



US 20060101575A1

(19) **United States**

(12) **Patent Application Publication**

**Louis**

(10) **Pub. No.: US 2006/0101575 A1**

(43) **Pub. Date: May 18, 2006**

(54) **DISPENSING SYSTEM AND METHOD, AND INJECTOR THEREFOR**

**Publication Classification**

(75) Inventor: **William M. Louis**, Encinitas, CA (US)

(51) **Int. Cl.**  
*E03C 1/04* (2006.01)

(52) **U.S. Cl.** ..... 4/676

Correspondence Address:

**DUCKOR SPRADLING METZGER**  
401 WEST A STREET, SUITE 2400  
SAN DIEGO, CA 92101-7915 (US)

(57) **ABSTRACT**

(73) Assignee: **Willow Design, Inc.**

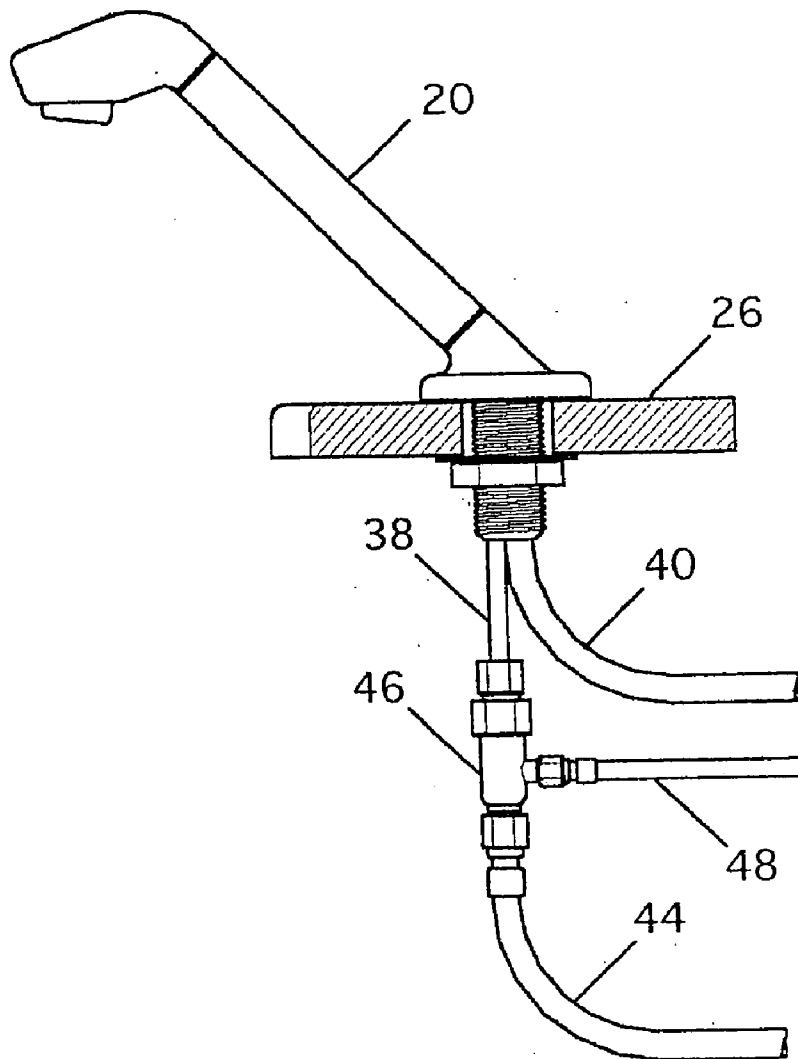
(21) Appl. No.: **11/280,577**

(22) Filed: **Nov. 16, 2005**

A dispensing system and method, and injector therefor are disclosed. The disclosed dispensing system, when used for washing hands, may include a faucet in communication with a water or other supply line and a soap or other substance dispensing device adapted to create, for example, a soap and water mixture in the supply line. The system may provide an injector which may include at least one vortex generator to create strong vortices that effectively commingle the two fluids into a thoroughly dispersed mixture, for discharging from the faucet outlet or other outlet.

**Related U.S. Application Data**

(60) Provisional application No. 60/629,065, filed on Nov. 18, 2004.



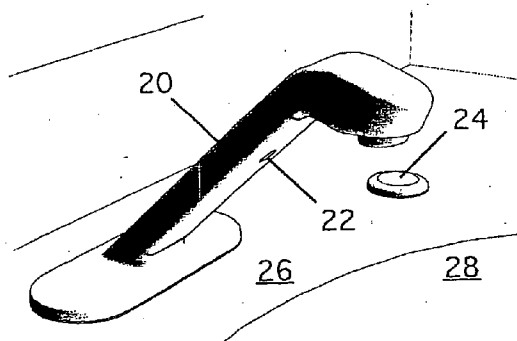


FIG. 1

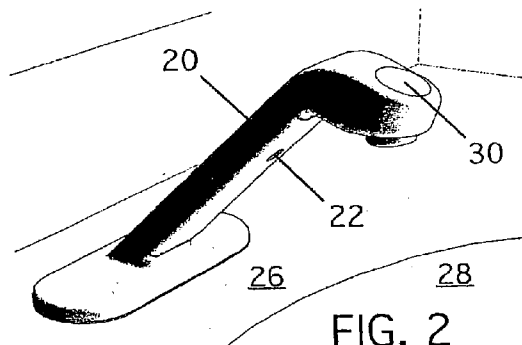


FIG. 2

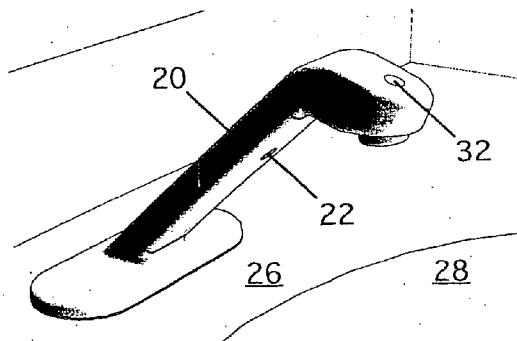


FIG. 3

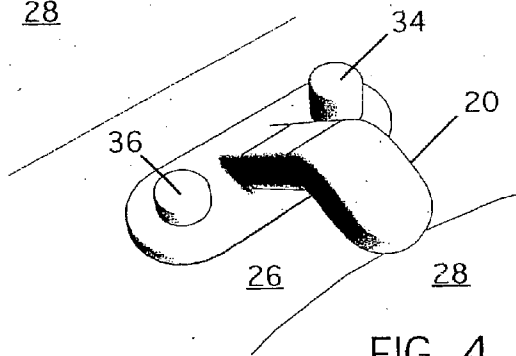
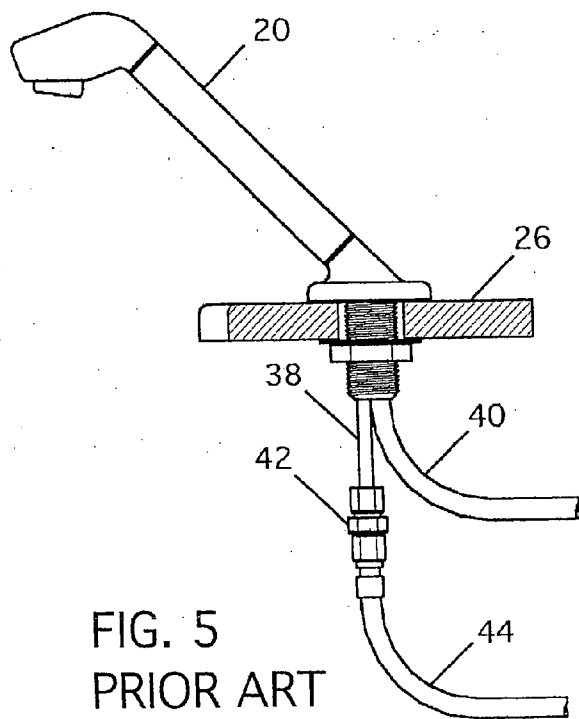
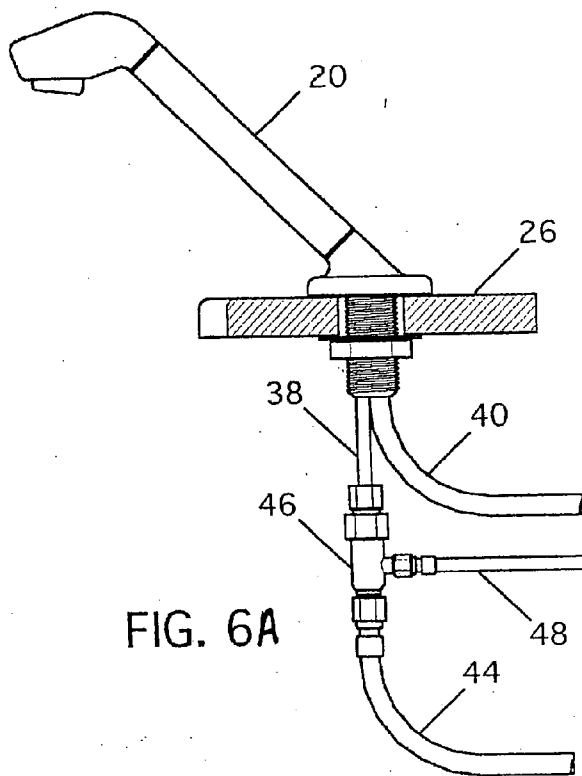


