



(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.04.2019 Bulletin 2019/15

(51) Int Cl.:
B41J 11/00 (2006.01)
B65H 85/00 (2006.01)
G03G 15/00 (2006.01)

(21) Application number: 18197575.6

(51) B41J 13/00 (2006.01)
B65H 7/06 (2006.01)
B41J 3/60 (2006.01)

(22) Date of filing: 28.09.2018

(84) Designated Contracting States: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR Designated Extension States: BA ME Designated Validation States: KH MA MD TN	(71) Applicant: OCE Holding B.V. 5914 CA Venlo (NL) (72) Inventor: CLEVERS, Ernest J.J. 5914 CA Venlo (NL) (74) Representative: OCE IP Department St. Urbanusweg 43 5914 CA Venlo (NL)
(30) Priority: 03.10.2017 EP 17194577	

(54)

DUPLEX PRINTING METHOD

(57)

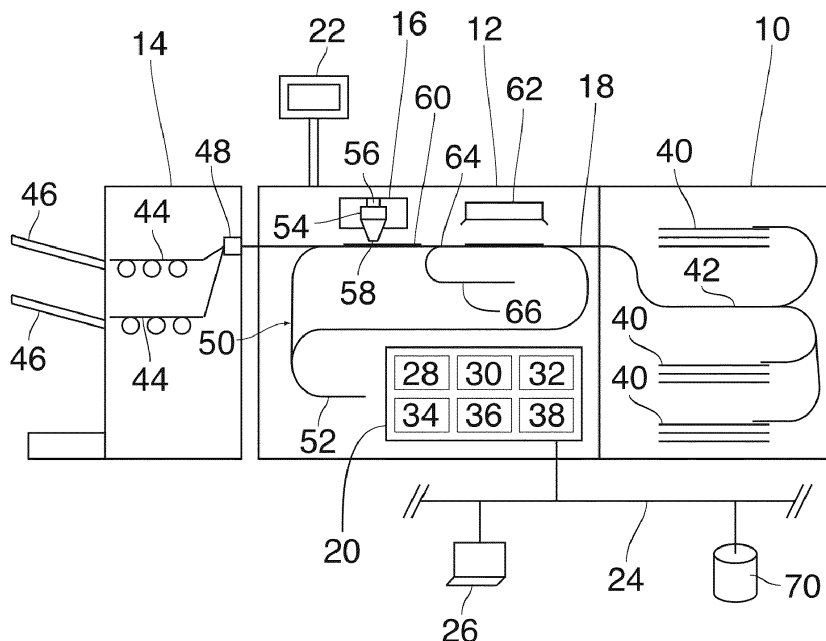
A method of printing on a printing system having a print station (16) and a duplex path (50) that is capable of accommodating a plurality of media sheets (60) at a time, the method comprising a step of checking the sheets for possible damage before they are fed to the print station (16), characterized by the steps of:

(a) determining, for each duplex sheet to be printed, a likelihood P that the sheet will be damaged in a process of printing an image on a first side of the sheet, so that the sheet would have to be discarded;

(b) at or before the time when the first image is printed, deciding, on the basis of the determined likelihood P, whether or not to print at least one redundant copy of the sheet; and

(c) when at least one redundant copy has been printed, and before a second image is printed on a second side of one of the sheets, checking whether the sheet and its redundant copies comprise at least one non-damaged sheet, and, if that is the case, selecting that sheet for further processing and discarding all other copies.

Fig. 1



Description

[0001] The invention relates to a method of duplex printing on a printing system having a print station and a duplex path that is capable of accommodating a plurality of media sheets at a time, the method comprising a step of checking the sheets for possible damage before they are fed to the print station.

[0002] A printing method of this type has been disclosed in WO 2016/177676 A1. In this method, when it is found in the checking step that a sheet is damaged, meaning for example that the sheet is warped to such an extent that the print quality would be compromised or the sheet would collide with a print head in the print station, the defective sheet is discarded and the allocation of images to be printed to the subsequent sheets is re-scheduled such that the print order is preserved. In this way, it can in many cases be avoided that the print process must be aborted. However, the scheduling process may be subject to certain constraints, concerning for example the selection of media types, which may not always be complied with or would lead to losses in productivity or a waste of material because, still, a relatively large number of sheets has to be discarded, especially when the duplex path is capable of accommodating a large number of sheets.

[0003] US 5 905 520 A describes a printing system wherein, in case of a paper jam, multiple pages are reprinted and the operator has to manually check for redundant pages and remove the same.

[0004] It is an object of the invention to provide a duplex printing method which permits a high productivity and/or a reduced waste of material even in cases where media sheets tend to become damaged.

[0005] In order to achieve this object, the method according to the invention is characterized by the steps of:

(a) determining, for each duplex sheet to be printed, a likelihood P that the sheet will be damaged in a process of printing an image on a first side of the sheet, so that the sheet would have to be discarded;

(b) at or before the time when the first image is printed, deciding, on the basis of the determined likelihood P, whether or not to print at least one redundant copy of the sheet; and

(c) when at least one redundant copy has been printed, and before a second image is printed on a second side of one of the sheets, checking whether the sheet and its redundant copies comprise at least one non-damaged sheet, and, if that is the case, selecting that sheet for further processing and discarding all other copies.

