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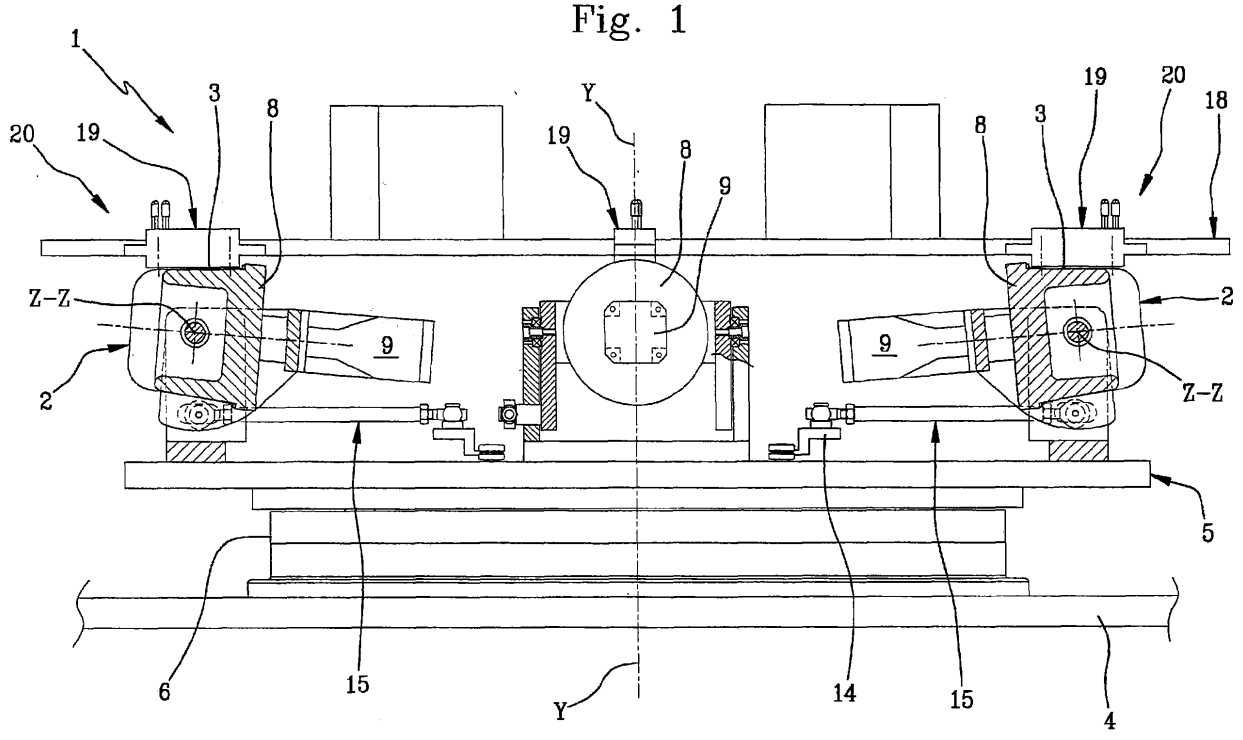
(54) **Apparatus and process for printing of cylindrical or conical surfaces**

(57) A process carried out with an apparatus (1) for printing of cylindrical or conical surfaces comprises the steps of: disposing a plurality of plastic containers (2) having each a cylindrical or conical surface (3) to be decorated, on respective supports (8) carried by a rotating table (5); bringing the supports (8) and containers (2) in succession to a plurality of printing stations (20), in each of which the cylindrical or conical surface (3) faces an ink-jet print head (19); in each printing station (20), setting each support (8) and the respective container (2) in rotation about a rotation axis (X-X) while the print head (19) is delivering ink onto the cylindrical or conical surface (3).

Fig. 1



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Description

[0001] The present invention relates to an apparatus and a process for printing of cylindrical or conical surfaces.

[0002] In particular, the invention advantageously applies, although not in a limiting sense, to surface decoration of containers suitable for food packaging, such as packaging of cheeses and yoghurts, or pharmaceutical, chemical and cosmetic products, but also to surface decoration of bigger containers designed to hold paints for display or sale, for example.

[0003] Said packages on their outer surface reproduce information relating to the product, or decorations/images aiming at tempting the consumer to buy it.

[0004] These packages usually comprise a container obtained from moulding of plastic material (polypropylene, for example) or made of metal or paper material and having a cylindrical or frustoconical shape, and a lid for closing the container.

[0005] According to a known method, decorations of the outer surface of said containers are carried out through offset lithography printing, or indirect printing, according to which the ink is taken from a matrix (plate) to a rubber roller and therefrom to the cylindrical or conical side surface of the container.

[0006] To lay down more than one colour, different passes are to be carried out, each with a different plate. The plates must be prepared based on the image to be transferred and therefore offset printing is suitable when big amounts of containers (greater than 30,000 units) are to be decorated, so as to enable the plate cost to be widely amortised.

[0007] In fact, for each variation of the image to be transferred and/or of the container format, the plates are to be done all over again, then it is necessary to carry out replacement of same on the plant, and repeat the starting procedures, aligning each individual colour again and checking the exactitude of the process through printing of a number of test units at each individual alignment adjustment. This process may even take different hours depending on the printing plant and the number of colours.

[0008] The offset printing of known type therefore is not at all convenient if the lot of the containers to be decorated is less than 30,000 units.

[0009] In accordance with a further method known as IML method (IML being an acronym for "In Moulding Labelling"), first a label is prepared (made and decorated), then said label is inserted into the mould designed to form each container. During moulding of the plastic material, the label adheres to the moulded material and becomes part of the container itself. This method is expensive and relatively slow because it consists of several steps: production of the label, decoration of same and insertion into a mould for each container produced with such a mould.

