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(54) **PRINTING APPARATUS AND CORRESPONDING METHOD**

(57) Printing apparatus for printing on at least one article (12), comprising at least two printing heads, respectively first (17') and second (17''), disposed aligned with respect to each other in a direction (F), and a feed

device (13) suitable to feed the article (12) to be printed along the direction of alignment of the two printing heads (17, 17', 17''), so as to position the article (12) sequentially in cooperation with the two printing heads (17, 17', 17'').

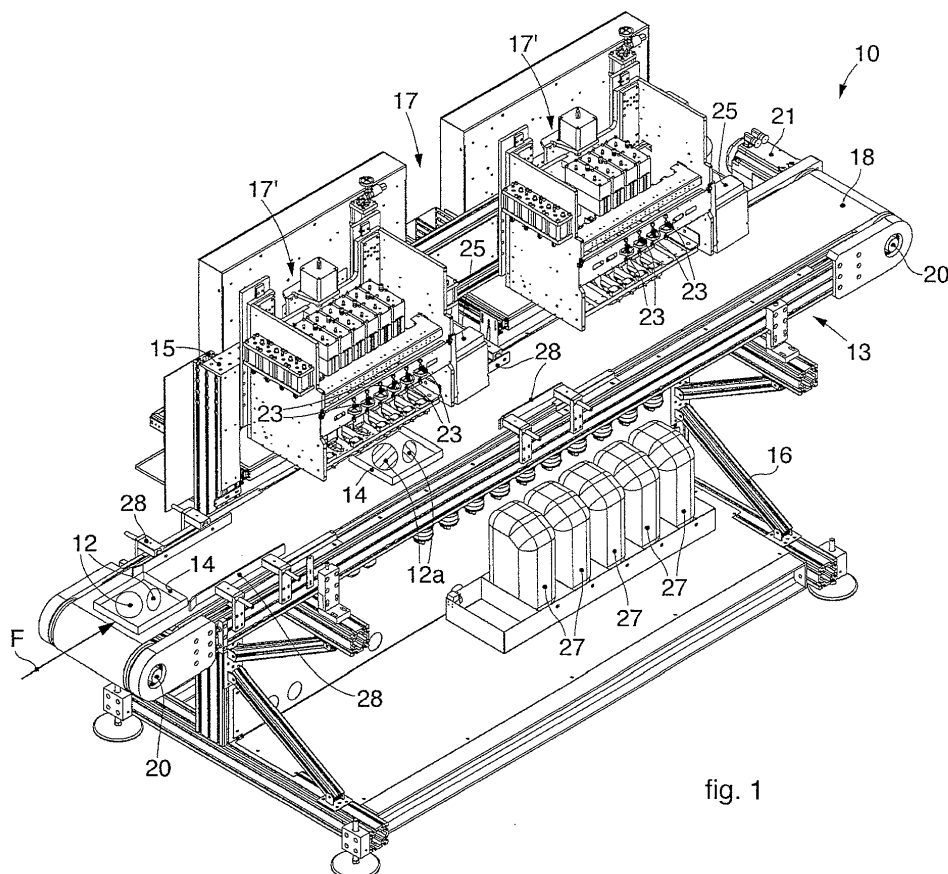


fig. 1

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention concerns a printing apparatus and the corresponding method, to deposit a printing material, in particular inks, paints, dyes or other similar or comparable product, on different types of articles, for example articles made of paper, cardboard, fabric, metal materials, plastic materials, glass or suchlike.

**[0002]** More generally, the printing material can be any material able to confer on the article specific esthetic, surface and/or technical characteristics.

### BACKGROUND OF THE INVENTION

**[0003]** Known printing apparatuses generally comprise a printing unit that normally has a printing head and a positioning device, for example a belt, plane or mat, to correctly position the article to be printed in cooperation with the printing head. The printing head can include a plurality of delivery nozzles disposed reciprocally in a coordinated manner in order to perform the correct printing sequence with the pre-set materials and colors.

**[0004]** Here and hereafter in the description, by the word "article" we mean both the simple object on which printing is to be done, and also a container or support, such as a tray, a box or other, containing the objects to be printed.

**[0005]** The printing head normally includes at least a vertical movement, toward/away from the mat or belt, to position the delivery nozzles at the correct distance from the support or from the article to carry out printing.

