A digital decorator (1) for printing on ceramic articles (11) comprises a conveyor (2) for carrying ceramic articles (11) and a printing unit (10) which is arranged above said conveyor (2) and includes a plurality of print heads (3).

The printing unit (10) is movable between a lower operational position, in which the print heads (3) can perform printing on the articles (11) carried by the conveyor (2), and an upper maintenance position, the print heads (3) being movable within the decorator (1) between a retracted operational position, wherein they lie in a reference plane (P), and an extended access position in which they project out from the reference plane.

Fig. 7
Description

[0001] Disclosed is herein a digital decorator with improved maintenance mode. Machines are known for printing of decorations on ceramic tiles, based on inkjet technology, which decorating machines are of the digital type.

[0002] In other words, such machines require the use of print heads similar in design to those used for printing on paper in common PC printers. Machines of the known type include a printing head arranged above a conveyor, said conveyor being predisposed for moving forward the ceramic articles to be decorated.

[0003] On "single pass" decorators, the printing unit includes print heads which are stationary and grouped by color on conveyor lines arranged transversely with respect to the forward direction of the conveyor.

[0004] In detail, two parallel rows of print heads are fitted in respective support plates, in turn hold by a metal frame.

[0005] When performing a four-colors printing, four plates are then generally arranged in the printing unit, in each of which two parallel rows of print heads are mounted, which print heads are fed with ink of the same color.

[0006] It should be appreciated that digital decorators printing units are subject to periodic maintenance, in particular for replacement or repair of the print heads.

[0007] During maintenance works, which must be particularly accurate in order to ensure the quality standards required for tiles decoration, printing is suspended.

[0008] On decorators of the prior art, the plates are removably mounted in the printing unit, so that they can be individually removed for easy maintenance of the print heads when need be.

[0009] It is to be noted in fact that when the plates are arranged within the printing unit, many of the print heads are not easily accessible by the operator.

[0010] This system of the prior art exhibits several drawbacks.

[0011] The main drawback is that, following maintenance works, the plates reassembling within the printing unit could be misaligned with respect to the initial position thereof, which misalignment could be imperceptible to the operator while having a very negative impact on the decoration performance in the subsequent printing operation.

[0012] Additionally, this system is time-consuming since each plate is to be removed and then re-assembled each time maintenance works are carried out.

[0013] The system of the known type further implies the danger that one of the plate can slip of the operator’s hand as a result of removal thereof, thus falling onto the ground and getting damaged.

[0014] The technical task at the base of the present invention is therefore to provide a digital decorator enabling cyclical maintenance works of the print heads, allowing at the same time to maintain unchanged the decorations printed on ceramic articles.

[0015] In particular, it is an object of the present invention to provide a digital decorator being able to eliminate or considerably reduce the danger of heads misalignment as a result of maintenance operations. A further object of the invention herein is to provide a digital decorator allowing to perform maintenance works within a shorter timeframe than that of the known art and able to prevent the decorator parts from being damaged.

[0016] The technical task mentioned and the aim specified are attained by the digital decorator realized according to claim 1.

[0017] Further characteristics and advantages of the present invention will become more apparent from the indicative, and therefore non-limiting embodiment of a preferred but not exclusive digital decorator according to the invention, as illustrated in the accompanying drawings wherein:

- Figure 1 is an isometric view of the digital decorator;
- Figure 2 is an exploded view of a print heads unit and the support thereof, comprised in the printing unit of the decorator of Figure 1;
- Figures 3, 5 and 7 are schematic representations of front views, partially in transparency and in section, of the main functional units of the invention, in different operating conditions; and
- Figures 4, 6 and 8 are schematic representations of side views, partially in transparency and in section, of said functional units in the above different operating conditions.

[0018] With reference to Figure 1 attached hereto, it is generically indicated with 1 the decorator of the invention herein.

[0019] The digital decorator 1 disclosed by the present invention is preferably of the "single pass" type and is designed for printing decorations on ceramic articles 11, such as tiles or the like, and comprises at least one conveyor 2 for continuously conveying the articles 11 via the decorator 1 along a horizontal and rectilinear path, prior, during and after the printing. The conveyor 2 can be a conveyor belt looped around pulleys or other similar means.

