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(54) **METHOD OF PROCESSING A SUBSTRATE WEB INTO INDIVIDUAL SHEETS FOR THE PRODUCTION OF SECURITY DOCUMENTS AND INSTALLATION FOR CARRYING OUT THE SAME**

(57) There is described a method of processing a substrate web (W) into individual sheets (S) for the production of security documents, such as banknotes, the method comprising the following steps:

- providing a substrate web (W) ;
- inspecting the substrate web (W) to check a quality thereof;
- cutting the substrate web (W) into individual sheets (S) ;
- sorting the individual sheets (S) in dependence of results of the inspection at step b) to produce at least two types of sorted sheets (S_A , S_B , S_C), including good sheets (S_A) meeting desired quality requirements and bad sheets (S_B , S_C) that are found to exhibit defects ; and
- processing at least the good sheets (S_A), and preferably also the bad sheets (S_B , S_C), into individual stacks or reams (R , R_W) each consisting of a predetermined number of individual sheets.

Also described is an installation for carrying out this method.

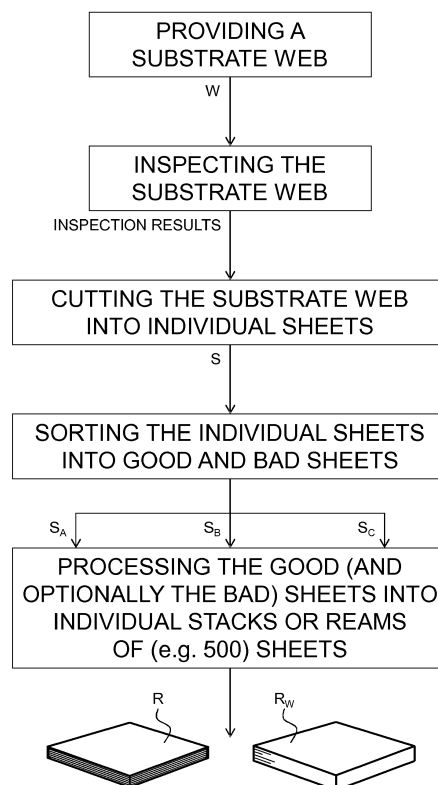


Fig. 2

Description

TECHNICAL FIELD

[0001] The present invention generally relates to a method of processing a substrate web into individual sheets for the production of security documents and an installation for carrying out the same.

BACKGROUND OF THE INVENTION

[0002] Security documents, such as banknotes, are produced using dedicated substrate material (be it paper, polymer or hybrid - i.e. paper and polymer - substrates) produced by security substrate manufacturers like Louisenthal (www.louisenthal.com), De La Rue (www.delarue.com), Crane Currency (www.crane.com), CCL Secure (www.cclsecure.com), Arjowiggins (www.arjowiggins.com), LandQart (www.landqart.com) and Fedrigoni (www.fedrigoni.com).

[0003] Paper substrates used for the production of security documents, such as banknotes, are typically made of cotton fibres (rather than wood pulp as used for the production of commercial paper). Banknote paper is usually produced by mixing cotton fibres (which can be combined with linen or other plant fibres) with water to produce a pulp. Colouring is further added to the pulp which is then filtered through a mould to produce a watermark, a widely-used security feature of paper substrates. Further security features can be embedded in the substrate material, such as security threads or the like, or be applied on either side of the substrate, for instance by printing patterns or by applying foil material using e.g. hot-stamping techniques. Paper substrates are commercially available from most of the aforementioned substrate manufacturers and have been widely used for several decades for the production of banknotes.

[0004] Methods of producing paper substrates using so-called cylinder-mould machines are for instance disclosed in European Patent Publications Nos. EP 0 059 056 A1, EP 0 229 645 A1, EP 1 630 285 A2 and British Patent Publication Nos. GB 2 397 582 A, GB 2 433 470 A.

[0005] Polymer substrates, in contrast, are produced from a transparent film - typically made of biaxially oriented polypropylene (or BOPP) - which is ultimately provided on both sides with white opacifying layers, typically by gravure printing. Such opacifying layers are omitted in certain portions of the substrate material so as to form transparent window regions, which is a characteristic security feature of polymer substrates. Like paper substrates, polymer substrates can be provided with a variety of additional security features at the time of the manufacture of the substrate material, including e.g. iridescent stripes, optically variable devices (or OVDs), etc.. Examples of polymer substrates are commercially available from CCL Secure - formerly known as Innovia Security - as Guardian™ substrate or more recently from De La Rue as the SafeGuard™ substrate.

[0006] The aforementioned transparent film of BOPP material is typically created using a unique "bubble" process to create a highly transparent and stiff film which is outputted in the form of a continuous web of transparent material, which web is subsequently fed through a number of printing and processing stations to apply the required opacifying layers and desired security features.

[0007] A method of producing polymer substrates based on a BOPP film is for instance disclosed in International (PCT) Publication No. WO 83/00659 A1.

[0008] Hybrid substrates are aimed at combining the best of both worlds, namely by bonding paper and polymer layers one with the other. Examples of such hybrid substrates are commercially available from Louisenthal as Hybrid™ substrate or from LandQart as Durasafe® substrate.

[0009] A method of producing hybrid substrates is for instance disclosed in European Patent Publication No. EP 2 153 988 A1.

[0010] The aforementioned substrate material is conventionally produced in the form of a continuous web which is ultimately processed into reels or individual sheets for transport and shipment to the end-customer, namely security printers.

[0011] A problem with the conventional approach to the production and supply chain of substrate material resides in that defects may still be present on the substrate material, which the end-user, namely the security printer, cannot readily identify. This leads to unnecessary waste as the security printer is ultimately led to process substrate material without necessarily knowing or being in a position to identify the presence of defects prior to printing.