**[0006]** The printing head is also provided or cooperates with a drying device, normally a UV lamp or other similar or comparable device, which performs a substantially instantaneous drying of the printing material at the end of the corresponding cycle.

**[0007]** It is known that, in printing machines, such as plotters, the printing cycle initially provides, if required, to deposit a background color, normally white, which forms the print base, and then to deliver the various colors to form, in a first pass, the desired image. Printing machines normally provide to use the four primary colors - black, cyan, magenta and yellow - to compose all the colors desired.

**[0008]** The color is then dried and subsequently the article is subjected to a second printing cycle, to form the definitive image, followed by another drying cycle.

**[0009]** In conventional printing machines, the printing head not only moves vertically to move toward/away from the support or article to be printed, but also moves transversely to the direction of feed of the article, to perform one or two successive printing cycles. As the number of passes increases, so does the definition of the image printed.

**[0010]** Indeed, the printing cycle provides that the printing head performs a first movement transverse to the

article, in which it makes a first delivery of the printing material with the article stationary, followed by a second pass to make a second delivery of the printing material, again with the article stationary.

**[0011]** After the two passes, the article is made to advance on the mat or belt, and the printing cycles are repeated.

**[0012]** One disadvantage of this known solution concerns the need to provide that, at least during the printing process, the article must be stationary.

**[0013]** Another disadvantage of the known solution concerns the duration of the printing process, generally long, due to the need to keep the article stationary during printing.

**[0014]** Another disadvantage derives from the need to move the printing heads repeatedly with alternate movements in one direction and the other, to carry out the printing operations.

**[0015]** One purpose of the present invention is to supply a printing apparatus able to print precisely and continuously, reducing the cycle times and movements.

**[0016]** Another purpose of the present invention is to supply a printing apparatus that can print on an article a graphical pattern that can be particularly complex and articulated.

**[0017]** Another purpose of the present invention is to perfect a printing process with a shorter duration than that of printing processes known in the state of the art.

**[0018]** The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

### SUMMARY OF THE INVENTION

**[0019]** The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

**[0020]** In accordance with the above purposes, the invention concerns a printing apparatus for printing, on at least one article, any graphical image whatsoever, with any color, substantially any size and in which the article can be made of any material whatsoever.

**[0021]** According to one characteristic of the present invention, the apparatus comprises at least two printing heads, respectively first and second, disposed aligned with respect to each other in a direction, and a feed device suitable to feed the article to be printed along the direction of alignment of the two printing heads or printing units, so as to position the article sequentially in cooperation with the two printing heads.

**[0022]** Thanks to this configuration, the article to be printed is positioned first in cooperation with the first printing head to carry out the first printing cycle, and then in cooperation with the second printing head to carry out the second printing cycle, without the article ever being stopped and without the printing heads being moved in

a direction transverse to the direction of feed of the article.

**[0023]** In one formulation of the present invention, the first printing head comprises a plurality of delivery nozzles among which at least one is suitable to deliver a background color, for example white, to form the print base, and other nozzles each suitable to deliver a respective primary color for the formation of the color during the first printing cycle.

**[0024]** The second printing head comprises a plurality of nozzles each suitable to deliver a respective primary color for the formation of the color during the second printing cycle.

**[0025]** In one formulation of the present invention, one or both of the two printing heads comprise, downstream of the respective delivery nozzles, at least a drying device configured to dry the color substantially instantaneously at exit from the respective printing pass.

**[0026]** In one formulation of the invention, the feed device is a belt or mat on which the articles are positioned sequentially at a reciprocal distance that substantially corresponds to the distance between the two printing heads or printing units.

**[0027]** In this way, when the second printing head, or second printing unit, carries out the second pass on an article on which the first pass has already been carried out, the first printing head, or first printing unit, carries out the first pass on a new article present on the belt or mat.

**[0028]** In one formulation of the invention, the two printing heads are mounted on a common support structure equipped with at least means which allow the simultaneous lowering/raising of the printing heads in relation to the printing step in progress at that moment.

**[0029]** The lowering/raising means are programmable so as to define a pre-ordained operating distance with respect to the article to be printed, depending on the shape, size of the article and the type of printing operation to be carried out.

**[0030]** The printing apparatus according to the invention advantageously carries out the printing process on the moving article and in a sequential mode, so as to be able to also print complex graphical patterns.