FIG. 4



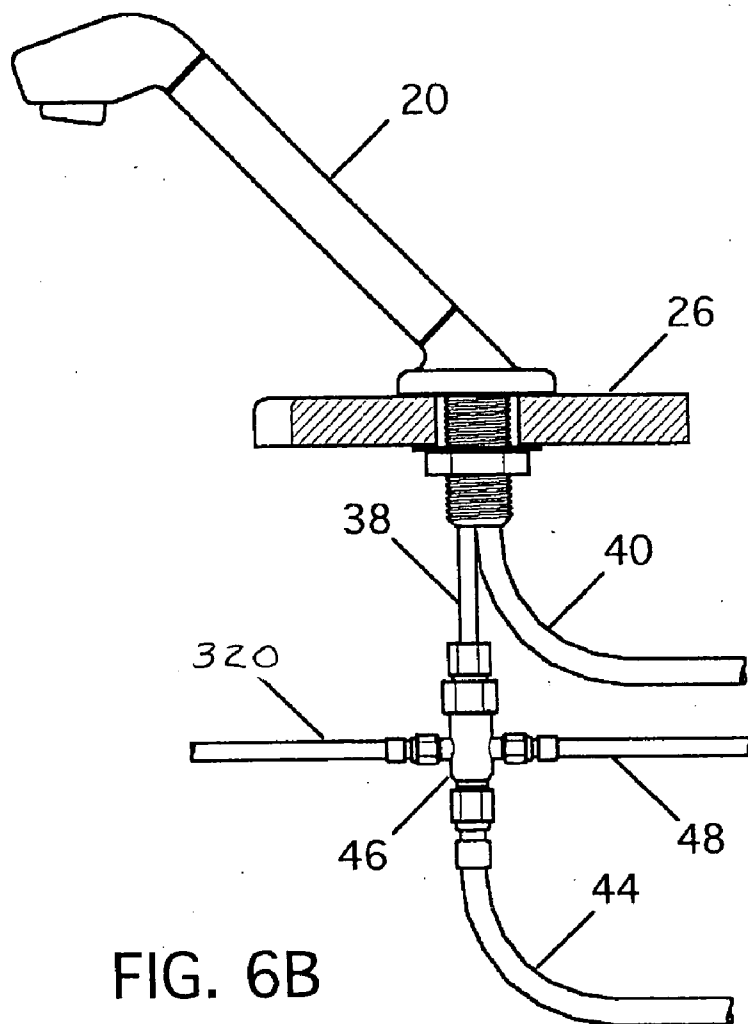
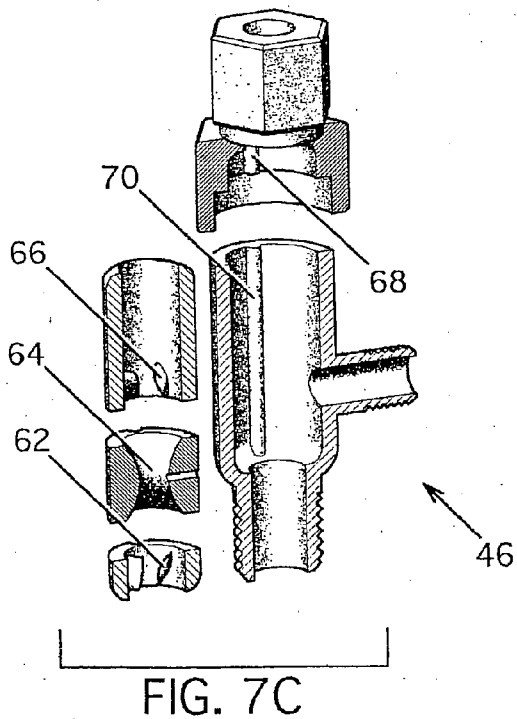
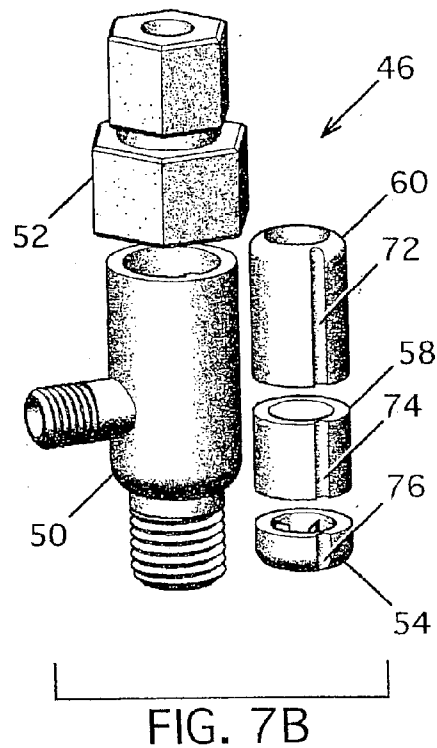
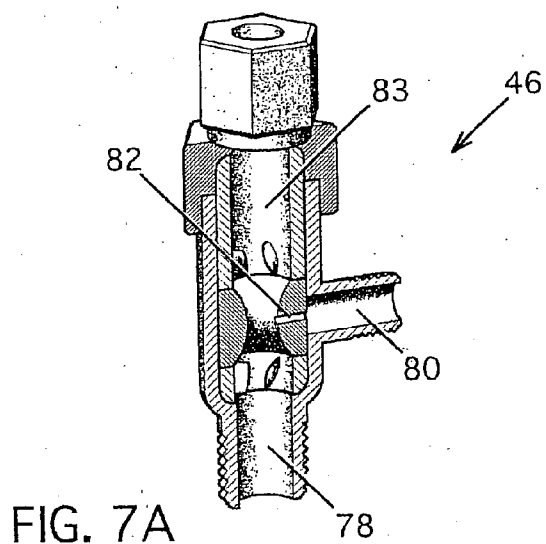
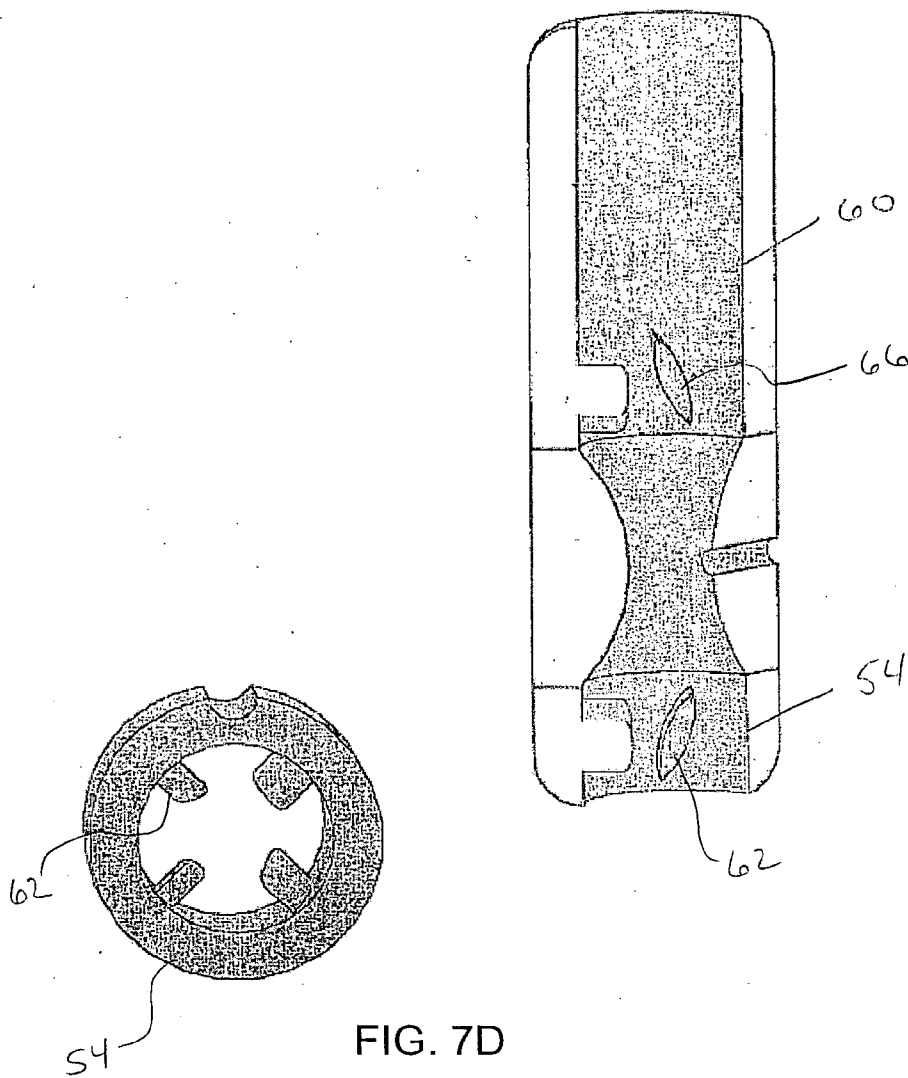
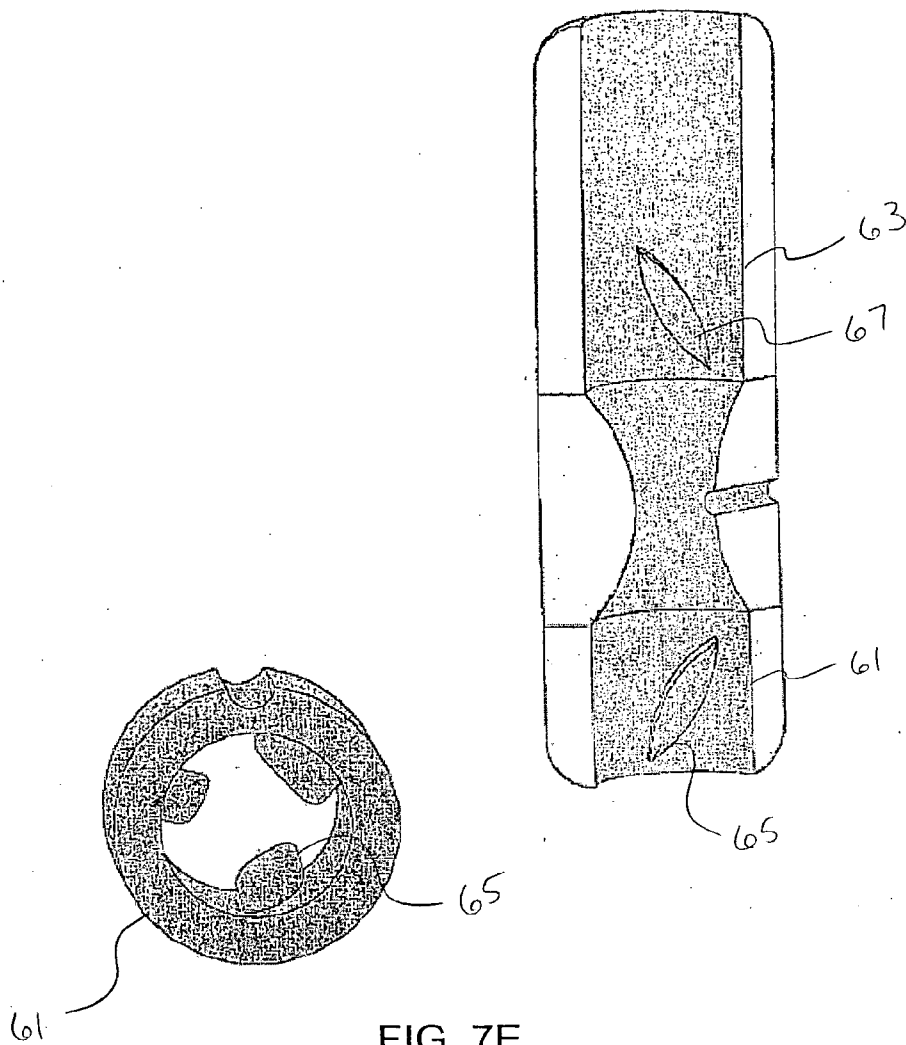