[0010] It is an aim of the present invention to obviate the above mentioned drawbacks, by providing an apparatus and a process for printing of cylindrical or conical surfaces which are flexible and can be easily adapted to the different formats of the containers to be decorated and to the different images to be laid thereon.

[0011] It is another aim of the present invention to propose an apparatus and a process for printing of cylindrical or conical surfaces enabling more detailed and complicated drawings to be executed than those obtained with known techniques.

[0012] In accordance with the present invention, the foregoing and still further aims are achieved by an apparatus for printing of cylindrical or conical surfaces comprising a plurality of working stations, at least one of said working stations being a printing station and comprising an ink-jet printing device provided with at least one print head;

- a plurality of supports for articles, each of said articles having a cylindrical or conical surface to be decorated;
- first actuating means to bring the supports in succession to each of said working stations, in the printing station the cylindrical or conical surface to be decorated facing the print head;
- second actuating means to rotate each of the supports around a rotation axis thereof at least when the support is in the printing station, so as to decorate said surface during rotation of the article.

[0013] Preferably, the apparatus comprises a plurality of printing stations for application of different inks in succession onto the cylindrical or conical surface. Preferably, the apparatus further comprises means for adjusting the distance between the support and the print head, so as to enable decoration of articles with different sizes.

[0014] Preferably, the apparatus further comprises means for adjusting the inclination of the support relative to the print head, to enable decoration of articles with different conicity.

[0015] Preferably, the plurality of working stations has a station for treatment of the cylindrical or conical surface, preferably for a "corona" treatment, disposed upstream of said at least one printing station, in order to improve adhesion between said surface and the ink.

[0016] Preferably, the plurality of working stations has a station for drying the decorated cylindrical or conical surface, which is disposed downstream of said at least one printing station and preferably including a UV lamp.

[0017] Preferably, the apparatus further comprises auxiliary drying devices, preferably of the UV type, disposed in each printing station or between printing stations in succession.

[0018] Preferably, the apparatus further comprises a station for loading the articles to be decorated on the supports, placed upstream of the working stations, and a station for unloading the decorated articles from the supports, placed downstream of the working stations.

[0019] Preferably, the first actuating means comprises

a table turning about a respective rotation axis and a motor operatively in engagement with the table, to determine an intermittent rotation of said table; the supports being mounted on said table and the print heads facing said table and being disposed along a path substantially in the form of an arc of a circle.

[0020] Preferably, the second actuating means comprises a plurality of motors, each of them being operatively in engagement with a respective support in order to determine a continuous rotation of said support about the rotation axis thereof.

[0021] Preferably, the distance-adjusting means comprises a frame carrying the heads and facing a table carrying the supports; said frame being translatable close to or away from the table and lockable relative to said table, based on the selected distance.

[0022] Preferably, the inclination-adjusting means comprises: a plurality of elements, each carrying a respective support and a respective motor and rotatably in engagement with a table; a plurality of transmission rods, each having one end pivotally mounted on said element and an opposite end pivotally mounted on a driving ring; in which the driving ring is rotatable relative to the table and lockable relative to said table, based on the selected inclination.

[0023] Preferably, the supports are mounted on the apparatus in a releasable manner, to enable servicing or replacement of said supports with others, based on the format of the article to be decorated.

[0024] Preferably, the supports comprise suction means to retain the article on each support.

[0025] Preferably, the supports comprise blowing means to move the article away from the support.

[0026] Preferably, the apparatus further comprises at least one device for printing control and a possible device for automatic elimination of faulty articles.

[0027] In accordance with a further aspect of the present invention, the above mentioned aims and still others are achieved by a process for printing of cylindrical or conical surfaces, comprising the steps of:

- disposing a plurality of articles, each having a cylindrical or conical surface to be decorated, on respective supports;
- bringing the supports and the articles in succession to at least one printing station in which the cylindrical or conical surface faces an ink-jet print head;
- at least in said printing station, setting each support and the respective article in rotation about a rotation axis while the print head is delivering ink onto said cylindrical or conical surface.

[0028] Preferably, the cylindrical or conical surface is a rotation surface and the generatrix of said surface preferably is a straight line.

[0029] Preferably, the articles are cup-shaped containers.

[0030] Preferably, the articles are made of plastic material, preferably polyethylene.

[0031] Preferably, the articles are brought in succession to a plurality of printing stations to apply different inks thereto.

[0032] Preferably, before printing, the cylindrical or conical surface is submitted to a treatment, preferably a "corona" treatment, for improving adhesion between said surface and the ink.

[0033] Preferably, after printing, the cylindrical or conical surface is submitted to a drying step, preferably of the UV type.

[0034] Preferably, during each printing step or between a printing step and the following one, the cylindrical or conical surface is submitted to an auxiliary drying step, preferably of the UV type.

[0035] Preferably, before bringing the supports and articles in succession to said at least one printing station, inclination of the support relative to the print head is adjusted so as to enable articles with different conicity to be decorated.

[0036] Preferably, before bringing the supports and articles in succession to said at least one printing station, the distance between the support and print head is adjusted, so as to enable articles with different sizes to be decorated.

[0037] Preferably, before bringing the supports and articles in succession to said at least one printing station, said supports are replaced by other supports that are selected based on the format of the article to be decorated.

[0038] Preferably, the articles are loaded in succession and one at a time at a loading station wherein they are loaded on the respective supports.

[0039] Preferably, the articles are unloaded in succession and one at a time at an unloading station where they are unloaded from the respective supports.

[0040] Preferably, the process further comprises the step of controlling the printing quality obtained at the end.