**[0031]** In accordance with possible forms of embodiment, the continuous printing method according to the invention provides to put the article in movement by means of a feed device, to bring it in correspondence with the at least two printing heads, to selectively command the release of the printing material, by means of at least one of the printing heads, while the article is in movement, and to determine the substantially instantaneous drying of the printing material through the at least one drying unit, while the article is in movement.

**[0032]** With this process, the printing on at least one article is advantageously carried out in limited times, thus reducing the duration compared with those in the state of the art.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0033]** These and other characteristics of the present invention will become apparent from the following description of some forms of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a perspective view of a printing apparatus in accordance with the invention in a first operating step,
- fig. 2 is another perspective view of the printing apparatus of fig. 1 in a second operating step.

**[0034]** To facilitate comprehension, the same reference numbers have been used, where possible, to identify identical common elements in the drawings. It is understood that elements and characteristics of one form of embodiment can conveniently be incorporated into other forms of embodiment without further clarifications.

## DETAILED DESCRIPTION OF SOME FORMS OF EMBODIMENT

**[0035]** We shall now refer in detail to the various forms of embodiment of the present invention, of which one or more examples are shown in the attached drawing. Each example is supplied by way of illustration of the invention and shall not be understood as a limitation thereof. For example, the characteristics shown or described insofar as they are part of one form of embodiment can be adopted on, or in association with, other forms of embodiment to produce another form of embodiment. It is understood that the present invention shall include all such modifications and variants.

**[0036]** In accordance with the present description, forms of embodiment of the invention described here concern a printing apparatus 10 usable for printing on articles 12, such as for example articles 12 made of paper, cardboard, fabric, metal materials, plastic materials, glass or suchlike.

**[0037]** In forms of embodiment described here, the printing apparatus 10 can comprise two or more printing heads 17, a support structure 15 to which the printing heads 17 are associated and a feed device 13, disposed below the printing heads 17.

**[0038]** The printing apparatus 10 can also comprise a support frame 16, configured to support at least the feed device 13 and the printing heads 17.

**[0039]** In forms of embodiment described here, the feed device 13 can include a belt 18, or mat, configured to selectively determine the movement of at least a support element 14 disposed on it, such as for example a plate or a tray, containing at least an article 12 to be printed.

**[0040]** With reference to fig. 1, the movement of the belt 18 can occur, for example, in a direction F indicated by an arrow in the attached drawings.

**[0041]** Moreover, the belt 18 can be configured closed in a ring and stretched between at least two rollers 20, with axes of rotation parallel and substantially perpendicular to the direction F indicated by the arrow.

**[0042]** In forms of embodiment described here, at least one of the rollers 20 can be connected to a motor 21, for example the electric type, configured to selectively drive it and determine a rotation thereof around its axis, with consequent movement of the belt 18 in the direction F indicated by the arrow.

**[0043]** In forms of embodiment of the present invention described here, the printing heads 17 can be disposed aligned in the direction of feed F defined by the movement of the belt 18, so as to carry out a process of sequential printing on the article 12.

**[0044]** In forms of embodiment described here with reference to fig. 1, the printing apparatus 10 can comprise two printing heads 17' and 17'', of which the first printing head 17' can be configured to carry out a first basic printing while the second printing head 17'' can be configured to determine the finishing printing of the article 12.

**[0045]** In forms of embodiment described here, the first and the second printing heads 17' and 17'' can be connected to the same support structure 15.

**[0046]** In variant forms of embodiment of the present invention, not shown in the attached drawings, each printing head 17' and 17'' can be connected to a respective support structure 15.

**[0047]** In forms of embodiment described here, the connection between the support structure 15 and the printing heads 17' and 17'' can be obtained, for example, through mechanical welding, or by using screws.

**[0048]** The printing heads 17' and 17'' can comprise at least a plurality of nozzles 23, configured to selectively release a printing material on the article 12.

**[0049]** Moreover, each printing head 17' and 17'', can also comprise at least a drying unit 25, as for example a lamp with UV, LED or other source of energy, configured to selectively dry the printing material substantially instantaneously, guaranteeing it is fixed on the article 12.

**[0050]** Each printing nozzle 23 can be selectively commanded, in a substantially known way, to deposit the printing material on the article 12 according to a prefixed pattern.

**[0051]** In forms of embodiment of the present invention, the printing material can be of different types, such as for example, but not only, ink, paint, dye, or other types of material able to confer the desired enhancement on the article 12.

