

(12) **DEMANDE DE BREVET CANADIEN**
CANADIAN PATENT APPLICATION

(13) **A1**

(86) **Date de dépôt PCT/PCT Filing Date:** 2013/02/25
(87) **Date publication PCT/PCT Publication Date:** 2013/08/29
(85) **Entrée phase nationale/National Entry:** 2014/08/21
(86) **N° demande PCT/PCT Application No.:** US 2013/027704
(87) **N° publication PCT/PCT Publication No.:** 2013/126921
(30) **Priorité/Priority:** 2012/02/24 (US61/603,232)

(51) Cl.Int./Int.Cl. **E03D 11/08** (2006.01),
E03D 11/02 (2006.01)

(71) **Demandeur/Applicant:**
AS IP HOLDCO, LLC, US

(72) **Inventeurs/Inventors:**
GROVER, DAVID, US;
BUCHER, CHRISTOPHE, US;
GATARZ, GREGORY, US;
MCHALE, JAMES, US

(74) **Agent:** GOWLING LAFLEUR HENDERSON LLP

(54) Titre : TOILETTES SANS REBORD

(54) Title: RIMLESS TOILET

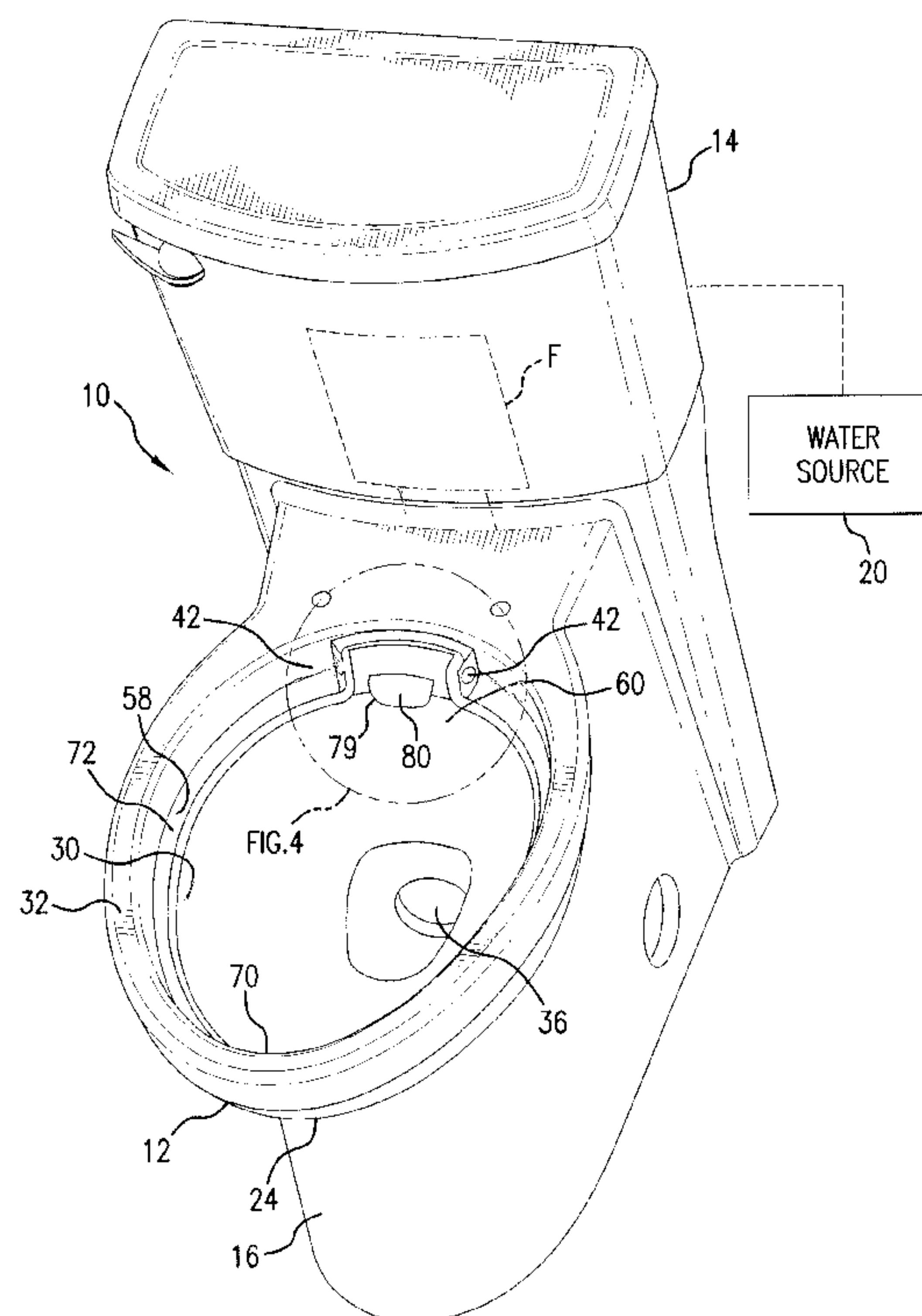


FIG. 1

(57) Abrégé/Abstract:

A siphonic gravity-powered toilet is provided that is a rimless toilet and includes a toilet bowl assembly having a body and an inlet for receiving fluid. The toilet bowl has an interior bowl surface with an upper peripheral portion configured to have a shelf formed

(57) Abrégé(suite)/Abstract(continued):

therein below an upper peripheral edge of the toilet bowl. The rimless toilet includes a jet having a jet inlet, an outlet and at least one jet channel. A manifold is included which is configured so that fluid entering an inlet of the toilet bowl assembly divides into a portion that enters the inlet of the direct-fed jet and a portion that enters an interior area of the toilet bowl. At least one toilet bowl inlet port is positioned at an upper rear portion of the toilet bowl. The at least one inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau(10) International Publication Number
WO 2013/126921 A2(43) International Publication Date
29 August 2013 (29.08.2013)(51) International Patent Classification:
E03D 11/08 (2006.01)

(21) International Application Number:

PCT/US2013/027704

(22) International Filing Date:

25 February 2013 (25.02.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/603,232 24 February 2012 (24.02.2012) US

(71) Applicant: **AS IP HOLDCO, LLC** [US/US]; One Centennial Avenue, Piscataway, NJ 08854 (US).(72) Inventors: **GROVER, David**; 97 Robin Drive, Hamilton, NJ 08619 (US). **BUCHER, Christophe**; 1568 Millstone River Road, Hillsborough, NJ 08844 (US). **GATARZ, Gregory**; 311 Milltown Road, East Brunswick, NJ 08616 (US). **McHALE, James**; 48 Riverview Terrace, Hillsborough, NJ 08844 (US).(74) Agents: **CALDERONE, Lynda, L.** et al.; Flaster/Greenberg PC, Four Penn Center, Suite 200, 1600 John F. Kennedy Boulevard, Philadelphia, PA 19003 (US).(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,

[Continued on next page]

(54) Title: RIMLESS TOILET

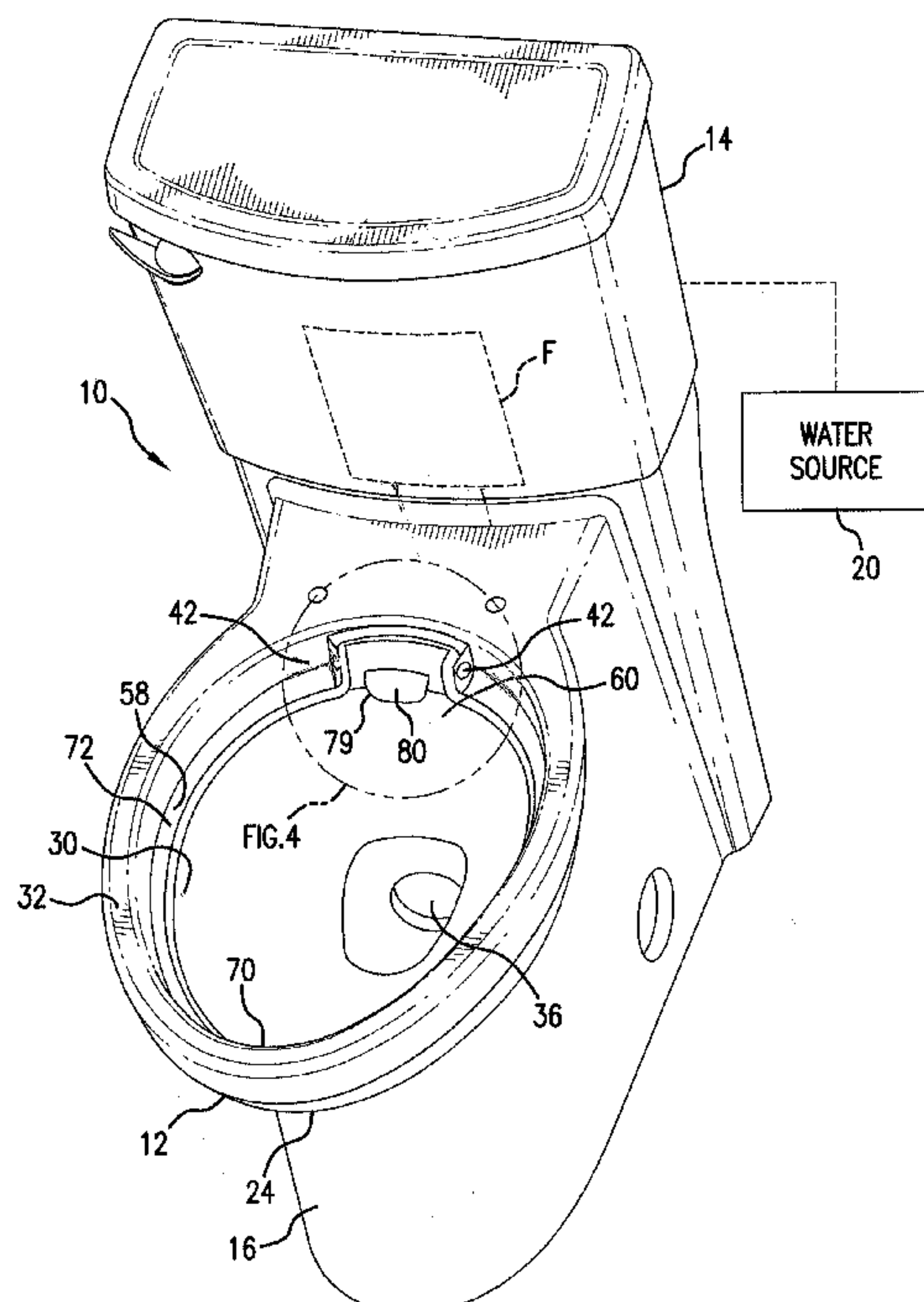


FIG. 1

(57) **Abstract:** A siphonic gravity-powered toilet is provided that is a rimless toilet and includes a toilet bowl assembly having a body and an inlet for receiving fluid. The toilet bowl has an interior bowl surface with an upper peripheral portion configured to have a shelf formed therein below an upper peripheral edge of the toilet bowl. The rimless toilet includes a jet having a jet inlet, an outlet and at least one jet channel. A manifold is included which is configured so that fluid entering an inlet of the toilet bowl assembly divides into a portion that enters the inlet of the direct-fed jet and a portion that enters an interior area of the toilet bowl. At least one toilet bowl inlet port is positioned at an upper rear portion of the toilet bowl. The at least one inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl.

WO 2013/126921 A2

- MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

— as to the applicant's entitlement to claim the priority of
the earlier application (Rule 4.17(iii))
- Declarations under Rule 4.17:**

— as to applicant's entitlement to apply for and be granted
a patent (Rule 4.17(ii))
- Published:**

— without international search report and to be republished
upon receipt of that report (Rule 48.2(g))

RIMLESS TOILET

[0001]

CROSS-REFERENCE TO RELATED APPLICATIONS

- 5 [0002] This application claims the benefit under 35 U.S.C. §119(e) of U.S. Provisional Patent Application No. 61/603,232, filed February 24, 2012, the entire disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

- 10 [0001] The present invention relates to the field of toilets for removal of human and other waste. The present invention further relates to the field of a toilet that operates for effective flushing without a rim.