[0041] The present invention will be now described with reference to the accompanying drawings, illustrating a preferred but not exclusive embodiment of an apparatus for printing of cylindrical or conical surfaces, in which:

- Fig. 1 is an elevation side view of an apparatus for printing of cylindrical or conical surfaces in accordance with the present invention;
- Fig. 2 is a plan view of the apparatus seen in Fig. 1;
- Fig. 3 is a perspective view of a portion of the apparatus shown in Figs. 1 and 2;
- Fig. 4 is a first perspective view of an enlarged element being part of the apparatus seen in the preceding figures;
- Fig. 5 is a second perspective view of the element shown in Fig. 4; and
- Fig. 6 is a side view of the element seen in Figs. 4 and 5.

[0042] With reference to Fig. 1, an apparatus for print-

ing of cylindrical or conical surfaces in accordance with the present invention has been generally identified by reference numeral 1.

[0043] In the present specification and in the claims, by the term "printing" it is intended laying of inks for obtaining decorations, inscriptions, images, etc. The technology used in the present invention is an ink-jet printing, known by itself. The devices for ink-jet printing, or digital printing, are governed and controlled by an electronic unit provided with a suitable software.

[0044] In the present specification and in the claims, the term "cylindrical surfaces" generally means those surfaces that are generated from a first curve that, remaining parallel to itself, moves along a second closed plane curve.

[0045] In the present specification and in the claims, the term "conical surfaces" generally means those surfaces generated from a first curve passing through a fixed point by moving along a second closed plane curve.

[0046] Apparatus 1 is intended for printing of articles 2 having said cylindrical or conical surfaces 3. These articles 2 preferably are cup-shaped containers for packaging foods, such as yoghurts, cheeses, etc., or other substances such as chemical, pharmaceutical, cosmetic products or paints. The side surface to be printed of said containers 2 is preferably a rotation surface (a surface obtained through rotation of a curve, known as generatrix, around a straight line, referred to as rotation axis) having a straight line as the generatrix.

[0047] In addition, containers 2, and of course their cylindrical or conical outer surfaces therewith, are made of plastic material, preferably polyethylene, or of metal or paper material.

[0048] Preferably, apparatus 1 is intended for printing of the cylindrical or conical outer surface of plastic containers 2.

[0049] Apparatus 1 comprises a base 4, on which a table 5 of circular shape is installed, which table can rotate relative to base 4 around a vertical axis "Y-Y" orthogonal to table 5 and passing through the centre of same. To this aim, table 5 is installed on guides 6 mounted on base 4 and is operatively engaged with an electric motor 7 adapted to determine rotation thereof.

[0050] Mounted on table 5, along a circular path concentric with axis "Y-Y" are supports 8, each of which is able to receive and retain a respective container.

[0051] In the embodiment shown, table 5 carries ten supports 8 that are disposed angularly spaced apart from each other (one every 36°) around axis "Y-Y". Table 5 and motor 7 define first actuating means for supports 8.

[0052] Each support 8 has a portion the shape of which substantially matches that of an inner wall of container 2, so that container 2 is fitted on support 8 and retained thereon, preferably with the aid of suction means, not shown, adapted to create the vacuum between container 2 and support 8. In the embodiment shown, support 8 has a cylindrical or conical side surface suitable for engagement against an inner surface of container 2.

[0053] Supports 8 are symmetrical to axis "Y-Y" and are turned towards the outside of table 5, i.e. they are disposed facing away relative to said axis "Y-Y".

[0054] Each support 8 further has a rotation axis "X-X" that when carrying a container 2, is coincident with the axis of symmetry or revolution of the cylindrical or conical surface 3 of container 2. These axes "X-X" mutually intersect at axis "Y-Y" of table 5.

[0055] Motors 9, dedicated each to a respective support 8, enable rotation of each of the containers 2 carried by supports 8 about the respective axis "X-X". Motors 9 define second actuating means for supports 8.

[0056] In more detail, with reference to the accompanying drawings, apparatus 1 comprises a plurality of U-shaped elements 10, one for each support 8.

[0057] Each U-shaped element 8 has two side plates 11 and a central connecting plate 12. Support 8 is installed between the two side plates 11 and is engaged through the central plate 12 to the shaft of a respective electric motor 9. The axis of said shaft is coincident with the rotation axis "X-X" of said support 8. Motor 9 is fastened to the central plate 12 on the side opposite to support 8.

[0058] Each U-shaped element 10 is in turn rotatably installed between two brackets 13 rigidly connected to table 5. In particular, each side plate 11 is hinged on one of brackets 13. Support 8, and motor 9 therewith, as well as the U-shaped element 10 are rotatable about a respective axis "Z-Z" that is tangent to a circumference concentric with axis "Y-Y" of table 5. Support 8 together with container 2 can be rotated relative to the U-shaped element about axis "X-X" of motor 9.

[0059] To cause rotation of support 8 about the respective axis "Z-Z", apparatus 1 comprises a driving ring 14 mounted on table 5 and concentric with axis "Y-Y". Ring 14 can be rotated relative to table 5 and locked to the selected position relative to said table, either automatically or manually.

[0060] Apparatus 1 further comprises a plurality of transmission rods 15, as many rods as the supports 8. Each transmission rod 15 has one end 15a hinged on ring 14 and the opposite end 15b hinged on one of the said plates 11, at a point spaced from the rotation axis of support 8. Each rod 15 is disposed along a non-radial direction that is substantially tangent to ring 14.

[0061] As a result, rotation of ring 14 relative to table 5 gives rise to an angular displacement of each of the supports 8 around their axis "Z-Z". The driving ring 14 together with the U-shaped elements 10 and the transmission rods 15, therefore define means for adjusting the inclination "α" of supports 8.

[0062] In the embodiment shown (Figs. 4, 5 and 6), rod 15 is hinged on a pivot 16 integral with one of the side plates 11 and passing through an elongated hole 17 formed in one of brackets 13, the shape of which is adapted to allow angular displacement of support 8.

