(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 628 502 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.04.2020 Bulletin 2020/14

(21) Application number: **19199439.1**

(22) Date of filing: **25.09.2019**

(51) Int Cl.:
B41J 11/00 *(2006.01)* ***B41J 3/407*** *(2006.01)*
B41J 3/28 *(2006.01)* ***B41M 7/00*** *(2006.01)*

(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

(30) Priority: **25.09.2018 IT 201800008887**

(71) Applicant: **GE.MA.TA. S.p.A.**
36070 Trissino (VI) (IT)

(72) Inventor: **MAITAN, Gianni**
30122 VENEZIA (IT)

(74) Representative: **Bonini, Ercole**
Studio Bonini Srl
Corso Fogazzaro, 8
36100 Vicenza (IT)

(54) **METHOD FOR DRYING IMAGES MADE BY DIGITAL PRINTING ON A GLASS SHEET AND A PLANT USING SUCH PRINTING METHOD**

(57) A method for drying writings and/or images made by digital inkjet printing on a glass sheet (L) in a plant (1) comprising a work surface (2) which supports the glass sheet (L), an inkjet printhead (5) and drying means (3) supplied by an electric power source and mechanically associated with means for moving said drying means (3) along at least one displacement direction (Y) parallel to the underlying glass sheet (L). The method comprises a plurality of translations (T, Ts, Ts', Ts") of said drying means (3) along the displacement direction (Y) and according to mutually opposite directions (Ya; Yr) starting from the initial/final edge to end up on the final/initial edge of said glass sheet (L), and vice versa. The intensity value (A) of the electric current supplying said drying means (3) during any one of the translations (T, Ts, Ts', Ts") is greater than the intensity value (A) of the electric current supplying the drying means (3) during the previous translation.

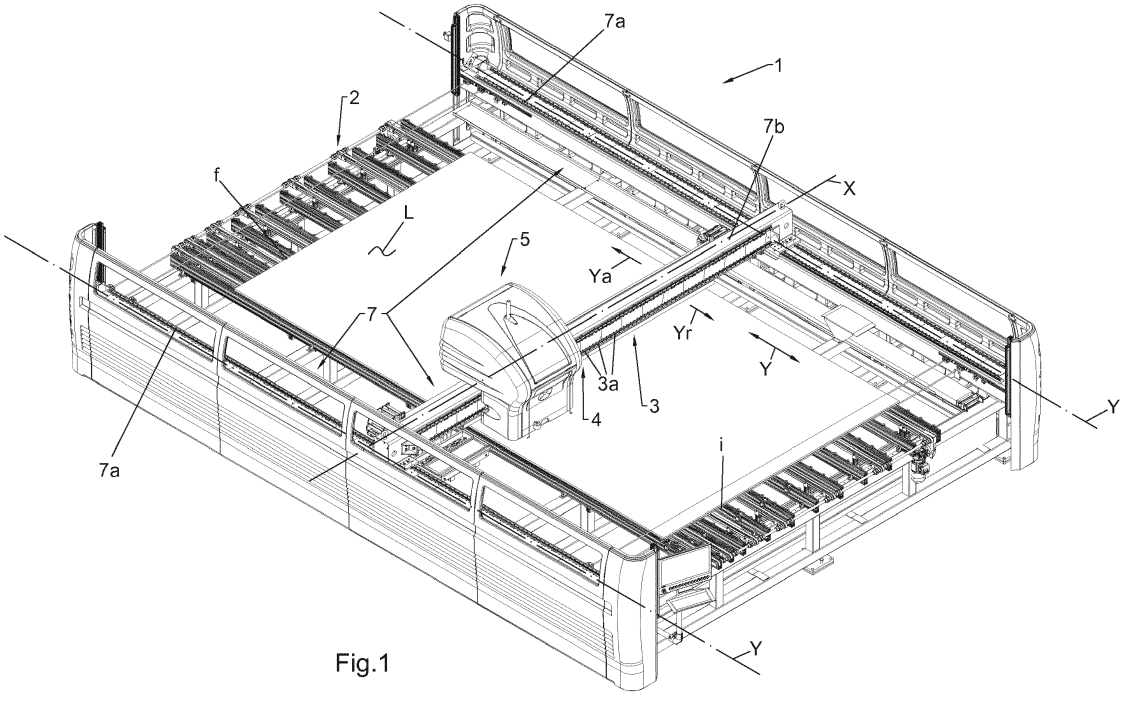

Fig.1

EP 3 628 502 A1

Description

[0001] The invention relates to a method for drying images made by digital printing on a glass sheet.