[0012] Solutions have been incorporated by substrate manufacturers to improve the quality of the substrate material delivered to security printers, including the provision of inspection systems to check the quality of the substrate material at various stages of the production, but further improvements are still required.

SUMMARY OF THE INVENTION

[0013] A general aim of the invention is therefore to provide an improved solution, namely such a solution that ensure that sheets meeting desired quality requirements can appropriately be delivered to security printers.

[0014] A further aim of the invention is to provide such a solution that is more optimal in respect of a possible valorisation of defective sheets that are normally discarded as waste.

[0015] These aims and others are achieved thanks to the solutions defined in the claims.

[0016] In accordance with the invention, there is provided a method of processing a substrate web into individual sheets for the production of security documents, such as banknotes, the method comprising the following steps:

- a) providing a substrate web ;
- b) inspecting the substrate web to check a quality thereof ;
- c) cutting the substrate web into individual sheets ;
- d) sorting the individual sheets in dependence of results of the inspection at step b) to produce at least two types of sorted sheets, including good sheets meeting desired quality requirements and bad sheets that are found to exhibit defects ; and
- e) processing at least the good sheets, and preferably also the bad sheets, into individual stacks or reams each consisting of a predetermined number of individual sheets.

[0017] Preferably, the method further comprising the steps of providing the substrate web and/or individual sheets with features, in particular security features, that are printed or otherwise applied on one or the other side of the substrate web and/or individual sheets and inspecting a quality of said features.

[0018] By way of preference, the method further comprises the step of inspecting the individual sheets after the cutting step c) to check a quality of the cutting.

[0019] Advantageously, the method further comprises the step of providing each individual sheet with a sheet identifying code, in particular a barcode, for track-and-trace purposes.

[0020] In accordance with a particularly preferred embodiment of the invention, sorting step d) further includes sorting the bad sheets into (i) partly-defective sheets that are found to exhibit only minor defects and that are partly usable for production of security documents and (ii) entirely-defective sheets that are found to exhibit major defects and that are not adequate for production of security documents. In this particular context, the good sheets can be processed at step e) into grade-A stacks or reams that are intended for production of security documents, while the partly-defective sheets can be processed at step e) into grade-B stacks or reams that are either intended for production of security documents or for print job preparation or make-ready purposes. The entirely-defective sheets, on the other hand, can be processed at step e) into grade-C stacks or reams that are only intended for print job preparation or make-ready purposes. In this way, optimisation of the production of the substrate material is achieved, while providing a clear indication to the security printer with respect to the quality of the sheets delivered for production and the use thereof.

[0021] Preferably, the individual sheets are sorted at step d) in separate delivery piles before being processed at step e) into the individual stacks or reams.

[0022] Furthermore, the individual stacks or reams can advantageously be wrapped at step e) for transport and/or shipment purposes.

[0023] By way of preference, step e) includes producing individual reams each consisting of five hundred individual sheets, which ream size is optimal for manual handling.

[0024] The invention is in particular applicable to the processing of a substrate web selected from the group consisting of :

- (i) paper substrates made of or containing cotton fibres ;
- (ii) polymer substrates comprising a transparent film of polymeric material, especially BOPP, which transparent film of polymeric material is provided on each side with at least one opacifying layer; and
- (iii) paper-polymer hybrid substrates comprising at least one transparent layer of polymeric material, such as but not necessarily BOPP, bonded to at least one paper layer made of or containing cotton fibres.

[0025] There is also provided an installation for carrying out the aforementioned method, comprising a web transport system adapted to transport the substrate web, at least one inspection system located along the path of the substrate web to check the quality thereof, a cross-cutter device adapted to perform transverse cutting of the substrate web into the individual sheets, and a sheet processing system adapted to sort the individual sheets into the good sheets and the bad sheets and to process at least the good sheets, and preferably also the bad sheets, into the individual stacks or reams each consisting of the predetermined number of individual sheets.

[0026] Preferably, the sheet processing system comprises a sheet delivery station comprising at least two sheet delivery piles where the good sheets and bad sheets are sorted, and a sheet stacker device cooperating with the sheet delivery station to produce the individual stacks or reams.

[0027] Advantageously, the installation may further comprise a least one processing station adapted to provide the substrate web and/or individual sheets with features, in particular security features, which processing station prints or otherwise applies the features on one or the other side of the substrate web and/or individual sheets.

[0028] Furthermore, the installation may further comprise a marking station adapted to provide each individual sheet with a sheet identifying code, in particular a barcode, for track-and-trace purposes. This marking station could in particular be provided upstream of the cross-cutter device to provide the sheet identifying code on successive portions of the substrate web which are ultimately cut into the individual sheets or downstream of the cross-cutter device to provide the sheet identifying code after cutting of the substrate web into the individual sheets.

[0029] By way of preference, the installation may further comprise an additional inspection system located along the path of the individual sheets, downstream of the cross-cutter device to check a quality of the cutting. In this way, 100% of the individual sheets are checked with respect to their quality, including the quality of the cutting.

[0030] In addition, the installation may further comprise a wrapping system adapted to wrap the individual stacks or reams for transport and/or shipment purposes.

[0031] Further advantageous embodiments of the invention form the subject-matter of the dependent claims and are discussed below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] Other features and advantages of the present invention will appear more clearly from reading the following detailed description of embodiments of the invention which are presented solely by way of non-restrictive examples and illustrated by the attached drawings in which :

Figures 1A and 1B are schematic views of an installation for carrying out a method of processing a substrate web into individual sheets for the production of security documents in accordance with an embodiment of the invention ; and

Figure 2 is a flow chart of a method of processing a substrate web into individual sheets for the production of security documents in accordance with the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0033] The present invention will be described in the context of the processing of a substrate web into individual sheets for the production of banknotes. It is however to be appreciated that the invention is applicable to the production of any security document, including for instance passports and like ID documents or other types of value documents.