[0020] In any case, the conveyor 2 moves forward the articles 11, which are freely resting, keeping them horizontal.

[0021] The decorator 1 includes a printing unit 10 which is arranged above the conveyor 2 and comprises a plurality of print heads 3 of the jet ink type. Each print head 3 includes a nozzle array facing downwards towards the conveyor 2.

[0022] The printing unit 10 is movable between a lower operational position wherein the print heads can perform printing on the articles 11 being carried by the conveyor 2, and an upper maintenance position.

[0023] In the maintenance position, the printing unit 10 is at a greater height than that exhibited in the operational
position; in addition, said printing unit 10 can be arranged in intermediate positions between the operational position and the maintenance position, as will be better detailed upon explanation of the invention working principles.

According to an important aspect of the invention, the print heads are movable in the decorator 1 between a retracted operational position, wherein they lie within a reference plane P, and an extended access position, wherein they project out from the reference plane P.

In short, as it will be detailed below, the print heads 3 of the decorator 1 are able to switch from one "retractable" configuration in the printing unit 10, to a configuration in which they inferiorly protrude thus being visible. Indeed, the print heads 3, in their maintenance position, preferably project out from the reference plane P in their entirety, thus being directly accessible to an operator for the purposes of maintenance work.

This arrangement makes it available for the printing unit 10 to rise far enough from the conveyor 2 as to create a lower volume suitable for housing the print heads 3 in their access position, and wherein the operator can work easily.

To be precise, the above reference plane P is an ideal plane integral with the printing unit 10 as a whole; of course, since the print heads 3 as well as the several parts they are integral with are movable relative to the rest of the printing unit 10, they can be movable with respect to the reference plane P.

The printing unit 10 is suitable for raising and lowering via actuating means known per se, such as linear actuators or similar mechanical parts.

Prior to explaining in detail the manner in which the invention overcomes the drawbacks of the prior art, further structural features of the preferred embodiment of the invention illustrated in the appended drawings will be described.

Also in the decorator 1 of the invention, the print heads 3 can be arranged based on at least four parallel "color bars" (or "groups of color") identified by C, M, Y, K in the industry jargon, to indicate the four-colors printing (see Figures 3 - 8).

In detail, each group usually includes two parallel rows of print heads 3 provided for delivering the same color in a manner which is widely known in the technical field the invention herein refers to.

As shown in Figure 2, the print heads 3 of the same color are mounted integrally but in a removable manner, relative to a respective plane supporting element 4.

According to a possible particular constructive aspect, the supporting element 4 is formed by two layers applied to one another, each consisting of a metal plate (see Figure 2).

In detail, each plane supporting element 4, hereinafter called simply support 4, houses the print heads 3 in respective through holes with the nozzle arrays facing downwards.

Due to known reasons which are therefore not discussed herein, the supports are elongated and mounted horizontally within the decorator 1, and arranged transversally relative to the conveyor 2, that is, relative to the forward direction of the ceramic articles 11.

The print heads 3 are distributed in rows arranged parallel to the longitudinal development of the respective support 4.

Such supports are slidably mounted in the printing unit 10; in this way, each of them can move individually and independently, with relative print heads 3 onboard, between an extended access position, wherein they inferiorly project out from the reference plane P, and a retracted operational position.

In detail, the supports move perpendicularly relative to the planar development thereof, that is, they move vertically.

Preferably, said supports do not stand alone, but they are part of functional movable units 5 related thereto, which constitute what was defined hereinabove in slang terms "color bar" or "color group", that is to say, a series of parts predisposed for printing with a given color (see for example Figure 3).

Thus, the decorator 1 of the invention can include at least four functional units 5 which are embedded in the printing unit 10, each of which has a bottom constituted by the respective support 4 carrying onboard the print heads 3 of a given color.

The parts of each functional unit 5 are integral to one another. Each functional unit 5 includes at least one distributor 51 (but preferably two of them), for feeding the print heads 3 with ink, which functional unit 5 is vertically movable within the decorator 1 so as to move the print heads 3 between the operational and access positions.