[0002] The invention also relates to a plant which carries out such method for drying the aforesaid images.

[0003] As is known, the digital printing process on glass is a technology which uses a dedicated software to read the information relating to images stored on digital media and manage an inkjet printer which prints the aforesaid images on a glass substrate.

[0004] A plant which carries out the aforesaid printing process essentially comprises a work surface on which the glass sheet to be printed is placed and a printhead which is provided with a plurality of ink spraying heads in the primary colours which, applied in combination between them, make it possible to obtain the colours of the images stored in the computer support.

[0005] The work surface is usually made up of a suctioned surface on which the glass sheet is fixed and the printhead is associated with a Cartesian system that allows it to be displaced above the surface of the glass sheet on which the images will be printed.

[0006] The Cartesian displacement system comprises a pair of longitudinal lanes that are parallel to each other, spaced and arranged according to the length of the glass sheet, and a transverse carriage that supports the printhead and is in turn supported at the ends by the longitudinal lanes.

[0007] The plant is also provided with drying means, usually consisting of infrared or UV lamps, which are fixed along the transverse carriage and are displaced along the glass sheet together with the printhead by the transverse carriage sliding along the longitudinal lanes.

[0008] The presence of the aforesaid drying means is justified by the fact that, for improving the adhesion of the dye on the glass sheet, before the image printing operation the sheet is usually dried through one or more passages by the aforesaid drying means over the whole length thereof.

[0009] Moreover, after printing, the image is fixed on the surface of the glass sheet accelerating the drying of the ink through one or more passages of the drying means.

[0010] As stated above, according to the prior art the drying means used are infrared or UV lamps and it is important that the drying of the ink takes place slowly since an excessively rapid drying would cause an excessive fluidification of the ink with consequent dilation and loss of incision of the image after drying.

[0011] For this reason, according to the prior art, the lamps are supplied at low current intensity.

[0012] This way of operation has the advantage of obtaining a good quality and a good incision of the printed image, but it also has the drawback that for obtaining an effective drying of the ink it is necessary to carry out a high number of drying passages by letting the drying means pass many times along the glass sheet.

[0013] As a result, there is an increase in processing times and related costs.

[0014] It is known the patent document US-A1-2013/0222498 which describes a system for inkjet printing on a glass sheet in which the current that supplies the drying means remains constant during the printing operations.

[0015] The present invention intends to overcome these drawbacks by providing a drying method which, with respect to the prior art, reduces the drying times of the ink and in any case guarantees the realisation of prints of excellent quality.

[0016] The object of the invention is achieved by the drying method according to what is described in the main claim to which reference will be made.

[0017] Other features of the invention are described in the dependent claims, some of which are also related to a printing plant which carries out the aforesaid printing method and is also object of the present invention.

[0018] Advantageously, the method of the invention allows reducing the drying times with respect to the prior art and obtaining images of excellent quality.

[0019] The objects and advantages listed will be better highlighted in the following descriptions of the drying method and of the plant which uses it, both object of the invention, which are given by way of an indicative and non-limiting example, with reference to the accompanying drawings in which:

- Figure 1 represents the plant of the invention which carries out the digital printing of images on a glass sheet and the method for drying the ink with which the aforesaid images are printed;
- Figures 2 to 5 represent graphs relative to the method of the invention.

[0020] The method of the invention concerns the drying by means of infrared ray emitters of writings and/or images made by digital inkjet printing on a glass sheet.

[0021] The method is described below with reference to Figure 1, which represents the plant, also object of the invention and indicated as a whole with **1**, in which the aforesaid writings and/or images are printed by means of an inkjet printhead **5** which, by means of movement means, is displaced over the glass sheet **L.**

[0022] The ink deposited on the glass sheet **L** is then dried by drying means **3**, comprising infrared or UV lamps, which are supplied by an electric power source and which are mechanically associated with movement means which displace them above the glass sheet **L** along at least one displacement direction **Y** parallel to the underlying glass sheet **L.**

[0023] The drying method comprises a plurality of "passages", better defined as translations **T, Ts, Ts', Ts"** of the infrared ray emitters **3** on the glass sheet **L** along at least the aforesaid displacement direction **Y** and according to mutually opposite directions **Ya; Yr** starting from the initial/final edge to end up on the final/initial edge

of the glass sheet **L** itself, and according to the invention the intensity value **A** of the electric current supplying the drying means **3,** during any of the aforesaid translations **T, Ts, Ts', Ts",** is greater than the intensity value **A** of the electric current supplying the drying means **3** during the previous translation.

