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(54) MULTIPLE FEED DISCHARGE FLUSH SYSTEM

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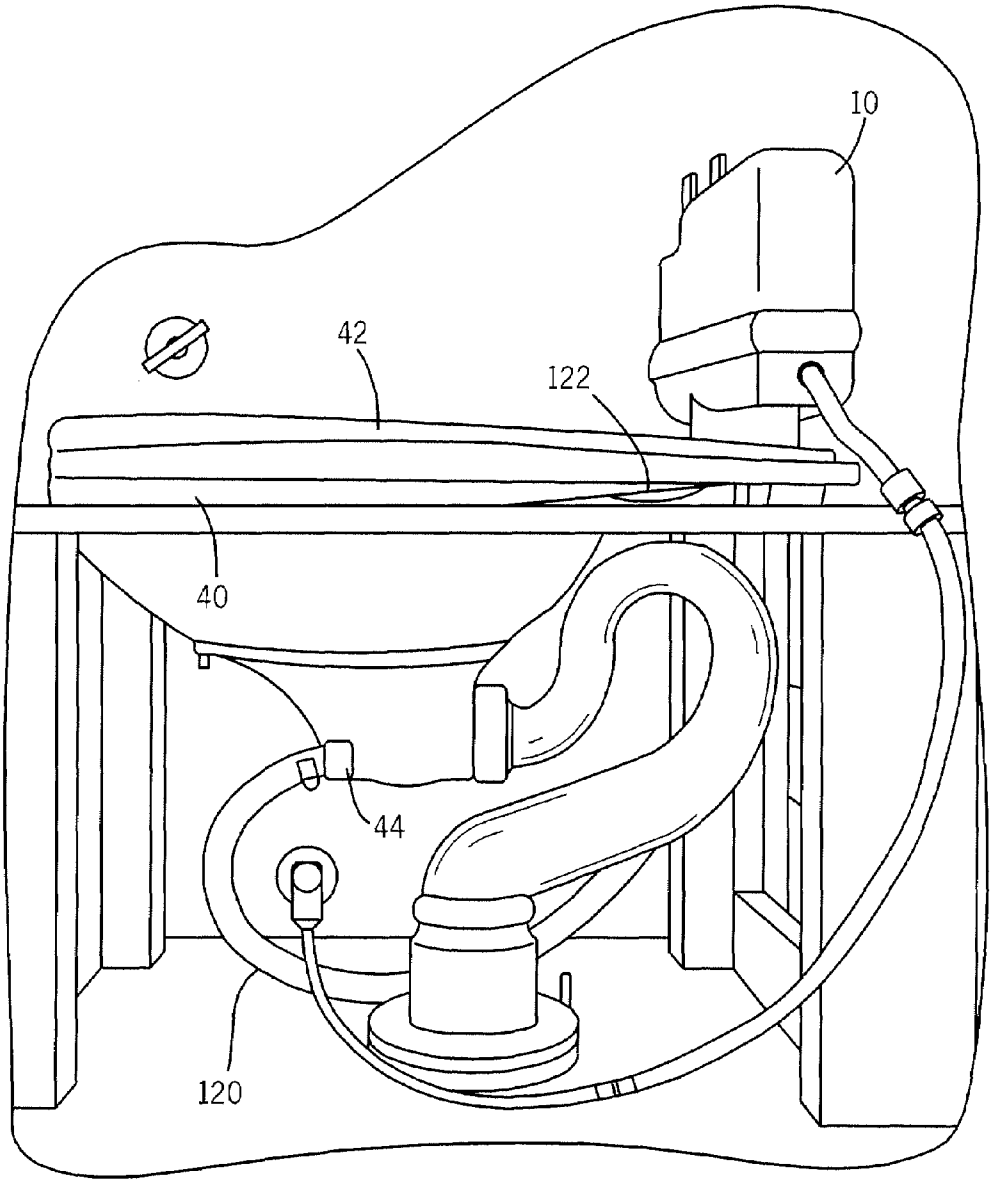
(57) **ABSTRACT**

A multi-path discharge feed for a pressurized flush system of a water closet. The discharge feed fluidly connected to the pressurizable flush tank includes an inlet and a first outlet and a second outlet. Contents of the pressurizable flush tank are received via the inlet and distributed between a wash portion directed to the first outlet and a flush portion directed to the second outlet. The first outlet is fluidly connected to a plurality of wash jets. The second outlet is fluidly connected to a flush jet. The volume of fluid directed to the wash portion and the flush portion may be controlled by selecting the area of the first outlet and the area of second outlet, respectively.