FIG. 6B







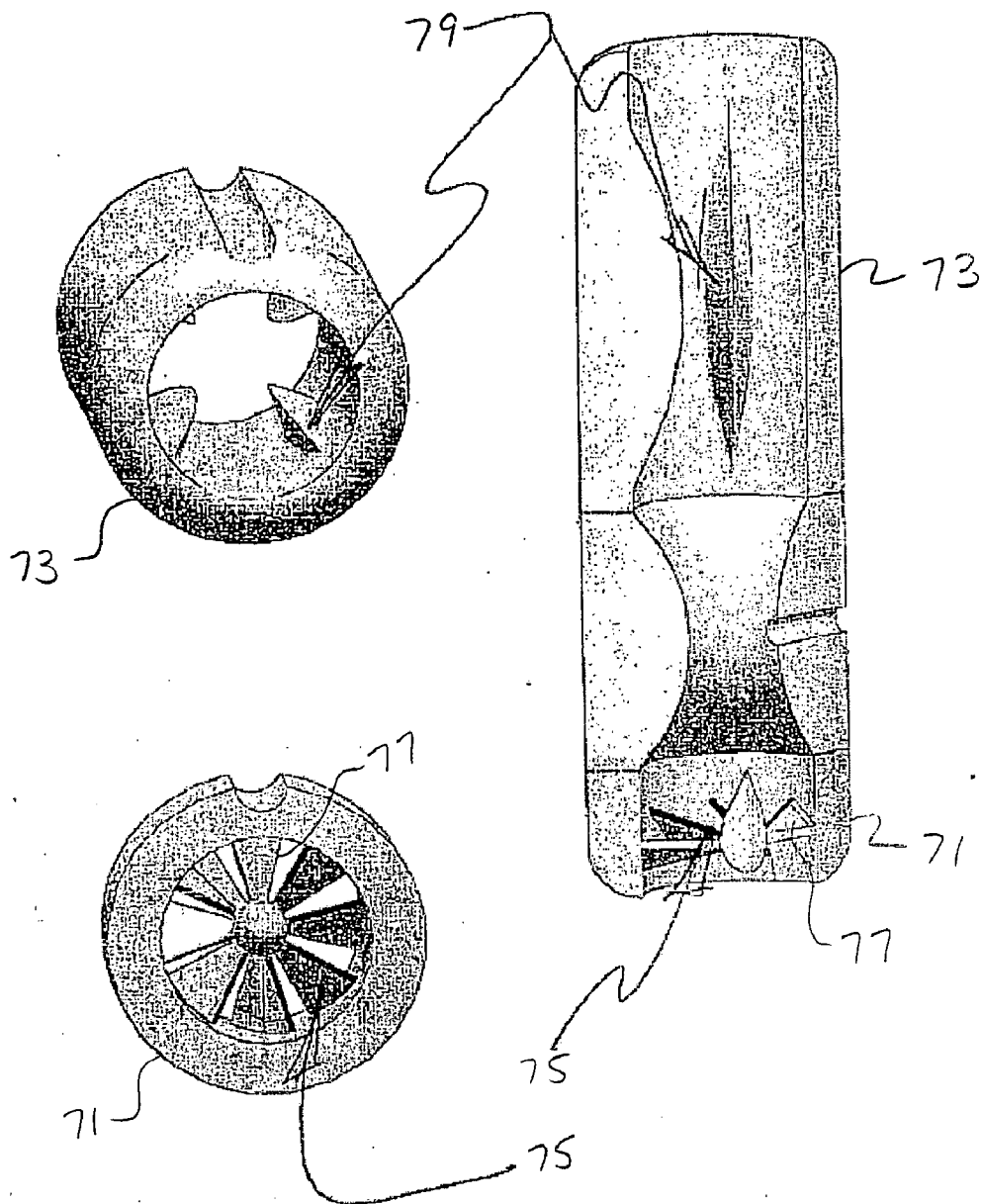
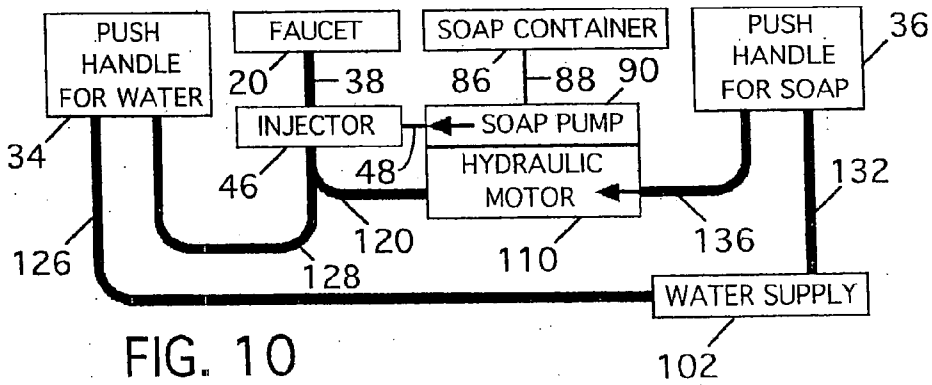
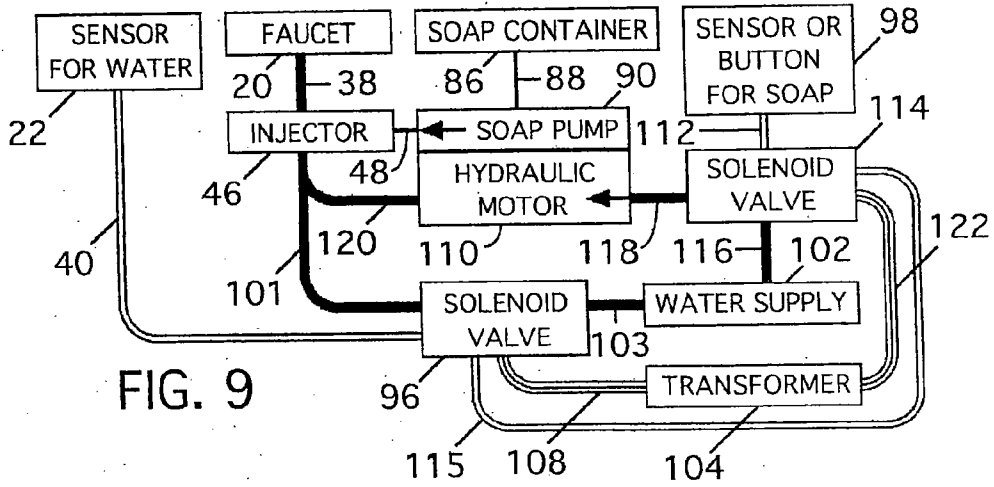
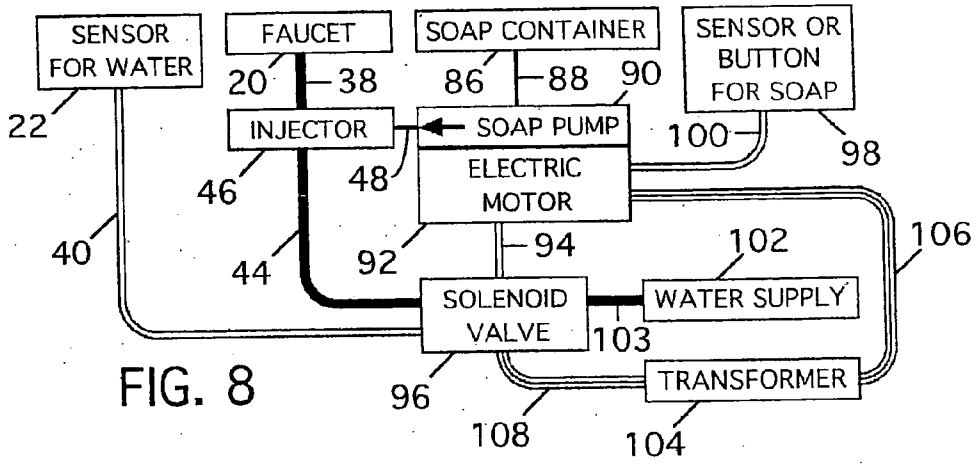
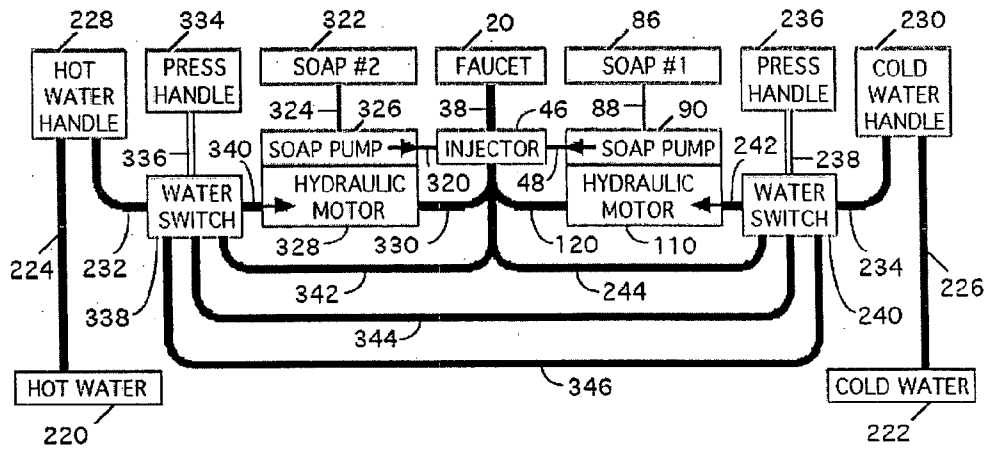
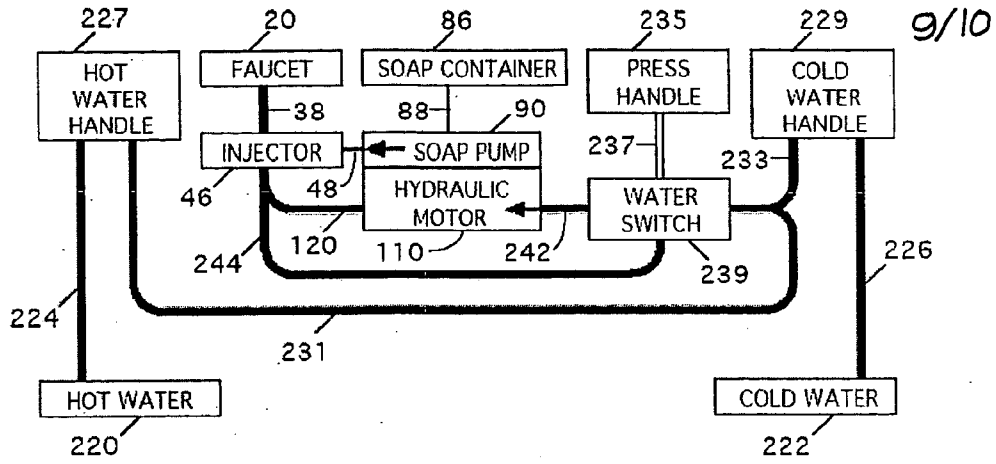