[0024] The above description is well represented in Figures 2 to 4 in which the variations of the values of the electric current **A** supplying the drying means **3** are represented in a Cartesian reference having on the abscissa the translations **T, Ts, Ts', Ts"** and on the ordinate the values of the supply current **A.**

[0025] In Figures 2 to 4 reference is made to four translations, but this is given only by way of an indication, since the translations can be in any number.

[0026] In particular, Figure 2 relates to a drying method in which, during each of the translations **T, Ts, Ts', Ts",** the intensity value **A** of the electric current supplying the drying means **3** remains constant.

[0027] Figure 3 relates instead to a drying method in which, during each of the translations **T, Ts, Ts', Ts",** the intensity value **A** of the electric current supplying the drying means **3** increases continuously and linearly, and therefore it is represented by a straight line **R.**

[0028] Finally, Figure 4 relates to a drying method in which, during each of the translations **T, Ts, Ts', Ts",** the intensity value **A** of the electric current supplying the drying means **3** increases with the trend represented by a curved line **C.**

[0029] Obviously, the variation of the intensity **A** of the electric current which supplies the drying means **3** may take place according to trends that differ from those described, depending on the choices of the manufacturer.

[0030] To reduce the drying time, the displacement speed **V** of the drying means **3** during each translation **T** is different depending on the direction in which the displacement of the drying means **3** takes place with respect to the glass sheet **L.**

[0031] In particular, with reference to Figure 1, the drying means **3** move along the displacement direction **Y** which identifies the length of the glass sheet **L** and their displacement speed in the outward direction **Ya** from the initial edge **i** to the final edge **f** of the sheet **L** is greater than the displacement speed in the opposite return direction **Yr** which brings them back again at the initial edge **i** of the sheet itself.

[0032] The trend of the speeds **V** is shown in Figure 5 in which the abscissa represents the travel time of the outward and return translations **Ya** and **Yr,** respectively, of the drying means **3** and the ordinate represents the translation **T.**

[0033] It should be noted that the speed trend is represented by straight lines **Ra, Rr** and therefore both displacements take place at constant speed, but the greater slope of the straight line **Rr,** which represents the return translation in the direction **Yr,** indicates that it takes place at a higher speed than the outward translation in the direction **Ya.**

[0034] Obviously, this constitutes only one of the possible operative choices since the displacements can be carried out by choosing displacement speeds with trends that are different from the linear trend.

[0035] Substantially, the method of the invention in which the intensity values of the electric current **A** which supplies the drying means **3** are managed and their displacement speeds **V** allows improving the drying process with respect to the prior art.

[0036] It has already been said, in fact, that an image with good print quality having well-defined edges is obtained if during drying the ink is not excessively fluidized.

[0037] This reduces its dilation and prevents it from expanding beyond the edges of the pattern, causing the image to lose the desired incision.

[0038] According to the prior art, this result is achieved by drying the ink through a plurality of translations of the infrared ray emitters above the printed image in which the emitters, during each translation, are supplied with low current intensity.

[0039] This way of operating has the drawback of significantly lengthening the drying times and therefore, substantially, the times of the whole printing cycle.

[0040] The method of the invention described allows reducing the drying times without compromising the final quality of the printed image since only the first translation is carried out by supplying the infrared ray emitters with low intensity current.

[0041] In fact, after the first translation, the ink is sufficiently fixed to the surface of the sheet and during subsequent translations its drying can be completed by gradually increasing, for each subsequent translation, the current that supplies the infrared ray emitters with an electric current of growing intensity.

[0042] This allows reducing the number of translations or drying passages and therefore reducing the processing time.

