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(71) Applicant:
INTERNATIONAL FLAVORS & FRAGRANCES INC.
New York New York 10019 (US)

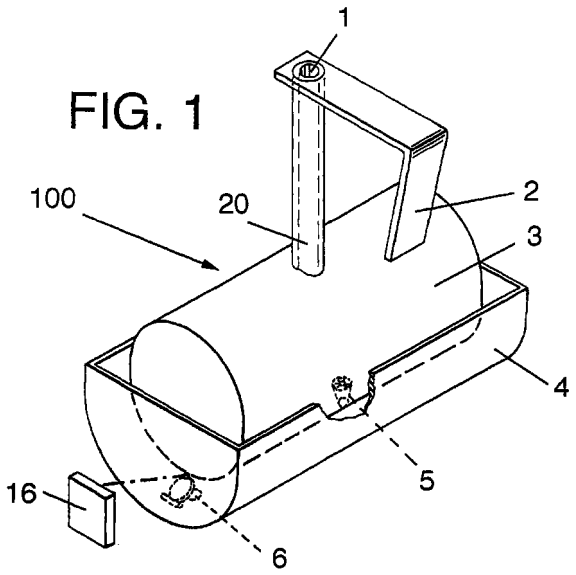
(72) Inventors:
- **Lindauer, Jerome I.**
  Hillsdale, County of Bergen, NJ 07642 (US)
- **Falabella, Elizabeth**
  Point Pleasant County of Ocean, NJ 08742 (US)
- **Rodriguez, Nikki**
  Yonkers, County of Westchester,NY 10705 (US)
- **Meyer, Andrea L.**
  Aberdeen, Cnty. Monmouth, NJ 07747 (US)

(74) Representative: **Richardson, Kate**
Forrester & Boehmert,
Franz-Joseph Strasse 38
80801 München (DE)

(54) Refillable apparatus using flushing water and having flow and diffusion control features for deodorizing and/or cleansing and/or aromatizing a toilet basin and process for operation of same

(57) Described is a liquid dispensing apparatus which uses flushing water and which controllably dispenses from a reservoir a metered dosage of deodorizing composition and/or cleansing composition and/or aromatizing composition into a portion of the flushing water (contained in a trough intermediate between the reservoir and a toilet basin) with the resultant composition being thereupon controllably dispensed into the toilet basin during the flushing cycle. The apparatus is easily refilled without the user being required to manually manipulate the dispensing apparatus while it is attached to the toilet basin. Also described is a process for employing the apparatus during the flush cycle.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

[0001] Devices that attach to the toilet bowl that dispense cleansing agents and/or aromatizing agents and/or deodorizing agents have been in use in commerce for a substantial period of time. Up until the last five years, such devices were of solid nature, composed of either paradichlorobenzene or solid surfactants. The paradichlorobenzene products are not environmentally friendly and have basically been discontinued. The solid surfactant blocks are still in use and are available. One of the disadvantages of these surfactant blocks is that the user must manually manipulate the plastic container containing the surfactant blocks that is attached to the toilet basin in order to replace or refill the products with the detergent block. During the past five years, there have been introduced into the marketplace devices that are refillable that are either gel or liquid in physical form. Such devices are described and claimed in, for example, Published European Patent Application No. 538,957 filed on October 21, 1992 and German Offenlegungsschrift No. 19520145 filed on June 1, 1995 and published on December 5, 1996 (corresponds to PCT Application No. 96/38637) as well as United States Design Letters Patent No. 370,710 issued on June 11, 1996.

[0002] Published European Application No. 538,957 dislcoses a cleansing and/or freshening unit capable of being suspended from the rim of a toilet bowl for the twofold purpose of spreading a fresh odor in the toilet room and introducing active substances into the flushing water with each flush. According to the invention of European Application No. 538,957, the unit comprises a reservoir for active substance such as a liquid containing cleansing and air freshening agent with the reservoir having its contents in constant communication with a porous mass which is arranged in the path of the flushing water when the unit has been suspended in a toilet bowl. Such a porous mass is a gel-like substance. U.S. Design Letters Patent No. 370,710 discloses a dispenser for cleanser compositions capable of being suspended from the rim of a toilet bowl.

[0003] PCT Application 96/38637 discloses a wash closet holder consisting of a container for an active agent preparation to be fitted beneath the rim of a toilet basin and rinsed over when the toilet is flushed, with at least one inlet and outlet for the flush water and a strap for securing it to the toilet bowl edge. At least a part of the lower region, when in the position of use, of the wall limiting the compartment for active agent preparation is penetrable by aqueous fluids with viscosities of up to 3,000 milipascals, but not by tenside-containing paste with viscosities of over 3,000 milipascals. The holder of the device of PCT Application 96/38637 releases the same quantity of active agents every time the toilet is flushed, and they are uniformly distributed in the bowl.

[0004] U.S. Letters Patent No. 3,946,448 issued on March 30, 1976 discloses apparatus for disinfection and chemical purification of toilet bowls, comprising a storage container spaced from the bowl and containing a purifying and a disinfecting liquid, and a valve capsule mounted on the cavity of the bowl edge near the water inlet opening of the bowl. The valve capsule is provided with a check valve and a flap actuated by the flush flow so as to open the check valve under the pressure of the flush flow. Fluid conveying means is provided for feeding the disinfecting and purifying liquid to the valve capsule from the storage container.

[0005] U.S. Letters Patent No. 4,209,864 issued on July 1, 1980 discloses a detachably affixable and refillable attachment for toilet basins comprising a perfume and/or deodorant bearing material which is a solid or which is in gel form at ambient conditions (and, optionally, an additional perfume and/or deodorant liquid proximate to or in contact with said solid) which produces a cleanser and/or sanitizer and/or deodorant and/or aromatizing solution with the water stored in the flush tank and which produces an emission into the atmosphere surrounding the flush tank of an aromatizing and/or deodorizing substance. The attachment is substantially contained within the flush tank of the toilet and is actuated in response to the level of the water in the tank.

[0006] Nothing in the prior art, however, discloses the novel and useful refillable apparatus using flushing water and having flow and diffusion control features for deodorizing and/or cleansing and/or aromatizing a toilet basin (or process for operation of same) of our invention.

THE INVENTION

[0007] Our invention is directed to apparatus for deodorizing and/or cleansing and/or aromatizing a toilet basin having at least one inside wall which uses flushing water comprising:

(1) means for conveying deodorizing and/or cleansing and/or aromatizing compositions into reservoir means;

(2) reservoir means equipped with deodorizing and/or cleansing and/or aromatizing composition first exit means for controllably gravity diffusing deodorizing and/or cleansing and/or aromatizing compositions into a finite fraction of flushing water with the first exit means being engaged and activated on contact with said flushing water and being disengaged and deactivated on removal of said flushing water;

(3) second conveying means for conveying the finite fraction of flushing water into trough means for holding the finite flushing water; and

(4) trough means for (a) holding the finite fraction of flushing water and (b) receiving deodorizing and/or cleansing and/or aromatizing composition from the first exit means of the reservoir means whereby the finite fraction of flushing water is admixed with the deodorizing and/or cleansing and/or aromatizing composition emanating from the first exit means of the reservoir means, with the trough means being equipped with the flush water-deodorizing and/or cleansing and/or aromatizing compositions second exit means for controllably gravity diffusing flush water-deodorizing and/or cleansing and/or aromatizing composition into a toilet basin,
with the apparatus being removably attached to an inner wall of the toilet basin.

[0008] Our invention is further directed to a repeating process for deodorizing and/or cleansing and/or aromatizing a toilet basin which uses flushing water which process consists essentially of the steps of:

(1) conveying a deodorizing and/or cleansing and/or aromatizing composition into a reservoir means which is equipped with a first exit means for controllably gravity diffusing the deodorizing and/or cleansing and/or aromatizing composition into flush water;

(2) conveying flush water into trough means;

(3) controllably gravity diffusing deodorizing and/or cleansing and/or aromatizing composition through the first exit means into the trough means as a result of conveying into the trough means flush water which activates and engages the first exit means;

(4) conveying the flush water-deodorizing and/or cleansing and/or aromatizing composition in the trough means through second exit means for controllably gravity diffusing the flush water-deodorizing and/or cleansing and/or aromatizing composition into the toilet basin; and

(5) repeating at least steps (2), (3) and (4).

[0009] From time to time, process step (1) must be repeated as the deodorizing and/or cleansing and/or aromatizing composition is depleted in the reservoir means.

[0010] More specifically, our invention is directed to apparatus useful for deodorizing and/or cleansing and/or aromatizing toilet basins equipped with liquid water flush means comprising:

(1) a substantially fully enclosed reservoir container for containing a deodorizing and/or cleansing and/or aromatizing liquid having an upper reservoir section and communicating therewith a lower reservoir section wherein the reservoir container is capable of containing deodorizing and/or cleansing and/or aromatizing liquid to a height $\mathbf{h}_{\alpha}$ above the lowest extremity of the reservoir container;
(2) a trough container having an inner void and having a longitudinal dimension greater than that of the reservoir container, surrounding at least the lower reservoir section of the reservoir container with the reservoir container being fixedly mounted within the trough container and with the outer walls of the reservoir or container being spaced from the walls of said trough container;
(3) deodorizing and/or cleansing and/or aromatizing composition refill means in the form of a hollow tube mounted in the upper reservoir section of said reservoir container and communicating with said upper reservoir section;
(4) at least one reservoir container exit orifice having an effective diameter $\mathbf{D}_{\mathbf{R}}$ located substantially at the lowest extremity of the lower reservoir section of said reservoir container, communicating with the inner void of said trough container;
(5) inserted through and fixedly fitting said reservoir exit orifice(s) a check valve means comprising:

(a) a vertically disposed hollow check valve tube having an upper end having at least two separate upper end openings and a lower end having one lower end opening; and

(b) contained within the hollow check valve tube a check valve ball (i) having a substantially solid outer shell and a solid, liquid or gaseous inner volume and (ii) having an effective diameter less than the internal diameter of said hollow check valve tube and greater than the effective diameter of any of said separate upper end openings and of said one lower end opening;

(6) at least one trough container exit orifice located substantially at the lowest extremity of the trough container having an effective diameter D_T; and

(7) fluid trough container feeding means for controllably feeding flush water during the flush period of the flush cycle into the trough container to a level h_β intermediate between the level of the reservoir container exit orifice, h_δ and a level of said lower reservoir section of said reservoir container below the height h_α;

the check valve component dimensions and check valve ball physical properties being such; and the trough outlets being so designed that (a) the quantity of reservoir additive released into said trough per flush is substantially between about 1% by weight and about 10% by weight of the initial quantity of reservoir additive present in the reservoir; and (b) the quantity of trough liquid which back diffuses into the reservoir liquid, per flush, is less than 5% of the initial quantity of reservoir liquid.

[0011] Thus, if the rate of flush water entering the trough is:

$$\left(\frac{dQ}{d\theta}\right)_i$$

and the rate of additive exiting from the reservoir is:

$$\left(\frac{dQ}{d\theta}\right)_{ii}$$

and the rate of flush water-additive composition exiting from the trough into the toilet bowl is:

$$\left(\frac{dQ}{d\theta}\right)_0,$$

then according to our invention:

$$\left(\frac{dQ}{d\theta}\right)_i >>> \left(\frac{dQ}{d\theta}\right)_0 \text{ and } \left(\frac{dQ}{d\theta}\right)_0 > \left(\frac{dQ}{d\theta}\right)_{ii}.$$

[0012] The rate of additive exit from the reservoir, however, is a function of a number of variables including:

$$\left(\frac{dh_\alpha}{d\theta}\right);$$

the density of the reservoir liquid, ρ_R; the viscosity of the reservoir liquid, μ_R; the density of the trough liquid, ρ_T; the area of the narrowest portion of the reservoir exit, A_0; and the rates of change with respect to time of the viscosity and density of reservoir liquid and trough liquid, to wit:

$$\left[\frac{d\rho_R}{d\theta}\right];\ \left[\frac{d\mu_R}{d\theta}\right];\ \left[\frac{d\mu_T}{d\theta}\right];\ \text{and}\ \left[\frac{d\rho_T}{d\theta}\right],$$

shown thusly:

$$\left(\frac{dQ}{d\theta}\right)_{ii} = f\left(\left[\frac{dh_\alpha}{d\theta}\right], \rho_R, \mu_R, \mu_T, \rho_T, A_0, \left[\frac{d\rho_R}{d\theta}\right], \left[\frac{d\mu_R}{d\theta}\right], \left[\frac{d\mu_T}{d\theta}\right], \left[\frac{d\rho_T}{d\theta}\right]\right).$$

[0013] The final concentration of additive in the trough, C_F, is a function of the time that the exit means from the reservoir is engaged (for example, the time that the check valve is open), θ_{CV}, as well as the concentratin of additives in the reservoir, C_R, and the rate of change of concentration of additives in the reservoir with respect to time,

$$\left[\frac{dC_R}{d\theta}\right],$$

as well as the rate of flow of additive from the reservoir through the reservoir exit means into the trough means when the exit means is engaged,

$$\left(\frac{dQ}{d\theta}\right)_{ii},$$

and is shown thusly:

$$C_F = f\left(\theta_{CV}, \left[\frac{dQ}{d\theta}\right]_{ii}, C_R, \left[\frac{dC_R}{d\theta}\right]\right).$$

[0014] Furthermore, the change of concentration of additive in the trough means then is shown by the following equation:

$$\Delta C = \int_0^{\theta_{CV}} \left[\frac{\partial^2 Q}{\partial \theta^2}\right] d\theta + \int_0^{\theta_{CV}} \left(\frac{\partial C_R}{\partial \theta}\right) d\theta + \int_0^{\theta_{CV}} \left[\frac{\partial^2 C_R}{\partial \theta^2}\right] d\theta$$

where the flow rate is the product of density, exit area and flow velocity, to wit:

$$Q = \rho A v \ .$$

More specifically, the change in concentration of additive in the trough is shown by the equation:

$$\Delta C = \int_0^{\theta_{CV}} \rho A_1 \left[\frac{\partial^2 v}{\partial \theta^2} + \frac{\partial v}{\partial \theta}\right] d\theta + \int_0^{\theta_{CV}} \left[\frac{\partial C_R}{\partial \theta} + \frac{\partial^2 C_R}{\partial \theta^2}\right] d\theta$$

where **v** is the additive flow velocity of fluid from the reservoir into the trough.

[0015] With respect to the reservoir exit means when that exit means is in the form of a check valve, the check valve ball design is critical to the timing of when the reservoir exit is engaged and when it is disengaged. The reservoir exit is engaged when the check valve is open or when the check valve ball is in a floating mode, and the reservoir exit is disengaged when the check valve ball is flushed against the bottom orifice of the check valve tube. The velocity of flow through the reservoir orifice is then shown by the equation:

$$v^2 = \frac{\left[\alpha g \int_0^{\theta_{CV}} \left(\frac{\partial h}{\partial \theta}\right) d\theta\right]}{\left[1 - \frac{D_0^4}{D_1^4}\right]} - 4g\left[\frac{D_P(\rho_P \rho_L)}{3\rho_L C_R}\right]$$

where **g** is the acceleration due to gravity; and wherein D_P is the effective diameter of the reservoir exit means ball; and wherein D_0 is the diameter of the lowest smaller of the openings of the check valve and D_1 is the diameter of the larger uppermost opening of the check valve; and wherein ρ_P is the density of the check valve ball and ρ_L is the density of the reservoir liquid additive flowing through the check valve.

[0016] When the reservoir exit means (e.g., check valve) is engaged, diffusion of additive into flush water occurs as does diffusion of flush water into additive (thereby diluting the additive in the reservoir container). The diffusion equations that govern this process are shown thusly:

$$\frac{\partial C_R}{\partial \theta} = \eta_{AB}\left[\frac{\partial^2 C_R}{\partial z^2}\right] ; \qquad \frac{\partial C_T}{\partial \theta} = \eta_{BA}\left[\frac{\partial^2 C_T}{\partial z^2}\right] ;$$

and

$$\Delta N_R + \frac{\partial C_R}{\partial \theta} - R_R = 0 \ ,$$

wherein C_R is the concentration of additive in the reservoir; C_T is the concentration of additive in the trough; η_{AB} is the diffusivity of reservoir additive into flush liquid; and η_{BA} is diffusivity of flush water into reservoir liquid.