In detail, each functional unit 5 preferably comprises a supporting structure having a substantially prismatic shape (for example parallelepiped), which is defined inferiorly by the respective support 4, which supporting structure is provided for containing at least the distributors and the electronic control means of the print heads 3, including the cards 52 of the operating logic, the power supply unit 53 and the ink supply ducts for supplying the ink from said power supply unit to the print heads 3, and so on.

According to a optional aspect, the supporting structure of each functional unit 5 comprises seats for rapid assembly and disassembly of the electronic cards 52 located at the upper portion and near the top thereof.

Said seats can be made from plastic elements and supplied with two opposing guide grooves suitable for receiving opposite edges of the cards 52, thereby enabling to easily insert and remove them for the purposes of maintenance work.

According to a preferred aspect illustrated schematically in Figures 3 - 8, the printing unit 10 includes a supporting framework comprising a horizontal perimeter.
Here the functional units 5 are laterally contained, or even better, they are enclosed within the frame 6 provided with cross through holes and vertical holes 61 distributed along opposite sides thereof, preferably the front and rear sides.

In short, in the case of a rectangular frame 6, these sides may be the longest sides.

In this preferred embodiment, each support 4 is provided with linear guiding elements relative to its longitudinal ends, which linear guiding elements comprise, by way of example, pegs or cylindrical columns which protrude transversely upwards.

The linear guiding elements 50, hereinafter called simply guides 50, are slidingly inserted in respective through holes 61 of the frame element 6, so as to constrain the supports to perform rectilinear vertical translatory runs. In fact the guides 50 are perpendicular to the relative supports and the holes are thoroughly vertical.

This arrangement is functional to the fact that the invention provides centring means 7 for releasably fastening each functional unit 5 to the framework, preferably to the frame 6, in a respective centered position.

A centered position is the correct position that the functional unit 5, and in particular the print heads 3, must have in order to perform the printing needed, so as to ensure invariance of the decorations printed. The horizontal frame 6 is then used as a reference.

According to an important aspect, the guides 50 are provided with a shoulder or end stop 500 acting as a stroke-end at the upper free end thereof for the sliding of the functional units 5 relative to aforementioned reference plane P, that is to say, relative to the rest of the printing unit 10. Preferably, the centring means comprises a plurality of shoulder screws 7. In this case, each support 4 includes cross through holes for receiving a corresponding shoulder screw 7, whilst aforesaid frame 6 comprises vertical threaded seats 62 for receiving respective shoulder screws, said vertical threaded seats 62 being aligned with the holes of the supports 4. Preferably, the seats 62 for the screws 7 are arranged side by side on opposite sides relative to said cross holes of the frame 6 housing the guide.

In detail, the centring means 7 also acts as a releasably fastening means of the print heads 3 supports with respect to the frame 6.

When the shoulder screws 7 are removed, the functional units 5 are freely slidable along the guides 50.

The preferred operation mode of the invention is described below with the aid of figures 3 - 8.

During printing operations, the printing units 10 is disposed in its working position wherein it is next to the conveyor 2, and then to the ceramic articles 11 to be decorated (see figures 3 and 4).

In order to predispose maintenance works, the printing head 10 is lifted in an intermediate position, as shown in Figures 5 and 6.

The intermediate position may be located at a lower level or at least at a corresponding level to that of said maintenance works.

At this stage, according to a preferred aspect, supporting elements, not shown, are positioned under the printing unit 10; such supporting elements can be common tanks for collecting bleed ink which are suitable for sliding horizontally above the conveyor 2 and then move under the print heads 3 when the same are being cleaned.

After that, the printing unit 10 is lowered until the supports of the print heads 3 abut against the supporting elements.

At this point, the shoulder screws mentioned above are removed thus leaving the functional units 5 in the resting position on the supporting elements.

The printing unit 10 is then raised again; during this step, the force of gravity causes the functional units 5, and in particular the supports of the print heads 3, to remain stationary on the supporting elements while the frame 6 is raised.

While is being raised, the frame 6 abuts against aforementioned end stops 500 of the guides 50 and, while continuing its raising, it drags the functional units 5 with it until the printing unit reaches the above-mentioned maintenance position.

Such arrangement as shown in Figures 7 and 8, is also the one wherein the print heads 3 are in the access position thereof, that is to say, they are fully protruding and easily accessible by the operator.