[0043] Moreover, a further reduction in the processing time is obtained by carrying out, differently from the prior art, each return translation of the drying means **3** in the direction **Yr** according to the length **Y** of the glass sheet **L,** at a speed **V** greater than the outward translation **Ya,** as shown in Figure 5.

[0044] Therefore, the method of the invention achieves the intended aims.

[0045] The described drying method is carried out in the plant for the digital printing of images and writings, also object of the invention, represented in Figure 1.

[0046] Some elements that make up the aforesaid plant **1** have already been briefly described in the introductory part of the description of the drying method and, taking up the above description, it can be seen that the plant comprises a work surface **2** configured to support the glass sheet **L** adapted to receive the digital printing of writings and/or images.

[0047] Above the work surface **2** and therefore of the glass sheet **L** arranged thereon there is a Cartesian structure **7** which is configured to support an inkjet printhead **5.**

[0048] More precisely, the Cartesian structure **7** comprises a pair of longitudinal lanes **7a** spaced and parallel from/to each other which define the longitudinal direction **Y** according to which the length of the glass sheet **L** extends.

[0049] The Cartesian structure **7** also comprises a transverse carriage **7b** which is supported at the ends of the longitudinal lanes **7a** and defines the longitudinal direction **X** according to which the width of the glass sheet **L** extends.

[0050] Motorization means to displace the printhead **5** of the type known per se and not shown are associated with the Cartesian structure **7,** and optical means **4,** preferably one or more laser emitters, are associated with the transverse carriage **7b** which are configured to position the glass sheet **L** on the work surface **2** before carrying out the printing operation.

[0051] Finally, the drying means **3** are associated with the transverse carriage **7b** which drying means extend along the transverse direction **X** and affect the work surface **2** in its whole width.

[0052] The drying means **3,** preferably but not exclusively, comprise infrared ray emission lamps **3a** which are supplied by an electric supply unit, not shown in the figures.

[0053] According to another embodiment, the lamps **3a** can be of the UV ray emission type.

[0054] The plant **1** also includes a numerical control for managing the printing and the drying process by means of a dedicated software configured to read the information relating to the writings and/or the images to be printed stored on digital media and to command the motorization means of said printhead **5** and of the drying means **3.**

[0055] Operationally, the described plant carries out the printing of the images and allows the ink with which these images have been printed by the printhead **5** to be dried, operating according to the method described.

[0056] The image printing operation can be preceded, depending on the case, by the pre-drying of the glass sheet which can take place by supplying the drying means **3,** in particular the infrared emission lamps or the UV emission lamps, with the same methods as the method of the invention.

[0057] After the possible pre-drying of the glass sheet, the images are then printed, and this is followed by the drying of the ink according to the methods of the method described.

[0058] Once the processing is completed, a quality print is obtained with shorter times and lower costs than the prior art.

[0059] Based on what has been said, the method of the invention and the plant which realizes it achieve the objects of the invention which have been mentioned in the introductory part of the present description and which have been better specified during the same description.

[0060] In the executive phase, modifications and variations may be made to the method and to the plant of the invention which have not been described and claimed in the present patent document.

[0061] It is understood, however, that such possible modifications and variations, if they were to be included in the following claims, must all be considered protected by the present patent.

Claims

1. A method for drying writings and/or images made by digital inkjet printing on a glass sheet (L) in a plant (1) comprising a work surface (2) which supports said glass sheet (L), an inkjet printhead (5) and drying means (3) supplied by an electric power source and mechanically associated with means for moving said drying means (3) along at least one displacement direction (Y) parallel to the underlying glass sheet (L), said method comprising a plurality of translations (T, Ts, Ts', Ts") of said drying means (3) along said at least one displacement direction (Y) and according to mutually opposite directions (Ya; Yr) starting from the initial/final edge to end up on the final/initial edge of said glass sheet (L), and vice versa, **characterized in that** the intensity value (A) of the electric current supplying said drying means (3) during any one of said translations (T, Ts, Ts', Ts") is greater than the intensity value (A) of the electric current supplying said drying means (3) during the previous translation.

2. The drying method according to claim 1, **characterized in that** during one or more of said translations (T, Ts, Ts', Ts") the intensity value (A) of the electric current supplying said drying means (3) is constant.

3. The drying method according to claim 1, **characterized in that** during one or more of said translations (T, Ts, Ts', Ts") the intensity value (A) of the electric current supplying said drying means (3) increases continuously.