FIG. 7F



WATER LINE  
 SOAP LINE  
 FIBER OPTIC CABLE  
 POWER CABLE



-  WATER LINE
-  SOAP LINE
-  MECHANICAL LINK

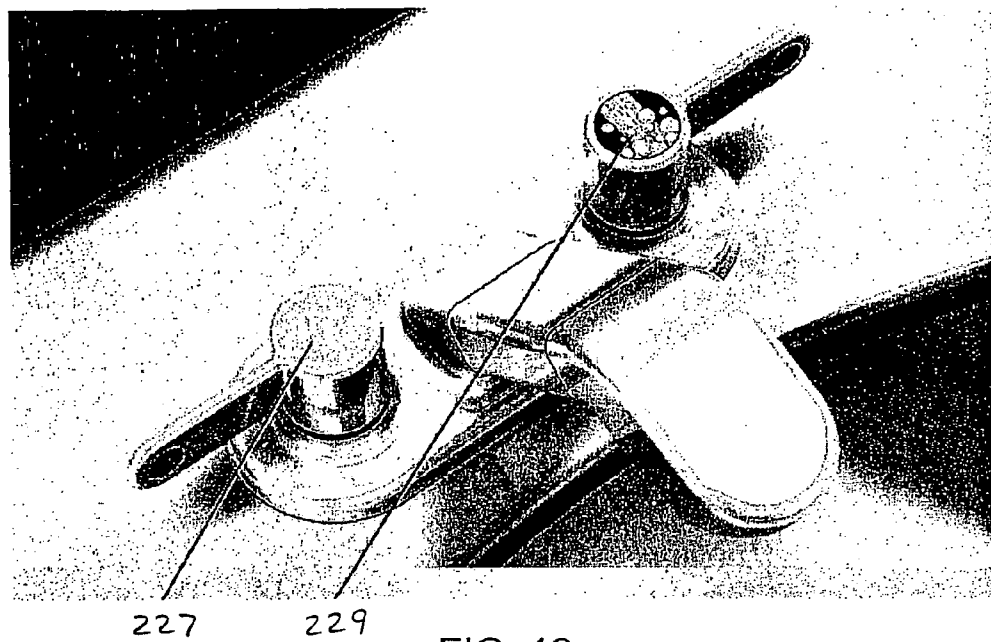


FIG. 13

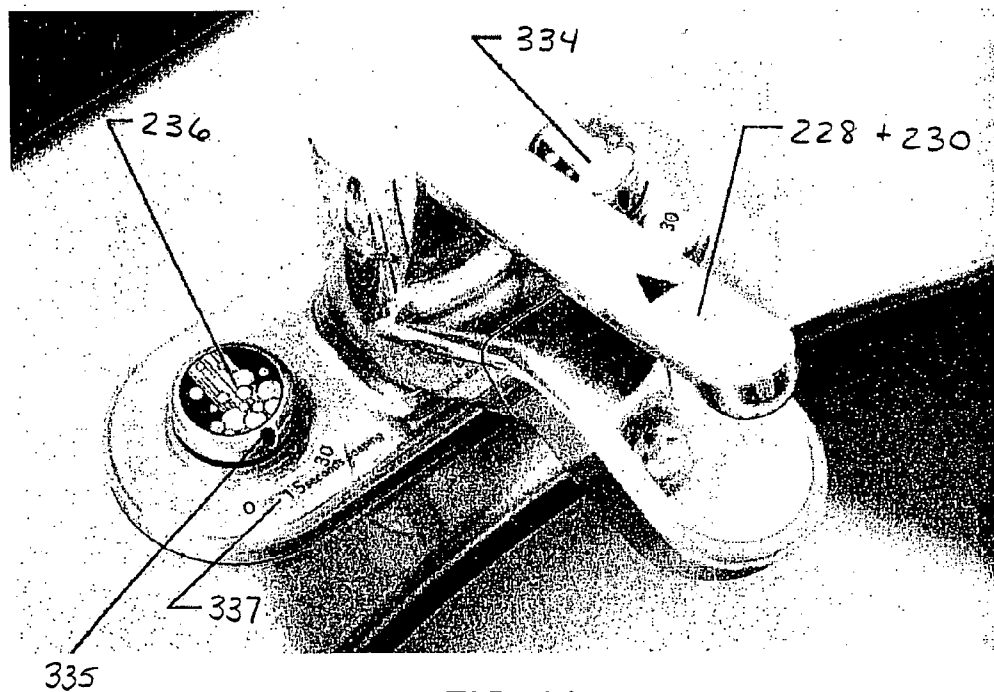


FIG. 14

**DISPENSING SYSTEM AND METHOD, AND  
INJECTOR THEREFOR**

RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Patent Application, filed Nov. 18, 2004, Serial No. 60/629,065, which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates in general to dispensing devices. It more particularly relates to a dispensing device which may be utilized to mix two fluids.

[0004] 2. Background Art

[0005] There is no admission that the background art disclosed in this section legally constitutes prior art.

[0006] There have been a variety of concerns or problems associated with the mixing or dispensing of two fluids, such as a liquid soap and water. For example, where there is a conventional hand cleaning basin, including those in rest rooms and kitchens, whether at home, restaurant, retail store, hotel, hospital rooms, and others, there are common problems in dispensing, handling, storing and cleaning up liquid hand soap.

[0007] Today many commercial establishments have installed infrared detector activated no-touch water faucets and no-touch liquid soap dispensing systems as well. This helps alleviate many aesthetic and sanitary problems for both customers and rest room cleanup crews. But there are still major drawbacks for some applications.

[0008] In washing their hands, users oftentimes reach to operate a liquid soap dispenser for soap. There are many different and inconsistent ways of pressing, pulling up or down to eject liquid soap. If the dispenser is wall mounted to the side of the sink, excess soap may dribble down to the floor or into a wastebasket. There are often problems, especially with the manual systems, of obtaining a sufficient amount but not too much, liquid soap.

[0009] If the dispenser is on the wall, opposite to or adjacent to the sink, the excess liquid soap may spill onto the sink or the counter and create an unwanted unsightly mess. The dispenser may be positioned on the counter and the excess soap may pool thereon in an undesirable way. In any case, in many applications the inadvertent spilling or accumulation of excess soap can be unsightly and a source of constant clean-up and irritation.

[0010] Concentrated liquid soaps, like Basic H (Shaklee Corp., Pleasanton, Calif.), are much more efficient to use and less contaminating to the environment. The overall cost is less expensive because of the greatly reduced volume and weight affecting manufacturing, shipping, and storage. Use of concentrated liquid soap results in a great savings of water and time, because they mix quicker with water, lather up more easily, and rinse off much more quickly.

[0011] According to the Centers for Disease Control and Prevention (CDC), the correct way to wash hands is to first wet them, and then to apply soap. Next, the hands are rubbed together to mix soap and water, scrubbing all surfaces to

dislodge germs. Finally, the hands are rinsed well to remove soap and germs, and then dry the hands.

[0012] But many people wash "incorrectly." They first apply soap onto the hands, and then turn on the water, which immediately rinses much of the soap off before washing can even begin.

[0013] In either case, the water and soap come from separate sources, are applied sequentially, and are mixed by rubbing the hands.

[0014] At best, the prevailing correct procedure has a number of problems in certain circumstances associated with it. Water, being applied first, may wet most of the hand surfaces, including under the fingernails, making it difficult for the soap to penetrate these hard-to-reach crevices, because surface tension of the water can prevent or at least greatly inhibit the liquid soap from entering the cracks and crevices, as did the water. Standardized testing methods used in the United States to determine the efficacy of surgical hand scrubs focus on the survival of bacteria on exposed skin surfaces. Fingernail crevices are excluded from testing by careful nail clipping and cleaning. Studies seem to suggest that subungual areas of the hand harbor high concentrations of bacteria. The water passage in the faucet can become contaminated under certain circumstances by pathogens, which can persist there undetected, to be spread to users during rinsing. Microbes harbored inside the faucet often may survive rigorous external cleanings.

[0015] Much of the volume of most or many hand washing solutions may be filler added to make it easier for users to control the amount of soap dispensed and as an aid in spreading or distributing it about their hands. There also may be a psychological aspect in that concentrated soaps may not give users the feeling that they are applying sufficient solution to properly perform the cleaning function. Filler, which adds to the bulk, weight and viscosity, also adds to the cost of manufacture, transportation, and storage. Filler also may make mixing the solution on the hands more difficult and takes longer. Because some of the solution may never really become well mixed, rinsing also may take longer, resulting in wasting of water. The excess soap and water may then flow into our waste water systems and is not ecologically desirable. The longer it takes to complete the whole hand washing process, the more likely the washing of one's hands may be performed inadequately and quickly, or may be skipped entirely. Even healthcare workers in hospitals may skip hand washing due to the time consuming nature of the process. Hence the CDC promotes the supplemental use of antiseptic gels because they may be more convenient than washbasin washing. However, regular hand washing is still necessary to remove dirt and viruses.

