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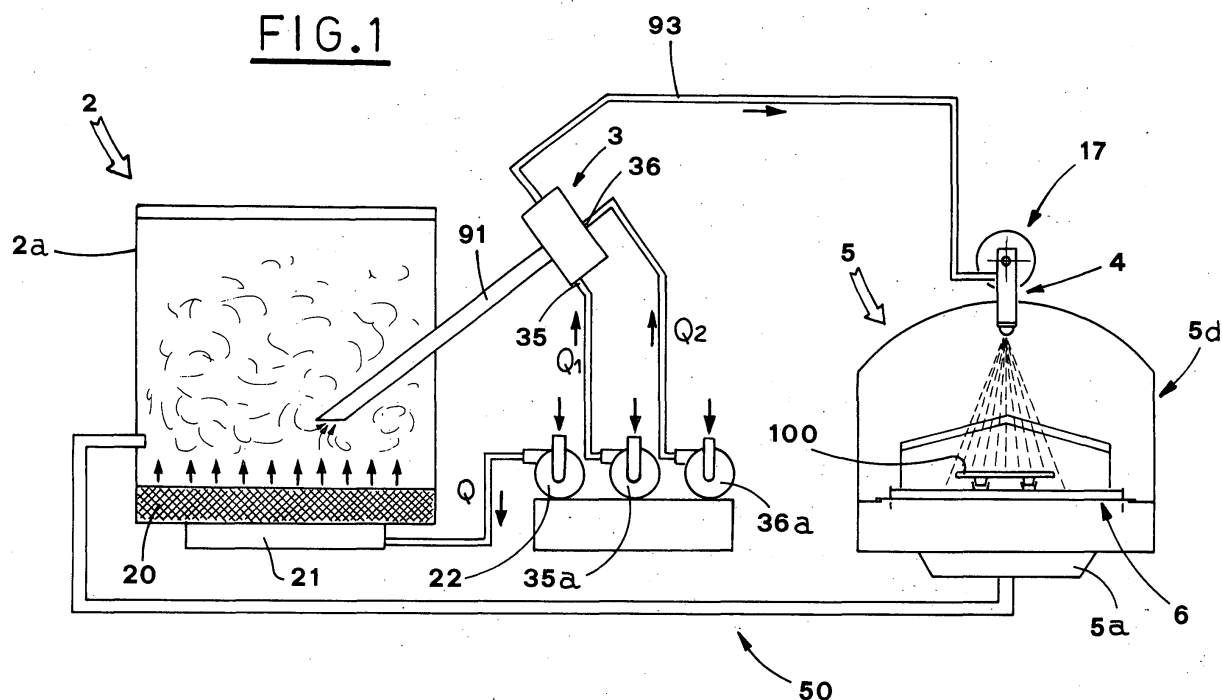
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AL LT LV MK RO(72) Inventor: **Malavasi, Paolo****Albareto, (Modena) (IT)**(74) Representative: **Dall'Olio, Giancarlo****Interbrevetti S.r.L.,****Via delle Armi 1****40137 Bologna (IT)**(30) Priority: **08.02.2002 IT BO20020069**(71) Applicant: **Malavasi, Paolo****Albareto, (Modena) (IT)**(54) **Apparatus for applying powder enamel to articles, in particular ceramic tiles**

(57) The apparatus for applying powder enamel to ceramic tiles includes a closed housing (2) containing powder enamel dispersed therein. Aspirator means are connected to the housing (2) and take out a flow of mixture containing air and powder enamel in solution from the housing (2), to send it under pressure toward an

applicator (4). The applicator includes a half-spherical cap nozzle (45), in which a delivery notch (47) is made for delivering the above mixture of air and enamel in solution, with a preestablished aperture angle, onto a plurality of tiles (100) passing in a application chamber (5). The aperture angle can be adjusted by adjusting means (10).

FIG.1

Description

[0001] The present invention relates to the technical field concerned with the ceramic industry, with particular reference to apparatuses for applying enamel to tiles.

[0002] It is known that in order to obtain a final product, a raw tile requires a complicated processing, among which enameling, flaming and enamel fixing are particularly important.

[0003] The enamel spray applying operations are usually performed in suitable application chambers.

[0004] Each application chamber includes basically a metallic casing, generally made of stainless steel, inside which a conveyor passes to convey continuously the tiles to be enameled along the enamel application path.

[0005] The lower part of the chamber is provided with a basin for collecting the remnants of the enamel atomized by suitable airbrushes situated in the upper part of the application chamber.

[0006] The airbrushes, usually oscillating on a plane crosswise to the tiles conveying direction, apply the enamel according to pre-established and well known decoration techniques.

[0007] Each airbrush is fed from a container for the enamel solution by means of a pump. The remaining enamel, collected by the above mentioned collection basin, is then reintroduced into the enamel solution container.

[0008] Apparatuses for applying dry powdered enamel to tiles are known.

[0009] These types of enamel are usually produced from powders and glass grains and are applied on the tiles, previously dampened with a fixing base, and made stable by fusion at high temperatures.

[0010] These apparatuses include a container with a pre-established quantity of powdered enamel, which feeds a distributing hopper by a suitable elevator.

[0011] The distributing hopper releases, in a basically continuous way, a flow of enamel to corresponding, suitably shaped, distributing rolls, which apply the powders onto the tiles carried below by conveying belts.

[0012] The distributing rolls are shaped in different ways, according to the geometries corresponding to the desired decoration pattern to be obtained on the tiles.

[0013] A disadvantage of the above apparatuses for applying powder enamels derives from their low production rate, essentially connected with the slowness of the distributor rollers for conveying and releasing the enamel.

[0014] Moreover, it is difficult for these apparatuses to apply very fine powders, whose grains dimensions are e.g. smaller than some millimeter hundredths.

[0015] The roll applying device can present problems with the powder distribution homogeneity, and thus cause defects to the tiles, in particular after a long use.

[0016] An object of the present invention is to avoid the above mentioned disadvantages by proposing an apparatus for applying powder enamel to tiles, in partic-

ular ceramic tiles, which ensures high application speed as well as constant enamel distribution even in long periods.

[0017] Another object of the present invention is to propose an apparatus for applying powders with a very small particle size.

[0018] A further object of the present invention is to propose an apparatus obtained by a simple technical solution, relatively cheap, which assures particularly high functionality and reliability standards.

[0019] The above mentioned objects are wholly obtained in accordance with the contents of claim 1.

