LIQUA-FLUSH™

Modular Cartridge-Based Liquid Dispenser System For Toilets

by

ZYCAD®

ZYCAD®

Website

www.zycad.com

Contact

sales@zycad.com

MARKET POTENTIAL

Introducing: LIQUA-FLUSH™

ZYCAD's new **patented** LIQUA-FLUSH™ automatic toilet cleaning system precisely dispenses liquid toilet sanitizing solution into a standard toilet's water-tank and/or toilet-bowl after each flush. It consists of a liquid dispensing assembly with a disposable cartridge element that contains sanitizing solution. This system can be offered in a number of different chassis configurations, including a compact embodiment that clips onto the inside rim of a standard toilet tank, as shown here:

Background of Toilet Sanitizers

Toilet bowl sanitation has been a problem since the invention of the flush toilet. Toilets may contain microscopic organisms that can thrive and propagate to contaminate the toilet and bathroom. These germs can leave smelly, hard to clean deposits in the toilet bowl.

Early attempts at toilet sanitation relied upon manual methods of cleaning. It is a laborious chore, requiring frequent cleaning sessions and an expenditure of a substantial amount of time and labor. This gave rise to the advent of the automatic toilet bowl cleaning device. Currently, there are many of such automatic toilet bowl cleaning devices on the market. However, these devices have proved to be lacking in many respects.

One common method is to utilize dry chemical, water-soluble tablets of cleaner. These dry tablets are generally submerged in the toilet tank so that the tablets slowly dissolve in the tank water, thereby releasing a cleaning or disinfectant agent. The cleaning agent is then released into the toilet bowl when the toilet is flushed. The basic problem with these devices is that there is no control over the rate of chemical discharge. The dry chemical tablet will disintegrate and dissolve away relatively quickly at a set

rate, which can result in far more of the product being consumed than needed for each flush cycle. Accordingly, it is necessary to replace the cleaning agent tablet frequently, resulting in an increased effort to keep the toilet clean. This is both costly and wasteful.

Another common method of toilet bowl sanitation utilizes a housing arrangement for a dry chemical tablet of cleaner. The housing partially isolates the tablet from the water supply to help slow the disintegration of the dry chemical in order to promote a more consistent delivery of the chemical treatment into the water for each flush. However, these passive devices still rely on a fixed dissolution rate. This results in an inconsistent delivery of the chemical for each flush.

The Toilet Sanitizer Market is a VERY BIG Business

A number of large companies sell many millions of toilet sanitizers each year in the United States alone, such as Willert Home Products, Reckitt Benckiser, WD-40, S.C. Johnson and Clorox. Their products, such as *Ty-D-Bol®, Bowl Fresh®*, *Lysol®*, *X-14®*, *2000 Flushes*, *Vanish® Scrubbing Bubbles®* and *Clorox® Blue* can be found just about everywhere. Other popular brands include *Iron Out®*, *Never Scrub®* and *Blu-Boy*. Many large supermarkets, such as Safeway, carry their own private label offerings as well. (See the attached list of toilet sanitizer products).

Although popular in sales, everyone knows these traditional solid tablet "in-tank" sanitizers are rather inefficient devices. Product waste can be *visually* noticed every time a very dark blue bowl of water is flushed away, where far more of the product was obviously used than necessary. Consumers also see the times when only light blue water appears in the bowl (after some frequent flushing) that indicates a lighter than required sanitizing dose was released. This uneven dosage is simply the nature of a product that constantly and passively dissolves away inside of the tank water. Consequently, it can only irregularly sanitize the toilet bowl and waste much of the product in the process. Consumers still use them because they have no alternatives. Certainly, there is room for improvement!

The LIQUI-FLUSH™ System is a Next Generation Product

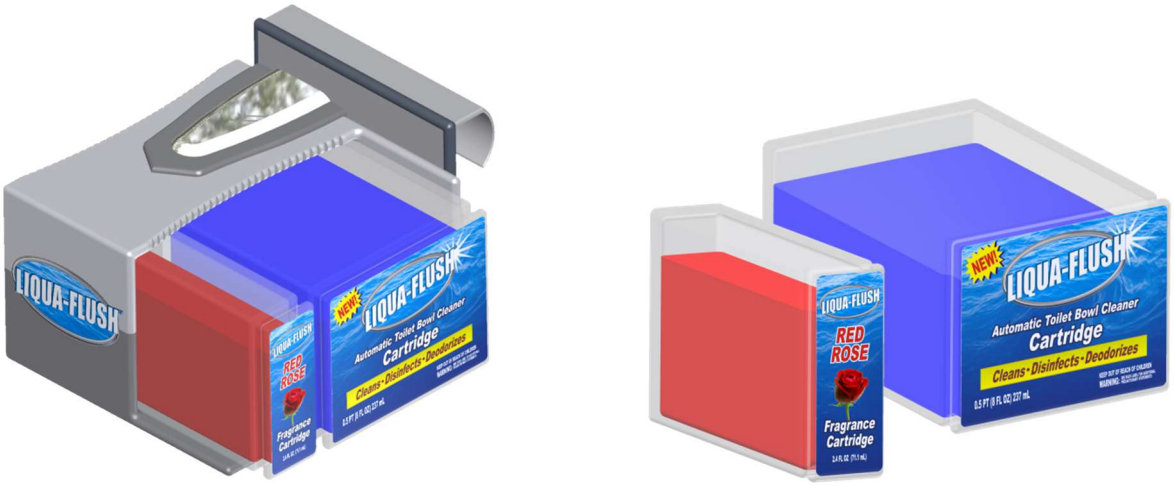
ZYCAD's new LIQUA-FLUSH™ cartridge-based liquid dispensing system was designed as a next-generation product to offer superior performance over the solid sanitizers. The LIQUA-FLUSH™ system automatically and consistently dispenses any desired amount of liquid sanitizer after each flush without any waste. This efficient device will instantly attract savvy consumers, whom are constantly looking for new and reliable home disinfecting and sanitizing products. Once they try the LIQUA-FLUSH™ product, they will be forever hooked! Why would they go back to old technology? It is not likely! Consequently, it can be easily predicted that the LIQUA-FLUSH™ product sales will grow and eventually displace the solid tablets.

The LIQUA-FLUSH™ system has the mass-market sex appeal that would be required for a large company to be interested in spending millions to promote it. This will be valid if it could seize even a small segment of the BIG toilet sanitizer market. This opportunity will be easily achieved because the LIQUA-FLUSH™ system was designed to be sold everywhere and used by everyone! The dispenser is a **compact**, **universal** and **inexpensive** device:

- **Compact Chassis:** The LIQUA-FLUSH™ system chassis very compact so that it can be offered for sale at even the smallest of stores due to its tiny need for shelf space.
- **Universal Fit:** The LIQUA-FLUSH™ system is a single, one-size-fits-all dispensing product that can fit virtually any existing toilet. It simply clips onto the back inside edge of a standard toilet tank's rim. The shape of the tank therefore makes no difference, so it will work with almost any toilet.
- **Inexpensive Hardware**: The LIQUA-FLUSH™ system can be very economically constructed. Mass-production would allow the dispenser assembly to be sold for an estimated retail price of around $10-15. That includes a cartridge valued at about $4.

More Product Options: Air-Freshener Cartridges

A dual-cartridge LIQUA-FLUSH™ system was also developed, where a second smaller cartridge can dispense a drop of fragrance into the toilet bowl after each flush and/or for a timed interval. This second cartridge format provides the introduction yet another new product idea that could be quite lucrative and could help enhance the overall sales potential of the LIQUA-FLUSH™ product line.



A Marketing Strategy

It can be appreciated that repetitive sales from the disposable cartridges would generate the real long-term profit from the LIQUA-FLUSH™ system. Consequently, it may well be advantageous to practically "give away" the dispenser at cost to help produce a demand for the consumable cartridges, similar to the approach used by the computer ink-printer industry.

A Great Opportunity

The LIQUA-FLUSH™ system's disposable cartridges will provide the public with great utility and convenience, resulting in a steady demand from repetitive buying. This unique invention could become a great success and could very well dominate the toilet sanitizer market. Supplying these consumables could prove to be a very profitable exploration of a new market. The old solid tablet sanitizer sales will no doubt erode and eventually become obsolete, just like the powered form of sanitizers.

ZYCAD's LIQUA-FLUSH™ system is now patented! This is a great opportunity for a progressive company to produce an ***exclusive*** hit new product! ZYCAD is already actively seeking partners to manufacture and distribute the LIQUA-FLUSH™ product.

Contact ZYCAD

If your company is interested in licensing, purchasing, manufacturing or distributing any of ZYCAD's products, please contact ZYCAD by email at sales@zycad.com. For more information on this or other ZYCAD products, please visit www.zycad.com.

LIQUA-FLUSH™ – *"Modular Cartridge Based Liquid Dispenser System For Toilets"*

A **ZYCAD®** Engineering Product

SINGLE-CARTRIDGE VERSION

DUAL-CARTRIDGE VERSION

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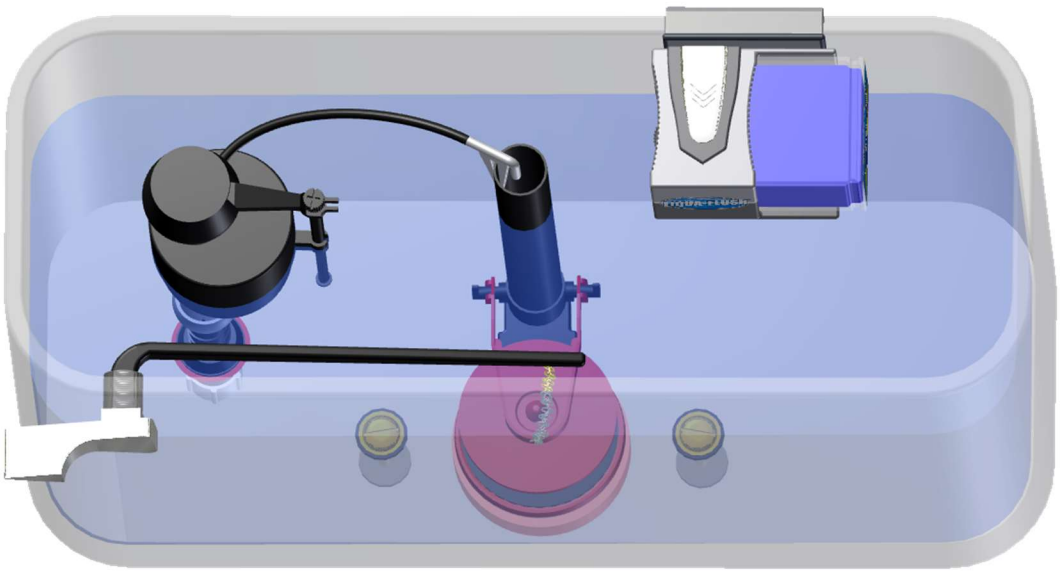

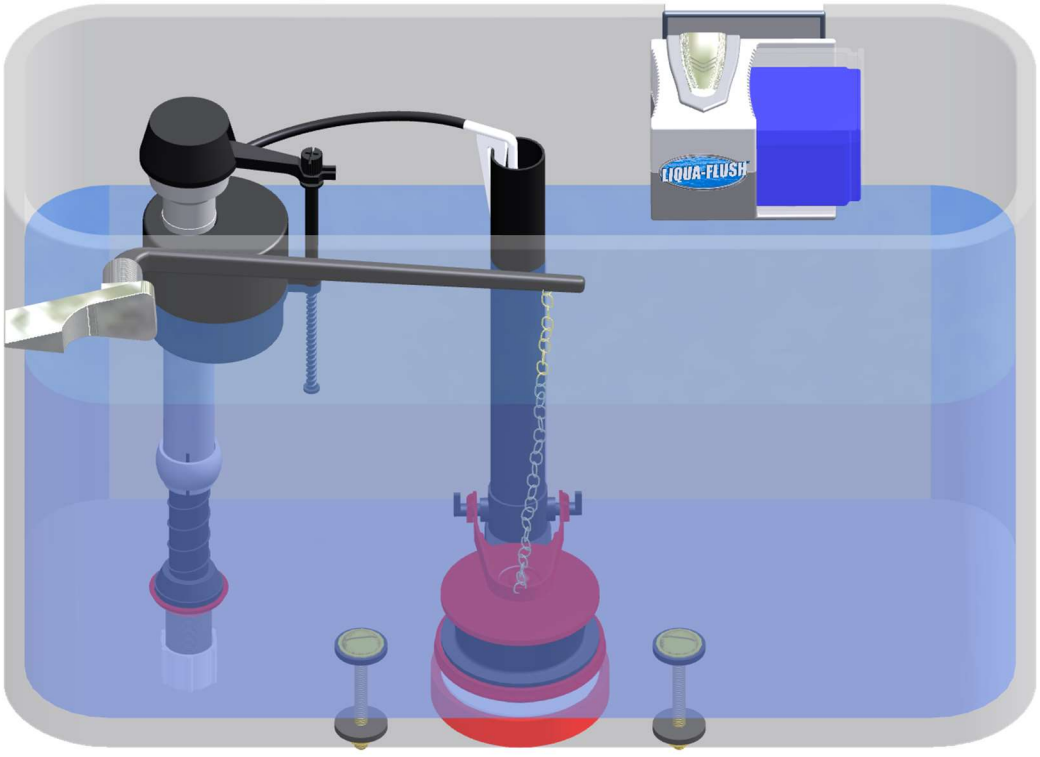

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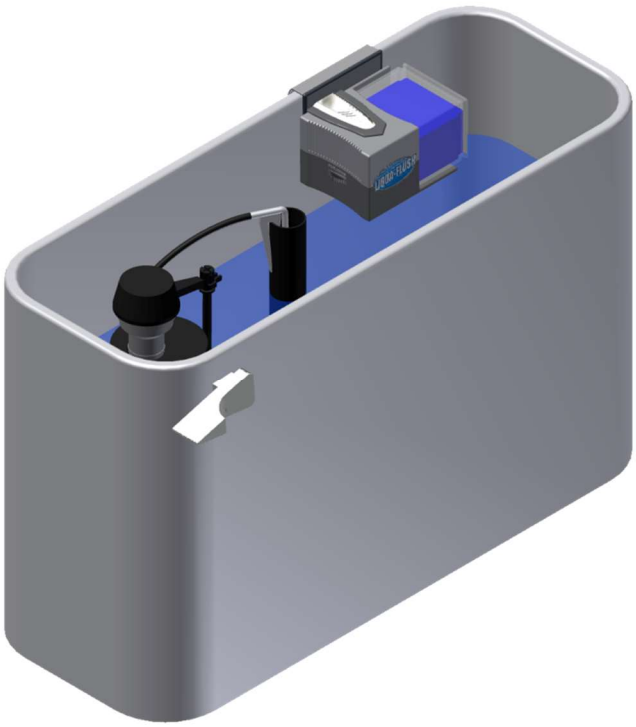
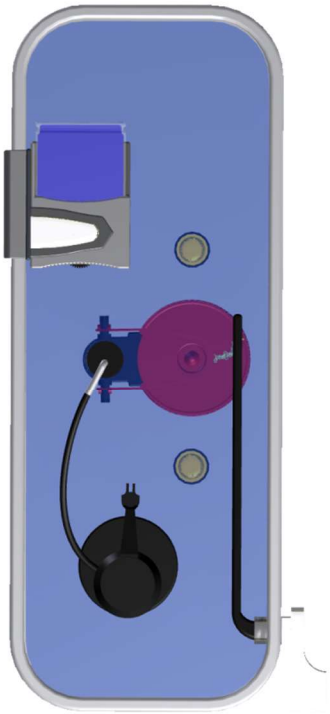
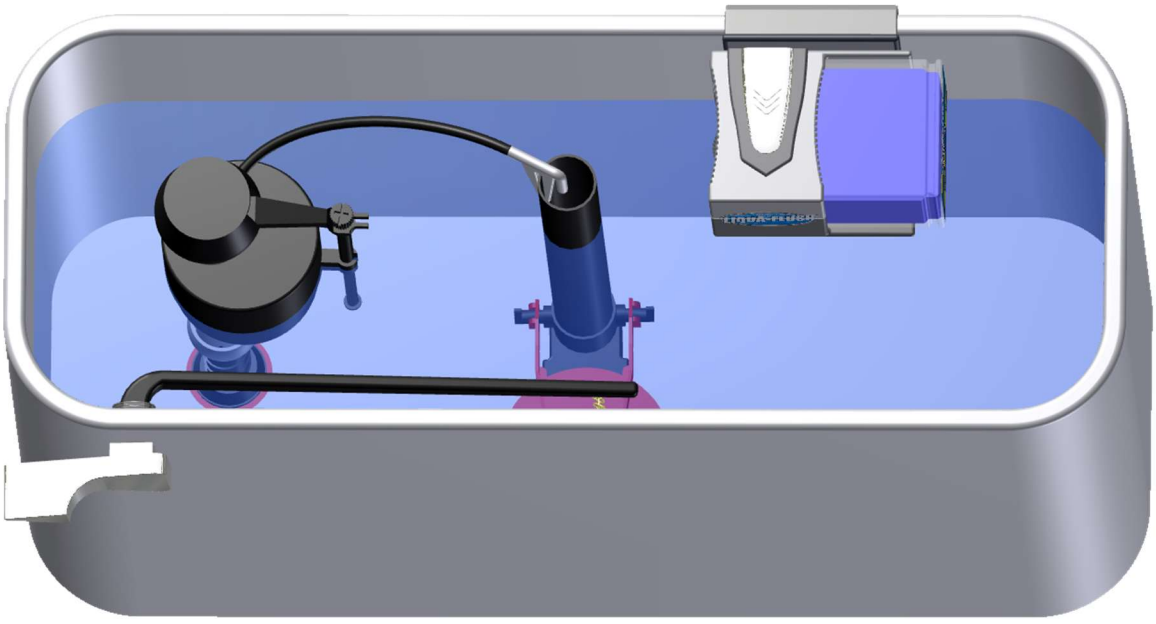
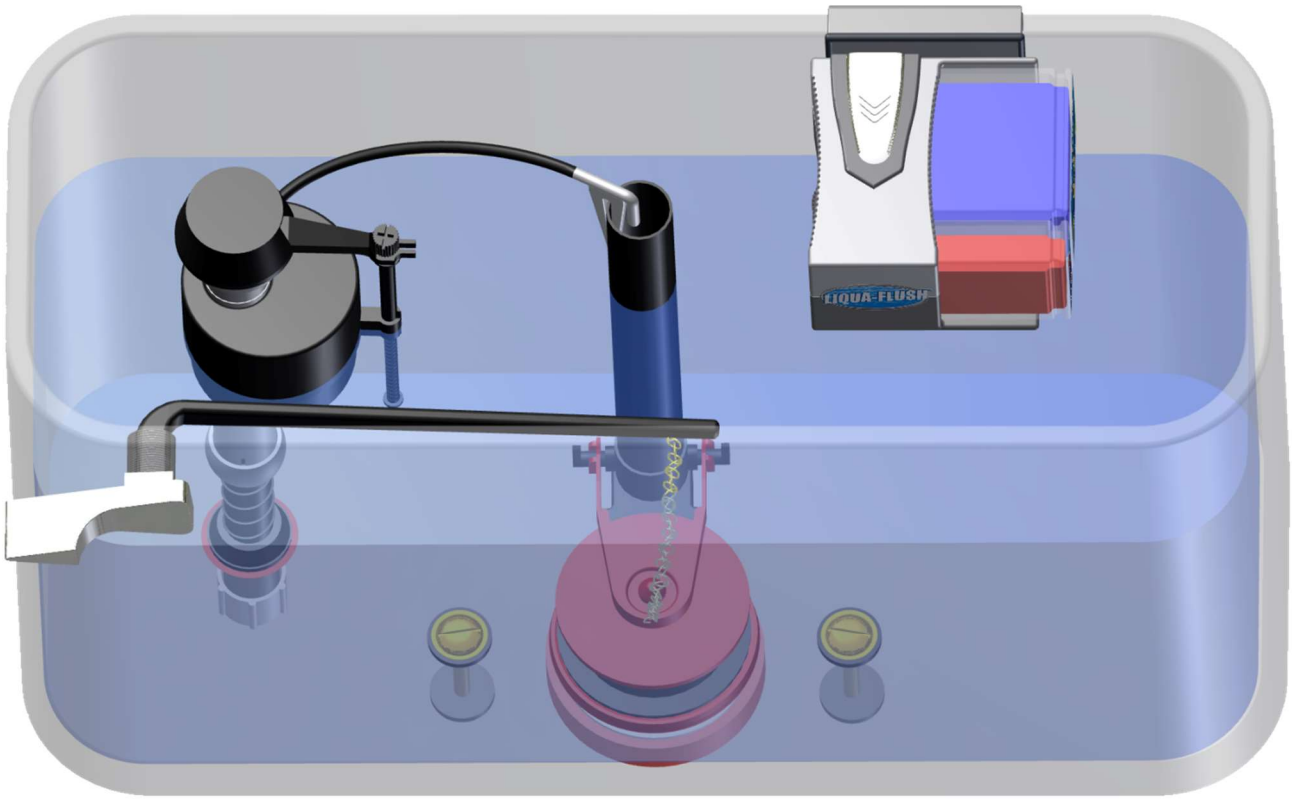






LIQUA-FLUSH™

DUAL-CARTRIDGE VERSION



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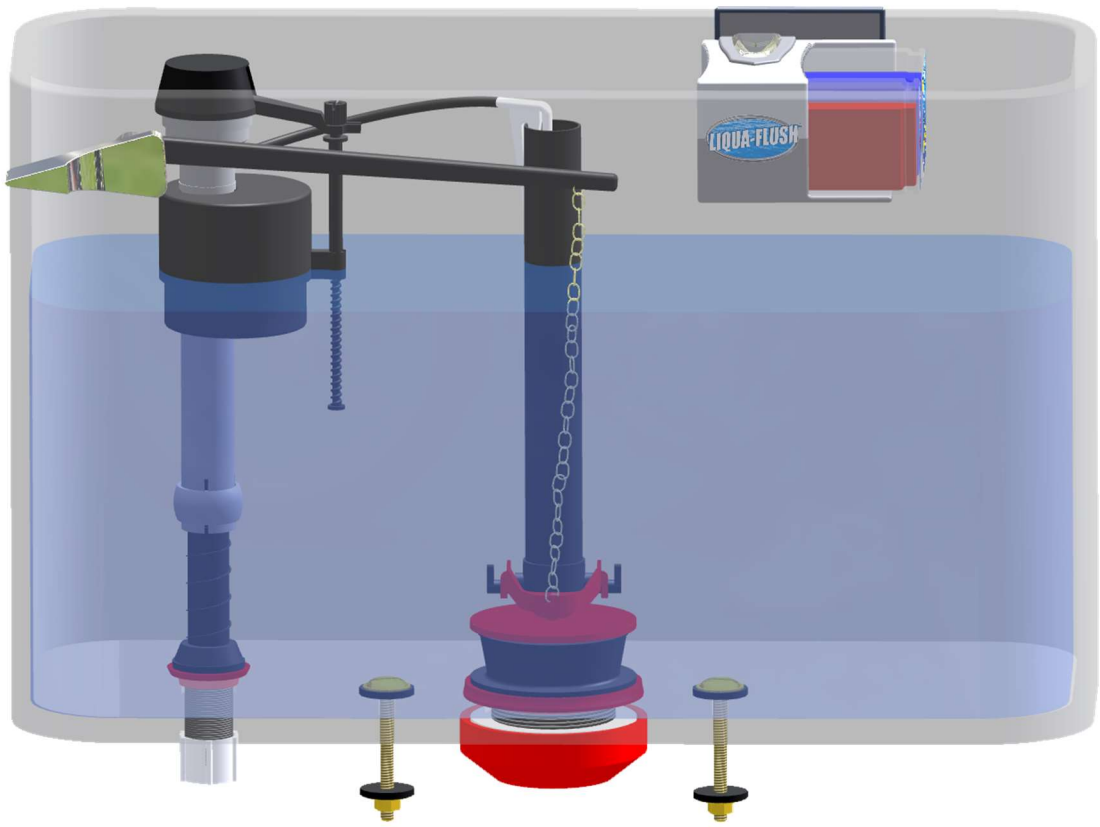