[0017] As shown in Figures 2A, 2B,2C, 2D, 2E, 2F and 2G, the trough exit means may be controlled by means of an electronic timing device, and the height of the fluid level in the trough may be controlled by a liquid level control device as is disclosed in U.S. Letters Patent No. 5,069,243 issued on December 3, 1991. Other liquid level control devices are specified in U.S. Letters Patent No. 4,216,554 issued on August 12, 1980. Other liquid level control devices are disclosed in U.S. Letters Patent No. 3,777,778 issued on December 11, 1973. The presence of such a liquid level control device is shown in Figure 2G, described in detail, infra.

[0018] The additive used in our invention can also include a dye for indicating the presence of the additive in the flush water portion held in the trough after the level of the flush water rises to the height which causes engagement of the check valve. Such a dye is water soluble and is, for example, COLAUYL BLAU® AR (trademark of Hoechst, A.G. of Germany).

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Figure 1 is a schematic perspective view of the apparatus of our invention, having a clip mechanism that attaches the device to the rim of a toilet basin such that the reservoir and attached trough are located underneath the rim directly underneath the holes in the toilet basin from which the flush water enters.

Figure 1A is an enlargement of the reservoir exit means of the apparatus of Figure 1, showing a check valve in disengagement mode (a closed check valve).

Figure 1B is an enlargement of the reservoir exit means of the apparatus of Figure 1, showing the reservoir exit means in engagement mode (that is, the check valve is "open" and additive fluid is diffusing into flush water).

Figures 2A, 2B, 2C, 2D, 2E, 2F and 2G show cutaway side elevation schematic diagrams of the apparatus of Figure 1 in various stages of operation.

Figure 2A shows the apparatus of Figure 1 without any additive fluid in the reservoir tank and without any flush water in the trough tank and showing the reservoir exit means in disengaged mode and the trough exit means closed.

Figure 2B shows the reservoir tank being filled with additive liquid through the refill means in the form of a hollow tube mounted in the upper reservoir section of the reservoir container (Stage II).

Figure 2C shows the reservoir container partially full of additive liquid (Stage III).

Figure 2D shows flush liquid entering the trough container, thereby causing the reservoir exit means (the check valve) to become engaged and open.

Figure 2E shows the trough liquid admixed with additive liquid leaving the trough tank through orifice 6 and entering the toilet basin. At this stage, Stage V, the reservoir exit means (check valve) becomes disengaged (closed).

Figure 2F shows a situation where the flush liquid rises to the upper level of the reservoir liquid, thereby causing total admixture of flush liquid and reservoir liquid and causing total dilution of additive liquid.

Figure 2G shows the use of a liquid level controller during flush liquid additive while the reservoir exit means is engaged (open) and while the trough exit means is engaged (open).

Figures 3A and 3B are cutaway side elevation schematic views of the apparatus of Figure 1 wherein the trough exit means is not an electronically controlled exit orifice as is the case with the apparatus of Figure 2, but is an open narrow orifice designed so that there is a continuous flow of flush water-additive mixture into the toilet basin.

Figure 3A shows the situation where flush water is flowing into the trough container and the flush water level is so high that the reservoir exit means (check valve) is engaged (the check valve is in an open position) so that the flush water is mixing at the reservoir exit orifice location with the additive fluid. Simultaneously, flush water-additive mixture is exiting from the trough means into the toilet basin.

Figure 3B shows the level of the additive-flush water mixture to have dropped to such a point that the reservoir exit means (check valve) is disengaged (closed); however, the additive-flush water mixture still continues to exit from the trough into the toilet basin.

Figures 4A and 4B are schematic cutaway side elevation views of the reservoir exit means (check valve).

Figure 4A shows the reservoir exit means in disengaged position (the check valve is closed).

Figure 4B shows the reservoir exit means in engaged position whereby the flush water level is at a such a height that the check valve ball is in a floating mode whereby the flush water is diffusing with the additive in the reservoir tank.

Figures 5 and 6 are front cutaway elevation views of the apparatus of Figure 1. Figure 5 shows the apparatus of Figure 1 without flush water in the trough tank, but with additive in the reservoir tank and with the reservoir exit means disengaged (the check valve is closed).

Figure 6 shows the reservoir tank containing additive and flush water in the trough tank to such a height that the reservoir exit means (check valve) is engaged (the check valve is open) whereby flush water is admixing with additive.

Figures 7A, 7B, 7C, 7D, 7E, 7F and 7G show cutaway side elevation schematic views of the detail of the reservoir exit means (the check valve) in various embodiments.

Figure 7A shows a disengaged check valve in the shape of a conical frustum containing a spherical ball.

Figure 7B shows a cylindrical check valve with a spherical ball.

Figure 7C shows a check valve in the shape of a conical frustum and containing a hollow sphere as the float ball.

Figure 7D shows the hollow float ball of Figure 7C in cutaway side elevation view indicating the inner diameter as $\mathbf{R_4}$ and the outer diameter as $\mathbf{R_3}$.

Figure 7E shows another embodiment of the reservoir exit means (check valve) wherein the shape of the check valve is a conical frustum and the check valve ball is a spherical ball having numerous voids therein (e.g., "sponge-like").

Figure 7F shows a reservoir exit means (check valve) in the shape of a skewed conical frustum and a cylindrical hollow float.

Figure 7G shows a reservoir exit means (check valve) in the shape of a conical frustum with a spherical ball.

Figures 8A, 8B, 8C, 8D, 8E, 8F and 8G also show cutaway side elevation views in detail of the reservoir exit means of the apparatus of our invention and also show in diagrammatic form the transition from disengagement to engagement as flush water fills the trough tank causing the ball within the check valve body to float upwards towards the upper orifice of the check valve.

Figure 8A shows a check valve having an outer shape of a conical frustum with a spherical ball.

Figure 8B shows a check valve with a cylindrical body and a spherical ball.

Figure 8C shows a check valve with a conical frustum and a hollow spherical ball.

Figure 8D shows a conical frustum with a spherical ball having numerous voids therein (e.g., a sponge-like ball).

Figure 8E shows the ball of Figure 8C in detail with the outer diameter being $\mathbf{R_3}$ and the inner diameter being $\mathbf{R_4}$.

Figure 8F shows a skewed conical frustum as the check valve body and a cylindrical float therein.

Figure 8G shows the check valve body as a conical frustum with a spherical ball therein.

Figures 9A, 9B and 9C set forth views of a novel check valve of our invention useful as part of the reservoir tank of our invention.

Figure 9A is a schematic perspective view of the novel check valve of our invention, which is cylindrical in shape containing a spherical float ball (engaged) and containing an inner cylindrical checking means at the upper end of the check valve.

Figure 9B is a perspective schematic view of the check valve of Figure 9A in disengaged mode (the check valve is closed).

Figure 9C is a cutaway side elevation view of the check valve of Figure 9A in engaged mode, showing the spherical ball checked by the upper inner cylinder.

Figure 10 is a vertical sectional view through a bowl edge illustrating a connecting pipe for the water feed pipe and the inserted valve capsule as well as the distributing flap to be actuated by the flush flow, all of which are shown in elevation of prior art, U.S. Letters Patent No. 3,946,448 issued on March 30, 1976.

Figure 11 is a schematic cutaway side elevation view of the unit in the service position sometime after a flush of the apparatus of European Published Application No. 538,957.

Figure 12 shows the unit of Figure 11 directly after a flush.

Figure 13 shows a refillable bottle for liquid containing active substances for use in the practice of European Published Application No. 538,957.

Figure 14 is a block flow diagram showing the process of our invention in schematic form.

Figure 15 is a block flow diagram of the process of our invention where the process steps are individually controlled by means of electronic program controller (electronic data processing) and where market input and feedback information and data is fed into and received from the electronic program controller so that various flow rates and fragrance components and ratios, for example, are optimized as a result of market input and feedback.

Figure 16 is a schematic block flow diagram setting forth a software program specifically designed to operate with the apparatus and process of our invention, the purpose of which is to optimize process variables so that the process and apparatus of our invention will be accepted by the marketplace.

DETAILED DESCRIPTION OF THE DRAWINGS

[0020] Referring to Figure 1, the apparatus thereof is shown by reference numeral 100. Reference numeral 1 sets forth a refill opening for refill tube 20 which communicates with reservoir 3 intended to contain deodorizing composition and/or cleansing composition and/or aromatizing composition. Reservoir 3 is contained within trough 4. Reservoir 3 also has at its lower extremity reservoir exit means (check valve) 5. The trough tank 4 also has at its lower extremity an exit means 6 shown by an electronically controlled valve operated via mechanism 16. Figures 1A and 1B show, respectively, check valve 6 in disengaged form (Figure 1A) and in engaged mode (Figure 1B). The lower orifice of the check valve is indicated by reference numeral 18, and the upper openings of the check valve are indicated by reference numerals 8 and 38, with the diameter of opening 8 being lesser than the outside diameter of the check valve ball 7. The outer body of the check valve is indicated by reference numeral 5.

[0021] Operation of the apparatus of Figure 1 is set forth in Figures 2A, 2B, 2C, 2D, 2E, 2F, 2G, 3A, 3B, 4A, 4B, 5

and 6.

[0022] Thus, the apparatus for deodorizing and/or cleansing and/or aromatizing a toilet basin 22, which uses flushing water (emanating from tubes 28 and from tank 18) comprises:

(1) gravity conveying means 20 (in the form of an inlet tube) for conveying deodorizing composition and/or cleansing composition and/or aromatizing composition 12 into reservoir means 3;

(2) reservoir means 3 equipped with deodorizing composition and/or cleansing composition and/or aromatizing composition first exit means (in the form of a check valve) 5 for controllably gravity diffusing deodorizing composition and/or cleansing composition and/or aromatizing composition 12 into a finite fraction of said flushing water 21 (as is shown in detail in Figure 4B); with said first exit means 5 being engaged and activated on contact with said flushing water 21 and being disengaged and deactivated on removal of said flushing water (as shown in Figure 2E) with the level of the flushing water/additive mixture being shown by reference numeral 41 and the level of the additive in the reservoir being shown by reference numeral 40; and

(3) trough means 4 for (a) holding the finite fraction of flushing water 21 and (b) receiving deodorizing composition and/or cleansing composition and/or aromatizing composition 12 from said first exit means 5 of said reservoir means 3 whereby said finite fraction of flushing water 21 is admixed with said deodorizing composition and/or cleansing composition and/or aromatizing composition emanating from said first exit means 5 of said reservoir means at orifice 18, said trough means 4 being equipped with flush water-deodorizing and/or cleansing and/or aromatizing compositions second exit means 6 for controllably gravity diffusing flush water-deodorizing and/or cleansing and/or aromatizing compositions into toilet basin 22 with the contents of the toilet basin being indicated by reference numeral 21a. The trough exit valve 6 may be electronically controlled by device 16 and timer 17 which also operates to control the flush water from tank 18. In addition, the fluid level controller 27, operated via device 26, controls and times the level of flush water in the trough tank (as shown in Figure 2G) in coordination with the timing of the flush from tank 18 through tubes 28.

[0023] Referring to Figure 2F, Figure 2F shows the full admixture of all of the additive fluid with flush water. The composition is shown by reference numeral 21-12. The height of the fluid in both the reservoir tank and the trough tank is the same and is shown by reference numeral 40-41. The reservoir tank is shown to be held in position by holding bars 30.

[0024] The apparatus of Figures 3A and 3B is shown by reference numeral 200. The trough exit valve, not electronically operated but continuously in operation, is shown by reference numeral 36. The empty section of the reservoir tank 3 is shown by reference numeral 11 with the additive shown by reference numeral 12 and the level of additive shown by reference numeral 40. By the same token, in Figure 5 the empty portion of the trough tank is indicated by reference numeral 31 and the flush water in the trough is indicated again by reference numeral 21 with the upper level of the flush fluid indicated by reference numeral 41.

[0025] Referring to the check valves shown in Figures 7A, 7B, 7C, 7D, 7E, 7F, 7G, 8A, 8B, 8C, 8D, 8E, 8F and 8G, the check valve bodies are shown by reference numeral 5. The lower orifice of each of the check valves is shown by reference numeral 18, and the upper openings of the check valve are indicated by reference numeral 8 and reference numeral 38. The orifice indicated by reference numeral 8 has a diameter less than the diameter of the check valve ball, indicated by reference numeral 7. Openings 38 are necessary in order to enable continuous diffusion of the additive liquid with the flush water, even though the check valve ball 7 is checked at orifice 8. The check valve ball indicated by reference numeral 7a is a "sponge-like" ball. The check valve ball indicated by reference numeral 7b in Figure 7C is a hollow ball having an inner void 71 and a shell 72 and having inner diameter $\mathbf{R_4}$ and outer diameter $\mathbf{R_3}$. The check valve cylinder in Figure 7F is indicated by reference numeral 7d and the check valve ball in Figure 7G is indicated by reference numeral 7c.

[0026] Referring to the novel check valve shown in Figures 9A, 9B and 9C, ribs 49 hold in place check cylinder 39 having a lower orifice 8a and an upper orifice indicated by reference numeral 8. The spacing between ribs 49 is indicated by reference numeral 38. The diameter of check valve ball 7 is greater than either the greatest dimension of orifices 38 or the diameter of orifice 8a. The body of the check valve of Figure 9A is indicated by reference numeral 5a. The lower orifice of the check valve of Figure 9A is indicated by reference numeral 18. The diameter of the lower orifice 18 is less than the diameter of the check valve ball 7 in order to prevent the check valve ball from falling out of the check valve.

[0027] The check valve as specifically set forth in Figures 9A, 9B and 9C is in and of itself a novel article. Specifically the check valve comprises:

(a) a substantially conical frustum outer hollow shell having an open top, having a substantially circular surface of

diameter D_U and an open bottom having a substantially circular orifice of diameter D_B and a length of L_F;

(b) a concentric hollow circular or elliptic cylinder fixedly mounted within said hollow frustum having a common top with said hollow frustum and having a diameter D_C and length L_C; and

(c) a substantially spherical or ellipsoidal ball having an outer solid surface and internal solid, liquid or gaseous volume located within said frustum, bounded by the lower bottom of said frustum and the lower bottom of said cylinder, having an effective diameter D_S and density ρ_S, said ball being freely moving in the vertical direction, bounded by the outer hollow shell of said conical frustum, the bottom orifice of said concentric cylinder, and the bottom orifice of said conical frustum shell, further limited by the following inequalities:

(i) $D_U > D_S > D_C \geq D_B$;

(ii) $L_F > L_C$;

(iii) $D_S > \frac{D_U - D_C}{\alpha}$;

(iv) $1\ mm \geq D_B \geq 0.1\ mm$;

(v) $1\ mm \geq D_U \geq 0.25\ mm$;

(vi) $\rho_S < 1$;

(vii) $2\ mm \geq L_F \geq 1\ mm$; and

(viii) $L_F \geq 3\,L_C$.

[0028] The density inequalty, $\rho_S < 1$, is in units of grams per cubic centimeter. All unidimensional units are in millimeters.

[0029] Preferably, the novel check valve of our invention has each part fabricated from high density polyethylene. However, other materials of construction are also useful. Thus, the ball of the check valve may be fabricated from materials other than high density polyethylene, for example, low density polyethylene or ethyl cellulose. The body of the check valve and all parts thereof can also be fabricated from teflon (polytetrafluoroethylene).

[0030] The novel check valve article of our invention as stated, supra, is useful in the apparatus of Figures 1, 2 or 3 and is particularly useful in cases where a fluid level controller is used (as is illustrated in Figure 2G, described, supra).

[0031] Referring to Figure 10 which sets forth the flushing mechanism of prior art, U.S. Letters Patent No. 3,946,448, when the flushing mechanism is actuated, the flushing water, flowing under pressure through the terminal pipe connection 201 for the water supply into the cavity 202 defined by the bowl edge 203, acts upon the left side of the top surface of a distributing flap 204 which is thereby pivoted about a hinge 206 which is positioned at the right end of the distributing flap 204 and secured to the casing of a valve capsule 205. The downward pivoting movement of the flap 204 is against the bias of the spring pressure of a valve spring (not shown) mounted in the valve capsule. In this process, the valve cone 208, rigidly connected to the distributing flap 204, moves downward and therefore away from its seat in the bottom wall of the casing of valve capsule 205. When the valve cone 208 is unseated, purifying and disinfecting liquid is discharged through the valve opening, with the liquid being continuously fed under light pressure through a thin hose 209 communicating with the upper area of the valve capsule from the storage container (not shown), preferably, according to U.S. Letters Patent No. 3,946,448, arranged at a higher level for gravity flow of the liquid.