[0063] Apparatus 1 further comprises a frame 18 disposed above table 5 from which it is spaced apart, said

frame 18 carrying a plurality of ink-jet print heads 19. Heads 19 lie on supports 8 along the same circular path concentric with axis "Y-Y" and they face table 5.

[0064] Each of the print heads 19 is part of an ink-jet printing device controlled and driven by an electronic unit, not shown.

[0065] Heads 19 are mounted in a fixed manner on frame 18 and frame 18 can be moved in a vertical direction, i.e. along axis "Y-Y", to adjust the distance of said heads 19 from table 5. Frame 18 and heads 19 on the contrary, cannot be rotated about axis "Y-Y". Each head 19 identifies a printing station 20 and is designed to deliver a single type of ink. The movable frame 18 therefore is part of the means for adjusting the distance of said heads 19 from axes "X-X" of supports 8.

[0066] In the embodiment shown, the apparatus comprises six print heads 19 disposed in succession along an arc of the above mentioned circular path. Four out of six heads carry out printing following a four-colour process and therefore deliver the following base colours: cyan, magenta, yellow and black. The two other heads 19 can deliver other specific colours as required by the customer (spot colours) that can be hardly reproduced by the combination of the four base colours of the process. In accordance with other embodiments not shown, the number of the heads and colours can be different (following a three-colour process, a six-colour process, etc., possibly with one or more spot colours).

[0067] Heads 19 have a face provided with nozzles, not shown, that during printing has to be maintained close (0.5-1 mm) to the cylindrical or conical surface 3 of article 2. The nozzles mainly extend along a longitudinal direction that must be maintained parallel to the generatrix of said surface 3 facing the head 19.

[0068] Apparatus 1 further comprises a loading station 21 for loading the containers 2 to be printed on the supports 8 of table 5 and an unloading station 22 for unloading them from the said supports 8, after printing. The two stations 21, 22 lie in side by side relationship and are disposed on the circular path concentric with axis "Y-Y" (Fig. 2).

[0069] The loading station 21 comprises a first magazine 23 that is fixed relative to base 4 and faces table 5. In the first magazine 23 containers 2 waiting for being loaded on supports 8, are disposed into each other so as to form a stack having a symmetry axis intersecting the rotation axis "Y-Y" of table 5. One end of the first magazine 23 is disposed close to table 5 and at this end there are loading members, not shown, adapted to pick up the first container 2 disposed on top of said end and to take it onto a respective support 8.

[0070] The unloading station 22 comprises a second magazine 24 that is fixed relative to base 4 and faces table 5. In the second magazine 24 the containers 2 already printed and unloaded from supports 8, are disposed into each other to form a stack having a symmetry axis intersecting the rotation axis "Y-Y" of table 5. One end of the second magazine 24 is disposed close to table 5 and at this end there are picking-up members not shown adapted to pick up the first container 2 from the respective support 8 and place it on top of the end of the second magazine 24.

[0071] Both the first and second magazines 23, 24 can be such inclined that the symmetry axis of the stack of containers 2 is coincident with axis "X-X" of the supports 8 placed in the loading 21 and unloading 22 stations, respectively.

[0072] Disposed between the loading station 21 and a first printing station 20 is a station 25 in which containers 2 are submitted to a treatment adapted to increase wettability of their plastic surface (in particular the only cylindrical or conical surface 3 designed to be printed), so as to improve adhesion between the plastic material and the ink layer that is wished to be applied.

[0073] In said treatment station 25 a "corona" treatment is carried out, which is known by itself and utilises the particular properties of the corona discharge characterised by high voltage, high voltage gradient and electric insulation between electrode and counterelectrode. In this manner a discharge without electric arc is obtained that generates a strongly ionised air flow, capable of polarising the molecules of the surface being treated. Thus an affinity is established with the polar groups present in the inks which adhere to the surface.

[0074] Finally, a drying station 26 is installed between the last printing station 20 and the unloading station 22, said drying station preferably comprising one or more UV lamps designed to dry the ink laid on containers 2 by the print heads 19. The UV lamps can be installed on frame 18 carrying heads 19, for example.

[0075] Further auxiliary drying devices (LED UV lamps, for example), not shown, can be installed in the printing stations 20 or between the printing stations 20 in succession. In accordance with an alternative embodiment, the UV lamps can be positioned on table 5 under each support 8, so as to dry the ink also during travel from a printing station 20 to the following one.

[0076] Apparatus 1 can further comprise at least one device for printing control, disposed downstream of the printing stations and/or between one working station and the subsequent one. This device can be for example managed by the electronic unit operating the whole apparatus 1 so as to enable automatic discarding of the printed containers 2 that should be faulty and accumulation of same in a suitable magazine.

[0077] The loading station 21, unloading station 22 and eight working stations (one 25 for treatment, six 20 for printing and one 26 for drying) are disposed angularly spaced apart (ten stations in all, one every 36°) around the rotation axis "Y-Y" of table 5.

[0078] Advantageously, also in the presence of a number of working stations different from that stated, the number of supports 8 on table 5 is equal to the number of the working stations plus the two loading 21 and unloading 22 stations. In this way, the stations work simultaneously because, except for a starting transient, there

is always a container 2 in each of them.

[0079] In use, before starting printing, the supports 8 adapted to accept the containers 2 to be decorated are mounted on the shafts of motors 9 installed on the U-shaped elements 10.

[0080] Based on the conicity of the outer surface 3 of containers 2, ring 15 is adjusted in such a manner that the surfaces 3 of all containers 2 facing heads 19 are parallel to the respective head faces provided with nozzles.

[0081] Frame 18 is displaced until bringing heads 19 to a suitable distance "d" (0.5-1 mm) for printing, from the surfaces 3 of all containers 2.

[0082] Apparatus 1 is started after the first magazine 23 has been filled.