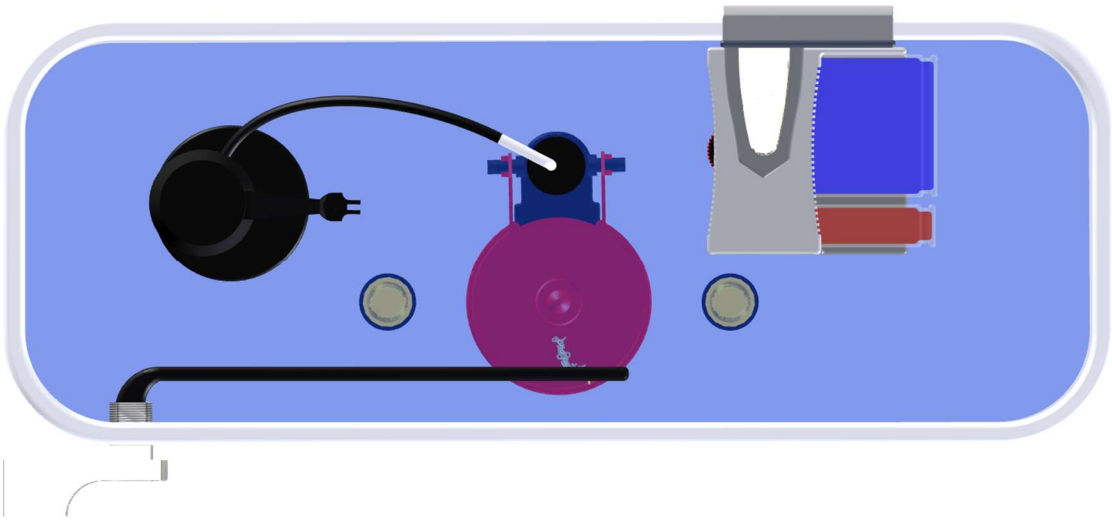

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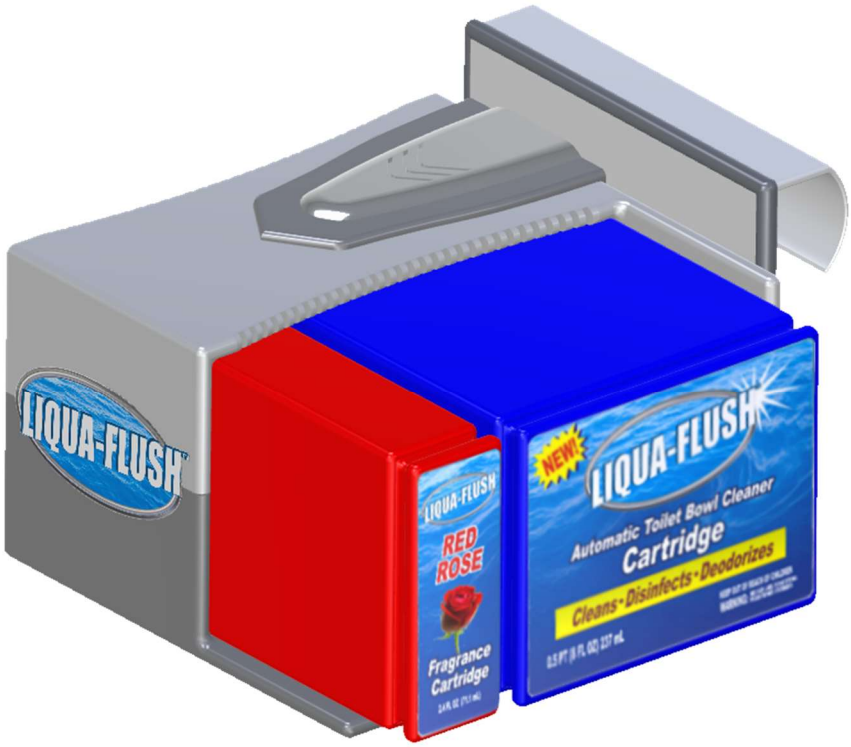

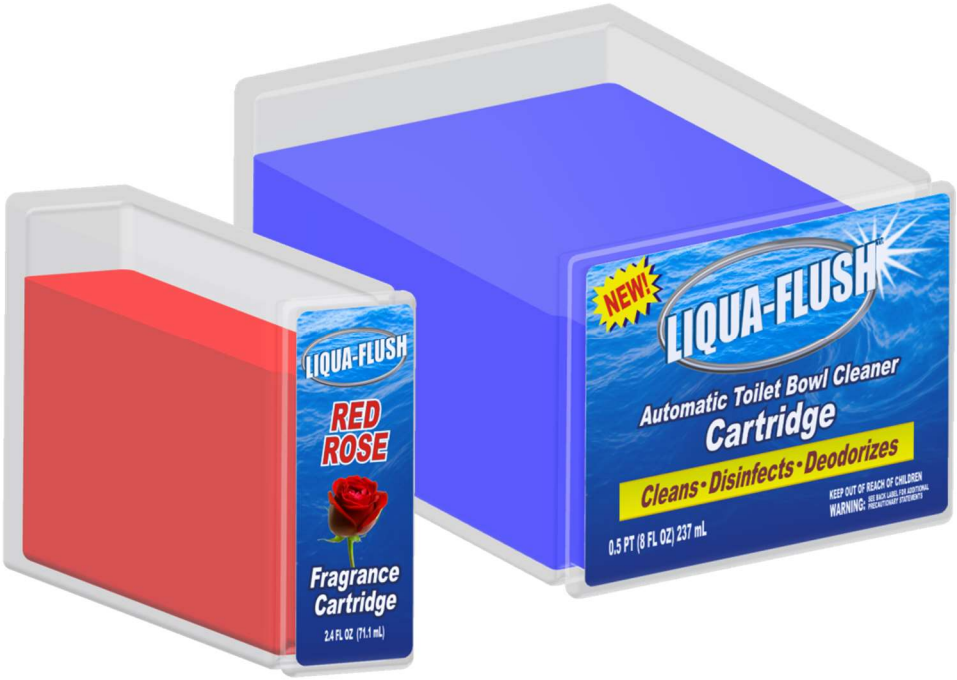

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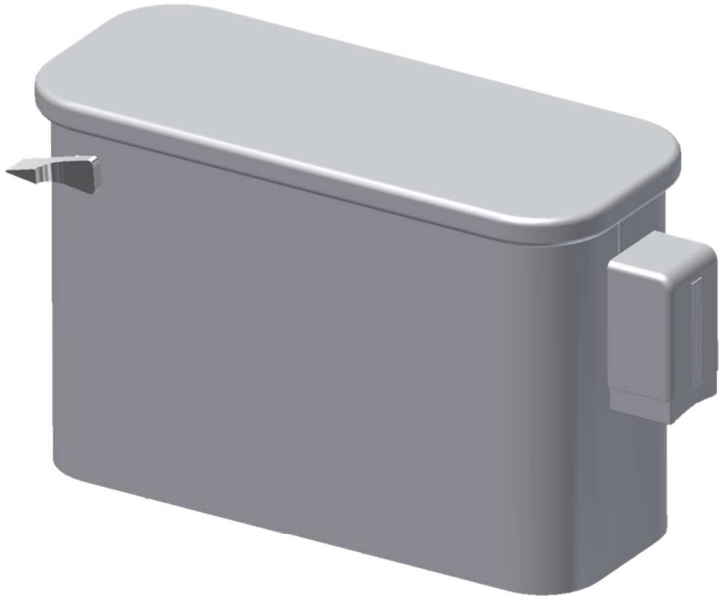
LIQUA-FLUSH™ FOR BALL FLOAT & PRESSURE ASSIST TANKS



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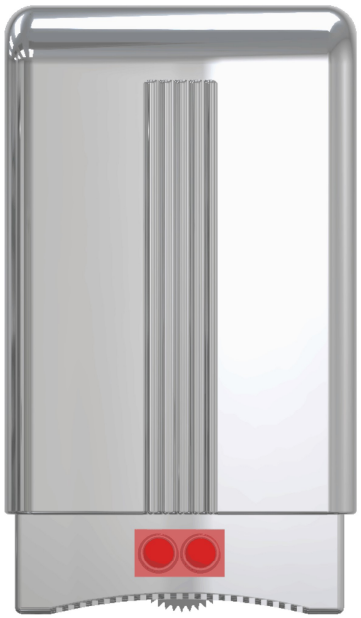
LIQUA-FLUSH™ FOR COMMERCIAL TOILETS



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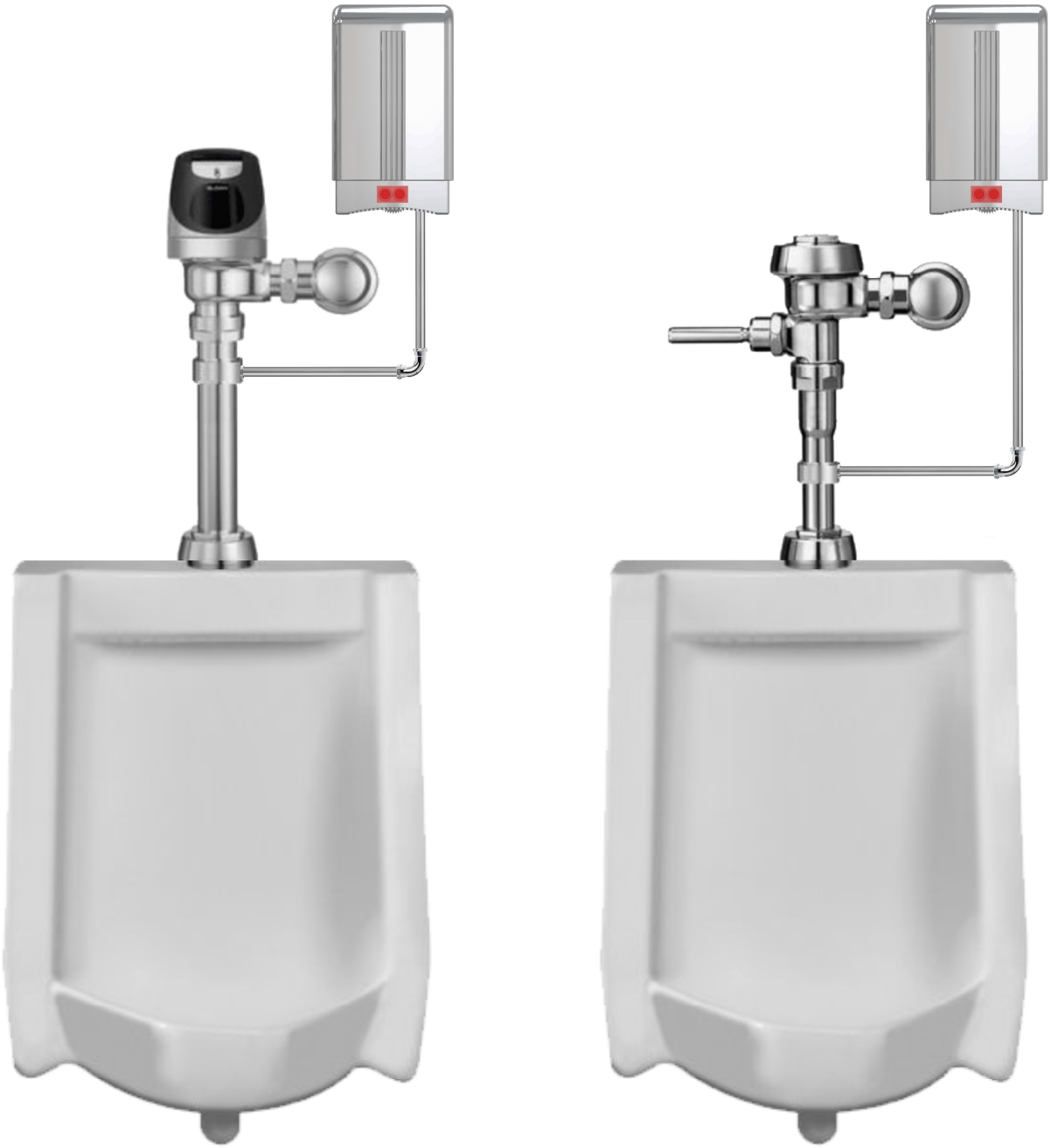
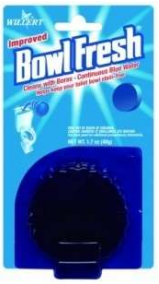
LIQUA-FLUSH™ FOR URINALS



TOILET SANITIZER PRODUCTS MARKET SURVEY

Alen-Festival
The Betty Mills Company
Big D
Blue Cross Laboratories
Blue Ribbon Products
Church & Dwight
Clorox
Continental Commercial Products
Dollar Days International
Dollar General
Fluidmaster
Fresh Products
HouseChem
Motsenbocker
NeverScrub
Personal Care
Qinggin
Reckitt Benckiser
Sano
SC Johnson
Summit
Walter Drake
WD-40
Whink
Willert Home Products
WMBarr

Ty-D-Bol® Air Freshener & Bowl Cleaner - Blue	Willert Home Products	www.willert.com	$2.99	
Ty-D-Bol® Air Freshener & Bowl Cleaner - Blue	Willert Home Products	www.willert.com	$2.99	
Ty-D-Bol® Air Freshener & Bowl Cleaner - Blue	Willert Home Products	www.willert.com	$2.99	
Ty-D-Bol® Air Freshener & Bowl Cleaner - Blue plus Bleach	Willert Home Products	www.willert.com	$2.99	
Ty-D-Bol® Air Freshener & Bowl Cleaner - Blue plus Bleach	Willert Home Products	www.willert.com	$1.99	

Bowl Fresh® Automatic Toilet Bowl Cleaner - Lavender	Willert Home Products	www.willert.com	$2.05	
Bowl Fresh® Automatic Toilet Bowl Cleaner - Orange	Willert Home Products	www.willert.com	$2.05	
Bowl Fresh® Bleach Tabs Automatic Toilet Bowl Cleaner	Willert Home Products	www.willert.com	$2.99	
Bowl Fresh® Blue Tabs Automatic Toilet Bowl Cleaner	Willert Home Products	www.willert.com	$2.99	
Bowl Fresh® Blue Tabs Automatic Toilet Bowl Cleaner	Willert Home Products	www.willert.com	$0.99	

Bowl Fresh® Blue Tabs Automatic Toilet Bowl Cleaner – twin pack	Willert Home Products	www.willert.com	$2.49	
Bowl Fresh® Blue Tabs Automatic Toilet Bowl Cleaner	Willert Home Products	www.willert.com	$3.19	
Bowl Fresh® Blue Tabs Automatic Toilet Bowl Cleaner – with Borax - 4 pack	Willert Home Products	www.willert.com	$3.79	
Bowl Fresh® Blue Tabs Automatic Toilet Bowl Cleaner – 4 pack	Willert Home Products	www.willert.com	$3.79	
Bowl Fresh® In Tank Jar Automatic Toilet Bowl Cleaner – 4 pack	Willert Home Products	www.willert.com	$3.29	
Bowl Fresh® Plus Toilet Deodorizer & Cleaner Over the Rim	Willert Home Products	www.willert.com	$3.90	

AirBoss Hanging Deodorizer	Willert Home Products	www.willert.com	$1.99	
Bowl Fresh® Ultra Toilet Bowl Cleaner Plus Deodorizer Over the Rim – Citrus, Pine, Lavender, Bleach	Willert Home Products	www.willert.com	$1.99	
Bowl Fresh® Gel Toilet Deodorizer Over the Rim	Willert Home Products	www.willert.com	$1.99	
Bowl Fresh® Toilet Deodorizer & Cleaner Over the Rim	Willert Home Products	www.willert.com	$4.59	
Bowl Fresh® Ultra Toilet Bowl Cleaner – Lavender Scented	Willert Home Products	www.willert.com	$2.06	
Bowl Fresh® Ultra Toilet Bowl Cleaner – Pine Scented	Willert Home Products	www.willert.com	$1.82	

Festival Toilet Bowl Cleaner and Deodorizer – Caribbean Breeze	Festival (Cadierno Corp.)	www.alenamericas.com	$3.99	
Festival Toilet Bowl Deodorizer – Lemon	Festival – Brand of Alen	www.alenamericas.com	$3.99	
4 Month In-Tank Toilet Bowl Cleaner	Walter Drake	www.wdrake.com	$9.99	
X-14® Automatic Toilet Bowl Cleaner - Blue plus Fragrance	X-14 is a member of the WD-40 Company brand family.	www.wd40.com www.x14brand.com	$1.99	
X-14® Anti-Bacterial Toilet Bowl Cleaner with Bleach	X-14 is a member of the WD-40 Company brand family.	www.wd40.com www.x14brand.com	$1.99	

2000 Flushes Blue Plus Bleach Automatic Toilet Bowl Cleaner	2000 Flushes is a member of the WD-40 Company brand family.	www.wd40.com www.x14brand.com	$3.99	
2000 Flushes Bleach Automatic Toilet Bowl Cleaner	2000 Flushes is a member of the WD-40 Company brand family.	www.wd40.com www.x14brand.com	$3.99	
2000 Flushes Blue plus Detergents Automatic Toilet Bowl Cleaner	2000 Flushes is a member of the WD-40 Company brand family.	www.wd40.com www.x14brand.com	$3.79	
Lysol® Cling gel 2 in 1 Continuous Bowl Cleaner - Spring Waterfall Scent	Lysol a Reckitt Benckiser Company	www.rb.com www.lysol.com	$1.82	
Lysol® No Mess Automatic Toilet Bowl Cleaner – Spring Waterfall Scent	Lysol a Reckitt Benckiser Company	www.rb.com www.lysol.com	$4.99	
Lysol® No Mess Automatic Toilet Bowl Cleaner – Lavender Scent	Lysol a Reckitt Benckiser Company	www.rb.com www.lysol.com	$4.99	

Lysol® No Mess Automatic Toilet Bowl Cleaner – Citrus Scent	Lysol a Reckitt Benckiser Company	www.rb.com www.lysol.com	$4.99	
Crystal Blue Automatic Bowl Cleaner	Continental Commercial Products Company	www.continentalcommercialproducts.com	$3.99	
Kleen Bowl Automatic Bowl Cleaner	Continental Commercial Products Company	www.continentalcommercialproducts.com	$3.99	
Sanobon Shiny Blue Perfumed Soap and Toilet Bowl Deodorizer – Blue	Sano	www.sanoenglish.com	$3.75	
Sanobon Shiny Blue Apple Soap and Toilet Bowl Deodorizer	Sano	www.sanoenglish.com	$3.75	
Sano Blue Toilet Cleaner	Sano	www.sanoenglish.com	$3.99	

Aqua Blue Toilet Cleaner for the Toilet Tank	Sano	www.sanoenglish.com	$3.99	
Sanobon Gel Toilet Cleaner	Sano	www.sanoenglish.com	$2.99	
Toilet Bowl Cleaner	Duette-HouseChem, Inc.	www.housechem.com	$0.99	
Royal Flush Bowl Cleaner – Concentrated Blue	Blue Cross Laboratories, Inc.	www.bc-labs.com	$2.99	
Royal Flush Automatic Bowl Cleaner	Blue Cross Laboratories, Inc.	www.bc-labs.com	$3.99	
Blue Too Bowl Cleaner – Plastic Jar	Blue Cross Laboratories, Inc.	www.bc-labs.com	$3.99	

Tab-Blu Automatic Toilet Bowl Cleaner	Blue Cross Laboratories, Inc.	www.bc-labs.com	$1.69	
Big D Blu Toilet Bowl Cleaner	Big D Industries, Inc.	www.bigdind.com	$3.99	
In-Tank Automatic Toilet Bowl Cleaner	Big D Industries, Inc.	www.bigdind.com	$2.99	
Clorox® Automatic Toilet Bowl Cleaner – Blue	Clorox®	www.clorox.com www.thecloroxcompany.com	$3.14	
Clorox® Automatic Toilet Bowl Cleaner with Teflon Surface Protector	Clorox®	www.clorox.com www.thecloroxcompany.com	$3.14	

Clorox® Automatic Toilet Bowl Cleaner – Bleach & Blue	Clorox®	www.clorox.com www.thecloroxcompany.com	$3.61	
Clorox® Automatic Toilet Bowl Cleaner – with Bleach	Clorox®	www.clorox.com www.thecloroxcompany.com	$5.49	
Rust Guard Bowl Cleaner	Whink	www.whink.com	$5.54	
Goof Off Rust Stain Toilet Tabs	Goof Off is a W.M. Barr & Company	www.wmbarr.com/ www.goofoffstainremover.com	$2.69	
Toilet Duck Auto Blue Cleanser Plus Fragrance	S C Johnson	www.scjohnson.com	$3.99	

Scrubbing Bubbles® Vanish® Continuous Clean Drop-Ins	Scrubbing Bubbles® an SC Johnson Company	www.scjohnson.com www.scrubbingbubbles.com	$3.99	
Scrubbing Bubbles® Toilet Cleaning Gel	Scrubbing Bubbles® an SC Johnson Company	www.scjohnson.com www.scrubbingbubbles.com	$5.69	
Scrubbing Bubbles® Continuous Clean 3 in 1 Cleaner	Scrubbing Bubbles® an SC Johnson Company	www.scjohnson.com www.scrubbingbubbles.com	$2.99	
Kaboom Scrub Free Toilet Cleaning System	Kaboom a Church & Dwight Company	www.kaboomkaboom.com www.churchdwight.com	$12.79	
Kaboom Scrub Free Refill (2 Pack)	Kaboom a Church & Dwight Company	www.kaboomkaboom.com www.churchdwight.com	$11.69	
Bowlblock Toilet Bowl Cleaner - Cherry	Hospeco a Betty Mills Company	www.hospeco.com www.bettymills.com	$2.99	

Hosepeco Health Gards Rim Cages Toilet Bowl Cleaner – Blue Mint	Hospeco a Betty Mills Company	www.hospeco.com www.bettymills.com	$2.99	
Hosepeco Health Gards Rim Cages Toilet Bowl Cleaner – Green Apple	Hospeco a Betty Mills Company	www.hospeco.com www.bettymills.com	$2.99	
Hospeco Health Gards ABC In Tank Automatic Bowl Cleaner	Hospeco a Betty Mills Company	www.hospeco.com www.bettymills.com	$3.99	
Bowl Block Toilet Bowl Cleaner	Krystal Deodorant & Restroom Products a Betty Mills Company	www.hospeco.com www.bettymills.com	$1.99	
Krystal In-Tank Automatic Bowl Cleaner Canister	Krystal Deodorant & Restroom Products a Betty Mills Company	www.hospeco.com www.bettymills.com	$3.99	
Iron Out®	Summit Brands	www.summitbrands.com	$5.75	

Flush n' Sparkle Toilet Bowl Cleaning system - Blue	Fluidmaster	www.fluidmaster.com	$10.79	
Flush n' Sparkle Toilet Bowl Cleaning system Refill Cartridges – Blue (2 pack)	Fluidmaster	www.fluidmaster.com	$13.55	
Flush n' Sparkle Toilet Bowl Cleaning system - Bleach	Fluidmaster	www.fluidmaster.com	$11.00	
Flush n' Sparkle Toilet Bowl Cleaning system Refill Cartridges - Bleach	Fluidmaster	www.fluidmaster.com	$13.55	
Never Scrub® Automatic Toilet Cleaning System	Never Srub	www.buyneverscrub.com	$7.99	

Never Scrub® Automatic Toilet Cleaning Refill Cartridges	Never Srub	www.buyneverscrub.com	$6.95	
PowerHouse Fresh Bowl Automatic Toilet Bowl Cleaner	PowerHouse by Personal Care Products	www.personalcareproducts.org	$2.95	
PowerHouse Fresh Bowl Bleach Automatic Bowl Cleaner	PowerHouse by Personal Care Products	www.personalcareproducts.org	$2.99	
PowerHouse Automatic Bowl Cleaner – Blue & Bleach Tabs	PowerHouse by Personal Care Products	www.personalcareproducts.org	$2.99	
PowerHouse Automatic Bowl Cleaner – Blue & Bleach Tabs	PowerHouse by Personal Care Products	www.personalcareproducts.org	$2.99	
120 Day Automatic Bowl Cleaner	Blue Ribbon Products	www.blueribboninc.com	$3.99	

Mr Bloo Toilet Bowl Cleaner and Air Freshener	Motsenbocker	www.liftoffinc.com/	$1.99	
Ultra Big Blue Enzymatic Automatic Bowl Cleaner	Fresh Products	www.personalcareproducts.org	$3.99	
Big Blue Automatic Bowl Cleaner	Fresh Products	www.personalcareproducts.org	$3.99	
Blue-Touch Automatic Toilet Bowl Cleaner	DDI – Dollar Days International, Inc.	www.dollardays.com/	$6.95	
Blue-Touch Toilet Bowl Cleaner & Air Deodorizer	DDI – Dollar Days International, Inc.	www.dollardays.com/	$2.99	
Dollar General Automatic Bowl Cleaner	Dollar General	www.dollargeneral.com	$1.00	

Auto Toilet Bowl Cleaner – 5 Disc	Qinggin		$1.99	

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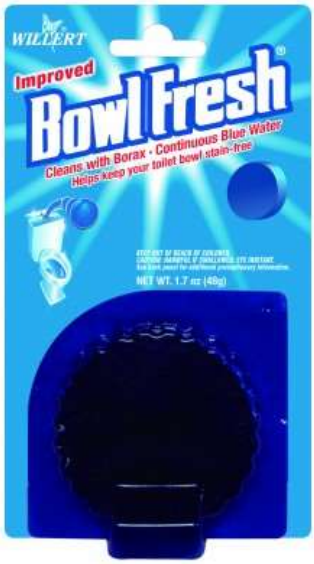

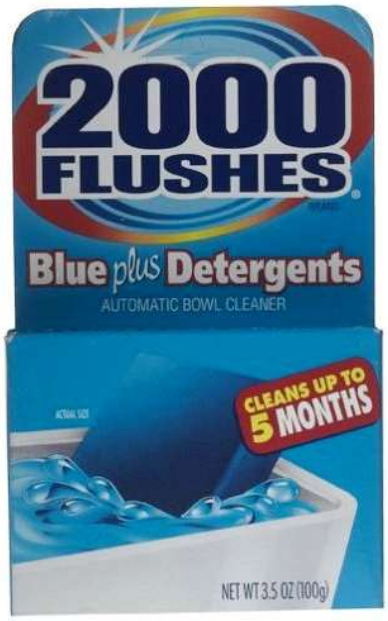

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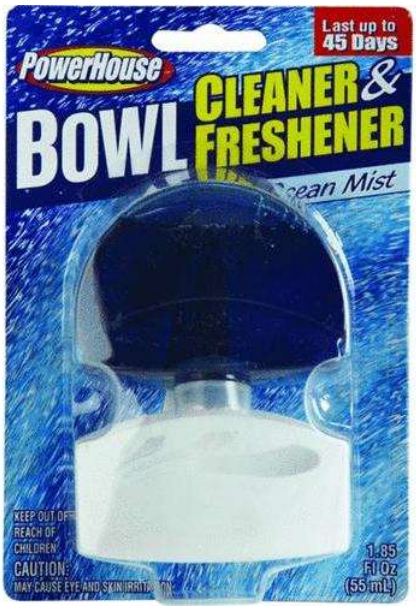


Modular Cartridge Based Liquid Dispenser System

ABSTRACT

A modular cartridge based liquid dispensing system for automatically dispensing a metered amount of liquid(s) into a toilet water tank and/or bowl. This unique programmable system mounts onto a standard water tank, and is shaped to match the tank so that it blends well with the existing toilet design for aesthetics. It is designed to dispense one or a plurality of solution types, allowing any desired solution to be dispensed, such as cleaning solutions and deodorants. It uses replaceable liquid cartridges that can be refillable or disposable, and can also use fixed tanks. This system can also utilize all of its components in a low-rise cabinet chassis that allows the entire system to be mounted inside the water tank where it is completely hidden from view. This system also has provisions for an optional automatic toilet flushing device and can also be used to dispense its liquids to a bidet apparatus.