4. The drying method according to claim 3, **characterized in that** said continuous increase takes place according to a straight line (R).

5. The drying method according to claim 3, **characterized in that** said continuous increase takes place according to a curved line (C).

6. The drying method according to any one of the preceding claims, **characterized in that** the displacement speed (V) of said drying means (3) in any one of said directions (Ya; Yr) is greater/less than the displacement speed (V) in the opposite direction.

7. The drying method according to claim 6, **characterized in that** said displacement speed (V) has a con-

stant value.

8. The drying method according to claim 6, **characterized in that** said displacement speed (V) has a variable value.

9. A plant (1) for digital printing of writings and/or images on glass including:

- a work surface (2) configured to support a glass sheet (L) adapted to receive digital printing of writings and/or images;
- optical means (4) configured to position said glass sheet (L) on said work surface (2) before executing said printing operation of said writings and/or said images;
- a printhead (5) provided with inkjet spraying heads (5a);
- a Cartesian structure (7) arranged coplanar above said glass sheet (L) arranged on said work surface (2) and configured to support said printhead (5);
- motorization means configured to displace said printhead (5) onto said Cartesian structure (7) and above said work surface (2);
- drying means (3) belonging to said Cartesian structure (7) and configured to dry said ink after deposition of said ink on said glass sheet (L);
- a numerical control for managing the printing process by means of a dedicated software configured to read the information relating to said writings and/or said images to be printed stored on digital media and to command said motorization means, said printhead (5) and said drying means (3),

characterized in that the drying of said ink takes place by means of the drying method according to any one of the claims 1 to 6.

10. The plant (1) according to claim 9, **characterized in that** said Cartesian structure (7) comprises a pair of longitudinal lanes (7a) that are spaced and parallel from/to each other and a transverse carriage (7b) that supports said printhead (5) and is supported at the ends by said longitudinal lanes (7a), said motorization means and said drying means (3) being associated with said Cartesian structure (7).

11. The plant (1) according to claim 9 or 10, **characterized in that** said optical means (4) comprise one or more laser emitters.

12. The plant (1) according to any one of the claims 9 to 11, **characterized in that** said drying means (3) comprise infrared ray lamps (3a).

13. The plant (1) according to any one of the claims 9 to 11, **characterized in that** said drying means (3) comprise UV ray lamps (3a).