[0020] The characteristic features of the invention will be pointed out in the following description of some preferred, but not exclusive embodiments, with reference to the enclosed drawing tables, in which:

- Figure 1 is a schematic view of the most important elements of an apparatus proposed by the present invention;
- Figure 2 is a schematic lateral, partially sectioned, view of an aspirator device belonging to the apparatus of Figure 1;
- Figure 3 is a schematic lateral, partially sectioned, view of an application device belonging to the apparatus of Figure 1, according to a first embodiment;
- Figures 4a, 4b are schematic views, lateral and top, respectively, of a nozzle belonging to the application device of Figure 3;
- Figures 5a, 5b are schematic views, correspondingly lateral and top, of the nozzle shown in Figures 4a, 4b, equipped with a regulation device;
- Figure 6 shows an application chamber obtained in accordance to a second embodiment of the invention;
- Figure 7 is a longitudinal section view of an application device, according to what has been shown in Figure 6;
- Figure 8 is a section view of the application device, taken along line VIII-VIII of Figure 7;
- Figure 9 shows an application chamber obtained in accordance to a third embodiment of the invention;
- Figures 10 and 11 are, respectively, longitudinal and cross sectional views of an application device shown in Figure 9;
- Figure 12 shows an application chamber obtained in accordance to a fourth embodiment of the inven-

tion;

- Figure 13 shows an application device according to what has been shown in Figure 12;
- Figure 14 shows an application chamber obtained in accordance to a fifth embodiment of the invention;
- Figure 15 shows an application device according to what has been shown in Figure 14.

[0021] With particular reference to Figure 1, and to a first embodiment of the invention, the apparatus for applying powder enamel to ceramic tiles includes a closed housing 2, of a tubular shape.

[0022] A so-called "soft bed" is obtained inside the closed housing 2, by a layer of a known porous material 20 situated in the lower part of the housing 2.

[0023] An inlet chamber 21, situated below the porous material' 20, is connected to a pump 22 via a duct.

[0024] The pump 22 is aimed at producing a continuous flow of air Q toward the inlet chamber 21 and, through the layer of the porous material 20, into the housing 2.

[0025] Powder enamel is contained in the housing 2, above the "soft bed", and is dispersed by the flow of air Q to obtain a suspension.

[0026] The enameling apparatus includes also aspirator means 3 for extracting a flow of a suspension of air and powder enamel from the housing 2, by an aspiration duct 91.

[0027] The aspirator means will be described in detail in the following.

[0028] A spray applicator 4, which likewise will be described in detail later on, is connected to the aspirator means by a delivery duct 93 and is aimed at delivering a jet of air and powder enamel.

[0029] An application chamber 5 is situated near the housing 2.

[0030] Conveying means 6 pass through the lower part of the application chamber 5 and are aimed at conveying continuously tiles 100 to be enameled into the chamber 5, between an inlet opening and an outlet opening thereof.

[0031] The conveying means 6 include preferably an endless small belt conveyor.

[0032] The chamber 5 features, mounted in its upper part, the above mentioned applicator 4, which is supported by driving means 17, which move the applicator so as to oscillate or perform other desired movements.

[0033] The delivery direction of the applicator 4 is suitably oriented in such a way as to hit the tiles 100 during their passage therebelow.

[0034] The driving means 17 are of the type known for other apparatuses used in the field, and advantageously include for instance a motor of known type, whose position can be controlled, e.g. a brushless mo-

tor, controlled in such a way as to change the direction of the enamel delivery by the applicator 4, according to a direction transversal with respect to the forward movement direction of the conveying means 6.

[0035] The movement of the applicator 4, as well as of the conveyor and the pumps, is obtained in accordance to the pre-established programs and known techniques, by means of a control unit, not shown.

[0036] The application chamber 5, basically including a metallic housing 5d, with possible access therein, is equipped, in its lower part, with a collecting basin 5a for collecting the part of unused powder enamel, which does not deposit on the tiles and which feeds a recycling device 50 opening in the closed housing 2.

[0037] The above mentioned aspirator means 3 include (see in particular Figure 2) a main hollow body 30, whose inside forms a basically "L"-like hollow 31, which extends from an inlet mouth 33 to an outlet mouth 34.

[0038] The inlet mouth 33 is connected to the above mentioned aspiration duct 91, so that a flow of air and dispersed enamel, coming from the housing 2, passes through the hollow 31.

[0039] A conveying gas intake 35, communicating with the hollow 31, is situated in the rear part of the main body 30.

[0040] The gas intake 35 is connected to a corresponding pump 35a and is aimed at receiving a first flow of gas Q1, usually compressed air, to mix it with the flow of suspension formed by air and enamel, in order to control the flow rate and concentration of the latter.

[0041] An atomization gas intake 36, likewise connected to the hollow 31, is situated downstream of the conveying gas intake 35.

[0042] The atomization gas intake 36 is connected to a corresponding pump 36a and is aimed at receiving a second flow of gas Q2, also in this case usually compressed air, which is mixed with the flow of air and enamel in the hollow 31 in order to optimize its atomization characteristics.

[0043] According to the first embodiment, described herein, the applicator 4, advantageously situated in accordance to a symmetry plane longitudinal to the application chamber 5, includes a tight-closed body 40 having an inlet mouth 40a, aimed at receiving the suspension of air and enamel coming from the aspirator means 3, and with an outlet mouth 40b, situated at the opposite end of the body 40.

[0044] A nozzle 45, connected to the outlet mouth 40b, delivers a controlled flow of air and enamel toward the tiles conveyed in the application chamber 5 (Figure 3).

[0045] The nozzle 45 includes a half-spherical cap'46, in which a delivery notch 47 is made.

[0046] The notch 47 expands diametrically along the whole extension of the cap 46 (Figures 4a, 4b).

[0047] In order to change constantly the angular aperture of the enamel flow delivery, the nozzle 45 features suitable adjusting means 10, for adjusting uniformly the

delivery section of the notch 41 made in the nozzle 4a.

[0048] The adjusting means 10 include a half-spherical cap 11, which is complementary to the nozzle 45 and which is rotatably connected to the outer wall thereof.

[0049] The cap 11 features a diametric adjustment notch 13, which co-operates with the delivery notch 47 of the nozzle 45, in order to adjust the delivery angular aperture, in accordance with the rotation of the half-spherical cap 11 with respect to the nozzle 45 (Figure 5a, 5b).

[0050] In particular, each of the opposite walls 14, 15 of the adjustment notch 13 includes a first essentially straight extending portion 14a, 15a, parallel to the delivery notch 47 direction, and a second curved portion 14b, 15b, following the first one.

[0051] The second portion is shaped in such a way, as to cover gradually, due to the rotation of the half-spherical cap 11 and beginning from the base of the delivery notch 47, bigger and bigger portions of the latter, in order to reduce gradually its angular extension.

[0052] More precisely, the straight portion 14a, 15a of a wall 14, 15 faces the curved portion of the corresponding opposite wall 15, 14.