DESCRIPTION OF RELATED ART

- [0003] Various toilets for removing waste products, such as human waste, are well known.
- 15 Most toilets are powered by gravity and generally have two primary sections: a tank and a bowl. The tank and bowl can be separate pieces which couple together to form the toilet system (commonly referred to as a two-piece toilet) or can be combined into one integral unit (typically referred to as a one-piece toilet).
- [0004] The tank, which is usually positioned over the back of the bowl, contains water that
- 20 is used for initiating flushing of waste from the bowl to the sewage line, as well as refilling the bowl with fresh water. Not all toilets have a tank, for example, those that are installed with an in-line flush mechanism as in many commercial buildings. When a user desires to flush the toilet, he activates a flush mechanism. Such flush mechanisms may be located within the wall behind a toilet having no tank, positioned above the back of a wall-mounted toilet or situated
- 25 within the tank. Upon activating a flush lever, for example, pushing down on a handle outside of a tank, the flush cycle begins. As a typical example, when such a flush lever is depressed, it

moves a chain or lever on the inside of the tank which acts to lift and open a flush valve, causing water to flow from the tank and into the bowl, initiating flushing of the toilet.

[0005] There are three general functions that most toilets are designed to accommodate in a particular flush cycle. The first is the removal of solid and other waste to the drain line. The
5 second is cleansing of the bowl to remove any solid or liquid waste which was deposited or adhered to the surfaces of the bowl, and the third function is exchanging the pre-flush water volume in the bowl so that relatively clean water remains in the bowl between uses.

[0006] To accomplish the three aforementioned functions, toilet bowl designs have adopted a general overall construction made up of a pan, trapway, and rim. The pan serves as a
10 reservoir for pre-flush water and collection of waste products. The trapway fluidly couples the pan to the drain line and blocks backflow of sewer gases. And the rim, which is generally formed as a hollow member capable of carrying flushwater, distributes water around the surface of the pan to provide cleansing.

[0007] Cleansing is sometimes an issue in toilets having this standard construction, as it is
15 difficult to get good cleaning action up under the rim, even if the toilet has a good flush design for washing the main pan of the bowl. The rim outlet ports are generally positioned on the underside of the rim and direct flow downward and outward towards the walls of the pan. No mechanism is generally provided to direct this water towards cleansing the rim itself. Dirt, human waste and germs can accumulate on or under the rim, where only manual cleaning
20 would serve to remove it. As the underside of the rim is not readily visible to someone cleaning the bowl, potentially harmful materials can remain under the rim for extended periods of time. Indeed, studies have shown that *Salmonella* bacteria can survive under the rim of a toilet bowl for up to four weeks, even with attempting cleaning. See, J. Barker et al., J. Appl. Microbiology 2000, 89, pp. 127-144.

[0008] A second and related issue presented by the standard pan-trapway-rim construction
25 of toilet bowls is its effective use as a urinal for standing males. The standard construction has the rim overhang the surface of the pan, which reduces the area available to accept a stream of urine. As a result, the rim of a toilet of the standard construction is more easily soiled by an errant stream. And as previously mentioned, no mechanism is generally provided for automatic
30 cleaning of the rim itself during a flush cycle. Manual cleaning is required in such circumstances.

[0009] A third issue presented by the standard pan-trapway-rim construction of toilet bowls is the associated complexity of manufacturing such geometries in vitreous china. The overhanging rim necessitates a more complex arrangement of molds for forming the toilet bowl geometry. The undercut section of the rim (i.e., the junction of the underside of the rim and the pan) cannot be formed from a single mold without locking the mold in place after casting. The desired geometry must be formed either by (1) casting the rim as a separate entity from the pan and sticking the two pieces together; or (2) utilizing a set of loose molds which can assemble and disassemble to form the toilet as a single entity, yet still remove the molds forming the undercut of the pan and rim.

[0010] Gravity-powered toilets can further be classified into two general categories: wash down and siphonic. Wash-down toilets allow the water level in the bowl to remain relatively constant at all times. When a flush cycle is initiated, water flows from the tank and spills into the bowl. This causes a rapid rise in water level and the excess water spills over the weir of the trapway, carrying liquid and solid waste along with it. At the conclusion of the flush cycle, the water level in the bowl naturally returns to the equilibrium level determined by the height of the weir.

[0011] In a siphonic toilet, the trapway and other hydraulic channels are designed such that a siphon is initiated in the trapway upon addition of water to the bowl. The siphon tube itself is an upside down U-shaped tube that draws water from the toilet bowl to the wastewater line.

When the flush cycle is initiated, water flows into the bowl and spills over the weir in the trapway faster than it can exit the outlet to the sewer line. Sufficient air is eventually removed from the down leg of the trapway to initiate a siphon which in turn pulls the remaining water out of the bowl. The water level in the bowl when the siphon breaks is consequently well below the level of the weir, and a separate mechanism needs to be provided to refill the bowl of the toilet at the end of a siphonic flush cycle to reestablish the original water level and protective "seal" against back flow of sewer gas.

[0012] Siphonic and wash-down toilets have inherent advantages and disadvantages. Siphonic toilets, due to the requirement that most of the air be removed from the down leg of the trapway in order to initiate a siphon, tend to have smaller trapways which can result in clogging. Wash-down toilets can function with large trapways but generally require a smaller amount of pre-flush water in the bowl to achieve the 100:1 dilution level required by plumbing

codes in most countries (*i.e.*, 99% of the pre-flush water volume in the bowl must be removed from the bowl and replaced with fresh water during the flush cycle). This small pre-flush volume manifests itself as a small "water spot." The water spot, or surface area of the pre-flush water in the bowl, plays an important role in maintaining the cleanliness of a toilet. A large
5 water spot increases the probability that waste matter will contact water before contacting the ceramic surface of the toilet. This reduces adhesion of waste matter to the ceramic surface making it easier for the toilet to clean itself via the flush cycle. Wash-down toilets with their small water spots therefore frequently require manual cleaning of the bowl after use.

[0013] Siphonic toilets have the advantage of being able to function with a greater pre-flush
10 water volume in the bowl and greater water spot. This is possible because the siphon action pulls the majority of the pre-flush water volume from the bowl at the end of the flush cycle. As the tank refills, a portion of the refill water is directed into the bowl to return the pre-flush water volume to its original level. In this manner, the 100:1 dilution level required by many plumbing codes is achieved even though the starting volume of water in the bowl is
15 significantly higher relative to the flush water exited from the tank. In the North American markets, siphonic toilets have gained widespread acceptance and are now viewed as the standard, accepted form of toilet. In European markets, wash-down toilets are still more accepted and popular, whereas both versions are common in the Asian markets.

[0014] Gravity-powered siphonic toilets can be even further classified into three general
20 categories depending on the design of the hydraulic channels used to achieve the flushing action. These categories are: non-jetted, rim jetted, and direct jetted.

[0015] In non-jetted bowls, all of the flush water exits the tank into a bowl inlet area and flows through a primary manifold into a rim channel in a standard rim. The water generally exits through a series of holes in the lower portion of the rim as noted above. A relatively high
25 flow rate is needed to spill water over the weir of the trapway rapidly enough to displace sufficient air in the down leg and initiate a siphon. Non-jetted bowls typically have adequate to good performance with respect to cleansing of the pan, but there is generally no mechanism provided to clean the surfaces of the rim itself. Bulk removal is relatively poor, as the feed of water to the trapway is inefficient and turbulent, which makes it more difficult to sufficiently
30 fill the down leg of the trapway and initiate a strong siphon. Consequently, the trapway of a non-jetted toilet is typically smaller in diameter and contains bends and constrictions designed

to impede flow of water. Without the smaller size, bends, and constrictions, a strong siphon would not be achieved. Unfortunately, the smaller size, bends, and constrictions result in poor performance in terms of bulk waste removal and frequent clogging, conditions that are extremely dissatisfying to end users. Such clogging can also lead to issues with cleanliness when waste has an opportunity to sit in the bowl or block in the trapway before flushing easily or clearing a clog.

[0016] Designers and engineers of toilets have improved the bulk waste removal of siphonic toilets by incorporating "siphon jets." In a rim-jetted toilet bowl, the flush water exits the tank, flows through the manifold inlet area and through the primary manifold into a hollow rim channel as noted above. Water is also generally dispersed around the perimeter of the bowl via a series of holes positioned underneath the rim. The remaining portion of water flows through a jet channel positioned at the front of the rim. This jet channel connects the rim channel to a jet opening positioned in the sump of the bowl. The jet opening is sized and positioned to send a powerful stream of water directly at the opening of the trapway. When water flows through the jet opening, it serves to fill the trapway more efficiently and rapidly than can be achieved in a non-jetted bowl. This more energetic and rapid flow of water to the trapway enables toilets to be designed with larger trapway diameters and fewer bends and constrictions, which, in turn, improves the performance in bulk waste removal relative to non-jetted bowls. Although a smaller volume of water flows out of the rim of a rim jetted toilet, the bowl cleansing function is better as the water that flows through the rim channel is pressurized by the upstream flow of water from the tank. This allows the water to exit the rim holes with higher energy and do a more effective job of cleansing the bowl. Even with that, the presence of the rim design with the overhanging surface remains with a cleanliness and sanitation issue, requiring manual cleaning. But as above, there is generally no mechanism provided to clean the surfaces of the rim itself.

[0017] Although rim-jetted bowls are generally superior to non-jetted, the long pathway that the water must travel through the rim to the jet opening dissipates and wastes much of the available energy. Direct-jetted bowls improve on this concept and can deliver even greater performance in terms of bulk removal of waste. In a direct-jetted bowl, the flush water exits the tank and flows through the bowl inlet and through the primary manifold. At this point, the water divides into two portions. One portion flows through a rim inlet port to the hollow rim

channel (of similar design to that noted above) with the primary purpose of the rim channel to provide the desired bowl cleansing. A second portion flows through a jet inlet port to a "direct-jet channel" that connects the primary manifold to a jet opening in the sump of the toilet bowl. The direct jet channel can take different forms, sometimes being unidirectional around one side of the toilet, or being "dual fed," wherein symmetrical channels travel down both sides connecting the manifold to the jet opening. As with the rim jetted bowls, the jet opening is sized and positioned to send a powerful stream of water directly at the opening of the trapway. When water flows through the jet opening, it serves to fill the trapway more efficiently and rapidly than can be achieved in a non-jetted or rim jetted bowl. This more energetic and rapid flow of water to the trapway enables toilets to be designed with even larger trapway diameters and minimal bends and constrictions, which, in turn, improves the performance in bulk waste removal relative to non-jetted and rim jetted bowls. With such improvement, better flushing occurs, but rim cleanliness of the rim itself remains a problem.

[0018] Several inventions have been aimed at improving the performance of siphonic toilets through optimization of the direct jetted concept. For example, in U.S. Patent No. 5,918,325, performance of a siphonic toilet is improved by improving the shape of the trapway. In U.S. Patent No. 6,715,162, performance is improved by the use of a flush valve with a radius incorporated into the inlet and asymmetrical flow of the water into the bowl.

[0019] As noted above, direct jetted bowls provide better flushing, however, bowl cleansing ability can be improved. Due to the hydraulic design of direct jetted bowls, the water that enters the rim channel is not pressurized. Rather, it spills into the rim channel only after the jet channel is filled and pressurized. The result is that the water exiting the rim has very low energy and the bowl cleansing function of direct jet toilets is generally inferior to rim jetted and non-jetted. This area is particularly affected when flush volume is reduced.

[0020] That issue was addressed in U.S. Patent Publication No. 2010/0186158 A1 which describes a toilet that introduces a swirling effect as a result of splitting flow between a lower jet portion and a rim portion. In the rim flow, incoming water is split so as to flow evenly left and right into the rim, and a portion thereof is directed to various "slots" in the back of the rim portion that spout water tangentially into the bowl for improving cleaning and flush action.

[0021] U.S. Patent Publication No. 2009/0241250 A1 also proposes to resolve problems of the prior art by providing a pressurized rim and direct fed jet configuration that enables

enhanced washing and adequate siphon for use with low volume water meeting current environmental water-use standards. It does, however, not address issues of rim cleanliness.

[0022] International Publication No. WO 2009/030904 A1 teaches a toilet having no rim on the upper surface of the bowl with an overhang for introducing water through a series of holes.

5 Instead, all of the tank flush water enters into the bowl in a primary manifold and then passes into two opposing inlets at the rear portion of the top of the bowl. A shelf-like ridge or water guide is formed into the bowl on which water entering the bowl travels generally horizontally until it comes closer to the front of the bowl where it travels generally vertically towards the bottom of the bowl to create a flush plume. The edge or wave guide can tilt downwards on an
10 angle to have some portion of the flow spill off the guide in a vertical direction for some cleansing action.