BACKGROUND – FIELD OF THE INVENTION

The present invention relates in general to a programmable cartridge based device for automatically dispensing a metered amount of liquid or liquids into a toilet's water tank and features an optional flush control system. This device is also designed to be used to dispense liquids to a bidet device under development by the present inventor.

BACKGROUND – DESCRIPTION OF THE PRIOR ART

Toilet bowl sanitation has been a problem since the invention of the flush toilet. Toilets may contain microscopic organisms that can thrive and propagate to contaminate the toilet and bathroom. These germs can leave smelly, hard to clean deposits in the toilet bowl.

Early attempts at toilet sanitation relied upon manual methods of cleaning. It is a laborious chore, requiring frequent cleaning sessions and an expenditure of a substantial amount of time and labor. This gave rise to the advent of the automatic toilet bowl cleaning device. Currently, there are many of such automatic toilet bowl cleaning devices on the market. However, these devices have proved to be lacking in many respects.

One common method is to utilize dry chemical, water-soluble tablets of cleaner. These dry tablets are generally submerged in the toilet tank so that the tablets slowly dissolve in the tank water, thereby releasing a cleaning or disinfectant agent. The cleaning agent is then released into the toilet bowl when the toilet is flushed. The basic problem with these devices is that there is no control over the rate of chemical discharge. The dry chemical tablet will disintegrate and dissolve away relatively quickly at a set rate, which can result in far more of the product being consumed than needed for each flush cycle. Accordingly, it is necessary to replace the cleaning agent tablet frequently, resulting in an increased effort to keep the toilet clean. This is both costly and wasteful.

Another common method of toilet bowl sanitation utilizes a housing arrangement for a dry chemical tablet of cleaner. The housing partially isolates the tablet from the water supply to help slow the disintegration of the dry chemical in order to promote a more consistent delivery of the chemical treatment into the water for each flush.

However, these passive devices still rely on a fixed dissolution rate. This results in an inconsistent delivery of the chemical for each flush.

A third method of toilet bowl sanitation utilizes a liquid chemical dispenser. These dispensers allow for a predetermined amount of the chemical solution to be injected into the water tank after each flush. However, many of these devices are bulky and can detract from the toilet aesthetics. They also have limited or no adjustments to allow a user to select a desired concentration level.

A toilet sanitation device suitable for retrofit installation to existing toilet fixtures, or original installation into manufactured fixtures that is easily installed, inexpensive and does not detract from the aesthesis of the bathroom would be highly desirable. It would also be desirable to have a device that can automatically dispense a programmed amount of a liquid into the water tank after each flush. It would also be desirable to have more than one dispensed type of solution.

Therefore, it can be appreciated that there exists a continuing need for a new and improved toilet sanitization devices for a toilet. In this regard, the present invention substantially fulfills this need.

OBJECTS AND ADVANTAGES

It is an object of the present invention to provide an improved toilet dispensing device wherein the rate of dispersal of the water treatment solution is positively controlled in comparison to prior art devices, which in turn results in the working life of the water treatment solution being significantly extended.

It is a further object of this invention to provide a liquid dispenser for automatically dispensing a metered and reproducible volume of disinfecting and deodorizing cleaner into the water tank of a toilet in response to the normal flushing action of the toilet

It is a further object of the present invention to provide an improved dispensing device wherein use is made of a removable cartridge containing the water treatment material, whereby, upon the material being fully consumed, a user need only insert a replacement cartridge, without having to remove the device in its entirety.

It is a further object of the present invention is to provide the ability to easily add disinfecting solution without the need to remove the toilet tank lid.

It is a further object of the present invention is to provide the ability for the device to dispense more than one type of solution.

It is a further object of the present invention to provide a liquid dispensing device that can also be used to dispense solutions to a bidet apparatus.

It is a further object of the present invention is to provide a product that has universal appeal to a wide variety of bathroom settings to provide the most inconspicuous and unobtrusive product as to maintain look the traditional bathroom.

It is a further object of the present invention to provide a toilet liquid dispensing device which is of extremely simple design and of low cost.

It is a further object of the present invention to provide a liquid dispensing device that has the ability to provide an indication of residual fluid level without the need to remove the tank lid.

It is a further object of the present invention is to provide a toilet sanitation device that can be readily fitted to and removed from an existing toilet tank system and that requires no bathroom alterations or special tools to install it.

SUMMARY OF THE INVENTION

In the view of the foregoing disadvantages inherent in the known types of toilet devices and accessories now present in the prior art, the present invention provides an improved sanitation device attachment for a toilet. As such, the general purpose of the present invention, which will be described subsequently in greater detail, is to provide a new

and improved sanitation attachment for a toilet that has all the advantages of the prior art and none of the disadvantages.

The present invention accomplishes the above-stated objectives, as well as others, as may be determined by a fair reading and interpretation of the entire specification.

The present invention is a modular, programmable liquid dispenser that is designed to dispense a metered amount of a liquid solution into the toilet bowl after each flush. Therefore, a precise, consistent amount of solution is automatically dispensed to the water tank or directly into the toilet bowl during the toilet bowl refill. Consequently, the amount of chemical needed to clean/disinfect the toilet bowl is reduced. This also spares the user the burden of frequently having to add more cleansing solution to the toilet tank. The present invention consists of a modular cabinet housing, an electronic user programmable controller, a liquid cartridge, a liquid pump, a flush sensing device and an optional mechanism to automatically flush the toilet.

Modular Cabinet:

The present invention uses a unique modular cabinet that is designed to mount onto the top rim of a standard toilet water tank, which is inserted between the water tank and the water tank's lid. It is shaped to blend in with the design of the water tank for aesthetics. The bottom of the cabinet has guides that allow the cabinet to securely fit onto the rim of a water tank without the use of fasteners. The top edge of the cabinet housing has a rim shaped just like that of the water tank to allow the original toilet's lid to be re-installed, if desired. This allows the stock lid to be reused so that the general stock design of the toilet can be maintained and to help the cabinet to blend into the existing bathroom décor. The cabinet can have its own custom or integrated top as well. The modular design of this unit allows other modular cabinet assemblies to be installed above or below it.

User Programmable Electronic Controller:

To effectively cleanse, disinfect and deodorize toilet flushing water, usually only a small amount of water treatment material or additive is needed to be mixed with the flushing water. However, if the toilet is subjected to frequent use, then the toilet may require a more substantial concentration of solution in the bowl. Also, some cleansing solutions can be used full strength, whereas other cleansing solutions are so strong that they should always be diluted. Thus, it would be desirable for a user to vary the amount of sanitizer which is discharged into the tank and thus reach the bowl so that the preferred solution concentration can be achieved.

The present invention addresses this issue by utilizing a small, battery powered electronic controller. This programmable device controls a liquid pump to meter out a precise volume of liquid to be dispensed so that any desired level of solution concentration is possible in the toilet bowl. The controller receives an input from a sensor that has components attached to the toilet flush actuator lever. Once the sensor detects movement of the lever as the toilet if flushed, the controller then schedules a dispensing cycle. After a programmed amount of time has elapsed following the flush, the controller activates the liquid pump to dispense the solution.

The modular cabinet provides the space to mount the programmable controller. The controller is located on the front access panel of the cabinet to allow convenient access for programming. A cover plate protects and conceals the controller from view.

Liquid Cartridge System:

With many previous art devices, it can be inconvenient to replace the chemical dispenser or replenish the chemical solution. Some chemical dispensers are continuously immersed in the tank water resulting in a gross and slippery mold that may grow outside the dispenser. Moreover, it is impossible to check the residual amount of the chemical dispenser visually, without pulling off the tank lid. Some liquid dispensers can be very messy to refill. The present invention addresses these problems by making use of a unique removable liquid cartridge system. This feature allows a user several advantages and options, such as:

1) Convenient Access: The replaceable cartridge is inserted into a slot in the front of the modular cabinet, behind an access panel. This position allows the user easy reach to service the unit, without having to pull off the lid of the toilet tank

2) Convenient Packaging to Reduce Mess: The cartridge is a convenient, leak free container for liquids, allowing the user to handle it without coming in contact with the liquid inside, which could be a harsh, extremely concentrated chemical. The cartridge contains a small, spring-loaded liquid valve that is

normally closed to prevent any leakage while the cartridge is removed from the cabinet. The liquid valve automatically opens when the cartridge is simply inserted into the cabinet.

3) Economical Use of Chemicals: A reusable and refillable cartridge options allows a user the ability to purchase sanitation solution in large quantities, such as economical gallon sized jugs. The cartridge can be simply removed from the cabinet, its cap removed and then refilled with solution.

4) User Choice of Chemicals: A refillable cartridge provides a user the ability to utilize any desired kind of readily available solution that could adequately sanitize the toilet, such as chlorine. Users that have swimming pools or hot tubs would likely have an ample supply of this, which saves the cost of special solutions.

5) Convenience of Service: An optional disposable cartridge allows the user the convenience of simply discarding a spent cartridge. This relieves the user from the task of refilling the cartridge and from the potential of making a mess. A user has only to flip down a convenient access door on the front panel of the cabinet, pull out and discard a spent cartridge and then simply insert a fresh cartridge into the device.

6) Solution Level Indication: A cartridge made of a transparent or semitransparent material would allow a user to visually see the fluid level inside the cartridge simply by glancing at it, thereby allowing the user to know how much fluid remains in the cartridge. An optional electronic fluid level detector could also be used sense the level of the liquid inside the cartridge and then provide feedback for the user, whereby the controller could flash a lamp and/or signal a beeper to occasionally chirp to indicate a low fluid level condition.

Multiple Liquid Cartridge System:

Many homes suffer from high concentrations of dissolved minerals in the water supply that can build up in the toilet bowl over time. These mineral deposits are not only unsightly, but can be a chore to clean. These deposits also provide an environment that allows bacteria to thrive, which can produce odors. Therefore, it would be desirable to have a device to automatically dispense a second solution into the toilet that can dissolve these mineral deposits.

The present invention addresses this issue by providing the ability for the device to dispense more than one kind of solution. This feature would fulfill the need for a user to select a second or third type of chemical solution to be dispensed into the toilet, such as a special chemical compound that can help dissolve mineral deposits before they have time to form. The present invention thus allows for multiple cartridges to be utilized. A dual-cartridge unit would allow one cartridge to contain a basic cleaning and sanitizing solution while the second cartridge can contain a solution to dissolve mineral deposits. A third cartridge could contain a deodorant.

The current invention utilizes a single electronic controller that is designed to allow each cartridge to be independently programmed and controlled. Each fluid can be separately programmed for the amount of liquid to be dispensed as well as the frequency. While the sanitizing solution can be dispensed after each flush, the mineral dissolving solution can be added to the tank less frequently, such as once a week. Moreover, as this second fluid may be needed to be administered directly to the toilet bowl in its full strength, the current invention allows this possibility by its use of a flexible liquid discharge tube that can be inserted into the toilet's overflow pipe. Thus, the full concentrated liquid would then flow directly from the cartridge into the bowl.

Automatic Flush Control:

One common toilet problem is that microscopic organisms can thrive and propagate around the bowl of an unused toilet, where a regular bowl rinsing with a sanitizing solution is rarely performed. In time, an unused toilet can develop mold around the bowl. This may happen while a house is unoccupied for long periods, or if a particular toilet is seldom used.

Another common toilet problem is that of an unflushed toilet. An unflushed toilet is a very unwelcomed sight, which may be quite embarrassing for the person who left it that way as well as for the person who then discovers it. Nobody wants to forget this responsibility. Although this may be an infrequent event for adults, this "forgetting to flush" inaction is a very frequent event among children. This is not only unsightly, but the condition leaves the toilet in an unsanitary condition. This could result in more toilet stains and buildup, causing more frequent cleanups and extra work.

The current invention solves this problem by automatically flushing the toilet after use. Another feature of the modular cabinet is to provide the mounting structure for an automation device that can flush the toilet. The cabinet provides a dedicated place over the flush handle actuator lever to mount a solenoid or similar device that has the ability to mechanical lift the actuator lever, thereby flushing the toilet. The modular cabinet is also designed to accommodate a proximity sensor, which will detect that someone is using the toilet. Once the proximity sensor senses the toilet's occupancy and then detects a vacancy, the flush device will activate, which will pull up on the flush handle actuator lever thus flushing the toilet.

The electronic controller can be programmed to automatically perform a toilet flush at regular intervals as well, such as once a week, to keep the bowl sanitized. An automatic weekly flush would kill any bacteria that may be trying to form, thus keeping the toilet sanitized and prolonging the regular cleaning intervals.

Large Liquid Tank System:

One embodiment of the present invention is to accommodate the use of non-cartridge, tank style containers. A much larger tank would allow the ability of the device to hold a vast amount of liquid, which would provide a user the convenience of less frequent service refill intervals.

Low Profile Cabinet:

Yet another embodiment of the present invention is to utilize a low-profile cabinet for the liquid dispenser assembly to actually reside hidden from view inside the toilet water tank. A thin mounting rim or hanging strap is used to mount the cabinet assembly in place as protruding down into the water tank. This embodiment requires that the components be arranged for clearance of any components that exist inside the tank. The benefit of this embodiment is that the entire unit is completely hidden from view inside the tank. To service the dispenser, the tank lid is simply removed to gain access to the cartridge or tank.

Multipurpose Device for Bidet System Use:

A further embodiment of the present invention allows it serve as a multipurpose device, where it can be used in other ways, such as to dispense a solution or solutions to a bidet device. The present inventor has developed a special bidet device that utilizes the current invention as a means to deliver a cleansing liquid or liquids to a bidet sprayer.

Bathroom and Toilet Aesthetics:

One main object of the current invention is to provide the most inconspicuous and unobtrusive cabinet as to maintain look the traditional bathroom. The current invention achieves this because the toilet water tank mounted modular cabinet is shaped like the water tank so as to blend in with the existing facility, making it inconspicuous. The aesthetics of the toilet then appear normal, with the appearance of only a slightly taller than usual water tank. The modular cabinet could be provided with its own detachable lid, but reusing the original stock toilet lid will better preserve the original toilet aesthetics.

Universal Applications:

The component of this invention requiring the concern for universal application is the shape of the water tank mounted modular cabinet and its mounting guides. For universal applications, this modular cabinet could also be offered in a generic cabinet shape or "skin" that is designed to work on and look good with a wide range of brands and models, thus enhancing the ability to more widely use this product on existing toilets.

Ease of Installation:

The modular cabinet's position on the water tank also allows easy installation of the device as it merely sits on the water tank, using no fasteners. Guides on the cabinet's bottom mates with the water tank's rim to keep the cabinet securely in place. The top of the modular cabinet has a rim just like the water tank so that the original lid can be attached to it. This modular design allows it to be easily removed so that quick service to the components inside the water tank can be made, such as freeing up a stuck flush valve.

Conclusion:

Although only a few embodiments of the present invention have been described, it should be understood that the present invention may be embodied in many other specific forms without departing from the spirit or the scope of the present invention. The present examples are to be considered as illustrative and not restrictive, and the invention

is not to be limited to the details given herein, but may be modified within the scope of the appended claims along with their full scope of equivalents.

The above mentioned objectives and advantages of this invention and the manner of attaining them will become more apparent by reference to the following accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, advantages, and features of the invention will become more readily apparent to those skilled in the art from the following detailed description when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a front perspective view of a dual-cartridge version of the modular liquid dispenser as mounted on a standard toilet.

FIG. 2 is a top front perspective view of a single-cartridge version of the modular liquid dispenser with its cartridge access cover closed and reveals openings in the top as passageways through the cabinet so that other cabinets that may be mounted above it and can route its components through it to reach the water tank.

FIG. 3 is a lower front perspective view of a single-cartridge version of the modular liquid dispenser with its cartridge access cover closed and reveals openings for the liquid discharge tube and toilet flush actuator chain.

FIG. 4 is a front perspective view of a single-cartridge version of the modular liquid dispenser with its cartridge access cover open to reveal a single docked cartridge and an electronic control module.

FIG. 5 is a top front perspective view of two single-cartridge versions of the modular liquid dispenser as stacked together to demonstrate the modular nature of the cabinets.

FIG. 6 is a front view of a dual-cartridge version of the modular liquid dispenser illustrating the two docked cartridges and shows a battery compartment cover open to reveal a battery that supplies power for the system.

FIG. 7 is a top front perspective view of a dual-cartridge version of the modular liquid dispenser with the cabinet top off to reveal the components mounted inside and is also shown with one of the cartridges pulled out to illustrate its removability.

FIG. 8 is a front view of a three-cartridge version of the modular liquid dispenser illustrating the three docked cartridges and an electronic control module that is used to program each dispenser independently.

FIG. 9 is a top rear perspective view of a liquid cartridge and liquid pump assembly to show how they would normally be mated together inside the cabinet.

FIG. 10 is a lower front perspective view of a liquid cartridge and liquid pump assembly to show how they would normally be mated together inside the cabinet.

FIG. 11 is a lower front perspective view of a liquid cartridge and liquid pump assembly with the liquid pump assembly slightly cocked from the normal alignment with the cartridge to illustrate the orientation of the mating orifices that communicate the liquid from the cartridge to the pump assembly. This view also shows the liquid level sensor on the pump assembly and its mating window pane on the cartridge.

FIG. 12 is a front perspective view of a refillable version of the liquid cartridge that utilizes a ventilated refill cap.

FIG. 13 is a front perspective view of the disposable version of the liquid cartridge with a pressure relief valve located on its top side.

FIG. 14 is front perspective view of the modular liquid dispenser where the liquid is stored in a larger, fixed tank rather than a smaller, removable cartridge.

FIG. 15 is front perspective view of the modular liquid dispenser where the liquid is stored in two larger, fixed tanks rather than smaller, removable cartridges.

FIG. 16 is front view of the modular liquid dispenser as mounted on a toilet tank, with a cross section view of the tank to reveal how the discharge tube of the dispenser can be inserted inside the overflow pipe and also shows the automatic flush control linkage cable connection to the flush actuator lever.

FIG. 17 is front perspective view of the modular liquid dispenser as mounted on a toilet tank, with a cross section view of the tank to reveal the details of the flush sensor and automatic flush control assembly.

FIG. 18 is front perspective of a low-profile embodiment of the invention that includes a large tank reservoir.

FIG. 19 is front perspective of a low-profile embodiment of the invention that includes a large tank reservoir and shown as mounted inside a standard toilet water tank to demonstrate the low-profile nature of the chassis.

FIG. 20 is front sectional view of a low-profile embodiment of the invention that includes a large tank reservoir and shown as mounted inside a standard toilet water tank to demonstrate the low-profile, hidden nature of the chassis.

FIG. 21 is front perspective of a low-profile embodiment of the invention that uses a replaceable liquid cartridge.

FIG. 22 is top front perspective of a low-profile embodiment of the invention that uses a replaceable liquid cartridge.

FIG. 23 is top front perspective of a compact, universal fit embodiment of the present invention that is shown with an installed replaceable cartridge. A simple clip allows the unit to be clipped onto the inside of virtually any size or shaped water tank.

FIG. 24 is top front perspective of a compact, universal fit embodiment of the present invention that is shown without a cartridge.

FIG. 25 is top front perspective of a compact, universal fit embodiment of the present invention that is shown mounted inside of a standard toilet water tank.

FIG. 26 is lower front perspective of a compact, universal fit embodiment of the present invention that uses an electronic sensor to determine a toilet tank's water level for feedback that the toilet has been flushed.

FIG. 27 is front perspective of a compact, universal fit embodiment of the present invention that uses a vertical style float system to determine a toilet tank's water level for feedback that the toilet has been flushed.

FIG. 28 is front perspective of a compact, universal fit embodiment of the present invention that uses a lever style float system to determine a toilet tank's water level for feedback that the toilet has been flushed.

FIG. 29 illustrates yet another method that the present invention can use to determine when the toilet has been flushed. A tilt-sensor that is mounted to the flush actuator lever transmits a signal wirelessly to the liquid dispenser.

FIG. 30 illustrates a flush actuator lever tilt-sensor and a liquid dispenser as mounted inside a standard toilet water tank.

FIG. 31 is top rear perspective view of a compact embodiment of the present invention that illustrates how a second cartridge assembly can be simply snapped onto it, thus converting the devices into a single, multi-cartridge liquid dispenser.

FIG. 32 is top rear perspective view of a compact, dual-cartridge embodiment of the present invention.

FIG. 33 is bottom rear perspective view of a compact, dual-cartridge embodiment of the present invention to illustrate how a second cartridge can be used to discharge liquid into the tank's overflow pipe.

FIG. 34 is top front perspective of a compact version of the present invention whereby the entire device is formed into a single, one-piece disposable chassis.

DETAILED DESCRIPTION OF THE DRAWINGS

Various other objects, advantages, and features of the invention will become more readily apparent to those skilled in the art from the following detailed description when read in conjunction with the accompanying drawings, in which like reference numerals designate like parts throughout the figures thereof.

FIG. 1 illustrates the basic idea of the present invention, where a dual-cartridge version of the modular liquid dispenser cabinet assembly **51** is shown mounted onto a standard toilet water tank **52**. The modular cabinet **54** is shaped to match the shape of the water tank **52** so that it helps blend in with the toilet and décor of the bathroom. The stock water tank lid **53** can be installed onto the cabinet assembly **51** to help maintain the stock look of the toilet, or a custom tank lid can be used. The cabinet assembly **51** could also have an integral, non-removable top as well. An access cover **56**, that normally conceals the cartridge compartment is shown open to illustrate the two cartridges **58** as docked into the modular cabinet **54**.

FIG. 2 shows a top front perspective view of a single-cartridge version of the modular liquid dispenser assembly **51** with its cartridge access cover **56** closed.

FIG. 2 and **FIG. 3** shows a liquid discharge tube passageway slot **70** located on the top and bottom of the modular cabinet **54** to allow a passageway completely through the cabinet **54**. Two stacked cabinets **54**, as shown in **FIG. 5**, would need this passageway to route the discharge tube **64** from the top unit through the bottom cabinet **54** and on into the water tank **52** below it. Likewise, a flush linkage passageway orifice **72** provides a passageway through the cabinet **54** to allow the, flush actuator lever linkage **76** of a top mounted cabinet **54** to route through a lower cabinet **54** to reach the tank **52**.

FIG. 3 shows a liquid discharge tube passageway slot **70** located at the back bottom side of the modular cabinet **54** that allows a passage space for the liquid discharge tube **64** so that it can extend down into the toilet water tank **52** to pass the liquid from the cabinet assembly **51** to the tank **52**. **FIG. 3** is also shows the mounting guides **69** that securely hold the cabinet assembly **51** onto a water tank **52** or onto the rim **68** of another cabinet assembly **51** as depicted in **FIG. 5**.

FIG. 4 is a top front perspective view of a single-cartridge version of the modular liquid dispenser cabinet assembly **51** with its cartridge access cover **56** open. A refillable cartridge **57** can be seen docked into the cabinet **54**. A programmable electronic control module **71** allows the assembly **51** to be programmed in a variety of ways.

FIG. 5 is a top front perspective view of two single-cartridge versions of the modular liquid dispenser cabinet assemblies **51** stacked together. This allows for two different types of solutions to be dispensed into the water tank **52**. Each modular liquid dispenser cabinet assembly **51** has a rim **68** and a mounting guide **69** that allows them to be stacked onto each other and onto the water tank **52**.

FIG. 6 is a front view of a dual-cartridge version of the modular liquid dispenser cabinet assembly **51** illustrating two refillable docked cartridges **57** and also shows a battery compartment cover **67** open to reveal a battery **66** that supplies power for the system.

FIG. 7 is a top front perspective view of a dual-cartridge version of the modular liquid dispenser cabinet assembly **51** with the cabinet top off to reveal the components mounted inside and is also shown with one of the refillable cartridges **57** pulled out to illustrate its removability. A cartridge alignment and support guide **84** keeps the cartridge **57** aligned and supported within the cabinet **54** while the cartridge **57** is inserted so that can then properly mate with the liquid pump assembly **61** that is mounted at the back of the guide 84.

FIG. 8 is a front view of a three-cartridge version of the modular liquid dispenser cabinet assembly **51** illustrating three docked disposable cartridges **58** and a single electronic control module **71** that is used to program each liquid dispenser independently.

FIG. 9 is a top rear perspective view of a liquid cartridge **57** and liquid pump assembly **61** to show how they would normally be mated together inside the cabinet **54**.

FIG. 10 is a lower front perspective view of a liquid cartridge **57** and liquid pump assembly **61** to show how they would normally be mated together inside the cabinet **54**. A label **65** can be affixed to the cartridge **57** to identify its contents.

FIG. 11 is a rear lower perspective view of the liquid pump assembly **61** as slightly cocked from its normal alignment with the liquid cartridge **57** to illustrate the mating of the cartridge drain tube **59** with the liquid pump inlet fitting **62** that conveys the liquid from the cartridge **57** into the pump assembly **61**. Once the cartridge **57** is

completely inserted into the cabinet **54**, its drain tube **59** becomes mated with liquid pump inlet fitting **62**. An O-ring style seal **89** is used around the outside circumference of the drain tube **59** so that it can seal with the inlet fitting **62**. A stationary valve actuator pin **90** inside the pump inlet fitting **62** pushes against the liquid drain valve **88** inside the cartridge drain tube **59**, causing it to open and allows the liquid inside cartridge **57** to flow into the pump inlet fitting **62**. Once the pump assembly **61** is activated, liquid is drawn out of the cartridge **57** and is discharged through a liquid pump discharge fitting **63** where a flexible liquid discharge tube **64** then directs the liquid down to the water **93** inside the water tank **52**.