[0053] The rotation of the half-spherical cap 11 is such as to change the interaction between the delivery notch 47 and the adjustment notch 13 from a maximum value A (Figure 5a), corresponding to a minimum angular aperture of the enamel flow, to a minimum value B (Figure 5b), corresponding to a maximum angular aperture of the same flow.

[0054] Because of high abrasiveness of the enamels used for tiles in the ceramic field, at least the aspirator means 3 and the applicator 4 should be made of materials resistant to abrasion, for instance stainless steel.

[0055] Specifically, it is advisable to make the nozzle 45 of a particularly resistant material, for example, particularly hard steel or tungsten carbide.

[0056] A second embodiment of the invention is shown in Figures from 6 to 8.

[0057] In particular, according to this embodiment, the applicator 104 includes a body 140, substantially straight, equipped with an inlet mouth 140a and an outlet mouth 140b.

[0058] The above mentioned body 140 is arranged substantially horizontal and is connected to the aspirator means 3 by a suitable pipe 145.

[0059] The above mentioned applicator 104 features also deflection means 150 for deflecting the flow of enamel in solution with respect to the applicator 104 axis.

[0060] The deflection means 150 include a plate 110, fastened to the body 140 in the area of the outlet mouth 140b, crosswise with respect to the body 140 axis.

[0061] The plate 110 is equipped, in its inside, with a cavity 115 communicating with the outlet mouth 140b and opened downwards, above the tiles 100 to be enameled.

[0062] Figure 8 shows the fan-like cavity 115, howev-

er, in relation to particular needs, the cavity can advantageously assume different configurations, like a bell or half-spherical.

[0063] The application of the enamel to the tiles with the above described applicator 104 is advantageous, because uniform enamel distribution requires smaller pressure of the feeding air with respect to the one of the previously described applicator 4 (usually 1 bar instead of about 3 bar), and ensures an efficient and homogeneous enamel distribution.

[0064] A third embodiment of the invention is shown in Figures from 9 to 11.

[0065] In particular, according to this embodiment, the applicator 204 includes a body 240, substantially straight and cylindrical, equipped with an inlet mouth 240a and an outlet mouth 240b.

[0066] The above mentioned body 240 is arranged substantially vertical with the outlet mouth 240b oriented downward and above the tiles 100 passing therebelow.

[0067] The body 240 is connected to the aspirator means 3 by a suitable pipe 245.

[0068] Like in the above described second embodiment, also the applicator 204 features deflection means 250 for deflecting the flow suspended enamel with respect to the applicator 204 axis.

[0069] The deflection means 250 include a poppet valve 210, situated in the area of the outlet mouth 240b.

[0070] The valve 210 is equipped with a stem 215, which extends axially toward the inside of the body 240.

[0071] The stem 215 is carried by support means 220, situated inside the body 240.

[0072] The support means include a hollow cylinder 221, aimed at receiving the stem 215 of the poppet valve 210, and a plurality of spokes 223, which extend crosswise from the hollow cylinder 221 and are fastened, at their respective opposite extremities, to the inner walls of the body 240.

[0073] The stem 215 and the hollow cylinder 221 are coupled by threading, in order to make the position of the poppet valve 210 adjustable with respect to the body 240.

[0074] The presence of the poppet valve 210 allows creation of a very thin layer of enamel, having substantially a bell shape, descending towards the tiles 100.

[0075] Moreover, the valve allows advantageously to prevent the jet of air containing the enamel dispersed therein from hitting directly the surface of the tiles 100, and therefore, the deposition of the enamel grains on the tiles is homogeneous.

[0076] According to a fourth embodiment of the invention, shown in Figures 12 and 13, particularly indicated for application of dry enamel in an intermittent way, an applicator 304 is situated at a suitable distance from the surface of the tiles 100 to be enameled.

[0077] The applicator 304 includes a body 340, substantially vertical, with an inlet mouth 340a for the flow of the suspension of enamel situated in its upper part, and an outlet mouth 340b situated in its lower part.

[0078] The outlet mouth 340b has the form of a through hole with small section in order to allow a homogeneous sprinkling of the enamel toward the tile 100.

[0079] The body 340 includes at least one discharge duct 310, situated between the inlet mouth 340a and the outlet mouth 340b.

[0080] The discharge duct opens to the outside environment, or is connected to a suitable container by a pipe, and is aimed at discharging a part of the air with enamel, in order to prevent the same from diffusing the enamel deposited on the tiles 100 in form of a bead.

[0081] The discharge duct can be also connected to a vacuum source, in order to facilitate the discharging operation.

[0082] In particular, the discharge duct 310 is situated near the inlet mouth 340a, extends crosswise with respect to the body 340 and its section is gradually increasing.

[0083] In this way, the speed of the aspirated air is subjected to gradual increase, due to Venturi effect.

[0084] Although it is not structurally indispensable, the increasing section conformation makes the air discharge more efficient. The vacuum applied to the discharge duct 310 is relatively low.

[0085] In normal operation condition, this allows to aspirate from the inside of the body 340, most of the compressed air used to feed the enamel flow, while the enamel grains proceed toward the outlet mouth 340b due to their inertia and mass.

[0086] This prevents the feeding air from coming out massively from the outlet mouth 340b and from dispersing the layer of granular enamel being formed on the tile 100.

[0087] The applicator 304 includes also a delivery duct 320, situated opposite to the above mentioned discharge duct 310 and substantially axially aligned therewith.

[0088] The delivery duct 320 is connected to a source of compressed air, aimed at supplying, when operated, a jet of air under a pre-established pressure, which deviates the whole flow of enamel from the outlet mouth 340b toward the discharge duct 310.

[0089] The activation of the compressed air supply to the delivery duct 320, in suitable time relation with the forward movement of the tiles 100 to be enameled, allows to apply the enamel only when a tile 100 is present below the applicator 304.

[0090] A fifth embodiment, shown in Figures 14 and 15, can be properly employed with the application of dry enamel in intermittent way and in form of a bead.

[0091] The apparatus obtained according to the fifth embodiment includes an applicator 404 situated near the surface of the tiles 100 to be enameled.

[0092] The applicator 404 includes a body 440 of substantially vertical extension, which includes a substantially cylindrical upper part 441 with an inlet mouth 440a, and a lower part 442, situated below the upper part 441 and having the section gradually decreasing toward an

outlet mouth 440b.

[0093] The latter has a form of a small hole, which allows to deposit the enamel on the tile 100 in form of a bead.

[0094] A discharge duct 410, connected to a vacuum source, is situated in the upper part of the body 440, above the above mentioned outlet mouth 440b.

[0095] The inlet mouth 440a is situated laterally in the upper part 441, and the incoming direction of the suspension of enamel is oriented substantially tangential with respect to the above mentioned upper part, in order, to allow the enamel to follow, inside the body 440, a "cyclone" path, that is a path of spiral form, which directs gradually downwards.