[0023] British Patent No. GB 2 431 937 shows a modified rim which narrows towards the front of the bowl, which may minimize some of the cleaning issues, and water enters through the rear of the bowl through curved openings in the rim so as to enter the bowl in a circular or
15 curved manner. The bowl has an inner face to create a more circular flow on the interior of the bowl for cleansing.

[0024] While designs for gravity-powered flush toilets on the market today are becoming increasingly effective in pan cleaning, even as water use standards become more restrictive, particularly with introduction of a pressurized rim, the traditional rim design of the toilet bowl
20 (with holes at the bottom for introducing flush water for cleaning the bowl area) remains an issue in terms of a lower surface that is harder to clean and keep free of germs. Recently introduced rimless toilets offer an alternative in terms of avoiding the rim cleanliness issue, but to date rely on the swirling action feature or the act of pushing all the flush water along a guide while balancing vertical and horizontal flow along the guide path and at the front of the bowl
25 sufficiently to achieve enough flush action. Furthermore, generally prior art rimless toilet technologies, aimed at wash down flushing action, present the disadvantages of a small water spot and easy staining of the bowl.

[0025] There is a need in the art for a toilet which achieves the benefits of the more traditional gravity-powered toilets using rim wash capabilities to assist in bowl surface cleaning
30 while achieving excellent flushing capability but that can still deliver those properties without

the need for a traditional rim. It is more preferred that such a toilet also be able to deliver an adequate siphon in modern, low-water-consumption toilets.

BRIEF SUMMARY OF THE INVENTION

5 [0026] Described herein is a unique rimless toilet that is also a siphonic, gravity-powered toilet. The toilet includes a toilet bowl assembly that comprises a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from a source of fluid; a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge, wherein the interior bowl surface of the toilet bowl defines an interior area for receiving fluid
10 during flushing, the interior area is in fluid communication with the toilet bowl assembly inlet, and an upper peripheral portion of the interior bowl surface is configured to have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge; a toilet bowl assembly outlet for fluid communication with a sewage outlet; a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet
15 outlet in communication with the toilet bowl assembly outlet and at least one jet channel extending between the jet inlet and the jet outlet; a manifold having a manifold area therein, wherein the manifold is configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl; at least one toilet bowl inlet port positioned at an upper rear
20 portion of the toilet bowl, wherein the at least one inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl.

[0027] The toilet bowl assembly may be formed so as to have two toilet bowl inlet ports, each positioned so that fluid entering the interior area of the toilet bowl passes in opposing
25 directions along the shelf. In such an embodiment, an optional opening may also be provided between the two toilet bowl inlet ports to introduce a portion of fluid from the manifold and/or jet channel into the toilet bowl in a generally downward direction for cleaning a rear area of the interior surface of the toilet bowl approximately between the two toilet bowl inlet ports. The cover may be formed so as to direct the flow of water and optimize cleansing. If an optional
30 opening is used as noted above, the toilet also preferably includes a distributor positioned so as

to at least partially cover the opening between the two toilet bowl inlet ports. The distributor may be a cover situated to extend over the opening. The distributor may also be an assembly comprising a distributor guide, a fastener, a distributor lock, and optionally a cover.

[0028] In one embodiment herein, the shelf has a width measured transversely across an upper surface thereof, and the width of the shelf is largest at a rear portion of the shelf than at a front portion of the shelf. The width of the shelf may also decrease gradually from the rear portion of the shelf to the front portion of the shelf. The shelf may or may be formed so as to extend around the entire upper peripheral portion of the toilet bowl. Further, the jet inlet is preferably located in a lower portion of the manifold. The toilet assembly may also include a mechanism to enable operation of the toilet using at least two different flush volumes for dual flush capability if desired.

[0029] The jet channel(s) can have varied configurations. In one embodiment, the at least one jet channel may extend within the interior of the toilet bowl assembly body around the outside of the toilet bowl and the jet outlet, in this case may be positioned so that fluid from the jet channel enters into the bottom of the toilet bowl so as to merge with fluid that traveled at least partially along the shelf in the toilet bowl. Such a configuration may be formed so as to have two jet channels formed within the jet, each such channel extending within the interior of the toilet bowl assembly body around the outside of the toilet bowl and meeting at the jet outlet.

[0030] Alternatively, the at least one jet channel may extend from the jet inlet within the interior of the toilet bowl assembly body and pass around the outside of the toilet bowl, with the jet channel positioned so as to be at least partially within a space defined within the toilet bowl assembly body generally under the shelf of the toilet bowl. In this embodiment, the jet outlet is positioned so that fluid from the jet channel enters the bowl at a front area of the toilet bowl proximate the upper peripheral portion of the bowl so that fluid from the jet channel and entering the jet outlet travels generally downwardly along the interior bowl surface at the front of the bowl so as to merge with fluid that traveled at least partially along the shelf in the toilet bowl. In this embodiment, the jet may include two such jet channels, each channel extending within the interior of the toilet bowl assembly body around the outside of the toilet bowl and meeting at the jet outlet. Such a construction could have manufacturing advantages if produced in vitreous china in that the geometry of the mold forming the pedestal of the bowl can be simplified.

[0031] In one embodiment, a hollow channel may be formed in the upper peripheral portion of the toilet beneath the peripheral edge, having at least one hollow channel inlet in fluid communication with the manifold and at least one hollow channel outlet in communication with a second shelf positioned in alignment with at least one hollow channel outlet for receiving fluid exiting therefrom and positioned above the shelf aligned with the at least one inlet port. The second shelf preferably has a width measured transversely across the second shelf that decreases towards a front of the toilet bowl so that fluid flowing off of the second shelf may merge with fluid flowing on the shelf aligned with the at least one inlet port before the merged flow passes into the lower portion of the toilet bowl.

10 [0032] The invention also includes a rimless, siphonic, gravity-powered toilet having a toilet bowl assembly that comprises a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from a source of fluid; a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge, wherein the interior bowl surface of the toilet bowl defines an interior area for receiving fluid during flushing, the interior area is in fluid communication with the toilet bowl assembly inlet, and an upper peripheral portion of the interior bowl surface is configured to have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge; a toilet bowl assembly outlet for fluid communication with a sewage outlet; a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet outlet in communication with the toilet bowl assembly outlet and at least one jet channel extending between the jet inlet and the jet outlet, wherein the at least one jet channel extends within the interior of the toilet bowl assembly body around the outside of the toilet bowl and the jet outlet is positioned so that fluid from the jet channel enters into the toilet bowl so as to merge with fluid that traveled at least partially along the shelf in the toilet bowl; a manifold having a manifold area therein, wherein the manifold is configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl; two toilet bowl inlet ports positioned at an upper rear portion of the toilet bowl, wherein each inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that a portion of the fluid travels in opposing directions along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl.

[0033] In this embodiment, an optional opening may be provided between the two toilet bowl inlet ports to introduce a portion of fluid from the manifold and/or jet channel into the toilet bowl in a generally downward direction for cleaning a rear area of the interior surface of the toilet bowl approximately between the two toilet bowl inlet ports. In addition, if such an optional opening is used, a cover may be provided over the opening between the two toilet bowl inlet ports. The toilet bowl may also comprise a distributor if such opening is used positioned so as to at least partially cover the opening between the two toilet bowl inlet ports. The distributor may be or may include a cover situated to extend over the opening. The distributor may also be an assembly comprising a distributor guide, a fastener, a distributor lock, and optionally a cover.

[0034] The shelf may or may not be formed so that it extends around the entire upper peripheral portion of the toilet bowl. The jet inlet is preferably in a lower portion of the manifold. The jet outlet in one embodiment may be positioned so that fluid from the jet channel enters into the bottom of the toilet bowl. There may also be two jet channels formed within the jet, each channel extending within the interior of the toilet bowl assembly body around the outside of the toilet bowl and meeting at the jet outlet. Alternatively, the jet channel may be positioned so as to be at least partially within a space defined within the toilet bowl assembly body generally under the shelf of the toilet bowl and the jet outlet is positioned so that fluid from the jet channel enters the bowl at a front area of the toilet bowl proximate the upper peripheral portion of the bowl so that fluid from the jet channel and entering the jet outlet travels generally downwardly along the interior bowl surface at the front of the bowl.

[0035] In a further embodiment, the invention includes a rimless, siphonic, gravity-powered toilet comprising:(a) a toilet bowl assembly comprising a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from a source of fluid; a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge, wherein the interior bowl surface of the toilet bowl defines an interior area for receiving fluid during flushing, the interior area is in fluid communication with the toilet bowl assembly inlet, and an upper peripheral portion of the interior bowl surface is configured to have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge; a toilet bowl assembly outlet for fluid communication with a sewage outlet; a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet

outlet in communication with the toilet bowl assembly outlet and at least one jet channel extending between the jet inlet and the jet outlet; a manifold having a manifold area therein, wherein the manifold is configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl; at least one toilet bowl inlet port positioned at an upper rear portion of the toilet bowl, wherein the at least one inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl; and (b) a toilet seat configured to fit over the upper peripheral edge of the toilet, comprising a lower surface having a seat bumper for contacting the upper peripheral edge of the toilet bowl, wherein the bumper abuts the upper peripheral edge of the toilet bowl when the toilet seat is in a lowered position over the upper peripheral edge of the toilet bowl.

[0036] The invention further includes embodiments having either a unitarily formed or an externally provided splash guard feature for the rear of the toilet bowl where water enters the rimless toilet bowl.

[0037] In one embodiment the splash guard is part of an assembly having a toilet seat. In that embodiment, the invention includes a rimless, siphonic, gravity-powered toilet is provided comprising: (a) a toilet bowl assembly comprising a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from a source of fluid; a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge, wherein the interior bowl surface of the toilet bowl defines an interior area for receiving fluid during flushing, the interior area is in fluid communication with the toilet bowl assembly inlet, and an upper peripheral portion of the interior bowl surface is configured to have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge; a toilet bowl assembly outlet for fluid communication with a sewage outlet; a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet outlet in communication with the toilet bowl assembly outlet and at least one jet channel extending between the jet inlet and the jet outlet; a manifold having a manifold area therein, wherein the manifold is configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl; at least one toilet bowl inlet port positioned at an upper rear

portion of the toilet bowl, wherein the at least one inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl; (b) a toilet seat configured to fit over the upper peripheral edge of the toilet, comprising a lower surface having a seat bumper for contacting the upper peripheral edge of the toilet bowl, wherein the bumper abuts the upper peripheral edge of the toilet bowl when the toilet seat is in a lowered position over the upper peripheral edge of the toilet; and (c) a splash guard having an upper portion and a downwardly extending portion, an exterior surface and an interior surface, wherein the splash guard is configured to fit beneath the toilet seat and above the rear portion of the toilet bowl, to complement a shape of the rear portion of the toilet bowl and to have an outwardly extending end portion extending from the rear portion of the toilet bowl in a direction of flow at least partially along the upper peripheral edge of the bowl towards the front of the toilet so as to at least cover the at least one toilet inlet port and block upward splashing water.

[0038] The splash guard noted above in one embodiment forms a generally right angle in transverse cross section along the outwardly extending portions. The outwardly extending portion of the splash guard may terminate rearwardly of the bumper on the toilet seat. The splash guard may also have a rearwardly extending portion configured to extend backwards towards a hinge on the toilet seat. In other embodiments, where there are two toilet bowl inlet ports, there may be two outwardly extending end portions on the splash guard. Further, the toilet may also comprise an opening positioned between the two toilet bowl inlet ports to introduce a portion of fluid from the manifold and/or the jet channel into the toilet bowl in a generally downward direction for cleaning a rear area of the interior surface of the toilet bowl approximately between the two toilet bowl inlet ports and a distributor positioned so as to at least partially cover the opening between the two toilet bowl inlet ports. Such optional distributor and the opening would be positioned under the splash guard as well.

[0039] The invention also includes a toilet splash guard for a rimless toilet, comprising an upper portion and a downwardly extending portion, an exterior surface and an interior surface, wherein the splash guard is configured to fit beneath a toilet seat and above a rear portion of a rimless toilet bowl, to complement a shape of a rear portion of a rimless toilet bowl and to have an outwardly extending end portion extending from a rear portion of a rimless toilet bowl in a

direction of flow at least partially along an upper peripheral edge of a rimless toilet bowl towards a front of the rimless toilet bowl so as to block upward splashing water.

[0040] In another embodiment, a splash guard may be formed into the toilet bowl of a rimless, siphonic, gravity-powered toilet having a toilet bowl assembly as an integral feature.