FIG. 11 also shows an electronic liquid level sensor **91** on the pump assembly **61** and a liquid level window pane **92** on the cartridge **57**. The pane **92** normally rests within very close proximity to the level sensor **91**. The window pane **92** portion of the cartridge **57** is made of a transparent material so that the sensor **91** can detect the level of the fluid inside the cartridge **57**. The level sensor **91** communicates with the control module **71** so that the fluid level can be known and displayed. The control module **71** could flash a lamp or provide a periodic audible beep to signal a low fluid level condition.

FIG. 12 is a front perspective view of a refillable liquid cartridge **57** shown with its refill cap **60**. The refill cap **60** is ventilated, which allows a one-way flow of air into the cartridge **57** as its solution is consumed. The refillable cartridge **57** can be removed at any time, where a spring loaded drain valve **88** located inside its drain tube **59** closes whenever it is pulled away from the pump assembly **61**. The refill cap **60** can be removed and more solution added, as depicted in **FIG. 11**. A label **65** is shown affixed to the front of the cartridge **57** to identify its contents.

FIG. 13 is a front perspective view of a disposable liquid cartridge **58**. This disposable cartridge **58** has no refill cap **60** since it is meant to be disposable. However, a refillable cartridge **57** could also be disposable. **FIG. 13** also shows a pressure relief valve **85** which allows a one-way flow of air into the cartridge **58** as its solution is consumed. The disposable cartridge **58** can be removed at any time, where a spring loaded drain valve **88** located inside its drain tube **59** closes whenever it is pulled away from the pump assembly **61**, as depicted in **FIG. 11**. A label **65** is shown affixed to the front of the cartridge **58** to identify its contents.

As shown in **FIG. 7**, the cabinet assembly **51** is designed to accept a refillable cartridge **57**, which allows insertion room for its cap **60**. But the cabinet assembly **51** can also accommodate the disposable cartridge **58** version as well, since the cap-less disposable cartridge **58** will still fit into the same cartridge slot.

FIG. 14 is front perspective view of an embodiment of the present invention where the modular liquid dispenser cabinet assembly **51** uses a larger, fixed tank **74** rather than a smaller, removable cartridge **57**. This larger tank **74** can be permanently fixed inside the cabinet **54** or could be made to be removable like the cartridge **57** version. The advantage of this embodiment is that a very large tank **74** can hold a lot of solution **80**, so that maintenance intervals would be extended. The disadvantage would be that the tank lid **53** would have to be removed to service the unit.

FIG. 15 is front perspective view of an embodiment of the present invention where the modular liquid dispenser cabinet assembly **51** uses two larger fixed tanks **74** rather than the smaller, removable cartridges **57**. These larger tanks **74** can be permanently fixed inside the cabinet **54** or could be made to be removable like the cartridge version.

FIG. 16 is front view of the present invention where the modular liquid dispenser cabinet assembly **51** is mounted on a toilet water tank **52**, with a cross section view of the water tank **52**. A flexible discharge tube **64** allows a user to place the tube **64** inside the toilet tank overflow pipe **86**, or can be used to route the flow of solution **80** around obstacles inside the tank **52**. **FIG. 16** depicts the discharge tube **64** of the left liquid pump assembly **61** as inserted into the overflow pipe **86**. This allows an application of solution **80** to be dispensed full strength, directly into the toilet bowl **55**. This may be desired if a user wants to administer a few drops of a deodorant solution, or wants to inject a large, full strength dose of a mineral scale dissolving solution directly to the bowl **55**. The second discharge tube **64** on the right side is shown positioned to discharge its solution **80** into the water **93** inside the water tank **52**. A longer discharge tube **64** would allow it to reach the tank **52** if the cabinet **54** is stacked onto other cabinets **54** as shown in **FIG. 5**. Liquid discharge tube passageway slots **70** in each cabinet would allow the discharge tubes **64** to extend down through each cabinet to finally reach the tank **52**.

FIG. 16 also shows the automatic flush lever control linkage **76** connection to the flush actuator lever **75** with a flush actuator lever linkage attachment magnet **77**. In the event that the actuator lever is plastic or other non-magnetic material, a small metal clip can be clipped onto the lever **75** so that the lever attachment magnet **77** can still detachably couple with the lever **75**. This technique to engage the lever **75** allows for a quick and tool-less connection to attach the linkage **76** to the lever **75**. It would also allow the cabinet assembly **51** to be quickly removed, as would be desired if the toilet tank components need fast service, as in the case of a stuck flush valve.

FIG. 17 is front perspective view of the modular liquid dispenser cabinet assembly **51** as mounted on a toilet tank **52**, with a cross section view of the water tank **52** to reveal the details of the automatic flush control system. The toilet flush actuator assembly **79** is positioned over the toilet flush actuator lever **75**. A linkage **76** with a magnet **77** connects the flush assembly **79** to the lever **75**. An automatic flush cycle starts when the electronic control module **71** detects that the toilet is in use, by monitoring the proximity detector **78**. The module **71** then waits until a time interval after the proximity detector **78** detects that a person has left the toilet. The module **71** then applies power to the flush actuator assembly **79** that then applies an upward force on the flush actuator lever linkage **76**. This in turn pulls up the attached flush actuator lever linkage **76** and its attachment magnet **77** which is magnetically coupled to the flush actuator lever **75**, thereby pulling up the lever **75** to perform a toilet flush. If the person actually flushes the toilet, then the automatic flush cycle would be canceled. The module **71** can also be programmed to performed automatic timed flushes. For example, the module **71** can be programmed to flush the toilet at least once a week, if it detects no flush had taken place in that time interval.

The toilet flush assembly **79** is a dual purpose device. It contains a device that can mechanically lift the flush actuator lever **75** in order to flush the toilet and also contains a device that is able to sense that a toilet flush has occurred. The mechanical lifting mechanism is used to automatically flush the toilet by pulling on the linkage **76** that is connected to the flush actuator lever **75**, thereby performing a toilet flush. A flush sensing device is utilized by sensing the movement of the linkage **76** which is designed to retract into the flush assembly **79** if the flush actuator lever **75** is moved. This provides the control module **71** with a signal so that it can trigger a release of water treatment solution.

FIG. 18 is front perspective of a low-profile embodiment of the present invention that includes a large tank **74** reservoir. A low-rise chassis **82** is able to hide the whole dispenser assembly **81** inside the water tank **52**. A flush sensor and flush actuator assembly **79** is mounted on an adjustable rail **83** to allow the assembly **79** to be moved for an optimal position. An optional proximity detector **78** protrudes from the chassis **82** so as to hang down over the edge of the water tank **52** so that it can be able to detect the toilet's occupancy for automatic flushing. It utilizes an adjustable clip **87** so that it can be mounted so that it is free from interference with the opening and closing of the toilet seat and seat lid. This detector **78** would be the only component of this embodiment that would be visible to the user.

FIG. 19 is front perspective of a low-profile embodiment of the present invention that includes a large tank **74** reservoir and is shown as mounted inside a standard toilet water tank **52** to demonstrate how the low-profile dispenser assembly **81** resides inside the water tank **52**, which would be completely hidden from view once the tank lid **53** is installed.

The advantage of this embodiment is that the dispenser assembly **81** is hidden, so that it has no impact on the aesthetics of the toilet and bathroom. Also, a larger tank **74** would require longer service time intervals. The disadvantage would be that the tank lid **53** would have to be removed and the tanks **74** would have to be refilled, which could be messy.

FIG. 20 is front sectional view of a low-profile embodiment of the present invention that includes a large tank **74** reservoir and is shown as mounted inside a standard toilet water tank **52** to demonstrate how the low-profile dispenser assembly **81** resides inside the water tank **52**, which would be completely hidden from view once the tank lid **53** is installed.

FIG. 21 and **FIG. 22** are front perspectives of a low-profile embodiment of the present invention that uses a replaceable liquid cartridge **57**. A low-rise chassis **82** is able to hide the whole dispenser assembly **81** inside the water tank **52**. A flush sensor and flush actuator assembly **79** is mounted on an adjustable rail **83** to allow the assembly **79** to be moved for an optimal position. An optional proximity detector **78** protrudes from the chassis **82** so as to hang down over the edge of the water tank **52** so that it can be able to detect the toilet's occupancy for automatic flushing. It utilizes an adjustable clip **87** so that it can be mounted so that it is free from interference with the opening and closing of the toilet seat and seat lid. This detector **78** would be the only component of this embodiment that would be visible to the user. The advantage of this embodiment is that the assembly **81** is hidden, so that the assembly **81** has no impact on the aesthetics of the toilet and bathroom. This liquid cartridge **57** embodiment also allows the ability to use convenient disposable cartridges **58**, saving the trouble of potentially messy refills. The disadvantage would be that the tank lid **53** would have to be removed to service the unit.

FIG. 23 illustrates a compact, universal fit chassis **104** that is shown with an installed replaceable cartridge **58**. This embodiment of the present invention uses a simple clip **98** that allows the unit to be clipped onto the inside of virtually any size or shaped water tank.

FIG. 24 illustrates a compact, universal fit chassis **104** that is shown without a cartridge. This embodiment of the present invention allows for an extremely small dispenser, which is not much larger than a cartridge. This chassis **104** thus takes little shelve space at supermarkets so that it can be displayed and sold alongside its required cartridges.

FIG. 25 illustrates a compact, universal fit chassis **104** that is shown mounted inside of a standard toilet water tank **52**. A simple clip **98** holds the chassis **104** inside the water tank **52**. From this location the dispenser is hidden from view, yet the cartridge **58** can still be easily replenished.

FIG. 26 – 29 illustrates several variations of present invention, each of which use a different flush detection method. The present invention is designed to dispense liquid into a toilet water tank after the toilet has been flushed. This dispenser must need to know just when to dispense its solution. The best time would be just after the tank's water level has risen back to its normal level after a toilet flush. Thus, a water level sensing device or flush detector is needed to work with the dispenser for this purpose. It would be desired to have a sensor that is a foolproof mechanism, reliable, and economical for mass-production with no moving parts. In addition, it must have low power drain for long battery life. Many types of commonly available methods exist that meet this criteria for this water level/flush detector and the present invention can work with almost any of them.

FIG. 26 is illustrates a compact, universal fit chassis **104** that uses an electronic sensor **99** to determine the toilet tank water level for feedback that the toilet has been flushed. The use of special sensors to measure water level is the most streamlined and elegant design method to determine when the present invention should dispense solution. An electronic water level sensor **99** is encased into the bottom side of the dispenser's chassis **104**. This proximity sensor **99** is used to determine when the water level has cycled from a low to a high state. The sensor can bounce light or sound from the water's surface.

FIG. 27 is illustrates a compact, universal fit chassis **104** that uses vertical style float system to determine a toilet tank's change in water level for feedback that the toilet has been flushed. A magnetic switch **102** is encased inside the guide float shaft **103**. A float **100** is able to freely move up and down the float shaft **103**. An embedded magnet inside the float **100** will magnetically activate and deactivate the switch **102** as the float rises and falls with the tank water. This float switch is a micro-sized device where its float guide shaft **103** is about the size of a pencil.

FIG. 28 illustrates a compact, universal fit chassis **104** that uses a lever style float system to determine a toilet tank's change in water level for feedback that the toilet has been flushed. A float **100** is fixed onto the end of a float rod **101**. The rod **101** is allowed to pivot in the chassis **104** so that the float **100** can move and thus float on the tank water's surface. A simple switch that is attached to the end of the rod **101** inside the chassis **104** is able to activate as the rod **101** pivots from a low to a high water state.

FIG. 29 illustrates yet another method that the present invention can use to determine when the toilet has been flushed, where a compact chassis **104** uses a flush handle tilt-switch system. A small tilt-sensor **96** that also contains an infra-red transmitter, is simply clipped onto the toilet's flush actuator lever **75**. This sensor **96** automatically calibrates itself with the normal positioning of the flush actuator lever **75**. Once the toilet is flushed, the flush actuator lever **75** would move which will be detected by the attached sensor **96**. The sensor **96** then activates its infra-red transmitter which saturates the tank's interior with infra-red light for a moment. An infra-red electronic detector **110** that is mounted onto the side of the chassis **104** receives this signal. The dispenser will then dispense sanitizing solution into the tank after a short delay to allow the flapper valve to close and the tank to refill. Wires or radio frequency can also be used instead of infra-red light.

FIG. 30 illustrates a flush tilt-sensor **96** and a compact liquid dispenser chassis **104** as mounted inside a standard toilet water tank **52**.

FIG. 31 – 33 illustrates the multiple cartridge capability of the compact embodiment of the present invention. Just like the full sized chassis version of the present invention, the compact liquid dispenser chassis **104** may also be configured to use multiple cartridges. This multi-cartridge capability can be achieved by using an integral multi-cartridge chassis, whereby a single chassis could hold multiple cartridges or by using a modular, expandable chassis system.

FIG. 31 illustrates an embodiment of the present invention that uses an expandable cartridge system whereby a second compact dual-cartridge chassis assembly **105** can function as an expansion module. This assembly **105** can

be simply snapped onto the main chassis **104**, thus converting the devices into a multi-cartridge liquid dispenser. The mounting guide pins for the assembly **105** can double function as electrical contacts for power and flush advice.

FIG. 32 illustrates an embodiment of the present invention that uses an expandable cartridge system whereby a second compact, dual-cartridge chassis assembly **105** is modularly attached onto the main compact chassis **104**, thus creating a multi-cartridge liquid dispenser.

FIG. 33 is bottom rear perspective view of a compact, dual-cartridge embodiment of the present invention to illustrate how a second cartridge can be used to discharge liquid into the tank's overflow pipe. For example, a compact dual cartridge chassis assembly **105** can dispense a concentrated fragrance directly into the toilet bowl by way of the toilet's overflow pipe **86**. Only a few drops worth of the fragrance is all that is required. In order to properly deliver this small amount of liquid to the toilet bowl, the expansion module uses a tank water intake tube **106**. This allows the dispenser use the tank water to flush the few drops that are dispensed from the fragrance cartridge **97** down the overflow pipe **86** to reach the toilet bowl.

FIG. 34 illustrates a compact, universal fit **DISPOSABLE** chassis **109** version of the present invention whereby the entire device is formed into a single, one-piece disposable chassis. For this instance, the cartridge simply becomes a small tank that is integral to the chassis, similar to the full sized version of the present invention that use a fixed tank. This allows the user even more convenience by simply discarding the entire unit, rather than refilling tanks or replacing cartridges.

Drawings – Reference Numerals

51 Assembly, Modular Liquid Dispenser Cabinet
52 Water Tank
53 Lid, Water Tank
54 Cabinet, Modular
55 Bowl, Toilet
56 Cover, Cartridge Access
57 Cartridge, Liquid Dispenser (Refillable)
58 Cartridge, Liquid Dispenser (Disposable)
59 Drain, Cartridge
60 Cap, Vented Refill
61 Assembly, Liquid Pump
62 Fitting, Liquid Pump Inlet
63 Fitting, Liquid Pump Discharge
64 Tube, Flexible Liquid Discharge
65 Label, Cartridge
66 Battery
67 Cover, Battery Compartment
68 Rim
69 Guide, Cabinet Mounting
70 Slot, Liquid Discharge Tube Passageway
71 Module, Programmable Electronic Control
72 Orifice, Flush Linkage Passageway
73 Handle, Flush
74 Tank, Fixed Liquid Dispenser
75 Lever, Flush Actuator
76 Linkage, Flush Actuator Lever
77 Magnet, Flush Actuator Lever Linkage Attachment
78 Detector, Proximity
79 Assembly, Flush Sensor and Flush Actuator
80 Solution, Disinfecting/Deodorizing/Sanitizing
81 Assembly, Low-Profile Modular Liquid Dispenser
82 Chassis, Low-Profile Modular
83 Rail, Adjustable Flush Apparatus Mounting
84 Guide, Cartridge Alignment and Support
85 Valve, Pressure Relief
86 Pipe, Toilet Overflow
87 Clip, Adjustable Proximity Senor Mounting
88 Valve, Liquid Drain
89 Seal, O-Ring
90 Pin, Valve Actuator
91 Sensor, Liquid Level
92 Pane, Cartridge Liquid Level Window
93 Water
94 Clip, Metal Flush Lever
95 Chain, Flapper Valve
96 Sensor, Tilt-Switch

97 Cartridge, Disposable Fragrance
98 Clip, Chassis Mounting
99 Detector, Electronic Water Level
100 Float, Water Level
101 Rod, Float
102 Switch, Magnetic
103 Shaft, Float Guide
104 Assembly, Compact Universal Chassis
105 Assembly, Compact Dual Cartridge Module
106 Tube, Water Intake
107 Clip, Tube Mounting
108 Filter, Water Intake
109 Assembly, Disposable Liquid Dispenser
110 Detector, Electronic