[0034] In the context of the present invention, the substrate material may in particular be paper, polymer or combinations thereof (typically referred to as "hybrid"). As mentioned in the preamble hereof, paper substrates are typically made of or contain cotton fibres, whereas polymer substrates typically comprise a transparent film of polymeric material (especially biaxially oriented polypropylene, or "BOPP"), which transparent film of polymeric material is provided on each side with at least one opacifying layer. A typical example is Guardian™ substrate as commercially available from CCL Secure. Paper-polymer hybrid substrates combine the best of both worlds by bonding together at least one transparent layer of polymeric material (such as but not necessarily BOPP) and at least one paper layer made of or containing cotton fibres. Hybrid™ substrate, which is commercially available from Louisenthal, is characterized by a paper inner core layer which is covered on both sides by thin layers of polymeric material. In contrast, Durasafe® substrate that is commercially available from LandQart is characterized by a polymer inner core layer which is covered on both sides by layers of paper. In any event, the inven-

tion is applicable to any suitable type of substrate material.

[0035] Figures 1A and 1B are schematic views of an installation, designated generally by reference numeral 100, for carrying out a method of processing a substrate web into individual sheets for the production of security documents in accordance with an embodiment of the invention, which method is summarized in the flow chart of Figure 2.

[0036] The installation 100 comprises a web transport system 10-15 that is adapted to transport the relevant substrate web W. In the illustrated example, the substrate web W is provided at an input of the installation 100 in the form of a reel 10 of web material which is being unwound to supply the substrate web W. A plurality of guiding and tensioning rollers or cylinders 11 to 15 are provided along the path of the substrate web W to adequately transport and guide the substrate web W past a variety of processing stations 20, 30, 40 and 50 that will be described in greater detail.

[0037] Processing station 20 - which is preferred but may be omitted - is here designed to operate as a printing unit (for instance an offset printing unit) to print features on one side of the substrate web W. The printing unit 20 could however be designed to operate in accordance with any suitable printing technique, for instance gravure printing (e.g. for the purpose of applying an opacifying layer on the relevant side of the substrate web W) or for screen printing, which other printing process may for instance be used to print optically-variable features such as iridescent stripes on the side of the substrate web W. While this is not specifically depicted in Figure 1A, the printing unit 20 could alternatively be designed to print the other side of the substrate web W and further printing units could be provided in order to print additional security features on the substrate web W.

[0038] Furthermore, the processing station 20 could alternatively be designed to apply features, especially security features, by other means than by printing, for instance to apply or laminate foil material onto one or both sides of the substrate web W (such as by hot-stamping).

[0039] The processing station 20 could in effect be any processing station adapted to provide the substrate web W with features, in particular security features, by printing or otherwise applying the features on one or the other side of the substrate web W. Furthermore, multiple processing stations 20 could be provided.

[0040] In the illustration of Figures 1A and 1B the processing station 20 is located along the path of the substrate web W, but it shall be appreciated that a similar processing station could be provided along the path of the individual sheets, designated by reference S, that are ultimately cut from the substrate web W.

[0041] Downstream of the processing station 20 of Figure 1A, there is provided an inspection system 30, which is located along the path of the substrate web W to check the quality thereof. By way of preference, the inspection

system 30 is of a type comprising multiple inspection units (here three) that are designed to fully inspect the substrate web W, namely in reflection from both sides and in transparency. In that respect, the inspection system 30 of Figure 1A comprises a first inspection unit 31/32 designed to inspect a front/recto side of the substrate web W, a second inspection unit 33/34 designed to inspect a reverse/verso side of the substrate web W, and a third inspection unit 35/36 designed to inspect the substrate web W in transparency. Reference numerals 31, 33 and 35 in Figure 1A each designate a camera of the relevant inspection units, while reference numerals 32, 34 and 36 designate associated illumination units. These cameras 31, 33, 35 are preferably line-scan cameras that are each designed to scan a relevant section of the substrate web W. In the illustrated example, the first and second inspection units 31/32 and 33/34 are each cooperating with a guiding roller 13, respectively 14, of the web transport system 10-15, which guiding roller 13, 14 provides adequate support for the substrate web W during the image acquisition process. No such guiding roller is depicted with respect to the third inspection unit 35/36, but such could be provided if necessary, in which case the function of the illumination unit 36 would be integrated in the relevant roller as taught for instance in International (PCT) Publication No. WO 03/052394 A1 or WO 2012/059861 A1.

[0042] Thanks to the inspection system 30, all of the relevant features that are provided on (including security features printed or otherwise applied on the substrate web W) or embedded in the substrate web W (including security features such as watermarks and/or security threads) can be inspected and the quality thereof checked.

[0043] The relevant inspection results are used, as this will be further described, for the purpose of carrying out a sorting of the individual sheets S that are ultimately cut from the substrate web W.

[0044] Downstream of the inspection system 30, there is provided a marking station 40 the purpose of which is to provide each individual sheet S with a corresponding sheet identifying code (such as a barcode) for track-and-trace purposes. The marking station 40 is shown in Figure 1A as being located along the path of the substrate web W so as to provide the sheet identifying code on successive portions of the substrate web W which are ultimately cut into the individual sheets S. Alternatively, as shown in dashed lines in Figure 1B, the marking station 40 could be located along the path of the individual sheets S to provide the sheet identifying code after cutting of the substrate web W into the individual sheets S.

[0045] In accordance with the invention, a cross-cutter device 50 is provided to perform transverse cutting of the substrate web W into individual sheets S. Such cross-cutter device 50 is preferably of a type comprising a cutting cylinder 51 carrying cutting blades, which cutting cylinder 51 cooperates with a counter-press cylinder 52, the substrate web W being fed through the nip formed by

cylinders 51, 52. Such cross-cutter device 50 is known as such in the art and does not need to be described in detail here. It suffices to understand that the cross-cutter device 50 is designed to cut the substrate web W at defined locations along the substrate web W to continuously produce individual sheets S at the output.