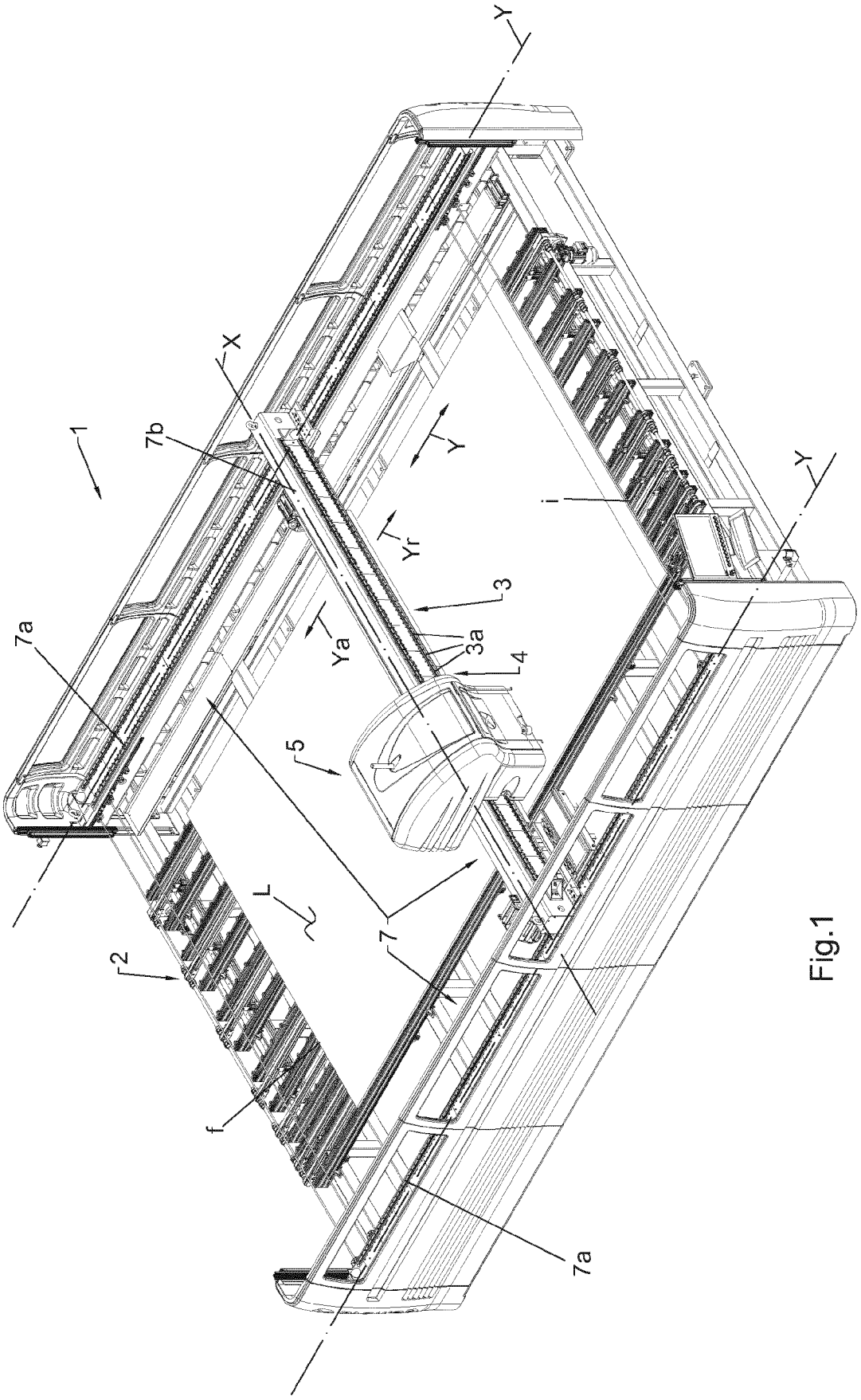

Fig.1

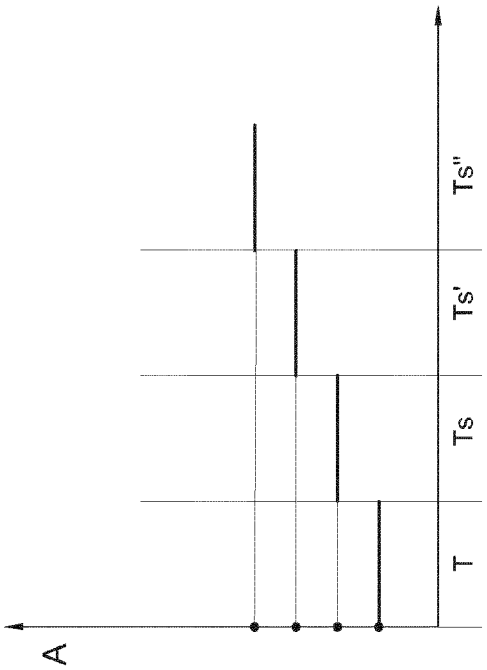

Fig.2

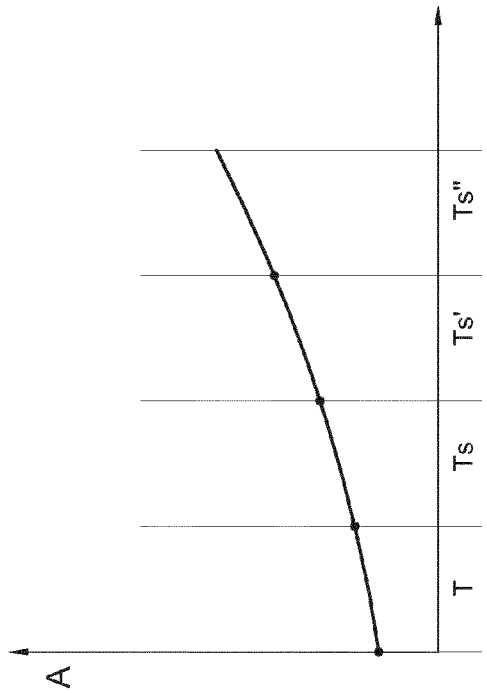

Fig.4

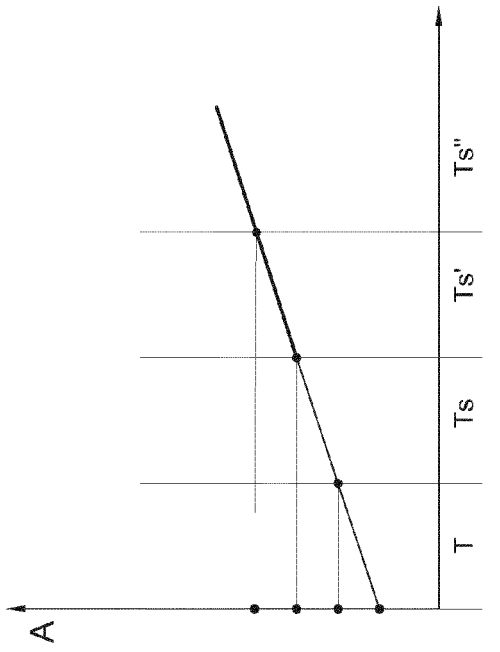

Fig.3

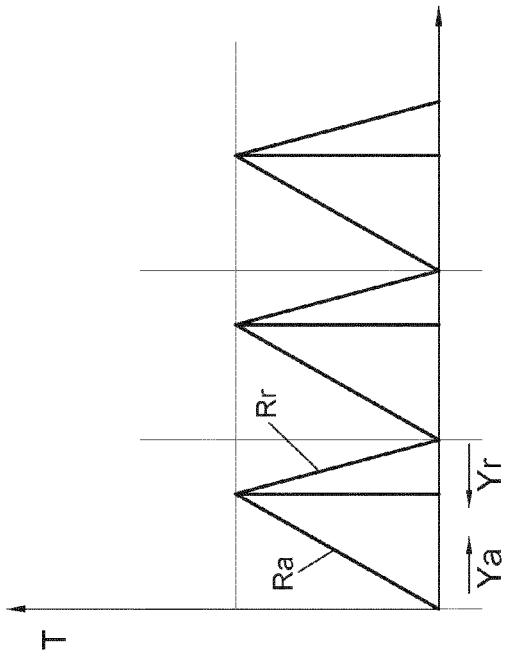

Fig.5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 19 9439

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	US 2013/222498 A1 (ERON GERA [IL]) 29 August 2013 (2013-08-29) * paragraphs [0002], [0014] - [0017], [0029] - [0032], [0047], [0048], [0058] - [0065]; claims 1-8; figures 1, 2 *	1-13	INV. B41J11/00 B41J3/407 B41J3/28 B41M7/00
A	US 2018/229517 A1 (CLOOTS TOM [BE]) 16 August 2018 (2018-08-16) * paragraphs [0002], [0014] - [0017], [0021], [0040] - [0046], [0066]; figures 3-5, 9 *	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

B41J
B41M
C09D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 January 2020	Bacon, Alan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 19 9439

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.