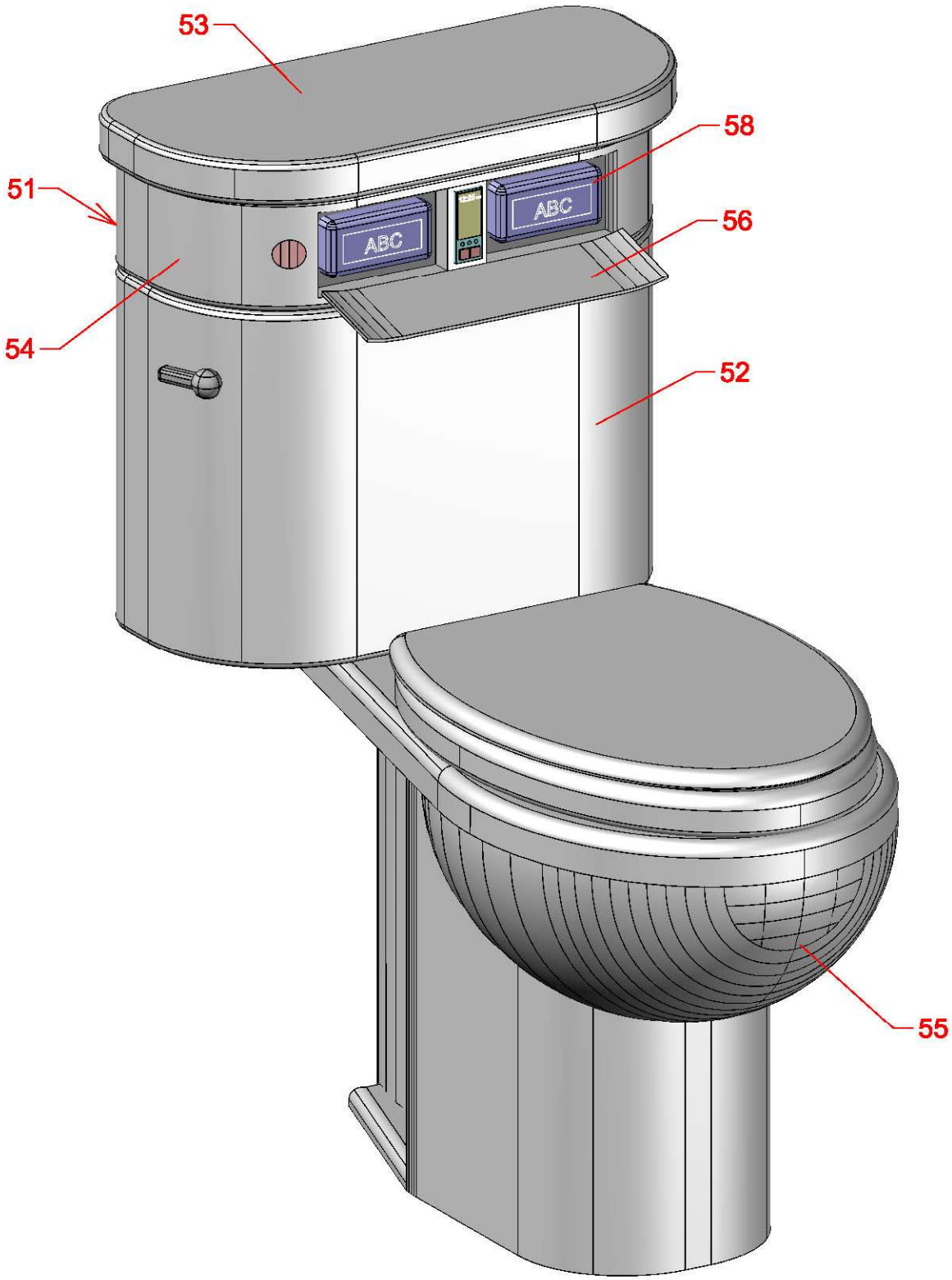


FIG. 1

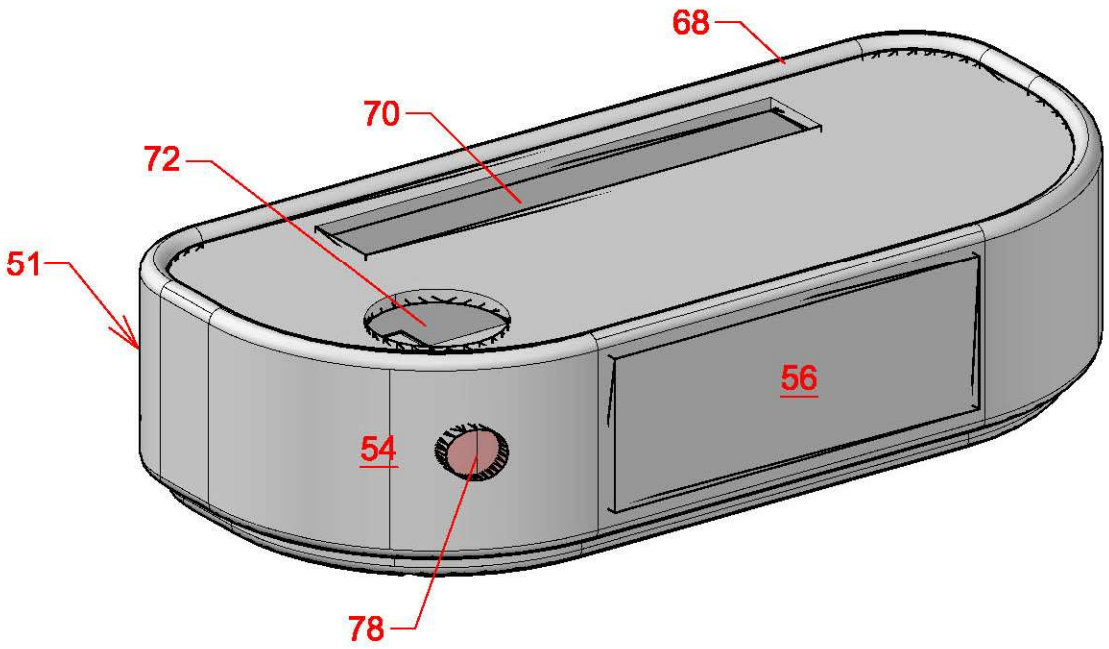


FIG. 2

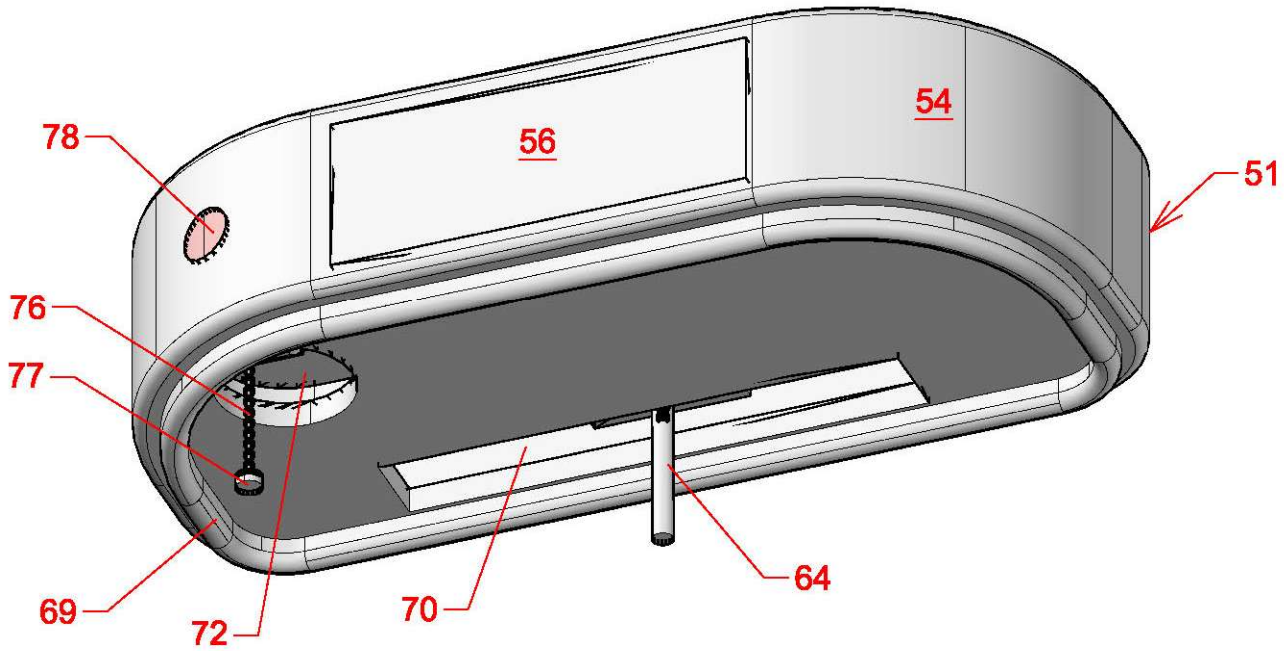


FIG. 3

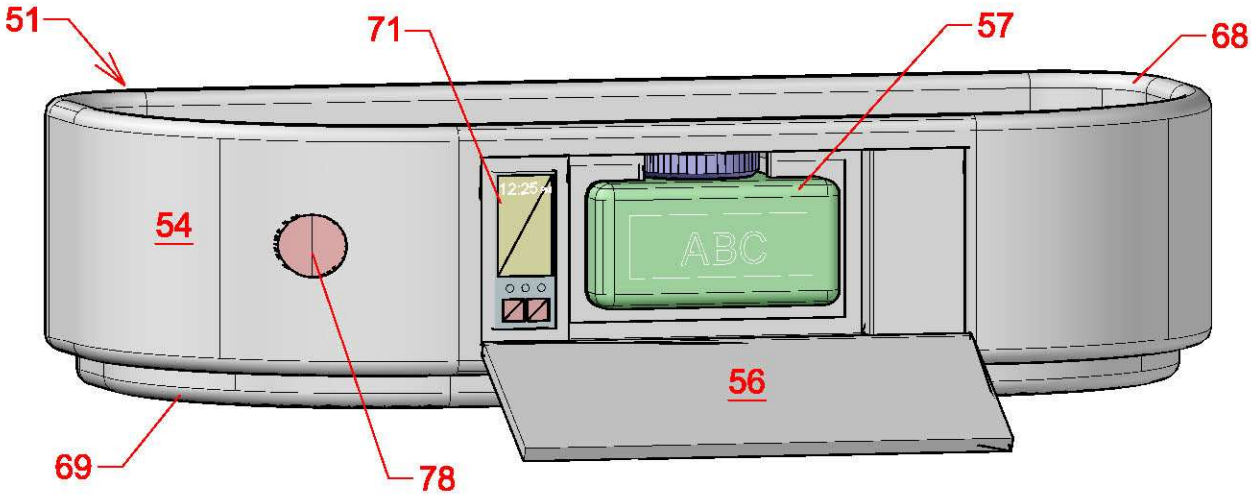


FIG. 4

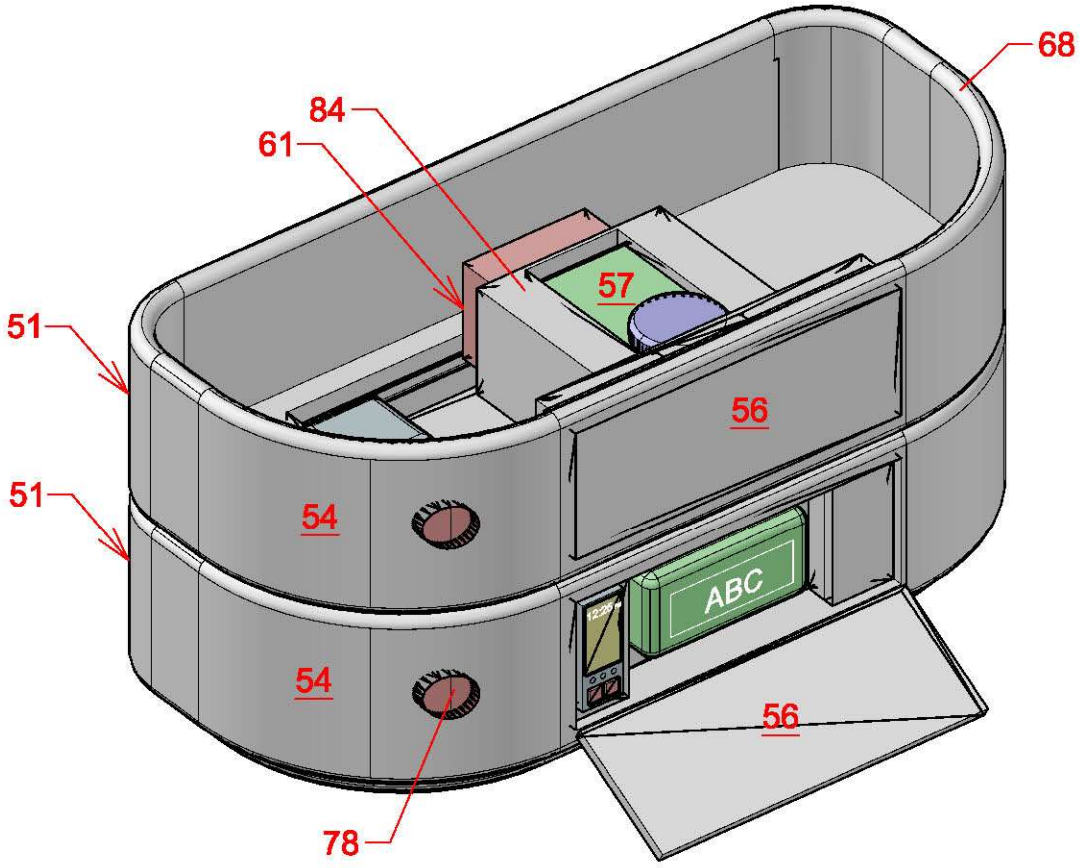


FIG. 5

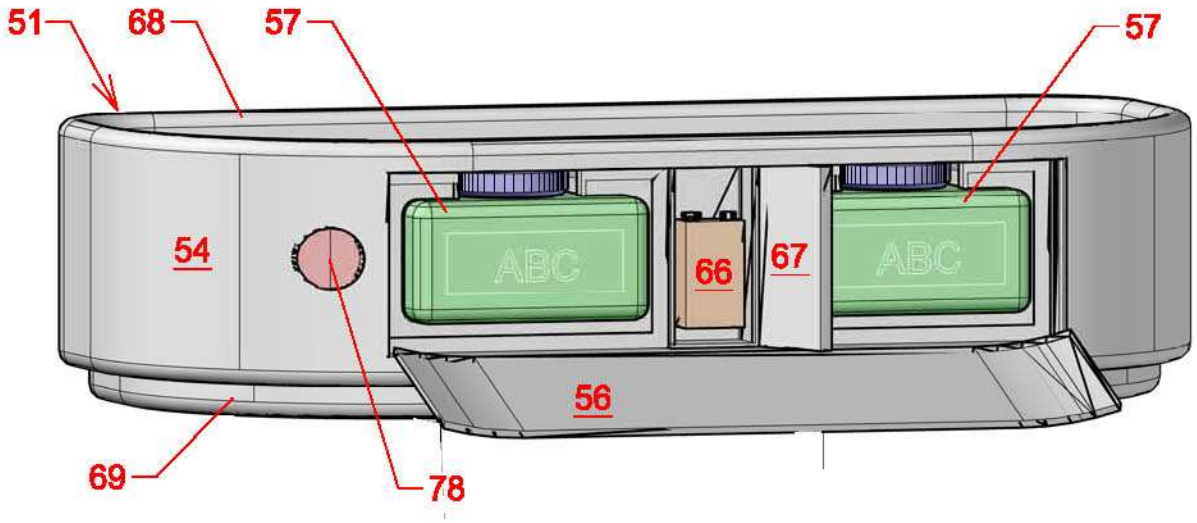


FIG. 6

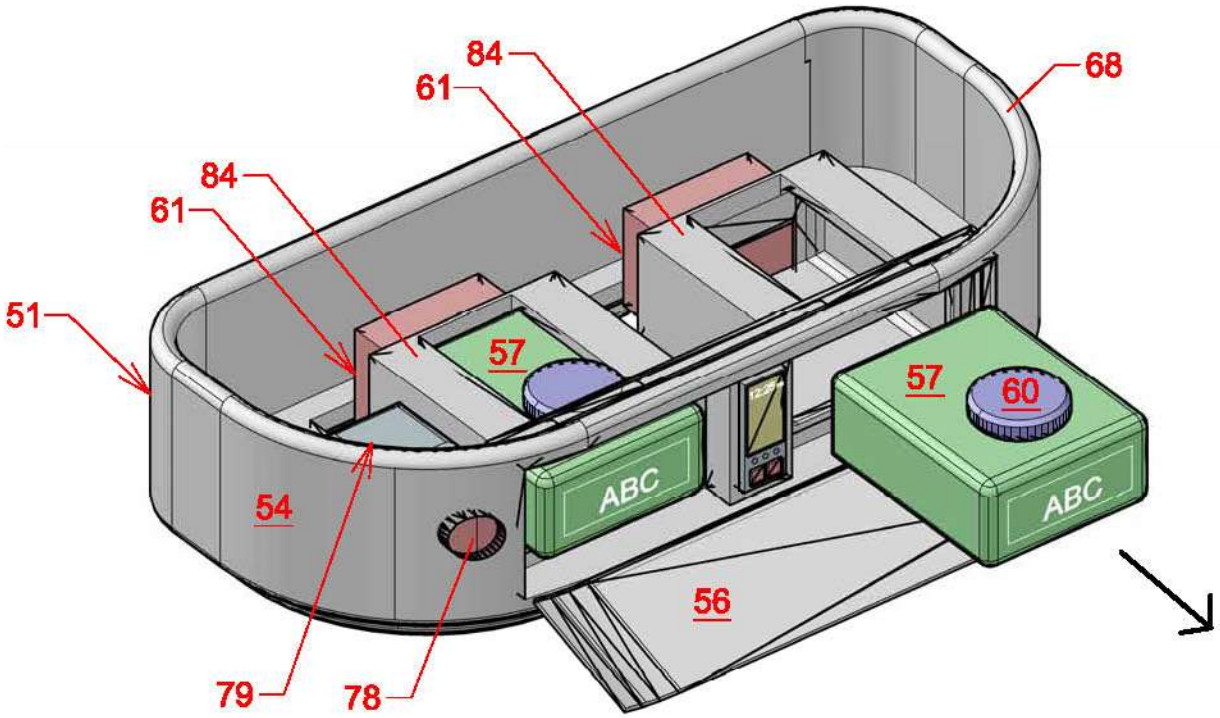


FIG. 7

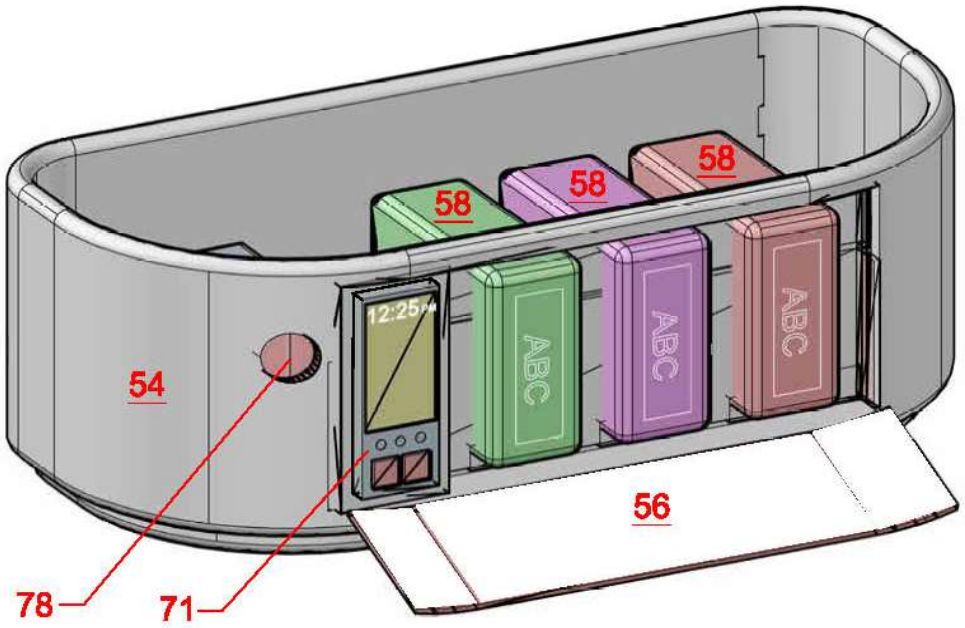


FIG. 8

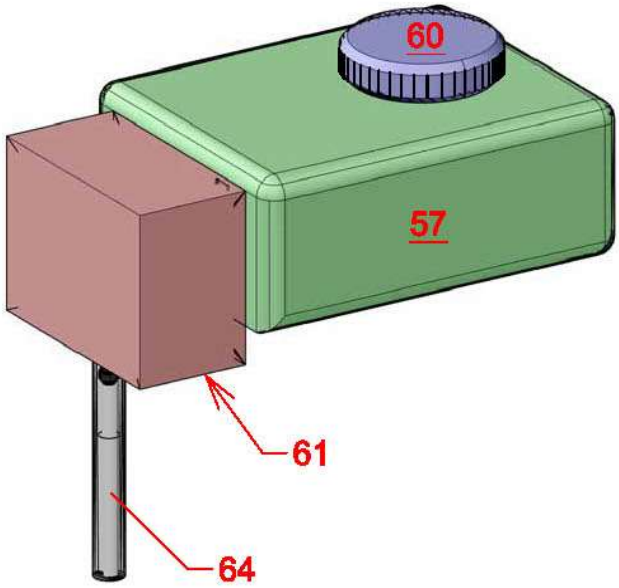


FIG. 9

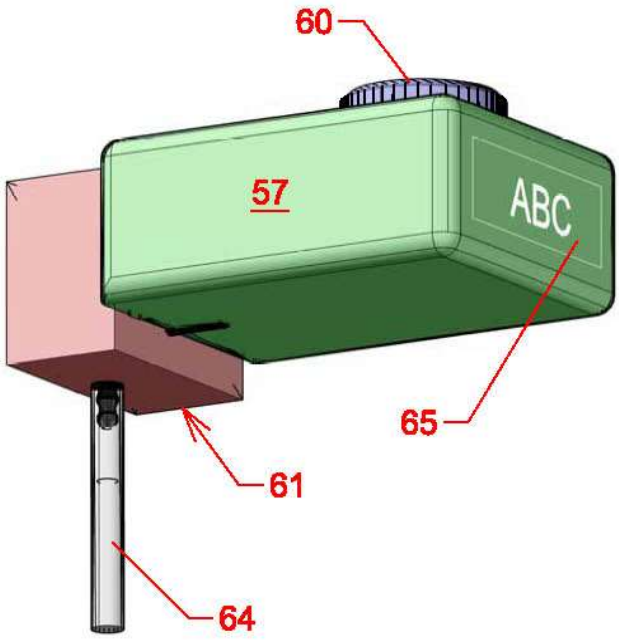


FIG. 10

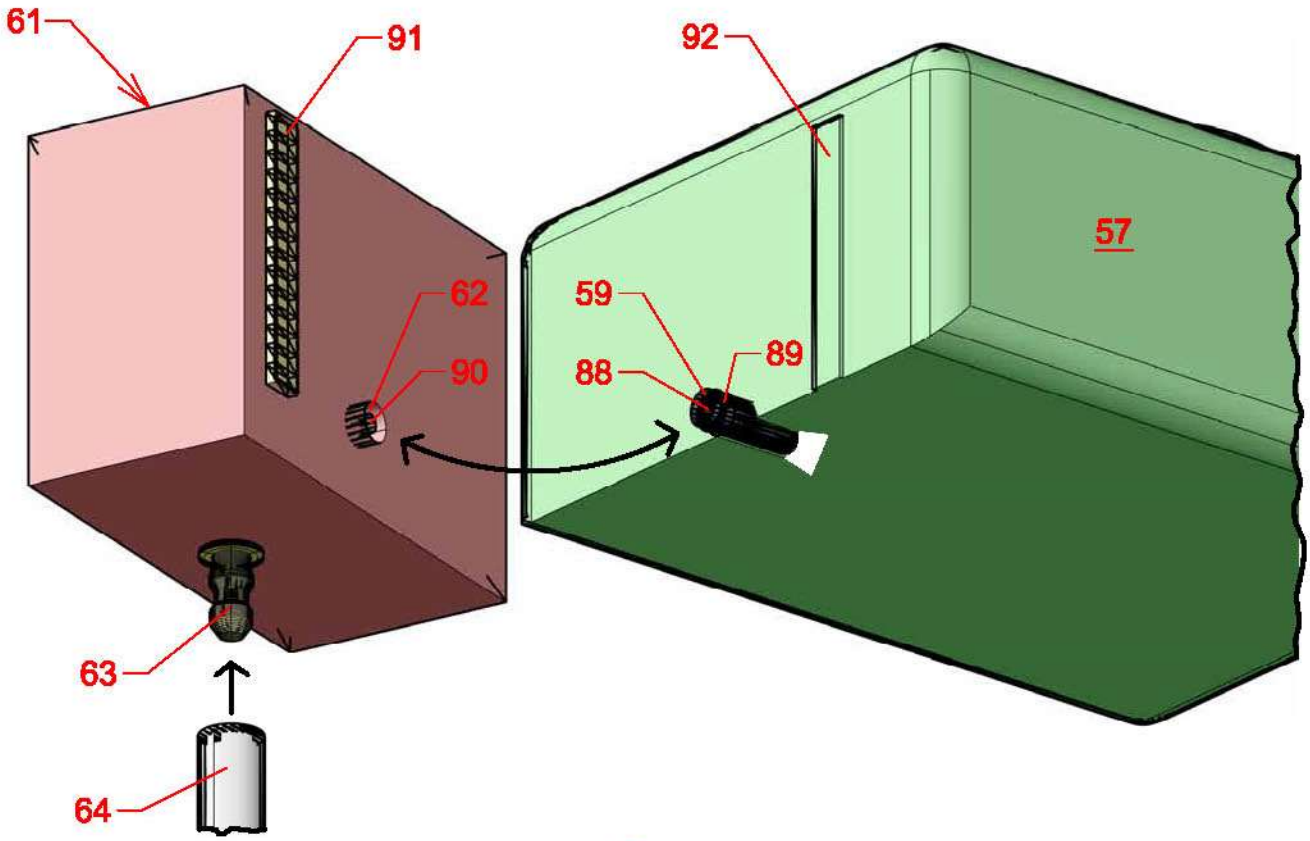


FIG. 11

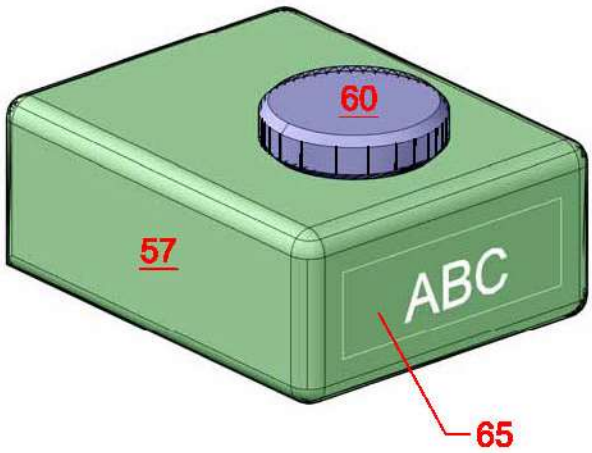


FIG. 12

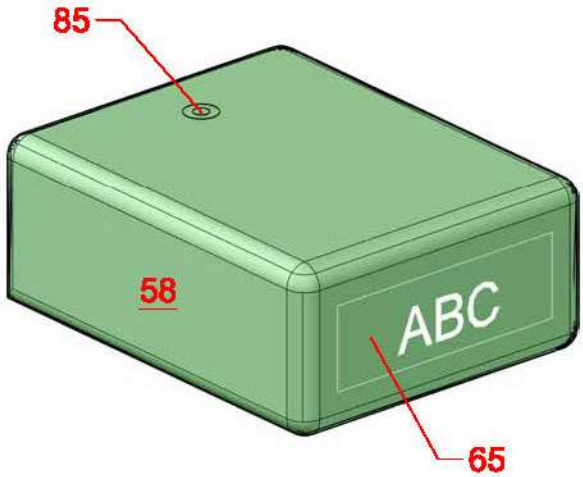


FIG. 13

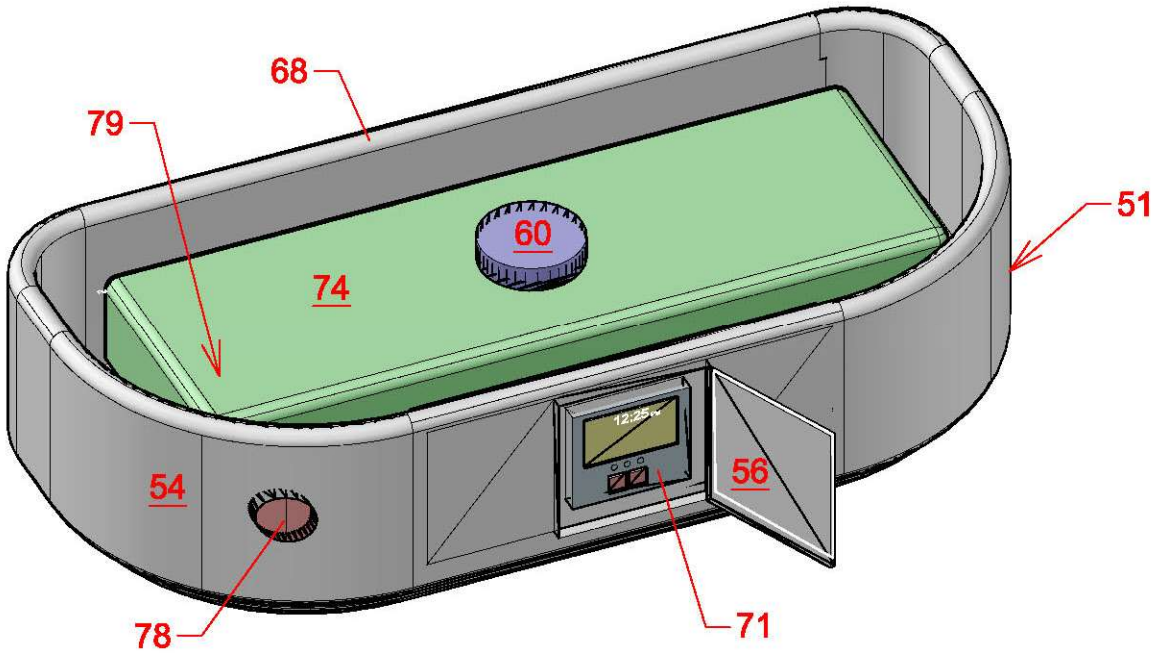


FIG. 14

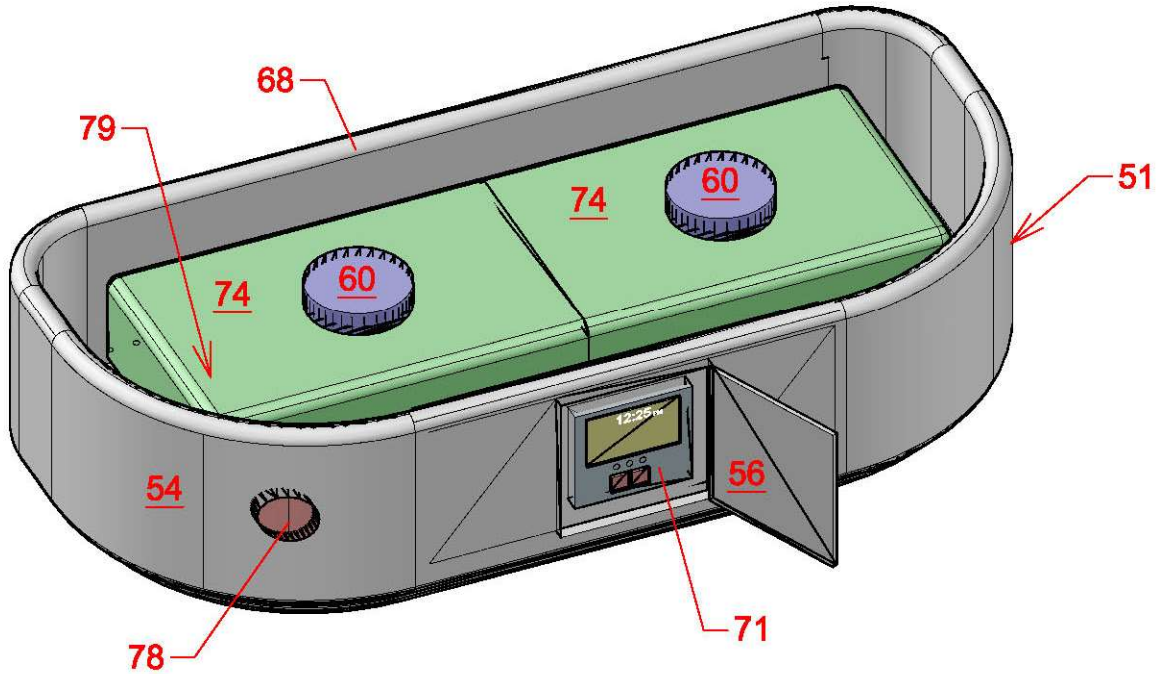


FIG. 15

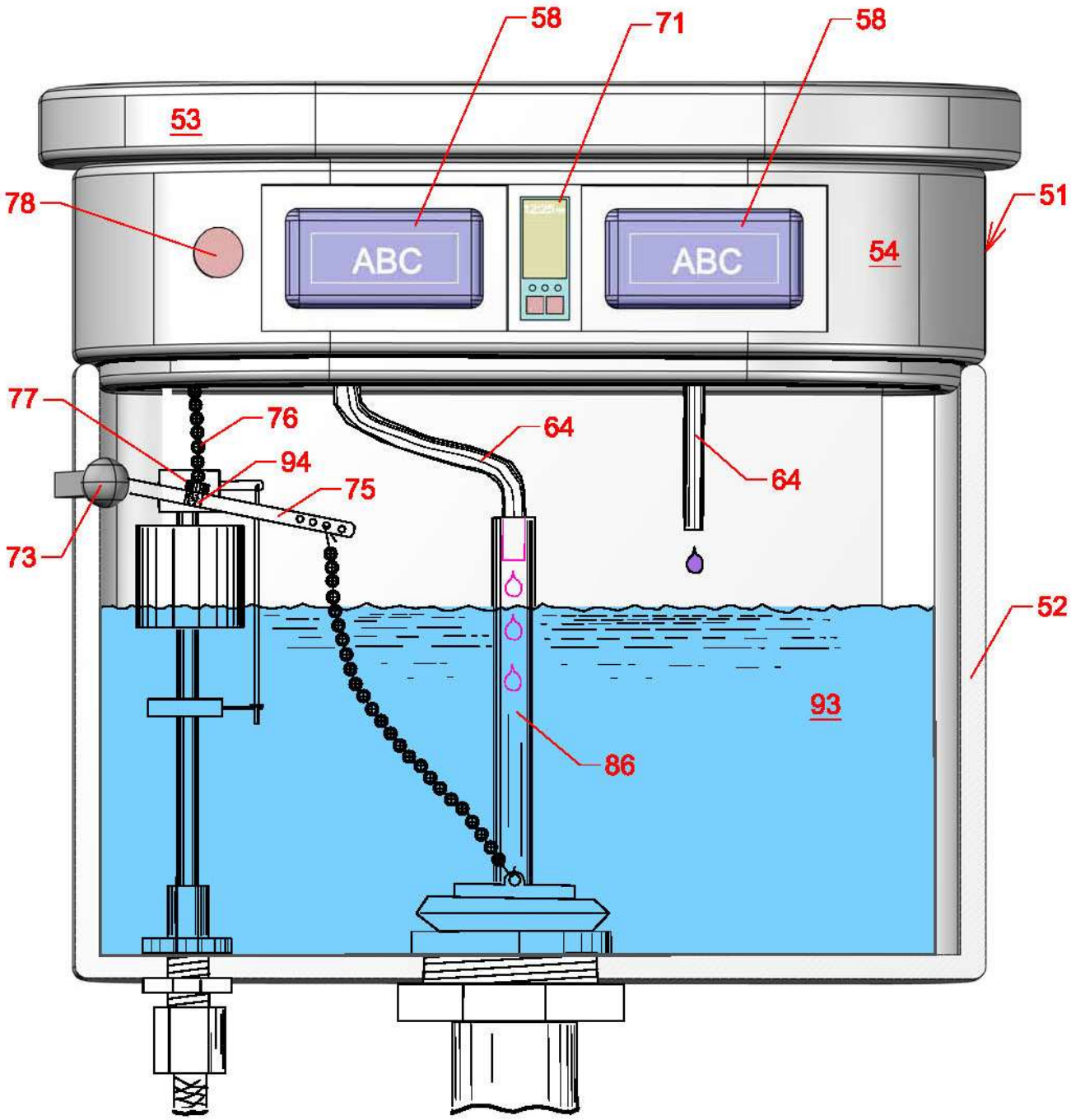


FIG. 16

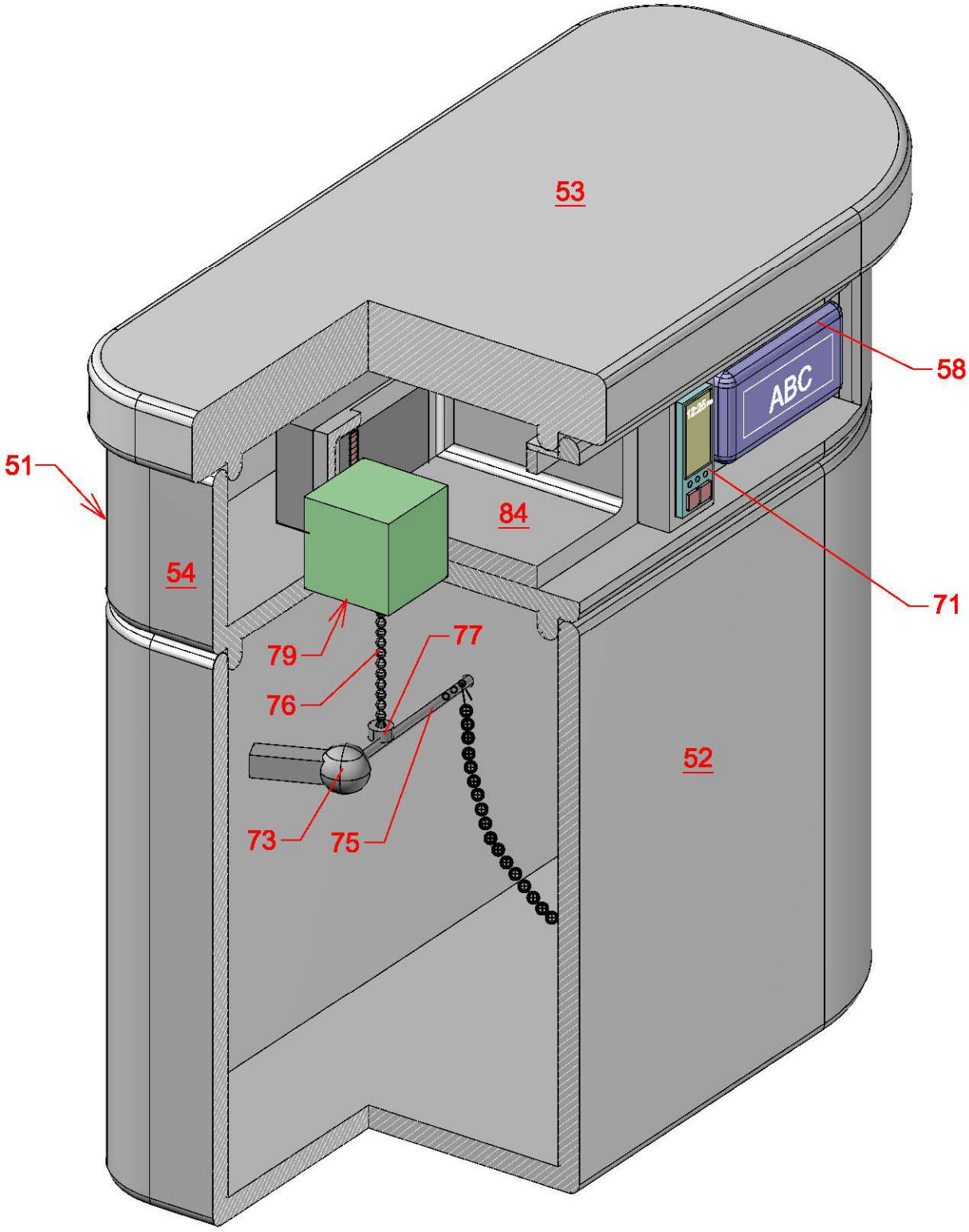


FIG. 17

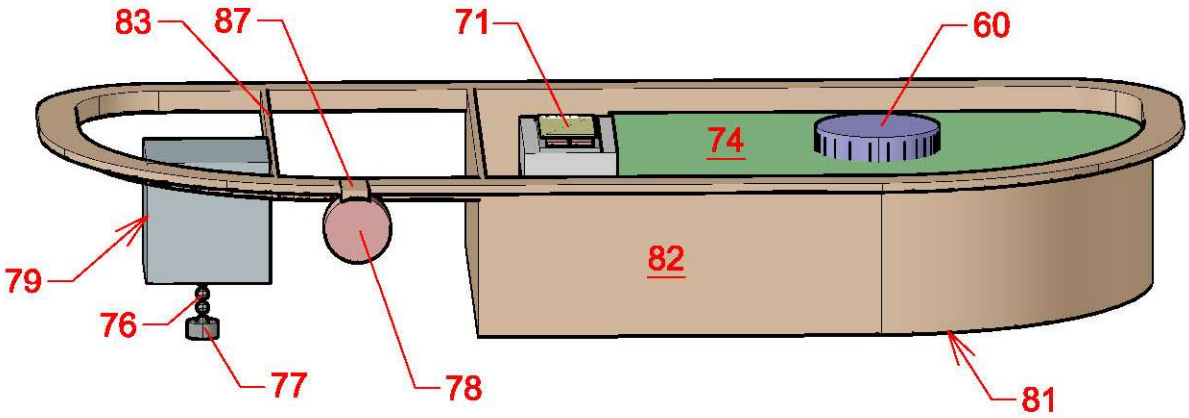


FIG. 18

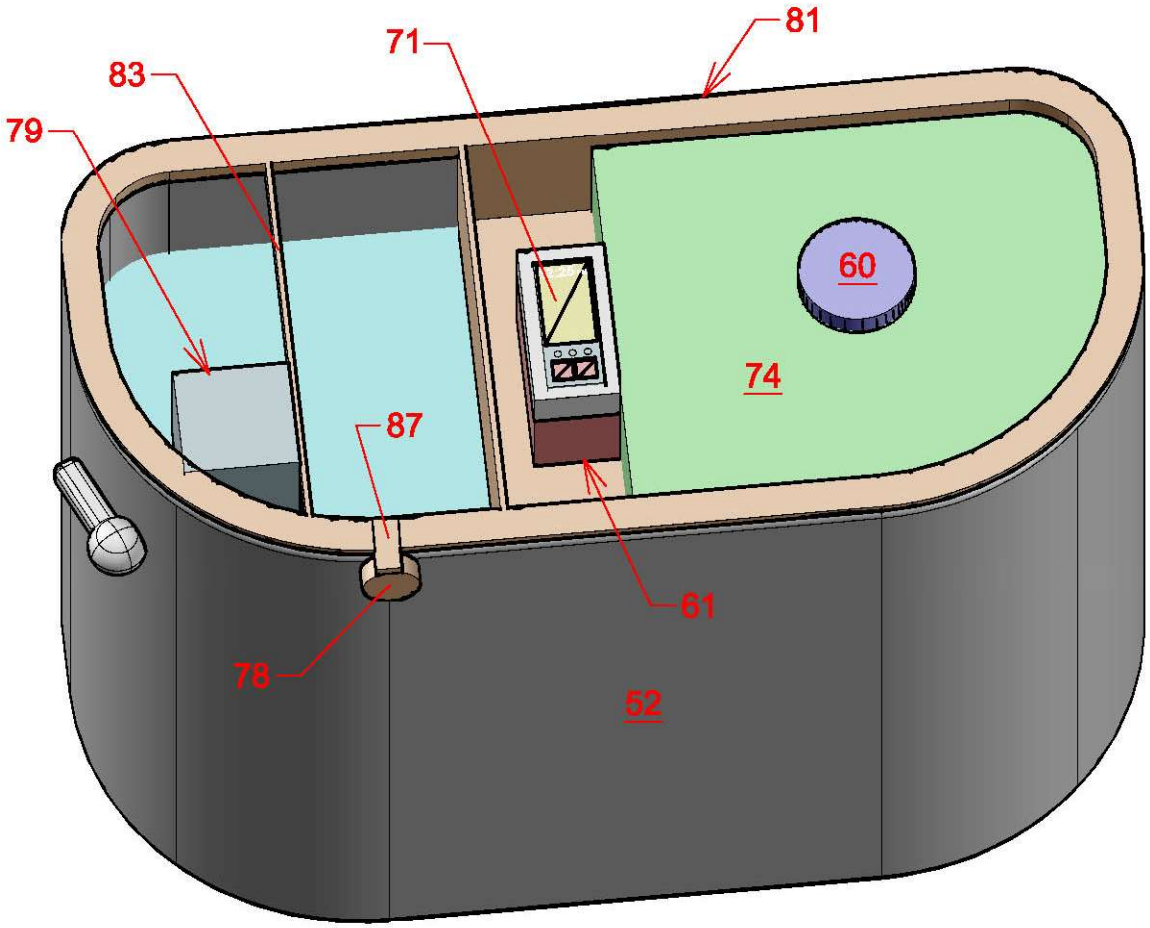


FIG. 19

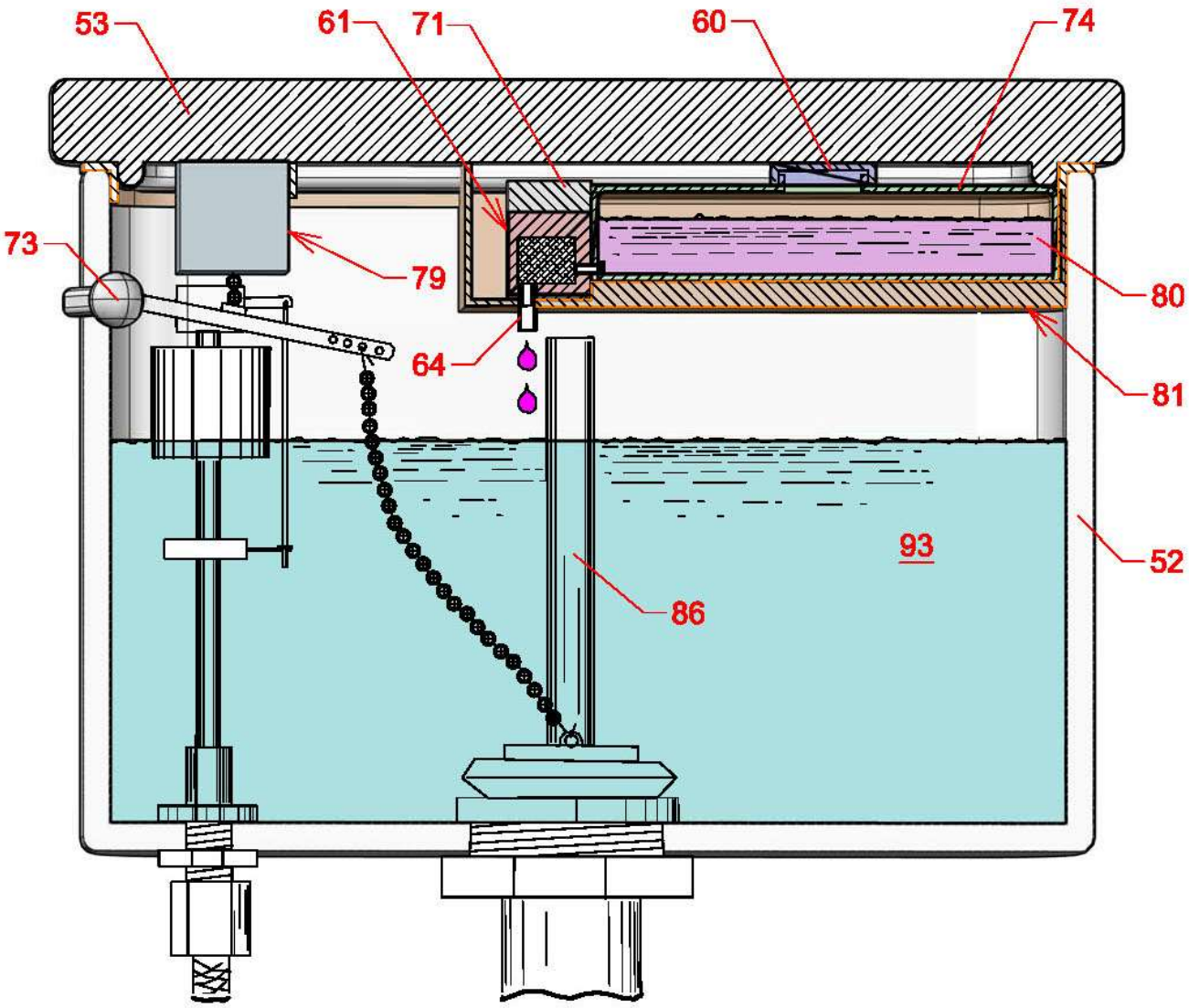


FIG. 20

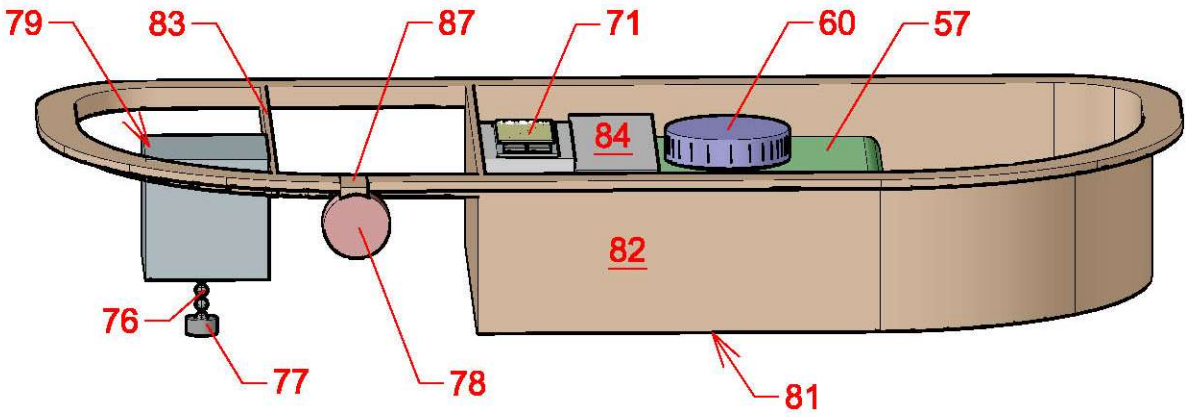


FIG. 21

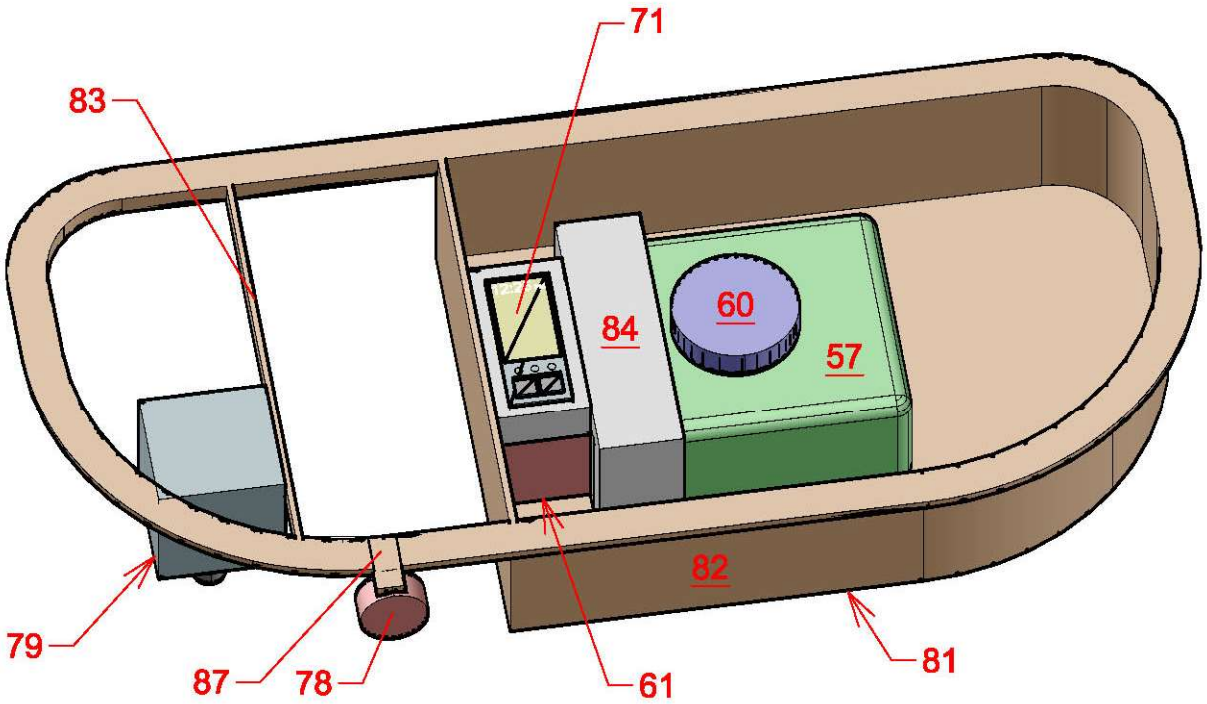


FIG. 22

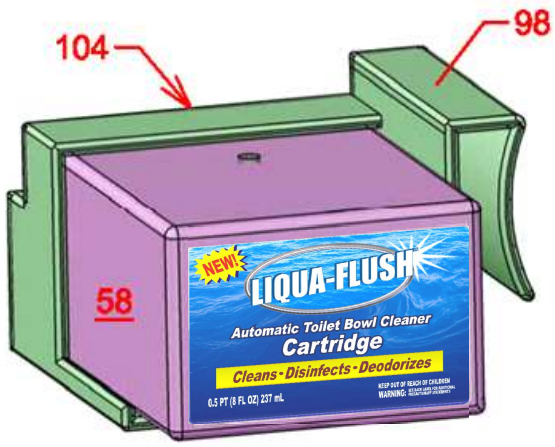


FIG. 23

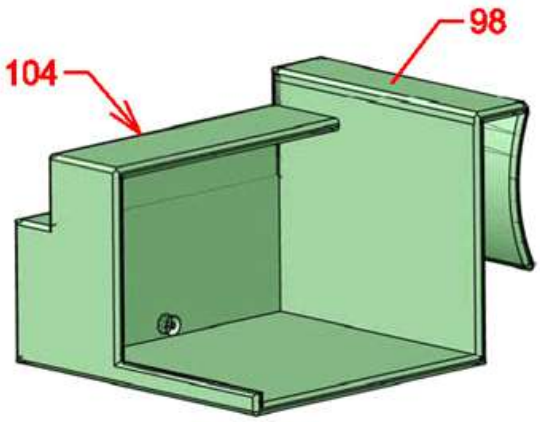


FIG. 24

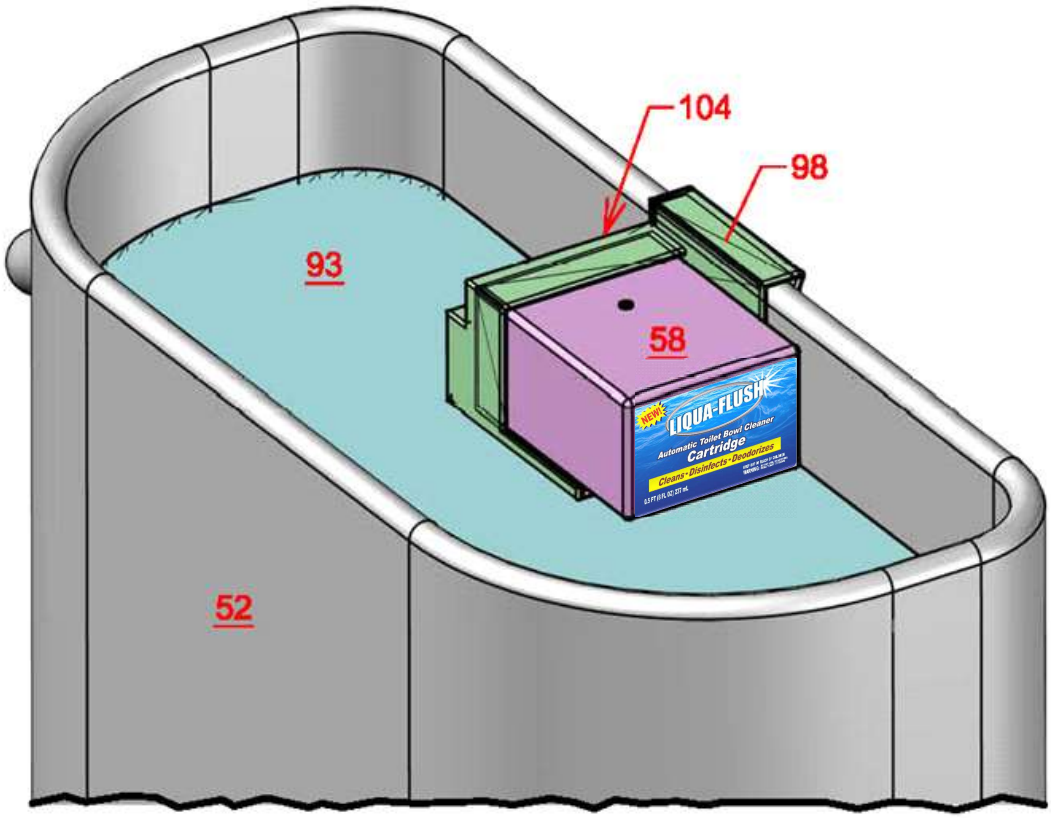


FIG. 25

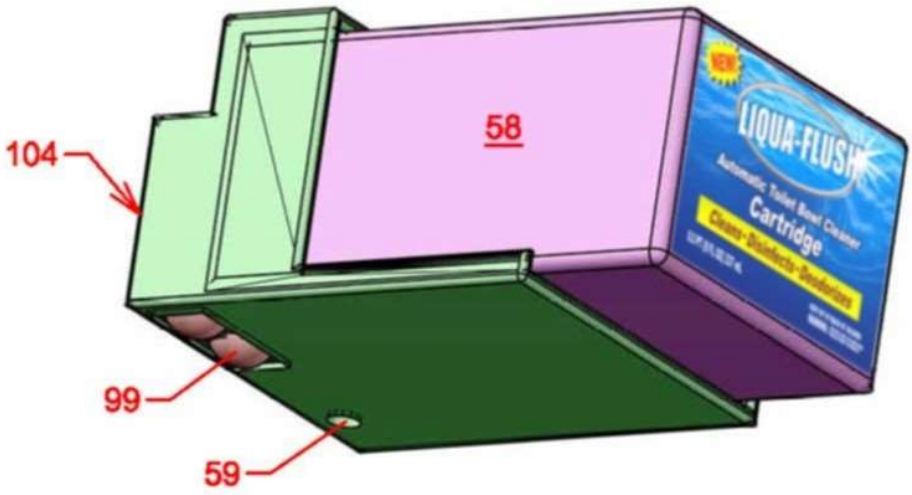


FIG. 26

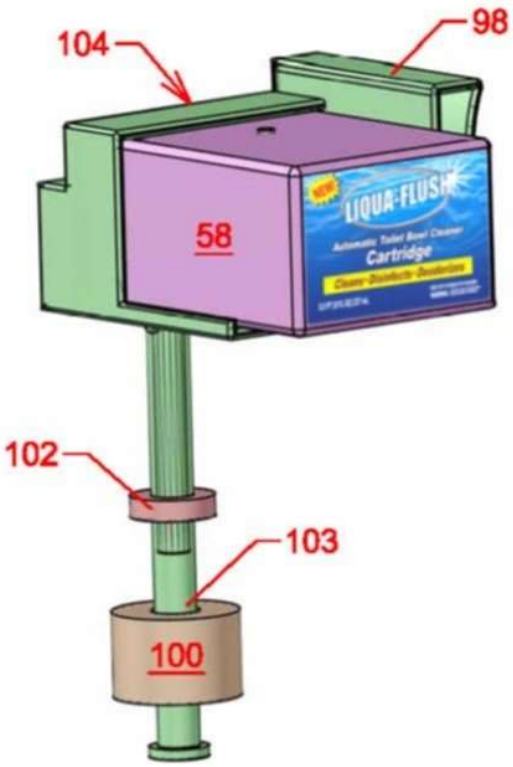


FIG. 27

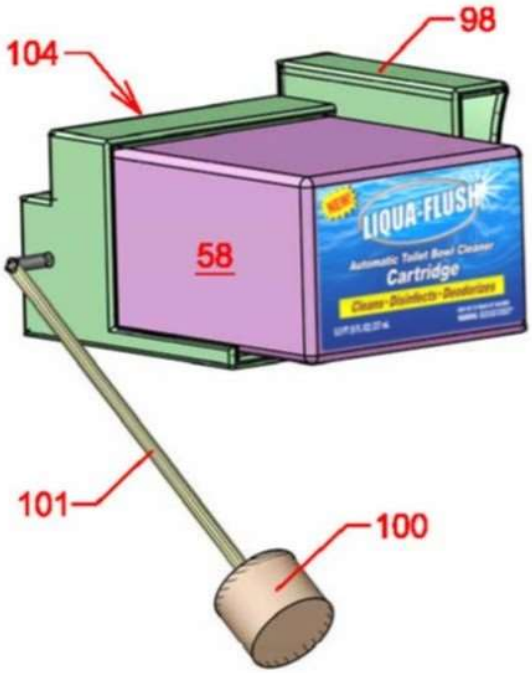


FIG. 28

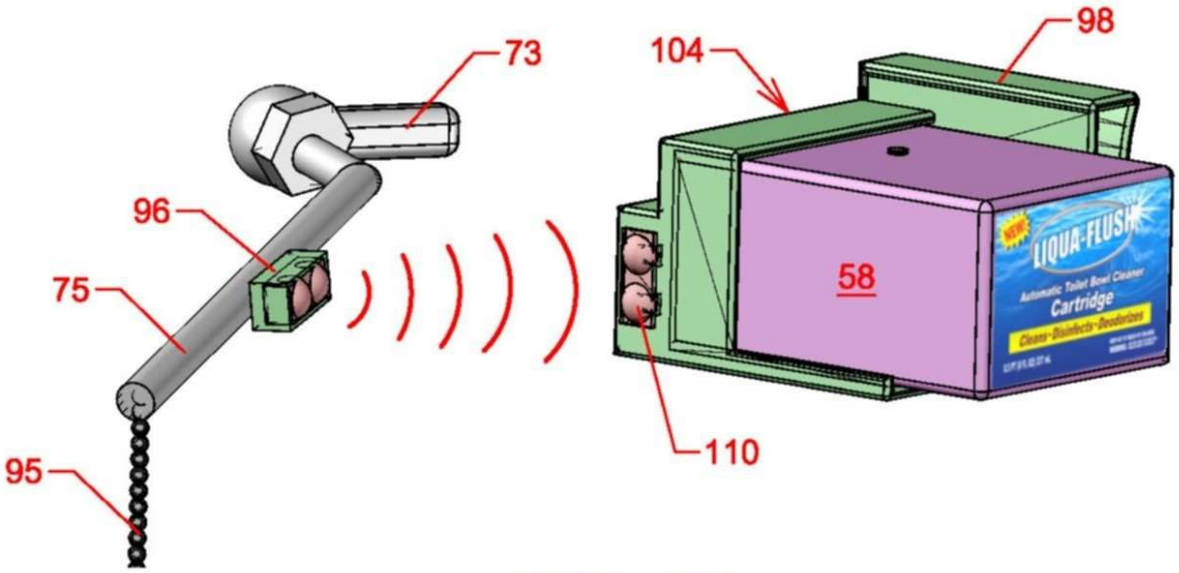


FIG. 29

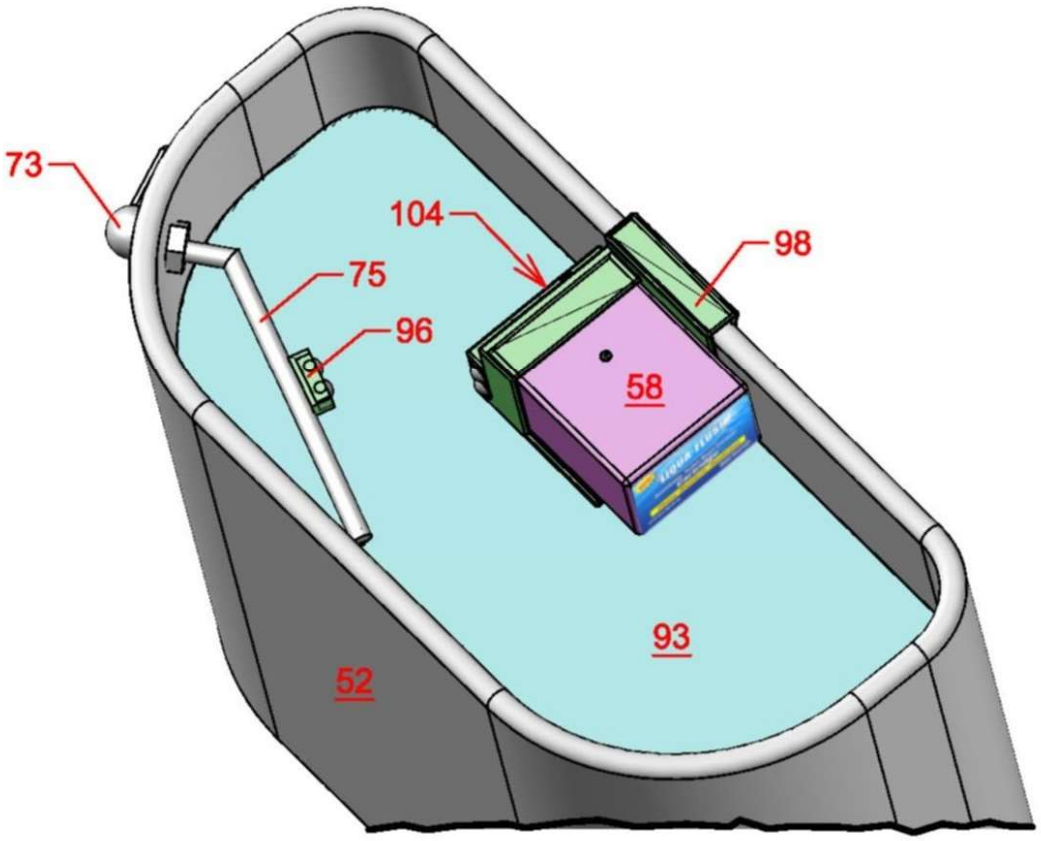


FIG. 30

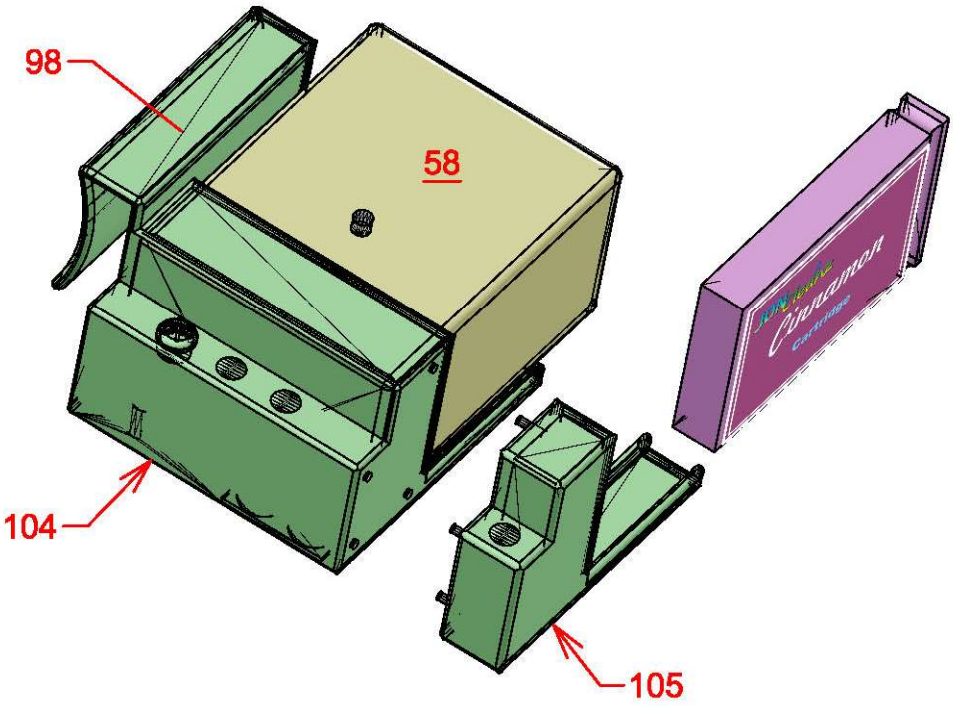


FIG. 31

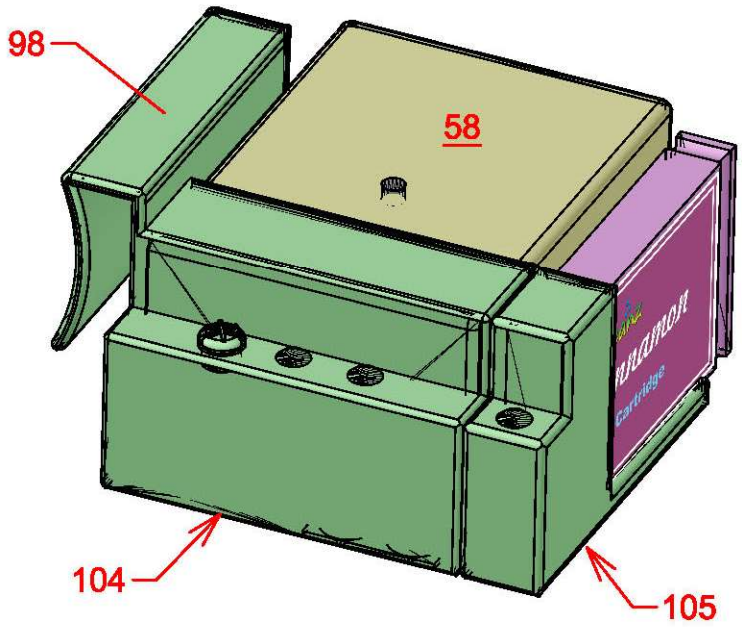


FIG. 32

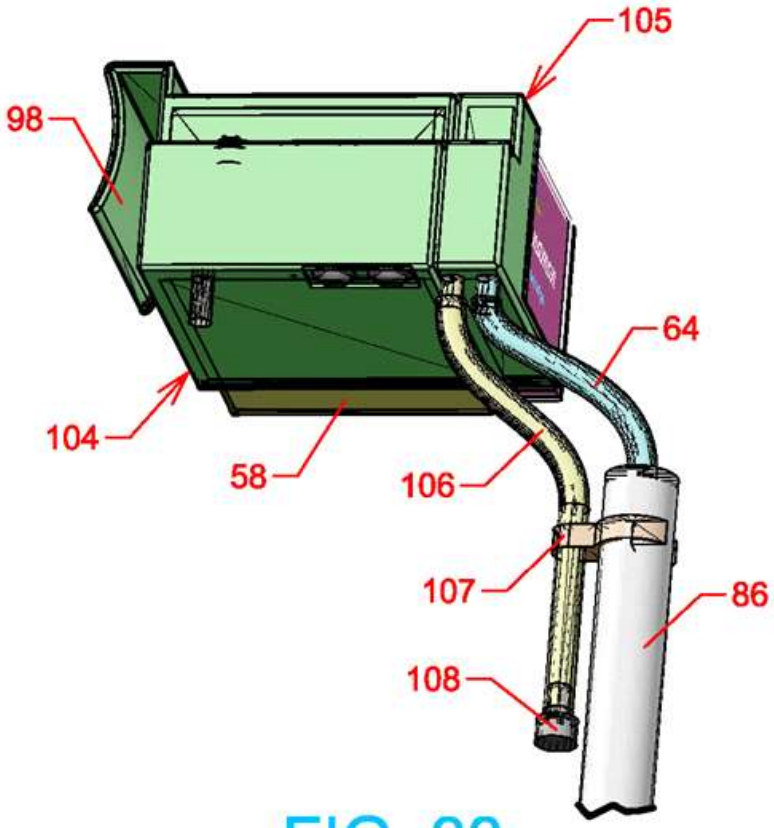


FIG. 33

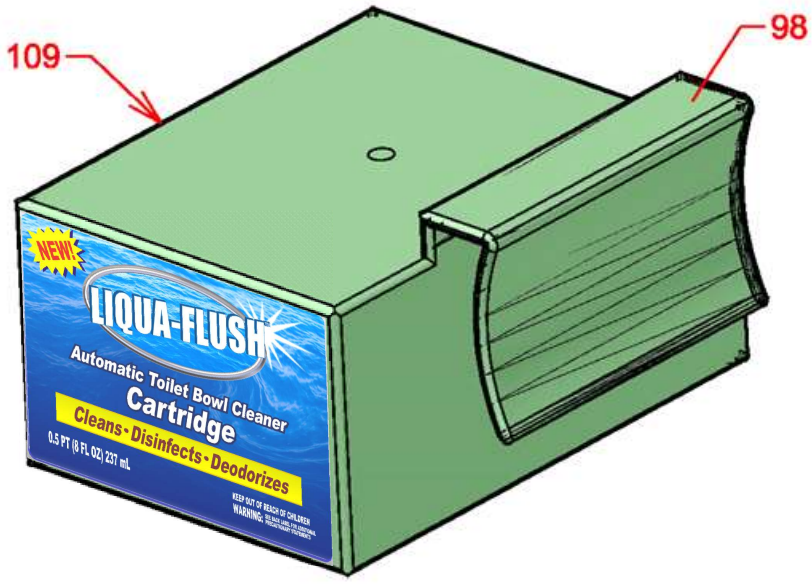


FIG. 34

Liqua-Flush™
Product Development Details

Marketing:

Determine product specifications:

- Product Name?

  LIQUA-FLUSH™:

- Product Logo?

- Product Aesthetics:
    - How should the product look? What shape? What Size?

    - Should the cartridge fit into the chassis horizontally or vertically;

- Product Features:
    - Buttons:
        - 2 push-buttons for solution concentration selection?
        - Tactile feel push-buttons (metal dome)?
        - Embossed membrane switch?
    - Control buttons located on the top or the side?
    - Buzzer for button feedback, low battery alert, low fluid alert
    - Automatic flush option?
    - LED indicators?

- Cartridge Features:
    - Cartridge Product Life; With normal setting, 3 months of product life? How many flushes per cartridge?
    - Color Option: Blue dye used in toilet cleaners is used to improve aesthetic appeal, or to act as a tracer (for example in certain toilet bowl cleaners, blue coloration indicates that the product is working). People often associate blue with cleanliness.
    - Types of Sanitation Solutions:
        - General Purpose Unscented;
        - General Purpose Scented (different kinds of fragrances?);
        - Reduced Minerals Additive (i.e. for Hard Water Stains);
        - "Green" Chemicals;
        - Septic tank friendly chemicals;
    - Cartridge Label Graphics

- Product Packaging:
    - Design of packaging?
        - "Window Box" to view product?
- Advertising:
    - Plan to advertise product?
- Distribution Channel:
    - Plan to distribute product?

Engineering Research & Design Details

COMPACT CHASSIS VERSION

Dispenser Chassis Details

Clip Mounting Bracket

The mounting clip is a simple bracket to hold the dispenser assembly securely inside the toilet tank. This bracket will need to be adjustable so it can fit a wide variety of toilets, and also help position the dispenser from tank obstacles.

Compact Chassis

The dispenser chassis is designed to be very compact for a universal fit so that it can easily fit almost any toilet.

The chassis tray (where the cartridge rests) must be sloped and corrugated so that any splashed water will not be trapped under the cartridge to stagnate. Water will then have the space and air under the cartridge inside grooved channels to evaporate and/or drain away from the dispenser into the tank. An open grill can also work well.

The chassis tray would also need to have a mating groove with the cartridge so that the cartridge will snap into the dispenser with tactile feedback for the user to insure that the cartridge is fully seated.

A waterproof battery cover will keep the battery compartment free from corrosion from the humid environment of the toilet tank and from the sanitizing solution.

Externally Mounted Chassis