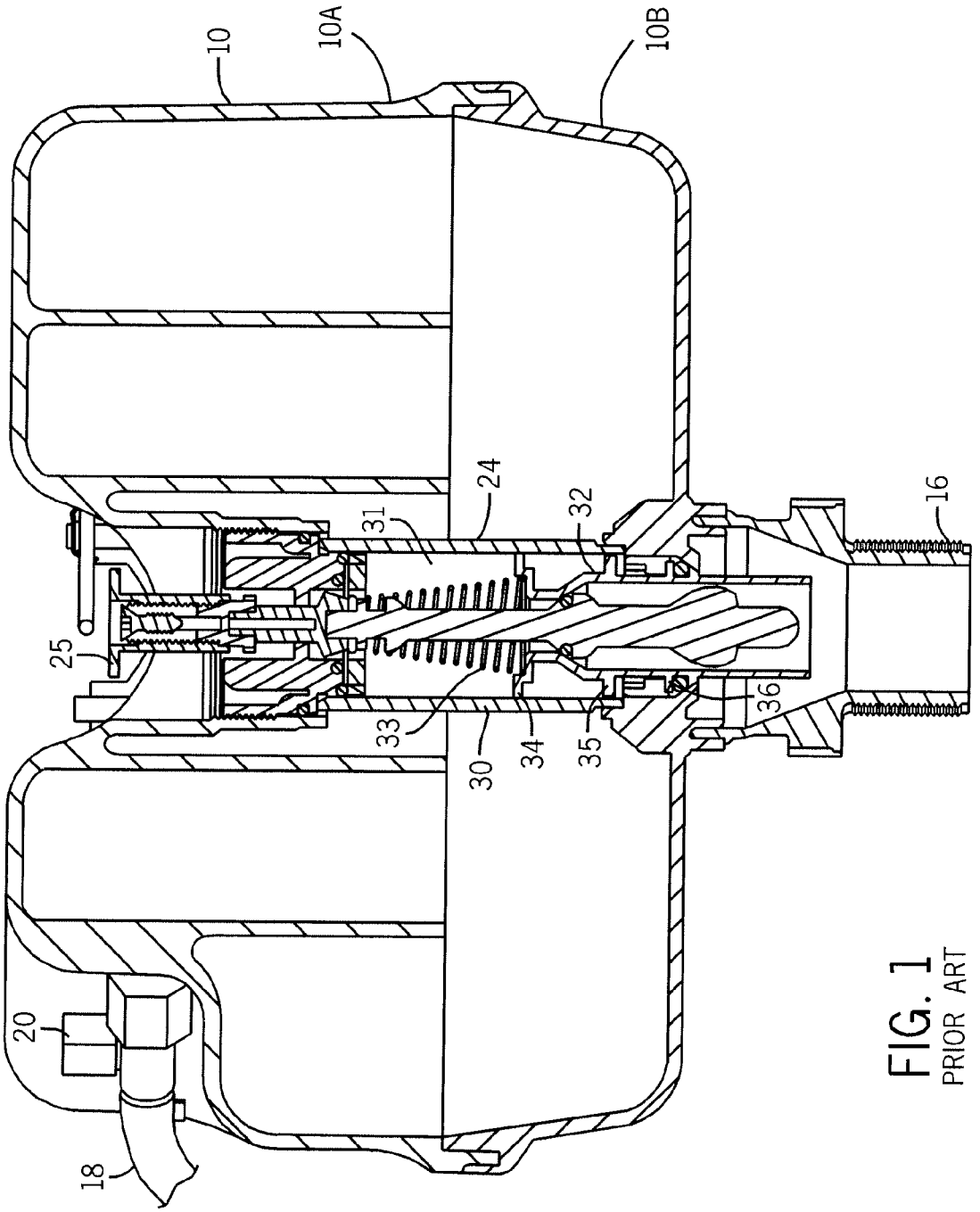


FIG. 1
PRIOR ART

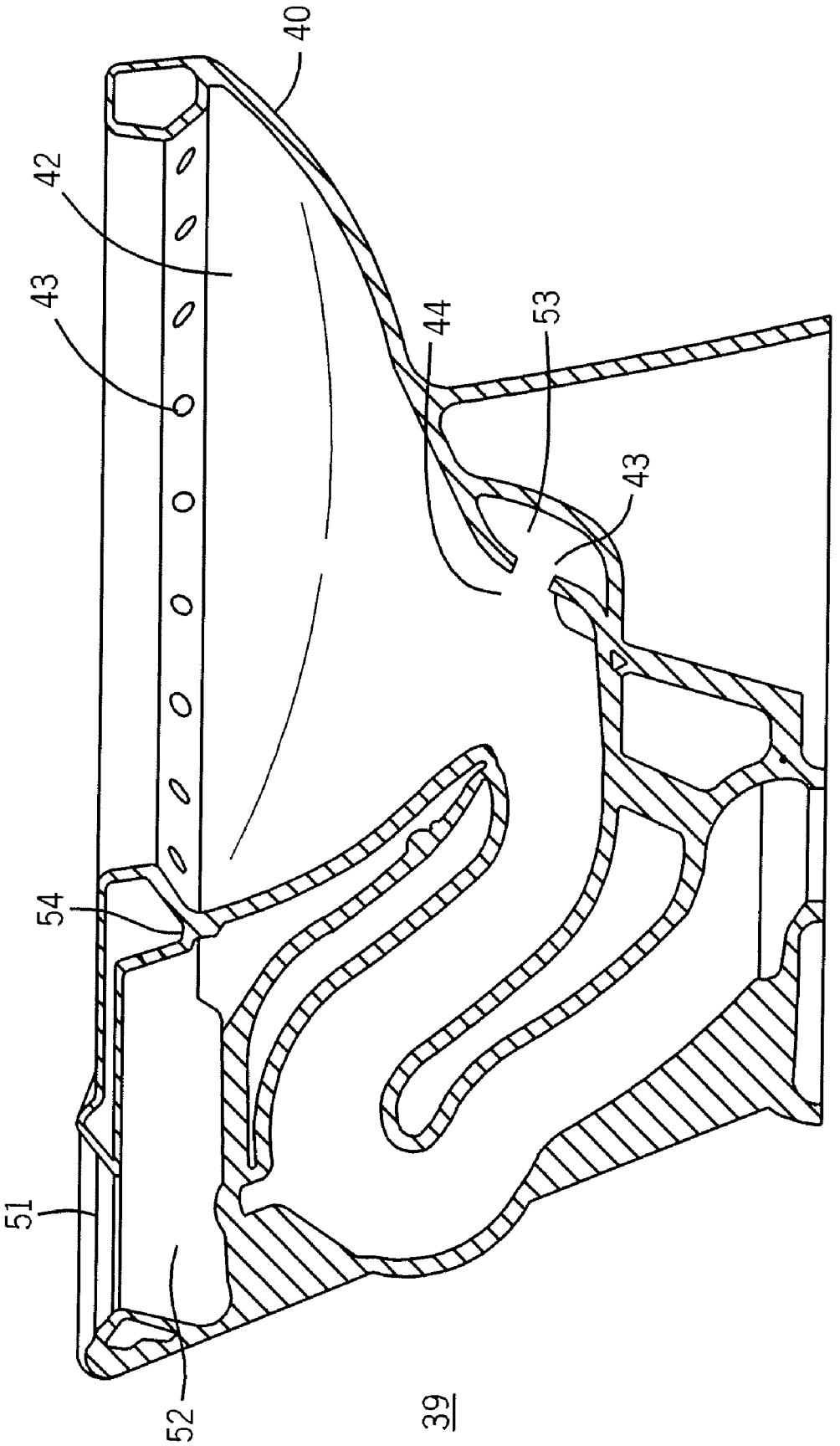


FIG. 2

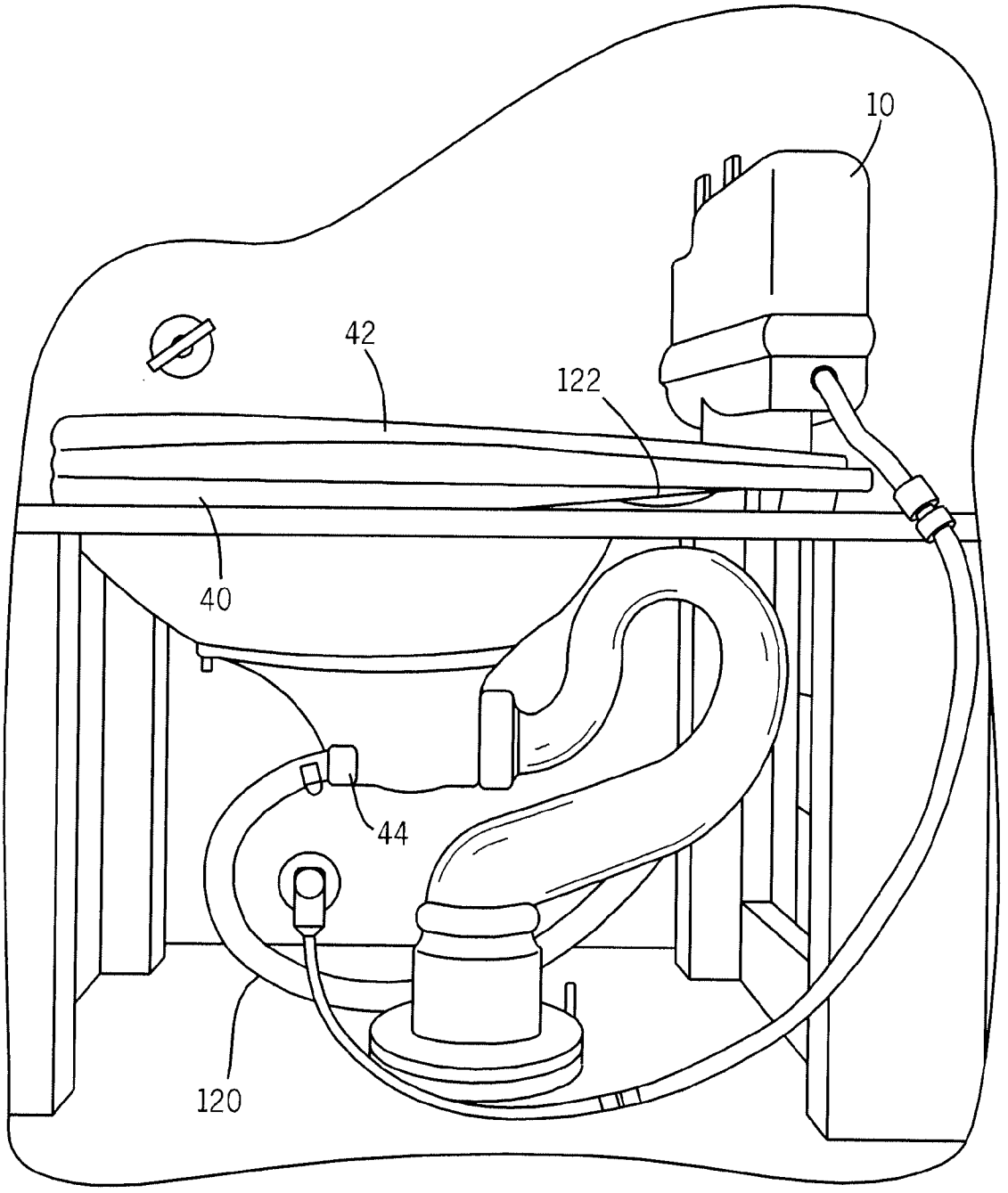


FIG. 3

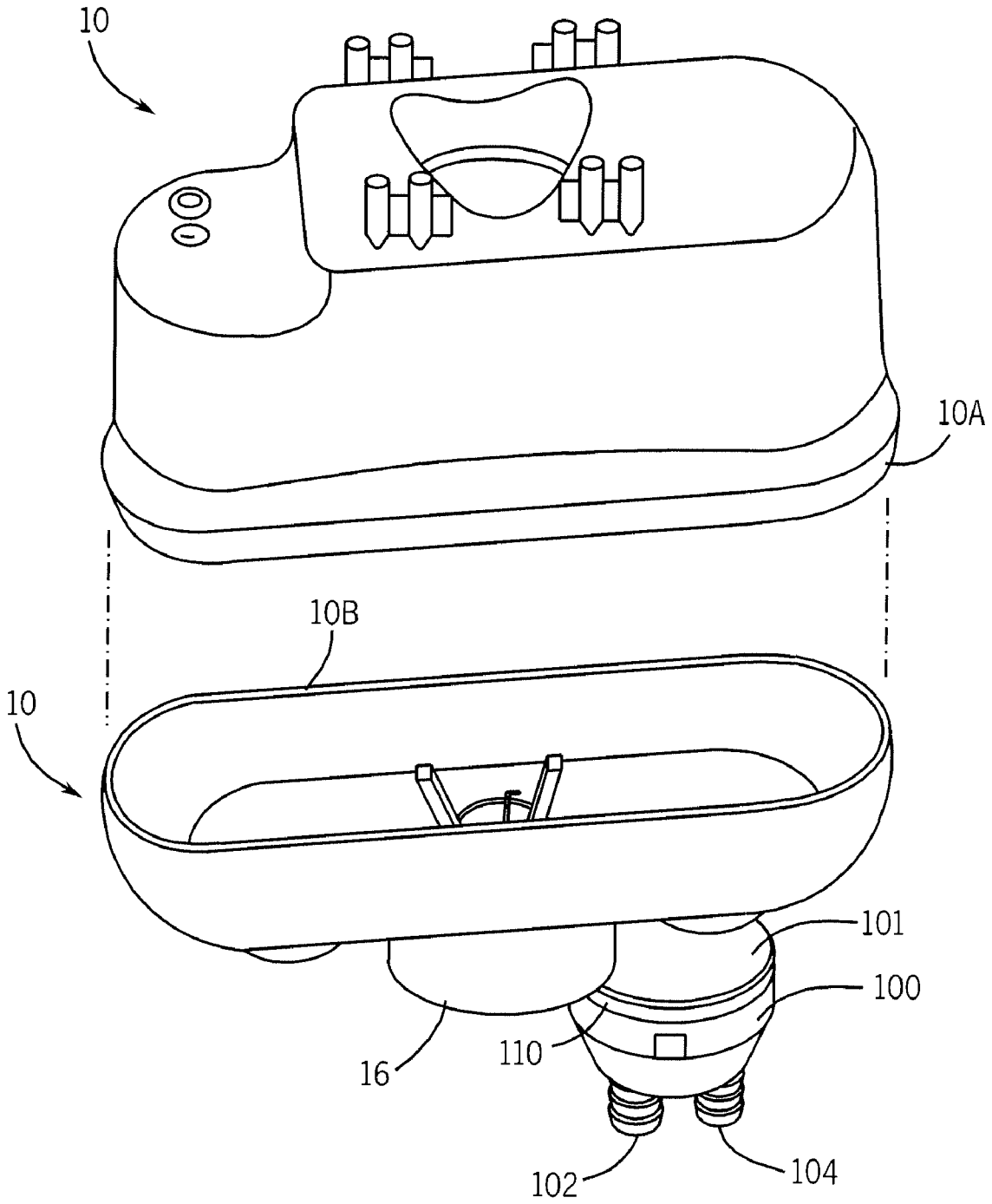