**[0052]** In forms of embodiment of the present invention, the printing material can be configured to supply to the article 12, once fixed on it, specific surface characteristics, such as for example a shiny or opaque effect, or other characteristics perceptible to the touch, such as a smooth or rough effect, or again other graphical effects.

**[0053]** In forms of embodiment described here, each printing head 17 can comprise a different number of printing nozzles 23, depending on specific needs.

**[0054]** In particular, the printing nozzles 23 can each release a different type of printing material, or all the same printing material, or again only some of them can release the same type of printing material different from that of the others.

**[0055]** In forms of embodiment of the present description described here, the printing nozzles 23 can be configured to release printing material of a specific color, chosen for example from white, black, magenta, yellow or cyan.

**[0056]** In variant forms of embodiment described here, the printing nozzles 23 can also be configured to release a combination of the colors cited above, depending on the specific characteristics of enhancement to be given to the article 12.

**[0057]** Generally, since the most commonly used printing material, at least to do the first printing step, is white, the first printing unit 17' can comprise, for example, at least two printing nozzles 23 configured to release this type of printing material, in order to make the first coat on the article 12 to be printed.

**[0058]** In forms of embodiment of the present invention, the printing material can be fed to the printing nozzles 23 by means of at least a pumping device, not shown in the attached drawings, configured to take the printing material from at least a corresponding tank 27.

**[0059]** In forms of embodiment described here, the printing apparatus 10 can comprise a plurality of tanks 27, located for example in a lower portion of the feed device 13, in order to reduce the bulk thereof.

**[0060]** In particular, each of the tanks 27 can contain a specific printing material, different from that contained in the others, and can be selectively connected, for example through one or more pipes, to each of the printing nozzles 23 of the printing heads 17' and 17'', configured to release that specific printing material (fig. 1).

**[0061]** In forms of embodiment described here, the printing heads 17' and 17'' can be selectively mobile vertically with respect to the work plane defined by the feed device 13.

**[0062]** In this way, when it is necessary to carry out the printing operation, the printing heads 17' and 17'' are lowered to take the printing nozzles 23 to the predetermined distance with respect to the articles 12 disposed on the belt 18, depending on their shape and size, so as to define the correct distance for delivering the printing material and to allow an optimal release of the printing material, for example in the form of drops, when the article 12 is located in correspondence to the printing heads 17' and 17''.

**[0063]** When the printing process has been completed, the printing heads 17' and 17'' can move away from the belt 18 and return to a non-operating position.

**[0064]** In forms of embodiment described here, the printing apparatus 10 can also comprise a command and control unit, not shown in the attached drawings, configured at least to command the movement of the printing heads 17', 17'' and determine their distance from the feed

device 13.

[0065] Moreover, the command and control unit can also be configured to detect the quantity and condition of the printing material sent to the printing nozzles 23.

[0066] For example, at least a level sensor can be connected to the command and control unit, configured to detect if in at least one of the tanks 27 the quantity of the printing material present is less than a pre-established value. The level sensors can be chosen from a group comprising, for example, optical sensors, magnetic sensors or floating sensors or suchlike.

[0067] In forms of embodiment of the present invention described with reference to figs. 1 and 2, the feed device 13 can also comprise one or more guide elements 28, configured to correctly position the support element 14 on the belt 18 if it should be in a position not to allow high precision of the printing process, for example because of the vibrations produced by the movement of the belt 18.

[0068] In forms of embodiment described here, the guide elements 28 can also be configured mobile in a direction substantially orthogonal to the direction of feed of the belt 18, so as to be able to adapt to the support elements 14 with different sizes.

[0069] In forms of embodiment of the present invention described with reference to fig. 1, when it is necessary to carry out printing, the support element 14, containing one or more articles 12, in this case two articles 12, can be disposed manually or automatically on the feed device 13, selectively activated by the motor 21, for example by means of the command and control unit.

[0070] In this way, the support element 14 can be made to advance in a continuous manner at a pre-fixed or adjustable speed, depending on the characteristics of the article 12 or the printing material.

[0071] Then, the feed device 13 can take the support element 14 into correspondence with the first printing head 17' (fig. 1).

[0072] In forms of embodiment described here, the printing material can be deposited continuously, that is, while the article 12 is in movement because it is transported by the belt 18.