[0046] By way of preference, an additional inspection system 37/38 (including e.g. a line-scan camera 37 and associated illumination units 38) is provided downstream of the cross-cutter device 50 (and preferably upstream of the marking station 40 should it be provided at the relevant location along the path of the individual sheets S) in order to check the quality of the cutting, including e.g. print-to-cut register accuracy.

[0047] Once the substrate web W has been inspected by means of the inspection system 30 and cut into individual sheets S by means of the cross-cutter device 50 (and optionally marked by the marking station 40 and further inspected as to the quality of the cutting by the additional inspection system 37/38), the individual sheets S are sorted in dependence of the inspection results to produce at least two types of sorted sheets, including good sheets, designated by reference S_A in Figure 1B, and bad sheets, designated by reference S_B , resp. S_C in Figure 1B.

[0048] Good sheets S_A are sheets that have been found to meet the desired quality requirements and bad sheets S_B , S_C are sheets that have been found to exhibit defects. Even more preferably, the bad sheets S_B , S_C are sorted into (i) partly-defective sheets S_B that are found to exhibit only minor defects and (ii) entirely-defective sheets S_C that are found to exhibit major defects. The distinction between minor and major defects can be defined depending on the production requirements. Partly-defective sheets S_B could be at least partly usable for production of security documents. Such would be the case for instance of sheets where the identified defects are limited to very localized regions on the sheets or are so minimal that they would not have a critical impact on the production of the relevant security documents. Such partly-defective sheets S_B could therefore be used for production of security documents or - if normal production using such sheets is ultimately excluded by the security printer - for print job preparation or make-ready purposes. As regards the entirely-defective sheets S_C , while such sheets would not be proper and adequate for the actual production of security documents, these sheets S_C could still be supplied to security printers solely for print job preparation or make-ready purposes.

[0049] The installation 100 is further equipped with a sheet processing system 60/70 adapted to sort the individual sheets into the good sheets S_A and the bad sheets S_B , S_C and to process at least the good sheets S_A , and preferably also the bad sheets S_B , S_C , into individual stacks or reams R each consisting of a predetermined number of individual sheets. By way of preference, reams R are produced each consisting of five hundred sheets, which ream size is optimal for manual handling.

[0050] Preferably, the sheet processing system 60/70 comprises a sheet delivery station 60 with at least two sheet delivery piles where the good sheets S_A and the bad sheets S_B , S_C are sorted. In the illustrated embodiment, three such sheet delivery piles 61, 62, 63 are provided, one for each type of sheets S_A , S_B , S_C . In addition, the sheet processing system 60/70 further comprises a sheet stacker device 70 that cooperates with the sheet delivery station 60 to produce the individual stacks or reams R . The main purpose of the sheet stacker device 70 is to ensure that a predetermined number of sheets are stacked to form the desired stacks or reams, especially reams of five hundred sheets each. A suitable sheet stacker device is for instance available from the Applicant for the purpose of stacking sheets at the input of a cutting and finishing machine and is sold as part of the Applicant's NumeroPak® machine.

[0051] By way of preference, the installation may be further equipped with a wrapping system 80 for wrapping the stacks or reams R and produce wrapped stacks or reams R_W for transport and/or shipment purposes. Such a wrapping system 80 would be advantageous in the event that the stacks or reams R (R_W) have to be transported and/or shipped to a remote location. Such wrapping system 80 could be omitted in the event that the stacks or reams R are used at the same site where they are produced. In that respect, while reams R of five hundred sheets are favoured for the purpose of transport and shipment, one could contemplate to produce pre-piled stacks of e.g. 5000 to 10'000 sheets at the output of the sheet stacker device 70, which pre-piled stacks could be sent directly to the feeder of a printing press.

[0052] In any event, the good sheets S_A could be processed into grade-A stacks or reams R (R_W) that are intended for production of security documents, while the partly-defective sheets S_B could be processed into grade-B stacks or reams R (R_W) that are either intended for production of security documents or for print job preparation or make-ready purposes. On the other hand, the entirely-defective sheets S_C could be processed into grade-C stacks or reams that are only intended for print job preparation or make-ready purposes. Thanks to this classification, the security printer can readily identify which type of sheets can be used for which purpose and the security printer benefits from greater assurances that the good sheets that are used for production of security documents have been adequately checked during production and packaged accordingly. This considerably reduces the risk for the security printer to erroneously use sheets for production that already exhibit defects. The security printer is furthermore in a position to be provided with lower-grade sheets that could at least be used for print job preparation and/or make-ready purposes.

[0053] A refinement of the invention may include designing the marking station 40 not only to provide a sheet identifying code, but also to encode information that is representative of the inspection results (including whether the relevant sheet was found to be a good sheet or

bad sheet, or the relevant location of defects in case the sheet was found to be a partly-defective sheet). Such information could alternatively be recorded in a suitable database or on a suitable recording medium shipped and delivered together with the relevant ream.

[0054] Various modifications and/or improvements may be made to the above-described embodiments without departing from the scope of the invention as defined by the annexed claims. For instance, the substrate web W does not need to be supplied in the form of a reel 10 of substrate material as shown in Figure 1A, but could be supplied directly as a continuous web delivered at the output of a web machine used for the production of the relevant substrate material.