The old ball float toilet supply valves are invincible! Consequently, millions of these old valves are still in service and will remain in service for many more years to come. Thus, it makes sense to consider a version of the LIQUA-FLUSH™ system that will work with these old toilets. The problem is that the float takes up almost all of the extra room inside of the tank, which leaves no room for an internally mounted dispenser. An externally mounted dispenser necessary. (Some users may actually prefer an external dispenser anyway). This version of the dispenser would require the use of the appropriate sensor to determine when a flush has occurred so that it can activate. For instance, a specially designed clip can be used to hang the dispenser on the outside of the tank and also be used to position a sensor inside the tank for flush sensing. The clip would also serve the purpose of providing a conduit for a liquid tube from the dispenser to the tank.

An externally mounted chassis, along with a proximity detector, could allow the LIQUA-FLUSH™ system to work very well with commercial tankless toilets and urinals.

Universal Chassis

User simplicity is very important. A user must be able to remove the dispenser from its packaging and place it into the toilet with little or no instructions. Thus, it would be prudent to offer two different products, one for internal and one for external applications. However, with a universal dispenser design, both configurations could be achieved with one product.

Electronic Controller

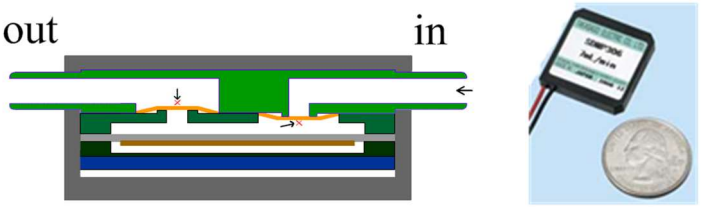
The controller for this product only requires rather elementary electronic circuits and basic programming. A simple, inexpensive, and standard programmable microcontroller can fulfill all of the needs for the dispenser.

Liquid Pump

A small electric pump is used to draw liquid from the cartridge to the toilet tank and/or toilet bowl. A timed interval of the pump's operation by an electronic controller would correspond to the precise delivery of solution. Only a few drops of a highly concentrated sanitizer is all that is required for each pump cycle.

The pump must be able to dispense precise, reproducible amounts of sanitizer over a large temperature variation (must be able to pump viscous concentrated liquids over a wide temperature range where variations in liquid viscosity cannot affect dispenser accuracy).

Liquid Pump Type: A piezoelectric micro liquid pump will probably be the best cost effective solution. The pump is just a couple of membranes that vibrate with a piezoelectric vibrator. The Liqua-Flush chassis itself could form the shell of the pump whereby only the pump's "plates" would need to be glued into place. All of the liquid passageways for the liquid from the cartridge actuator through the pump and toilet tank outlet are formed into the plastic shell of the product. Once the two halves of the shell are "fused" together, a complete liquid duct would be formed. This would save the cost of tubing and assemblage cost.



- Can easily pump various viscosities of sanitizing solution;
- Can work well in a wide range of temperatures;
- Manufactured to have a very long life;
- Corrosion free with various types of very harsh acidic sanitizing solution;

Inlet Orifice

The inlet orifice in the compact chassis consists of an actuator pin that activates a valve mechanism in the cartridge to allow solution to flow from the cartridge into the chassis and on to the pump. Inlet Port: Will simply be a small tube that protrudes into the cartridge compartment; Once the cartridge is inserted into the compartment, the inlet port becomes inserted into the valve mechanism inside the cartridge, thereby opening the valve.

Outlet Orifice

Sanitizing solution is dispensed from an outlet orifice on the bottom surface of the compact chassis, where it will then drain into the toilet tank. Discharging the solution directly into the tank water will allow the sanitizer solution to dissipate and treat the entire tank water. When the toilet is flushed, the entire tank water will quickly encircle the toilet bowl through the bowl rim slots to thoroughly wash over and cleans the bowl.

There is enough room inside most toilet tanks to install the dispenser above the water line. Therefore, there will not be a clogging/build-up concern on the dispensing outlet because it never comes in contact with the tank water (i.e. there will be no slime buildup).

In case that the toilet is not flushed for long periods of time, the sanitizing solution itself would need to have a chemical makeup so that it will not dry up inside of the outlet orifice.

Outlet Port: Will simply be a small tube that protrudes from the bottom of the unit. It will reside inside a small concave indentation so that the unit will sit flat without the outlet tube touching anything. This would consist of a small convex or hemisphere indentation on the bottom surface of the unit with a tiny tube protruding from within. This protruding tube inside this cavity will allow drops to form and fall without a mess.

Outlet Orifice & Overflow Pipe

A tube can be attached to the outlet orifice to direct the flow of solution into the tank overflow pipe, where it will then drain into the toilet bowl without contacting the tank water.