[0032] Referring to Figure 11, the cleansing and freshening unit of European Published Patent Application No. 538,957, the unit is essentially composed of a container 301 having a suspension hook 302, a bottle 303 with cleansing and odorizing liquid and a spongy liquid permeable closure 304B. In the operative position shown in Figures 11 and 12 in which the bottle is inverted, the closure 304B is in liquid-transmisive contact with a generally disk shaped, porous member 304A of a porous substance, which member 304A is arranged on the bottom 305 of the container. Thus, with respect to Figure 11, the container 301 has a bottom 305 with perforations or aperatures 306 and an upright sidewall 307 in which passages 308 may be formed. Extending from the bottom 305 are retaining means 309 and 310 for securing a liquid reservoir or bottle 311. In the embodiment shown in European Published Application No. 538,957, the retaining means are resilient strips 309 having inwardly directed projections 310.

[0033] Referring to Figure 13, the bottle 303, which is refillable, comprises a mouth or neck 311 with two rings 312 and 313 formed on the exterior thereof and capable of being closed by means of a cap 314 having a ring 315 extending inwards from the surface thereof, which ring 315 is capable of being snapped between the bottle neck rings 312 and 313. Figure 13 further shows an annular label 316 which can be removed after undoing cap 314. Arranged in the bottle neck 311 is the spongy closure member 304B. Further referring to Figure 13, fitting a full bottle 303 in the container 301 is effected by removing the cap 314 and the label 316 and moving the bottle in inverted position into the container 301 with projections 310 of the resilient retaining strips 309 snapping between the rings 312 and 313 formed on the bottle neck 311. In the mounted condition of the bottle, the axial positions of the rings 312, 313 and the projection 310 as well as the axial dimensions of the porous masses 304A and 304B are such that when the bottle 303 has been fitted in the container 301, the members 304A and 304B are in fixed mutual contact. Furthermore, bottle 303 comprises radial gripping ribs 317. The bottom of the bottle 303 is convex so as to prevent water from being retained on the bottom of the bottle in the service position.

[0034] Referring to Figure 14, the block flow diagram illustrating the process of our invention, deodorizer and/or cleanser and/or aromatizer at location 140 is fed through line 141 past valve 142 through line 143 into reservoir 144. Subsequently, flush water from location 153 (e.g., tank 18) is passed through line 154 past valve 155 into catch trough 152. When the flush water in the catch trough reaches the height of the check valve which is part of the reservoir means, flush water diffuses into the aromatizing composition and/or deodorizing composition and/or cleansing composition located in the reservoir 144, through line 149 past valve 148. The resulting mixture of flush water and aromatizing composition and/or deodorizing composition and/or cleansing composition is then passed through line 158 past valve 156 into toilet basin 157. All of the flush water may be conveyed through line 154 past control valve 155 into the catch trough, but more preferably and practically, a fraction of the flush water proceeds from the flush water source at location 153 to the trough 152. Such a fraction may vary between about 10% and 20% of the entire flush water rate. The remainder of the flush water goes directly to the toilet through line 161 past control valve 160.

[0035] Referring to Figure 15, the aromatizing composition and/or deodorizing composition and/or cleansing composition may be varied according to specific ingredients and quantity and concentration of composition components using electronic program controller 400 via control line 140c. The overall data processing system is indicated by reference numeral 400c. Market input and feedback (401) is indicated by lines 401c (feedback) and line 400c (input). The rate of flow of aromatizing composition and/or deodorizing composition and/or cleansing composition through line 141 past control valve 142 is controlled via control line 142c. The level of aromatizing composition and/or deodorizing composition and/or cleansing composition in the reservoir using level controller $\mathbf{L_1}$ (indicated by reference numeral 174) and the level of the flush water in the trough and rate of change of such level in the trough 152 controlled by level controller 172 is optimized via control line 172c. Both levels are optimized in unison and in combination with one another via control line 176c. The rate of flow and rate of diffusion between the additive in the reservoir and the flush water in the trough is controlled via CAD techniques via control line 150c so that, if necessary, the check valve designs and number of check valves can be changed as a result of market input and feedback. The rate of flow and design of exit means from the trough into the toilet past valve 156 through line 158 is controlled via control line 156c, which also controls the timing of opening and closing the exit means from the trough (when such timing exit means is part of the design). The rate of flush water fraction being conveyed into the trough versus the rate of flush water fraction proceeding directly into the toilet is controlled through control lines 155c and 160c, respectively. The diffusion of flush water from the trough back into the reservoir is a function of flush water rates as well as check valve designs and check valve numbers in the reservoir wall, and the rates and design of the check valves and location thereof are controlled via control lines 146c and 148c.

[0036] Referring to the software program designed for use in conjunction with the design of the apparatus and process of our invention, the program starts at location 501 with additive composition including nature of additives and quantity of components being set at location 502. This is followed by setting the rate of additive flowing into the trough from the reservoir and the computer assisted design of the check valve(s) at location 504. The partial flush water rates and ratio of flush water going into the trough versus flush water going directly into the toilet are set at location 505 with the trough exit rate being set at location 506. The instruction for the operation of the system is set out at location 507 with the ascertainment of whether the market "likes" the fragrance being done at location 508. An answer of "yes" at location

510 (based on scaled market research input data, for example, on a scale of 1-100) means that the next question at location 511 is raised, to wit: "Does the market "like" the system?" An answer of "no" to the question, "Does the market like the fragrance?" requires a redesign at location 509 of the additive composition and ratio of component types as well as composition. Whether the market "likes" the system (again on a scale of 1-100) is a function of a series of variables, not only concerning the additive components and ratios thereof, but also the design of the check valves; the rates of additive into the trough from the reservoir; the ratio of flush water going into the trough versus flush water going directly into the toilet; as well as the trough exit rate. Thus, an answer of "no" at location 514 requires a redesign of the entire system at location 515. An answer of "yes" to the question, "Does the market like the system?" gives rise to an actual marketing of the system at location 513.

[0037] It is to be understood that in all cases where a particular rate is "set" or market research data is examined in order to answer the question (on a scale of 1-100): "Does market like fragrance?" the data is stored in a computer hardware memory.

[0038] The following examples serve to illustrate embodiments of our invention as it is now preferred to practice it, with reference to using cleansing and/or aromatizing and/or deodorizing additives. It will be understood that these examples are illustrative and that the invention is to be considered restricted thereto only as defined in the appended claims.

EXAMPLE I

[0039] The following perfume oil is prepared:

Ingredients	Parts by Weight
Para cresol	1
Acetyl methyl anthranilate	20
Farnesol	4
Nerolidol	30
Indol	30
Eugenol	15
Benzyl alcohol	20
Methyl linoleate	40
Jasmin lactone	40
Dihydromethyl jasmonate	10
Linalool	150
Benzyl acetate	400
Abietyl alcohol	150
cis Jasmone	50

[0040] The following formula is prepared using the above perfume composition:

Ingredients	Parts by Weight
Perfume composition of this Example as shown above.	1.0
Octylphenoxypolyethoxy ethanol	6.0
Parts water	93
Red beet dye	0.05

[0041] The resulting product is added to the apparatus of Figure 1 through tube 20.

[0042] The apparatus of Figure 1 is engaged whereby flush water is passed into trough 4. The apparatus of Figure 1 is used to aromatize and/or cleanse and/or deodorize a toilet basin, and the toilet basin is effectively deodorized and/or aromatized and/or cleansed using the apparatus of Figure 1 and the composition of Example 1.

EXAMPLE II

[0043] The following mixture is prepared:

Ingredients	Parts by Weight
DeodIFF® perfume oil, as set forth in Example I, supra	1.5
Sodium dodecyl diphenyloxide disulfonate	10.0
Ethyl dimethyl benzyl ammonium chloride	0.3
Water	88.2

[0044] The resulting mixture is placed into the apparatus of Figures 3A and 3B. On engagement of said apparatus using the mixture as set forth in this Example, supra, the resulting toilet basin is aromatized in an esthetically pleasing manner; is deodorized and cleared of malodors; and is appropriately cleansed.

EXAMPLE III

[0045] The following mixture is prepared:

Ingredients	Parts by Weight
Perfume oil of Example I	2.0
Polyoxyethylene (20) stearyl ether	10.0
Hydroxyethyl cellulose (80,000 molecular weight)	2.0
Water	86.0

[0046] When the above formulation is placed in the reservoir of the apparatus of Figure 2G and used to aromatize and/or cleanse and/or deodorize a toilet basin, the formulation of this Example III worked efficiently and efficaciously in cleansing and/or deodorizing and/or aromatizing the toilet basin upon which the operation was carried out.

[0047] The features disclosed in the foregoing description, in the following claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. Apparatus for deodorizing and/or cleansing and/or aromatizing a toilet basin having at least one inside wall which uses flushing water, comprising:

   (1) gravity conveying means for conveying deodorizing and/or cleansing and/or aromatizing compositions into reservoir means;

   (2) reservoir means equipped with deodorizing and/or cleansing and/or aromatizing composition first exit means for controllably gravity diffusing a deodorizing composition and/or a cleansing composition and/or an aromatizing composition into a finite fraction of said flushing water with said first exit means being engaged and activated on contact with said flushing water and being disengaged and deactivated on removal of said flushing water;

(3) second conveying means for conveying said finite fraction of flushing water into trough means for holding said finite fraction of the flushing water; and

(4) trough means for (a) holding said finite fraction of flushing water and (b) receiving deodorizing compositions and/or cleansing compositions and/or aromatizing compositions from said first exit means from said reservoir means whereby said finite fraction of flushing water is admixed with said deodorizing composition and/or cleansing composition and/or aromatizing composition emanating from said first exit means of said reservoir means, said trough means being equipped with flush water-deodorizing composition and/or cleansing composition and/or aromatizing composition exit means for controllably gravity diffusing flush water-deodorizing and/or cleansing and/or aromatizing compositions into a toilet basin;
said apparatus being removably attached to an inner wall of said toilet basin.

2. A repeating process for deodorizing and/or cleansing and/or aromatizing a toilet basin which uses flushing water consisting essentially of the steps of:

(1) conveying a deodorizing and/or a cleansing and/or an aromatizing composition into reservoir means which is equipped with first exit means for controllably gravity diffusing said deodorizing composition and/or said cleansing composition and/or said aromatizing composition into flush water;

(2) conveying flush water into trough means;

(3) controllably gravity diffusing deodorizing and/or cleansing and/or aromatizing compositions through said first exit means into said trough means as a result of conveying into said trough means flush water which activates and engages said first exit means; and

(4) conveying the flush water-deodorizing and/or cleansing and/or aromatizing compositions in said trough means through second exit means for controllably gravity diffusing said flush water-deodorizing and/or cleansing and/or aromatizing compositions into said toilet basin.

3. The apparatus of Claim 1 for deodorizing and/or cleansing and/or aromatizing a toilet basin equipped with liquid water flush means comprising:

(1) a substantially fully enclosed reservoir container for containing a deodorizing and/or cleansing and/or aromatizing liquid having an upper reservoir section and communicating therewith a lower reservoir section;

(2) a trough container having an inner void and having a longitudinal dimension greater than that of the reservoir container, surrounding at least the lower reservoir section of the reservoir container with said container being fixedly mounted within said trough container and with the outer walls of said reservoir container being spaced from the walls of said trough container;

(3) refill means in the form of a hollow tube mounted in the upper reservoir section of said reservoir container and communicating with said upper reservoir section;

(4) at least one reservoir container exit orifice having an effective diameter $\mathbf{D_R}$ located substantially at the lowest extremity of the lower reservoir section of said reservoir container, communicating with the inner void of said trough container;

(5) inserted through and fixedly fitting said reservoir exit orifice(s) a check valve means comprising:

(a) a vertically disposed hollow check valve tube having an upper end, having at least two separate upper end openings and a lower end having one lower end opening; and

(b) contained within the hollow check valve tube a check valve ball having a substantially solid outer shell and a solid, liquid or gaseous inner volume and having an effective diameter less than the internal diameter of said hollow check valve tube and greater than the effective diameter of any of said separate upper end openings and of said one lower end opening;

(6) at least one trough container exit orifice located substantially at the lowest extremity of the trough container

having an effective diameter D_T; and

(7) fluid trough container feeding means for controllably feeding flush water during the flush period of the flush cycle into the trough container to a level h_β intermediate between the level of the reservoir container exit orifice h_δ and a level of said lower reservoir section of said reservoir container below the height h_α;
the check valve component dimensions and check valve ball physical properties being such; and the trough outlets being so designed that (a) the quantity of reservoir additive released into said trough per flush is substantially between about 1.0% by weight and about 10.0% of the initial quantity of reservoir additive present in the reservoir; and (b) the quantity of trough liquid which back diffuses into the reservoir liquid, per flush, is less than 5.0% of the initial quantity of reservoir liquid.

4. A check valve comprising:

(a) a substantially conical frustum outer hollow shell having an open top having a substantially circular orifice of diameter D_U and an open bottom having a substantially circular orifice of diameter D_B and a length of L_F;

(b) a concentric hollow circular or ellipitic cylinder fixedly mounted within said hollow frustum having a common top with said hollow frustum and having a diameter D_C and a length L_C;

(c) a substantially spherical or ellipsoidal ball having an outer solid surface and internal solid, liquid or gaseous volume located within said frustum bounded by the lower bottom of said frustum and the lower bottom of said cylinder having an effective diameter D_S and a density ρ_S,
wherein the check valve is limited by the following inequalities:

(i) $D_U > D_S > D_C \geq D_B$;

(ii) $L_F > L_C$;

(iii) $D_S > \frac{D_U - D_C}{\alpha}$;

(iv) $1\ mm \geq D_B \geq 0.1\ mm$;

(v) $1\ mm \geq D_U \geq 0.25\ mm$;

(vi) $\rho_S < 1$;

(vii) $2\ mm \geq L_F \geq 1\ mm$; and

(viii) $L_F \geq 3\,L_C$.

5. The check valve of Claim 4 having each part fabricated from high density polyethylene.

6. The apparatus of Claim 1 wherein the first exit means is the check valve comprising:

(a) a substantially conical frustum outer hollow shell having an open top having a substantially circular orifice of diameter D_U and an open bottom having a substantially circular orifice of diameter D_B and a length of L_F;

(b) a concentric hollow circular or ellipitic cylinder fixedly mounted within said hollow frustum having a common top with said hollow frustum and having a diameter D_C and a length L_C;

(c) a substantially spherical or ellipsoidal ball having an outer solid surface and internal solid, liquid or gaseous volume located within said frustum bounded by the lower bottom of said frustum and the lower bottom of said cylinder having an effective diameter D_S and a density ρ_S, wherein the check valve is limited by the following inequalities:

(i) $D_U > D_S > D_C \geq D_B$;

(ii) $L_F > L_C$;

(iii) $D_S > \frac{D_U - D_C}{\alpha}$;

(iv) $1\ mm \geq D_B \geq 0.1\ mm$;

(v) $1\ mm \geq D_U \geq 0.25\ mm$;

(vi) $\rho_S < 1$;

(vii) $2\ mm \geq L_F \geq 1\ mm$; and

(viii) $L_F \geq 3\ L_C$.

7. The apparatus of Claim 3 wherein at least one check valve means fitted in a reservoir orifice is a check valve comprising:

(a) a substantially conical frustum outer hollow shell having an open top having a substantially circular orifice of diameter D_U and an open bottom having a substantially circular orifice of diameter D_B and a length of L_F;

(b) a concentric hollow circular or ellipitic cylinder fixedly mounted within said hollow frustum having a common top with said hollow frustum and having a diameter D_C and a length L_C;

(c) a substantially spherical or ellipsoidal ball having an outer solid surface and internal solid, liquid or gaseous volume located within said frustum bounded by the lower bottom of said frustum and the lower bottom of said cylinder having an effective diameter D_S and a density ρ_S,
wherein the check valve is limited by the following inequalities:

(i) $D_U > D_S > D_C \geq D_B$;

(ii) $L_F > L_C$;

(iii) $D_S > \frac{D_U - D_C}{\alpha}$;

(iv) $1\ mm \geq D_B \geq 0.1\ mm$;

(v) $1\ mm \geq D_U \geq 0.25\ mm$;

(vi) $\rho_S < 1$;

(vii) $2\ mm \geq L_F \geq 1\ mm$; and

(viii) $L_F \geq 3\ L_C$.