[0096] The above mentioned source of vacuum creates, when operated and in suitable step relation with the tiles 100 forward movement, at least two operation conditions inside the applicator 404.

[0097] In a first operation condition, occurring during the application of the beads, the air with enamel dispersed therein is supplied to the applicator 404.

[0098] In this case, a part of air with the enamel is taken from the discharge duct 410, in order to prevent the air from removing the enamel already deposited in form of a bead.

[0099] In a second operation condition, in which the supply of air with enamel dispersed therein through the inlet mouth 440a is interrupted, the vacuum created immediately inside the applicator 404 interrupts at once the enamel outlet from the outlet mouth 440b.

[0100] The applicators described with reference to the embodiments from the second to the fifth can be supported, inside the relative application chambers 5, by support means of known type, not shown, operated to move and aimed at changing the position and/or orientation of the applicator with respect to the surface of the tiles 100 to be enameled.

[0101] In particular, the moving support means can include a driving member operated by a motor, whose position can be controlled, for example a brushless motor.

[0102] They can also include a robot-operated manipulator, controlled by an electronic control unit on the basis of a software program, which allows the relative applicator to move at least along the directions parallel to the surface of the tiles 100.

[0103] This type of support means is particularly indicated for the applicators 304, 404 described in the fourth and fifth embodiments, because they allow to obtain, on the tiles 100 surface, particular decorative effects or beads of any shape and dimension.

[0104] The above described apparatus for applying powder enamel to the tiles allows to apply the enamel to the tiles in a way very similar to the techniques used at present for applying liquid enamels, and to maintain all the advantages of performance and application homogeneity, offered by these techniques.

[0105] Moreover, the present apparatus allows to apply powder enamels of any fineness, even of very small

particle size, assuring at the same time high production rate.

[0106] The apparatus performance remains substantially high due to the presence of the device for re-cycling the powders not deposited on the tiles, conveyed by the collecting means situated inside the working chamber of closed housing.

[0107] The proposed apparatus, obtained by a simple technical solution, ensures also particularly high functionality and reliability standards, not less than traditional apparatuses for wet enamel applying.

Claims

1. Apparatus for applying powder enamel to tiles, in particular ceramic tile, **characterized in that** it includes:

- an application chamber (5), aimed at receiving said tiles (100) arranged in a sequence and moved along a working path by conveying means (6),
- at least one housing (2), situated near said application chamber (5) and containing powder enamel aimed at being maintained substantially dispersed due to a flow of gas (Q);
- aspirator means (3), set in communication with said housing (2) by an aspiration duct (91) and aimed at extracting a continuous flow of said powder enamel from said housing (2);
- at least one applicator (4, 104, 20, 4, 3, 04) of said powder enamel, supported in said application chamber (5), set in communication with said aspirator means (3) by a delivery duct (93) and aimed at receiving, from said aspirator means (3), said flow of enamel in order to spread it onto the tiles (100).

2. Apparatus, according to claim 1, **characterized in that** said aspirator means (3) include: a main hollow body (30), forming inside a hollow (31), extending from an inlet mouth (33) to an outlet mouth (34) and aimed at aspirating said flow of enamel from said housing (2) by said aspirating duct (91) and at conveying it toward said outlet mouth (34); a conveying gas intake (35), aimed at receiving a first flow of gas (Q1), to mix it with the flow of suspension of enamel, in order to control the flow rate and concentration of said powder enamel.

3. Apparatus, according to claim 2, **characterized in that** said aspirator means (3) include also an atomization gas intake (36), connected to the hollow (31) and aimed at receiving a second flow of gas

(Q2), which is destined to interact with the flow of enamel in order to optimize its atomization characteristics.

4. Apparatus, according to claim 1, **characterized in that** it includes a recycling device (50), connected to a collecting basin (5a), situated in said application chamber (5) below the conveying means (6) and aimed at collecting the portion powder enamel, not deposited on the tiles (100).

5. Apparatus, according to claim 1, **characterized in that** said housing (2) includes a box-like structure (2a), whose lower part contains a layer of porous material (20), and an inlet chamber (21), situated below the porous material (20) and aimed at receiving the flow of gas (Q) and at conveying it toward said porous material (20), the powder enamel being situated inside said housing (2) above said porous material (20).

6. Apparatus, according to claim 1, **characterized in that** said applicator (4) includes a tight-closed body (40), with an inlet mouth (40a), aimed at receiving the flow of suspension formed by air and powder enamel dispersed therein, and with an outlet mouth (40b), featuring a nozzle (45), aimed at delivering said dispersed enamel, with a pre-established angular aperture, toward the tiles (100) present in the application chamber (5).

7. Apparatus, according to claim 6, **characterized in that** said nozzle (45) includes a substantially half-spherical cap (46), in which a delivery notch (47) is made.

8. Apparatus, according to claim 6 or 7, **characterized in that** said nozzle (45) features suitable adjusting means (10), for adjusting the angular aperture of said flow of enamel going out.

9. Apparatus, according to claim 8, **characterized in that** said adjusting means (10) include a half-spherical cap (11), which is rotatably connected to the outer wall of said nozzle (45) and features a diametric adjustment notch (13), which co-operates with said delivery notch (47) of the nozzle (45), in order to adjust the delivery angular aperture, as a consequence of the rotation of the half-spherical cap (11) with respect to the nozzle (45).

10. Apparatus, according to claim 9, **characterized in that** each of the opposite walls (14, 15) of said adjustment notch (13) includes a first portion (14a, 15a) of an essentially straight extension, parallel to the delivery notch (47), and a second curved portion (14b, 15b), following the first one, said second portion being shaped in such a way, as to cover grad-

ually, due to the rotation of the half-spherical cap (11) and beginning from the base of said delivery notch (47), larger and larger portions of the latter, in order to reduce gradually its angular extension, with the straight portion of a wall (14,15) facing the curved portion of the corresponding opposite wall (15,14).

11. Apparatus, according to claim 6, **characterized in that** it includes driving means (17), connected mechanically to said applicator (4) and aimed at moving the latter in step relation with the tiles (100) passage inside the application chamber (5), in order to 'change the direction of the enamel flow delivery, according to known techniques.

11. Apparatus, according to claim 10, **characterized in that** said driving means (17) include at least one electric motor, whose position can be controlled.

12. Apparatus, according to claim 1, **characterized in that** said applicator (104,204) 'includes a substantially straight body (140,240), featuring an inlet mouth (140a,240a) and an outlet mouth (140b, 240b), with enamel flow deflection means (150,250) being situated near said outlet mouth (140b,240b) to deflect the flow of the suspension of enamel with respect to the axis of said applicator (104,204).