[0073] The support material can be deposited by means of the selective lowering of the first printing head 17' toward the article 12.

[0074] In this way the first printing head 17' can determine the release onto the article 12 of at least a first layer of the printing material, for example comprising a base layer of white, and a graphical image formed by a combination of the primary colors, black, yellow, magenta or cyan, delivered by the respective printing nozzles 23.

[0075] Continuing the feed, the support element 14 can be transported by the belt 18 in correspondence to the drying unit 25, carrying out the drying, again continuously, and as a consequence, the attachment of the printing material on the articles 12a.

[0076] The support element 14 is then made to advance to the second printing head 17'' where, in the same way as described above, except for the delivery of white,

the second printing cycle is carried out.

[0077] Since the distance at which two successive trays 14 are positioned on the belt 18 substantially corresponds to the distance between the two printing heads 17' and 17'', at the moment when a first tray 14 is positioned in correspondence to the second printing head 17'' to carry out the second printing cycle, a second tray 14 is positioned in correspondence to the first printing head 17', in order to carry out the first printing cycle, as seen in fig. 2.

[0078] There is also a drying unit 25 downstream of the second printing unit 17'' that attaches the printing material on the article 12, determining the completion of the operation.

[0079] With the present invention it is therefore possible to deposit the printing material on the articles 12 in a sequential and continuous manner, avoiding the need to stop the belt 18 during the printing operation.

[0080] In other variant forms of embodiment, not shown in the attached drawings, if the graphical design to be reproduced on the article 12 is particularly complex, it is possible to provide the presence of more than two printing heads 17, for example three or more, disposed aligned in the direction of feed of the belt 18, each of which can be configured to determine the depositing and attachment of at least one layer of printing material on the article 12.

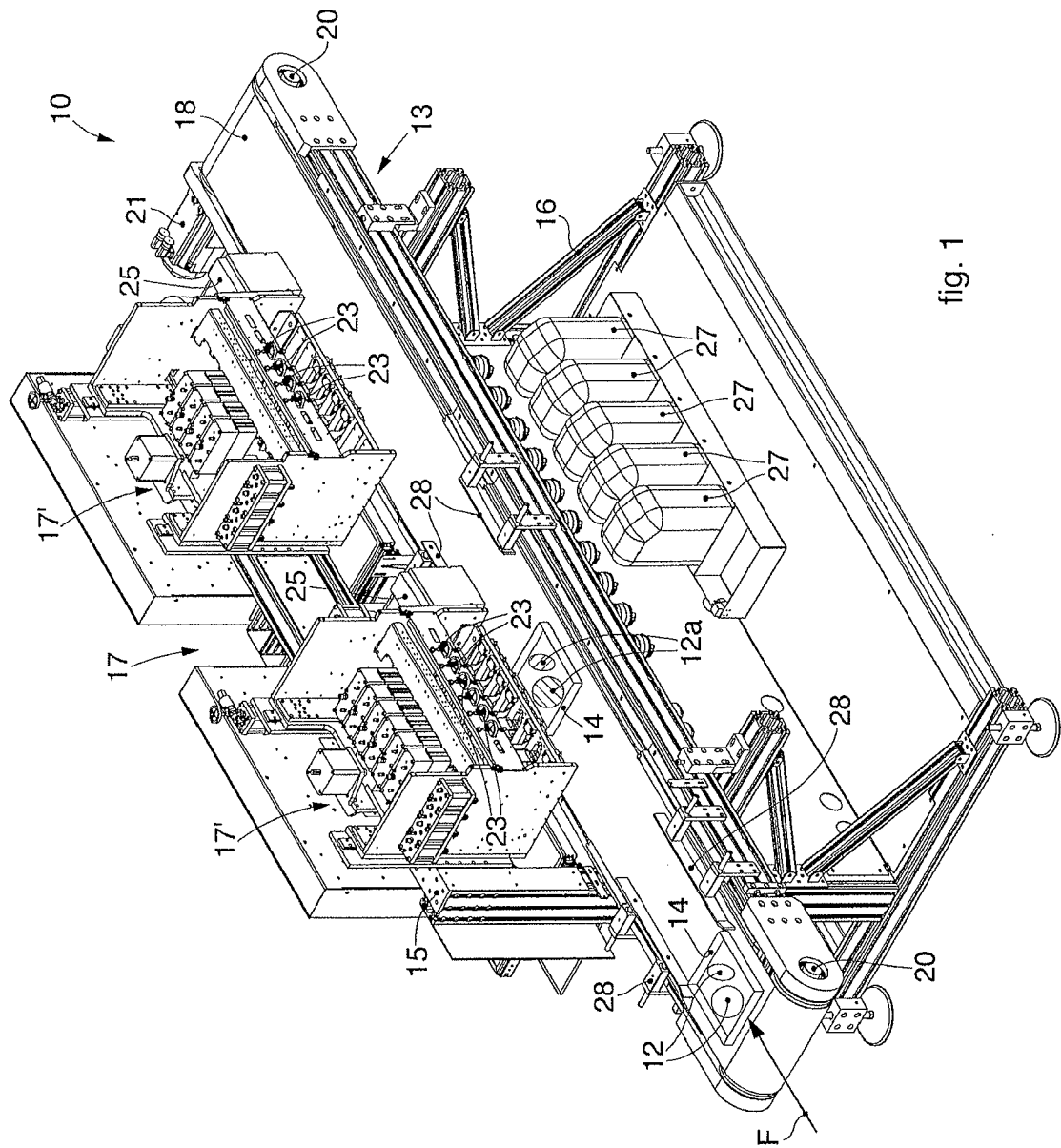
[0081] It is clear that modifications and/or additions of parts may be made to the apparatus 10 and corresponding as described heretofore, without departing from the field and scope of the present invention.