5 In such an embodiment, the toilet comprises a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from a source of fluid; a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge along an upper surface thereof, wherein the interior bowl surface of the toilet bowl defines an interior area for receiving fluid during flushing, the interior area is in fluid communication with the toilet bowl
10 assembly inlet, and an upper peripheral portion of the interior bowl surface is configured to have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge; a toilet bowl assembly outlet for fluid communication with a sewage outlet; a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet outlet in communication with the toilet bowl assembly outlet
15 and at least one jet channel extending between the jet inlet and the jet outlet; a manifold having a manifold area therein, wherein the manifold is configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl; at least one toilet bowl inlet port positioned at an upper rear portion of the toilet bowl, wherein the at least one inlet port is
20 configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl; and wherein a portion of the upper surface of the toilet bowl is configured to extend downwardly so as to cover the at least one inlet port and a rear portion of the shelf so as to act as a splash guard for water entering the shelf from the at least one inlet
25 port.

[0041] In further embodiments of the above-noted toilet with integral splash guard, the portion of the upper surface of the toilet bowl that acts as a splash guard may form a generally right angle in transverse cross section. The outwardly extending portion of the portion of the upper surface of the toilet bowl that acts as a splash guard may be configured so that it
30 terminates rearwardly of a position where a toilet seat would contact the upper peripheral edge of the toilet bowl. In an embodiment in which there are two toilet bowl inlet ports, there may be

two outwardly extending end portions on the upper portion of the toilet bowl that acts as a splash guard. The toilet may further comprise an opening positioned between the two toilet bowl inlet ports to introduce a portion of fluid from the manifold and/or the jet channel into the toilet bowl in a generally downward direction for cleaning a rear area of the interior surface of the toilet bowl approximately between the two toilet bowl inlet ports and a distributor positioned so as to at least partially cover the opening between the two toilet bowl inlet ports. Such features would be located under the splash guard.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

- 10 [0042] The foregoing summary, as well as the following detailed description of preferred embodiments of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings embodiments which are presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown. In the
- 15 drawings:
- [0043] Fig. 1 is a perspective view of a toilet bowl assembly according to an embodiment herein;
- [0044] Fig. 2 is a longitudinal side cross-sectional view of the toilet bowl assembly of Fig. 1;
- 20 [0045] Fig. 3 is a top plan view of the toilet bowl assembly of Fig. 1;
- [0046] Fig. 4 is a enlarged front elevational view of a portion of the rear of the toilet bowl in the toilet bowl assembly of Fig. 1;
- [0047] Fig. 5 is a perspective view of the jet channel of the toilet bowl assembly of Fig. 1;
- [0048] Fig. 5A is a perspective partial-sectional view of a toilet bowl assembly according to Fig. 1 showing its jet path;
- 25 [0049] Fig. 6 is a perspective partial-sectional view of a toilet bowl assembly according to another embodiment herein;
- [0050] Fig. 7 is a perspective partial-section view of the embodiment of a toilet bowl assembly according to Fig. 1 having a modified toilet seat according to a further embodiment of
- 30 the invention;

[0051] Fig. 8 is an enlarged view of a portion of the toilet assembly and seat of Fig. 7;

[0052] Fig. 9 is a top plan view of an toilet bowl assembly formed according to a further embodiment herein having an additional upper peripheral hollow channel;

5 [0053] Fig. 10 is a perspective view of the toilet of Fig. 1 with an exploded view of the distributor assembly;

[0054] Fig. 11 is an enlarged view of the distributor assembly of Fig. 10;

[0055] Fig. 12 is a rear elevational view of a distributor guide in the distributor assembly of Fig. 11;

[0056] Fig. 13 is a perspective rear view of the distributor guide of Fig. 12;

10 [0057] Fig. 14 is a angled partial cross-sectional rear view of the toilet of Fig. 1 showing a rear installed view of the distributor guide of Fig. 12;

[0058] Fig. 15 is a perspective schematic view of a mold and molded part illustrating a partially formed toilet according an embodiment herein;

15 [0059] Fig. 16 is a perspective view of a further embodiment of a toilet assembly herein having a splash guard therein;

[0060] Fig. 17 is a top plan view of the toilet assembly of Fig. 16;

[0061] Fig. 18 is a perspective partial cross-sectional view of the toilet assembly of Fig. 16;

[0062] Fig. 19 is a perspective view of a toilet assembly according to the embodiment of Fig. 1 with a toilet seat assembly installed thereon which includes a splash guard;

20 [0063] Fig. 20 is a top plan view of the toilet assembly with the toilet seat assembly of Fig. 19;

[0064] Fig. 21 is a perspective view of the toilet seat assembly of Fig. 19;

[0065] Fig. 22 is a bottom plan view of the toilet seat assembly of Fig. 21;

25 [0066] Fig. 23A is a perspective view of the splash guard of the toilet seat assembly of Fig. 21;

[0067] Fig. 23B is a top plan view of the splash guard of the toilet seat assembly of Fig. 21; and

[0068] Fig. 23C is a bottom plan view of splash guard of the toilet seat assembly of Fig. 21.

DETAILED DESCRIPTION OF THE INVENTION

[0069] The rimless toilet described herein is designed to be able to incorporate advantages achieved in flush efficiency from use of a jetted toilet flush system as well as the advantages of bowl cleanliness and an enlarged interior bowl pan or target area associated with the rimless design configuration. The toilet is able to provide strong flushing and cleaning capability without use of a rim channel wash function and without pressurization of rim water as in traditional prior art jetted toilet bowls.

[0070] The toilet is able to provide good flush capability consistent with today's 6.0 liters/flush (1.6 gallons/ flush toilets), and preferably with toilets utilizing 4.8 liters/flush (1.28 gallons/flush), while allowing for a clean bowl after flushing and without the deposition of dirt and germs that can occur in conventional toilets having an overhanging rim channel. The balance in achieving excellent bowl cleanliness in a jetted bowl typically requires rim channel assistance, especially with current water standards. Direct-fed jet bowls are known for their strong ability bulk waste removal capabilities, but have needed design improvements to assist their cleaning function and performance as government standards for flush water use have gotten stricter. Generally the design assistance needed to meet such standards has come from unique design features focusing on the traditional rim channel (such as rim pressurization and uniquely designed wash openings in the rim channel to alter water flow patterns). Government agencies have continually demanded that municipal water users reduce the amount of water they use. A primary focus is reduction of water demand required by flushing. The amount of water used in a toilet for each flush has gradually been reduced by governmental agencies from 7 gallons/flush (prior to the 1950's), to 5.5 gallons/flush (by the end of the 1960's), to 3.5 gallons/flush (in the 1980's). The National Energy Policy Act of 1995 now mandates that toilets sold in the United States can use water in an amount of only 1.6 gallons/flush (6 liters/flush). Regulations have recently been passed in the State of California which require water usage to be lowered ever further to 1.28 gallons/flush.

[0071] Many prior art 1.6 gallons/flush toilets lose the ability to consistently siphon when pushed to these lower levels of water consumption, and furthermore lose ability to effectively wash surfaces of the bowl. Designs have been introduced to improve performance at low water use, but generally these improvements focus on the traditional rim channel design and/or the trapway design. Use of a traditional rim channel with enhancements has become a more

important focus to maintaining and enhancing performance in siphonic, jetted toilets. Thus, such designs have not been able to take advantage of a cleaner rimless design as provided herein.

[0072] Referring now to Fig. 1, a rimless, siphonic, gravity-powered toilet according to one embodiment is shown. The toilet bowl, referred to generally as 10 is shown with a tank 14 and a toilet bowl assembly 12. It should be understood based on this disclosure that the unique features described herein are described with reference to the toilet bowl assembly 12, and a tank such as tank 14 is optional in the overall toilet design. Thus, a toilet having a separately attached toilet tank as shown is within the scope of the invention as is a one-piece (unitary) toilet design. The toilet may also be a wall-mounted flush system engaged with a plumbing system (not shown) to form a toilet according to the invention wherein water enters through a top-mounted flush valve or through a rear-facing inlet. Thus, any general type of toilet can be used in the invention provided it has a toilet bowl assembly as described herein. The nature and mechanisms through which fluid is introduced into the toilet bowl assembly inlet for flushing the toilet, whether from a tank as shown or some other mechanism, may be varied.

[0073] As will be explained in greater detail below, preferred embodiments of rimless toilets having a toilet bowl assembly according to the invention are capable of delivering exceptional bulk waste removal and bowl cleansing at flush water volumes while eliminating the issues of germs and difficult manual cleaning around a traditional overhanging rim, even in toilets having no greater than about 6.0 liters (1.6 gallons) per flush, preferably 4.8 liters per flush (1.28 gallons) and even as little as no greater than 3.8 liters (1.0 gallons) per flush. Furthermore, the preferred embodiments described below can achieve even higher and more consistent levels of performance in bulk removal, as the geometry of ports controlling flow to the bowl can be greatly simplified relative to the traditional, prior art pan-rim-trapway toilet construction. It should be understood by those skilled in the art based on this disclosure that by being capable of achieving these criteria at flush volumes of about 6.0 liters or less, that does not mean that the toilet as described herein does not function well at higher flush volumes and generally does achieve good flush capabilities at higher flush volumes as well.

[0074] As shown in Figs. 1 and 2, the toilet bowl assembly 12 includes a toilet bowl assembly body 16 that includes a toilet bowl assembly inlet 18 for receiving fluid from a source of fluid 20. The source of fluid may be any tank, pipe, or other mechanism for delivering water

to a toilet, including, but not limited to, use of a tank such as tank 14, direct pipe, or combination thereof. The toilet bowl assembly inlet 18 is in fluid communication with the source of fluid 20 as described above. Thus, flush water may enter from tank 14, a wall-mounted flusher, etc., each providing fluid such as water from a city or other fluid supply source, including through use of various flush valves as known in the art. If a tank is present as shown, it is typically coupled above the rear portion 21 of the toilet bowl assembly body over the toilet bowl assembly inlet 18.

[0075] Alternatively, a tank could be integral with the toilet bowl assembly body 16 of the toilet 10, provided it were located above the toilet bowl assembly inlet 18. Such a tank would contain water used for initiating siphoning from the toilet bowl 24 through the toilet bowl assembly outlet 38 into the sewage line, as well as a valve mechanism F for refilling the bowl with fresh water after the flush cycle. Any such valve or flush mechanism F is suitable for use with the present invention. The invention also is able to be used with various single, dual- or multi-flush mechanisms. It should be understood therefore by one skilled in the art based on this disclosure that any tank, flush mechanism, etc. in communication with a water source capable of actuating a flushing siphon and introducing water into the toilet bowl assembly inlet 18, including those mechanisms providing dual- and multi-flush which are known in the art or to be developed at a future date may be used with the toilet bowl assembly herein provided that such mechanism(s) can provide fluid to the bowl assembly and are in fluid communication with the inlet port of the rim channel and the inlet port of the direct-fed jet.

[0076] The toilet bowl assembly also includes a trapway 22, a toilet bowl 24, a jet 26 and a manifold 28. The toilet bowl assembly body 16 can be formed using standard chinaware manufacturing techniques and in a single mold or multiple mold pieces if desired. The chinaware mold(s) can be formed so as to provide exterior aesthetic designs and the like, provided that the interior of the toilet bowl assembly body is configured to have the features as described herein. The outer surface of the toilet bowl assembly body may be formed with the interior surface 30 of the toilet bowl 24 to have a continuous glaze exterior appearance which is aesthetically appealing and easy to clean.

[0077] The toilet bowl 24 in the assembly 12 is configured to have an interior bowl surface 30 which an upper peripheral edge 32 and does not have a traditional hollow rim channel. The interior bowl surface defines an interior area A of the toilet bowl that receives flush water from

a water source during flushing and the interior area A is also in fluid communication with the toilet bowl assembly inlet through which fluid from a fluid source flows into the toilet bowl assembly body. The shape of the interior surface 30 provided by formation through a mold in shaping the chinaware structure can vary from a standard oblong bowl shape, a more round bowl shape and a variety of designs, but it is preferred that the bowl have a lower portion 34 of its interior surface 30 which smoothly slopes towards the toilet bowl outlet 36 (the entrance to the trapway) so that flush water washes waste downwardly toward the toilet bowl outlet 36, through the trapway 22 upon a siphon flush and out the toilet bowl assembly outlet 38 which is generally designed to allow waste to flow towards a sewer or septic waste removal area.