13. Apparatus, according to claim 12, **characterized in that** the body (140) of said applicator (104) is arranged substantially horizontal, and **in that** said deflection means (150) include a plate (110), fastened to the body (140) in the area of the outlet mouth 140b, crosswise with respect to the body (140) axis, with said plate (110) featuring an inner cavity (115) communicating with said outlet mouth (140b) and opened downwards.

14. Apparatus, according to claim 13, **characterized in that** said cavity (115) has a fan-like shape.

15. Apparatus, according to claim 12, **characterized in that** the body (240) of said applicator (204) is arranged substantially vertical, with said outlet mouth (240b) oriented downwards, and **in that** said deflection means (250) include a poppet valve (210), situated in the area of the outlet mouth (240b) and equipped with a stem (215), which extends axially toward the inside of said body (240), said stem (215) being carried by support means (220), situated inside the body (240).

16. Apparatus, according to claim 15, **characterized in that** said support means (220) include a hollow cylinder (221), aimed at receiving the stem (215) of the poppet valve (210), and a plurality of

spokes (223), which extend crosswise from said hollow cylinder (221) and are fastened to the inner walls of said body (240).

17. Apparatus, according to claim 16, **characterized in that** said stem (215) and hollow cylinder (221) are coupled by screw-threading, in order to make the position of the poppet valve (210) adjustable with respect to the body (240).

18. Apparatus, according to claim 1, **characterized in that** said applicator (304) includes a substantially vertical body (340), with an inlet mouth (340a) of the flow of enamel suspension situated in its upper part, and an outlet mouth (340b) situated in its lower part, the latter having the form of a hole with small section to allow a homogeneous release of the enamel toward the tile (100), with at least one discharge duct (310), situated between said inlet mouth (340a) and outlet mouth (340b) and aimed at discharging a part of the air with enamel and at preventing the same from removing the enamel deposited in form of a bead.

19. Apparatus, according to claim 18, **characterized in that** said discharge duct (310) is connected to a vacuum source.

20. Apparatus, according to claim 18, **characterized in that** said discharge duct (310) is situated near the inlet mouth (340a), extends crosswise with respect to the body (340) and its section is gradually increasing.

21. Apparatus, according to claims 18 or 20, **characterized in that** said discharge duct (310) has a gradually increasing section.

22. Apparatus, according to any of claims from 18 to 21, **characterized in that** the applicator (304) includes also a delivery duct (320), which is situated opposite to said discharge duct (310) and substantially in axial alignment therewith, and which is connected to a source of compressed air, aimed at supplying, when operated, a jet of compressed air, in order to deviate the flow of enamel from the outlet mouth (340b) and toward the discharge duct (310).

23. Apparatus, according to claim 1, **characterized in that** said applicator (404) includes a body (440), arranged substantially vertical, which includes a substantially cylindrical upper part (441) with an inlet mouth (440a), and a lower part (442), having the section gradually decreasing toward an outlet mouth (440b), the latter having a form of a hole as small as to allows the enamel to deposit on the tile 100 in form of a bead, with at least one discharge duct (410) being situated in the upper part of said

body (440), above said outlet mouth (440b), said discharge duct (410) being connected to a vacuum source.

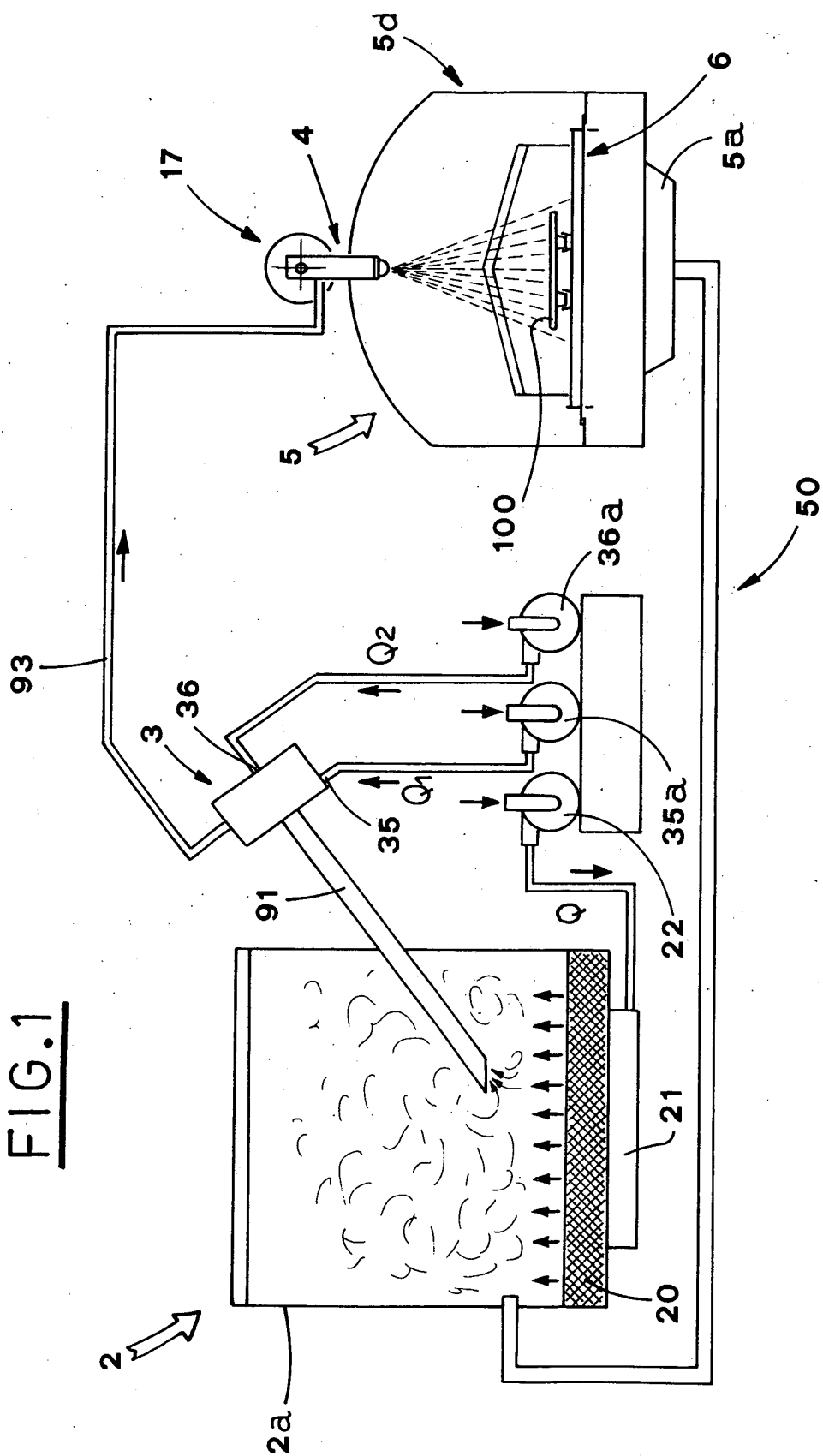
24. Apparatus, according to claim 23, **characterized in that** said inlet mouth (440a) is situated laterally in said upper part (441) and the incoming direction of the enamel suspension is oriented in a direction substantially tangential with respect to said upper part, in order to allow the enamel to follow a "cyclone" path inside said body (440).