[0082] It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of apparatus 10 and corresponding method, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

## Claims

1. Printing apparatus for printing on at least one article (12), **characterized in that** it comprises at least two printing heads, respectively first (17') and second (17''), disposed aligned with respect to each other in a direction (F), and a feed device (13) suitable to feed the article (12) to be printed along the direction of alignment of the two printing heads (17, 17', 17''), so as to position said article (12) sequentially in co-operation with said two printing heads (17, 17', 17'').
2. Printing apparatus as in claim 1, **characterized in that** said first printing head (17') is configured to carry out at least a first basic printing and said second printing head (17'') is configured to carry out a finishing printing.

3. Printing apparatus as in claims 1 and 2, **characterized in that** said first printing head (17') comprises a plurality of delivery nozzles (23) among which at least one is suitable to deliver a background color to form the print base, and other nozzles (23) each suitable to deliver a respective primary color for the formation of the color during the first printing cycle. 5
4. Printing apparatus as in claim 3, **characterized in that** said second printing head (17'') comprises a plurality of nozzles (23) each suitable to deliver a respective primary color for the formation of the color during the second printing cycle. 10
5. Printing apparatus as in claim 3 or 4, **characterized in that** one or both of the two printing heads (17', 17'') comprise, downstream of the respective delivery nozzles (23), at least a drying device (25) configured to dry the color substantially instantaneously at exit from the respective printing pass. 15 20
6. Printing apparatus as in any claim hereinbefore, **characterized in that** said feed device (13) is a belt or mat (18) on which the articles (18) are positioned sequentially at a reciprocal distance that substantially corresponds to the distance between the two printing heads (17', 17''). 25
7. Printing apparatus as in any claim hereinbefore, **characterized in that** the two printing heads (17', 17'') are mounted on a common support structure (15) equipped with at least means which allow the simultaneous lowering/raising of the printing heads (17', 17'') in relation to the printing step in progress at that moment. 30 35
8. Printing apparatus as in any claim hereinbefore, **characterized in that** it comprises a command and control unit configured to at least selectively command the movement of said printing heads (17', 17'') toward/away from the article (12) during the printing process. 40
9. Method for printing on at least one article (12, 12a, 12b), **characterized in that** it provides to move said article (12, 12a, 12b) continuously by means of a feed device (13), through at least two printing heads (17', 17'') to respectively carry out a first basic printing operation and at least a second finishing printing operation, keeping said article (12, 12a, 12b) in movement along said printing heads (17', 17''). 45 50
10. Printing method as in claim 9, **characterized in that** it provides to carry out a substantially instantaneous drying cycle at exit of each of the printing heads (17', 17''), keeping said article (12, 12a, 12b) in movement. 55
11. Printing method as in claim 9 or 10, **characterized in that** it provides that two or more articles (12, 12a, 12b) are positioned on the feed device (13) at a distance substantially corresponding to the distance between said printing heads (17', 17'') so that when a second article (12b) is subjected to finishing printing in the second printing head (17'') a first article (12a) is subjected to basic printing in the first printing head (17').