10 [0078] The manifold 28 receives fluid through the toilet bowl assembly inlet 18 into a manifold area 40 and allows for fluid communication from the inlet of the toilet bowl assembly to the jet 26 and into inlet port(s) 42 as described further below. The toilet bowl assembly has a longitudinal axis L-L extending in a direction transverse to a plane P-P defined by the upper peripheral edge of the toilet bowl, and in one embodiment, the primary manifold preferably extends in a direction generally transverse to the longitudinal axis of the toilet bowl. Thus, the manifold is preferably configured in a traditional manner so as to extend in a direction generally transverse to the longitudinal axis L-L of the toilet bowl, wherein the longitudinal axis L-L extends in a direction transverse to a plane P-P defined by the upper peripheral edge 32 of the toilet bowl. The manifold may have other designs as desired for various jet configurations including a generally vertically extending manifold. It is also possible to utilize a control element, as described in co-pending U.S. Patent Application No.13/266,241, incorporated in relevant part herein by reference, for optimizing and controlling flow to the bowl and jet outlet port. Such a control element is particularly preferred in an embodiment where flush volume is below about 4.8 liters or the ratio of the trapway volume to total flush volume exceeds about 25 40%

[0079] The manifold is configured so that fluid entering the toilet bowl assembly inlet 18 divides into a first portion of fluid f_1 as shown by a flow arrow in Fig. 2 for entering the jet 26 through jet inlet 44 and a second portion f_2 designated by a flow arrow in Fig 2 for entering the interior area A of the toilet bowl 24 through one or more inlet ports 42. Preferably, fluid flows from the toilet bowl assembly inlet 18 through the manifold 28 into the manifold area 40 where

it is pressurized and then divides to flow into the jet 26 and inlet port(s) 42. The flow to f_2 should be about 10% to about 50% of the total flow, and more preferably about 20 % to about 40% of the total flow.

[0080] The jet inlet 44 is preferably positioned in a lower portion 43 of the manifold 28.

5 The jet inlet 44 is in fluid communication with the toilet bowl assembly inlet 18. The jet outlet 50 is in fluid communication with the toilet bowl outlet 36 and the toilet bowl assembly outlet 38. One or more jet channel(s) 46 connect the jet inlet 44 to the jet outlet 50. The fluid enters the jet through jet inlet 44 and flows through one or more jet channel(s) 46 having a hollow interior 48. The fluid flows out of the jet channel(s) 46 at a jet outlet 50 in the embodiment
10 shown at the bottom 52 of the toilet bowl 24. The at least one jet channel(s) as shown are designed to extend within the interior 54 of the toilet bowl assembly body 16 around the outside 56 of the toilet bowl 24. The jet outlet 50 is positioned so that fluid flow from the jet channel(s) 46 as shown in Fig. 5A with reference to flow f_5 enters into or near the bottom 52 of the toilet bowl 24 so as to merge with fluid that has entered the toilet bowl inlet ports 42 and
15 traveled along a shelf 58 formed in the toilet bowl interior surface as described further below as shown in Fig. 5A with reference to flow f_4 . In the embodiment shown, the jet channels can take a form similar to that described in U.S. Patent No. 6,715,162 or U.S. Patent Publication No. 2009/0241250 A1, each of which is incorporated herein by reference.

[0081] The water in the jet channel(s) 46 flows out of the jet outlet port 50 in the trapway
20 22 or sump and directs a strong, pressurized stream of water at the outlet 36 of the toilet bowl which is also the trapway opening. This strong pressurized stream of water is capable of rapidly initiating a siphon in the trapway 22 to evacuate the bowl and its contents to the sewer line in communication with toilet bowl assembly outlet 38.

[0082] Fig. 5 shows the jet path into the trapway isolated from the toilet bowl in a partly
25 exploded perspective view according to the embodiment shown in Figs. 1-3. The internal water channels of the jet toilet, which is a direct-fed jet example, includes passage first through the toilet bowl assembly inlet 18, then through the manifold 28, into the jet inlet 44, through two jet channels 46 as shown, wherein the jet divides after the jet inlet 44 into two channels 46 that can curve around the outside of the toilet bowl and merge together at the jet outlet, then passing out

the outlet of the toilet bowl 36 into the trapway 22, wherein the parts are shown partially disconnected to view the outlet passages and omitting the toilet bowl.

[0083] The toilet bowl inlet port(s) 46 may be present as one port facing in one direction or two such ports facing in opposite directions. In addition, multiple such ports may be formed, but preferably are positioned to push flow in opposite directions along the shelf 58. The inlet port(s) are preferably positioned at the upper rear portion 60 of the toilet bowl 24. A surface 62 that covers the front-most end 64 of the manifold 28 isolating the manifold area 40 from the interior area A of the toilet bowl 24 and can assist the function of pressurizing the fluid flow through the inlet port(s) 42. As best shown in Fig. 4, surface 62 may be set into the interior surface 30 of the toilet bowl 24 so as to form a recessed portion 66 where the shelf 58 can begin to extend away from the toilet bowl inlet port(s) 42 which can then be formed into a recessed surface 68 so as to face toward a side of the toilet bowl 24 and so that if two such ports 42 are used, flow would go in opposing directions away from the entry point from the upper rear portion 60 of the toilet bowl toward the front 70 of the toilet bowl.

[0084] With respect to the embodiment of Fig. 1, the toilet bowl port(s) 42 can be configured and sized to control flow. Preferably the inlet port(s) 42 are shaped in a round (generally circular), shape, but may also be of a variety of shapes, curved slits, oblong holes, elliptical holes, and the like. The port(s) should have a diameter (or longest cross-sectional dimension) of about 5 mm to about 25 mm, and preferably about 10 mm to about 20 mm for optimal flow pressure. They may be adjusted for various effects in different toilet configurations.

[0085] As noted above, the toilet bowl inlet port(s) 42 are positioned at an upper rear portion 60 of the toilet bowl 24. The inlet port(s) 42 are each configured to receive fluid from the manifold 28 into the interior area A of the toilet bowl 24 such that at least a portion of the fluid introduced as flow f_2 passes along the shelf 58 of the toilet bowl as flow f_4 as shown in Fig. 5A. The shelf 58 is formed in the interior surface 30 thereof before the flow passes into the lower portion or bottom 52 of the toilet bowl. In doing so, if one port is provided, a more concentrated flow could be introduced to travel either clockwise or counterclockwise along the shelf. When using two opposing ports 42 (of multiple opposing ports), flow can travel in both the clockwise and counterclockwise direction away from surface 68 with both streams flowing towards the front of the toilet bowl.

[0086] The interior surface 30 of the toilet bowl in an upper peripheral portion 71 thereof may be configured so as to form a shelf 58 therein along at least a part 73 of the upper peripheral portion of the interior surface 30 that is below the upper peripheral edge 32 of the toilet bowl. The shelf 58 is preferably positioned so as to be sufficiently beneath the upper peripheral edge 32 to prevent splashing upwards of flush fluid, but also in alignment beneath the outflow of fluid from the ports in recessed surface 68 to catch a majority of the fluid exiting the toilet bowl inlet port(s) 42 and direct the flow along the shelf. The shelf is preferably positioned about 10 mm to about 100 mm and more preferably about 20 mm to about 50 mm beneath the upper peripheral edge of the toilet bowl, but designs may also be varied depending on flush effects desired from the invention described herein. The shelf 50 is preferably also positioned about 0 mm to about 20 mm below the location of the lowermost toilet bowl inlet port(s) 42.

[0087] The shelf 58 may take a variety of structures, and may include longitudinally extending flow grooves or features to assist sustaining or directing flow along the shelf to a desired point. Further slightly raised and/or angled transversely extending features to force some flush water to drop off the shelf at various points can also or alternatively be formed along the path can also be used. Such optional features can be designed for various flow patterns, however, the shelf may also be simply a generally flat upper surface as shown. The upper surface 72 of the shelf may also optionally be angled along its path downwardly with respect to the transverse width in a manner described in International Publication WO 2009/030904 A1, incorporated herein by reference in relevant part with respect to the port and shelf configuration. Preferably the shelf is angled at about 1° to about 3° towards the center of the bowl, primarily to prevent the accumulation of standing water after a flush. The shelf may also be placed on a slight incline along its longitudinal flow path as it moves from the rear portion 74 of the shelf 58 towards the front portion 76 of the shelf if desired.

[0088] The shelf 58 has a width w (as measured transversely across the shelf). The width of the upper surface 72 of the shelf 58 may be constant or as shown can be largest towards a rear portion 74 of the shelf 58 in comparison with the front portion 76 of the shelf. The shelf 58 may also be configured such that the width w , decreases gradually as shown in Fig. 3 from a largest width w_1 towards the rear portion 74 of the shelf 58, decreasing through intermediate widths

such as width w_2 along the shelf and culminating in a small width w_3 near the front portion 76 of the shelf 58. In one embodiment herein the shelf 58 does not continue all the way around the upper peripheral portion 71 of the interior surface 30 of the toilet bowl 24. The shelf 58 may also be formed so as to continue all the way around the upper peripheral portion of the interior surface of the toilet bowl. However, as shown, it is preferred that a shelf 58 having a gradually decreasing width extend around the upper peripheral portion of the interior surface of the toilet bowl until at the area where flow meets at the front 70 of the toilet bowl the shelf 58 has a width w of only about 0 mm to about 10 mm and is sufficient small as to allow a large portion of the mating flow from opposite directions to fall downwardly towards the bottom 52 of the toilet bowl 24 so as to merge with flow from the jet entering the bowl through jet outlet 50.

[0089] Optionally, in an alternative embodiment as shown in Fig. 9, a toilet bowl assembly 212, wherein like elements have like reference numbers to the embodiment of Fig. 1, has an upper hollow channel 299 formed in the upper peripheral area 271 just below the upper peripheral edge 232. Additional fluid from the manifold under pressure can also enter an inlet 295 to the hollow channel 299 until it reaches a hollow channel outlet 297. Additional such outlets 297 may be formed along this path as shown in Fig. 9, wherein there are two hollow channel outlets 297 each at the 9 o'clock and 3 o'clock positions with respect to the view shown. As water exits the outlets, it continues on a further, second shelf 259 formed into the upper peripheral area 271 just below the hollow channel 299 and aligned with the outlet(s) 297. Preferably, as shown, the second shelf, 259 is positioned above the shelf 258 which receives flow from toilet bowl inlet ports 242 and has a decreasing width as it approaches the front 270 of the toilet bowl 224. Thus fluid flowing along the shelf having flow f_4 as noted above merges with flow f_6 shown in Fig. 9 as the two flows approach the front 270 of the toilet bowl 224 and then flow downward into the toilet bowl. Such hollow channels can be formed so as to flow within the existing rimless toilet structure and without the overhang associated with a traditional prior art rim channel. If desired, further such outlets like outlets 297 can be placed in fluid communication with the manifold by forming a hollow channel and placing outlet openings along its length and/or with multiple shelves if desired in the upper peripheral area 271 beneath the upper peripheral edge 232 of the toilet bowl 224 in the assembly 212.

[0090] With reference to the embodiment of Fig. 1, an optional opening 78 may be provided to the toilet 24 herein for providing additional cleansing specifically focused toward the rear area 60 where it lies within or, preferably beneath, the surface 62 approximately in the transverse center of the toilet bowl. If two inlet ports 42 are used the opening 78 is preferably approximately between the two inlet ports 42. The opening 78 if formed in the surface 62 receives additional pressurized water from the manifold. However, as shown, the opening positioned beneath the surface 62 may receive pressurized flow from either the manifold 28 or the jet channel 46 which is typically already traveling in a generally downwardly flow. The additional fluid entering opening 78 from the manifold or jet channel should be directed as to enter the toilet bowl in a generally downward direction for cleaning the rear area 60 of the interior surface 30 of the toilet bowl 24. This can be accomplished by inclusion of a distributor 79 positioned in or over the opening 78. The distributor 79 can be formed of a variety of suitable materials, including but not limited to polymeric, polymeric composite, or metallic materials, and is preferably situated on the surface 62 or opening 78 so as to direct fluid downwardly and outwardly to cleanse the area between bowl inlet ports 42.