8. The apparatus of Claim 1 equipped with a fluid level controller.

9. The apparatus of Claim 3 equipped with a fluid level controller.

10. The apparatus of Claim 6 equipped with a fluid level controller.

11. The apparatus of Claim 7 equipped with a fluid level controller.

12. The process of Claim 2 wherein the deodorizing and/or cleansing and/or aromatizing composition conveyed into the reservoir means is conveyed into said reservoir means in admixture with a water soluble dye.

13. The process of Claim 2 controlled by an electronic program controller system.

14. A software program for operation of the apparatus of Claim 1 comprising:

(a) entering data into the memory of computer hardware for additive composition components and quantities of additive to be placed in the reservoir means;

(b) entering data into a computer hardware memory for the rate of additive flow from the reservoir means into the trough means;

(c) entering data into computer hardware memory concerning variables for the first exit means;

(d) entering data into computer hardware memory concerning the fraction of water flush going into the trough means and the fraction of water flush going directly into the toilet basin;

(e) entering data into computer hardware memory concerning the rate of flow of flush water-reservoir additive mixture from the trough means through the second exit means into the toilet basin;

(f) entering instructions into the computer hardware memory whereby the system is operated;

(g) entering market research data into the computer hardware memory in order to determine whether the market "likes" the aroma of the additive after said additive is passed through the reservoir means and the trough means and into the toilet basin;

(h) ascertaining from the computer hardware memory whether the market data received require that the additive composition be reformulated and, if so, entering additional data into the computer hardware memory to reformulate the additive composition;

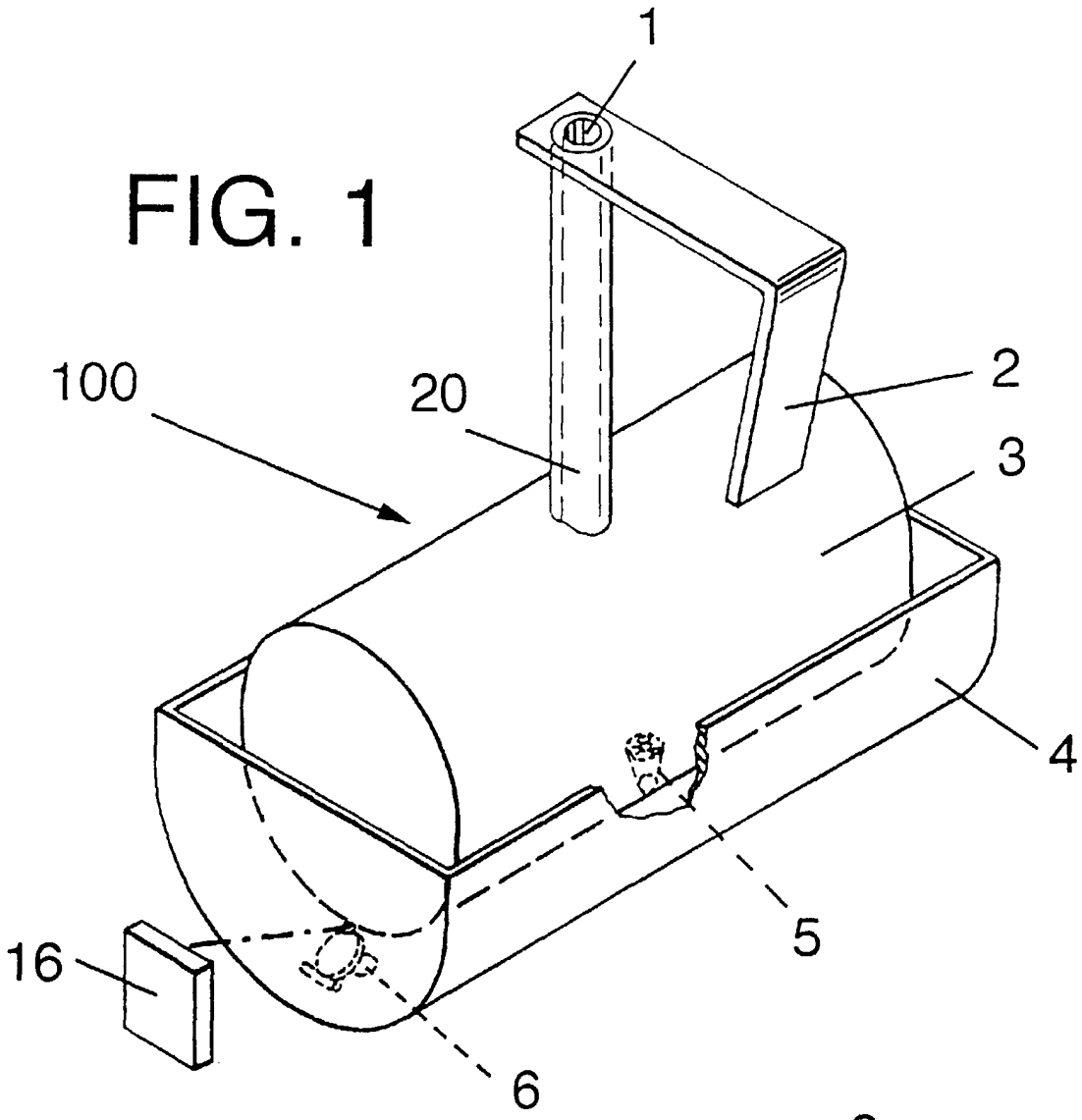
(i) if the market "likes" the fragrance, ascertaining from market data entered into the computer hardware memory whether the market "likes" the entire system;

(j) ascertaining from the data concerning whether the market "likes" the system, whether to redesign the system with respect to additive compositions; rate of flow of additive from reservoir means into trough means; first exit means design; second exit means design; flush water rate fraction going into trough means; flush water rate fraction going into toilet basin; and flush water-additive composition rate going into toilet basin from trough means; and

(k) if not, ascertaining from data stored in computer hardware memory whether to market apparatus.

15. A software program for the operation of the process of Claim 2 comprising the software as defined according to Claim 14.

FIG. 1



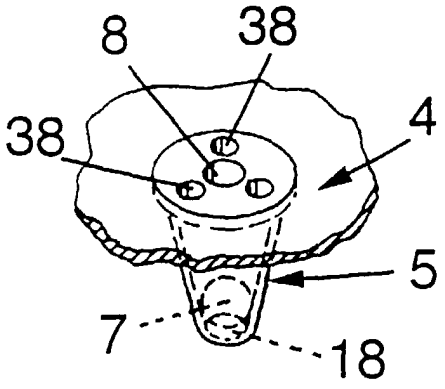


FIG. 1-A

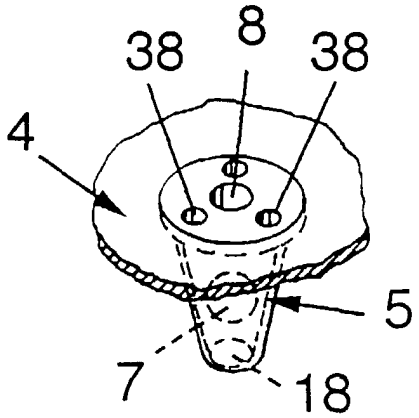


FIG. 1-B

FIG. 2-A

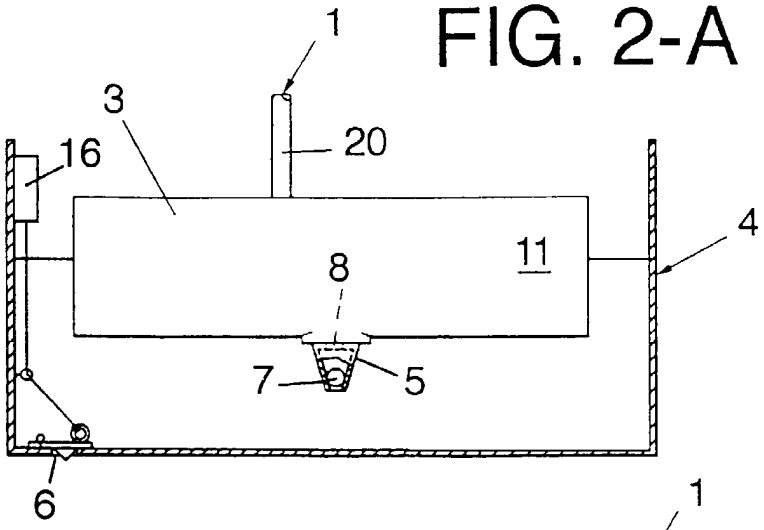
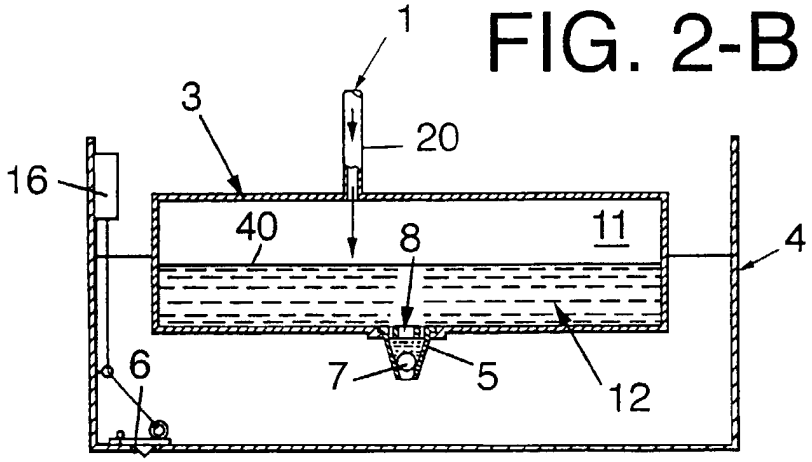


FIG. 2-B



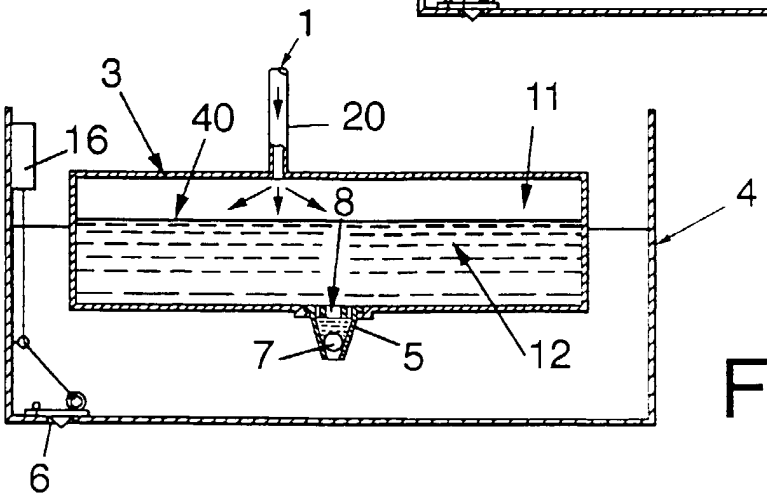


FIG. 2-C

FIG. 2-D

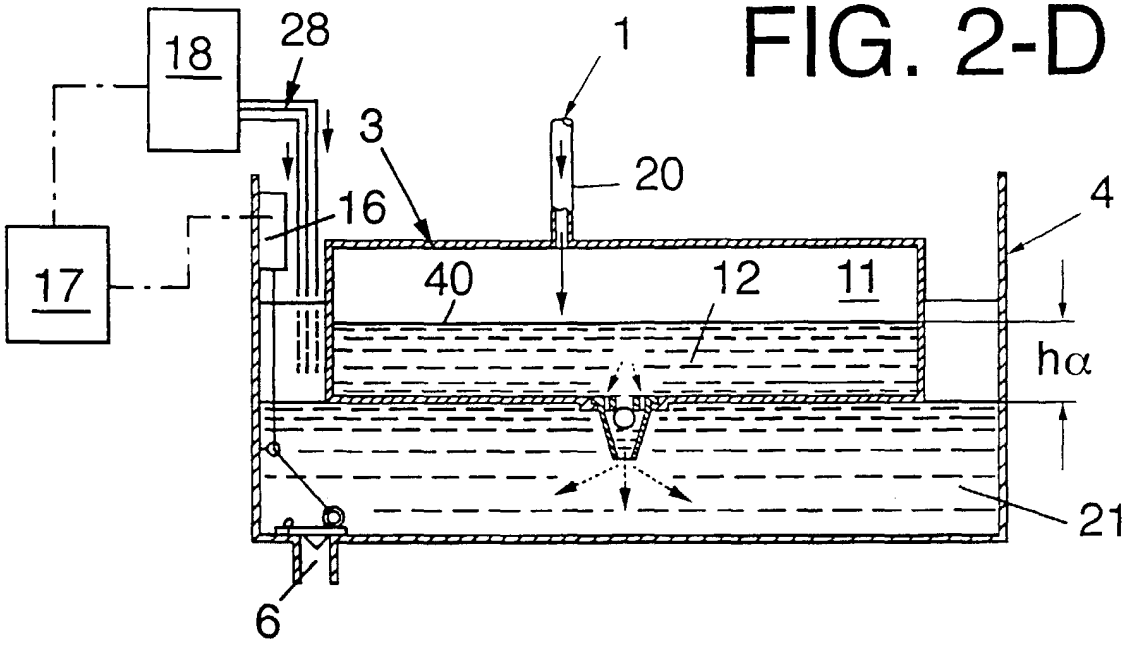

18
28
1
3
20
16
4
17
40
12
11
hα
21
6

FIG. 2-E

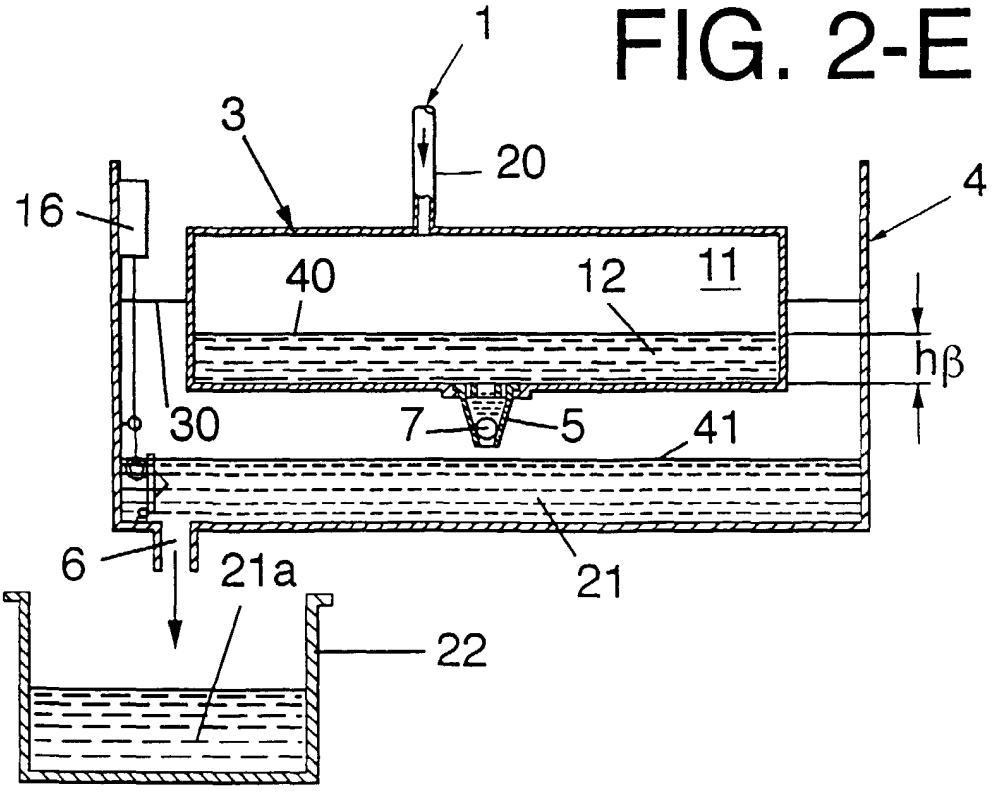
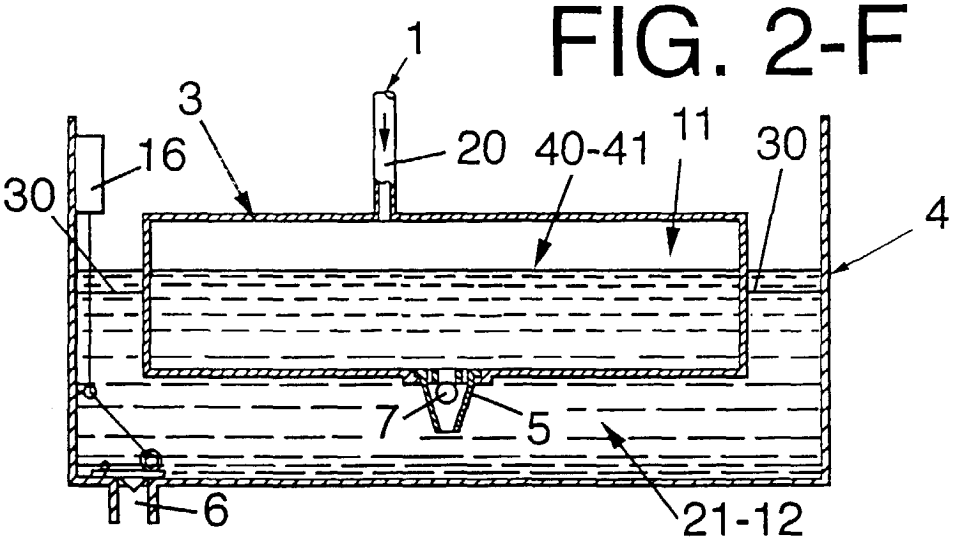