[0006] In duplex printing, the treatments applied to the media sheets in the process of printing a first image on the first side of the sheet may sometimes lead to a deformation of the media sheet. For example, in an ink jet printer, the media sheets are wetted when liquid ink is applied and are then subjected to heat or radiation in order to cure the ink and to dry the sheet. These treatments may cause the sheet to warp or deform, so that the height of the sheet becomes uneven. Then, when the same sheet is fed to the print station a second time in order to print a second image on the back side, the height variations of the sheet may be too large in view of the narrow gap which the print head forms with the media sheets, so that the print quality is compromised or the sheet even collides with the print head.

[0007] When several copies of a multi-sheet document or set have to be printed, the likelihood that a sheet gets damaged in the way described above is usually not the same for all sheets of the document. Instead, even when all media sheets are of the same media type, the likelihood of damage may depend upon the image content to be printed thereon, because the image content determines the amount of liquid ink to be applied to the sheet as well as the distribution of the ink.

[0008] In the method according to the invention, the likelihood of damage is estimated in advance, so that suitable counter-measures may be taken individually for each sheet in the set.

[0009] According to the invention, the sheets for which the likelihood of damage is high receive a special treatment in that, each time when a sheet with that image content has to be printed, the printer is controlled to print at least one redundant copy of the sheet. That is, instead of printing the image content just on one sheet, the same image content is printed onto two or more subsequent sheets.

[0010] Then, when the sheets are conveyed along the duplex path and are fed to the print station or to another print station for forming the second image on the back side, it is checked as usual whether any of the sheets has become damaged. If that is not the case, the redundant copies may be discarded. If it turns out, however, that one sheet has become damaged, there will be a second copy with the same image content in reserve, so that the damaged sheet may be discarded and printing may continue with the non-damaged sheet.

[0011] In a conventional print process, when a sheet arriving from the duplex path turns out to be damaged, it is not only the damaged sheet that has to be discarded, but all other sheets that follow in the duplex path and bear already an image on the front side have to be discarded as well, and printing with a correct page order can only be resumed after the entire duplex path has been emptied. This may imply not only a loss in productivity but also a considerable waste of material, especially when the duplex path is capable of accommodating a large number of sheets. In such cases it is a great advantage to have a redundant copy in reserve, so that the print process may be continued immediately without having to empty the duplex path first.

[0012] On the other hand, when no damages occur, the method according to the invention incurs itself a certain waste of material because all the redundant copies are eventually discarded.

[0013] Therefore, the break-even point where the advantages of a redundant copy outweighs the disadvantages depends upon the likelihood with which damages occur for the sheets with the particular image content. This is why, according to the invention, it is the likelihood of damage that it determines whether or not redundant copies are printed.

[0014] More specific optional features of the invention are indicated in the dependent claims.

[0015] The step (b) of deciding whether or not a redundant copy shall be made will preferably involve a comparison of the likelihood of damage to the number of sheets that will have to be discarded whenever such a damage occurs.

[0016] The likelihood P that a sheet becomes damaged in the process of printing the first image on the front side will typically depend upon several factors, including for example the amount of ink to be applied, the distribution of ink, the media type, the temperature to which the sheet is exposed during or after printing, the humidity content of the sheet, ambient air humidity, and the like. In one embodiment, a database stores a likelihood value for all realistic combinations of the above factors and the step (a) of determining the likelihood P comprises identifying the parameters that apply to the particular sheet and then look-up the likelihood P in the database. The database may be established and updated on the basis of empirical data.

[0017] In another embodiment, the method may employ a self-learning algorithm for counting, separately for each of the sheets that are distinguished from one another by their intended image contents, the total number T of printed sheets as well as the number D of sheets which have become damaged. The likelihood of damage will then be approximated by the quotient D/T of these numbers.

[0018] Of course, it is also possible to combine these embodiments by using the self-learning algorithm for updating and refining the database.

[0019] Embodiment examples will now be described in conjunction with the drawings, wherein:

Fig. 1 is a schematic view of a printing system to which the invention is applicable;

Figs. 2 and 3 are diagrams of a duplex path in the printing system, illustrating different stages in a print process according to the invention;

Fig. 4 is a flow chart illustrating essential steps of a method according to the invention; and

Fig. 5 is a flow diagram showing essential steps of a method according to another embodiment of the invention.

[0020] As is shown in Fig. 1, a printing system that is described here as a representative example comprises an input section 10, a main body 12, and an output section 14. The main body 12 comprises a print station 16 disposed at a sheet transport path 18, an electronic controller 20 and a user interface 22.

[0021] The controller 20 may be formed by a computer, a server or a workstation and is connected to all the functional components of the printing system for controlling the same and is further connected to the user interface 22 and to a network 24 via which the controller may communicate with a remote workstation 26 of a user or operator. In an alternative embodiment, the controller 22 may also be installed outside of the main body 12 for controlling the various system components via the network 24.

[0022] The hardware and/or the software of the controller 20 includes among others a print job receiving section 28, a scheduler 30, a feed control section 32, a print control section 34, an output control section 36, and a sheet manager 38. The print job receiving section 28 is arranged to receive, e.g. via the network 24, print jobs each of which includes image data for one or more pages to be printed as well as various job settings. Optionally, the image data may also be received from a local scanner whereas the job settings are input at the user interface 22. The job settings include among others instructions that specify for each image to be printed the properties or type of a recording medium on which the image shall be printed.