[0091] The distributor 79 is preferably formed so that it can be removably or permanently attached to the toilet bowl. Alternatively, the distributor 79 can be formed as an integral part of the toilet bowl by, for example, placing a vertical wall of vitreous china about 2 mm to about 20 mm in front of the opening 78, such that fluid exiting the opening during the flush cycle impacts the wall and is directed downwardly and outwardly to cleanse the rear portion of the bowl. Such a construction can be achieved in vitreous china by sticking the distributor feature to the bowl when both are in their green state (i.e., before high temperature firing). This distributor feature, as explained above, ensures that even with opposing directions of flow along the shelf and a powerful jet action, a small area where flow is less likely to be complete along the surface is adequately cleansed.

[0092] In one embodiment, the distributor may be simply a cover 80 that bends flow downwardly into the toilet bowl. Alternatively, as shown in Figs. 10-14, the distributor may be an assembly of components including a cover 80 that in addition to being part of the distributor as an assembly, may be provided also to improve the aesthetics of the distributor feature. The cover, whether acting itself as a distributor or as a cover of a distributor assembly may have a variety of designs and be formed of various materials, including but not limited to composites,

color match materials, chinaware, stainless steel and the like. The cover should extend outwardly toward the interior area of the toilet bowl 24 sufficiently to provide clearance for flow and direct flow downwardly along the interior surface 30 of the toilet bowl 24.

Alternatively, the distributor and decorative cover can be a single entity.

5 [0093] In the assembly as shown in Fig. 10, the distributor assembly 79 includes the cover 80, an optional distributor guide 77, a distributor lock 81 and a distributor fastener 75. The fastener may be any of a variety of fasteners, including press-fit, snap-fit, interlocking pieces, or as shown herein, a screw 75. The distributor is shown in an exploded view in its intended location in Fig. 10 and in an enlarged expanded view in Fig. 11. As shown in Fig. 11, the cover
10 is configured so that it may fit over a preferred distributor guide. The guide is shaped also for this purpose with an upper portion 77e for deflecting flow downwards, and a front surface portion 77a that slopes gradually away from the rear of the toilet bowl when installed for mating with the cover and for allowing flow to pass downward and slightly outwardly along the distributor guide so as to fan out and contact the interior surface 30 of the toilet bowl 24. The
15 distributor guide 77 also incorporates a transversely extending hole 77c therethrough, as best shown in Fig. 12, for receiving the distributor screw 75. When using a preferred distributor assembly 79, the cover 80 is optional but can be used to hide the head of the screw for aesthetic purposes. Further, the cover 80 can be made to be removed, and the screw 75 also removed, by removing the distributor lock so as to clean the toilet near the hole 78.

20 [0094] The distributor lock acts like a nut and can be configured in a traditional nut or washer form, or as shown for ease of installation and removal, can have a peripheral shape that is designed with a gripping feature 81a in mind along its periphery 81b. The distributor lock also has an opening 81c passing therethrough in a transverse manner as shown for receiving the distributor screw 75.

25 [0095] As shown in Figs. 12 and 13, from the rear view, the distributor guide 77 may be made to have a feature 77d for directing flow. As shown, the area where the screw 75 passes through the distributor can be extended rearward, with optional threads on the interior of the hole 77c if desired. The rearward extending portion 77f can be used to provide a base of attachment for one or more features such as feature 77d for directing flow downward along and
30 behind the rear surface 77b so as to flow downwardly in a fanned out manner toward the interior surface 30 of the toilet bowl for cleaning the area 60 and below that area on the interior

surface 30. As shown feature 77d is simply a divider, however, grooves, channels, multiple dividers and the like may be provided to the rear surface 77b of the distributor guide 77 without departing from the spirit and scope of the invention.

[0096] When assembled and installed on the toilet as shown in Fig. 14 from the rear view, the distributor lock 81 tightens and fits over the screw 75 which passes through the distributor guide 77 and the distributor lock 81 so that the lock is tightened against the interior manifold surface 29 behind the surface 62 covering the manifold at the top of the opening 78 and the rear surface 77b of the distributor guide is tightened against the interior surface 30 of the toilet bowl 24 at the top of the opening 78. Thus the distributor guide is secure and the cover 80 can be placed over the distributor guide. Flow thus passes along flow f_3 shown in fig. 14 downwardly into the bowl.

[0097] Alternatively the cover 80 can be used over the hole 78 without the distributor guide, screw and lock and function both aesthetically and functionally as a distributor. In a preferred embodiment herein, the cover 80 is part of a distributor 79 that is an assembly as noted above.

[0098] In a further embodiment herein, a toilet may have an alternative toilet bowl assembly 112 as shown in Fig. 6. Such alternative assembly may be used in a toilet 100 which other than the toilet bowl assembly 112 is identical to that described above for toilet 10 and like numerals are used to refer to like parts throughout. Toilet bowl assembly 112 is further the same but for the jet design. In toilet bowl assembly 112, the jet inlet 144 is preferably still positioned in a lower portion 143 of the toilet bowl assembly manifold 128. The jet inlet 144 is in fluid communication with the toilet bowl assembly inlet 118. The jet outlet 150 is in fluid communication with the toilet bowl outlet 136 and the toilet bowl assembly outlet 138. One or more jet channel(s) 146 connect the jet inlet 144 to the jet outlet 150. The fluid enters the jet through jet inlet 144 and flows through one or more jet channel(s) 146 having a hollow interior 148. The fluid flows in the jet channel(s) along the upper portion of the bowl as shown through the jet channel(s) 146 and exits at a jet outlet 150 in the embodiment shown but does not pass downward towards the jet outlet 150 until it flow to the front 170 of the toilet bowl 124 proximate the upper peripheral portion 171 of the toilet bowl 124 along a flow f_7 as shown in Fig. 6.

[0099] The at least one jet channel(s) 146 as shown in Fig. 6 are designed to extend within the interior 154 of the toilet bowl assembly body 116 so as to pass around the outside 156 of the toilet bowl 124 but are positioned to be at least partially within a space 155 defined within the toilet bowl assembly body 116 generally under or beneath the inwardly extending shelf 158.

5 The jet outlet 150 is positioned so that fluid from the jet channel(s) 146 enters into the toilet bowl as noted above in the front area 170 anywhere from proximate the upper peripheral portion 171 to the area 152 near the bottom of the bowl and merges with fluid that entered the toilet bowl inlet ports 142 and traveled in flow f_4 along the shelf 158 formed in the toilet bowl interior surface 130. The flow f_4 merges and the combined fluid flows together generally
10 downwardly along the interior surface 130 on the front 170 of the toilet bowl into the bottom 152 of the toilet bowl 112 and merges with flow f_7 and then exits through the toilet bowl exit 136 in a pressurized stream into the trapway 122. The advantage of this construction is that the geometry of the underside of the sump (i.e., the top surface of the pedestal of the bowl) is greatly simplified by the removal of the more traditional direct fed jet channels under the bowl,
15 which could result in improved yields and lower costs when manufacturing the toilet from vitreous china.

[0100] The water from the jet channel(s) 146 flows out of the jet outlet port 150 in the trapway 122 or sump and directs that strong, pressurized stream of water from the outlet 136 of the toilet bowl to initiate a siphon in the trapway 122 to evacuate the bowl and its contents to
20 the sewer line in communication with toilet bowl assembly outlet 138.

[0101] If desired, at least one opening 169 may also be provided to allow some portion of the jet flow to exit at the front 170 of the bowl and travel downward with flow f_4 from the shelf to create a further cleansing capability, however, such opening(s) is/are optional only.

[0102] As can be appreciated by consideration of Figures 2 and 3, the geometry of the sump 35, interior bowl surface 30, and shelf 58 are formed so as to present only acute angles with
25 respect to any reference plane longitudinal to the toilet bowl. Such geometry provides significant advantages in manufacturing by casting methods. As shown in Fig. 15, as a single mold M can be inserted and extracted from the sump 35, interior bowl surface 30, and shelf 58 features without interfering with the cast part P. The presence of obtuse angles or significant or

obvious perpendicular overhanging features presented by standard prior art pan-trapway-rim constructions preclude the use of such simple mold geometry in casting.

[0103] As shown in Figs. 7 and 8, a lid 82 can be formed in one embodiment herein which creates a unique toilet bowl assembly for a rimless, gravity-powered, siphonic toilet. The lid is shown in conjunction with the toilet assembly embodiment of Fig. 1, however, it will be understood based on this disclosure that the lid can also be combined with the embodiment herein of Fig. 6. The lid 82 preferably has an upper lid portion 84 which may include a spacer support 86 for avoiding compression against a lower lid and for providing structural support against an applied load on the toilet seat such as by a user sitting on top of the lid 82. The toilet lid 82 also preferably has a lower lid 88. The lower lid is configured to work with the rimless toilets herein. The lower surface 89 of the lower lid 88 is preferably formed so as to have further structural support such as lower lid support 90, which may extend along some or all of the lower surface 89 of the lower lid. Such a support 90 as well as the spacer support 86, and the toilet lids if desired, may be formed of a variety of materials, coated wood, polymeric materials, or composite materials. A seat bumper 92 is preferably provided to the lower surface of the support (or may be directly provided to the lower surface of the lower lid without the support). The bumper may have a curved section 93 along the bottom thereof which is configured to contact the upper peripheral edge of the toilet bowl. The lid may have any of a variety of standard bowl attachment devices at a rear thereof, which are well known in the art, and may include future such attachment devices within the scope of this invention.

[0104] The lid as noted above works well with the rimless toilet designs of the embodiments herein, and provides structural support and stability to the lid in view of the narrower upper peripheral edge of the invention.

[0105] With reference to Figs. 19 to 23C, a further embodiment of a rimless, siphonic, gravity-powered toilet 300 is shown having a toilet seat 383. The toilet 310 in the embodiment may be any of those noted above, including a toilet bowl assembly 312 that has toilet bowl assembly body 316 with inlets, outlets and other features as described in other embodiments herein in detail. The toilet bowl 324 in the assembly body 316 has an interior bowl surface 330 with an upper peripheral edge 332. The interior area of the bowl 324 receives fluid and is in fluid communication with a toilet bowl assembly inlet which may be any of those described above. The upper peripheral portion 371 of the interior bowl surface 330 as shown in Fig. 19 is

configured to have a shelf 358 formed into the surface that extends along a part of the upper peripheral portion 371 of the surface below the upper peripheral edge 332.

[0106] The toilet bowl would also have the other features as noted above such as an outlet and connection to a drain in the manner of the other embodiments. The toilet bowl also includes a jet which may be any of the configurations noted above having an inlet into the jet in fluid communication with the toilet bowl assembly inlet and a jet outlet 350 as shown in communication with the toilet bowl assembly outlet 338. The jet should also have at least one jet channel extending between the jet inlet and the jet outlet, which may be any of the configurations noted above with respect to toilet embodiments 10, 100 and 200. Similarly a manifold is provided having a manifold area and configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl. The manifold may likewise resemble any of those noted above in the toilet bowls of embodiments 10, 100 and 200.

[0107] Also as noted in embodiments 10, 100 and 200, the toilet 300 also has at least one toilet bowl inlet port positioned at an upper rear portion 360 of the toilet bowl 324. The at least one, and preferably two, inlet ports should be configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf 358 of the toilet bowl in the same manner and as shown in embodiments 10, 100 and 200 prior to passing into a lower portion 334 of the toilet bowl 324. The toilet 300 also includes a toilet seat 383 configured to fit over the upper peripheral edge 332 of the toilet bowl 324 in the manner of the toilet seat as described, for example, with reference to Figs. 7 and 8, although it should be understood based on this disclosure that other toilet seat embodiments may be used. The preferred toilet seat 383 has a lid 382 with an upper lid cover 384 and a lower lid 388 having lower surface 389 having a seat bumper 392, and preferably two or more such bumpers, and as shown, four such bumpers. The bumpers 392 are configured to contact the upper peripheral edge 332 of the rimless toilet bowl so that the bumpers 392 abut the upper peripheral edge 332 when the toilet seat 383 is in a lowered position over the upper peripheral edge of the toilet.

[0108] As shown in Figs. 19-23C, a splash guard 398 is provided which has an upper portion 396 and a downwardly extending portion 394. The exterior surface 391 sits generally flat over the upper surface 340 in the manifold area and an interior surface 387 is configured to

seat over part of the upper rear portion 360 of the toilet bowl 324 and preferably over a rear portion 365 of the shelf 358. The splash guard 398 is shaped and configured so as to fit in the area beneath the toilet seat 383, specifically the lower lid 388 in a two-piece toilet seat and above the upper rear portion 360 of the toilet bowl extending partly over the surface 340 in the manifold area and complements the shape of the rear portion 360 of the toilet bowl 324. The splash guard 398 in the embodiment shown forms a generally right angle α in transverse cross section as best shown in Fig. 23A along the outwardly extending portions 385 described below. Preferably, for additional stability and to avoid water extending upwardly, the splash guard also has a rearwardly extending portion 369 configured to extend backwards towards a hinge 367 on the toilet seat.