14-01-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013222498 A1	29-08-2013	AT 453513 T	15-01-2010
		AT 467665 T	15-05-2010
		EP 1658342 A1	24-05-2006
		EP 1660325 A1	31-05-2006
		EP 2233539 A1	29-09-2010
		ES 2338332 T3	06-05-2010
		ES 2345985 T3	07-10-2010
		ES 2493065 T3	11-09-2014
		IL 173769 A	29-02-2012
		PL 1660325 T3	30-06-2010
		US 2007031603 A1	08-02-2007
		US 2008210122 A1	04-09-2008
		US 2012007930 A1	12-01-2012
		US 2013187983 A1	25-07-2013
		US 2013222498 A1	29-08-2013
		WO 2005018941 A1	03-03-2005
		WO 2005019360 A1	03-03-2005
US 2018229517 A1	16-08-2018	BR 112018008124 A2	06-11-2018
		CN 108290427 A	17-07-2018
		CN 108367576 A	03-08-2018
		EP 3159172 A1	26-04-2017
		EP 3365178 A1	29-08-2018
		US 2018229516 A1	16-08-2018
		US 2018229517 A1	16-08-2018
		WO 2017068047 A1	27-04-2017
		WO 2017068050 A1	27-04-2017

EPO FORM P0459

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

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

- US 20130222498 A1 **[0014]**