[0023] The input section 10 includes a plurality of holders 40 each of which accommodates a supply, e.g. a stack of media sheets of a certain media type. The media types in the different holders 40 may differ in sheet thickness, sheet material, surface properties of the sheets and the like. The input section 10 further includes a feed mechanism 42 arranged to separate individual sheets from a selected one of the holders 40 and to supply them one by one into the sheet transport path 18 under the control of the feed control section 32.

[0024] When the job receiving section 28 has received a print job, the scheduler 30 determines a sequence in which the images of this print job shall be printed. For the purposes of this description, the term "image" shall designate a page size image that is to be printed onto one side of a recording sheet. The scheduler 30 further has access to a database that stores the media types and properties of the sheets accommodated in the various holders 40. Based on the job settings that concern the media properties, the scheduler 30 selects the holders 40 from which the sheets with the desired properties are to be taken and determines a sequence in which the sheets of the different media types are to

be fed into the sheet transport path 18 such that the sequence of sheets matches the sequence of images to be printed.

[0025] When the print process has been started, the feed control section 32 controls the feed mechanism 42 to supply the sheets in the sequence as scheduled into the sheet transport path 18, and the print control section 34 controls the print station 16 so as to print a corresponding image on the top side of each sheet.

[0026] In the example shown, the output section 14 has a plurality of holders 44 on which the sheets may be stacked after they have left the print station 16. When a stack, which may for example comprise a set of sheets forming a complete copy of a multi page document, has been completed, the holder 44 will forward the stack onto an associated output tray 46. In an alternative embodiment the completed stacks may also be forwarded to a finisher (not shown) for performing finishing operation such as stapling, punching and the like.

[0027] The output section 14 further includes a switch 48 which is controlled by the output control section 36 for directing each sheet to a designated one of the holders 44.

[0028] The main body 12 of the printing section includes a duplex path 50 which branches off from the sheet transport path 18 downstream of the print station 16, reverses the orientation of the sheets in a sheet reversing mechanism 52 and then returns the sheets upside down to the entry side of the sheet transport path 18.

[0029] It shall further be assumed in this example that the print station 16 includes as print engine an ink jet print head 54 that is disposed above the sheet transport path 18 and is adjustable in height by means of a height adjustment mechanism 56. Dependent upon the thickness and other properties of the sheets, the height of the print head 54 is adjusted such that a nozzle face 58 at the bottom side of the print head forms only a very narrow gap with a top surface of a sheet 60 that is being conveyed past the print head. In this way, it will be assured that, for each individual sheet, the ink jet print process will be performed with an optimal nozzle-to-sheet distance.

[0030] As the gap between the nozzle face 58 and the sheet 60 may be very small, any wrinkles or a surface waviness or other surface irregularities of the sheet 60 may result in a poor image quality or even in a collision of the sheet with the print head. For this reason, a sensor 62 for monitoring the quality of the sheets is disposed at the sheet transport path 18 upstream of the print station 16. The sensor 62 may for example be a 3D laser scanner that scans the entire surface of the sheet in order to capture a surface relief. An example is described in US 2016103634 A1. The relief data are transmitted to the sheet manager 38 in the controller 20, where they are processed further to decide whether the quality of the sheet is acceptable or not. In this specification, a sheet will be designated as "damaged" if the quality detected by the sensor 62 is not acceptable. The sensor 62 may also detect other quality criteria relating to, for example, alignment errors or skew errors of the sheets.

[0031] When a sheet is found to be damaged, the sheet manager 38 controls a switch 64 in the sheet transport path 18 in order to excise this sheet from the scheduled sequence and to divert it into a discharge path 66 via which the sheet is discharged into a discharge bin (not shown). In this way, the defective sheet will be skipped in the print process. However, the image that was designated for being printed onto the discarded sheet must nevertheless be printed. Normally, this situation would lead to an abortion of the print process, with the result that the entire print process, including the scheduling process, has to be started anew, and all the sheets that had been present already duplex path 50 would have to be discarded.

[0032] It should be observed in this context that Fig. 1 is only a schematic sketch and that, in practice, the number of sheets that can be accommodated in the duplex path 50 can be considerably large. For example, the duplex path 50 may be arranged to accommodate as many as 40 sheets.

[0033] Fig. 2 is a diagram of the duplex path 50 which, in this example, has the capacity to accommodate ten sheets at a time. It is further assumed in this example that the print job consists of printing a large number of copies of an 8 sheet set, each set having sheets 1-8. Further, the scheduler 30 has determined that, in case of sheets 2 and 3, redundant copies 2a and 3a shall be printed immediately after the sheet 2 and 3, respectively.

[0034] In the situation shown in Fig. 2, all sheets 1 through 7 have already received a first image on the front side, and the print head 54 is busy with printing a first image on the front side of sheet 8. Sheet 2 is damaged, as has been symbolized by a bulge 68 on the top side of the sheet, which bulge would collide with the print head 54 when the sheet reaches the print station. The sensor 62 will detect this damage and will discard sheet 2 into the discharge path 66.

[0035] This has been illustrated in Fig. 3 which shows the duplex path 50 in a state three print cycles later. Sheet 1 is completed, i.e., it has received a second image on the back side and is being conveyed to the output section 14. The defective sheet 2 is in the discharge path 66, and the print head 54 is busy with printing an image on the back side of sheet 2a which will take the place of sheet 2 in the output stack.