[0109] The splash guard 398 is also configured to have one or more outwardly extending end portion(s) 385 extending from the rear portion 360 of the toilet bowl in a direction of flow D at least partially along the upper peripheral edge 332 of the bowl towards the front 370 of the toilet bowl 324 so as to at least cover the at least one toilet inlet port and block upward splashing water. Such port(s) in this embodiment are identical to those shown in embodiments 10, 100 and 200 and would be positioned on the back portion 360 of the bowl under the splash guard 398 of Fig. 19. Preferably, there are two toilet bowl inlet ports and two outwardly extending end portions on the splash guard.

[0110] The outwardly extending portion(s) 385 of the splash guard 398 preferably each terminate rearwardly of any bumpers 392 on the toilet seat 383, for example at a position E as shown. As the water may exit with some force at the rear of the bowl, the splash guard alleviates any upward splashing that may occur particularly if the seat 383 is not in the downward position.

[0111] As shown in embodiments 10, 100 and 200, the toilet 300 may also include the optional opening best shown in Fig. 10 as opening 78 positioned between two toilet bowl inlet ports, see, for example, Fig. 1, opening 42, to introduce a portion of fluid from the toilet manifold and/or jet channel(s) into the toilet bowl (also as shown in embodiments 10, 100 and 200) in a generally downward direction for cleaning a rear area 360 of the interior surface 330 of the toilet bowl approximately between the two toilet bowl inlet ports. An optional distributor as shown for examples in Figs. 1, 2 and 10-14 may also be included in the toilet 300, but is preferably situated as shown so that the splash guard 398 at least partially, and preferably

substantially completely or completely, covers the distributor. The distributor should be positioned as shown in figs. 1, 2 and 10-14 to at least partially cover the opening between the two toilet bowl inlet ports. The splash guard, like the toilet seat, may be removed for cleaning and replaced easily by the user.

5 [0112] In another embodiment of a rimless, siphonic, gravity-powered toilet herein, described as embodiment 400 and shown in Figs. 16-18, a toilet bowl assembly 412 is shown that includes a unitary splash guard 498. The splash guard 498 is similar to the splash guard 398 with the exception that it is not a separate and removable piece, but formed into the body of the toilet bowl while molding the toilet. Such a toilet bowl assembly body 416 and toilet bowl
10 424 may in all other respects be identical to the toilet bowls in embodiments 10, 100, 200 and 300, with the exception of the molded in splash guard 498, and thus, for the sake of convenience one skilled in the art based on this disclosure will understand that each of bowls and bowl assemblies, 12, 24, 112, 124, 212, 224 and 310, 324, respectively, have like parts throughout other than the additional splash guard 498.

15 [0113] As shown in Fig. 16, a portion 494 of the upper surface 440 of the toilet bowl in the manifold area is configured to extend downwardly so as to cover the at least one inlet port 442 and a rear portion 465 of the shelf 458 so as to act as a splash guard for water entering the shelf 458 from the at least one inlet port 442. Thus a portion 463 of the upper surface 440 of the toilet bowl in the manifold area acts as a splash guard. The portion 463 preferably bends to
20 form the downwardly extending portion 494 of the splash guard 498 and, as with the embodiment of the removable splash guard 398 described above, forms an angle α' that is generally a right angle in transverse cross section as best shown in Fig. 16. With respect to the removable and unitary splash guards, but "generally" a right angle, it is meant that some variation may be provided to the angles α , α' to accommodate different designs in the rear
25 portion of the toilet, for example but not limited to $\pm 15^\circ$, and/or may have a softer curve instead of a hard angle downward.

[0114] The splash guard 498 preferably also includes outwardly extending portion(s) 461 of the portion 463 of the upper surface 440 of the toilet bowl that acts as a splash guard, preferably with the downwardly extending portion 494, which portion(s) 461 is/are configured so that each
30 terminates rearwardly of a position E' where a toilet seat would contact the upper peripheral edge 432 of the toilet bowl 424. As noted above, two toilet bowl inlet ports 442 may be

provided, as well as an optional opening in the center of the two inlets and/or a distributor, which may be the same as central openings and the distributors noted above in embodiments 10, 100 and 200 and as best shown in Figs. 1, 2 and 10-14. If two inlets are provided, two outwardly extending end portions 461 are included in the splash guard 498. The distributor
5 should be positioned also as shown in Figs. 1, 2 and 10-14 to at least partially cover any central opening between two toilet bowl inlet ports 442.

[0115] It will be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiments disclosed,
10 but it is intended to cover modifications within the spirit and scope of the present invention as defined by the appended claims.

CLAIMS

We claim:

1. A rimless, siphonic, gravity-powered toilet having a toilet bowl assembly comprising
 - a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from
 - 5 a source of fluid;
 - a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge, wherein
 - the interior bowl surface of the toilet bowl defines an interior area for receiving fluid during flushing,
 - 10 the interior area is in fluid communication with the toilet bowl assembly inlet, and
 - an upper peripheral portion of the interior bowl surface is configured to have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge;
 - 15 a toilet bowl assembly outlet for fluid communication with a sewage outlet;
 - a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet outlet in communication with the toilet bowl assembly outlet and at least one jet channel extending between the jet inlet and the jet outlet;
 - a manifold having a manifold area therein, wherein the manifold is configured so
 - 20 that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl;
 - at least one toilet bowl inlet port positioned at an upper rear portion of the toilet bowl, wherein the at least one inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of
 - 25 the toilet bowl prior to passing into a lower portion of the toilet bowl.
2. The rimless, siphonic, gravity-powered toilet according to claim 1, wherein there are two toilet bowl inlet ports, each positioned so that fluid entering the interior area of the toilet bowl passes in opposing directions along the shelf.
3. The rimless, siphonic, gravity-powered toilet according to claim 2, wherein an opening
- 30 is provided between the two toilet bowl inlet ports to introduce a portion of fluid from the

manifold and/or the jet channel into the toilet bowl in a generally downward direction for cleaning a rear area of the interior surface of the toilet bowl approximately between the two toilet bowl inlet ports.

4. The rimless, siphonic, gravity-powered toilet according to claim 3, wherein the toilet
5 bowl further comprises a distributor positioned so as to at least partially cover the opening between the two toilet bowl inlet ports.

5. The rimless, siphonic, gravity-powered toilet according to claim 4, wherein the distributor comprises a cover situated to extend over the opening.

6. The rimless, siphonic, gravity-powered toilet according to claim 4, wherein the
10 distributor is an assembly comprising a distributor guide, a fastener, and a distributor lock.

7. The rimless, siphonic, gravity-powered toilet according to claim 6, wherein the assembly further comprises a cover.

8. The rimless, siphonic, gravity-powered toilet according to claim 1, wherein there are two toilet bowl body inlet ports, each positioned so that fluid entering the interior area of the
15 toilet bowl passes in opposing directions along the shelf, and further comprising an opening between the two toilet bowl body inlet ports to introduce a portion of fluid from the manifold and/or the jet channel into the toilet bowl in a generally downward direction for cleaning a rear area of the interior surface of the toilet bowl approximately between the two toilet bowl inlet ports.

20 9. The rimless, siphonic, gravity-powered toilet according to claim 8, further comprising a distributor positioned so as to at least partially cover the opening between the two toilet bowl inlet ports.

10. The rimless, siphonic, gravity-powered toilet according to claim 1, wherein the shelf has a width measured transversely across an upper surface thereof, and the width of the shelf is
25 largest at a rear portion of the shelf than at a front portion of the shelf.

11. The rimless, siphonic, gravity-powered toilet according to claim 10, wherein the width of the shelf decreases gradually from the rear portion of the shelf to the front portion of the shelf.

12. The rimless, siphonic, gravity-powered toilet according to claim 10, wherein the shelf
30 does not extend around the entire upper peripheral portion of the toilet bowl.

13. The rimless, siphonic, gravity-powered toilet according to claim 1, wherein the jet inlet is in a lower portion of the manifold

14. The rimless, siphonic, gravity-powered toilet according to claim 1, wherein the toilet assembly further comprises a mechanism that enables operation of the toilet using at least two
5 different flush volumes.

15. The rimless, siphonic, gravity-powered toilet according to claim 1, wherein toilet bowl assembly has a longitudinal axis extending in a direction transverse to a plane defined by the upper peripheral edge of the toilet bowl, and the primary manifold extends in a direction generally transverse to the longitudinal axis of the toilet bowl.

10 16. The rimless, siphonic, gravity-powered toilet according to claim 1, wherein the at least one jet channel extends within the interior of the toilet bowl assembly body around the outside of the toilet bowl and the jet outlet is positioned so that fluid from the jet channel enters into the bottom of the toilet bowl so as to merge with fluid that traveled at least partially along the shelf in the toilet bowl.

15 17. The rimless, siphonic, gravity-powered toilet according to claim 16, wherein there are two jet channels formed within the jet, each channel extending within the interior of the toilet bowl assembly body around the outside of the toilet bowl and meeting at the jet outlet.

18. The rimless, siphonic, gravity-powered toilet according to claim 1, wherein the at least one jet channel extends from the jet inlet within the interior of the toilet bowl assembly body
20 and passes around the outside of the toilet bowl, and wherein the jet channel is positioned so as to be at least partially within a space defined within the toilet bowl assembly body generally under the shelf of the toilet bowl and the jet outlet is positioned so that fluid from the jet channel enters the bowl at a front area of the toilet bowl proximate the upper peripheral portion of the bowl so that fluid from the jet channel and entering the jet outlet travels generally
25 downwardly along the interior bowl surface at the front of the bowl so as to merge with fluid that traveled at least partially along the shelf in the toilet bowl.

19. The rimless, siphonic, gravity powered toilet according to claim 18, wherein there are two jet channels formed within the jet, each channel extending within the interior of the toilet bowl assembly body around the outside of the toilet bowl and meeting at the jet outlet.

30 20. The rimless, siphonic, gravity powered toilet according to claim 1, wherein a hollow channel is formed in the upper peripheral portion of the toilet beneath the peripheral edge,

having at least one hollow channel inlet in fluid communication with the manifold and at least one hollow channel outlet in communication with a second shelf positioned in alignment with at least one hollow channel outlet for receiving fluid exiting therefrom and positioned above the shelf aligned with the at least one inlet port.

5 21. The rimless, siphonic, gravity powered toilet according to claim 20, wherein the second shelf has a width measured transversely across the second shelf that decreases towards a front of the toilet bowl and fluid flowing off of the second shelf merges with fluid flowing on the shelf aligned with the at least one inlet port before the merged flow passes into the lower portion of the toilet bowl.

10 22. A rimless, siphonic, gravity-powered toilet having a toilet bowl assembly comprising a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from a source of fluid;

a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge, wherein

15 the interior bowl surface of the toilet bowl defines an interior area for receiving fluid during flushing,

the interior area is in fluid communication with the toilet bowl assembly inlet, and

an upper peripheral portion of the interior bowl surface is configured to have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge;

a toilet bowl assembly outlet for fluid communication with a sewage outlet;

25 a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet outlet in communication with the toilet bowl assembly outlet and at least one jet channel extending between the jet inlet and the jet outlet, wherein the at least one jet channel extends within the interior of the toilet bowl assembly body around the outside of the toilet bowl and the jet outlet is positioned so that fluid from the jet channel enters into the toilet bowl so as to merge with fluid that traveled at least partially along the shelf in the toilet bowl;

30 a manifold having a manifold area therein, wherein the manifold is configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl;

two toilet bowl inlet ports positioned at an upper rear portion of the toilet bowl, wherein each inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that a portion of the fluid travels in opposing directions along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl.

5 23. The rimless, siphonic, gravity-powered toilet according to claim 22, wherein an opening is provided between the two toilet bowl inlet ports to introduce a portion of fluid from the manifold and/or the jet channel into the toilet bowl in a generally downward direction for cleaning a rear area of the interior surface of the toilet bowl approximately between the two toilet bowl inlet ports.

10 24. The rimless, siphonic, gravity-powered toilet according to claim 23, wherein the toilet bowl further comprises a distributor positioned so as to at least partially cover the opening between the two toilet bowl inlet ports.