FIG. 4

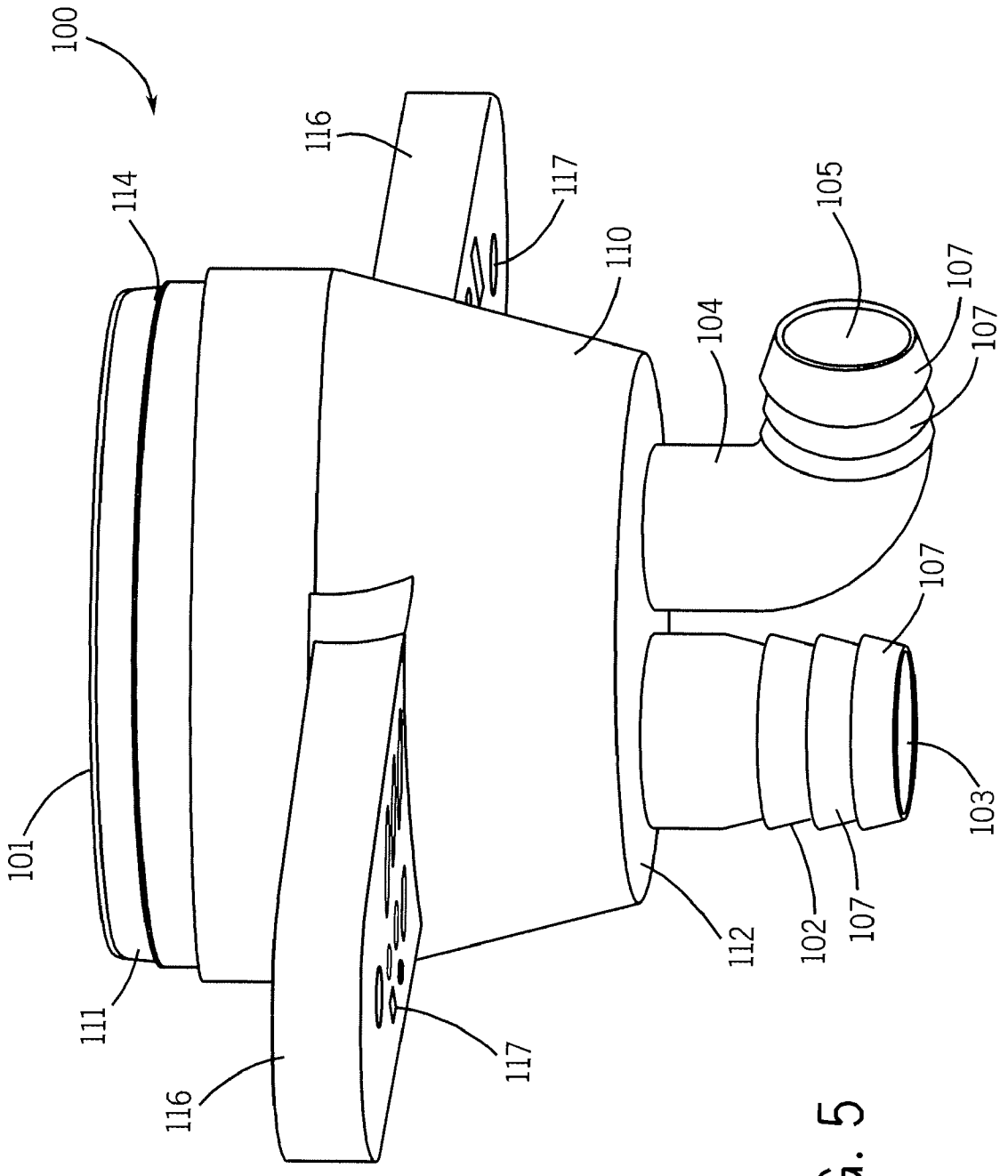

100
116
114
117
110
105
107
104
107
107
101
103
111
112
102
107
117
116

FIG. 5

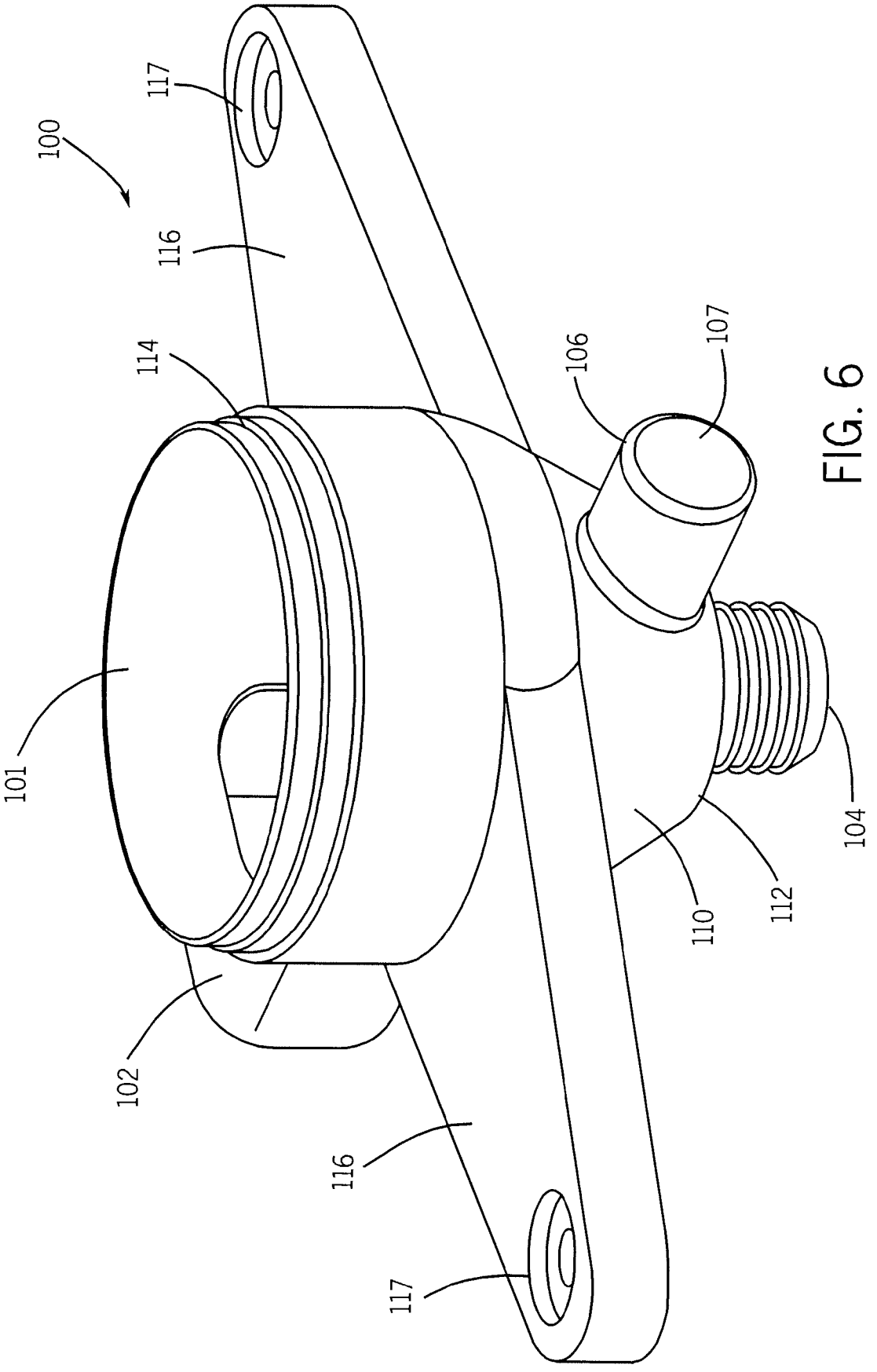


FIG. 6

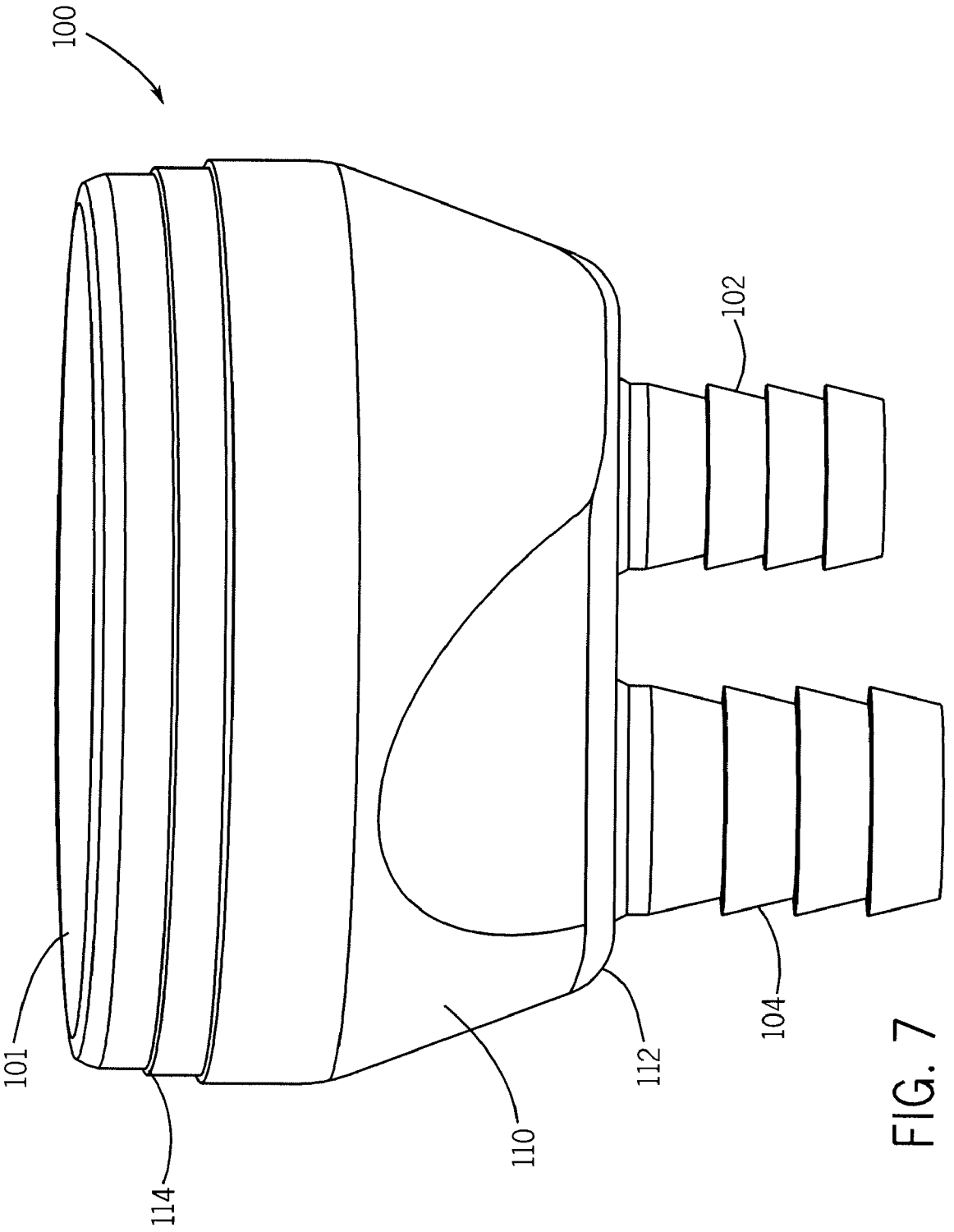