[0083] Motor 7 causes rotation of table 5 with an intermittent motion according to an angular step of table 5 through 36°, so as to displace supports 8 between one station 20, 21, 22, 25, 26 and the subsequent one 20, 21, 22, 25, 26. After each angular step, table 5 remains stationary for a time sufficient to carry out the respective working operations in each station. In particular, the necessary time must be that required for carrying out the "corona" treatment, laying the ink layers and drying the executed print.

[0084] Each individual support 8 first receives a container 2 in the loading station 21. By a subsequent angular step of table 5, this support 8 and container 2 are moved to the treatment station 25 where the cylindrical or conical surface 3 is submitted to a "corona" treatment. Simultaneously, in the loading station 21 another container 2 is loaded on the following support 8. By six subsequent angular steps, support 8 and container 2 are brought to the six printing stations 20. In each of the printing stations 20, the respective head 19 delivers an ink, while support 8 and container 2 are rotating with a continuous motion about their axes "X-X". The printed container 2 then by a further angular step reaches the drying station 26 where the container is dried by UV radiation. Finally, in the unloading station 22, container 2 is ejected towards the second magazine 24, preferably through blowing means, not shown, capable of moving container 2 away from support 8. The suction means and blowing means comprise a pneumatic circuit with nozzles that for example open onto support 8 and within the volume delimited by the container 2 fitted on said support 8. Said blowing means can also be used for automatically ejecting the faulty containers 2 once for example the drying station 26 has been reached.

[0085] Although in the embodiment herein shown and described in detail, supports 8 are moved by the rotating table 5, in accordance with other embodiments not shown but falling at all events within the scope of the present invention, supports 8 can be moved differently, through a linear handling device carrying out a translation movement under the print heads, for example.

[0086] The present invention reaches the intended purposes and achieves important advantages.

[0087] First of all, the present invention allows quick and easy passage from printing containers having a predetermined format (sizes, conicity and shape) to other containers with a different format. Preferably, the apparatus is able to manage containers with diameters included between about 30 mm and about 140 mm and a conicity included between about 0° and about 15°. The machine stopping time has a very short duration because it is sufficient to change the supports and adjust the inclination of same as well as their distance from the heads. In addition, the possibility of dismantling the supports ensures an easy maintenance of the apparatus.

[0088] The apparatus further allows the image to be printed to be changed through software, the connected operations being greatly simplified since new preparation of the plates is not required, which plates are on the contrary used in the offset lithography printing.

[0089] Since printing is of the ink-jet type and is obtained by a digital system, the quality of the printed images is greatly improved too and complexity is reduced, as compared with traditional printing.

Claims

1. An apparatus for printing of cylindrical or conical surfaces, comprising:

   - a plurality of working stations (20, 25, 26), at least one of said working stations (20, 25, 26) being a printing station (20) and comprising an ink-jet printing device provided with at least one print head (19);
   - a plurality of supports (8) for articles (2), each of said articles (2) having a cylindrical or conical surface to be decorated;
   - first actuating means to bring the supports (8) in succession to each of said working stations (20, 25, 26), in the printing station (20) the cylindrical or conical surface (3) to be decorated facing the print head (19);
   - second actuating means to rotate each of the supports (8) around a rotation axis (X-X) thereof at least when the support (8) is in the printing station (20), so as to decorate said surface (3) during rotation of the article (2).

2. An apparatus as claimed in claim 1, comprising a plurality of printing stations (20) for application of different inks in succession onto the cylindrical or conical surface (3).

3. An apparatus as claimed in claim 1, further comprising means for adjusting the distance between the support (8) and the print head (19), so as to enable decoration of articles (2) with different sizes.

4. An apparatus as claimed in claim 1, further compris-

ing means for adjusting the inclination of the support (8) relative to the print head (19), to enable decoration of articles (2) with different conicity.

5. An apparatus as claimed in claim 1, wherein the first actuating means comprises a table (5) turning about a respective rotation axis (Y-Y) and a motor (7) operatively in engagement with the table (5), to determine an intermittent rotation of said table (5); the supports (8) being mounted on said table (5) and the print heads (19) facing said table (5) and being disposed along a path substantially in the form of an arc of a circle.

6. An apparatus as claimed in claim 1, wherein the second actuating means comprises a plurality of motors (9), each of them being operatively in engagement with a respective support (8) in order to determine a continuous rotation of said support (8) about the rotation axis (X-X) thereof.

7. An apparatus as claimed in claim 3, wherein the distance-adjusting means comprises a frame (18) carrying the heads (19) and facing a table (5) carrying the supports (8); said frame (18) being translatable close to or away from the table (5) and lockable relative to said table (5), based on the selected distance.

8. An apparatus as claimed in claim 4, wherein the inclination-adjusting means comprises:

- a plurality of elements (10), each carrying a respective support (8) and a respective motor (9) and rotatably in engagement with a table (5); a plurality of transmission rods (15), each having one end (15b) pivotally mounted on said element (10) and an opposite end (15a) pivotally mounted on a driving ring (14); in which the driving ring (14) is rotatable relative to the table (5) and lockable relative to said table (5), based on the selected inclination.

9. A process for printing of cylindrical or conical surfaces, comprising the steps of:

- disposing a plurality of articles (2), each having a cylindrical or conical surface (3) to be decorated, on respective supports (8);
- bringing the supports (8) and the articles (2) in succession to at least one printing station (20) in which the cylindrical or conical surface (3) faces an ink-jet print head (19);
- at least in said printing station (20), setting each support (8), and the respective article (2), in rotation about a rotation axis (X-X) while the print head (19) is delivering ink onto said cylindrical or conical surface (3).

10. A process as claimed in claim 9, wherein the articles (2) are made of plastic material, preferably polyethylene.

11. A process as claimed in claim 9, wherein the articles (2) are brought in succession to a plurality of printing stations (20) to apply different inks thereto.

