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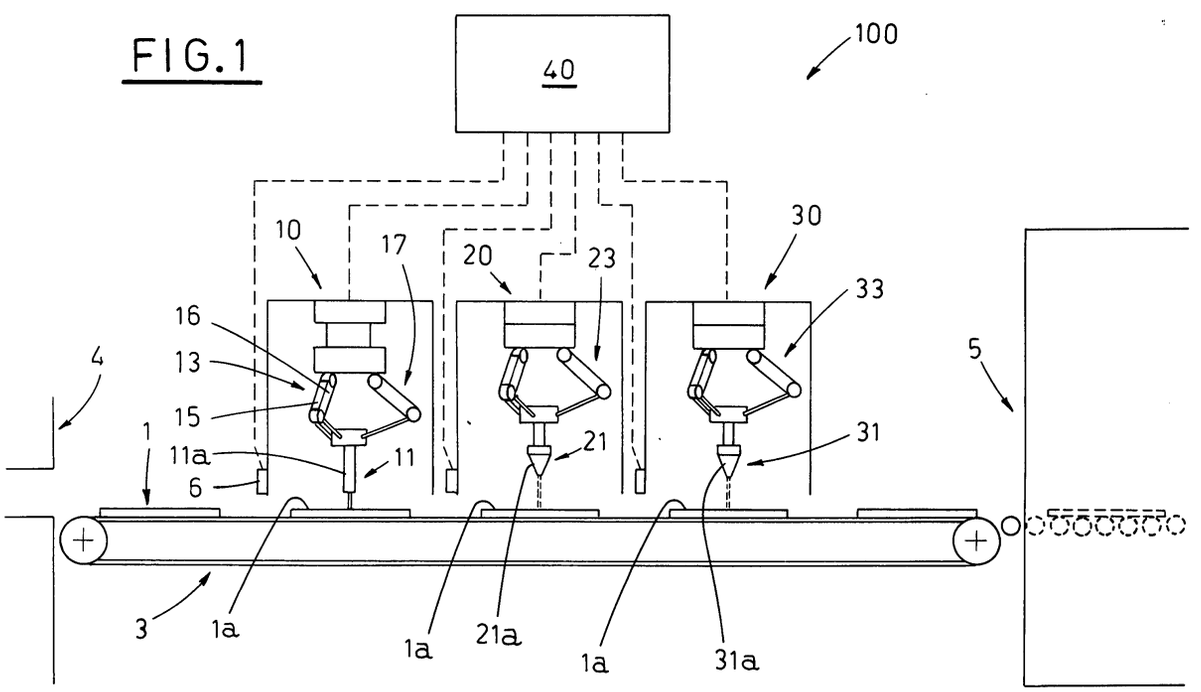
(54) Apparatus for making a kind of artistic decoration on ceramic tiles

(57) The present apparatus for making artistic decorations on ceramic tiles in a single-firing tiles production line is placed downstream of a press (4) forming said raw tiles (1), and upstream of a drying kiln (5), above a conveyor (3) of said tiles (1).

The decorating apparatus (100) comprises one or more operating stations (10,20,30), arranged in series above said conveyor (3). Each one of the above operating stations (10,20,30 comprises an operating head (11,21,31), supported by a corresponding positioning means consisting of a robotized driver (13,23,33), for driving said head along pre-defined and controlled paths near the tile surface (1 a).

The robotized drivers (13,23,33) are driven by a program operated control unit (40), in a phase relationship with the passage of the tiles (1) under the corresponding head (11,21,31). Said program carries coded information for guiding the heads along a plurality of predefined paths, for making on the tile surface (1 a) corresponding artistic decorations.

FIG.1



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Description

DESCRIPTION OF THE INVENTION

[0001] The present invention fits into the technical sector regarding the production of glazed ceramic tiles.

[0002] More precisely, the present invention relates to an apparatus and to a method for making, directly on a tiles production line, a kind of artistic decoration, called "third fire" decoration, on glazed tiles, and particularly those produced using the "single-fired" technique.