FIG. 7

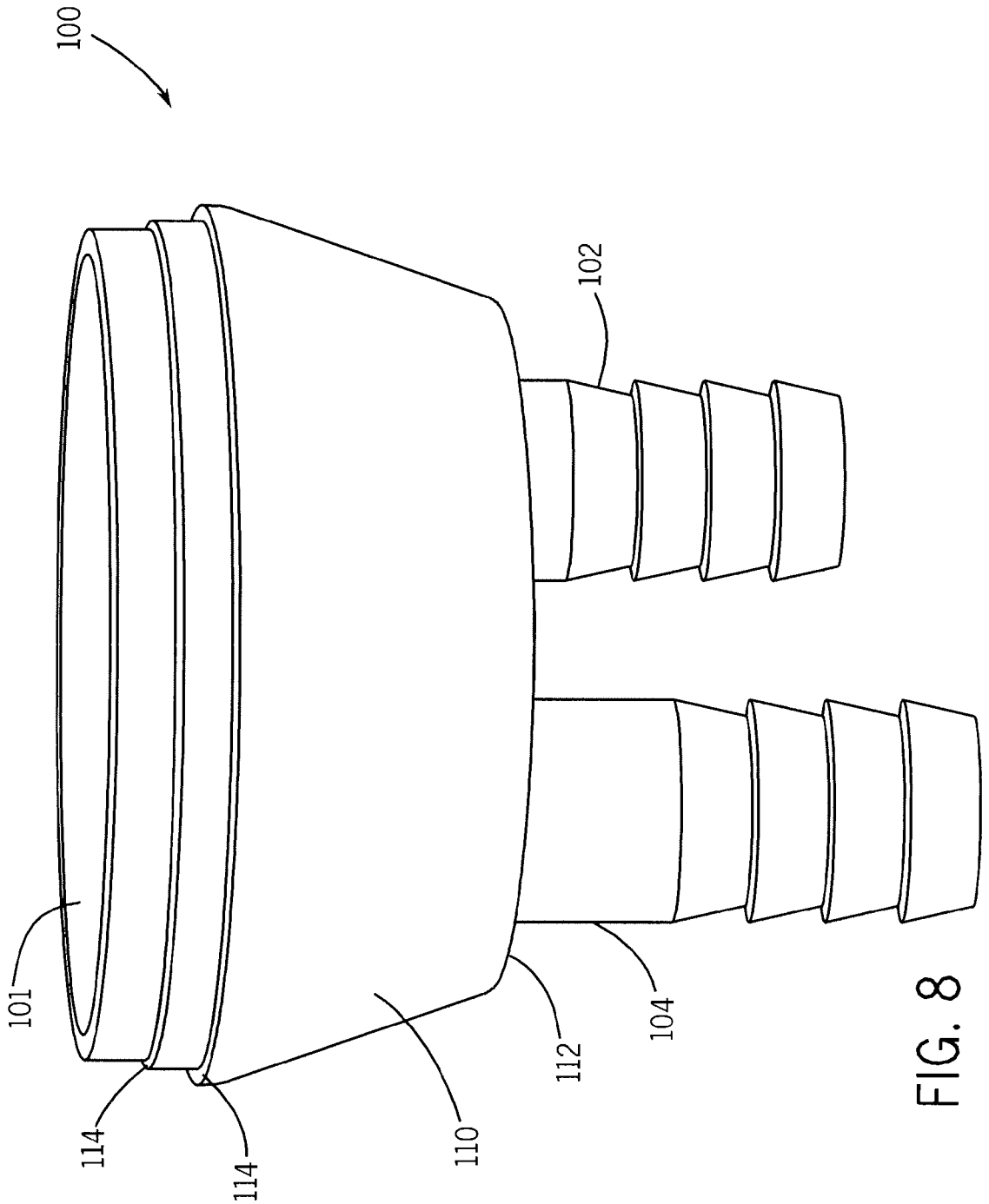


FIG. 8

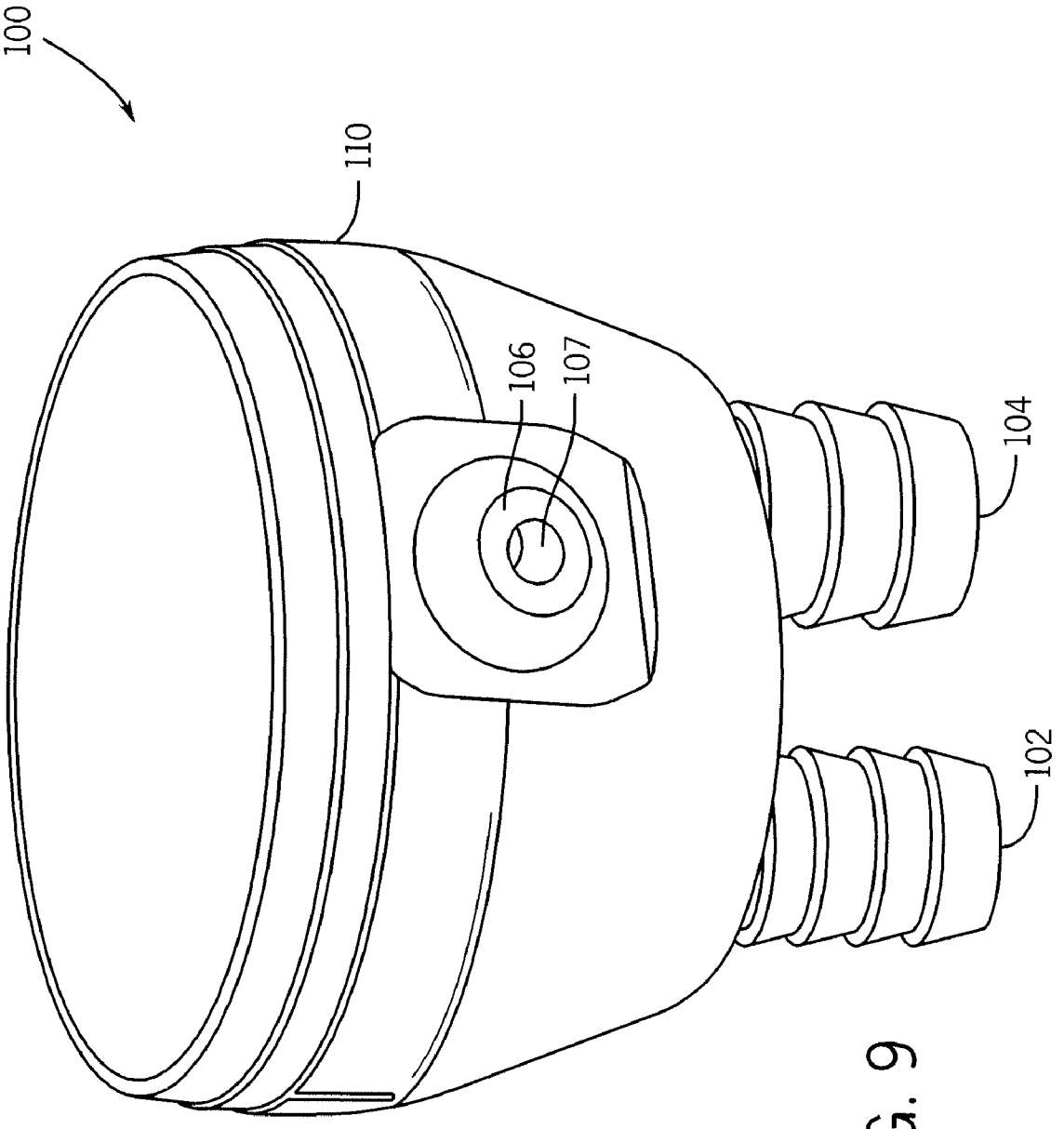


FIG. 9

MULTIPLE FEED DISCHARGE FLUSH SYSTEM

FIELD OF THE INVENTION

[0001] The field of the invention relates to pressurized flush systems. More particularly, the present invention relates to a pressurized a flush system having multiple fluid paths between the flush tank and the fixture.