In this phase, the operator can easily change the print heads 3 or perform repair operations as well as all possible maintenance works required. After completing maintenance works, the supports 4 bearing the print heads 3 are rearranged in the aforementioned retracted position and the shoulder centring screws 7 are reinserted.

This can for example be performed by rearranging the printing unit 10 in the lower position wherein the supports 4 regain contact with the supporting elements, or in any other way.

The important functional characteristics are due to the fact that the print heads 3 have an exclusively rectilinear translation when returning to the retracted position, wherein they are predisposed for the printing, and to the fact that the centring means ensure that the print heads 3 return to the above centring position in which they were placed prior to performing maintenance works.

Accordingly it becomes clear that the print heads 3 are not misaligned or otherwise misplaced even after maintenance works, therefore the accurate reproducibility of decorations on ceramic articles 11 is always guaranteed. As the functional units 5 do not need to be separated from the decorator 1, there is no danger of rough handling by operators.

In addition, maintenance works are faster than those of the prior art. In view of the aforesaid, the digital decorator 1 herein disclosed completely goes beyond
the limits of the known art.

Claims

1. A digital decorator (1) for printing on ceramic articles (11), comprising at least one conveyor (2) for conveying ceramic articles (11) and at least one printing unit (10) above said conveyor (2) and comprising a plurality of print heads (3) able to print decorations on ceramic articles (11), characterized in that said printing unit (10) is movable between a lower operating position, wherein the printheads (3) can print on the articles (11) conveyed by the conveyor (2) and an upper maintenance position, and in that said printheads (3) are movable in the decorator (1) between a retracted operational position, wherein they lie within a reference plane (P) and an extended access position, wherein they project out from the reference plane (P), the maintenance position of the printing unit (10) enabling the printheads (3) in the access position to be directly accessible to an operator for the purposes of maintenance work.

2. The decorator (1) according to the preceding claim, wherein, in the access position, the printheads (3) project out from the reference plane (P) in their entirety.

3. The decorator (1) according to at least one of the preceding claims, wherein the printheads (3) are mounted integrally with one or more plane supporting elements (4), said supporting elements (4) being slidably mounted in the printing unit (10), so as to move in translatory motion between an extended maintenance position, wherein they project out below the reference plane (P), and a retracted operational position.

4. The decorator (1) according to the preceding claim, wherein each plane element comprises at least one plate provided with a plurality of holes, which houses respective printheads (3) arranged in one or more rows.

5. The decorator (1) according to claim 3 or claim 4, wherein said plane elements constitute the bottom of a respective movable functional unit (5), comprising at least one distributor for supplying the printheads (3) with ink, each functional unit (5) being vertically translatable in the decorator (1) so as to shift the printheads (3) between the operational and access positions.

6. The decorator (1) according to the preceding claim, wherein each functional unit (5) comprises a supporting structure, which is defined in the lower part by the relative plane (4) that bears the respective printheads (3), said structure being fit for containing at least said distributor (51) and electronic means (52, 53) for controlling the printheads (3).

7. The decorator (1) according to at least one of claims 3 to 6, wherein the printing unit (10) includes and supporting framework (4), comprising a horizontal perimeter frame (6), provided with cross through holes and vertical holes (61), distributed along opposite sides thereof, each plane element (4) being provided with linear guiding elements (50) slidingly inserted in respective through holes (61) of the frame element (6), so as to constrain the plane elements to do rectilinear vertical translatory runs.

8. The decorator (1) according to the preceding claim, comprising centring means (7) for releasably fastening each functional unit (5) to said frame (6) in a respective centred position, so as to ensure the invariance of the decorations printed on said articles (11).

9. The decorator (1) according to the preceding claim, wherein said centring means comprises a plurality of shoulder screws (7) and wherein each plane supporting element (4) includes cross through holes to receive a corresponding shoulder screw, whereas said frame (6) comprises vertical threaded seats for receiving respective shoulder screws, aligned with these holes in the plane elements.
# EUROPEAN SEARCH REPORT

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**Place of search**: The Hague **Date of completion of the search**: 24 July 2015 **Examiner**: João, César

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