1
3
20
16
4
40
12
11
hβ
30
7
5
41
6
21a
21
22

FIG. 2-F


1
3
16
20
40-41
11
30
30
4
7
5
6
21-12

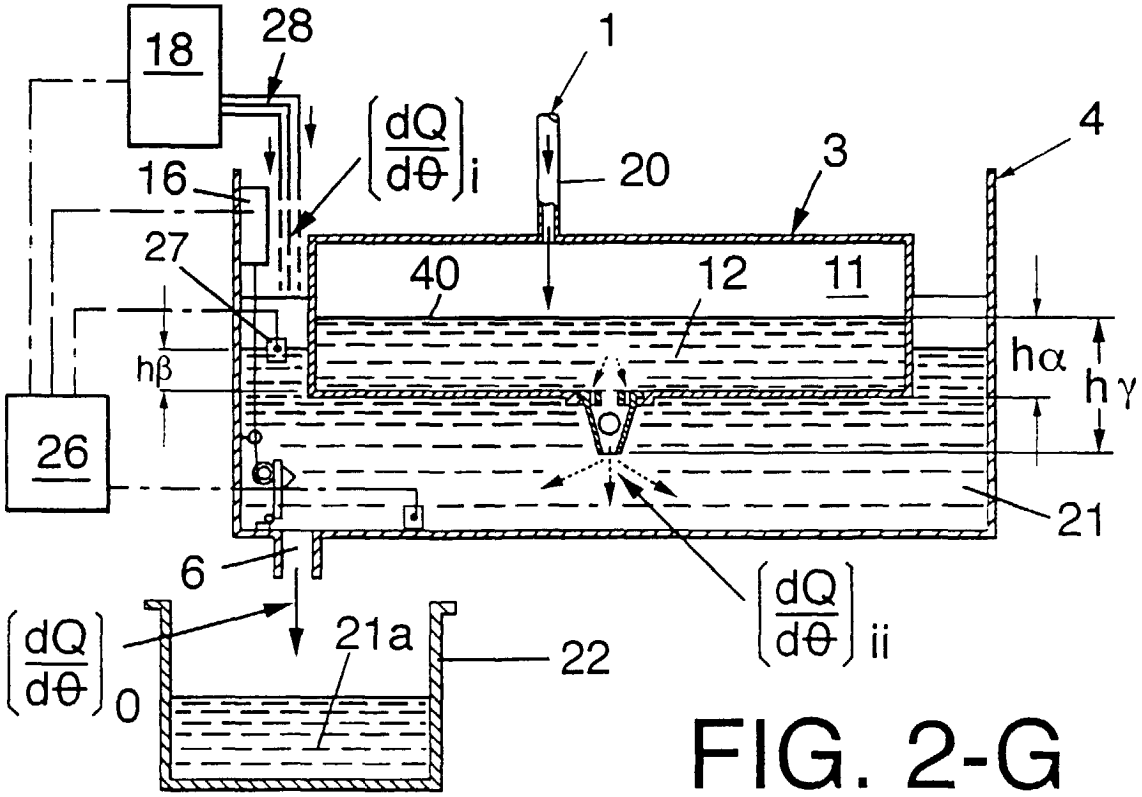

18
28
1
4
16
20
3
27
40
12
11
hβ
hα
hγ
26
21
6
21a
22
0
ii

FIG. 2-G

FIG. 3-A

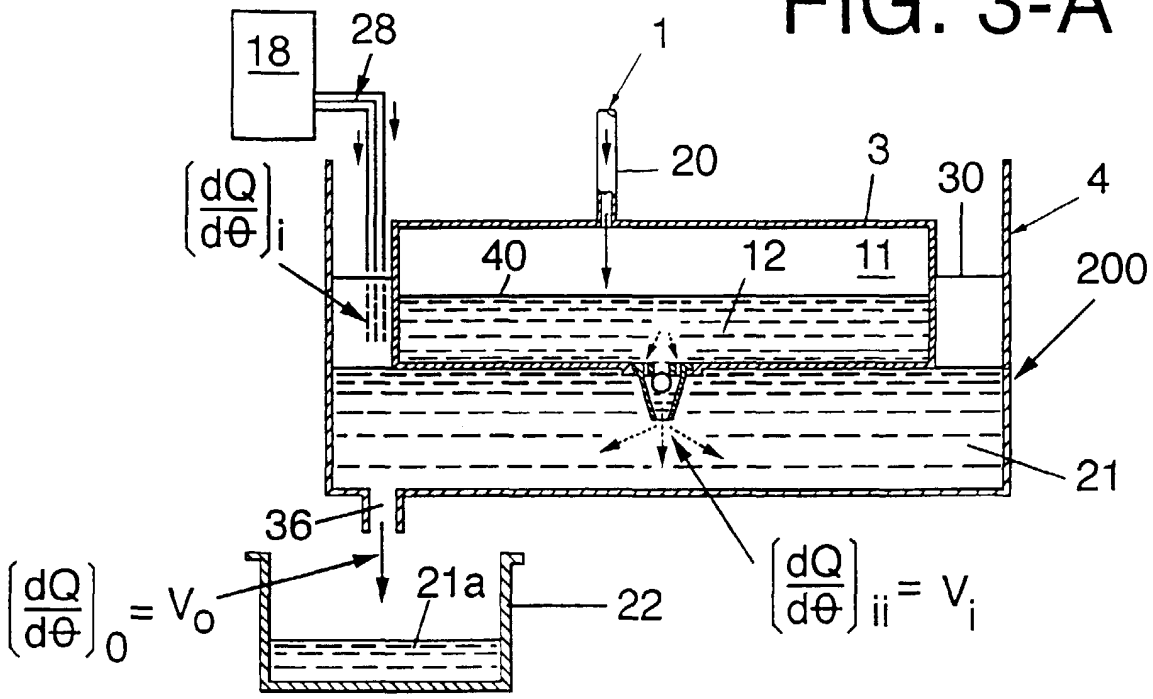

18
28
1
20
3
30
4
$\left[\frac{dQ}{d\theta}\right]_i$
40
12
11
200
21
36
21a
22
$\left[\frac{dQ}{d\theta}\right]_0 = V_o$
$\left[\frac{dQ}{d\theta}\right]_{ii} = V_i$

FIG. 3-B

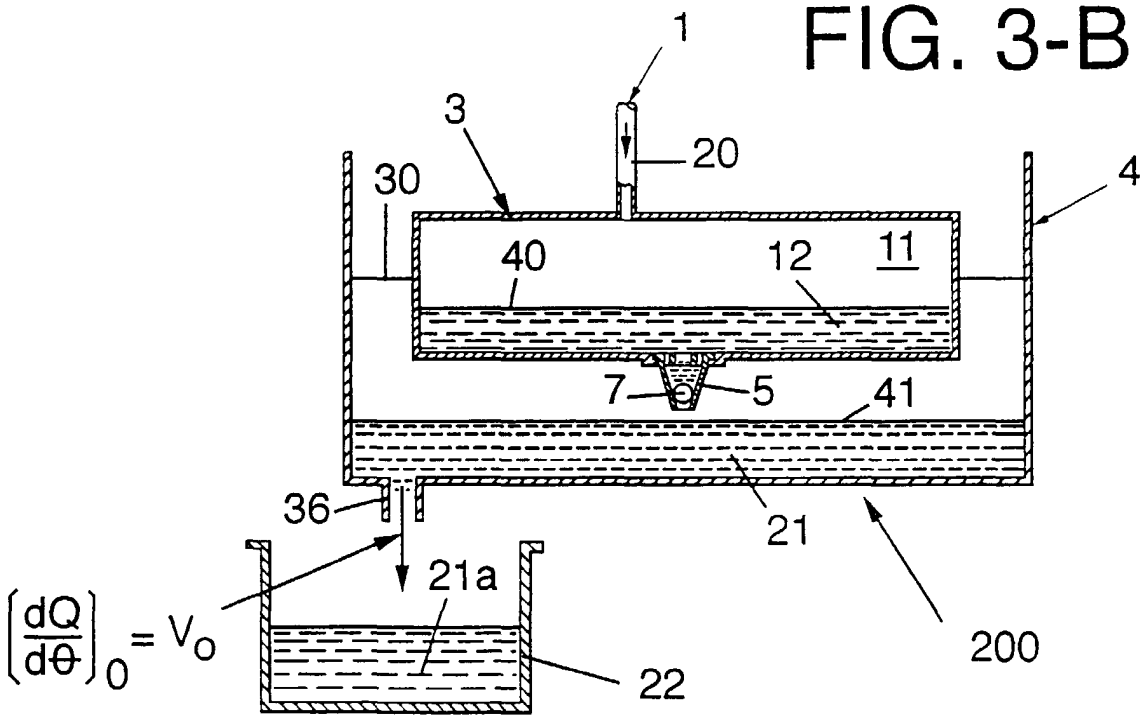

1
3
20
30
4
40
12
11
7
5
41
36
21
21a
200
22
$\left[\frac{dQ}{d\theta}\right]_0 = V_o$

FIG. 4-A

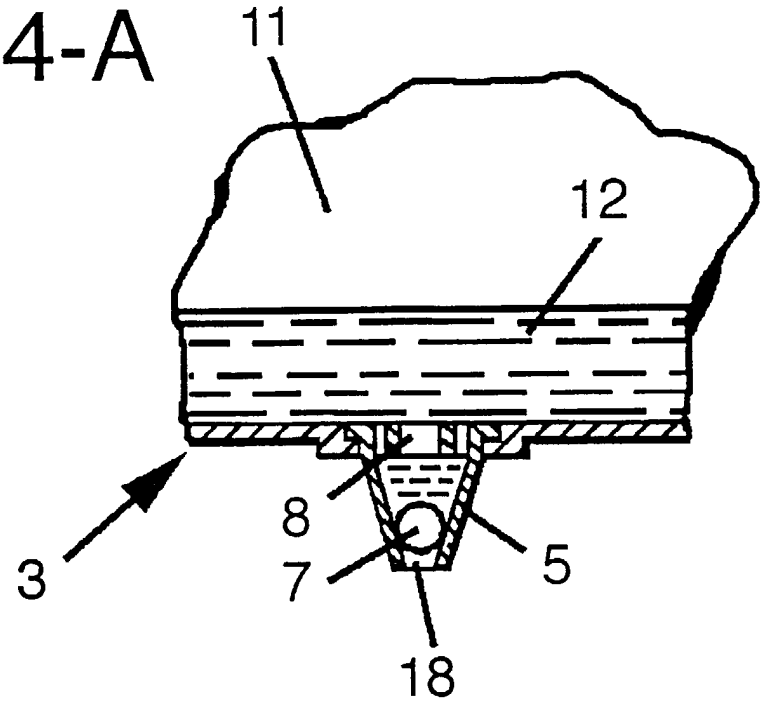


FIG. 4-B

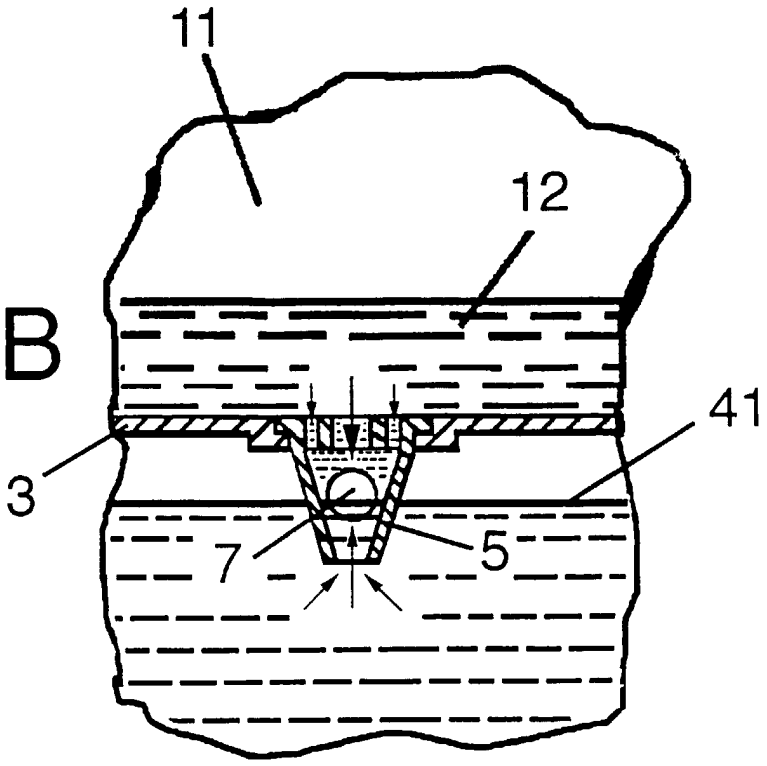
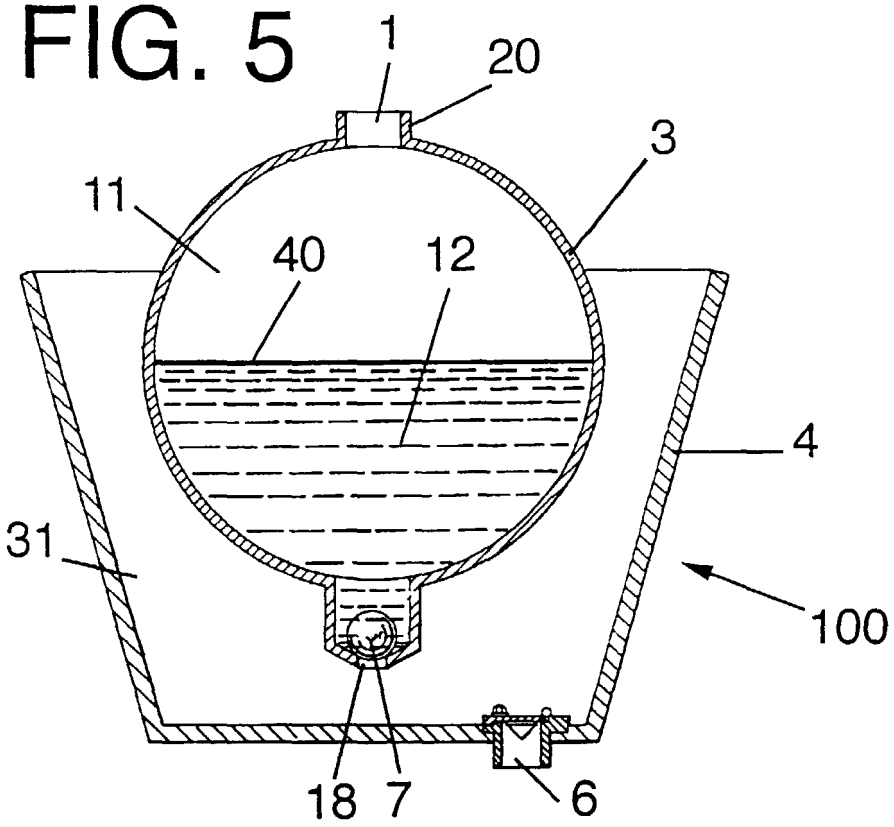