Some valve manufacturers warn against the use of harsh chemicals in the tank, such as bleach and chlorine. This is because the chemicals can shorten the life of the various tank components, such as the rubber flapper valve. For this reason, a tube can be attached to the outlet orifice to direct the flow of solution into the tank overflow pipe, where it will then drain into the toilet bowl without contacting the tank water. The toilet's water supply valve not only refills the tank, it also ensures that the toilet's P-Trap is refilled by diverting some water to the toilet bowl via the toilet overflow pipe. If the dispenser releases its few drops of sanitizer into the overflow pipe during the tank refill cycle, then the valve water will flush the sanitizer into the toilet bowl.

The tube that connects the dispenser to the overflow pipe must have some design considerations to ensure a precise, reproducible discharge:

- The length of tube will need to be about 6" or so to reach the pipe;
- The tube must be primed with sanitizer before use (i.e. After a new dispenser is installed, a button could be pushed until solution is discharged); (the diameter of the tube could be very small);
- Once the tube is primed, it must have a method to prevent the tube from draining, (such as a valve or restrictor).

Even if his method of liquid discharge is possible, it does not clean the whole toilet bowl as well as directly discharging it into the tank water. While the tank is refilling, water only trickles down the overflow pipe and into the toilet bowl through a few of the toilet bowl rim slots. Consequently, the liquid will not thoroughly rinse over the whole bowl.

Multi-Cartridge System

Just like the full sized version of the LIQUA-FLUSH™ liquid dispensing system, the compact dispenser may also be configured to use multiple cartridges. Although not much room is available in some toilet tanks, most will be able to use a dual-cartridge system. This dual-cartridge capability can be achieved by using an integral dual-cartridge chassis or by using cartridge expansion modules.

If the second cartridge contains fragrance, only a tiny drop is all that is required. A tube can be attached to the outlet orifice to direct the fragrance into the tank overflow tube, where it will then drain into the toilet bowl. If the dispenser releases its fragrance into the overflow pipe during the tank refill cycle, then the supply water will flush the sanitizer into the toilet bowl. In order to properly deliver this small amount of liquid to the toilet bowl in between toilet flushes, a dispenser water intake tube would allow the dispenser to use the tank water to flush the fragrance down the overflow pipe to reach the toilet bowl.

Corrosion

Chassis Shape: Chassis will get wet. Chassis must be designed to that all water splash will be able to drain off and not pool. This is especially important where there is a space between the cartridge and the chassis.

- R&D: Determine statistics on toilet tanks: How many ball types, how much space between the water level and the top of the tank.

- Electronic Board: The board should be encapsulated to prevent corrosion.

- Chassis: The chassis should use an O-Ring seal and should be screwed tightly together.

- Battery Compartment Cover: The cover must use a waterproof "O-ring" design since water can splash onto the unit; Many products use this waterproofing method, such as the S.C. Johnson "Scrubbing Bubbles Shower Cleaner" product (illustrated below); the contacts come with a dab of silicone grease to help prevent corrosion.



Control Buttons

Sealed Buttons: Two tactile pushbuttons used to select the liquid concentration level with a piezoelectric buzzer; this will allow a user to select the sanitizer concentration. Each push of the button would activate a piezoelectric buzzer as feedback. There could be 10 or more levels of concentration. The buzzer could get louder and louder with each button push as a signal; also, several seconds after releasing the button, the beeper could beep the number of times 1-10 to indicate the exact level of concentration that was selected. A soft, sealed membrane with button illustrations such as those below would allow a user to push the buttons behind the film that are mounted onto the computer circuit board;

Audio Feedback

Piezoelectric Buzzer can be used to signal concentration level, low battery condition and possibly low fluid level;

Flush Sensor Details

The LIQUA-FLUSH™ dispenser must need to know when to dispense its solution. Thus, a water level sensing device or flush detector is needed. It would be desired to have a sensor that is a foolproof mechanism, reliable and economical for mass-production with no moving parts. In addition, it must have low power drain for long battery life. Many devices and techniques can be used for this water level/flush detector and LIQUA-FLUSH™ can work with almost any of them. Some of the more common methods will now be discussed below.