25. Apparatus, according to any .of claims 12, 18 and 23, **characterized in that** said applicator (104,204,304,404) is supported by support means, which receive suitable commands to move and change the position and/or the orientation of said applicator with respect to the surface of the tiles (100) to be enameled.

26. Apparatus, according to claim 25, **characterized in that** said moving support means include a driving member operated by a motor, whose position is can be controlled.

27. Apparatus, according to claim 25, **characterized in that** said moving support means include a robot-operated manipulator, which allows the applicator to move at least along directions parallel to the surface of said tiles (100).

FIG.1



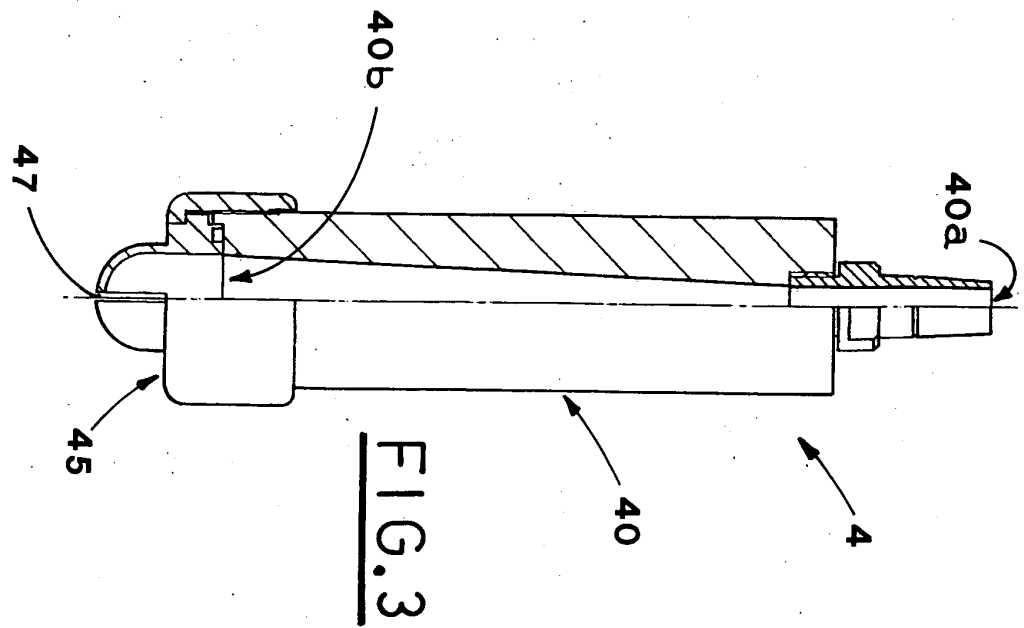
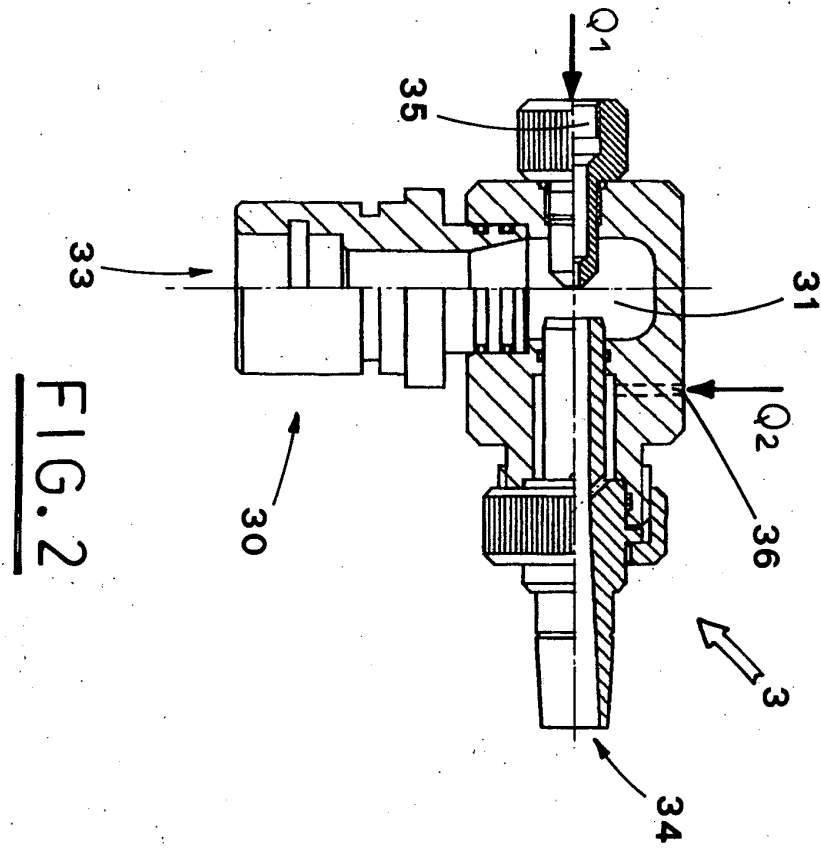


FIG.4b

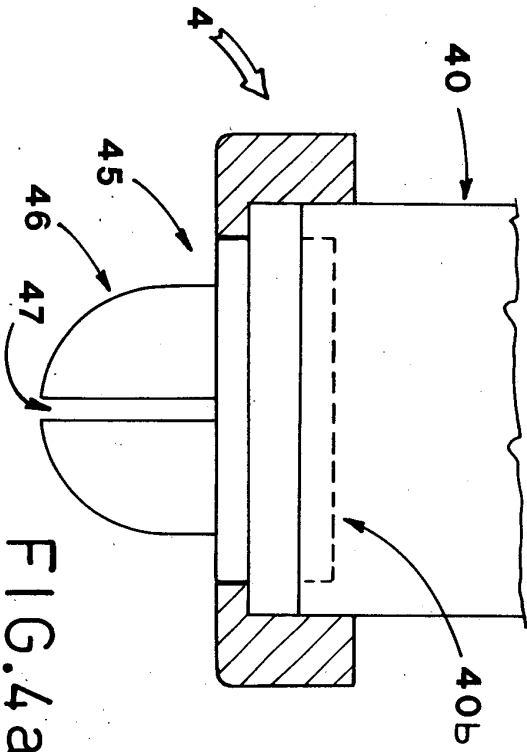
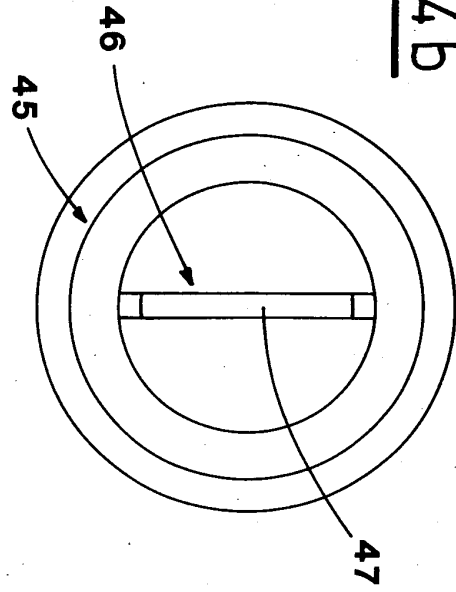