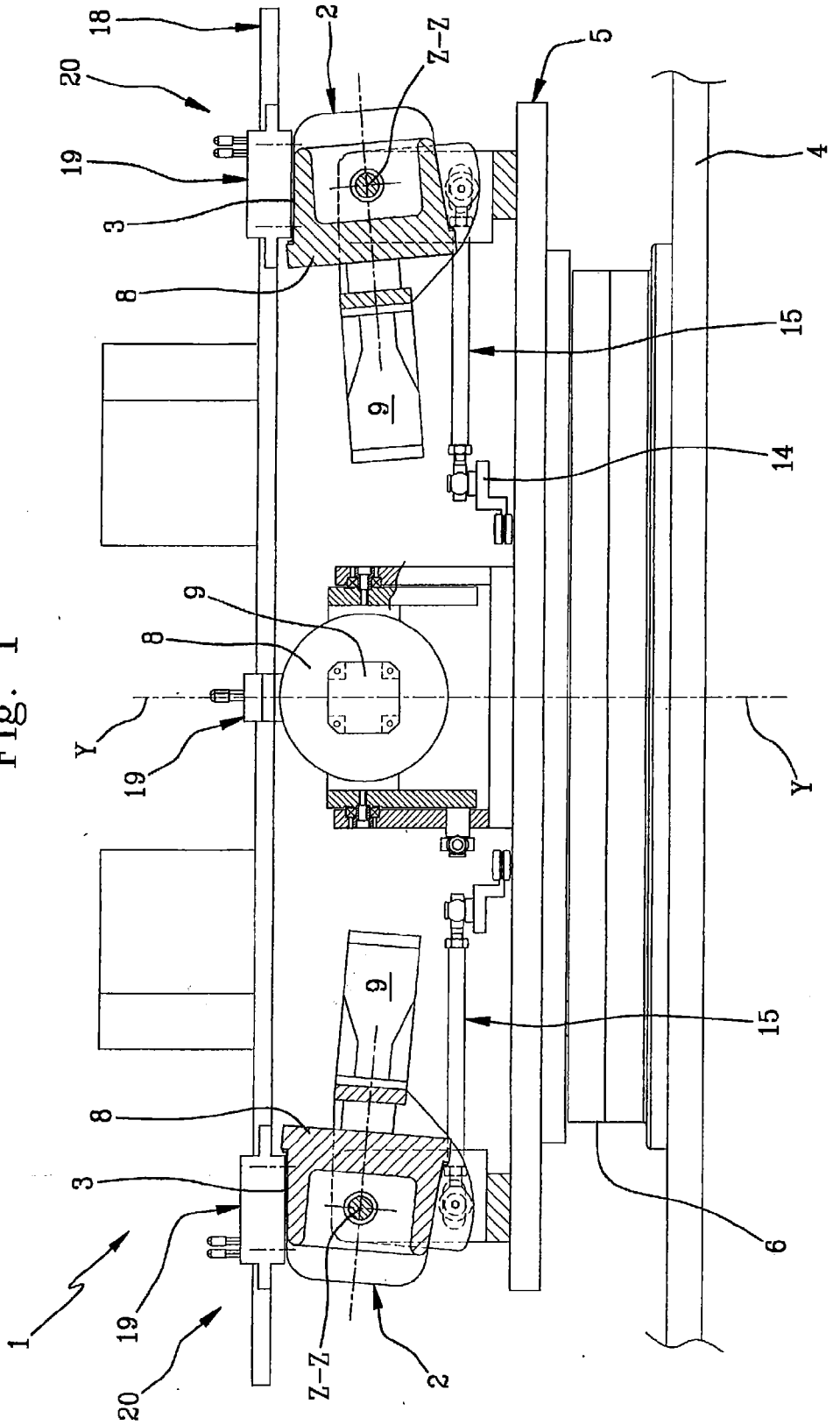
12. A process as claimed in claim 9, wherein before printing, the cylindrical or conical surface (3) is submitted to a treatment, preferably a "corona" treatment, for improving adhesion between said surface (3) and the ink.