[0003] It is known that the particular kind of tile ornament called "third fire" artistic decoration generally applies to double-fired ceramic tiles. More particularly, with said technique, standard decorated, double-fired tiles are painted with a further glaze layer, which makes them particularly valuable. The above further decoration is normally made offline, totally by hand. Brushes, manually handled airbrushes, jigs, barens and other painting tools are generally used for this purpose. The so obtained tiles are then heated again in a high temperature kiln, in order to fix the glaze. They are used, in small numbers because of their high prices, for improving the appearance and value of surfaces made with standard ceramic tiles.

[0004] With the above described third fire treatment what is technically known as the tile "structure" is made. A third-fire treated tile can be moreover provided with recesses and relieves, and it can be made slightly different from each other tile, in order to enhance its characteristics of a hand-crafted and personalized product.

[0005] The growing request in the market for a product being always more differentiated and with a fine workmanship has lead, for third-fired tiles, to an increasing number of subsequent application of different glaze layers, sometimes performed with different techniques.

[0006] The above decorating operation have been so far performed offline, because they require a time so big that they are incompatible with the standard on-line production speeds, which are generally several dozens of meters per second. Some tiles to be third-fired are normally drawn from the production lines and sent to a specialized site, which is usually far from the tiles production site.

[0007] As the aforesaid third-fired tiles are repeatedly moved, and as the above operation require a big amount of specialized manpower, together with a long production time, said third-fired tiles are extremely expensive. This limits their use to particularly valuable applications, and in any case they cannot be used extensively.

[0008] Some kind of decoration made with the above described techniques are sometimes made on single fired tiles. A typical production line for single fired tiles comprises a press, fit to obtain a series of raw tiles. The tile surface configuration (or "structure") is obtained by means of a known baren which operates in the press. This structure can be flat, or it may have some roughness, or some recesses and relieves, but each tile is always identical to all the other tiles. Downstream of the press there is a glazing station, which applies a layer of glaze with conventional techniques. Said techniques comprise the using of glazing heads, airbrushes or, in some cases, a particular kind of silkscreen rollers.

[0009] Some single-firing production lines comprise, upstream of the aforesaid press, a further press, which allows the raw ceramic material to be subjected to a preliminary, slight pressing operation. Downstream of said further press, and upstream of the main press, there are sometimes provided one or more stations for applying a layer of powdery glaze, using spraying or silkscreening devices. When pressed by he main press, this glaze is embedded inside the tile, and it is fixed by the subsequent kiln-drying operation. In this case, the above mentioned main glazing operation may be sometimes omitted.

[0010] The so obtained tiles are normally less valuable than double-fired tiles. In this case the costs added by the offline performing of some artistic decoration (which could be called, in this case, "second fire" decoration) are hardly justifiable.

[0011] The main object of the present invention is to provide an apparatus for performing the above described "third fire" artistic decoration, particularly on single fired ceramic tiles, directly on their production line.

[0012] A further object of the invention is to provided an apparatus which is able to make on-line artistic decoration which can be made different on each tile.

[0013] Another object of the invention is to provide an apparatus for making said artistic decoration with one or more decorating steps.

[0014] Another object of the invention is to provide a method for making on-line artistic decoration operations on single-fired ceramic tiles.

[0015] The above mentioned objects are fully achieved by an apparatus and a method according to the independent claims.

[0016] All the characteristic features of the present invention, as they will appear from the subsequent claims, are highlighted in the following detailed description, with reference to the enclosed drawing tables, wherein:

- figure 1 shows schematically a side view of a portion of a production line for single-fired ceramic tiles, comprising the apparatus according to the present invention;
- figure 2 shows a ceramic tile being transported along the production line of figure 1, while passing at a first operating station;
- figure 3 shows the tile of figure 2 while passing under a second operating station;
- figure 4 shows a ceramic tile, being transported along the production line of figure 1, while passing under a third operating station.

[0017] Referring now to the aforesaid figures, numeral 1 indicates a ceramic tile being processed on a single-firing production line. The tile 1 lays on a belt conveyor 3, of the kind which is commonly used for conveying tiles. An active branch of said conveyor transports the tile 1 between the output of a press 4, wherein it has been formed, and the input of a kiln 5, wherein the same tile has to be subject to a high temperature drying process. As usual for single-firing production lines, the press 4 is provided with a baren fit to give the tiles 1 a base structure. Of course, this base structure is always the same for all the tiles coming out from the press 4.

