controller 7 may adapt the rotational speed of each of the printing cylinders 1, 2 and 3 in such a way that the printing cylinders 1, 2 and 3 are driven at the same tangential speed. This way, the speed of the web W passing by the printing cylinders 1, 2 and 3 will remain constant throughout the whole printing process.

On the other hand, the system controller 7 is configured to control the conveying mechanism 11 according to at least one registration procedure. Such registrations procedures may for example include control of web conveying speed, control of lateral web alignment, control of conveying path length between the printing cylinders and control of web tension. By selectively disabling at least one of the registration procedures when printing the first and second printing patterns, the system controller 7 is able to provide a certain randomness in the printing parameters of the processing system 100, thereby introducing a degree of irreproducibility to the printed patterns. In particular, owing to disabling of one or more of the registration procedures each of the first second image patterns has a certain degree of randomness due to the granted ability for the web W to move out of registry over the first and/or second and/or third printing rollers. Consequently, each of the first, second and third image patterns are random or at least pseudo-random and the final image pattern obtained at the outlet 9 of the processing system 100, which is made of a combination of the first, second and third image patterns is also random or at least pseudo-random. The printed web W_p is therefore printed with a unique final image pattern, which is therefore very hard to reproduce.

The processing system 100 may be used to print continuous webs W_p of material that include a truly or at least pseudo-random pattern printed on a surface thereof. The web W_p may for example comprise separation means, such as score lines, perforation lines or die cuts formed in the material of the web W_p , that are adapted to allow separation of at least one sheet from the web W_p . Each separated sheet then comprises a portion of the printed random pattern. Such sheets may subsequently be used in manufacturing or tagging a package, for example a cigarette box.

Fig. 3 schematically illustrates a block diagram of a method M for processing a continuous web of material, such as the web W of Figs. 1 and 2. The method M may particularly be

implemented with a web processing system, such as the processing system 100 as illustrated in and explained in conjunction with Figs. 1 and 2.

In a first stage, the method M may comprise at M1 the process of conveying a continuous web W of material along a conveying path in a processing system 100 by a conveying mechanism 11. The web W may for example be made from a material comprising one of cardboard, paper, cellulose, textile fabric, plastic, metal or a laminate combination thereof. The conveying mechanism 11 may for example comprise a number of rollers and web feed modules, such as rollers 10. The conveying mechanism may in particular be distributed over a series of processing stages 12 of the processing system 100.

In a second stage M2, a first image pattern is printed on at least one surface of the continuous web W, for example the upper surface, using a first printing cylinder 1 having a first diameter d1 and a first printing pattern. Then, in a third stage M3, a second image pattern may be printed on top of the first image pattern on the continuous web W using at least one second printing cylinder 1 having a second diameter d2 different from the first diameter d1 and a second printing pattern, preferably different from the first printing pattern. The printing processes of M2 and M3 may for example comprise transferring compositions in liquid form, such as ink, varnish or wax, onto the at least one surface of the web W.

In a fourth stage M4, while the first and second image patterns are printed on the web W by the printing cylinders 1, 2 and 3, at least one registration procedure for the conveying mechanism 11 in the processing system 100 may be selectively disabled. The processing system 100 may be under control of a system controller 7 that controls various registration procedures in the system such as the control of web conveying speed, the control of lateral web alignment, the control of conveying path length between the printing cylinders 1, 2 and 3, and the control of web tension.

Due to disabling at least one registration procedure for the conveying mechanism 11 the first and second printing pattern of the printing cylinders may each provide random image patterns onto the web W. In order to create as much randomness in the resulting overall final image pattern on the web W, the first printing pattern and the second printing pattern may each provide different image patterns. To achieve an independence of the image patterns, the first printing cylinder 1 and the at least one printing cylinder 2, 3 may be driven at different rotational speed, but at the same tangential speed. This ensures that the sequence of the first and second image patterns is randomly shifted with respect to

each other. On the other hand, having the first and second printing cylinders 1, 2 and 3 run at the same tangential speed will guarantee a constant web speed of the web W in the conveying mechanism without the risk of mechanical or tensile stress due to the printing processes at the different cylinders.

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If the image patterns have been transferred from the printing cylinders to the web W as compositions in liquid form, those compositions may be dried in an optional stage M5 of the method M. Said drying stage may alternatively be carried out after each of the printing processes M2 and M3.