[0036] Had the redundant copy 2a not been scheduled, then the damage detected for sheet 2 had the effect that not only sheet 2 would have to be discarded but all subsequent sheets in the duplex path 50, i.e. sheets 3, 3a and 4 to 8, would have to be discarded as well and only after the duplex path 50 had been emptied completely would it have been possible to resume the print process which feeding a new blank sheet, which will become the new sheet 2 and printing again the first image on the front side and then printing again the first images of the following sheets until the duplex path 50 is filled again. Consequently, the damage detected for sheet 2 would cause a considerable waste, i.e., a waste of 9 sheets in this example.

[0037] The purpose of scheduling the redundant sheet 2a is to avoid this waste. On its front side, the sheet 2a will receive the same image as has been printed on the front side of sheet 2, and if the sheets are of different media types, the scheduler 30 will also command the feed control section 32 to assure that sheet 2a is of the same media type as sheet 2, so that sheet 2a can substitute sheet 2 in any respect.

[0038] On the other hand, printing the redundant sheet a also produces a certain amount of waste, namely one sheet per set. The decision whether or not it is advantageous to print a redundant sheet depends upon the likelihood P that the sheet 2 will be damaged. For example, if 20 out of 100 copies of sheet 2 become damaged, then the amount of waste produced when no redundant sheet is printed will be $20 \times 9 = 180$ sheets per 100 copies of the set. For comparison, when a redundant sheet 2a is printed, the amount of waste will be only 100 sheets per 100 copies of the set. Consequently, scheduling a redundant copy would be more advantageous in this case.

[0039] In case of sheet 3, the calculation is slightly different because, if sheet 3 is damaged, the number of sheets to be discarded will only be 8 instead of 9. Consequently, if the likelihood P for sheet 3 is such that 10 sheets out of 100 will be damaged, then the amount of waste without a redundant sheet 3a would be $10 \times 8 = 80$ per 100 copies of the set, and the amount of waste with redundant sheet 3a would be 100 per 100 copies of the set, so that, in this case, it would be more advantageous not to schedule the redundant sheet 3a. On the other hand, if the likelihood of damage for sheet 3 is 20% rather than 10%, then the ratio of expected wastes would be 160:100, so that a redundant sheet 3a should be scheduled.

[0040] In general, if P is the likelihood of damage for a given sheet, and W is the number of sheets to be discarded in case of damage (including redundant copies of other sheets in the duplex path), then the criterion for scheduling a redundant copy of the given sheet is:

$$P > 1/W \quad (1)$$

[0041] If the likelihood P is large, it may also be possible to schedule two or more redundant copies for a given sheet. Then, the criterion for scheduling a number n of redundant copies would be:

$$P^n > n/W \quad (2)$$

[0042] The numerator n on the right side is due to the fact that, even when no damage occurs, n sheets would be wasted in each set.

[0043] It will be observed that the number W for a given sheet depends upon the position of the sheet in the duplex path 50 in a state where the duplex path is filled completely. For example, in Fig. 2, the number W for sheet 1 would be $W = 10$ and the number W for sheet 8 would only be $W = 1$. In the special case shown in Fig. 2, the number of sheets in the duplex path 50 (including redundant copies) is equal to the number of sheets per set. In this case the position of a sheet in the duplex path is the same for each set and, consequently, W for a given sheet has always the same value. In general, however, the position of a sheet in the duplex path shifts from set to set. For example, if, in Fig. 2, the set to be printed had 9 pages rather than 8, then the next duplex cycle (i.e. the cycle in which the duplex path 50 is filled and emptied again) would start with the last sheet 9 of the present set and the next set sheet 1 would be shifted backwards by one step, and this would result in a different (smaller) number W.

[0044] In the example shown here, the duplex print mode is a batch mode in which a batch of (8) sheets receive images on both sides before the next batch is processed. However, the invention is not limited to this mode. For example, the duplex mode could also be an interleaved mode in which, in the stream of sheets fed to the print station 16, blank sheets are interleaved with sheets from the duplex path 50.

[0045] Further, the duplex path does not have to be a loop. If separate print stations are used for printing the front side and back side images, then the duplex path would simply be a path leading from the first print station to the second.

[0046] The likelihood P of damage for a given sheet depends upon a number of factors such as the media type (thickness, dimensions and material of the sheet), humidity and temperature of the sheet, air humidity and temperature in the environment and during a curing or drying treatment of the sheet, chemical composition of the ink being used, the amount of ink applied on the first side of the image, the distribution of ink, and the like. The latter factors, in particular the amount and distribution of ink depend upon the image content of the image to be printed on the front side of the sheet. Consequently, the likelihood P can vary significantly from sheet to sheet and must therefore be determined independently for each sheet in the set.

[0047] In the example shown in Fig. 1, the controller 20 can access a database 70 via the network 24, and the database 70 stores likelihood values P for all combinations of the above-mentioned factors that may occur in practice. As regards the amount of ink to be applied, the likelihood may be a linear or non-linear function of that amount. As regards the

distribution of ink, the images to be printed will be classified in one of a number of pre-defined classes (such as: ink concentrated on a few lines or dots in the image; ink fills a large solid area near the center of the image; ink fills a large solid area near a corner of the sheet; and the like) and the likelihood will depend upon the class into which the image has been classified.

[0048] An example of a method of scheduling the images to be printed in accordance with the principles described above has been shown in Fig. 4.

[0049] In step S1, a media type is determined for the next sheet to be fed from the input section 10 into the sheet transport path 18, typically by reference to corresponding instructions in the print job specifications.