[0016] Several systems to dispense soap and liquids into the water stream have been proposed. U.S. Pat. No. 6,471,847 B2, titled *Household Liquid Dispensing System*, describes a system for dispensing a household liquid through an outlet of a household water system. It can be utilized for showers, bathtubs, laundry tubs and sinks. It has an exterior storage unit of considerable size and complexity with controls to affect both the rate and time fluid or soap is added to the water flow.

[0017] The focus of the system is on the dispensing of soap and requires conscious monitoring of the procedure.

The system utilizes either a venturi or gravity feed system to add the liquid to the water. In either case, the water pressure and flow rate have a strong effect on the mixture ratio of fluid to water, and are dependent upon a fairly high speed of water through the system. The soap is not mixed with the water before exiting the outlet, such as a spray head. So both the quantity of soap introduced and degree of mixing with water may be variable for at least some applications.

[0018] U.S. Pat. No. 5,961,049, titled *Shower Spray with Admixture of Ingredients and Air*, accomplishes much the same function as the above cited patent, but is limited by describing the venturi method only. The system has very small liquid storage chambers; however, it can also add air to the mix.

[0019] A more common approach, in which the soap and water are not mixed together, but discharged in proximity is described in U.S. Pat. No. 5,114,048, titled *Faucet Assembly Having Integral Liquid Product Dispenser*. As stated in the patent, the dispenser block discharges the liquid products adjacent to the flow of water from the faucet assembly. An advantage to this system appears to be that the discharge is over the washbasin.

[0020] U.S. Pat. No. 5,031,258, titled *Wash Station and Method of Operation*, discloses a system for automating the entire water/soap discharge operation in an effort to streamline hand washing. It too discharges soap and water selectively from separate outlets at the end of a faucet. Hence it has the same limited advantage over current practice of entirely separate water and soap dispensers as the previously cited patent.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The features of this invention and the manner of attaining them will become apparent, and the invention itself will be best understood by reference to the following description of certain embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

[0022] FIG. 1 is a pictorial view of an embodiment of the present invention having a soap actuating button on the countertop and a water actuating sensor on the faucet;

[0023] FIG. 2 is a pictorial view of another embodiment of the present invention having the soap actuating button on a faucet and a water actuating sensor on the faucet;

[0024] FIG. 3 is a pictorial view of yet another embodiment of the present invention having a soap actuating sensor on the faucet and a water actuating sensor on the faucet;

[0025] FIG. 4 is a pictorial view of still another embodiment of the present invention having a soap actuating push handle on the faucet and a water actuating push handle on the faucet;

[0026] FIG. 5 is a side view of a conventional no-touch faucet;

[0027] FIG. 6A is a side view of an embodiment of the present invention including a soap injector under the counter;

[0028] FIG. 6B is a side view of an embodiment of the present invention including a second soap line.

[0029] FIG. 7A is a left pictorial sectional view of the soap injector of FIG. 6A;

[0030] FIG. 7B is a right pictorial exploded view of the soap injector of FIG. 6A;

[0031] FIG. 7C is a left pictorial exploded sectional view of the soap injector of FIG. 6A;

[0032] FIGS. 7D-7F are views of different embodiments of the vortex generators for the soap injector of FIG. 6A;

[0033] FIG. 8 is a system diagram of an embodiment of the present invention having an electric motor driving a soap pump;

[0034] FIG. 9 is a system diagram of another embodiment of the present invention having a hydraulic motor driving the soap pump actuated by a sensor or button;

[0035] FIG. 10 is a system diagram of yet another embodiment of the present invention having a hydraulic motor driving the soap pump actuated by the soap actuating push handle;

[0036] FIG. 11 is a system diagram of another embodiment of the present invention having both a hot and a cold water handle;

[0037] FIG. 12 is a system diagram of still another embodiment of the present invention using two kinds of soap; and

[0038] FIG. 13 is a pictorial view of another embodiment of the present invention having a faucet with both a hot and a cold water handle and incorporating a soap actuating push handle into the cold water handle; and

[0039] FIG. 14 is a pictorial view of yet another embodiment of the present invention having a pair of soap actuating press handles on the faucet for providing two kinds of soap.

DESCRIPTION OF CERTAIN EMBODIMENTS OF THE INVENTION

[0040] It will be readily understood that the components of the embodiments as generally described and illustrated in the drawings herein, could be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description of the embodiments of the system, components and method of the present invention, as represented in the drawings, is not intended to limit the scope of the invention, as claimed, but is merely representative of the embodiments of the invention.

[0041] A method and system are disclosed. According to an embodiment, as well as an injector therefore, of the invention, the disclosed dispensing system, when used for washing hands, may include a faucet in communication with a water or other supply line and a soap or other substance dispensing device adapted to create, for example, a soap and water mixture in the supply line.

[0042] The disclosed method and system may include an injector, which may have at least one vortex generator to create strong vortices that effectively commingle two fluids into a thoroughly dispersal mixture, for discharging from a faucet outlet or other outlet.

[0043] In accordance with another disclosed embodiment of the invention, there is provided a soap dispensing system

having a container for holding a supply of soap, an injector for allowing the introduction of soap into the a water line of the faucet, a soap pump in communication with the container and the injector to provide soap to the injector, and an activator adapted to control the soap pump.

[0044] According to another aspect of a disclosed embodiment of the invention, there is provided an injector for mixing a first and a second fluid having a constrictor that accelerates the flow of the first fluid and includes a hole or aperture for the introduction of the second fluid, a first vortex generator located upstream of the constrictor, and a second vortex generator located downstream of the constrictor.

[0045] In accordance with an embodiment of the invention, the soapy mess common to washbasins may be eliminated. Hand washing may be quick and easy: Press a button and soapy water comes out of the faucet. To rinse, hold your hands under the same faucet for an automatic flow of water. It may also improve sanitation and hygiene (public health) by making washing quicker, easier, more effective, and therefore more often actually done.

[0046] In use according to the disclosed embodiments, a naive user approaching a faucet for the first time may hesitate for a moment, contemplating the absence of any conventional soap dispenser (not shown). When the user notices a prominent "soap" label on the faucet or counter top associated with a button or obvious sensor, the user may be inclined to press the button or move his or her hand over the sensor, curious to see what will happen. When the soap solution comes out of the faucet, the user may dither a brief moment before testing it by putting a hand in the flow, but when the user easily determines that it looks and feels like soap, the user may be inclined to quickly soap up in the normal way. Should the user inadvertently move or keep his or her hands too close to the water activating sensor on the faucet, water could flow before he or she is finished soaping up and ready to rinse. However, a delay may be employed in the system of a sufficient time such as about 15 seconds during which no water is dispensed, only more soap if the user so desires. When the water does come on when the user continues to hold his or her hands close under the faucet, the user will be ready for it, and quickly rinses off, satisfied that he or she knows how the system works and may not hesitate or think much about using it the next time.

[0047] The user may spend the 15 seconds or other such delay time actually soaping up, because there is nothing the user can do to expedite or skip that sequence according to an embodiment of the invention. In an application where the system is used in a service organization such as a restaurant, this delay time can facilitate the employee user to take the time to properly soap the hands before the rinse cycle occurs.

[0048] In actual use, the 15 second pause may be longer than would be desirable, for home or public toilet installations. In such applications, the delay time may be 7 or 8 seconds. However, for hospitals, even longer than 15 seconds might be desirable.

[0049] According to certain embodiments of the invention, the soap/rinse operation may be controllably sequenced. The sequencing may be:

[0050] 1) water off;

[0051] 2) adjusting water flow rate and temperature;

[0052] 3) initiating an automatic soap/rinse sequence;

[0053] 4) turning water flow off briefly;

[0054] 5) flowing soap solution at throttled water flow rate for predetermined time interval;

[0055] 6) turning off the flow of soap solution for a timed pause to permit soaping up (no water or soap flow); and

[0056] 7) reestablish adjusted water flow rate and temperature (set prior to soap press).

There are four steps in the above automated sequence, which may only be interrupted by initiating another soap/rinse automatic sequence. According to certain embodiments, the soap dispensing may be timed and the flow rate (water component) may be less than the water only rate. Soap dilution (water/soap ratio) may remain the same, despite variation in water flow rates.

[0057] The disclosed embodiments of the present invention may effectively deal with many of the problems associated with current hand washing practice. The water/soap mixture may be applied to dry hands, easily and quickly wetting substantially all surfaces and may be drawn by surface tension into cracks in the skin and under the nails. It may flow very easily, being of low viscosity and in abundant supply. Disinfectant action may be much more complete and effective. Little or no time may be wasted, because mixing and spreading of the solution takes but moments. Antiseptic hand wash solutions, if used, may tend to disinfect the water passage in the faucet. Concentrated soap may be used without need for any fillers. The generous volume of water/soap mixture may be psychologically satisfying by itself. Reduced bulk of soaps used in commercial, public and home situations may lead to significant economies in manufacture, transportation and storage. Because of more the efficient application, less soap may be used. Reduced hand rubbing time necessary to mix, clean and rinse may results in water savings, too. The whole hand washing process may be shortened and made much more convenient and pleasant, so it may be done more effectively and skipped much less often. This may improve our sanitation and hygiene with consequent health benefits.

[0058] It is desirable for some applications to eliminate separate and often messy soap dispensers. Also, it may be desirable to replace soap dispensers with a system that dispenses a soap/water mixture out of the water faucet itself. After soaping up, the faucet discharges water in the usual manner for rinsing.

[0059] Such a system may eliminate liquid soap mess, and thus there would not be messy counters and floors to clean up. Clean counters are more appealing to users, and more inviting and more likely to be used.

[0060] In short, the experience may be more pleasant, more attractive and improve sanitation. It may be a more effective application with a better cleaning action and more ecologically sound. The disclosed embodiment may use less cleaner, with little or no bulk additives. Such a system and method may well, for certain applications, conserve water.