- Consume low power so that battery life will last at least a year;
- Accurately measure the water level of the tank;
- Still work if any water is splashed onto the sensor; (the sensors could be located away from the chassis' bottom surface to minimize the potential of water splash); (i.e. inside of a tube);

Ultrasonic Flush Sensor

A ultrasonic sensor can measure water level to determine when a flush has occurred. The sensor can reflect sound waves from the water's surface to measure the difference between a low to a high state to determine that a flush has occurred.

Waterproof Ultrasonic Transmitter/Receiver Sensors

Waterproof Ultrasonic Single Integrated Sensor

This ultrasonic distance measuring transducer system provides precise, stable, non-contact distance measurements from about 2 cm (0.8 inches) to 4 meters (13 feet) with a resolution of 0.3 cm (0.1 inch). The system can consume 2 mA standby and 15 mA while transmitting. Its compact size and its ability to detect the surface of water make it a candidate for measuring the water level inside a toilet tank.

This system consists of a transmitter (speaker) and receiver (microphone) pair of sensors. At a desired interval, the ultrasonic speaker sensor transmits a brief ultrasonic chirp. The ultrasonic receiver microphone listens for the echo. An object that is closer to the ultrasonic detector will reflect the emitted sound back to the microphone faster than an object farther away. An electronics circuit can interpret this send/receive ping to calculate the object's distance from the sensors.

Waterproof, single unit ultrasonic sensors are now available, where the transmitter and receiver functions are integrated into one compact unit.

It is not necessary to provide continuous "real time" measurement of the toilet tank water level. Once a toilet is flushed, it takes between 20 to 45 seconds or more for the tank to empty and then completely refill. This time will depend on the line water pressure and the performance of the water supply valve. In order to conserve battery power, the ultrasonic sensors can be intermittently switched on to measure the tank level, then off again. Therefore, it would be safe to measure the water level for a split second of time every 10 seconds. For example, if it takes the ultrasonic sensor 20 mS to complete a measurement cycle and it only does this task every 10 seconds, a power saving factor of 500 can be achieved, (10 s / 0.020 s = 500).

This distance measuring circuit can calibrate itself, once the unit is turned on and a sample flush if performed. This calibration cycle can also help save even more power by determining the minimum sampling period for a particular toilet. The device will initially measure the water level every second until the tank is full. Since a toilet tank float and valve will keep the toilet level very consistent, even a two inch drop in water level will mean that a flush has occurred. Thus the maximum time to measure the tank level would be the time from the start of the flush until the water level reaches two inches from full.

Condensation from the humid toilet tank environment on the transducers may affect performance and lifespan of the device. However, ultrasonic sensors can be made to be waterproof.

PROS:
- Low profile/compact
- No contact with the tank water
- Simple to use with no user adjustments

CONS:
- Dual sensor pair consumes more power
- Sensors can be costly

Photoelectric Water Level Flush Sensor

A photoelectric infrared sensor can measure water level to determine when a flush has occurred. The sensor can reflect light from the water's surface to measure the difference between a low and a high state.

Photoelectric Sensor

This optical distance measuring system uses a transmitter and detector pair of infrared diodes. The transmitter emits a modulated pulse of infrared light that the detector will receive after it has reflected from the tank water. When the light returns, it comes back at an angle that is dependent on the distance from the water. The detector has a special precision lens that transmits the reflected light onto an enclosed linear array. Using the beam angle and triangulation, distance can then be determined. The modulated frequency from the emitted beam makes it almost immune to interference from ambient light. (*If necessary, an additive to the dispensed solution could be used to help enhance the performance of these sensors!).*

Just like the above description of the ultrasonic flush sensor, it is not necessary to provide continuous "real time" measurement of the toilet tank water level. Once a toilet is flushed, it takes between 20 to 45 seconds or more for the tank to empty and then completely refill. This time will depend on the line water pressure and the performance of the water supply valve. In order to conserve battery power, the photoelectric sensors can be intermittently switched on to measure the tank level, then off again. Therefore, it would be safe to measure the water level for a split second of time every 10 seconds. For example, if it takes the photoelectric sensor 20 mS to complete a measurement cycle and it only does this task every 10 seconds, a power saving factor of 500 can be achieved, (10 s / 0.020 s = 500).

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PROS:
- Low profile/compact
- No contact with the tank water
- Simple to use with no user adjustments

CONS:
- Dual sensor pair consumes more power

Magnetic Vertical Float Switch Flush Sensor

A magnetic liquid level float switch system would no doubt be the most inexpensive and reliable of all water sensors. A magnetically operated switch, such as a hermetically sealed glass reed switch, is mounted inside of a vertical tube that extends down from the dispenser into the tank water. A float that contains an internal magnet is arranged to slide freely up and down the vertical tube as the tank water rises and falls. When the tank is full, the magnet inside of the float will cause the switch inside the tube to activate. After a toilet flush, the water level will drop and the float will also move with the water, thereby deactivating the switch. Thus, this system will provide the dispenser feedback that a flush has occurred.

Magnetic Switch

This float switch is a micro-sized device where its float shaft would be about the size of a pencil! Although it has a single moving part, the float, it is extremely reliable, very inexpensive to produce and uses no power.

PROS:
- Passive device that uses no power (it is just a switch) for long battery life
- Low cost
- Very reliable with extremely long life (50 million cycles)

CONS:
- Contacts the tank water
- A little clunky – not low-profile
- User must fold down & adjust

Magnetic Pivot Arm Float Switch Flush Sensor

This passive, no power type of float switch uses a pivoting arm that allows the float to rise and fall with the tank water. The float pivots an arm that has an internal connection to an actuation switch. The float can be slid along the arm shaft so that the arm can hang vertically while the tank water is in a low state. This would provide for an exact arm position to trigger a passive switch. Other types of switches could be used with the arm so that the user would not need to adjust the float, but they may need power to work.

PROS:
- Passive device that uses no power (it is just a switch) for long battery life
- Aid to long battery life
- Low cost
- Very reliable with extremely long life (50 million cycles)

CONS:
- Contacts the tank water
- A little clunky – not low-profile
- User must adjust float

Flush-Handle Tilt-Switch Flush Sensor

A wireless tilt-switch system can be used to determine when a flush has occurred. A module containing an infra-red transmitter and a tilt-switch sensor can be simply clipped onto the toilet flush-handle actuator and monitored to detect its movement. This sensor could be a simple glass mercury filled switch or a solid state motion sensor. This module would be designed to automatically calibrate itself with the normal position of the flush actuator. Once the toilet is flushed, the flush actuator will move and thus tilt, which will be detected by the attached switch. If the flush-handle is tilted enough to flush the toilet, the module will activate its infra-red transmitter to saturates the toilet tank interior with infra-red light for a moment. An infra-red detector that is mounted on the dispenser will receive this signal. The LIQUA-FLUSH™ system will then dispense sanitizing solution into the tank after a short delay to allow the flapper valve to close and the tank to refill. A radio frequency device can also be used instead of infrared diodes.

Mercury Tilt Switch

Ball Tilt Switch

Solid State Tilt Switch

A wired tilt-switch can also be used, which would save the cost of a infrared/RF transmitter pair and the need to eventually change the remote sensor's battery. Due to the close proximity of the detector ant the flush actuator, the wires are not a bad choice, though a little bit clunky).

PROS:

- Passive device that uses no power (it is just a switch) for long battery life
- Low cost, reliable
- Very reliable with extremely long life
- Does not contact the tank water

CONS:

- A little clunky – not low-profile
- Wireless or wired version, user must attach to flush handle
- For the wireless version, user must periodically replace batteries
- For the wired version, wire are even more clunky

Microphone Flush Sensor

A low cost and low power sensor to function as a flush monitor can be just a simple microphone. The microphone can listen for the sound and vibrations of a flushing toilet and can trigger a dispensing cycle. This feature can be calibrated with voice recognition type of technology. A user can be instructed to flush the toilet once a new cartridge is installed so that the dispenser can then "learn" the flush sounds. The dispenser will then be programmed to listen for the unique sound of that particular flushing toilet as a trigger.

Electret Microphone

A good electret condenser microphone draws only 14 uA of power. With this little power draw, the microphone could be left on and monitored all of the time. To save power, the microphone could be intermittently switched off and on every few seconds to "sample" the environment for a toilet flush. If a certain noise threshold has be reached, the microphone could then be switched on continuously to listen for a flush. However, this switching technique

cannot be relied upon to use a more power hungry microphone, because many false alarms from a noisy bathroom environment would drain the battery too fast and make for an unpredictable level of battery life.

PROS:
- Low profile/compact
- No contact with water
- Long life sensor
- Low power requirement

CONS:
- Indirect flush determination
- Extra programming effort
- More costly sensor

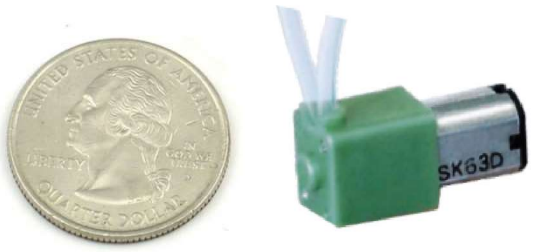
Pump Details

The LIQUA-FLUSH™ dispenser must be pumped from its liquid reservoir to the toilet tank and/or toilet bowl. Thus, a liquid pump is needed. It would be desired to have a pump that has low power drain for long battery life. Many devices and techniques can be used for this liquid pump and LIQUA-FLUSH™ can work with almost any of them. Some of the more common methods will now be discussed below.

Peristaltic Micropump

A peristaltic pump is a type of positive displacement pump. The fluid is contained within a flexible tube fitted inside a circular pump casing. A rotor with a number of rollers or wipers attached to the external circumference compresses the flexible tube. As the rotor turns, the part of the tube under compression closes thus forcing the fluid to be pumped to move through the tube. Additionally, as the tube opens to its natural state after the passing of the cam fluid flow is induced to the pump. Nothing but the tube touches the fluid, eliminating the risk the fluid contaminating the pump. It is ideal for viscous and aggressive toilet sanitizer fluids. This pump design also prevents backflow and siphoning without valves. A peristaltic pump can be made very compact, operate only with only 3 Volts (30 mA) and use only 0.12 W of power.

Peristaltic Micropump



Power Details

Battery Type & Life

Most small liquid pumps that would work for this products need at least 3 volts. This would require at least two 1.5 volt batteries installed in series.

This product should be designed with a battery life of at least one year. Therefore, it must be designed using components that use power sparingly to ensure long battery life. A year of dispenser operation would require 2 to 4 standard "AA" or "AAA" size alkaline batteries.

Power Calculations

All of the following calculations are only approximate based on data collected from selected industry standard parts. The purpose of supplying this data is just to add food for thought.

The three main components that require power are the Microcontroller, Liquid Pump and Flush Sensor:

1) Microcontroller: With today's low power electronics, the microprocessor circuit would use almost no power at all.

2) Liquid Pump: Only a few drops of a highly concentrated sanitizer is required for each flush cycle. A micro pump would have to operate for only a few seconds to dispense this amount. The pump uses no power until it is needed, so its power consumption is determined by its own power rating and its frequency of operation. Here are some basic calculations:

   According to the World Toilet Organization (WTO), the average person uses a toilet 2,500 times year, or 7 times daily. According to the U.S. Census Bureau, there are 2.59 persons per household in the U.S. (2006-2010). While many households have 2 or more toilets, and many people work and therefore use public toilets instead, let us just estimate as a high figure that 2 people will use a single toilet a total of 14 times every day.

   That is: 2 people x 7 flushes per day = 14 flushes total per day => 14 x 365 = 5,110 flushes per year per toilet. If the pump must operate for 3 seconds for each cycle, then the pump would operate for 3 x 5,110 = 15,330 seconds per year, which is 255 minutes of continuous duty.

3) Flush Sensor: The flush sensor is a waterproof ultrasonic sensor that uses little power. Alternatively, an optoelectric infrared sensor, an electret condenser microphone, etc., can be used.

Energy: 1 Joule = 1 Watt x 1 Second

Power: 1 Watt = 1 Volt x 1 Amp

Seconds in a year:

S/Y = (60 seconds/1 minute) x (60 minutes/1 hour) x (24 hours/1 day) x (365 days/1 year) =

60 s/m x 60 m/h x 24 h/d x 365 d = 31,536,000 seconds/year

Battery: 1 – AAA Size Alkaline Battery @ 1.5 Volt @ 1,150 mAh = 1.5 V @ 1.15Ah

An AA battery's voltage will drop from 1.5V to 0.9V over its life. The discharge curve is relatively linear in that range, so the average voltage is 1.225 V. The energy stored in the battery is:

Energy (in Joules) = J = W x S = (V x A) x S =

(1.225 x 1.150) x (1 h x 60 m/h x 60 s/m) = 5,072 Joules

A battery pack of four AAA batteries = 4 @ x 5,072 J = **20,286 Joules**

Battery: 1 – AA Size Alkaline Battery @ 1.5 Volt @ 2,850 mAh = 1.5 V @ 2.85 Ah

An AA battery's voltage will drop from 1.5V to 0.9V over its life. The discharge curve is relatively linear in that range, so the average voltage is 1.225 V. The energy stored in the battery is:

Energy (in Joules) = J = W x S = (V x A) x S =

(1.225 x 2.850) x (1 h x 60 m/h x 60 s/m) = 12,569 Joules

A battery pack of four AA batteries = 4 @ x 12,569 J = **50,275 Joules**

Microprocessor: Draws 17 uA = .000017 A

Energy required to operate the microprocessor for 1 year:

Energy (in Joules)/year = J/(1 year) = W x S = (V x A) S/year =

(6 V x .000017 A) x 31,536,000 S/year =

6 x .000017 x 31,536,000 = **3,217 Joules/year**

Pump: Draws 30 mA = .030 A

Energy required to operate the pump for 255 minutes which will be its consumption for a year, (If the pump must operate for 3 seconds for each cycle, then the pump would operate for 3 x 5,110 = 15,330 seconds per year, which is 255 minutes of continuous duty):

Energy (in Joules)/year = J = W x S = (V x A) S =

(6 V x 0.030 A) x 255 minutes x (60 seconds/1 minute) =

6 x 0.030 x 255 x 60 = **2,754 Joules/year**

Sensor: Draws 30 mA = .03A

Energy required to operate the sensor for 1 year:

Power Factor: If the sensor is switched off and on to conserve energy, where it is on for 20 mS every 10 seconds: 10S/20mS = 500, resulting in an intermittent operation of 31,536,000 S/year / 500 = 63,072 S.

Energy (in Joules)/year = J = W x S = (V x A) S/year=

(6 V x 0. 03 A) x 63,072 S/year =

6 x 0. 000165 x 63,072 = **11,353 Joules/year**

POWER USED IN ONE YEAR

Microprocessor:	**3,217**	**Joules**
Pump:	**2,754**	**Joules**
Sensor:	**11,353**	**Joules**
Total Power Need:	**-17,324**	**Joules**
Available Power (4 AAA):	**20,286**	**Joules**
Surplus Power:	**2,962**	**Joules**
% Surplus Power:	**15%**	

As shown here, the sensor uses far more power than the microprocessor and pump. If a passive sensor is used, such as a glass reed magnetic float switch, then only about 6,000 Joules would be needed, requiring only one AAA battery (though two would be needed if the pump needs 3 volts). However, if power savings techniques are used for the photoelectric or ultrasonic sensors, more power can be conserved and the dispenser could work with 4 AAA or 2 AA batteries.

Cartridge Details

Cartridge Description

The cartridge is simple, disposable device consisting a shell to hold the solution, a pressure relief device (or other method) and a simple drain with a spring-loaded valve (or a "tensioned" valve).

Cartridge Issues:

- Valve Design: The best and least expensive way to design the cartridge valve system is to use "tensioned plastic". A flap of plastic that is formed with the cartridge will hold tension against an outlet port. Once an actuator is inserted into the outlet port, it will push open this plastic valve to allow the flow of liquid; The chassis actuator is simply a hollow tube that is responsible for engaging and opening the cartridge valve and to duct the liquid into the chassis. A small amount of felt-like material could be used just inside the actuator and cartridge port to prevent leakage once the cartridge is removed;

- Plastic bladder design? The cartridge will use a plastic bag to hold the sanitizing solution. That way, the cartridge shell that it resides in is simply vented with air holes to the environment. No pressure vents would be needed and gas expansion/contraction with temperature would no longer be an issue. One side of the bag would be fused onto the valve assembly.

- Designed for no leaks; A seal and or cap can prevent any solution leaking from the cartridge during storage & transit; Once the seal is removed, a tensioned valve inside the cartridge should prevent leakage while the cartridge is installed or removed; A small felt-like mesh could be installed inside the cartridge and chassis orifices to further prevent leakage (i.e. a small drop could discharge while the cartridge is being changed);

- Volume of cartridge to last at least 3 months? How much solution per flush? How many flushes on average per day?

Cartridge Ventilation

A method, such as a one-way pressure relief valve, is required to allow air to displace the withdrawn solution. A pressure relief valve on the topside of the cartridge may be the most economical method; however, other methods can be used as well, such as a pull-off tab seal that cover a ventilation hole.

A cartridge bladder can also be used to eliminate the issue of pressure relief. A plastic bag that is used to contain the solution inside of the cartridge would not contain any air. The cartridge would simply act as a docking shell for the dispenser. Since the cartridge would have ventilation slots, air could freely enter as the bag of solution is depleted.

Cartridge Valve Design

The cartridge's drain provides a path for the solution to exit the cartridge. This drain consists of an orifice with a spring loaded valve, such that a spring and valve keeps the drain closed and leak free. A pin on this valve engages a mating actuator pin in the dispenser, thus opening the valve and allowing a leak free connection of fluid into the dispenser. As an example, below is an image of common valve core that is used in tires.

A similar functioning, low-pressure plastic version that is formed into the cartridge would be very cost effective. If a 16 oz. finger-pump bottle of hand soap can be purchased for $1 (where the finger-pump assembly includes a spring, piston and other parts), then a simple spring-loaded valve cannot be out of reason on a $4.50 cartridge of toilet sanitizer.

Rather than using a spring and valve arrangement, other even more inexpensive methods could be used to prevent cartridge leakage:

1. The cartridge shell itself could be designed with a pocket near the drain orifice where a plastic rib could apply tension to some sealing material that covers the orifice.

2. The cartridge could use a self-healing material at the outlet orifice area so that a hollow tube from the dispenser can penetrate it to gain access to the solution. Once the cartridge is withdrawn, the self-healing material will seal the pin hole to prevent leakage (if the cartridge is still full), similar to how a basketball is filled with air.

3. A tight leak-free cap can be installed onto the cartridge orifice. The cap is removed before the cartridge is inserted into the dispenser. A fibrous material, such as a felt material like that used in felt pens would prevent the liquid from leaking (just like the ink will not spill out from a felt pen). Other special materials can be used so that the pump can more easily draw liquid from the cartridge. The cartridge orifice could also be located at the top back end of the cartridge where an inside cartridge tube can extend down into the liquid.

If simplicity and low cost is paramount, then the cartridge could still be used without regard to leakage. A hollow pin could penetrate the cartridge, even without self-healing material. If the cartridge is removed while it is still full, then the cartridge will leak from the penetration. A user will just have to be aware of this. However, this is a poor and unacceptable solution if customer satisfaction is important.

Leak-Free Orifice

As an aid to provide for a leak free cartridge, the valve orifice could be blocked by a fibrous material, such as a felt material like that used in felt pens. This would keep the liquid from leaking out even if the valve is wide open outside of the dispenser (just like the ink will not spill out from a felt pen). The pump would be able to easily draw liquid through the felt. Likewise, a mating surface inside of the dispenser's inlet orifice can contain the same material so that any liquid can be absorbed.

Sanitizer Chemical Properties

The chemical properties of the sanitizer must be "green" (earth friendly) and biodegradable. It should not harm plumbing , septic systems or colored toilets; it should also not contain abrasives that might scratch surfaces.

Sanitizing Solution:

- Characteristics of Sanitizing/Disinfectant Solution:
  - Disinfectants are antimicrobial agents that are applied to objects to destroy microorganisms that are living on the objects.
  - Sanitizers are substances that simultaneously clean and disinfect.
- Chemicals Used with Toilet Sanitizing Solution:
  - Hydrochloric Acid: is an active ingredient in many toilet bowl cleaners, such as;
    - Diversey VANISH Thick Liquid Disinfectant Bowl Cleaner
    - Diversey Crew Heavy Duty Toilet Bowl Cleaner
    - Diversey Crew Mean Green Toilet Bowl Cleaner
  - Oxalic Acid
    - Diversey Crew Super Blue Mild Acid Bowl Cleaner
  - Alkyl Dimethyl Ethyl Benzyl Ammonium Chloride;
    - Diversey VANISH Non-Acid Bowl & Bathroom Cleaner II
    - Diversey Crew Clinging Toilet Bowl Cleaner
  - Alkyl Polyglucoside;
    - Clorox Greenworks Natural Bowl Cleaner
  - Sodium Hypochloride, Sodium Cocoate, Sodium Hydroxide, Myristamine Oxide, Lauramine Oxide;
    - Clorox Toilet Bowl Cleaner with Bleach
  - Sodium Citrate (Trisodium Citrate); (is used in laundry and hard surface cleaners to help remove soap scum and stains, and to help regulate the pH of the product); Acrylic Copolymer (bind

minerals such as calcium and magnesium -known as water hardness-, enabling a cleaning product to remove hard water stains);

- http://householdproducts.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=37&query=Sodium+Citrate&searchas=TblChemicals
- Clorox Blue Toilet Bowl Cleaner

- Sodium Percarbonate (Peroxydicarbonic Acid) (Disodium Peroxydicarbonate);
  - http://householdproducts.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=2536&query=Sodium+Percarbonate&searchas=TblChemicals
  - Clorox Bleach & Blue Automatic Toilet Cleaner – Tablet
- Hydrogen Peroxide, Benzyl Alcohol, Hydroxyacetic Acid;
  - Diversey Sporicidal Toilet Bowl Cleaner
- Acid Anionic (Peracetic Acid)
- Phosphoric Acid
- Chlorine Bleach
- Alcohol, Isopropyl Alcohol, Laureth-3, Lauralkonium Choride, Parfum

Sanitizer Concentration

The sanitizer must be highly concentrated so that the size of the cartridge can be as compact as possible to insure a universal toilet tank fit and so that one cartridge of sanitizer can last up to 3 months.

Amount to be dispensed? How much solution is necessary for each dispensing cycle? What range from light to heavy?

Sanitizer Temperature Effects on Viscosity

Many people prefer to save energy costs in the winter by lowering their thermostats at night. It would be a design requirement that the viscosity of the fluid remain fairly constant even at very low temperatures. This or else the pump/power requirements would have to compensate. A special pump design could be chosen that has wider tolerances to changes in viscosity due to temperature.

Viscosity Issues with Temperature and Age: The solution must be thin enough to flow under a wide range of temperatures; The solution should not "dry out" or age so that it could clog the system; The solution must have a very long shelf life; The chemicals should never separate over time;

Cartridge Size and Capacity

The cartridge must hold enough liquid sanitizer to sanitize a toilet for at least three months. The cartridge size must accommodate a volume of liquid as well as have a shape that allows it to fit well inside of a toilet tank. Here are some data about a prototype cartridge:

- Cartridge size = 2.5" W x 2" H x 3.5" L = 17.5 cubic inches = 8 fluid ounces = 237 ml
- If it takes 0.1 to 0.3 ml of cleaner to sanitize a toilet for each flush, and the toilet is flushed 14 times a day, then:
  - 237 ml /0.2 ml (average) = 1,185 doses (flushes)
  - At 14 flushes per day => 1,185/14 = 85 days or about 3 months

Thus, a cartridge with the above dimensions and product usage will last for about 3 months.

Solution Color Options

Colored Solution Options: Blue: Chemical Name: Acid Blue 9 (C.I. 42090) is a colorant (widely used food dye or pigment) added to cleaning products to improve aesthetic appeal, or to act as a tracer (for example in certain toilet bowl cleaners, blue coloration indicates that the product is working).

- http://householdproducts.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=1633must

Fragrance Options

Fragrances and perfumes are mixtures of fragrant essential oils, aroma compounds, fixatives and solvents to add a particular scent (lavender, lemon, etc.), and to mask unpleasant odors.

Commercial Market

Tankless Toilets & Urinals

A premium commercial version of the LIQUA-FLUSH system can be offered for commercial tankless toilets and urinals. An outlet tube from a wall-mountable chassis embodiment of the LIQUA-FLUSH™ system simply taps into the inlet water line just after the flush supply valve for a commercial toilet or urinal. The LIQUA-FLUSH™ system's occupancy sensor would be responsible for initiating a dispensing cycle. This commercial version uses a larger capacity cartridge for extending cartridge replacement service.

User Operation

Instructions for Use

The LIQUA-FLUSH™ toilet liquid dispensing system is easy to use:

1) Remove the toilet tank lid and clip the dispenser onto the inside top edge of a toilet tank.

2) Insert a new cartridge into the dispensing unit.

3) Turn the dispenser on.

   The dispenser will rapidly chirp for 5 seconds to warn the user that it is about to dispense solution. After this 5 seconds, the dispenser will operate its liquid pump for about 5 seconds, just enough time for the pump prime itself and dispense some solution into the toilet tank.

   The dispenser will then beep slowly until a toilet flush is performed so that the unit can calibrate itself to the tanks high/low water levels, (or to the sound of the flushing toilet).

4) Flush the toilet.

   The dispenser will calibrate itself during the flush and will cease beeping once it is finished. It when then start to monitor tank water level for the next flush.

5) Replace the toilet lid.

LIQUA-FLUSH™ Electrical Diagram