FIG.4a

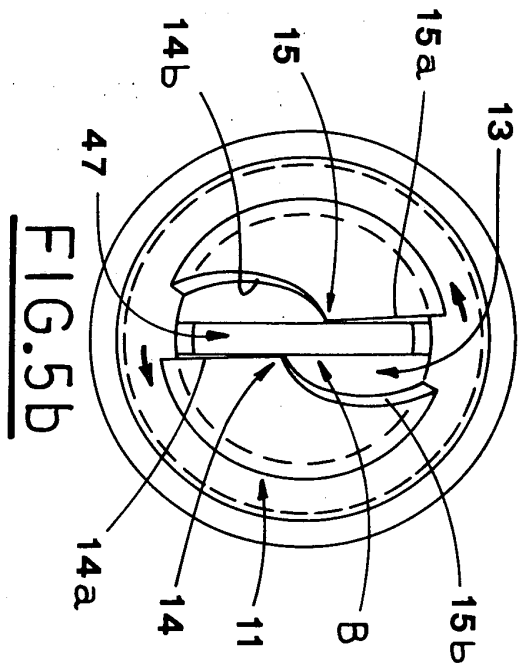


FIG.5b

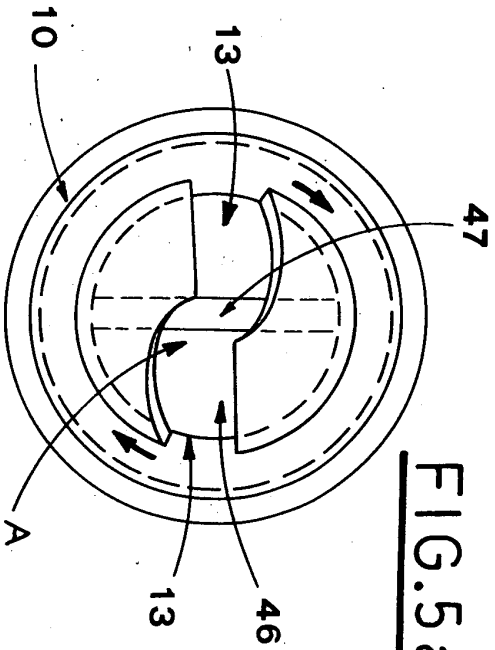


FIG.5a

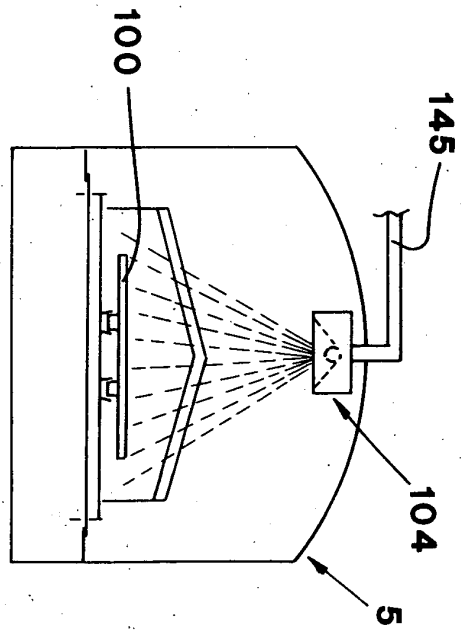


FIG. 6

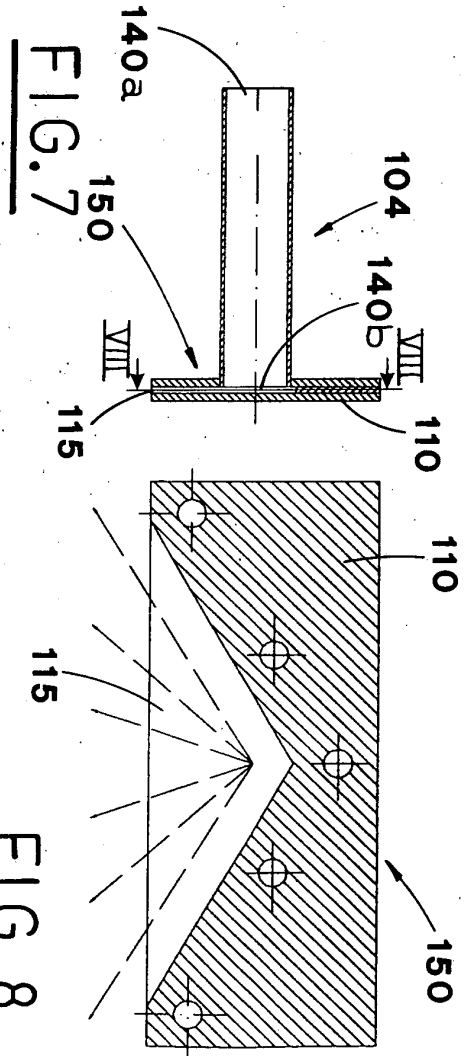
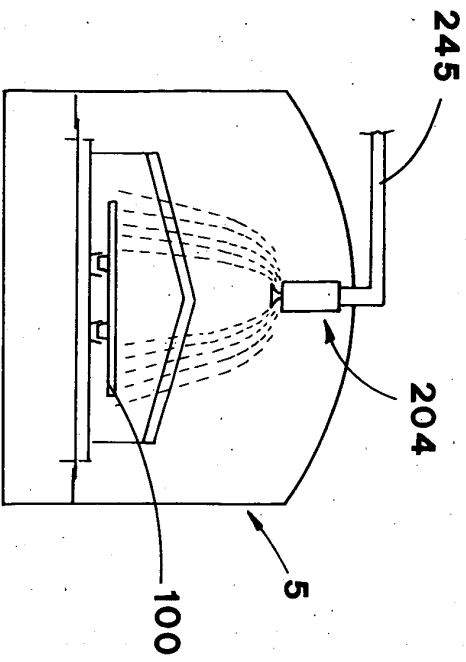