[0018] Downstream of the press 4 is moreover provided a conventional tiles glazing station, not shown for convenience, for applying a layer of glaze to the tiles 1. This station can be provided with a glazing head or with airbrushes.

[0019] Downstream of the press 4, and upstream of the drying kiln 5, is placed the apparatus 100 for decorating tiles 1, according to the present invention. Figure 1 shows schematically one out of the large number of different configurations that can be assumed by the present apparatus 100.

[0020] A unique characteristic feature of the apparatus 100, and of the corresponding operating method according to the present invention, is that there are one or more operating stations 10,20,30 laying along the path of tiles 1 upstream of the drying kiln 5, said operating stations 10,20,30 being suitable to make decorations on the tiles which define the final decorative aspect thereof. The number of the above operating stations is a function of the decoration complexity, as it will be explained in details in the following.

[0021] More particularly, in the embodiment illustrated in figure 1, three operating stations are provided, respectively a first station 10, a second station 20 and a third station 30, which are arranged subsequently along the belt conveyor 3, above the tiles path.

[0022] The first station 10 comprises an operating head 11, whose position is defined by means of a robotized (i.e. position controlled by a computer) driver 13, in a phase relationship with the passing of tiles 1 below the operating area of the same head 11. The robotized driver 13 is fit to define travels of said head 11 across the operating area on the tiles surface 1a, according to a predefined computer program.

[0023] In the above embodiment, the robotized driver 13 is provided with three articulated arms 15,16,17, which are independently driven by motor means and capable to give the aforesaid operating head 11 a three-axis moving. That means, the head 11 can be moved along the tile surface 1a and up and down with respect to this latter.

[0024] The driver 13 is electrically connected to a control unit 40, which comprises a computer running a program which controls the position of each one of the arms 15,16,17 along a series of programmed moving sequences, corresponding to pre-defined paths of the operating head 11. The information corresponding to said sequences is coded and stored inside a computer memory, in a known way. The above paths depend on the kind of decoration which has to be made on each tile 1.

[0025] As from figure 2, the first station 10 comprises, mounted on the operating head 11, an engraving tool 11a, fit to engrave the tile surface 1a according to the aforesaid path. This engraving can be easily made on the tile 1 as it is still soft, because it is not yet kiln-dried.

[0026] A second operating station 20, arranged downstream of said first station 10 and similar to this latter (see figure 3), comprises an operating head 21 provided with a glaze applying device 21a of known type. The second head 21 can be programmed such that the device 21a follows the same path of the engraving tool 11a, in order to fill the engraving made by this latter with glaze. The glaze can be a liquid glaze, a powdery glaze or a pasty glaze. According to the glaze type, different decorating effects can be obtained on the tiles 1, more particularly if they are polished after the kiln-drying process.

[0027] A third operating station 30 is shown in figure 1 and figure 4, and comprises a third operating head 31 mounting a glaze applying device 31 a for powdery or pasty glaze. When the above device 31 a applies a glaze line on predefined paths along the tile surface 1a, under control of the control unit 40, a corresponding relief path is obtained on the same surface, which are subsequently fixed to the tile 1 during the kiln-drying process.

[0028] On the same operating head 31 can be otherwise mounted a spraying device, as a small angle airbrush. The decorating path can thus comprise a travel along the tile surface 1a as well as a height variation program, in order to obtain on the tile 1 a side-shaded path of variable width.

[0029] The present apparatus 100 moreover comprises a detecting means 6, connected to the control unit 40, fit to detect the tile position and to synchronize the operating stations 10,20,30. Several kinds of detecting means 6 are well known in the art, and thus they will no more detailed.

[0030] All the electronic devices and memory devices that make up the control unit 40 and the drivers 13,23,33 are of known type and commercially available, as well as the programming techniques for driving the operating heads 11,21,31 are well known to medium-skilled engineers.

[0031] From the above description is easily arguable that any combination of operating stations can be provided, carrying any kind of tool or any glaze application device, only depending on the number and kind of operation and glaze application, even of different colours, that a designer's fantasy can imagine for decorating a tile. The computer storing capacity allows to store inside its memory a large number of coded information representing different decorating paths, and also allows to vary the decoration for each undried tile passing under the operating stations. The actuating speeds of drivers

13,23,33 and of the computer residing in control unit 40 is moreover abundantly tested to comply with the actual line speed of a production line of single-fired tiles.