[0050] Then, also by reference to the print job specifications, the image content of the image to be printed on the front side of the sheet is analysed in step S2. The purpose of this analysis is to determine factors such as the amount of ink and the ink distribution, that will influence the likelihood P, together with other factors such as the media type.

[0051] In step S3, the likelihood P is determined as a function $P(x_1, \dots, x_j)$ of the relevant factors $x_1, \dots, x_j$, by reference to the database 70, said factors including among others the factors determined in steps S1 and S2.

[0052] Then, in step S4, the number n of redundant copies is determined by applying the criterion (2), starting with $n = 1$ and then incrementing n until the criterion is no longer met.

[0053] In step S5, it is checked whether n is larger than zero, i.e. if at least one redundant copy shall be scheduled. In that case, the next n sheets are scheduled to have the same media type and the same image content (on the first side) as the sheet presently under inspection. These sheets will then become redundant copies which may be used for replacing the original sheet in case of damage.

[0054] Of course, if, in the print process, the original sheet is found to be not damaged, or if at least one of the redundant copies is found to be not damaged, this sheet or copy will receive the image on the back side of the sheet and will be fed to the output section, whereas all subsequent redundant copies, if any, will be discarded.

[0055] It will be understood that the steps S1 - S5 should be performed no later than the time when the next subsequent sheet, i.e. the successor of the sheet in consideration, has to be fed from the input section 10, so that it is still possible to choose the media type. If all sheets are of the same media type, it is sufficient when the steps S1 - S5 are completed at the time when the next subsequent sheet is fed to the print station 56.

[0056] Fig. 5 illustrates a modified embodiment in which the likelihood of damage is determined only in the course of the print process in which several copies of multi-sheet set are printed. In this case, the print process starts with step S10.

[0057] In Step S11, the number W is calculated for each sheet in the set or, more precisely, for each sheet in each copy of the set, because the number W varies with the position of the sheet in the duplex path 50, which position may be different for different copies of the set.

[0058] While the print process continues, the total number T of prints and the number D of damaged sheets are counted separately for each sheet in the set in step S12. For a given sheet, e.g. the first sheet in the set, the number T is the number of print operations in which an image is printed on the first side of the sheet. If no damage occurs, T is equal to the number of copies of the set that have been printed. The number D related to the first sheet in the set is the number of instances where the sensor 62 finds this sheet to be damaged.

[0059] Then, in step S13, it is checked for each sheet in the set whether the counts obtained in step S12 for that sheet fulfil the criterion $D \cdot W > T$.

[0060] It is observed that, here, the quotient D/T is taken as an estimate for the likelihood P. Then, the criterion applied in step S13 is equivalent to the criterion (2) with $n = 1$.

[0061] A possible extension of this method to $n > 1$ is straightforward.

[0062] In the first phase of a print process, when T is still small, the quotient D/T may not be a good approximation for the likelihood P, because the statistical fluctuations are still large. It may therefore be considered to perform the step S13 only after a certain time, when the count T has reached a certain value. In general, however, it will do no harm if the step S13 is performed from the very beginning. If a damage happens to occur early, although the likelihood P is small, step 13 will have the effect that a redundant copy is scheduled, but when it turns out that no further damage occurs for that sheet, the ratio D/T will drop from set to set and, eventually, no redundant copy will be scheduled any more, so that the error is corrected automatically. Thus, the method shown in Fig. 5 assures that the strategy of printing redundant copies is automatically adapted to the actual frequency of damages.

Claims

1. A method of printing on a printing system having a print station (16) and a duplex path (50) that is capable of accommodating a plurality of media sheets (60) at a time, the method comprising a step of checking the sheets for possible damage before they are fed to the print station (16), **characterized by** the steps of:

(a) determining, for each duplex sheet to be printed, a likelihood P that the sheet will be damaged in a process

of printing an image on a first side of the sheet, so that the sheet would have to be discarded;
 (b) at or before the time when the first image is printed, deciding, on the basis of the determined likelihood P, whether or not to print at least one redundant copy (2a, 3a) of the sheet; and
 (c) when at least one redundant copy has been printed, and before a second image is printed on a second side
 5 of one of the sheets, checking whether the sheet and its redundant copies comprise at least one non-damaged sheet, and, if that is the case, selecting that sheet for further processing and discarding all other copies.

2. A method of scheduling a print process on a printing system having a print station (16), a duplex path (50) that is capable of accommodating a plurality of media sheets (60) at a time, and a sensor (62) arranged to check the sheets for possible damage before they are fed to the print station (16), **characterized by** the steps of:

(a) determining, for each duplex sheet to be printed, a likelihood P that the sheet will be damaged in a process of printing an image on a first side of the sheet, so that the sheet would have to be discarded; and
 (b) at or before the time when the first image is printed, deciding, on the basis of the determined likelihood P,
 15 whether or not to schedule at least one redundant copy (2a, 3a) of the sheet.

3. The method according to claim 1 or 2, wherein step (b) includes comparing the likelihood P to a number W of sheets in the duplex path (50) that would have to be discarded in a case damage of the present sheet.

4. The method according to claim any of the preceding claims, wherein the media sheets (60) are of different media types, and wherein the steps (a) and (b) for a given sheet are performed at a time before the media type of the next sheet has to be decided upon.

5. The method according to claim 4, wherein, in step (a), the likelihood P is determined as dependent upon the media type of the sheet.