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Particular features of an embodiment of the invention may have been disclosed with respect to only one of several implementations, however, said feature may be combined with one or more other features of the other implementations as may be desired and advantageous for any given or particular application. Furthermore, to the extent that the terms "include", "have", "with", or other variants thereof are used in either the detailed description or the claims, such terms are intended to be inclusive in a manner similar to the term "comprise". The terms "coupled" and "connected", along with derivatives may have been used. It should be understood that these terms may have been used to indicate that two components work together or interact with each other, irrespective of whether they are in direct physical or electrical contact or not. Additionally, any terminology used in the foregoing description related to the spatial arrangement of features, elements or components of the embodiments depicted in the drawings, such as "top", "bottom", "left", "right", "lower", "upper" and similar terms, is used solely for purposes of an easier understanding and is not intended to limit the invention in any way.

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List of Reference Signs

	1	Printing cylinder
	2	Printing cylinder
5	3	Printing cylinder
	4	Pressure roller
	5	Pressure roller
	6	Pressure roller
	7	System controller
10	8	Web inlet
	9	Web outlet
	10	Conveying roller
	11	Conveying mechanism
	12	Processing stage
15	d1	Cylinder diameter
	d2	Cylinder diameter
	M	Method
	M1	Method step
	M2	Method step
20	M3	Method step
	M4	Method step
	M5	Method step
	W	Web
	Wp	Printed web

Claims

1. Processing system for a web, comprising:
 - 5 a conveying mechanism configured to feed a continuous web of material along a conveying path in the processing system;
 - a first printing cylinder having a first diameter and a first printing pattern, the first printing cylinder being arranged adjacent to the conveying path and configured to print a first image pattern on at least one surface of the continuous web;
 - 10 at least one second printing cylinder having a second diameter different from the first diameter and a second printing pattern, the second printing cylinder being arranged adjacent to the conveying path and configured to print a second image pattern on top of the first image pattern on the continuous web; and
 - a system controller coupled to the conveying mechanism and configured to control
 - 15 the conveying mechanism according to at least one registration procedure, wherein the system controller is configured to selectively disable at least one of the registration procedures when printing the first and second image patterns to print a final random image pattern on the at least one surface of the continuous web.
- 20 2. Processing system according to claim 1, wherein the first printing pattern and the second printing pattern are different.
3. Processing system according to one of the claims 1 or 2, wherein the registration procedures comprise one or more of control of web conveying speed, control of
 - 25 lateral web alignment, control of conveying path length between the printing cylinders and control of web tension.
4. Processing system according to one of the claims 1 to 3, wherein the system controller is further coupled to the first printing cylinder and the at least one
 - 30 second printing cylinder and configured to drive the first printing cylinder and the at least one second printing cylinder at different rotational speed.

5. Processing system according to claim 4, wherein the system controller is further configured to drive the first printing cylinder and the at least one second printing cylinder at the same tangential speed.
- 5 6. Method for processing a web, the method comprising:
conveying a continuous web of material along a conveying path in a processing system by a conveying mechanism;
printing a first image pattern on at least one surface of the continuous web using a
10 first printing cylinder having a first diameter and a first printing pattern;
printing a second image pattern on top of the first image pattern on the continuous web using at least one second printing cylinder having a second diameter different from the first diameter and a second printing pattern; and
15 selectively disabling at least one registration procedure for the conveying mechanism when printing the first and second image patterns to print a final random image pattern on the at least one surface of the continuous web.
7. Method according to claim 6, wherein the first image pattern and/or the second image pattern comprise random image patterns.
- 20 8. Method according to one of the claims 6 and 7, wherein the first printing pattern and the second printing pattern comprise different patterns.
9. Method according to one of the claims 6 to 8, wherein the registration procedures
25 comprise one or more of control of web conveying speed, control of lateral web alignment, control of conveying path length between the printing cylinders and control of web tension.
10. Method according to one of the claims 6 to 9, wherein the continuous web material
30 comprises one of cardboard, paper, cellulose, textile fabric, plastic, metal or a laminate combination thereof.
11. Method according to one of the claims 6 to 10, wherein the first printing cylinder and the at least one second printing cylinder are driven at different rotational speed.

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12. Method according to claim 11, wherein the first printing cylinder and the at least one second printing cylinder are driven at the same tangential speed.
- 5 13. Method according to one of the claims 6 to 12, wherein printing the first and second printing pattern comprises transferring compositions onto the at least one surface of the web comprising at least one of an ink, a varnish and a wax onto the at least one surface of the web.