[0032] Thus the present apparatus advantageously allows to make complex decorating operations on single-fired tiles before they reach the drying kiln, without affecting the production line performances. The decorations so obtained can be easily modified and personalized.

[0033] Moreover, with the present apparatus it is no more necessary for the "third-fire" decorated tiles to be further treated in a kiln for fixing the new decoration.

[0034] A configuration variant for the apparatus 100 according to the present invention, which is not shown as immediately arguable, comes when the production line of single-fired tiles comprises a further press, located upstream of the main press 4 and fit to subject the raw ceramic material to a pre-pressing operation. The conveyor 3 is in this case broken, and carries the forming tile 1 from the above further press to the main press 4, and downstream to the drying kiln 5. In this case, according to the aim of the invention, operating stations 10,20,30 can be provided both just upstream of the main press 4 and upstream of the kiln 5, in order to increase the number of decorating effects that can be obtained.

Claims

1. Apparatus for making artistic decorations on ceramic tiles in a production line of single-fired tiles, said production line comprising at least one press (4), fit to form a series of said tiles (1), and a drying kiln (5), fit to subject said tiles (1) to a high temperature drying process, said ceramic tiles (1) being moved along said production line by means of a conveyor (3) at least from said press (4) to said drying kiln (5), said apparatus (100) being **characterized in that** it comprises at least one operating station (10,20,30), placed along said conveyor (3), upstream of said drying kiln (5) and above said moving ceramic tiles (1), said operating station (10,20,30) comprising at least one operating head (11,21,31), supported by positioning means (13,23,33), carrying a tool (11a,21a,31a) and fit to define for said head controlled travels near the tiles surface (1a) as they pass under said operating station (10,20,30), said positioning means (13,23,33) being driven by a program operated control unit (40), in a phase relationship with the passage of said ceramic tiles (1) under said operating head (11,21,31), said operating program carrying coded information for driving said operating head (11,21,31) along a plurality of pre-defined paths, for obtaining on the tiles surface (1a) corresponding artistic decorations.

2. Apparatus according to claim 1, **characterized in that** a plurality of said operating stations (10,20,30) is provided along said production line, said operating stations (10,20,30) being arranged in series on said conveyor (3), each one being fit to make on said tile (1) a part of a complex decoration.

3. Apparatus according to claim 2, **characterized in that** it comprises a pair of said operating stations, respectively an upstream station (10) and a downstream station (20), arranged in series, said operating head (11) of the upstream station (10) comprising an engraving tool (11a) for engraving said raw ceramic tiles (1) according to pre-defined paths, and the operating head (21) of said downstream station (20) comprising glaze applying means (21a), fit to release a glaze in said engraving, according to the same decorating path, and to fill said engraving with said glaze.

4. Apparatus according to claim 3, **characterized in that** said glaze applying means (21a) comprises at least one nozzle for liquid glaze.

5. Apparatus according to claim 3, **characterized in that** said glaze applying means (21a) comprises at least one nozzle for powdery glaze or for pasty glaze.

6. Apparatus according to claim 1, **characterized in that**, in said operating station (30), said operating head (31) comprises powdery or pasty glaze applying means (31a) fit to apply on said tiles (1) a relief path of powdery or pasty glaze.

7. Apparatus according to claim 6, **characterized in that** said glaze applying means (31a) comprises a nozzle for powdery or pasty glaze.

8. Apparatus according to claim 1, **characterized in that**, in said operating head (30), said operating head (31) comprises at least one small angle airbrush, for making side-shaded painting paths with liquid glaze on the tile surface (1a).

9. Apparatus according to any one of the previous claims, **characterized in that** said positioning means (13,23,33) comprises a robotized driver, provided with a plurality of independently driven articulated arms (15,16,17), fit to move said operating head (11,21,31) on a three-axis moving.

10. Apparatus according to any one of the previous claims, **characterized in that** detecting means (6) are moreover provided, connected to said control unit (40) and fit to detect said tiles (1) while passing at a pre-defined distance from said operating stations (10,20,30), for synchronize their operation.