6. The method according to any of the preceding claims, wherein, in step (a), the likelihood P is determined as dependent upon an image content of an image to be printed on the first side of the sheet.

7. The method according to any of the preceding claims, wherein, in step (a), the likelihood (P) is determined by reference to a database (70).

8. The method according to any of the claims 1 to 6, wherein, in step (a), the likelihood P is determined as dependent upon a ratio D/T between a count D of damaged sheets and a count T of a total number of sheets on which an image has been printed on the first side, the counts of D and T being taken separately for each sheet in the set to be printed.

9. A printing system comprising a print station (16), a duplex path (50) that is capable of accommodating a plurality of media sheets (60) at a time, and a controller (20), **characterized in that** the controller (20) is configured to perform a method according to any of the preceding claims.

10. A software product comprising program code on a computer-readable non-transitory medium, the program code, when loaded into a controller (20) of a printing system according to claim 7, causes the controller (20) to perform a method according to any of the claims 1 to 8.

Fig. 1

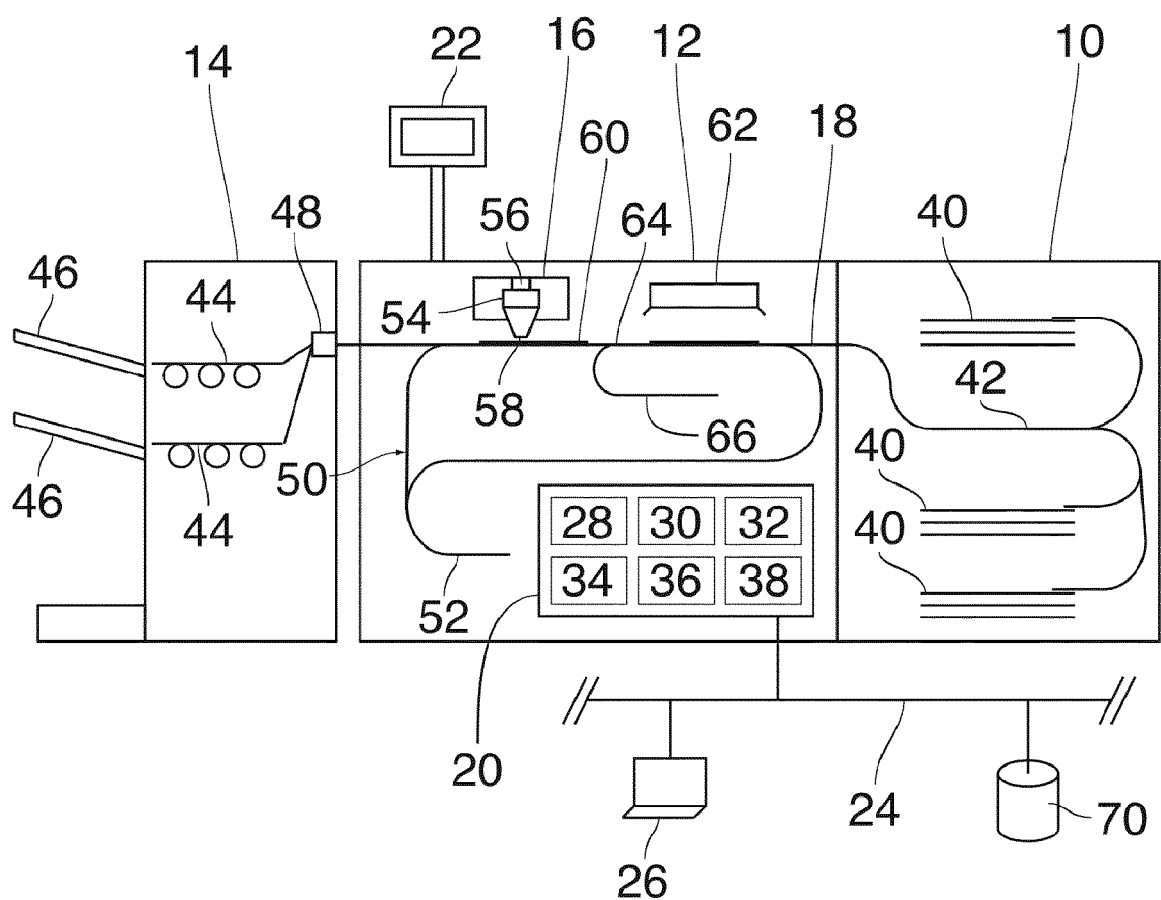


Fig. 2

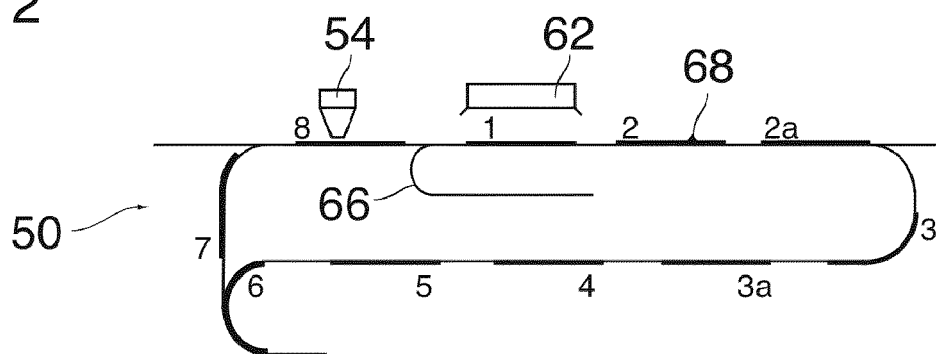


Fig. 3

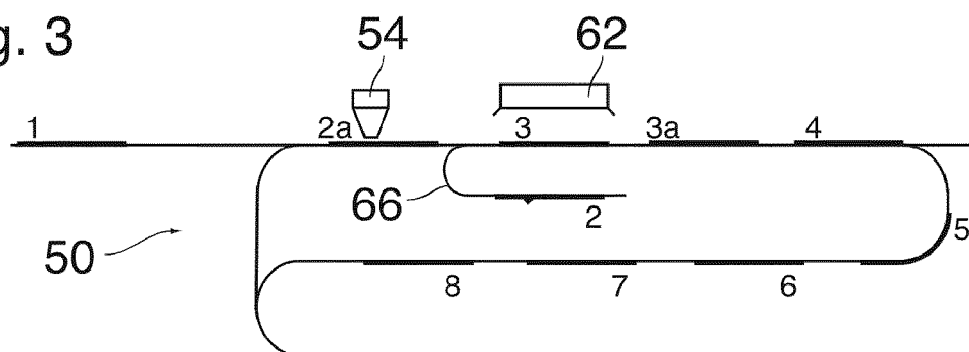


Fig. 4

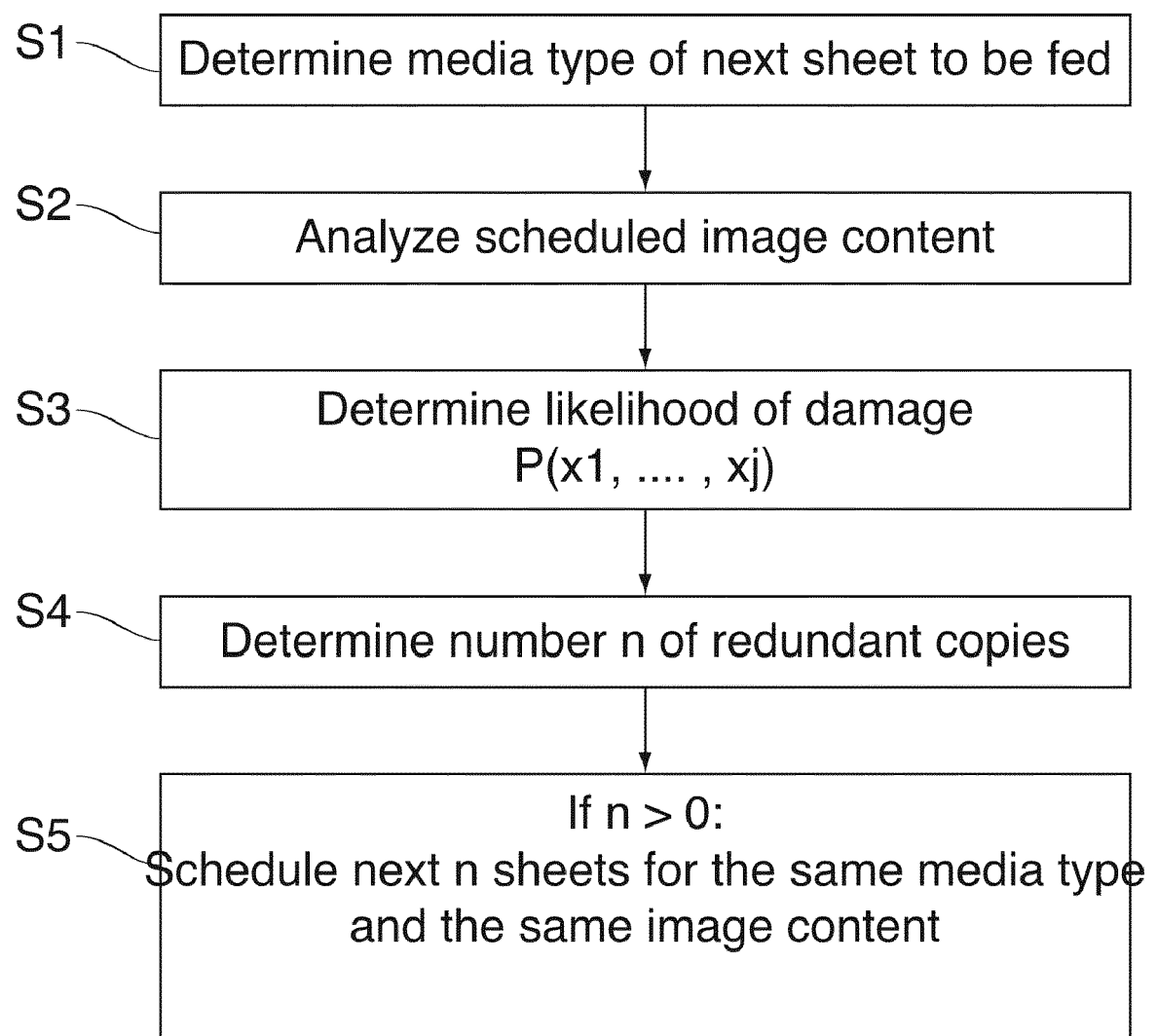
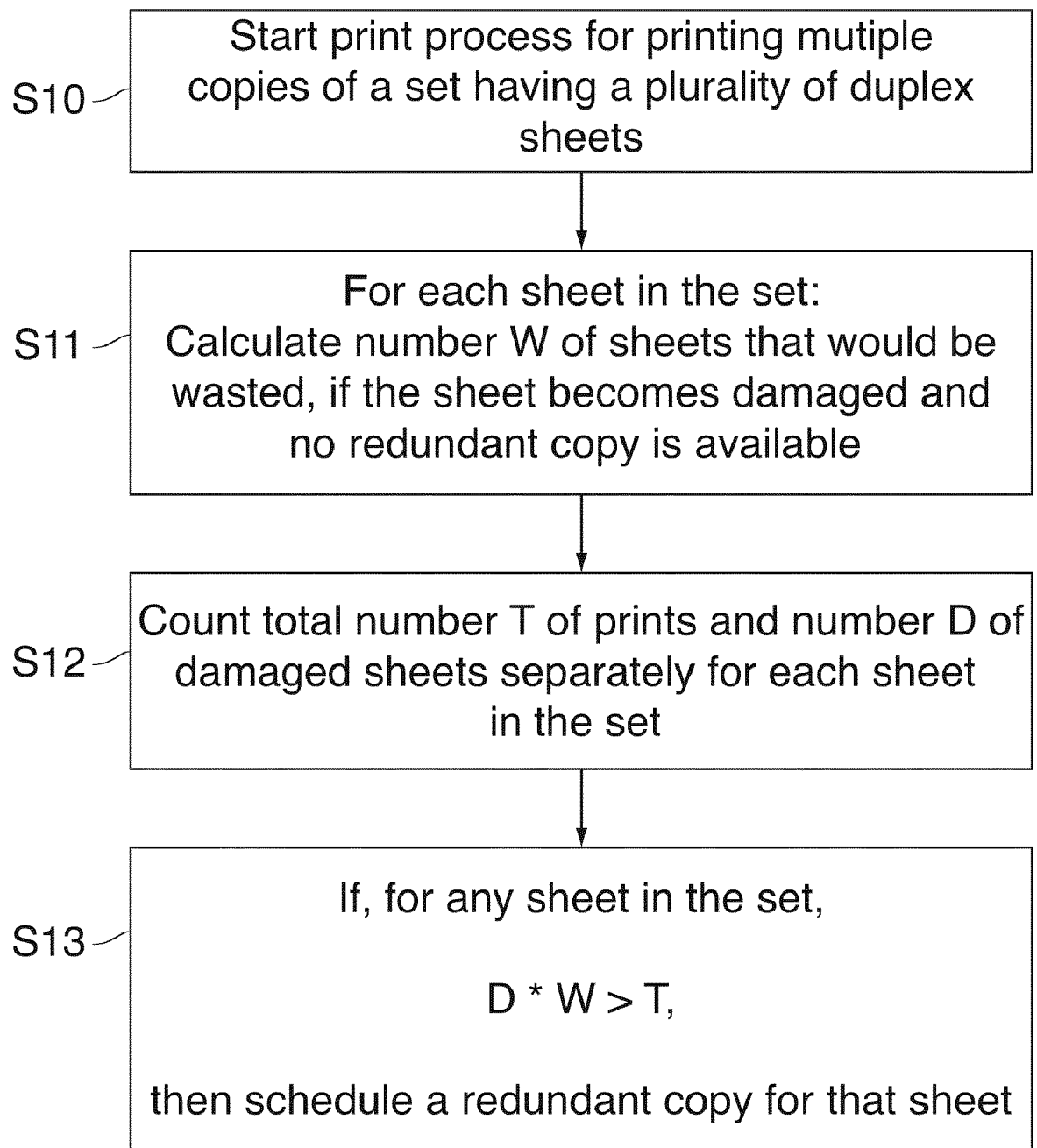