[0061] Referring to **FIG. 1**, an embodiment of the present invention as normally seen by a user looking down onto a

countertop and washbasin is shown. The integrated soap and water dispensing system includes a faucet 20, a water actuating sensor 22, and a soap actuating button 24. The faucet 20 may be located on a countertop 26 and adjacent to a washbasin 28. The water actuating sensor 22 may be located on the faucet to turn on a stream of water when the user places their hands under the faucet spout for washing or rinsing. The soap actuating button 24 may be located on the countertop 26.

[0062] Referring now to FIGS. 5 and 6A, a typical system and an embodiment of the present invention are shown for comparison. The typical system of FIG. 5 includes a faucet 20 mounted in countertop 26. The faucet 20, a standard no-touch or automatic water faucet, includes a water line 38 and a fiber optic cable 40. Water line 44 providing water to faucet 20 is connected to water line 38 via water line connector 42. In contrast, this embodiment shown in FIG. 6A may include a soap injector 46 in place of the water line connector 42. The soap injector 46 may connect the water line 44 to the water line 38 of faucet 20 and may be connected to soap line 48.

[0063] Referring now to FIG. 7A, internal details of the soap injector 46 are shown. At the bottom of the soap injector may be an inlet 78 leading from the water line 44 (FIG. 6A). The soap line 48 may attach on the side at an inlet 80. Immediately adjacent to and lining up with the inlet 80 may be a soap injection hole 82. Towards the top of the soap injector 46 may be a mixing chamber 83 that leads towards the faucet water line 38.

[0064] Referring now to FIG. 7B, an exploded view illustrates additional details of the soap injector 46. At the top, there may be a cap with a connector 52, which may be permanently attached to a case 50. These two parts may capture and hold internally a counterclockwise vortex generator 60, a constrictor 58, and a clockwise vortex generator 54. Each of these internal parts may have a position or locating groove so that the parts must be installed in the correct position, remain in alignment and cannot rotate after installation. This may be accomplished by placing a locating groove 72 on the counterclockwise vortex generator 60, a locating groove 74 on the constrictor 58, and a locating groove 76 on the clockwise vortex generator 54.

[0065] Referring now to FIG. 7C, an exploded sectional view further illustrates details of the soap injector 46. The counterclockwise vortex generator 60 may have a set of identical counterclockwise vortex generator vanes 66. The vanes 66 may be arrayed around the internal circumference of the mixing chamber 83 at equally spaced intervals. This vortex generator 60 includes four vanes separated by 90°. The vanes 66 may be set at an angle to the vertical axis through the center of the chamber. A typical angle may be about 20°. The clockwise vortex generator 54 may have a set of clockwise vortex generator vanes 62. The vanes 62 may be identical to the vanes 66 in the counterclockwise vortex generator 60, except that the vanes may be set at an opposite angle to the vertical axis of the vortex generator. For the vanes 62 this angle may be -20°.

[0066] The vanes 62 and 66 may protrude about half-way to the center axis of the vortex generators 54 and 60, respectively, and may have an aspect ratio of approximately 1:1 (length to width) when viewed perpendicular to the side of a vane. The vanes 62 and 66 may have a streamlined cross

section, with a thickness of between about 10% and about 30%. The constrictor 58 may have a venturi 64, which may be a smoothly shaped internal bore that may be smaller at the center than at either end. Locating ridge 68 in the cap 52 and locating ridge 70 in the case 50 may be shaped to nest into the locating grooves in the vortex generators and the constrictor as the parts are assembled.

[0067] Referring to FIGS. 7D-7F, different embodiments of the vanes of the vortex generators are shown. FIG. 7D shows the four vane vortex generators described above. FIG. 7E shows alternative three vane generators 61 and 63. Each vortex generator 61 and 63 may include three vanes 65 and 67, respectively, which may be slightly larger than the vanes 62 and 66 in the four vane vortex generators 62 and 66, respectively.

[0068] FIG. 7F shows a stator and strake vortex generator. Vortex generator 71 may include a stator 75 with angled blades 77 for setting up a rotating current. Vortex generator 73 may include four strakes 79 along the inside wall of the vortex generator 73. These strakes 79 may interrupt or inhibit the swirling current into vortices of various sizes, converting rotational energy into turbulence, while slowing over-all rotation of flow.

[0069] Referring now to FIG. 8, none of the components except the faucet 20, the water actuating sensor on faucet 22, and the soap actuating sensor or button 98 are above the countertop and visible to and accessible by the user.

[0070] A water supply 102 may bring in water under pressure from outside this immediate system. A solenoid valve 96 may be connected to the water supply by a water line 103, and may receive signals from the water actuating sensor 22, signals from which may be relayed over a fiber optic cable 40. The solenoid valve 96 may also receive signals from the electric motor 92, as relayed from the soap actuating sensor or button 98 by fiber optic cable 94.

[0071] A transformer 104 may provide low voltage electric current to power the solenoid valve and electric motor. An electric power cable 108 may run from the transformer to the solenoid valve and a power cable 106 may run from the transformer to the electric motor. A water line 44 may run from the solenoid valve 96 to the soap injector 46, which in turn may be connected to the faucet water line 38, as well as the soap line 48. The faucet water line 38 may terminate at the faucet 20. A soap container 86 may be connected by a soap line 88 to a soap pump 90, which may be driven by the electric motor 92. The soap line 48 may connect the pump and injector. The soap actuating sensor or button 98 may send signals to the electric motor through a fiber optic cable 100. The electric motor may be connected mechanically to the soap pump.

[0072] In operation the integrated water and soap dispensing system may be as straightforward as possible with the soap dispensing function adding as little as possible to conventional water only dispensing functionality. As illustrated in FIG. 1, the only evidence to a user of added functionality to the faucet 20 may be the soap actuating button 24 on the countertop 26. All the user may have to do that is different or in addition to using a water only faucet, may be to press the soap actuating button once. The user holds their hands under the faucet stream of soapy water, and begins rubbing them together over the washbasin 28, mov-

ing them somewhat away from the faucet 20. To rinse, the user may activate the water flow in the usual manner by moving their hands near the water actuating sensor 22.

[0073] As shown in FIG. 6A underneath the countertop 26, the faucet 20 may be fed water through the water line 44, which first may carry water to the soap injector 46. Feeding soap into the soap injector 46 may be the soap line 48. The water and the mixture of soap and water may be carried from the soap injector 46 to the faucet by the water line 38. Signals may be communicated from the faucet 20 over the fiber optic cable 40. From above the counter, the only difference the user observes may be the soap actuating button and the fact that when the button is pressed, a soap mixture comes out of the faucet for several seconds.

[0074] The soap injector 46 shown in FIGS. 7A to 7C may provide minimal resistance to normal water flow passing through from the inlet 78, but may thoroughly mix concentrated soap into the water when soap is injected into it from the inlet 80. Water entering the soap injector 46 may encounter a set of clockwise vortex generator vanes 62. The vanes 62 may both initiate a general clockwise swirling action of the water and turbulence or vortices which may be shed from the downstream side of the vanes (flow separation), and from the vane tips towards the center of the injector 46.

[0075] The resulting turbulence with both large- and small-scale vortices may break up laminar flow and may be carried downstream into the venturi 64, where the flow may be accelerated as it passes the soap injection hole 82. If a stream of soap is being injected into the flow, it may be broken apart by the turbulence and swirling of the water, to be further mixed as it is carried through the counterclockwise vortex generator vanes 66. These vanes 66 may abruptly impart a reverse direction to the swirling water, further breaking up the small patches of soap with turbulence that may be even more severe than set up by the first set of vanes, because the water flow may be already turbulent, not laminar, as it may be when encountering the first set of vanes.

[0076] The vanes may convert a portion of the energy contained in the water entering the soap injector under pressure into rotational motion of various types and scale, effecting mixing of the soap and water.

[0077] The mixing may continue downstream in the mixing chamber 83, and to a certain extent, even along the entire path of travel to the exit nozzle on the faucet. The speed or flow rate of the water through the injector may have considerable affect on the flow patterns, which may be more violent at higher speeds, and less severe at lower speeds. At lower speed the less severe turbulence may be compensated for by more sustained eddies that may facilitate mixing, so the resultant stream exiting the faucet may always be thoroughly mixed.

[0078] If the vortex generators were not present, it would be possible in some flow conditions for the soap stream to maintain integrity and exit the faucet in a laminar manner, with little or no mixing with the water at all. Therefore, just introducing the soap into the water does not guarantee thorough mixing.

[0079] The venturi may facilitate scouring of the soap from the soap injection hole or aperture, so that water only

flow may have a minimal or small amount of soap residue, even at the beginning of flow, after a soap/water flow.

[0080] The system diagram of FIG. 8 shows how all the elements of the system function together. Water may come into the system at line pressure from the water supply 102. On the way to the faucet, it may be throttled by the solenoid valve 96 that is normally off, unless the system is actuated by a user. This may happen either when the user interacts with the water actuating sensor 22, or activates the soap actuating button or sensor 98 on the countertop. Whether the soap actuating button or sensor 98 is a button or sensor does not affect the internal operation of the system, it may only affect how the user interacts with the system from outside.

[0081] When the user interacts with the system by pressing or actuating the soap button, a signal may be relayed through the fiber optic cable 100 to the electric motor 94, which in turn may drive the soap pump 90. Soap may be pumped through the soap line to the injector 46 where it may be introduced into the general water flow to the faucet. The soap pump may receive concentrated liquid soap, disinfectant, or cleaning solution from the soap container 86 by means of the soap line 88. The electric motor may have associated with it control circuits, such as a microprocessor or a timing device that may determine how long and how fast the motor runs upon receiving a signal from the soap actuating button.

[0082] The electric motor may also send a "run" signal to the solenoid valve, opening it for about the same time the electric motor may be running so that water may be released to flow through the water line to the injector, where the two fluids may be commingled or mixed. After the run time is up, the system may shut down. The run time and flow rates for both the solenoid valve and soap pump may be programmable to meet various specifications resulting from using different soaps, different use requirements, or other. The soap/water mixture may be normally proportioned to create an ideal mix to facilitate instant soaping up of the hands and subsequent rinsing. The flow rates through the solenoid valve and soap pump may be programmed to result in a consistent ratio of soap to water, independent upon water pressure.