FIG. 7

FIG. 8

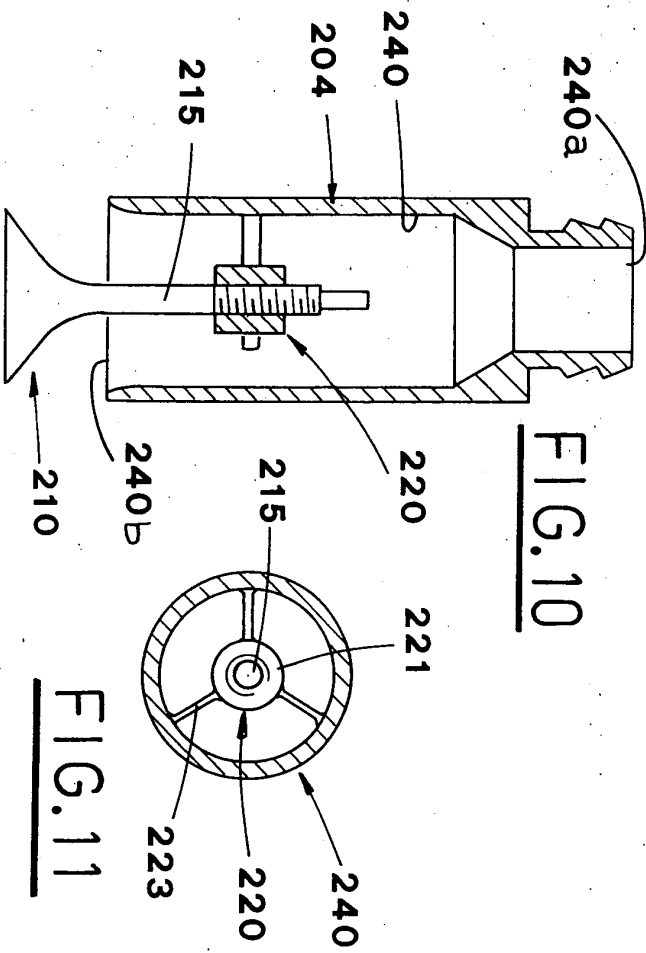


FIG. 10

FIG. 11

FIG.12

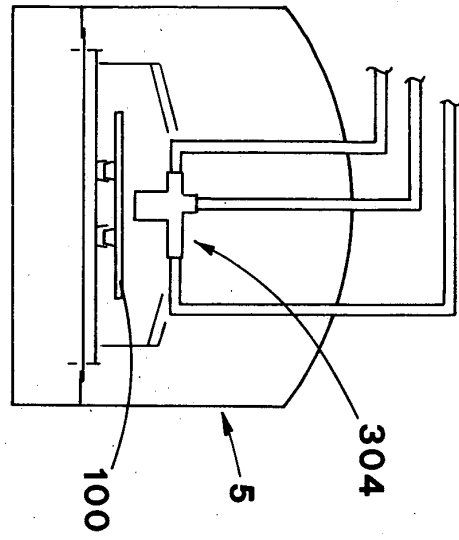


FIG.14

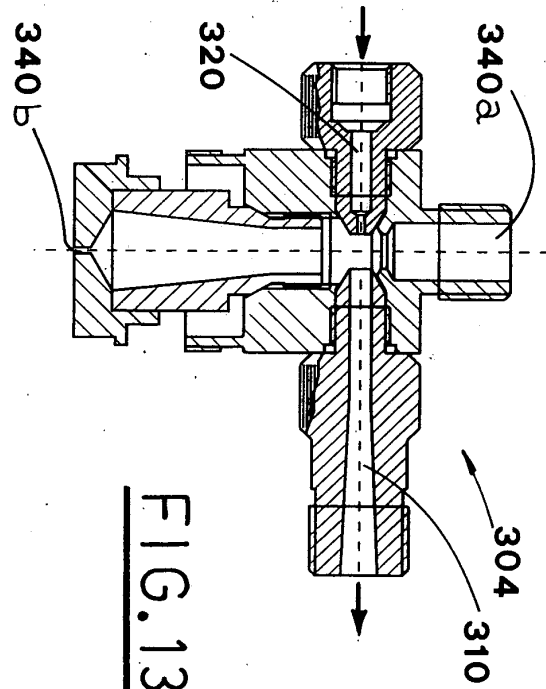
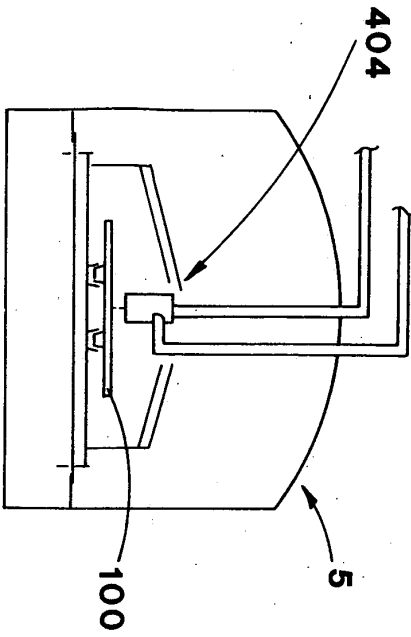


FIG.13

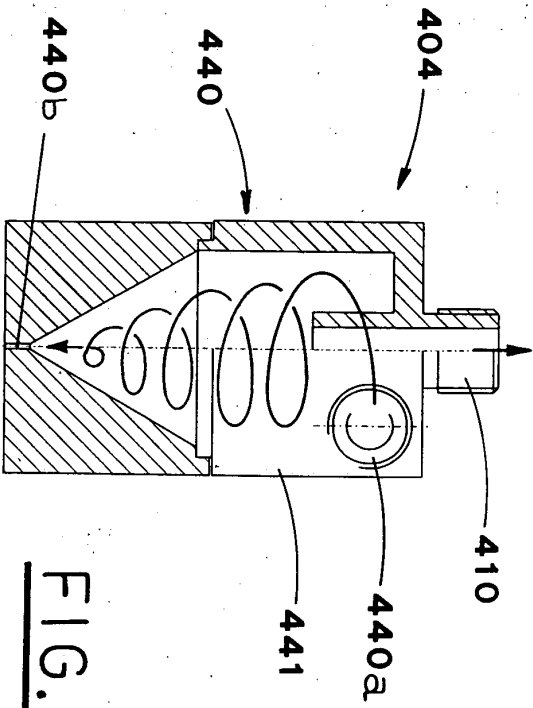


FIG.15