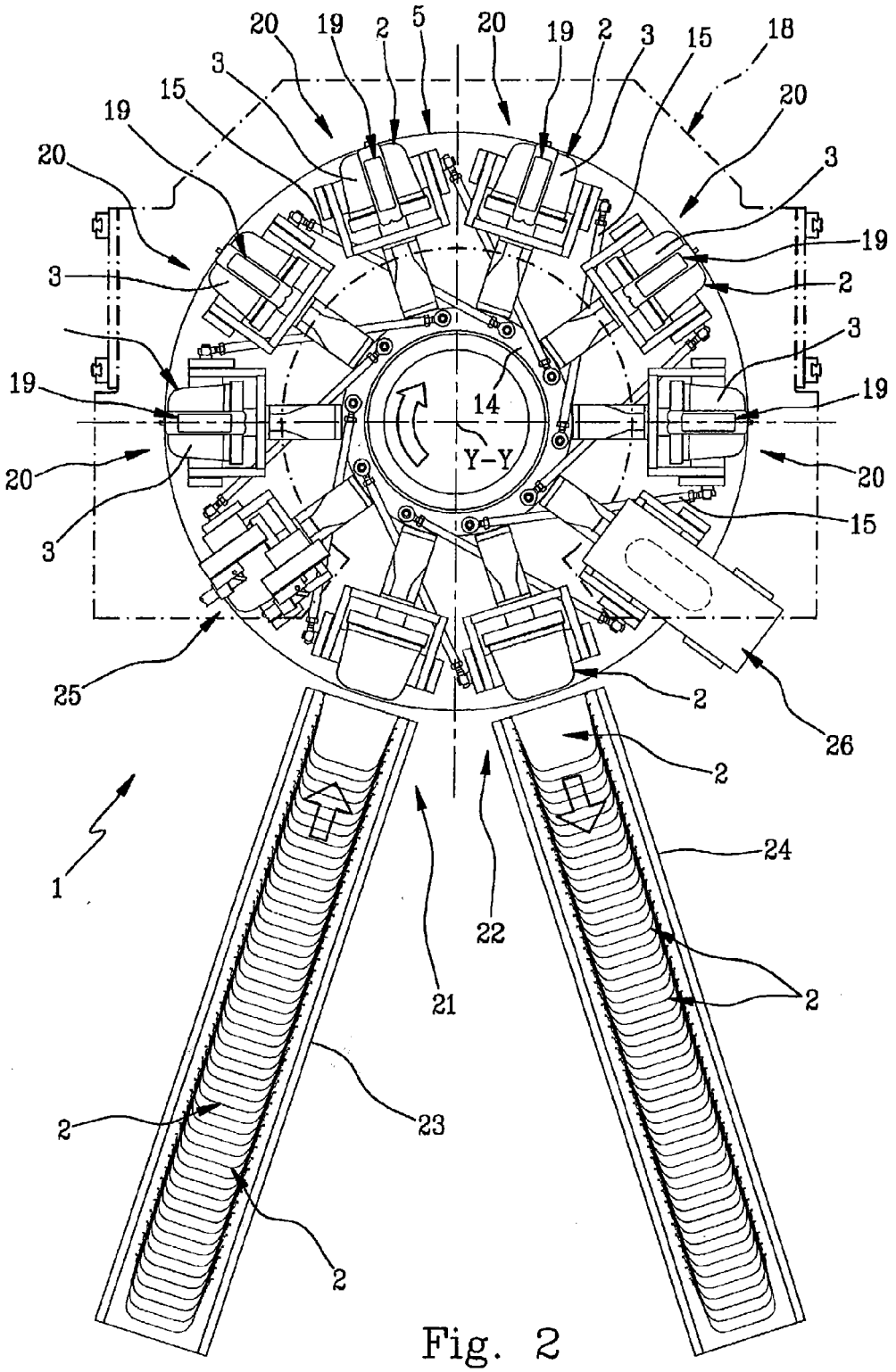
13. A process as claimed in claim 9, wherein before bringing the supports (8) and articles (2) in succession to said at least one printing station (20), inclination of the supports (8) relative to the print head (19) is adjusted so as to enable articles (2) with different conicity to be decorated.

14. A process as claimed in claim 9, wherein before bringing the supports (8) and articles (2) in succession to said at least one printing station (20), the distance between the supports (8) and the print head (19) is adjusted, so as to enable articles (2) with different sizes to be decorated.

15. A process as claimed in claim 9, wherein before bringing the supports (8) and articles (2) in succession to said at least one printing station (20), said supports (8) are replaced by other supports that are selected based on the format of the article (2) to be decorated.