BACKGROUND OF THE INVENTION

[0002] This section is intended to provide a background or context to the invention that is recited in the claims. The description herein may include concepts that could be pursued, but are not necessarily ones that have been previously conceived or pursued. Therefore, unless otherwise indicated herein, what is described in this section is not prior art to the description and claims in this application and is not admitted to be prior art by inclusion in this section.

[0003] Water conservation has extended into most aspects of building planning and operation. This includes restroom fixtures such as urinals and water closets. Among the specific types of water closets, some utilize a pressurized flush tank to provide additional water pressure during a flush cycle beyond that provided by typical "gravity"-type flush systems. It has been recognized that traditional restroom fixtures were designed with a volume of flush water to handle a maximum design load. Yet typical usage does not approach this maximum amount, and waste can be cleared using a lesser volume of flush water. It is generally recognized that a pressurized flush provides benefits in the distance the volume "carries" in the drain pipe, as well as in allowing for a reduced flush water volume to clear any debris in the water closet.

[0004] Both conventional gravity-type flush systems as well as pressurized systems typically divide the total volume of flush water between a wash portion and a flush portion within the fixture. Water is directed from the tank (standard or pressurized) during a flush cycle through a single inlet and channeled to via distinct flow paths, typically raceways formed in the fixtures, to respective outlets. Water directed toward the wash portion typically enters the fixture near the top of bowl and may be distributed about the periphery of the bowl. The flush portion typically enters the fixture near the outlet, at or near the bottom of the fixture. Each of the portions generally encounters one or more restrictions, for example, bends of 90 degrees, in travelling through their respective flow paths. Such flow path configurations cause head loss, decreasing the velocity of flush flow and effectiveness of the flush system. Moreover, division of the total flush volume between the wash portion of flush volume is typically not optimized within the fixture.

[0005] Thus, mitigating restrictions in the flow path enhances flow of the flush water in the fixture and overall effectiveness of a flush cycle. Substantially optimized division of the total flush volume between the wash portion and the flush portion further enhances overall performance of the fixture. Enhancement of fluid flow characteristics and division may be particularly effective in pressurized tank systems and reduced flow systems where the total flush volume is often reduced from typical fixtures.

SUMMARY OF THE INVENTION

[0006] Various embodiments of the present invention provide a multi-path pressurized flush system. A discharge feed fluidly connected to a flush tank includes an inlet and a first outlet, and a second outlet. The flush volume is received via the inlet and is divided between a wash portion directed to the first outlet and a flush portion directed to the second outlet. The first outlet is fluidly connected to a plurality of wash outlets generally disposed proximate the top of a bowl of the fixture. The second outlet is fluidly connected to a flush outlet generally disposed proximate the bottom of the bowl. The volume of fluid directed to the wash portion and the flush portion may be controlled by selecting the area of the first outlet and the area of second outlet, respectively. Selective adjustment of the area of the first outlet and/or second the second outlet permits flow optimization for a particular fixture or installation. The present invention mitigates head loss of the flush volume by reducing unnecessary restrictions in the flow path, thereby mitigating energy loss of the flush volume upon arrival to the bowl. Consequently, the invention may be used with a low flush volume, for example, about 4 liters, and an ultra-low flush volume, for example, about 2 liters.

[0007] One embodiment of the invention relates to a pressurized flush system. The pressurized flush system comprises a pressurizable flush tank having an inlet, an outlet, and a flush mechanism having a flush valve. The flush tank is disposed on a fixture and the fixture includes a bowl having a generally central jet flush opening and a plurality of wash jets positioned around an annulus of the bowl. A discharge feed is positioned in communication with the flush tank and the fixture and has a first opening and a second opening, the sum of the area of the first opening and the second opening being less than the area of the outlet. A first fluid flow path is defined by the first opening and a first tube and directs water from the flush tank to the flush jet. A second fluid flow path defined by the second opening and a second tube directs water from the flush tank to the wash jets.

[0008] Prior art fixtures, such as FIG. **2**, typically include an interior manifold into which the water from the tank empties prior to being diverted towards the wash openings and the flush opening. Prior art fixtures typically utilize molded-in pathways, such that the water from the flush tank experiences several energy dissipating restrictions resulting in head loss, for example, the water typically empties into the fixture manifold with a downward flow but must change flow direction by 90 degrees to exit the fixture manifold and enter the respective pathways that flow substantially laterally through the fixture to the wash openings or flush opening. The fluid flow paths described above provide an alternative pathway that can eliminate the energy dissipating restrictions of the prior art designs. For example, the tubes extending from the discharge feed can extend through the manifold into the fixture's molded-in pathways, thus by-passing the manifold and its attendant **90** degree turn in the direction of flow.

[0009] In another embodiment, a pressurizable flush tank comprises a tank housing having a lower portion and an upper portion, the lower portion including an outlet. The tank housing includes an inlet in communication with a water supply line and an air and water inducer configured to pressurize the tank housing. A flush mechanism is disposed within the tank housing and in communication with a flush actuator positioned at least partially outside the tank housing. The flush mechanism further includes a flush valve controllably sealing the outlet. A discharge feed is attached to the outlet such that water exiting the outlet passes through the discharge feed, the discharge feed having a first opening and a second opening.

The sum of the area of the first opening and the second opening is less than the area of the outlet. Water from within the tank housing flows through the outlet and through one of either the first opening or the second opening in a flush cycle.

[0010] These and other advantages and features of the invention, together with the organization and manner of operation thereof, will become apparent from the following detailed description when taken in conjunction with the accompanying drawings, wherein like elements have like numerals throughout the several drawings described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is an illustration of a prior art pressure flush vessel;

[0012] FIG. **2** is a cross section of a prior art toilet fixture;

[0013] FIG. **3** is a side view of a pressurized flush system and water closet with a discharge feed;

[0014] FIG. **4** is an exploded view of a pressure flush tank with a discharge feed;

[0015] FIG. **5** is a perspective view of an embodiment of the discharge feed;

[0016] FIG. **6** is a perspective view of another embodiment of the discharge feed;

[0017] FIG. **7** is a perspective view of yet another embodiment of the discharge feed;

[0018] FIG. **8** is a perspective view of still another embodiment of the discharge feed; and

[0019] FIG. **9** is a perspective view of an embodiment of the discharge feed including a vacuum break valve.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] One type of pressurized system utilizes a tank that is pressurized by the water feed line pressure itself. FIG. **1** illustrates a typical prior art system, such as described in U.S. Pat. No. 4,233,698 ("the '698 patent"), incorporated herein by reference. The general system of FIG. **1** includes a tank **10**, which may comprise an upper portion **10**A and a lower portion **10**B for ease of assembly, and the tank **10** receives water from a water supply line **18**. Positioned between the water supply line **18** and the tank **10**, is an air and water inducer **20**. As described in the '698 patent, as water fed from the water supply line **18** passes through the air and water inducer **20**, air is drawn into the tank **10** via a venturi effect. Accordingly, the air and water will pressurize the tank **10** to roughly the same pressure as that of the water supply line **18**. The tank **10** fills to a predetermined level of water and air.

[0021] The system of FIG. **1** utilizes a flush valve **24** to release the contents of the tank **10** and activate a flush cycle. The '698 patent describes in detail one type of flush valve that may be utilized. Generally, the flush valve **24** includes a flush valve sleeve **30**. Within the flush valve sleeve **30** is disposed an inner column **32**; and a control chamber **31** is defined by a space within the top of the flush valve sleeve **30** and bounded on the bottom by the inner column **32**. The inner column **32** includes a plurality of flanges, in one preferred embodiment three flanges **34**, **35** and **36**. The flanges **34**, **35** and **36** are sized to have a minimal amount of clearance with the flush valve sleeve **30**. The amount of clearance is dictated, in part, by the desired flow pattern and volume as is understood in the art.