LIST OF REFERENCE NUMERALS USED THEREIN

[0055]

20	W	substrate web
	S	individual sheets cut from substrate web
	S_A	good sheets meeting desired quality requirements
	S_B	bad sheets exhibiting defects / partly-defective sheets
25	S_C	bad sheets exhibiting defects / entirely-defective sheets
	R	stacks/reams of sheets each consisting of a predetermined number (e.g. five hundred) of individual sheets
30	R_W	wrapped stacks/reams of sheets R
	100	installation for processing substrate web W into individual sheets and individual stacks or reams of sheets
35	10	unwinding station for substrate web W
	11-15	guiding/tensioning rollers
	20	processing station (e.g. printing unit)
	30	inspection system
	31	camera (e.g. line-scan camera) / inspection of front/recto side of substrate web W
40	32	illumination unit for camera 31
	33	camera (e.g. line-scan camera) / inspection of reverse/verso side of substrate web W
	34	illumination unit for camera 33
45	35	camera (e.g. line-scan camera) / transparency inspection of substrate web W
	36	illumination unit for camera 35
	37	camera (e.g. line-scan camera) / cutting inspection
50	38	illumination unit for camera 37
	40	marking station (e.g. barcode inkjet printer)
	50	cross-cutter device (e.g. transverse cutter)
	51	cutting cylinder (cylinder carrying cutting blades)
55	52	counter-pressure cylinder
	60	sheet delivery station
	61	(first) delivery pile (for good sheets S_A)
	62	(second) delivery pile (for partly-defective

- 63 sheets S_B)
 (third) delivery pile (for entirely-defective
 sheets S_C)
 70 sheet stacker device for processing the good
 sheets S_A (and preferably also the bad sheets
 S_B and S_C) into individual stacks or reams R of
 sheets
 80 wrapping system for wrapping the stacks or
 reams R of sheets

Claims

1. A method of processing a substrate web (W) into individual sheets (S) for the production of security documents, such as banknotes, the method comprising the following steps:
 - a) providing a substrate web (W) ;
 - b) inspecting the substrate web (W) to check a quality thereof ;
 - c) cutting the substrate web (W) into individual sheets (S) ;
 - d) sorting the individual sheets (S) in dependence of results of the inspection at step b) to produce at least two types of sorted sheets (S_A , S_B , S_C), including good sheets (S_A) meeting desired quality requirements and bad sheets (S_B , S_C) that are found to exhibit defects ; and
 - e) processing at least the good sheets (S_A), and preferably also the bad sheets (S_B , S_C), into individual stacks or reams (R , R_W) each consisting of a predetermined number of individual sheets.
2. The method according to claim 1, further comprising the steps of providing the substrate web (W) and/or individual sheets (S) with features, in particular security features, that are printed or otherwise applied on one or the other side of the substrate web (W) and/or individual sheets (S) and inspecting a quality of said features.
3. The method according to claim 1 or 2, further comprising the step of inspecting the individual sheets (S) after the cutting step c) to check a quality of the cutting.
4. The method according to any one of the preceding claims, further comprising the step of providing each individual sheet (S) with a sheet identifying code, in particular a barcode, for track-and-trace purposes.
5. The method according to any one of the preceding claims, wherein sorting step d) further includes sorting the bad sheets (S_B , S_C) into (i) partly-defective sheets (S_B) that are found to exhibit only minor defects and that are partly usable for production of security documents and (ii) entirely-defective sheets (S_C) that are found to exhibit major defects and that are not adequate for production of security documents.
6. The method according to claim 5, wherein the good sheets (S_A) are processed at step e) into grade-A stacks or reams that are intended for production of security documents, wherein the partly-defective sheets (S_B) are processed at step e) into grade-B stacks or reams that are either intended for production of security documents or for print job preparation or make-ready purposes, and wherein the entirely-defective sheets (S_C) are processed at step e) into grade-C stacks or reams that are only intended for print job preparation or make-ready purposes.
7. The method according to any one of the preceding claims, wherein the individual sheets (S) are sorted at step d) in separate delivery piles (61, 62, 63) before being processed at step e) into the individual stacks or reams (R , R_W).
8. The method according to any one of the preceding claims, wherein the individual stacks or reams (R_W) are further wrapped at step e) for transport and/or shipment purposes.
9. The method according to any one of the preceding claims, wherein step e) includes producing individual reams (R , R_W) each consisting of five hundred individual sheets.
10. An installation for carrying out the method of any one of claims 1 to 9, comprising :
 - a web transport system (10-15) adapted to transport the substrate web (W);
 - at least one inspection system (30-36) located along the path of the substrate web (W) to check the quality thereof;
 - a cross-cutter device (50) adapted to perform transverse cutting of the substrate web (W) into the individual sheets (S) ; and
 - a sheet processing system (60/70) adapted to sort the individual sheets into the good sheets (S_A) and the bad sheets (S_B , S_C) and to process at least the good sheets (S_A), and preferably also the bad sheets (S_B , S_C), into the individual stacks or reams (R , R_W) each consisting of the predetermined number of individual sheets.
11. The installation according to claim 10, wherein the sheet processing system (60, 70) comprises :
 - a sheet delivery station (60) comprising at least two sheet delivery piles (61, 62, 63) where the

good sheets (S_A) and bad sheets (S_B , S_C) are sorted ; and
 - a sheet stacker device (70) cooperating with the sheet delivery station (60) to produce the individual stacks or reams (R , R_W).

12. The installation according to claim 10 or 11, further comprising a least one processing station (20) adapted to provide the substrate web (W) and/or individual sheets (S) with features, in particular security features, which processing station (20) prints or otherwise applies the features on one or the other side of the substrate web (W) and/or individual sheets (S).

13. The installation according to any one of claims 10 to 12, further comprising a marking station (40) adapted to provide each individual sheet (S) with a sheet identifying code, in particular a barcode, for track-and-trace purposes.

14. The installation according to any one of claims 10 to 13, further comprising an additional inspection system (37, 38) located along the path of the individual sheets (S), downstream of the cross-cutter device to check a quality of the cutting.

15. The installation according to any one of claims 10 to 14, further comprising a wrapping system (80) adapted to wrap the individual stacks or reams (R_W) for transport and/or shipment purposes.

Amended claims in accordance with Rule 137(2) EPC.