[0083] The soap container may be refillable or replaceable, depending upon system requirements. Another way the system may be actuated is the conventional one, in which the system delivers water only in response to the user triggering the water actuating sensor on the faucet 22, which actuating may send a signal to the solenoid valve to open and allow water to flow through the injector and out the faucet. It may be that the water flow rates for water only and the water/soap mixture may differ, with that for the mixture potentially being a considerably lower flow rate.

[0084] The soap actuating button or sensor may be located so that in activating the system, at least one hand may be out of the way from the water flow from the faucet. The first several moments of water flow may be water only with no soap included, because of the water standing in the faucet between the soap injector and the faucet outlet. If maximum washing efficiency is necessary, such as in hospital environments, the user should not put either hand under the faucet after activating the soap/water flow during those first moments of flow. That way all fluid contacting the hands will have the soap/water mixture and all wetting of surfaces and cracks may be with the soap solution.

[0085] Normally the soap pump may stop moments before the water flow as controlled by the solenoid valve 96, so as to flush or scour soap from the water line between the soap injector and the end of the faucet. This may be necessary so that the next time the system is actuated to deliver water only, essentially no soap solution may be discharged from the faucet. It cannot be assumed that the same user who uses an individual faucet installation to soap up will be the next user to use it for water only. The first user may leave one faucet and go to another for any number of reasons.

[0086] The soap mixture may start flowing whenever actuated by the user, even if water is already flowing, having been started by a signal from the water actuating sensor 22. The signal relayed from the electric motor to the solenoid valve may act as a blocking signal to override the signal from the water actuating sensor. Thus both the water/soap mixture may start flowing and the water flow rate may be throttled by the solenoid valve to the lower soap/water flow rate.

[0087] Referring now to FIGS. 2 and 3, two additional embodiments of the present invention are shown. The embodiments in FIGS. 2 and 3 differ from the embodiment in FIG. 1 due to the location of the soap actuating button or sensor. Therefore the system diagram of FIG. 8 may also be applied to the embodiments in both FIGS. 2 and 3. In FIG. 2 a soap actuating button 30 may be on the faucet 20, not on the countertop as in FIG. 1. In FIG. 3 the soap actuating button 30 of FIG. 2 may be replaced with a soap actuating sensor 32. The location and type of actuator as called out in the system diagram of FIG. 8 as the soap actuating sensor or button 98 differentiates the three embodiments shown in FIGS. 1-3. As the diagram stresses, the 3 embodiments are functionally identical.

[0088] In a similar manner, FIG. 9 may also represent the three embodiments of the present invention as shown in FIGS. 1-3. The above the counter components may remain the same for each embodiment, but several of the other components may be different. For example, the system shown in FIG. 8 may feature an electric motor 92 driving a soap pump 90, whereas the system shown in FIG. 9 may feature a hydraulic motor 110 driving the soap pump 90. The system shown in FIG. 9 may also differ from the system shown in FIG. 8 by the addition of a second solenoid valve 114.

[0089] In FIG. 9 the water supply 102 may be connected by a water line 116 to the solenoid valve 114, which in turn may be connected by a water line 118 to the hydraulic motor 110, which may be mechanically connected to the soap pump 90. The hydraulic motor 110 may be connected by water line 120 to water line 101 leading into the soap injector 46. The solenoid valve 114 may be connected by a fiber optic cable 112 to the soap actuating sensor or button 98. The solenoid valve 114 may also be connected by a power cable 122 to the transformer 104. The solenoid valve 96 may be connected by a fiber optic cable 115 to the solenoid valve 114.

[0090] To operate the embodiment shown in FIG. 2, the user may press the soap actuating button 30, which may be located on the faucet 20 instead of the soap actuating button 24 on the countertop 26 as shown in FIG. 1. To operate the embodiment shown in FIG. 3, the user may move a hand over the sensor 32 on the faucet 20.

[0091] Referring now to FIG. 9, the embodiment may work in a manner similar to that shown in FIG. 8, but with several differences. When the user interacts with the system by pressing or actuating the sensor or soap button, a signal may be relayed through the fiber optic cable 112 to a solenoid valve 114. The valve 114 opens, allowing water from the water supply 102 to flow through the water line 116, through the valve 114, and through water line 118 to the hydraulic motor 110.

[0092] The hydraulic motor 110, which may be mechanically connected to the soap pump 90 may be driven by the water flow in proportion to the rate of water flow, thus the soap pump may pump soap through the soap line 48 to the soap injector at a rate proportional to the rate of water flow through water line 120. The ratio of soap to water as mixed in the soap injector may be constant, independent of the rate of water flow through this part of the system. However, the system may be programmed to do otherwise.

[0093] The “smarts” of the system may reside in association with the solenoid valves, solenoid valve 114 for the soap portion of the system and solenoid valve 96 for the water only portion of the system. The two systems may normally operate independently except for the time that the solenoid valve 114 is open and for several seconds afterwards. This may allow the user to their place hands under the faucet to soap up without being interrupted by unwanted water only coming out of the faucet. When soap is being dispensed through the faucet and for a brief time (several seconds) after, the solenoid valve 114 may send a blocking signal to the solenoid valve 96 so it does not open and send water only. The two systems may communicate through the fiber optic cable 115.

[0094] As discussed in regards to FIG. 8, the soap mixture may start flowing whenever actuated by the user, even if water is already flowing, having been started by a signal from the water actuating sensor 22. But in this case, the signal may be relayed from the solenoid valve 114 to the solenoid valve 96 to act as a blocking signal overriding the signal from the water actuating sensor. Thus both the water/soap mixture may start flowing and the water flow rate may be throttled by the solenoid valve to the lower soap/water flow rate.

[0095] Referring now to FIG. 4, the above the counter components for a mechanical system with no electrical components is shown. In this embodiment, a faucet 20 includes a water actuating push handle 34 and a soap actuating push handle 36. The water actuating push handle 34 may meter the water and may replace the water actuating sensor 22 shown in FIGS. 1-3. The soap actuating push handle 36 may meter the soap and may replace the soap actuating button or sensor 20, 30, and 32 shown in FIGS. 1-3, respectively.

[0096] Referring now to FIG. 10, a system diagram relating to the embodiment of FIG. 4 is shown. The water supply 102 may be connected by a water line 126 to the water actuating push handle 34. The push handle 34 may be connected by a water line 128 to the soap injector 46. The sub-system comprising the soap injector and faucet may be similar to that shown in FIG. 9. The water supply 102 may also be connected by a water line 132 to the soap actuating push handle 36. The push handle 36 may be connected by a water line 136 to the hydraulic motor 110. The sub-system

comprising the hydraulic motor, the soap pump, and the soap container may be similar to that shown in FIG. 9.

[0097] In operation, the user presses the soap actuating push handle 36 and the handle 36 may meter water from the water supply 102 for several seconds. Water may be sent to the hydraulic motor 110. The subsystem comprised of the hydraulic motor, soap pump, soap container, and soap injector operate as described for the system of FIG. 9. The water actuating push handle 34 may meter water from the water supply 102 in the conventional way for water only faucets. The water and soap sides of the system may operate independently and may be dependent upon interaction of the system by the user.

[0098] Referring now to FIGS. 11 and 13, a soap dispensing system with a faucet having two handles is shown. This soap dispensing system may present the user with what appears to be a standard two-handled faucet. The hot water handle 227 and cold water handle 229 may be manipulated by the user in conventional fashion to select the desired water temperature and flow rate, combining the two water streams from the hot water supply 220 and the cold water supply 222, which streams flow through their respective water lines 224 and 226. Leaving the water handles, hot and cold water flow through respective water lines 231 and 233 to converge at the water switch 239. The press handle 235 may be concealed in the base of the cold water handle 229 and actuated by pressing down on the cold water handle itself. The control functions may reside in the water switch 239, which controls water flow to the hydraulic motor 110 and the injector 46 through water lines 242 and 244, respectively. When the faucet is acting strictly to dispense water only, the water switch 239 may remain in "default position" allowing water to flow freely to the injector 46. The subsystem comprised by the hydraulic motor 110, soap pump 90, soap container 86, soap injector 46, and faucet 20 may operate as described for the system illustrated in FIG. 9.

[0099] When the user initiates dispensing of soap by activating the press handle 235, the mechanical link 237 may move an internal control mechanism in the water switch 239 compressing a spring (not shown) that drives an internal mechanism (not shown) that controls water flow through water line 242 to the hydraulic motor 110, through water line 120 to the soap injector 46. The water switch 239 stays in the latter position, metering soap solution for several seconds before switching off all water flow, creating a pause in flow from the faucet of a sufficient delay time such as about 15 seconds for soaping, before the water switch 239 returns to the default position, once more allowing water to flow freely to the injector 46.

[0100] Referring now to FIGS. 6B, 12, and 14, a soap dispensing system for dispensing two soaps is shown. The soap dispensing system may include a second press handle 334, soap container 322, water switch 338, soap pump 326, and hydraulic motor 328 for introducing the second soap into the injector 46 via line 320. The hot water handle 228 and cold water handle 230 may be manipulated by the user in conventional fashion to select the desired water temperature and flow rate, combining the two water streams from the hot water supply 220 and the cold water supply 222, which flow through their respective water lines 224 and 226. Leaving the water handles, hot and cold water may flow

through respective water lines 232 and 234 to the hot water switch 338 and the cold water switch 240. The water switches may control, or sequence, dispensing of the water and soap mixture. When the faucet is acting strictly to dispense water only, the water switches 240 and 338 may remain in "default positions" allowing hot and cold water to flow freely to the injector 46. The routing may be indirect. In this "default position" cold water may flow from the cold water handle through water switch 240, then by means of water line 344 to water switch 338, where it may be mixed with hot water flowing through water line 232 before flowing through water line 342 to injector 46. Similarly, hot water may flow from the hot water handle through water switch 338, then by means of water line 346 to water switch 240, where it may be mixed with cold water flowing through water line 234 before flowing through water line 244 to injector 46. This indirect routing of both hot and cold water to the injector may pass both streams in turn through both water switches, facilitating the control of all water coming out of the faucet when either of the two soaps may be dispensed.