FIG. 5



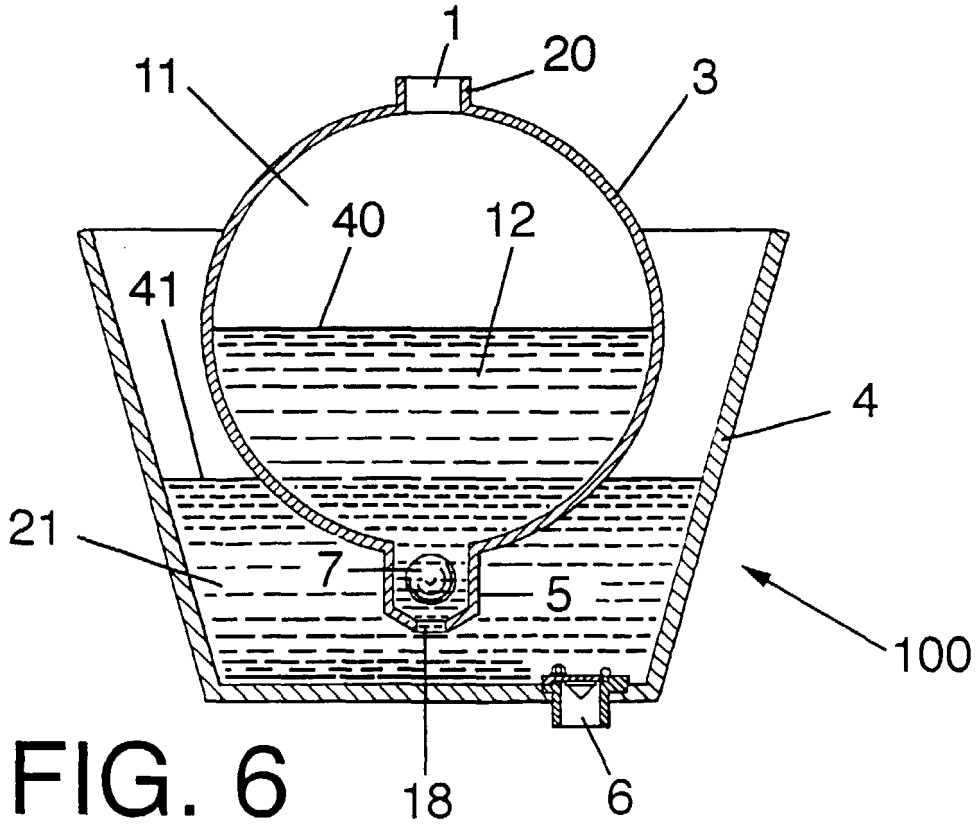
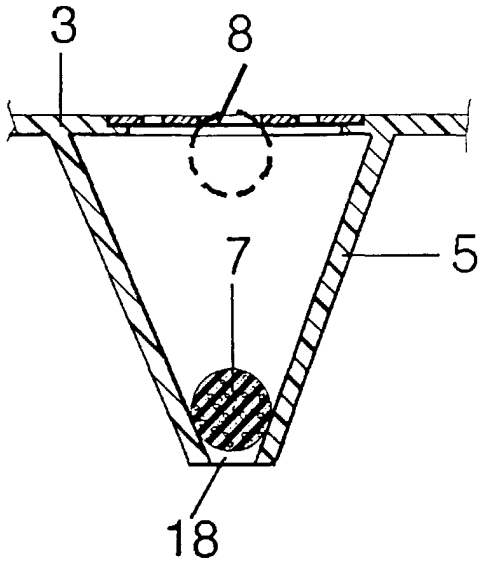


FIG. 6

FIG. 7-A



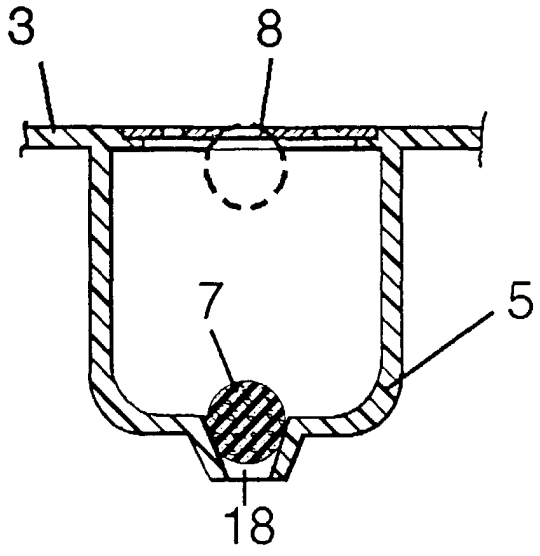


FIG. 7-B

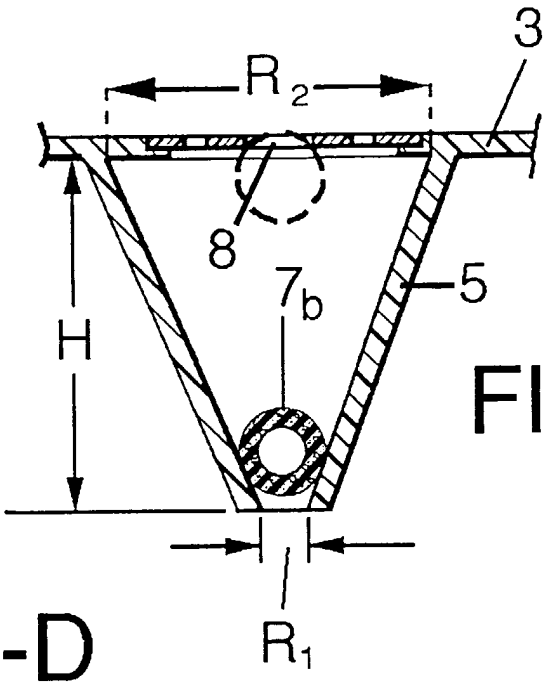
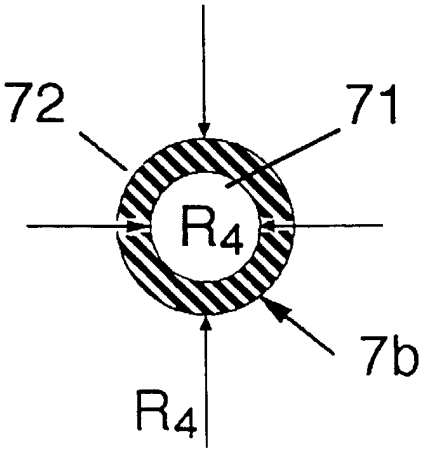


FIG. 7-C

FIG. 7-D



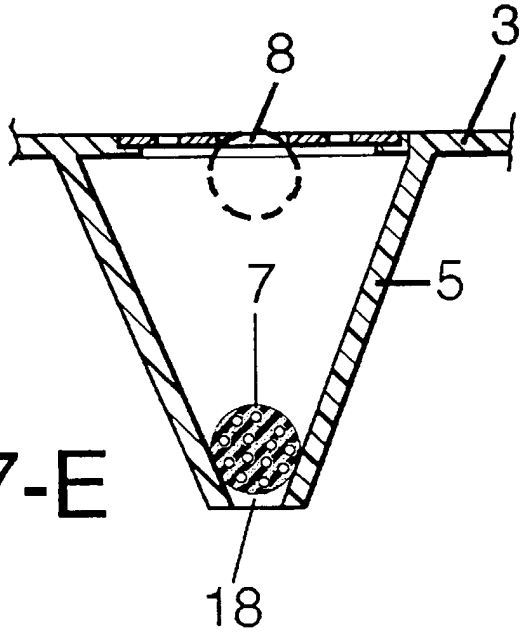
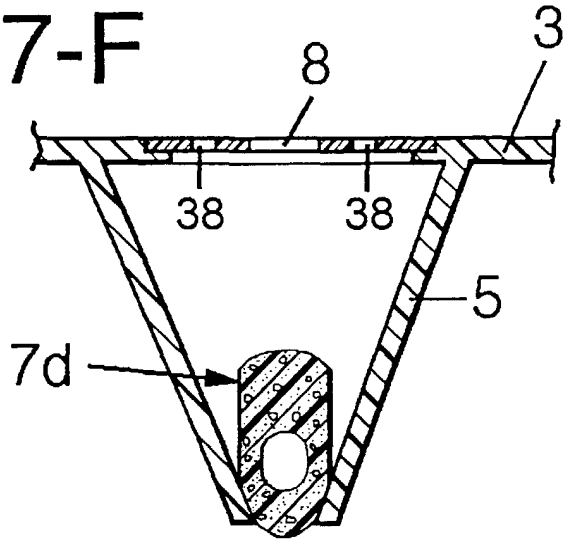


FIG. 7-E

FIG. 7-F



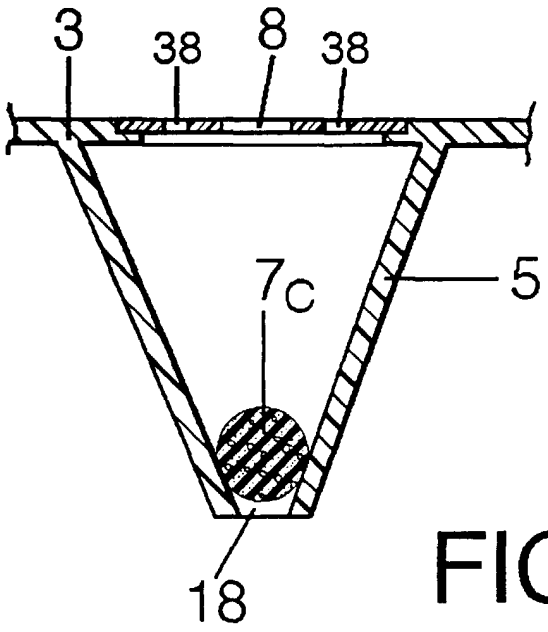
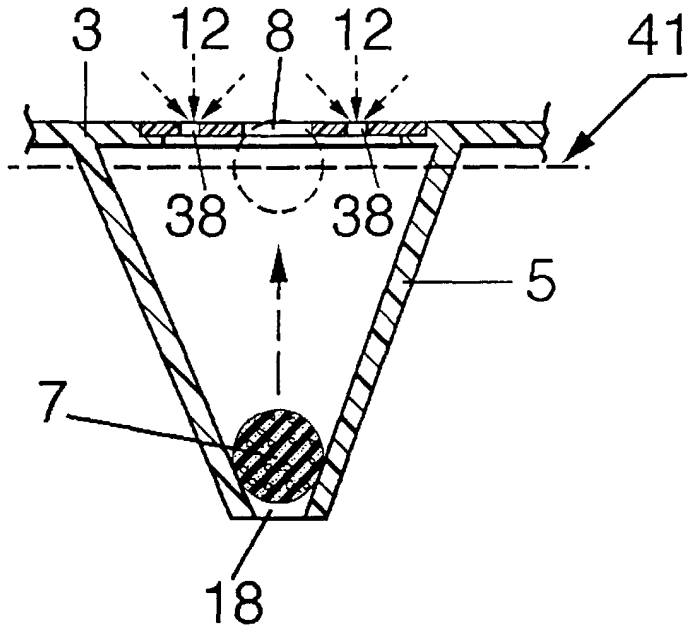


FIG.7-G

FIG. 8-A



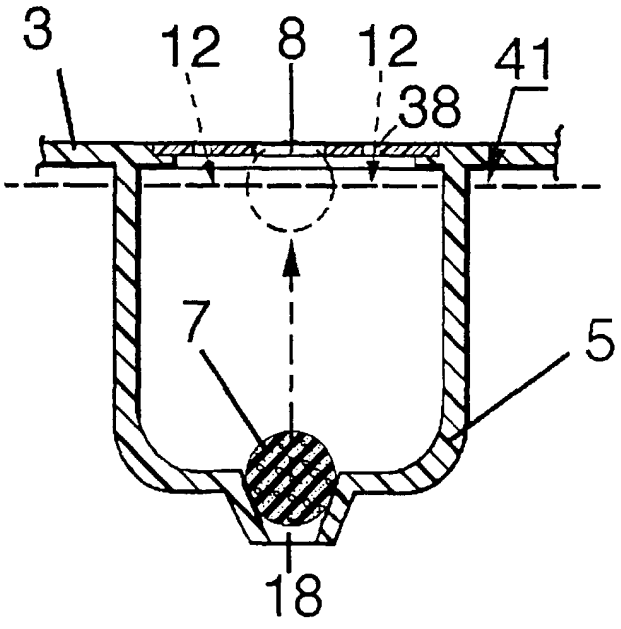


FIG. 8-B

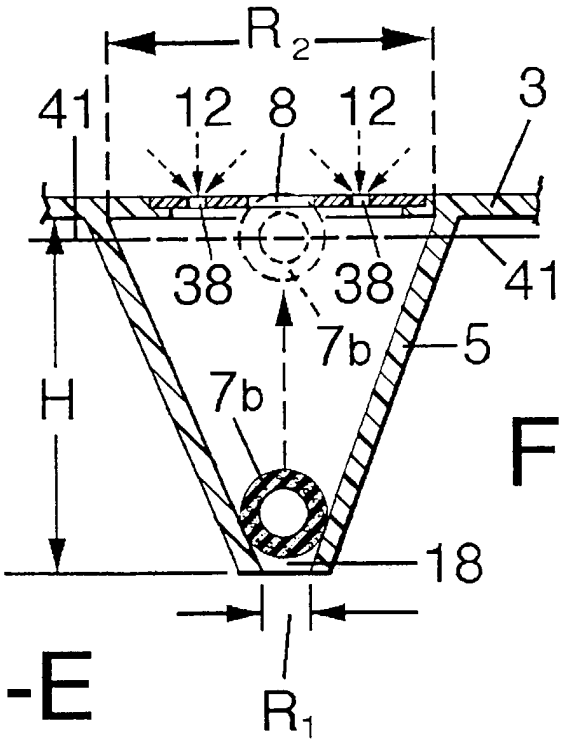
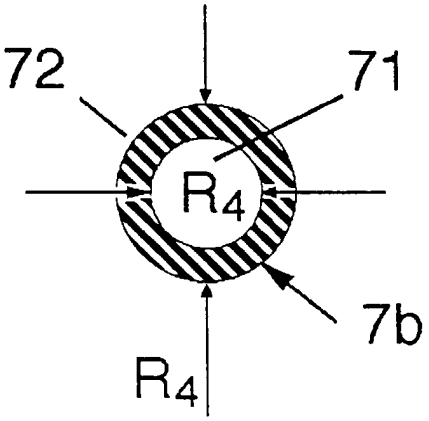


FIG. 8-C

FIG. 8-E



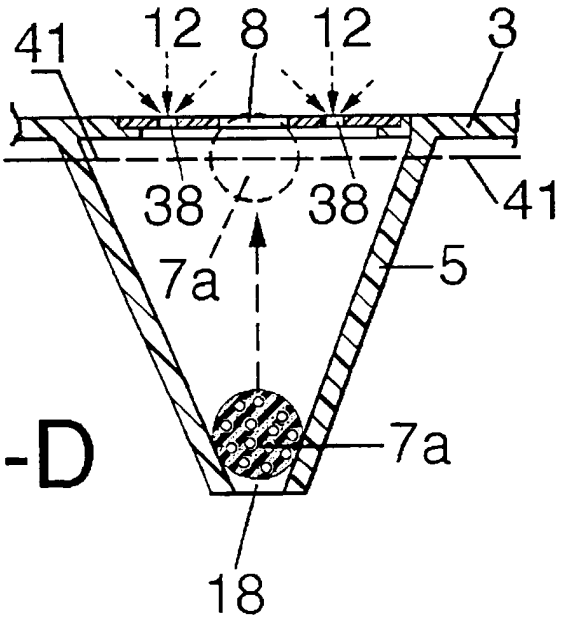
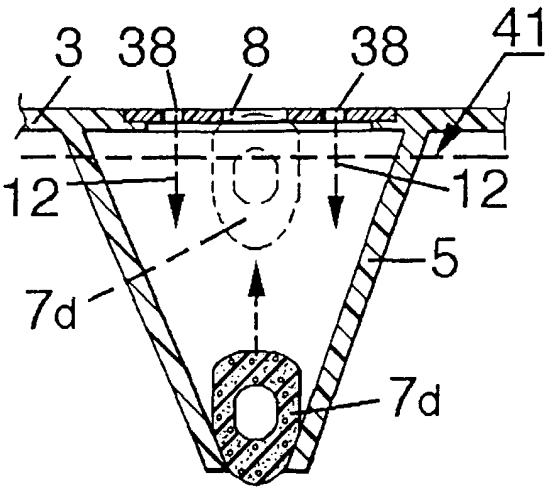