[0022] The pressure within the flush valve sleeve **30** and above the inner column **32** holds the inner column **32** against the action of a bias, such as a spring **33**, so that the flush valve flange **34** is sealed against the flush valve seat **36**. The flush valve **24** is actuated via a flush valve actuator **25**. The flush valve actuator **25** engages the flush valve and initiates a flush cycle.

[0023] When a flush cycle has been initiated, the system discharges water from the tank **10** through the flush valve **24** to a water outlet line **16**, which may be a flange, which is in communication with the bowl **40**. The flush valve **24** is positioned, in the embodiment of FIG. **1**, substantially in the center of the tank **10**.

[0024] FIG. **2** illustrates a cross-sectional view of a typical toilet fixture **39**. Water is directed from the tank (standard or pressurized) during a flush cycle through a single inlet **51** into a manifold **52** that causes the water to abruptly change direction, resulting in a loss of water velocity. The water is then channeled to distinct flow paths **52**/**53**, typically raceways formed in the fixtures, to respective outlets for flushing and washing.

[0025] The present invention is directed to a pressurized flush system shown in FIGS. **3** and **4** having a discharge feed **100** fluidly connected to the tank **10**. The discharge feed **100** includes multiple fluid flow paths **122**/**124**, whereby the discharge feed **100** directs a first portion of the water within tank **10** to a first outlet **102** and a second portion of the water to a second outlet **104**. The first outlet **102** may be fluidly connected to the bowl **40** to deliver water from the tank **10** a first portion **42** of the bowl. The second outlet **104** may be fluidly connected to the bowl **40** to deliver water from the tank **10** to a second **44** portion of the bowl **40**. In an embodiment, the first portion **42** of the bowl **40** may comprise a plurality of openings **43** disposed about the interior periphery of upper portion of the bowl **40**, to wash the bowl **40** such that the first portion of water is a wash portion. The second portion **44** of the bowl **40** may comprise a flush jet **45** disposed proximate the bottom of the bowl **40**. To achieve the primary flush such that the second portion of water is a flush portion.

[0026] With reference to FIGS. **3**-**9**, various preferred embodiments of the discharge feed **100** of the present invention are depicted. The discharge feed **100** generally comprises an inlet **101**, a plurality of outlets **102**/**104**, a housing **110**, and an interface **114**. The inlet **101** is typically disposed near the top of the discharge feed **100**. In the depicted embodiments, a top portion **111** of the housing **110** is substantially open comprising the inlet **101**. The inlet **101** is fluidly coupled to the water outlet line **16** (shown in FIG. **1**) and receives the water and/or air from the tank **10** during a flush cycle. The inlet **101** may have a circular cross-section but other embodiments may have an elliptical or other cross-section. The area of the inlet **101** is configured to accept the contents of the tank **10**.

[0027] The housing **110** generally comprises a hollow shell manifold with openings for the inlet **101** and the plurality of outlets **102**/**104**. The inlet **101** maybe disposed proximate the top **111** of the housing **110**. One or more of the plurality of outlets **102**/**104** may be deposed near a bottom **112** of the housing **110**. The contents of tank **10** enter the housing **110** and are directed to the plurality of outlets **102**/**104**. The housing **110** may comprise a cylindrical shape or other geometry. In the depicted embodiments, where one or more of the plurality of outlets **102**/**104** is disposed near the bottom **112**, the housing **110** has a tapered cylindrical or frusta configuration. This configuration transitions the fluid path from the area of the inlet **101** to the area of the one or more of the plurality of

outlets **102/104** disposed on the bottom **112**, thereby mitigating head loss within the housing **110**. However, one or more of the plurality of outlets **102/104** may be disposed along the lateral surface of the housing **110**. The housing **110** may be constructed from a variety of materials including various plastics appropriate for use in plumbing, as known in the art.

[0028] One or more outlet may be used for purposes other then providing a fluid flow path. For example, FIG. **6**, depicts the discharge feed **100** having three outlets where the second outlet **104** and a third outlet **106** are disposed on the lateral surface of the housing **110**. The third outlet **106** is provided to serve as a vent, preferably closing upon the occurrence of a flush and then opening to provide a "vacuum break" to prevent suction from forming following the flush. FIG. **9** is a perspective view of an embodiment of the discharge feed **100** including a vacuum break valve **126** as the vent (third outlet **106**). A vacuum break valve **126** may be included in the housing **110** of the discharge feed **100**. The vacuum break valve **126** provides a mechanism to relieve the back pressure that can be created with in the discharge feed **100**. Various types of valves maybe utilized to accomplish such, for example, but not limited to "duck bill" and "umbrella" type valves.

[0029] The housing **110** may also include one or more brackets **116** configured to operatively connect the discharge feed **100** to the tank **10**. A plurality of openings **117** may be included on the one or more brackets **116**. The plurality of openings **117** are adapted to receive connecting elements to secure the discharge feed **100** to the tank **10** and or the water outlet connection line **16**.

[0030] The discharge feed **100** may also include an interface **114** in communication with the housing **110**. The interface **114** is adapted to operatively connect to the water outlet line **16**. The interface **114** may be adapted to directly connect to the water outlet line **16** or may connect to an intervening pipe or tube operatively connected to the water outlet line **16**. The interface **114** may include threads, barbs, or other attachment features for operative connection to the water outlet line **16**. Alternatively, the interface **114** may employ a slip or interference fit with the water outlet line **16**. The operative connection may further be secured by a clamp, adhesive, or other feature. In an embodiment, the interface **114** is adapted to fit one or more of a standard water outlet line **16**.

[0031] The discharge feed **100** includes a plurality of outlets **102/104/106**, for example, the first outlet **102** and the second outlet **104**, from the housing **110**. Various embodiments, such as the embodiment depicted in FIG. **6**, may include one or more additional outlets, such as a third outlet **106**. Each of the plurality of outlets **102/104/106** generally comprise a hollow protuberance open to the interior of the housing **110** and extending outwardly from the housing **110**. Each of the plurality of outlets **102/104/106** include a corresponding opening **103/105/107** at the distal end of the protuberance. Each of the plurality of openings **103/105/107** is adapted for fluid connection to a flow path **122/124** [not shown] in fluid communication with the bowl **40**. The flow path may comprise, for example, a pipe, hose, tube, or a raceway. In addition, at least a portion of the respective pathways may be formed by internal passages in the fixture. One end of the flow path **122/124** is operatively connected to one or more of the outlets **102/104**. The other [not shown] end of the flow path may be fluidly connected to one or more openings or jets disposed on or proximate the bowl **40**. The respective flow paths **122/124** may be directed to various portions of the bowl **40**. In an embodiment, the first portion of the bowl **42** may be fluidly connected to the first outlet **102** via flow path **122** and the second portion of the bowl **44** may be fluidly connected to the second outlet **104** via flow path **124**.

[0032] In one embodiment, each of the plurality of outlets **102/104/106** is adapted for operative connection to a flow path. Each outlet may feed into a separate flow path. Generally, the plurality of outlets **102/104/106** comprise substantially circular geometry for operative connection to a conventional pipe, hose, tube, or connector. However, the configuration of the plurality of outlets **102/104/106** is not so limited. For example, FIG. **6** depicts an outlet **102***a* with a substantially rounded rectangular configuration. The plurality of outlets **102/104/106** may also comprise other configurations, such as elliptical or other. In yet another embodiment, as shown in FIG. **5**, one or more of the plurality of outlets **102/104** may include a bend portion. In various embodiments, such configurations may be particularly adapted to operatively connect to a raceway disposed in a fixture. The plurality of outlets **102/104/106** also may include a plurality of connection features **109** such as barbs or threads to facilitate securement to components forming the respective flow paths. Hose clamps and/or adhesive [not shown] may also be used to ensure securement of the respective flow paths to the plurality of outlets **102/104/106**.