[0101] When the user initiates the dispensing of a first soap stored in soap container 86 by activating the press handle 236, the mechanical link 238 may move an internal control mechanism in the water switch 240 compressing a spring that drives an internal mechanism (not shown) that controls water flow through water line 242 to the hydraulic motor 110, through water line 244 to the soap injector 46, through water line 344 to water switch 338 and through water line 346 from water switch 338. Rotation of the press handle 236 to a position indicated on the dial visible to the user may set the timing function that determines the time that all flow out of the faucet may be stopped to allow for soaping. The mechanical link 238 may convey the user's time setting for washing to the water switch. The soap dispensing sequence may be as follows, starting with a steady stream of water with hot and cold flow rates set by the user: After the user presses the press handle, the water flow may be interrupted for several seconds, then a several second long flow of the first soap water mixture may be initiated at a factory set rate of flow. (Soap mixture flow may be considerably less than most users set for water flow only.) Next, there may be a pause with no flow of about 0 to about 30 seconds for soaping, before the water flow recommences at the rate settings chosen before soap dispensing was initiated. The timing of this pause may be determined by the position of a press handle pointer 335 on the press handle 236 as set by the user in relation to dial 337. The subsystem comprised by the hydraulic motor 110, soap pump 90, soap container 86, soap injector 46, and faucet 20 may operate as described for the system illustrated in FIG. 9.

[0102] The same sequence and control function may be mirrored on the other side of the system when the user presses the press handle 334 to dispense a second soap solution.

[0103] Other embodiments or modifications are contemplated. A spring loaded valve (not shown) may be included at the soap injection hole or aperture to check soap leakage into the flow. The shape of the mixing chamber portion of the soap injector may be varied considerably; the length and diameter may be greater or less than shown. Similarly, the shape, arrangement, number of the vortex generator vanes may also be varied; there may be a greater or fewer number

of vortex generators. The venturi may be more or less pronounced, or even eliminated for some applications.

[0104] Color or dye may be added to the soap concentrate. This could make it obvious to users that they are getting a soap mixture, not just water. Fragrance may also be added to the soap concentrate to enhance the user experience.

[0105] To avoid contamination of highly sensitive hospital installations, soap may be enclosed- in sealed cartridges. A soap container may hold two cartridges, one of which may normally be a spare. When the in-service cartridge becomes empty, the spare may automatically come on line, assuring continuous service. Most other types of installations may be filled with soap poured from economical bulk containers.

[0106] The basic system design may be applicable to other uses and installations other than washing hands in washbasins. The soap injector mechanism may be used to mix one fluid—not necessarily a liquid, the system may work with gasses—with another fluid in other environments which may include commercial, industrial or research installations for purposes other than hand washing, in which effective and complete mixing is desired, without adding a separate mixing machine or device to effect stirring action. In the disclosed embodiments of the present invention, the mixing mechanism may be integral to the fluid flow route, and the internal shape itself effects the mixing.

[0107] If the motor/pump module has the system's controls, for example, with an imbedded programmable microcontroller, the same unit may be programmed or adapted to work in installations with different kinds of water valves, injectors, faucets and soaps. It may also be programmed to have different duty cycles, dependent upon the kind of users or environment it is to work in. For maximum flexibility, the system may be designed to allow easy reprogramming after installation. For a consistent soap/water mixture ratio despite variations in water pressure, the soap flow rate may be directly related to the water flow rate.

[0108] To work with upgrades of existing automatic sensor operated water faucets, the motor/pump module may recognize the signal from the existing installed faucet sensor assembly. Likewise, the signal sent from the motor/pump module may be recognized by the pre-existing solenoid valve module assembly. In this case, it may rely on some of the controls in the existing solenoid valve module if it has a self-calibration procedure to automatically set the range setting to the faucet sensor's environment.

[0109] Plumbing codes generally require positive means to keep soap from getting into the water supply when the supply has negative pressure. Except for upgrades, the anti-siphon function may be integrated into the solenoid valve module. For upgrades, it may be between the valve and water supply. The transformer may be used to reduce the operating voltage to a safe level and make the system compatible with interchangeable DC battery pack operation in installations where AC line power is not available. The water supply may be a single line from either a cold water line or an automatic temperature regulating mixing valve with connections to both hot and cold lines.

[0110] As illustrated in **FIG. 10**, water need not go directly from the handles to the faucet as in conventional faucet designs, but may be routed indirectly back down under the countertop, through the soap dispensing system.

This may allow a greater flexibility in the choice and application of various soap and water actuating sensors and mechanisms. The intervening mechanisms between the handles and the faucet need not be packed into the constraining volume of the above the countertop faucet.

[0111] Thus such faucet control mechanisms as a single control faucet, may be readily adapted to the integrated soap dispensing system. Such faucets may be commonly rotated clockwise and counterclockwise to control water temperature and moved towards and away from the user to control the volume or rate of water flow. The soap dispensing feature may be added by having the single control faucet actuate soap dispensing when pressed downwards, as the soap actuating push handle.

[0112] From the description above, a number of advantages of the integrated soap dispensing system may be realized in connection with the disclosed embodiments of the invention for at least some applications. The operation of the systems by users may be simple, quick and effective to use. This may be important for certain applications because many users do not consider hand washing a pleasant experience to be indulged in for pleasure, like showering. The disclosed system may only minimally obtrude on the appearance of the wash station which also may make it more attractive to use and those who maintain it as well. The disclosed systems may be unique in their precision in metering and thoroughly mixing soap and water, something that may become more important when sanitation and hygiene are considered. The mixing of soap and water in prior known systems in haphazard and may be very poorly accomplished.

[0113] The disclosed systems include a soap dispensing side of the system that interacts with and may override the water only side of the system, so that the soap dispensing mode may be initiated at any time by the user, even when water is already flowing from the faucet. Thus, there may be an interval after soap dispensing is completed, during which time the water only flow cannot be initiated by the user.

[0114] The disclosed embodiment of a faucet, or the discharge tube or nozzle of the disclosed faucet may be repeatedly washed by the water/soap solution, and if the soap is a disinfectant, providing disinfectant action internally in the faucet, tending to keep the faucet free of contaminants.

[0115] While particular embodiments of the present invention have been disclosed, it is to be understood that various different embodiments are possible and are contemplated within the true spirit and scope of the appended claims. For example, while the soap specified herein is a liquid soap in the preferred embodiment of the invention, it is contemplated that solid soap particles or the like may be employed. Also, other fluid products may also be employed, and fluid vehicles other than water are also contemplated. Furthermore, it is contemplated that the present invention may also be employed for applications other than washing hands. Such other application may include washing clothes or other articles, mixing chemicals in chemical processes, and others. There is no intention, therefore, of limitations to the exact abstract or disclosure herein presented.

What is claimed is:

1. An injector for mixing first and second fluids, comprising

a constrictor that accelerates the flow of the first fluid and includes a first aperture for the introduction of the second fluid;

a first vortex generator located upstream of the constrictor; and

a second vortex generator located downstream of the constrictor.

2. The injector of claim 1 further including an injector body having at least three external interfaces.

3. The injector of claim 2, wherein the injector body includes a cap and both the injector body and the cap include an interior locating ridge.

4. The injector of claim 3, wherein the constrictor, the first vortex generator, and the second vortex generator each have an external locating groove.

5. The injector of claim 1, wherein the first vortex generator is adapted to create fluid flow rotating in a first direction and the second vortex generator is adapted to create turbulence rotating in a second direction, wherein the second direction is the opposite of the first direction.

6. The injector of claim 1, wherein at least one of the first and second vortex generators includes fins.

7. The injector of claim 1, wherein the first vortex generator and the second vortex generator each have a plurality of approximately wing-shaped fins.

8. The injector of claim 1, wherein the first vortex generator includes a stator and the second vortex generator includes a plurality of strakes.

9. The injector of claim 1, wherein the constrictor includes a second aperture for the introduction of a third fluid into the flow of the first fluid.

10. A soap dispensing system for a faucet, comprising:

a container for holding a supply of soap;

an injector for allowing the introduction of soap into a water line of the faucet;

a soap pump in communication with the container and the injector to provide soap to the injector; and

an activator adapted to control the soap pump.

11. The soap dispensing system of claim 10, wherein the injector includes a constrictor, and at least one vortex generator.

12. The soap dispensing system of claim 10, wherein the soap pump includes an electric motor.

13. The soap dispensing system of claim 10, wherein the soap pump includes a hydraulic motor.

14. The soap dispensing system of claim 10, wherein the activator is a push button.

15. The soap dispensing system of claim 10, wherein the activator is an electronic sensor.

16. The soap dispensing system of claim 10, wherein the activator is a push handle.

17. The soap dispensing system of claim 10, wherein the activator utilizes a fiber optic cable to control the soap pump.

18. The soap dispensing system of claim 10, wherein the activator is located on the faucet.

19. A hand washing system, comprising:

a faucet in communication with a water supply via a water line; and

a soap dispensing device adapted to create a soap and water mixture in the water line, the soap dispensing device including an injector, a first soap pump, and a first soap container.

20. The hand washing system of claim 19, wherein the injector includes a constrictor and at least one vortex generator.

21. The hand washing system of claim 19, wherein the faucet includes at least one sensor to control water flow.

22. The hand washing system of claim 19, wherein the soap dispensing device includes an activator adapted to control the soap pump.

23. The hand washing system of claim 19, wherein the water supply includes a hot water supply and a cold water supply.

24. The hand washing system of claim 19, wherein the soap dispensing device further includes a second soap pump and a second soap container.

25. A method of mixing first and second fluids, comprising:

accelerating the flow of the first fluid by using a constrictor having a first aperture;

admitting the second fluid into the second aperture; and

creating at least one vortex to cause the mixing of the first and second fluids by using at least one vortex generator.

26. A soap dispensing system for a water faucet, comprising:

an injector for allowing introduction of soap into a water line of the faucet;

a soap pump for providing soap to the injector;

an activator adapted to control the soap pump; and

control means for causing a soap/rinse sequence, wherein the sequence includes flowing a soap solution, turning off the flow of soap solution for a sufficient time, and establishing a water flow.

27. A method of dispensing soap, comprising:

admitting soap into a water line of a faucet; and

causing a soap/rinse sequence using control means, wherein the sequence includes flowing a soap solution in response to activation by a user, turning off the flow of soap solution for a sufficient time, and establishing a water flow.

\* \* \* \* \*