1. A method of processing a substrate web (W) into individual sheets (S) for the production of security documents, such as banknotes, the method comprising the following steps:

- a) providing a substrate web (W) ;
- b) inspecting the substrate web (W) to check a quality thereof;
- c) cutting the substrate web (W) into individual sheets (S) ; inspecting the individual sheets (S) after the cutting step c) to check a quality of the cutting;
- d) sorting the individual sheets (S) in dependence of results of the inspection at step b) to produce at least two types of sorted sheets (S_A , S_B , S_C), including good sheets (S_A) meeting desired quality requirements and bad sheets (S_B , S_C) that are found to exhibit defects; sorting the bad sheets (S_B , S_C) into (i) partly-defective sheets (S_B) that are found to exhibit only minor defects and that are partly usable for production of security documents and (ii) entirely-defective sheets (S_C) that are found to exhibit

major defects and that are not adequate for production of security documents; and
 e) processing at least the good sheets (S_A), and preferably also the bad sheets (S_B , S_C), into individual stacks or reams (R , R_W) each consisting of a predetermined number of individual sheets, wherein the good sheets (S_A) are processed at step e) into grade-A stacks or reams that are intended for production of security documents,

wherein the partly-defective sheets (S_B) are processed at step e) into grade-B stacks or reams that are either intended for production of security documents or for print job preparation or make-ready purposes, and wherein the entirely-defective sheets (S_C) are processed at step e) into grade-C stacks or reams that are only intended for print job preparation or make-ready purposes.

2. The method according to claim 1, further comprising the steps of providing the substrate web (W) and/or individual sheets (S) with features, in particular security features, that are printed or otherwise applied on one or the other side of the substrate web (W) and/or individual sheets (S) and inspecting a quality of said features.

3. The method according to any one of the preceding claims, further comprising the step of providing each individual sheet (S) with a sheet identifying code, in particular a barcode, for track-and-trace purposes.

4. The method according to any one of the preceding claims, wherein the individual sheets (S) are sorted at step d) in separate delivery piles (61, 62, 63) before being processed at step e) into the individual stacks or reams (R , R_W).

5. The method according to any one of the preceding claims, wherein the individual stacks or reams (R_W) are further wrapped at step e) for transport and/or shipment purposes.

6. The method according to any one of the preceding claims, wherein step e) includes producing individual reams (R , R_W) each consisting of five hundred individual sheets.

7. An installation for carrying out the method of any one of claims 1 to 6, comprising :

- a web transport system (10-15) adapted to transport the substrate web (W) ;
- at least one inspection system (30-36) located along the path of the substrate web (W) to check the quality thereof;
- a cross-cutter device (50) adapted to perform

transverse cutting of the substrate web (W) into the individual sheets (S) ;

- an additional inspection system (37, 38) located along the path of the individual sheets (S), downstream of the cross-cutter device to check a quality of the cutting; and 5
- a sheet processing system (60/70) adapted to sort the individual sheets into the good sheets (S_A) and the bad sheets (S_B, S_C) and to process at least the good sheets (S_A), and preferably also the bad sheets (S_B, S_C), into the individual stacks or reams (R, R_W) each consisting of the predetermined number of individual sheets, 10

wherein the sheet processing system (60, 70) 15 comprises :

- a sheet delivery station (60) comprising at least two sheet delivery piles (61, 62, 63) where the good sheets (S_A) and bad sheets (S_B, S_C) are sorted ; and 20
- a sheet stacker device (70) cooperating with the sheet delivery station (60) to produce the individual stacks or reams (R, R_W). 25

8. The installation according to claim 7, further comprising a least one processing station (20) adapted to provide the substrate web (W) and/or individual sheets (S) with features, in particular security features, which processing station (20) prints or otherwise applies the features on one or the other side of the substrate web (W) and/or individual sheets (S). 30
9. The installation according to any one of claims 7 or 8, further comprising a marking station (40) adapted to provide each individual sheet (S) with a sheet identifying code, in particular a barcode, for track-and-trace purposes. 35
10. The installation according to any one of claims 7 to 9, further comprising a wrapping system (80) adapted to wrap the individual stacks or reams (R_W) for transport and/or shipment purposes. 40