[0033] As described, during a flush cycle, the flow paths **122/124** are in fluid communication with the discharge feed **100** and, in turn, the inlet **101**. Accordingly, the contents of the tank **10** received by the inlet **101** are distributed among the plurality of outlets **102/104/106**. The proportion of the contents of the tank **10** distributed to each of the plurality of outlets **102/104/106** substantially depends on the ratio of the areas of the corresponding plurality of openings **103/105/107**. For example, in one embodiment of a discharge feed **100** with dual outlets where the area of the first opening **103** is **50** percent of the area of the second opening **105**, about one-third of the contents will be directed to the first outlet **102** and about two-thirds of the contents will be directed to the second outlet **104**. Similarly, in the instance of the discharge feed **100** with three outlets and the area of the first opening **103** is 75 percent of the area of the second opening **105** and the area of a third opening **107** is 25 percent the area of the opening the second opening **105**, about three-eighths of the contents will be directed to the first outlet **102**, about one-eighth of the contents will be directed to the third outlet **106**, and about one-half of the contents will be directed to the second outlet **104**.

[0034] Accordingly, the distribution of the contents of the tank **10** can be customized such that a specific volume of water in the tank **10** can be delivered to various portions of the bowl **40** by selection of the areas of the plurality of openings **103/105/107**. In an embodiment, with first and second outlets **102/104**, the area of the first opening **103** is between about 25 percent and 100 percent of the area of the second opening **105**. In various embodiments, the sum of the areas of the plurality of the openings **103/105/107** is less than or equal to the area of the inlet **101**.

[0035] In an embodiment, the area of one or more of the plurality of openings **103/105/107** is selectable to customize the distribution of the flush volume between the wash and the flush jets **45** for a particular fixture or installation. In a particular embodiment, one or more of the plurality of outlets **102/104/106** comprises a substantially frusta shape, defined by a length and a cross-sectional area and having an opening extending over the length that decreases with decreasing

cross-sectional area as the cross-section of the outlet tapers with increasing distance from the housing **110**. The length of one or more of the plurality of outlets **102/104/106** may provided with a predetermined length to achieve a specified area of the outlet. Alternatively, the length of one or more of the plurality of outlets **102/104/106** may trimmed before or substantially at the time of installation to a predetermined length to achieve the desired area of the outlet.

[0036] In another embodiment, a restricting element (not shown) may be operatively coupled to and in fluid communication with one or more of the plurality of outlets **102/104/106**. The restricting element comprises an annular housing, which may include connecting elements such as threads, barbs, or other fitting. The area of the restricting element is substantially less than the area of the respective opening **103/105/107**. Accordingly, placement of the restricting element in the flow path alters the effective area ratios of the plurality of openings **103/105/107**. A plurality of restricting elements of varying annular area may be provided to achieve a customized flow distribution for a particular fixture or installation. In a particular embodiment, the restricting element comprises an adjustable valve of a type generally known in the art.

[0037] In particular embodiments the discharge feed **100** may be used in conjunction with a low flush volume, about **4** liters per flush cycle, pressurizable flush tank. In still other embodiments the discharge feed **100** may be used in conjunction with an ultra-low flush volume, less than about 2 liters per flush cycle, pressurizable flush tank. The configuration of the discharge feed **100** and capability for substantially direct fluid feed from the flush tank to the fixture outlets mitigates head loss, allowing for effective operation at low and ultra-low flush volumes. The foregoing description of embodiments of the present invention have been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the present invention to the precise form disclosed, and modifications and variations are possible in light of the above teachings or may be acquired from practice of the present invention. The embodiments were chosen and described to explain the principles of the present invention and its practical application to enable one skilled in the art to utilize the present invention in various embodiments and with various modifications as are suited to the particular use contemplated. The features of the embodiments described herein may be combined in all possible combinations of methods, apparatus, modules and systems.

What is claimed is:

1. A pressurized flush system, comprising:

a pressurizable flush tank having an inlet, an outlet line, and a flush mechanism having a flush valve;

the pressurizable flush tank disposed on a fixture, the fixture including a bowl having a generally central jet flush opening and a plurality of wash jets positioned around an annulus of the bowl;

a discharge feed positioned in fluid communication with the pressurizable flush tank and the fixture, the discharge feed having an inlet, a first outlet and a second outlet, the first outlet having a first opening and the second outlet having a second opening;

a first fluid flow path fluidly connecting the first opening and the plurality of wash jets; and

a second fluid flow path fluidly connecting the second opening and the central flush jet.

2. The pressurized flush system of claim **1**, wherein the area of the first opening is less than or substantially equal to the area of the second opening

3. The pressurized flush system of claim **2**, wherein the area of the first opening is between about 50 percent and 100 percent of the area of the second opening.

4. The pressurized flush system of claim **1**, wherein the sum of the area of the first opening and the second opening is less than the area of the inlet.

5. The pressurized flush system of claim **1**, further comprising a third outlet having a third opening, wherein a third fluid flow path fluidly connects the third opening and the bowl.

6. The pressurized flush system of claim **1**, wherein each of the first fluid flow path and the second fluid flow path comprise a component selected from the group consisting of pipe, tube, hose, or combinations thereof.

7. The pressurized flush system of claim **1**, wherein one or more of the first outlet and the second outlet comprise a substantially frusta shape defined by a length, and wherein one or more of the area of the first opening and the second opening is configurable by altering the length.

8. The pressurized flush system of claim **1**, further comprising a restricting element disposed in the first flow path or the second flow path.

9. The pressurized flush system of claim **8**, wherein the restricting element comprises a selectively adjustable valve.

10. The pressurized flush system of claim **1**, wherein the discharge feed includes a valve configured to create a vacuum break during a flush cycle.

11. The pressurized flush system of claim **1**, wherein one or more barbs are disposed on an outer surface of one or more of the first outlet and the second outlet.

12. A pressurizable flush tank comprising:

a tank housing having a lower portion and an upper portion, the lower portion including an outlet line;

the tank housing having a water inlet in communication with a water supply line and an air and water inducer configured to pressurize the tank housing;

a flush mechanism disposed within the tank housing and in communication with a flush actuator positioned at least partially outside the tank housing, the flush mechanism further includes a flush valve controllably sealing the outlet;

a discharge feed operatively connected to the outlet line such that water exiting the outlet line passes through the discharge feed, the discharge feed having a first opening and a second opening, the sum of the area of the first opening and the second opening being less than or equal to the area of the outlet line.

13. The pressurizable flush tank of claim **12**, wherein, during a flush cycle, water from within the tank housing flows through the outlet line and through one of either the first opening or the second opening.

14. The pressurizable flush tank of claim **13**, further comprising:

a fixture including a bowl having a generally central jet flush opening and a plurality of wash jets positioned around an annulus of the bowl;

a first fluid flow path fluidly connecting the first opening and the plurality of wash jets; and

a second fluid flow path fluidly connecting the second opening and the central flush jet.

15. The pressurizable flush tank of claim **14**, wherein one or more of the first fluid flow path and the second fluid flow path comprise a pipe, tube, hose, or combinations thereof.

16. The pressurizable flush tank of claim **12**, wherein the area of the first opening is between about 50 percent and 100 percent of the area of the second opening.

17. The pressurizable flush tank of claim **12**, wherein the tank housing is adapted for a reduced flush volume.

18. A method of distributing water in a pressurized flush system comprising providing a pressurizable flush tank having an inlet, an outlet line, and a flush mechanism having a flush valve;

providing a fixture including a bowl having a generally central jet flush opening and a plurality of wash jets positioned around an annulus of the bowl; and

providing a discharge feed in fluid communication with the pressurizable flush tank and the fixture, the discharge feed having an inlet, a first opening, and a second opening,

wherein the first opening is fluidly connectable to the plurality of wash jets via a first flow path, and wherein the second opening is fluidly connectable to the central jet flush via a second flow path defined by a pipe, tube, or hose.

19. The method of claim **18**, wherein the area of the first opening is greater than the area of the second opening.

20. The method of claim **18**, further comprising selectably establishing the area of the first opening or the area of the second opening.

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