FIG. 8-D

FIG. 8.F



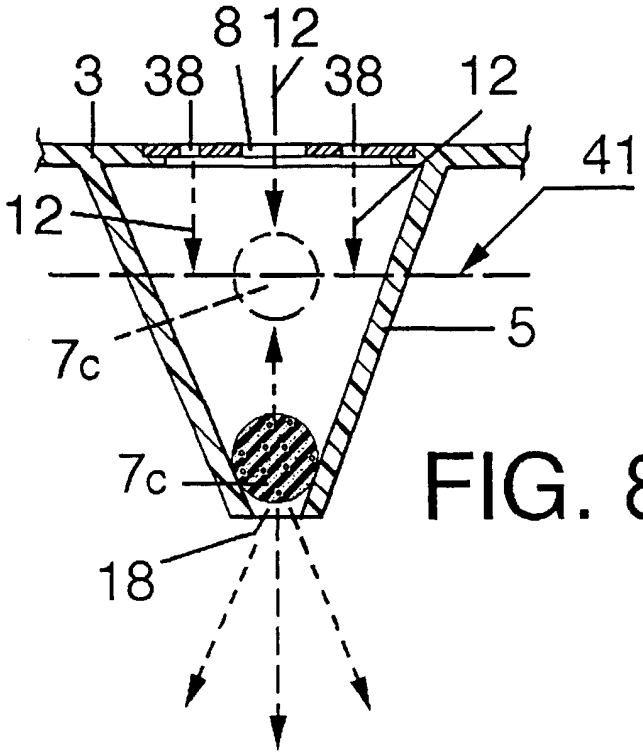
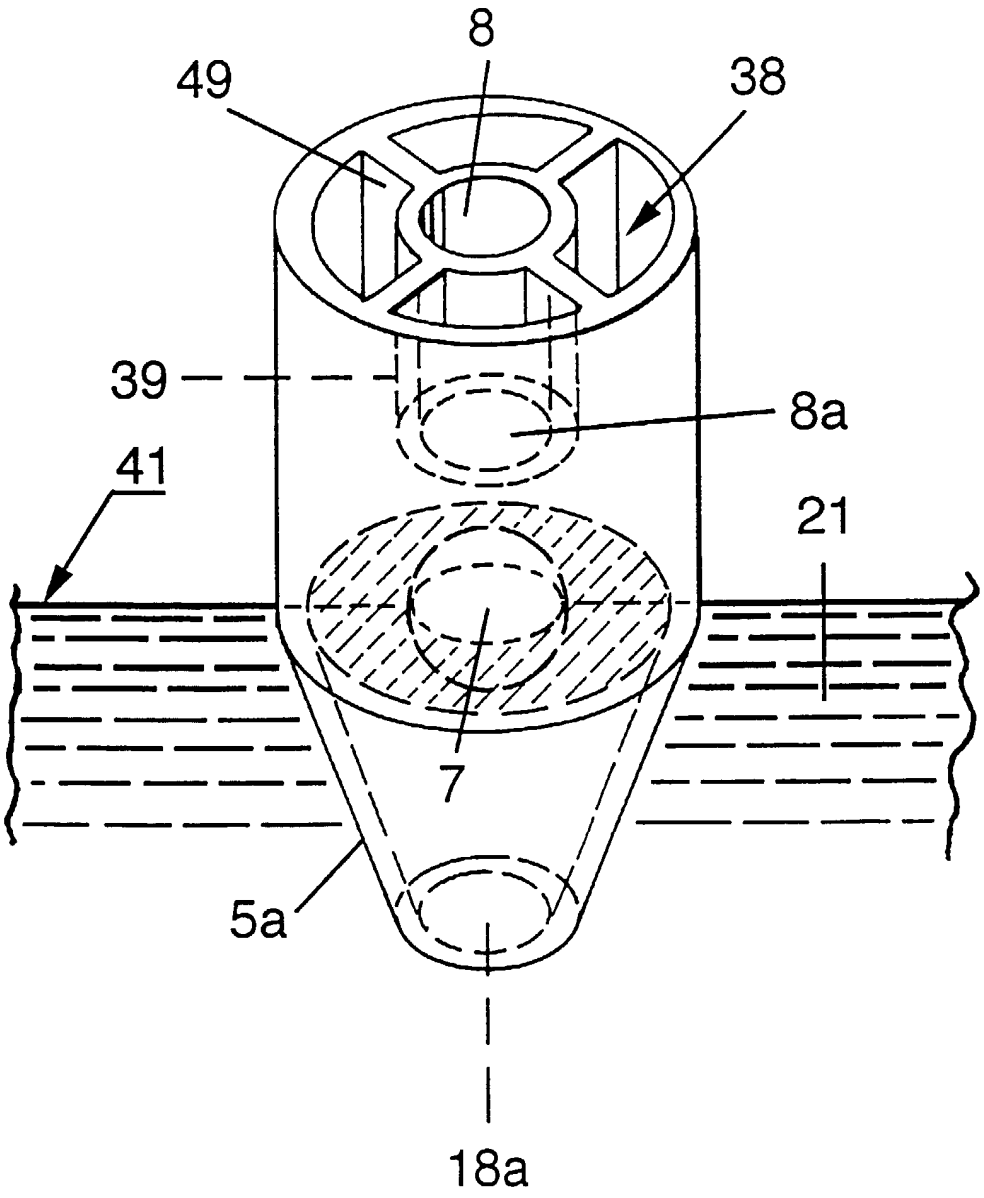


FIG. 8.G

FIG. 9-A



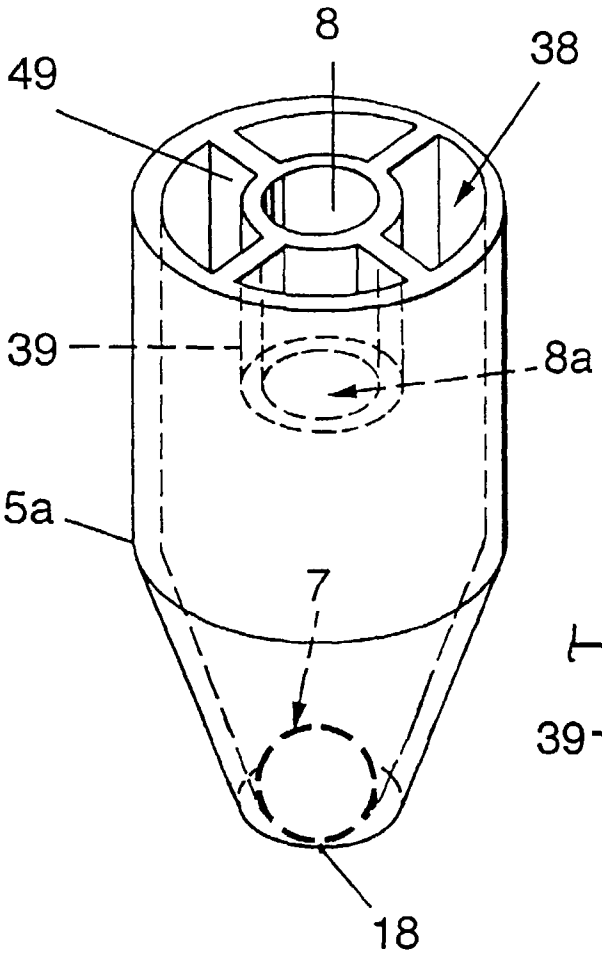
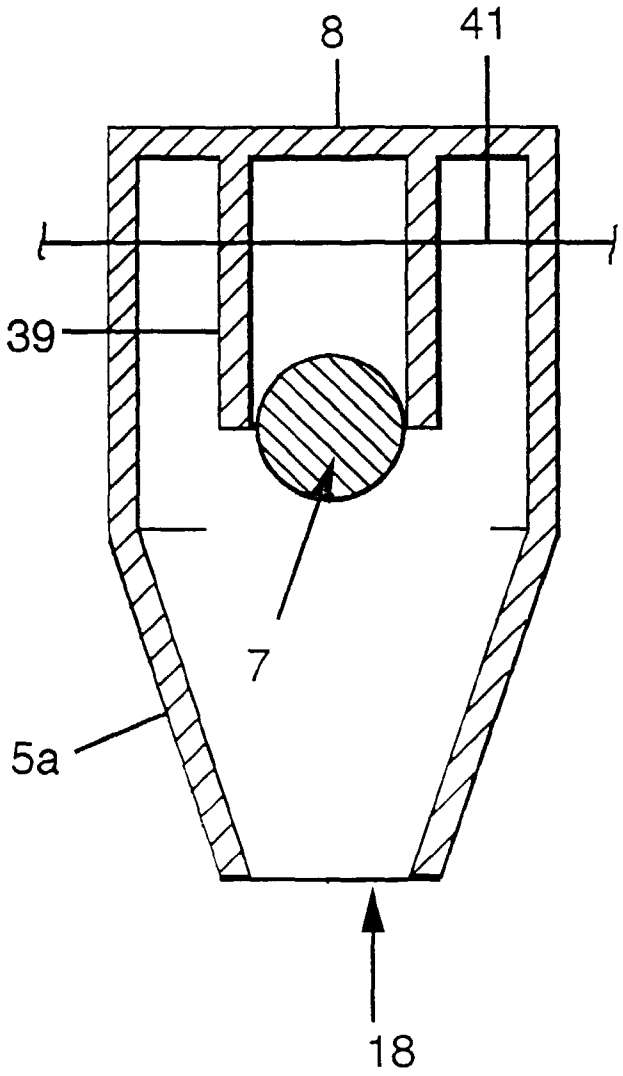


FIG. 9-B

FIG. 9-C



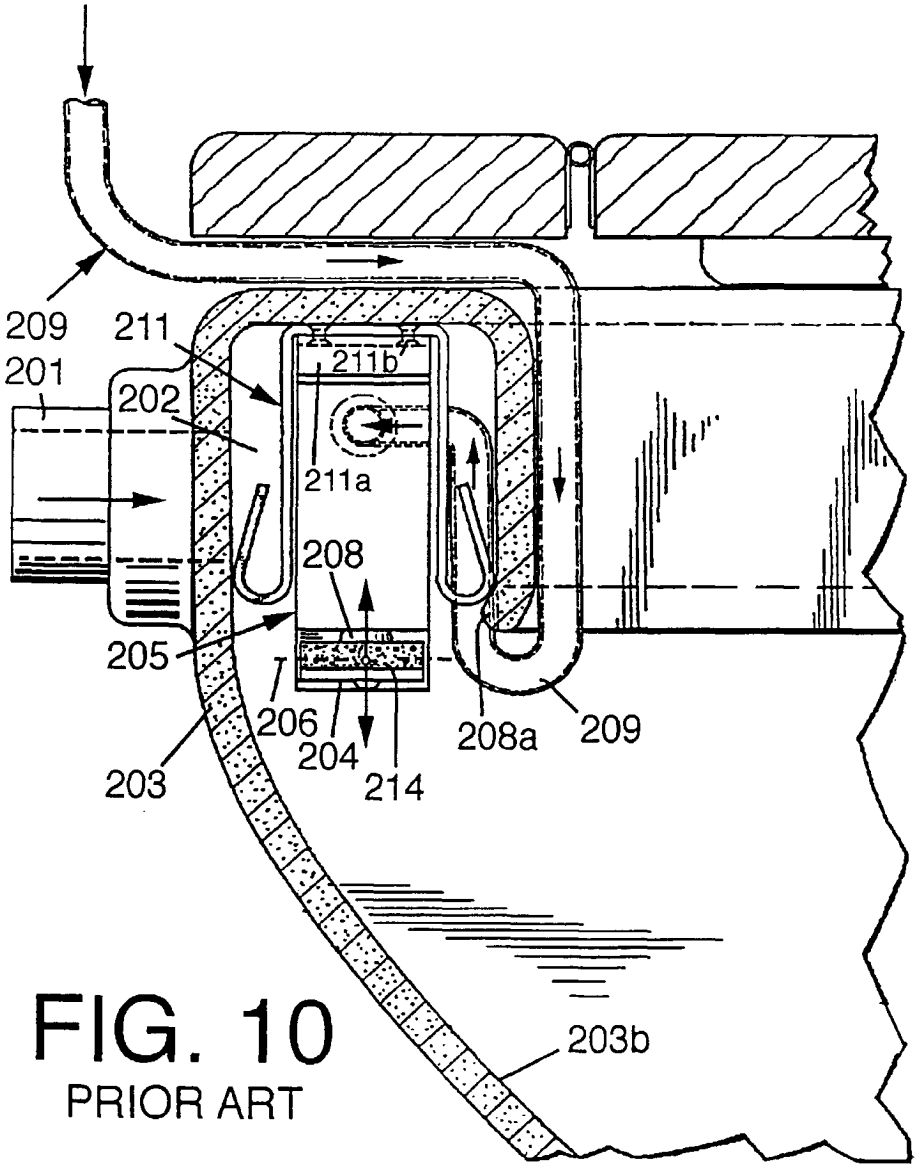
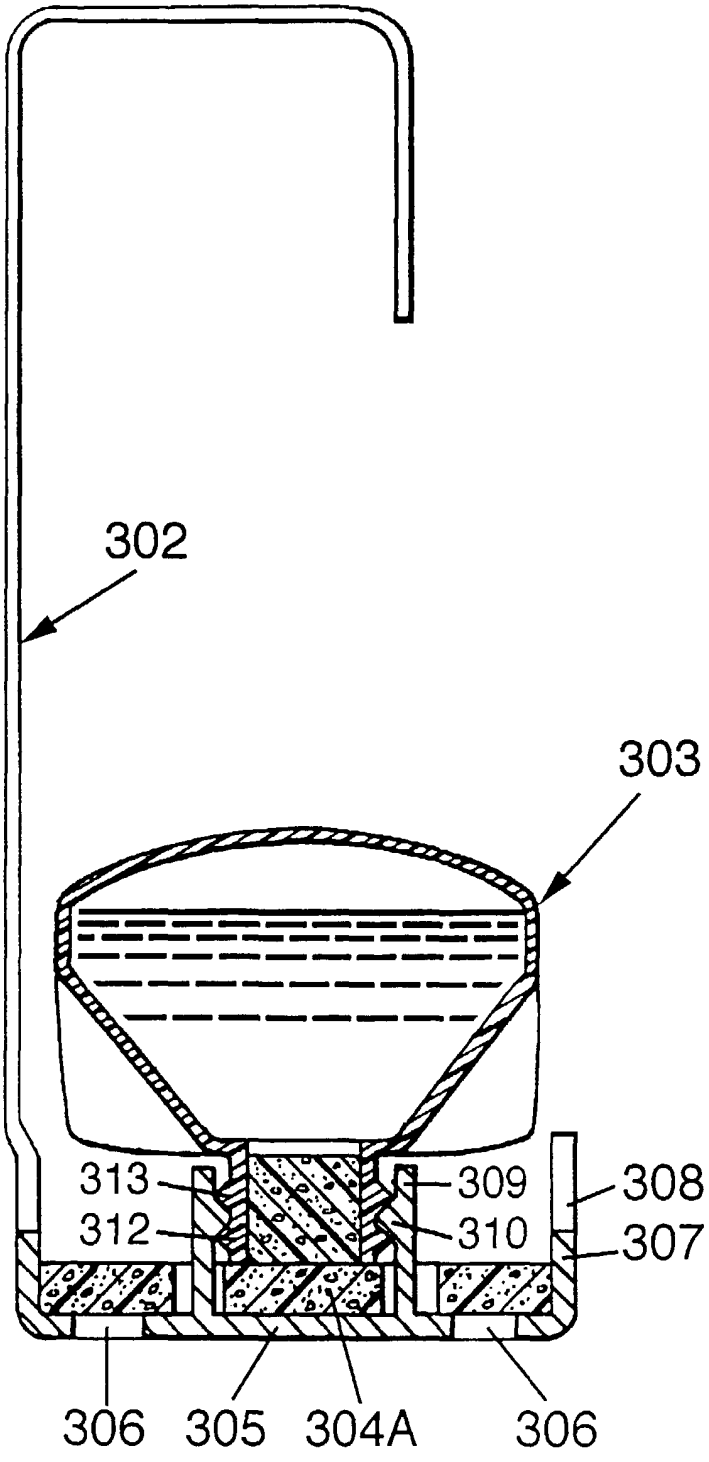