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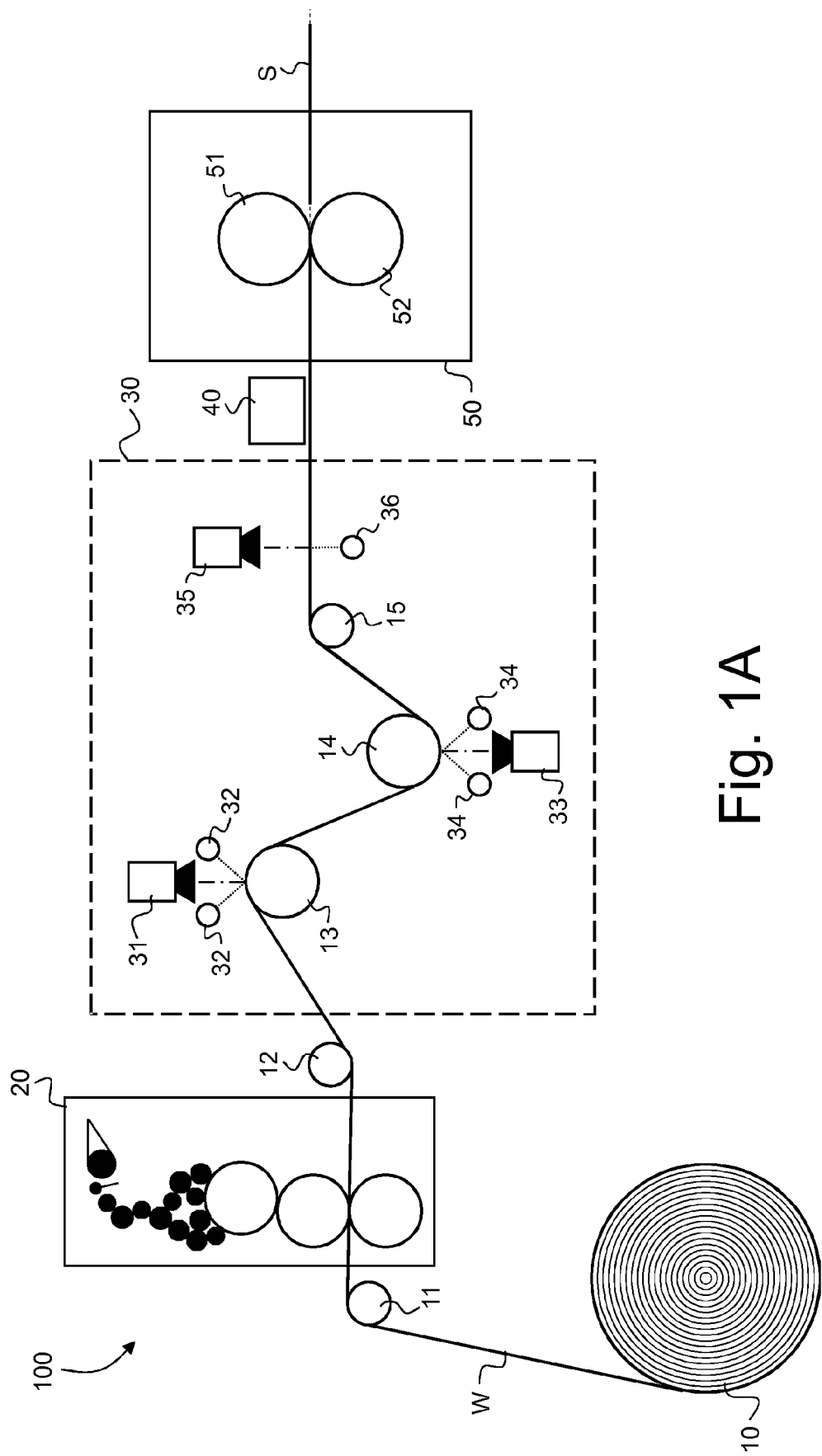
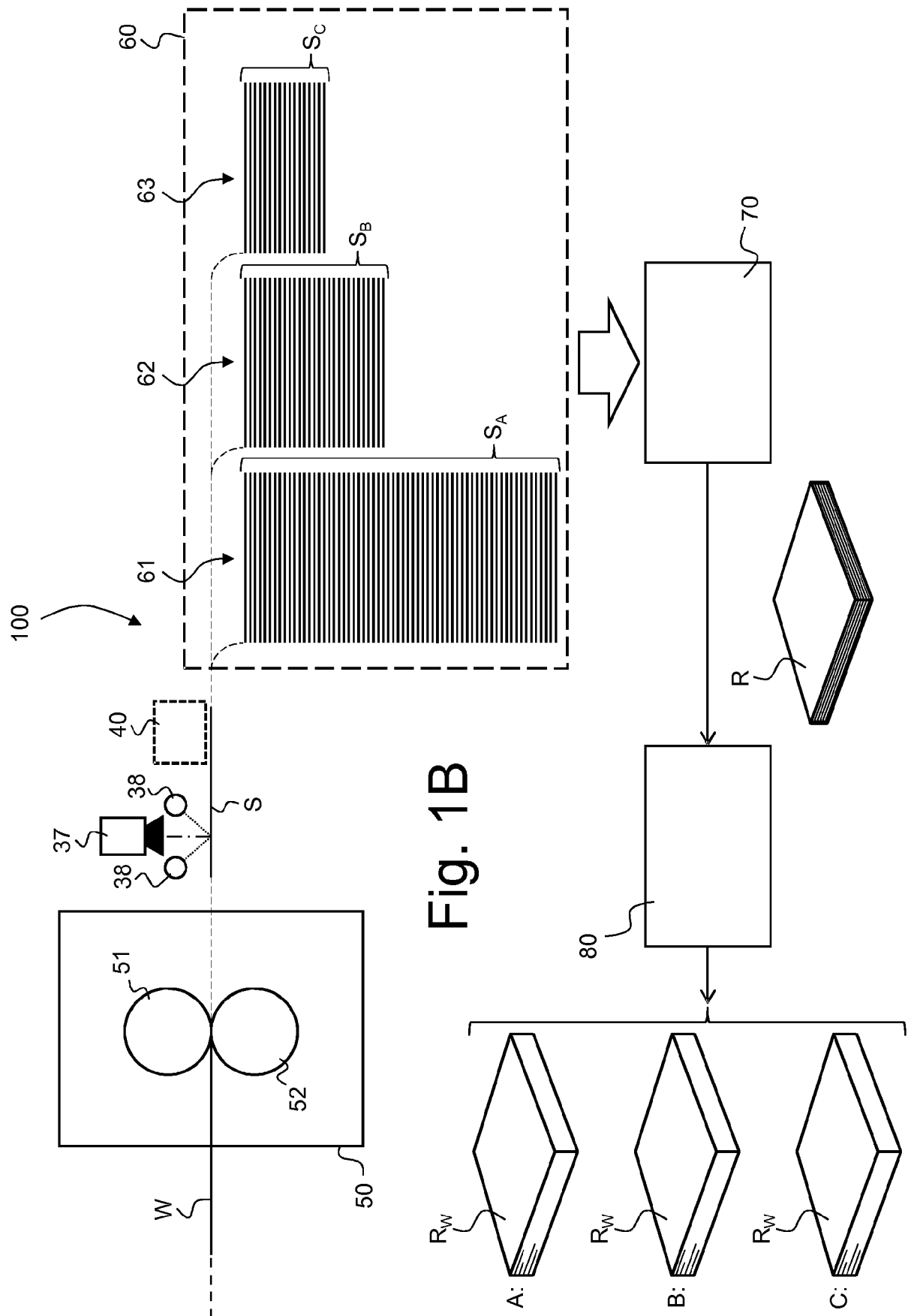