11. Apparatus according to claim 1, **characterized in that** said single-firing production line comprises a further press, placed upstream of said main press (4) and fit to gently press the raw ceramic material forming said tiles (1), and **in that** at least one of said operating station (10,20,30) is placed between said further press and said main press (4).

12. Apparatus according to claim 11, **characterized in that** at least one of said operating station (10,20,30) is placed downstream of said main press (4).

13. Apparatus according to claim 11, **characterized in that** a plurality of said operating stations (10,20,30), placed either upstream and/or downstream of said main press (4).

14. Method for making artistic decorations on ceramic tiles in a single-firing production line, said production line comprising at least one press (4), fit to form a series of raw tiles (1), and a drying kiln (5), fit to subject said tiles (1) to a high temperature drying process, said ceramic tiles (1) being moved on a conveyor (3) from said press (4) to said drying kiln (5), said method being **characterized in that** said decorations are applied to the surface (1a) of said raw tiles (1) at least at one operating station (10,20,30), placed downstream of said press (4) and of any conventional glaze-head or airbrush glazing station and upstream of said drying kiln (5), said decorations being obtained by means of operating heads (11,21,31), provided in said operating stations (10,20,30), supported by positioning means (13,23,33) being driven by a program operated control unit (40), for defining pre-defined travels of said operating heads (11,21,31) along a plurality of paths above the surface of said raw tiles (1).

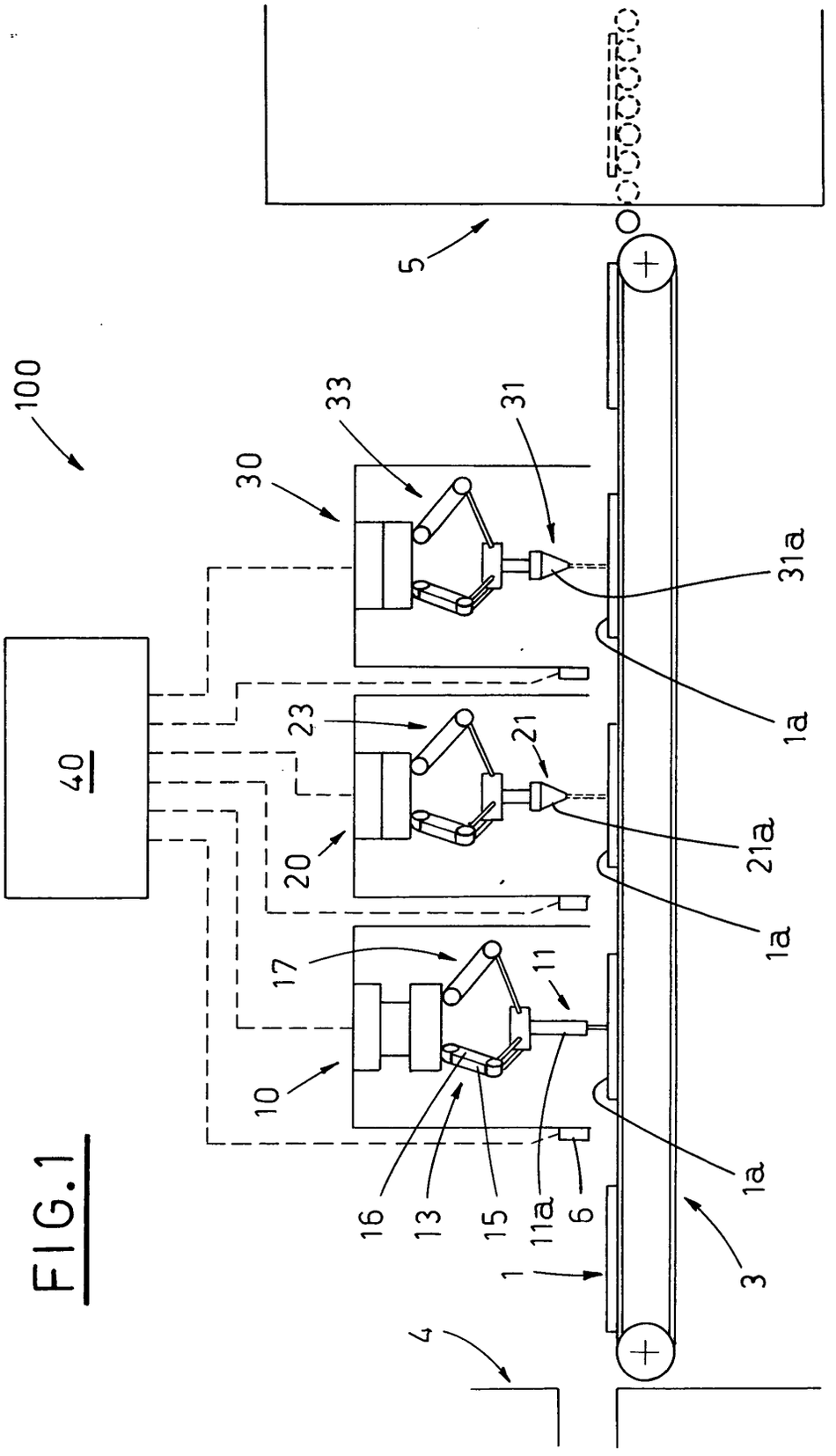
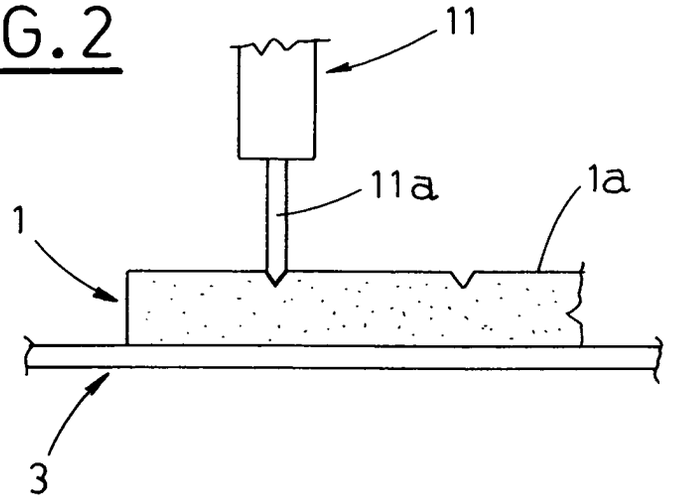