Fig. 1

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2

Fig. 2

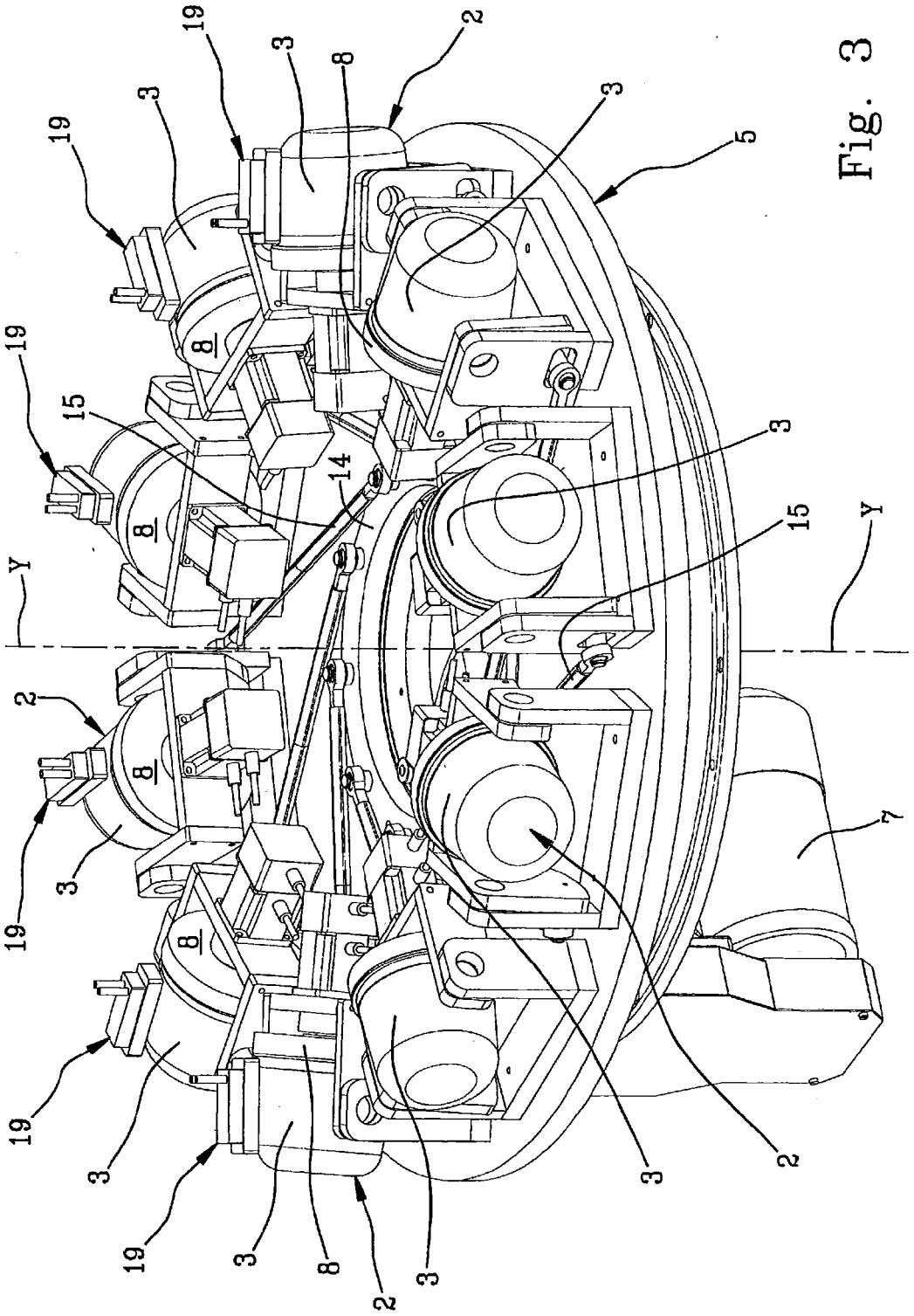

Fig. 3

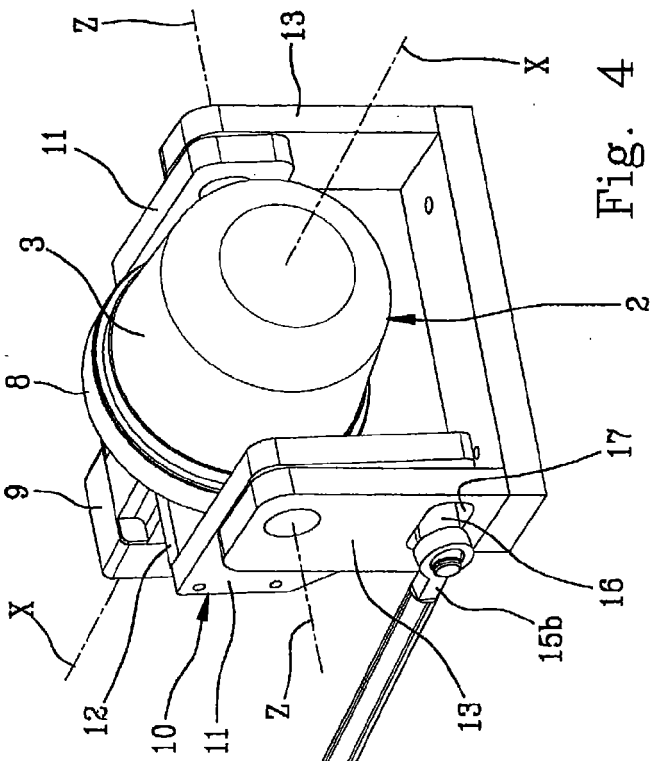
Z
13
X
11
3
2
8
17
9
16
X
15b
12
10
11
Z
13

Fig. 4

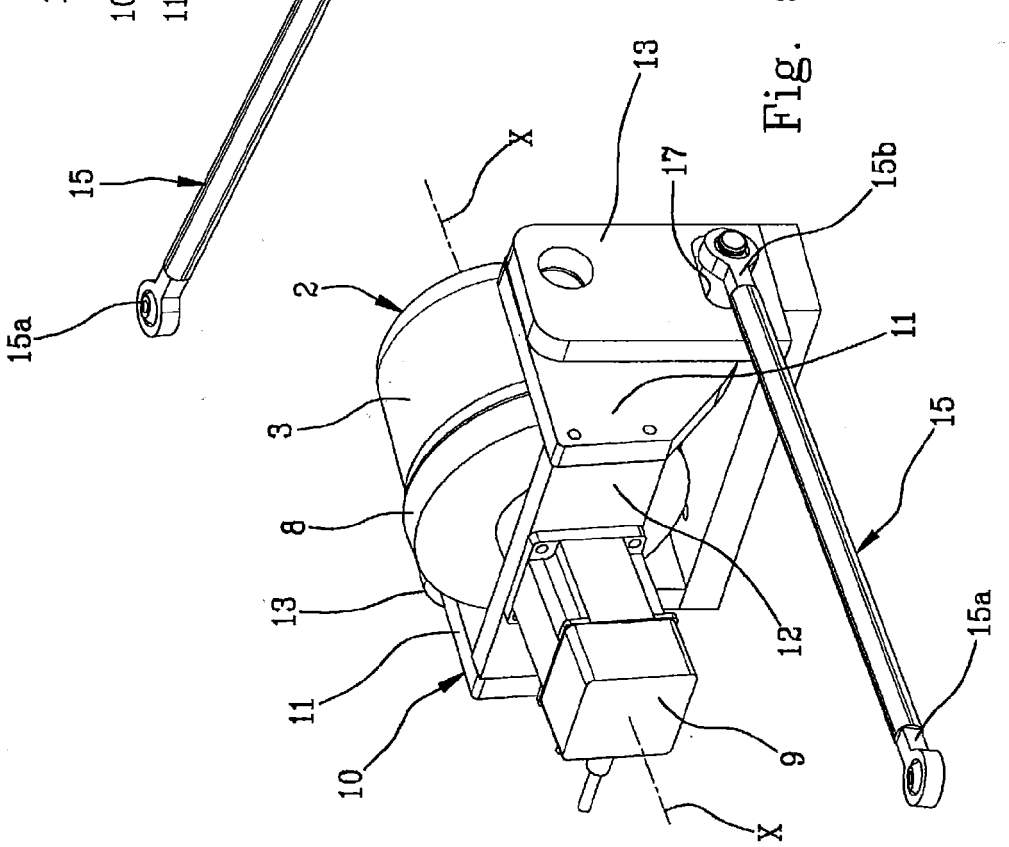
15
15a
13
X
17
15b
2
11
3
15
8
12
13
15a
11
9
10
X

Fig. 5

Fig. 6