Fig. 1A



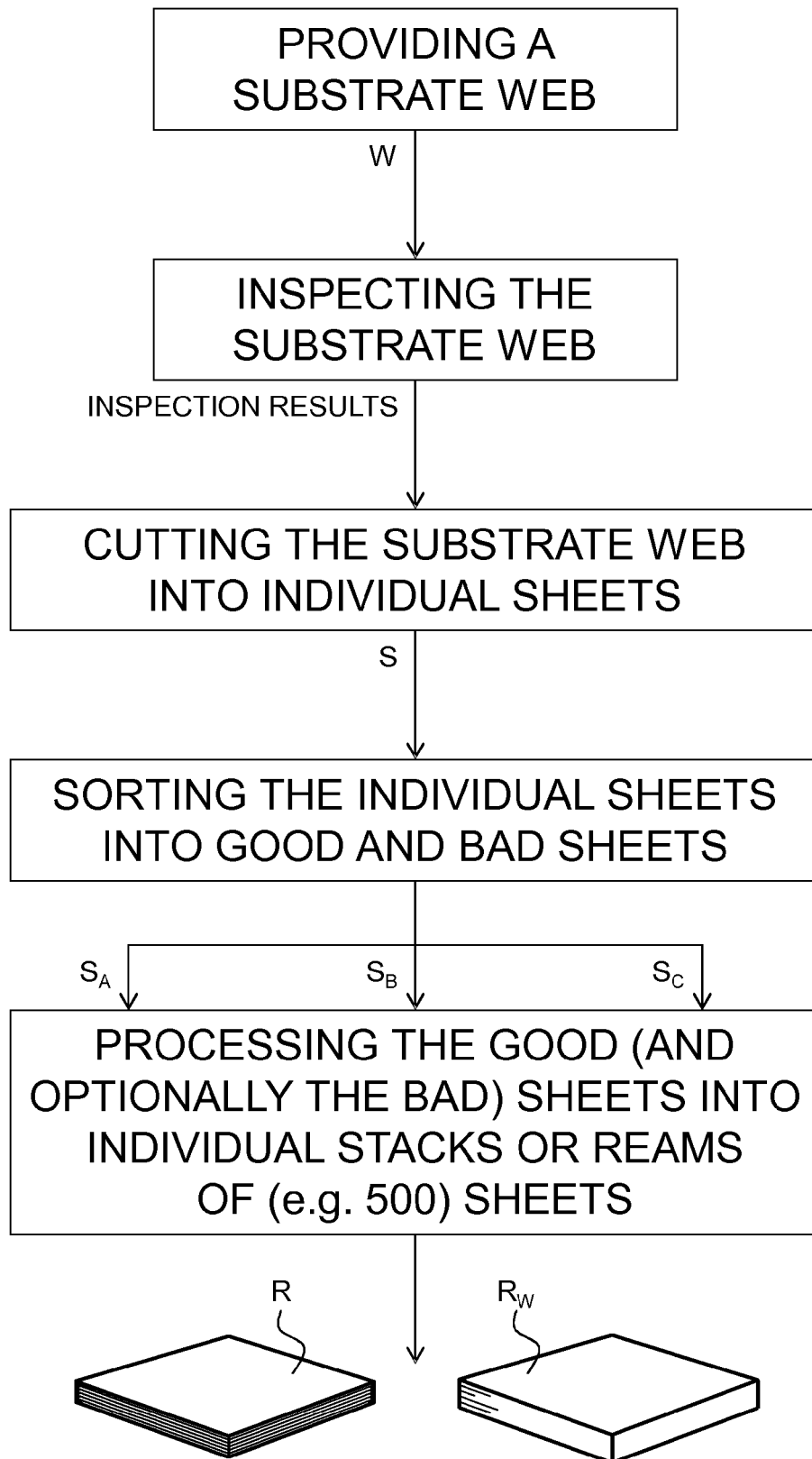


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 17 17 8848

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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	EP 0 286 317 A1 (KOMORI CURRENCY TECHNOLOGY UK [GB]) 12 October 1988 (1988-10-12) * column 6, line 42 - column 8, line 5 * * column 9, lines 8-14 * * column 12, line 20 - column 13, line 4 * * column 14, lines 5-21 * * figures *	1-4,7,8, 10-15	INV. D21G9/00 B07C5/00 B41F33/00 B65H43/00
X	EP 0 193 267 A2 (BURROUGHS CORP [US]) 3 September 1986 (1986-09-03) * paragraphs [0014] - [0018] * * figures *	1,2,5,7, 8,10-12, 15	
			TECHNICAL FIELDS SEARCHED (IPC)
			D21G B07C B41F B65H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 November 2017	Examiner Pregetter, Mario
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			

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ON EUROPEAN PATENT APPLICATION NO.**

EP 17 17 8848

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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21-11-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0286317 A1	12-10-1988	DE 3877239 D1	18-02-1993
		EP 0286317 A1	12-10-1988
		JP S63276545 A	14-11-1988
		US 4843959 A	04-07-1989

EP 0193267 A2	03-09-1986	DE 3665561 D1	19-10-1989
		EP 0193267 A2	03-09-1986
		GB 2171396 A	28-08-1986
		JP H0829872 B2	27-03-1996
		JP S61197359 A	01-09-1986
		US 4650178 A	17-03-1987

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0059056 A1 [0004]
- EP 0229645 A1 [0004]
- EP 1630285 A2 [0004]
- GB 2397582 A [0004]
- GB 2433470 A [0004]
- WO 8300659A1 A [0007]
- EP 2153988 A1 [0009]
- WO 03052394 A1 [0041]
- WO 2012059861 A1 [0041]