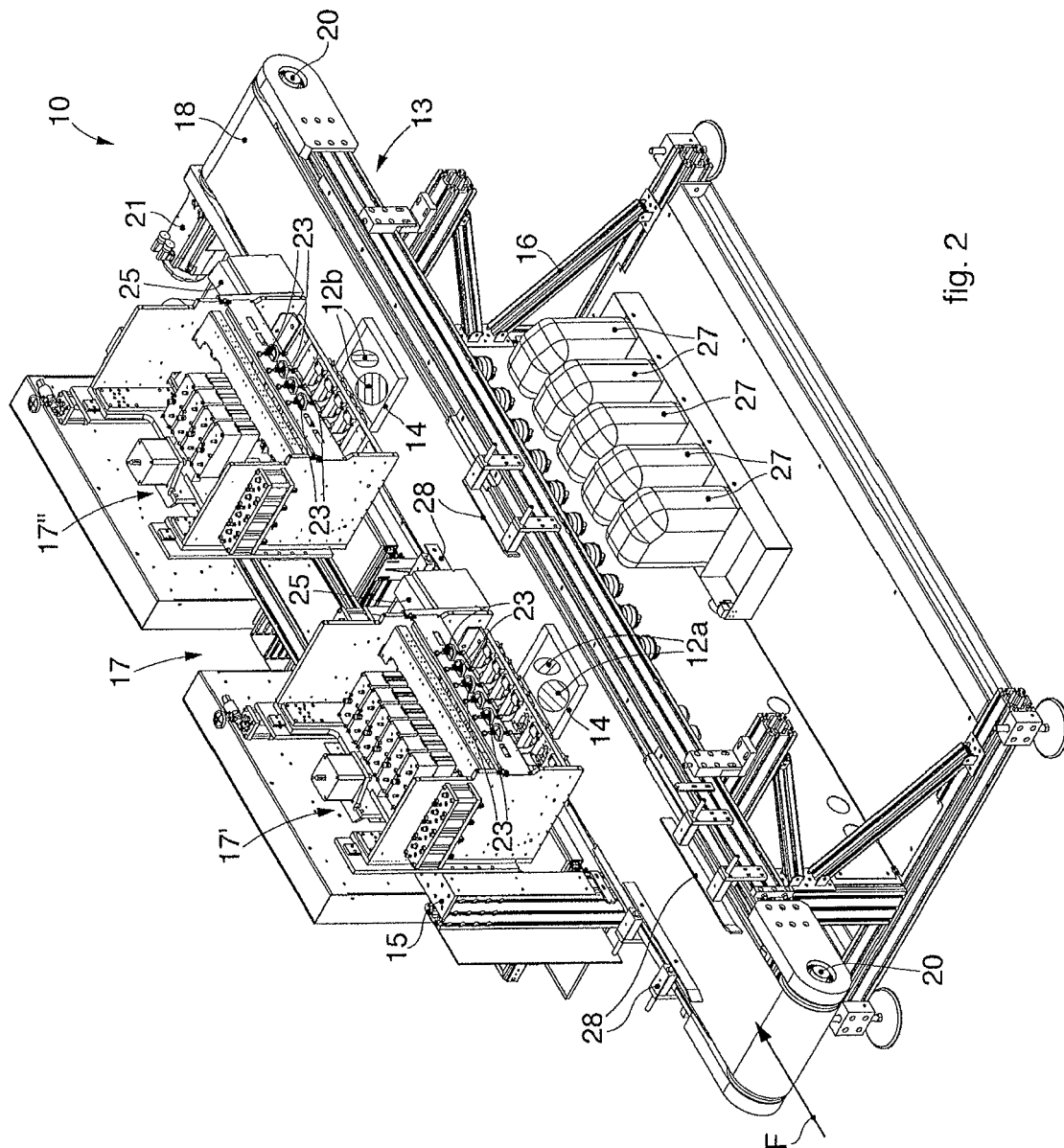


fig. 2





## EUROPEAN SEARCH REPORT

Application Number  
EP 15 16 8738

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Place of search The Hague		Date of completion of the search 29 September 2015	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			

EPO FORM 1503 03.92 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 15 16 8738

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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