Fig. 5





EUROPEAN SEARCH REPORT

 Application Number
 EP 18 19 7575

5

10

15

20

25

30

35

40

45

50

55

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,D	WO 2016/177676 A1 (OCE-TECHNOLOGIES B V [NL]) 10 November 2016 (2016-11-10) * page 2, paragraph 2 - paragraph 3; claim 1 *	1-10	INV. B41J11/00 B41J13/00 B65H85/00 B65H7/06 G03G15/00 B41J3/60
A	EP 3 007 133 A2 (OCE TECH BV [NL]) 13 April 2016 (2016-04-13) * paragraphs [0037], [0041] *	1-10	
A	EP 3 007 421 A1 (OCE TECH BV [NL]) 13 April 2016 (2016-04-13) * paragraph [0047] *	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H B41J G03G
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 27 February 2019	Examiner Joosting, Thetmar
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	

 1
 EPO FORM 1503 03/82 (P04C01)

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

EP 18 19 7575

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

27-02-2019

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2016177676 A1	10-11-2016	EP 3291993 A1	14-03-2018
		JP 2018515362 A	14-06-2018
		US 2018056679 A1	01-03-2018
		WO 2016177676 A1	10-11-2016

EP 3007133 A2	13-04-2016	EP 3007133 A2	13-04-2016
		US 2016103634 A1	14-04-2016

EP 3007421 A1	13-04-2016	EP 3007421 A1	13-04-2016
		US 2016103632 A1	14-04-2016

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2016177676 A1 [0002]
- US 5905520 A [0003]
- US 2016103634 A1 [0030]