FIG.1

FIG.2



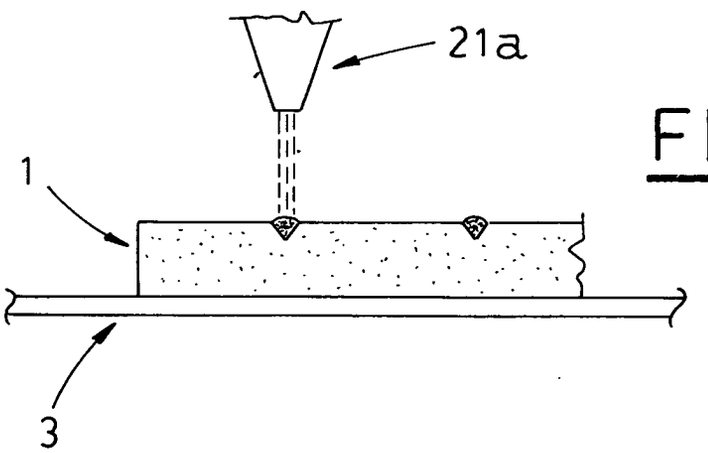


FIG.3

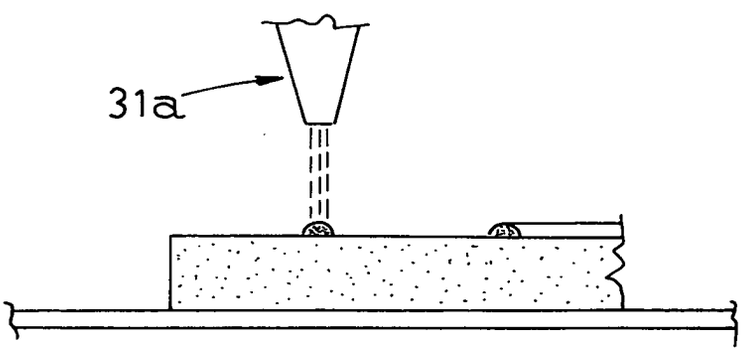


FIG.4