FIG. 10
PRIOR ART

FIG. 11
PRIOR ART



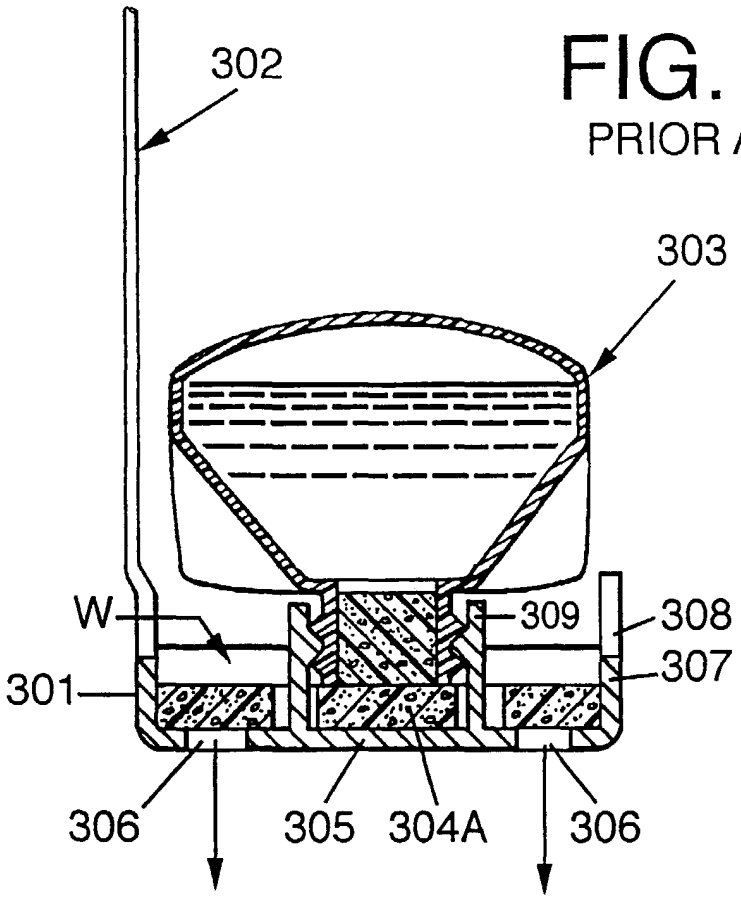


FIG. 12
PRIOR ART

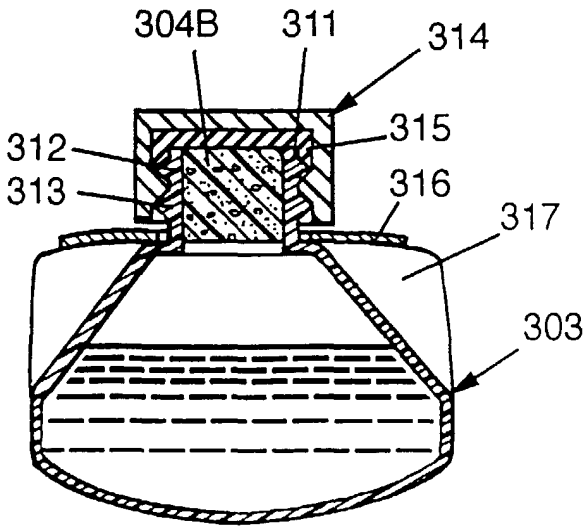


FIG. 13
PRIOR ART

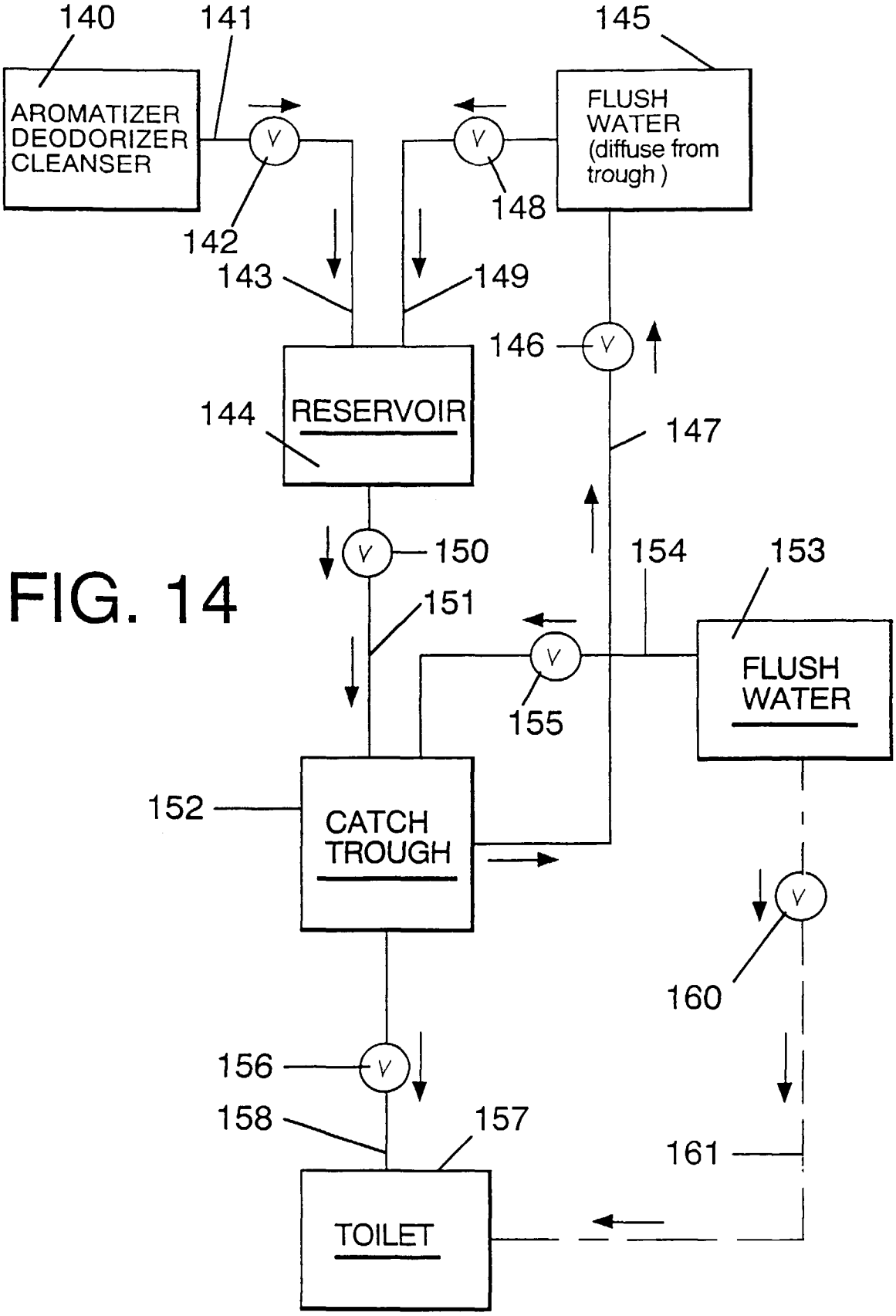
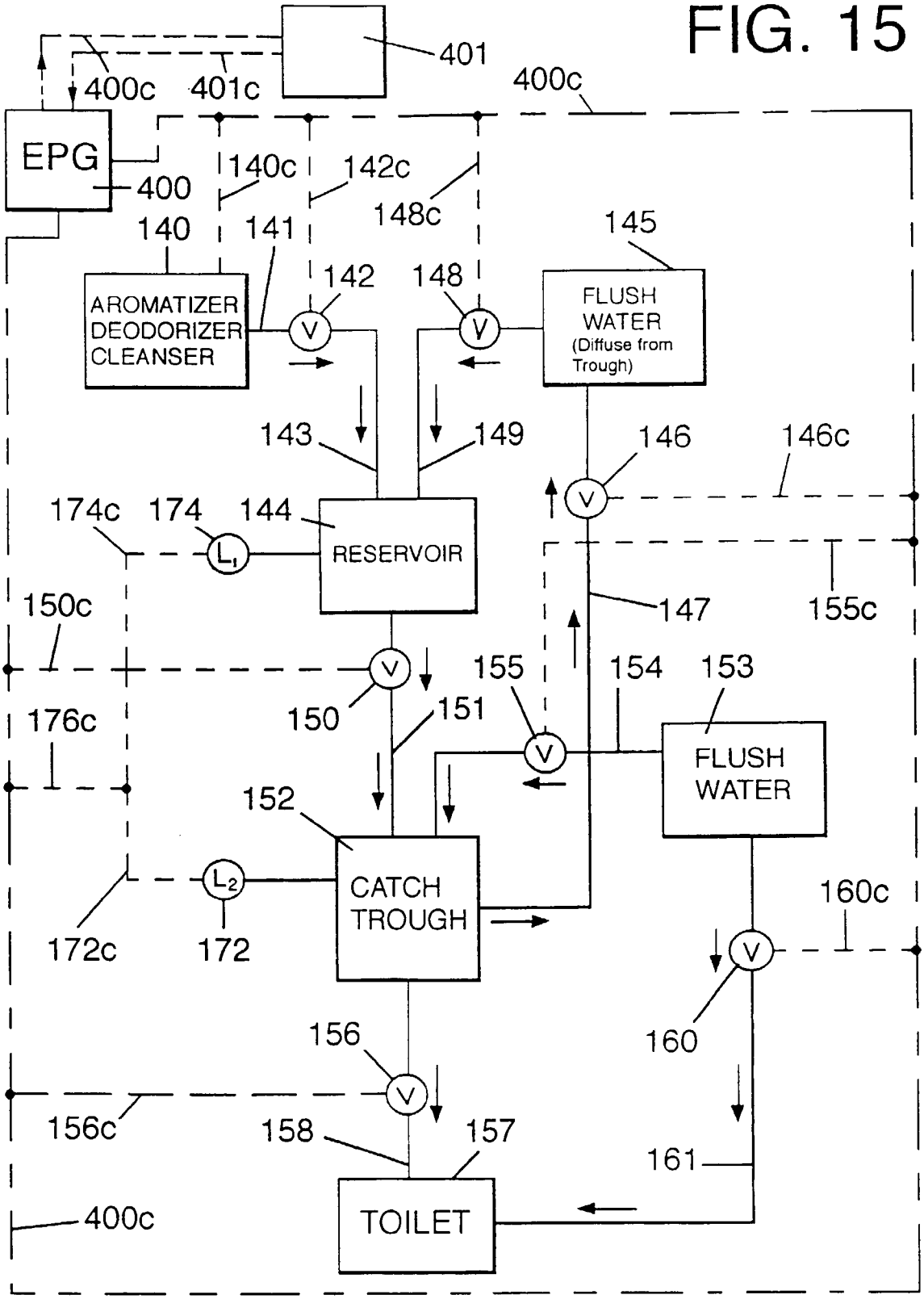

140
141
145
AROMATIZER
DEODORIZER
CLEANSER
V
FLUSH
WATER
(diffuse from
trough)
148
142
143
149
146
144
RESERVOIR
147
150
154
153
151
155
FLUSH
WATER
152
CATCH
TROUGH
160
156
158
157
161
TOILET

FIG. 14

FIG. 15


401
400c
401c
400c
EPG
400
140c
142c
148c
140
141
145
142
148
AROMATIZER
DEODORIZER
CLEANSER
FLUSH
WATER
(Diffuse from
Trough)
143
149
146
146c
174c
174
144
RESERVOIR
150c
147
155c
155
154
153
150
151
176c
FLUSH
WATER
152
CATCH
TROUGH
160c
172c
172
160
156
156c
158
157
161
400c
TOILET

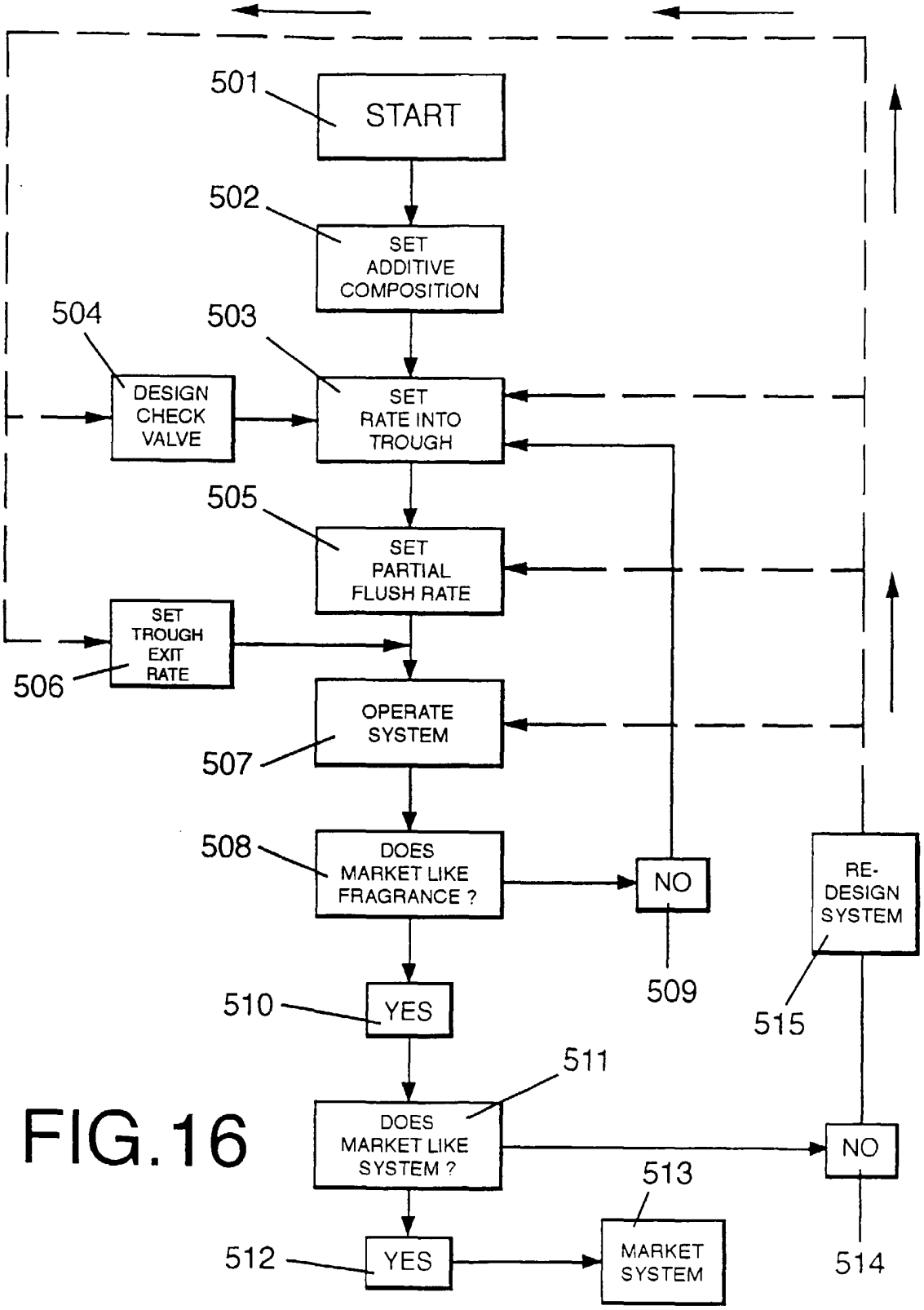

501
START
502
SET ADDITIVE COMPOSITION
504
503
DESIGN CHECK VALVE
SET RATE INTO TROUGH
505
SET PARTIAL FLUSH RATE
SET TROUGH EXIT RATE
506
OPERATE SYSTEM
507
508
DOES MARKET LIKE FRAGRANCE ?
NO
509
RE-DESIGN SYSTEM
515
510
YES
511
DOES MARKET LIKE SYSTEM ?
NO
513
512
YES
MARKET SYSTEM
514

FIG.16