25. The rimless, siphonic, gravity-powered toilet according to claim 24, wherein the distributor comprises a cover situated to extend over the opening.

15 26. The rimless, siphonic, gravity-powered toilet according to claim 24, wherein the distributor is an assembly comprising a distributor guide, a fastener, and a distributor lock.

27. The rimless, siphonic, gravity-powered toilet according to claim 26, wherein the assembly further comprises a cover.

20 28. The rimless, siphonic, gravity-powered toilet according to claim 22, wherein the shelf does not extend around the entire upper peripheral portion of the toilet bowl.

29. The rimless, siphonic, gravity-powered toilet according to claim 22, wherein the jet inlet is in a lower portion of the manifold.

30. The rimless, siphonic, gravity-powered toilet according to claim 22, wherein the jet outlet is positioned so that fluid from the jet channel enters into the bottom of the toilet bowl.

25 31. The rimless, siphonic, gravity-powered toilet according to claim 22, wherein there are two jet channels formed within the jet, each channel extending within the interior of the toilet bowl assembly body around the outside of the toilet bowl and meeting at the jet outlet.

30 32. The rimless, siphonic, gravity-powered toilet according to claim 22, wherein the jet channel is positioned so as to be at least partially within a space defined within the toilet bowl assembly body generally under the shelf of the toilet bowl and the jet outlet is positioned so that fluid from the jet channel enters the bowl at a front area of the toilet bowl proximate the upper

peripheral portion of the bowl so that fluid from the jet channel and entering the jet outlet travels generally downwardly along the interior bowl surface at the front of the bowl.

33. A rimless, siphonic, gravity-powered toilet comprising:

(a) a toilet bowl assembly comprising

5 a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from a source of fluid;

a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge, wherein

10 the interior bowl surface of the toilet bowl defines an interior area for receiving fluid during flushing,

the interior area is in fluid communication with the toilet bowl assembly inlet, and

15 an upper peripheral portion of the interior bowl surface is configured to have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge;

a toilet bowl assembly outlet for fluid communication with a sewage outlet;

20 a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet outlet in communication with the toilet bowl assembly outlet and at least one jet channel extending between the jet inlet and the jet outlet;

a manifold having a manifold area therein, wherein the manifold is configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl;

25 at least one toilet bowl inlet port positioned at an upper rear portion of the toilet bowl, wherein the at least one inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl; and

30 (b) a toilet seat configured to fit over the upper peripheral edge of the toilet, comprising a lower surface having a seat bumper for contacting the upper peripheral edge of the toilet bowl, wherein the bumper abuts the upper peripheral edge of the toilet bowl when the toilet seat is in a lowered position over the upper peripheral edge of the toilet bowl.

34. A rimless, siphonic, gravity-powered toilet comprising:

(a) a toilet bowl assembly comprising

a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from a source of fluid;

5 a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge, wherein

the interior bowl surface of the toilet bowl defines an interior area for receiving fluid during flushing,

the interior area is in fluid communication with the toilet bowl assembly inlet, and

an upper peripheral portion of the interior bowl surface is configured to have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge;

a toilet bowl assembly outlet for fluid communication with a sewage outlet;

a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet outlet in communication with the toilet bowl assembly outlet and at least one jet channel extending between the jet inlet and the jet outlet;

a manifold having a manifold area therein, wherein the manifold is configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl;

at least one toilet bowl inlet port positioned at an upper rear portion of the toilet bowl, wherein the at least one inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl;

(b) a toilet seat configured to fit over the upper peripheral edge of the toilet, comprising a lower surface having a seat bumper for contacting the upper peripheral edge of the toilet bowl, wherein the bumper abuts the upper peripheral edge of the toilet bowl when the toilet seat is in a lowered position over the upper peripheral edge of the toilet; and

(c) a splash guard having an upper portion and a downwardly extending portion, an exterior surface and an interior surface, wherein the splash guard is configured to fit beneath the

toilet seat and above the rear portion of the toilet bowl, to complement a shape of the rear portion of the toilet bowl and to have an outwardly extending end portion extending from the rear portion of the toilet bowl in a direction of flow at least partially along the upper peripheral edge of the bowl towards the front of the toilet so as to at least cover the at least one toilet inlet
5 port and block upward splashing water.

35. The rimless, siphonic, gravity-powered toilet according to claim 34, wherein the splash guard forms a generally right angle in transverse cross section along the outwardly extending portions.

36. The rimless, siphonic, gravity-powered toilet according to claim 34, wherein an
10 outwardly extending portion of the splash guard terminates rearwardly of the bumper on the toilet seat.

37. The rimless, siphonic, gravity-powered toilet according to claim 34, wherein the splash guard has a rearwardly extending portion configured to extend backwards towards a hinge on the toilet seat.

15 38. The rimless, siphonic, gravity-powered toilet according to claim 34, wherein there are two toilet bowl inlet ports and two outwardly extending end portions on the splash guard.

39. The rimless, siphonic, gravity-powered toilet according to claim 38, wherein the toilet further comprises an opening positioned between the two toilet bowl inlet ports to introduce a portion of fluid from the manifold and/or the jet channel into the toilet bowl in a generally
20 downward direction for cleaning a rear area of the interior surface of the toilet bowl approximately between the two toilet bowl inlet ports and a distributor positioned so as to at least partially cover the opening between the two toilet bowl inlet ports.

40. A toilet splash guard for a rimless toilet, comprising,
an upper portion and a downwardly extending portion, an exterior surface and an
25 interior surface, wherein the splash guard is configured to fit beneath a toilet seat and above a rear portion of a rimless toilet bowl, to complement a shape of a rear portion of a rimless toilet bowl and to have an outwardly extending end portion extending from a rear portion of a rimless toilet bowl in a direction of flow at least partially along an upper peripheral edge of a rimless toilet bowl towards a front of the rimless toilet bowl so as to block upward splashing water.

30 41. A toilet seat assembly for a rimless toilet comprising the toilet splash guard of claim 40.

42. A rimless, siphonic, gravity-powered toilet having a toilet bowl assembly comprising,

a toilet bowl assembly body and a toilet bowl assembly inlet for receiving fluid from a source of fluid;

a toilet bowl in the toilet bowl assembly body having an interior bowl surface with an upper peripheral edge along an upper surface thereof, wherein

5 the interior bowl surface of the toilet bowl defines an interior area for receiving fluid during flushing,

 the interior area is in fluid communication with the toilet bowl assembly inlet, and

 an upper peripheral portion of the interior bowl surface is configured to
10 have a shelf formed therein along at least a part of an upper peripheral portion of the interior bowl surface below the upper peripheral edge;

 a toilet bowl assembly outlet for fluid communication with a sewage outlet;

 a jet having a jet inlet in fluid communication with the toilet bowl assembly inlet, a jet outlet in communication with the toilet bowl assembly outlet and at least one jet channel
15 extending between the jet inlet and the jet outlet;

 a manifold having a manifold area therein, wherein the manifold is configured so that fluid entering the toilet bowl assembly inlet will divide into a first portion for entering the inlet of the jet and a second portion for entering the interior area of the toilet bowl;

 at least one toilet bowl inlet port positioned at an upper rear portion of the toilet
20 bowl, wherein the at least one inlet port is configured to receive fluid from the manifold into the interior area of the toilet bowl such that at least a portion of the fluid travels along the shelf of the toilet bowl prior to passing into a lower portion of the toilet bowl; and

 wherein a portion of the upper surface of the toilet bowl is configured to extend downwardly so as to cover the at least one inlet port and a rear portion of the shelf so as to act
25 as a splash guard for water entering the shelf from the at least one inlet port.

43. The rimless, siphonic, gravity-powered toilet according to claim 42, wherein the portion of the upper surface of the toilet bowl that acts as a splash guard forms a generally right angle in transverse cross section.

44. The rimless, siphonic, gravity-powered toilet according to claim 42, wherein an
30 outwardly extending portion of the portion of the upper surface of the toilet bowl that acts as a

splash guard is configured so that it terminates rearwardly of a position where a toilet seat would contact the upper peripheral edge of the toilet bowl.

45. The rimless, siphonic, gravity-powered toilet according to claim 42, wherein there are two toilet bowl inlet ports and two outwardly extending end portions on the upper portion of the
5 toilet bowl that acts as a splash guard.

46. The rimless, siphonic, gravity-powered toilet according to claim 45, wherein the toilet further comprises an opening positioned between the two toilet bowl inlet ports to introduce a portion of fluid from the manifold and/or the jet channel into the toilet bowl in a generally downward direction for cleaning a rear area of the interior surface of the toilet bowl
10 approximately between the two toilet bowl inlet ports and a distributor positioned so as to at least partially cover the opening between the two toilet bowl inlet ports.

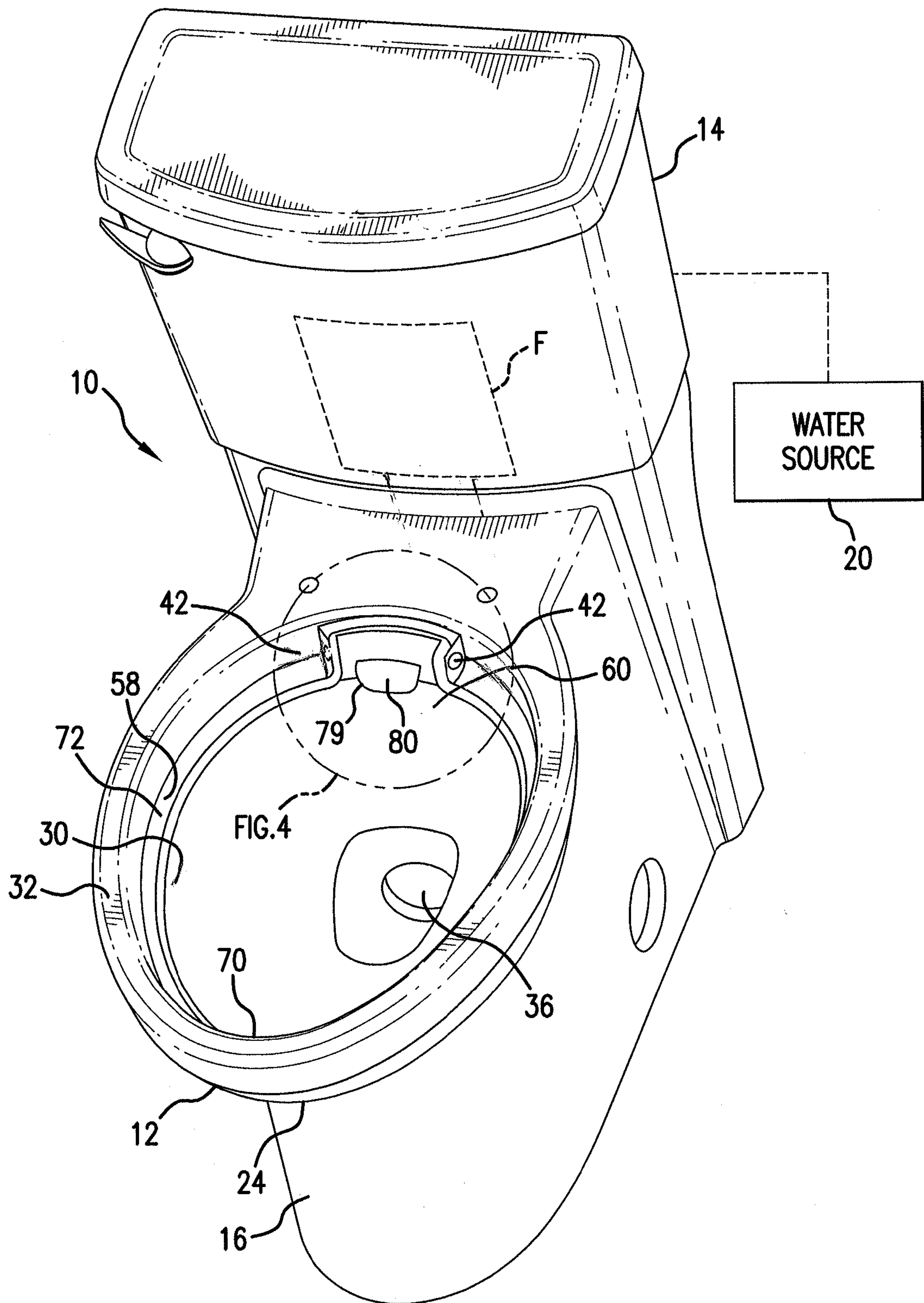


FIG. 1

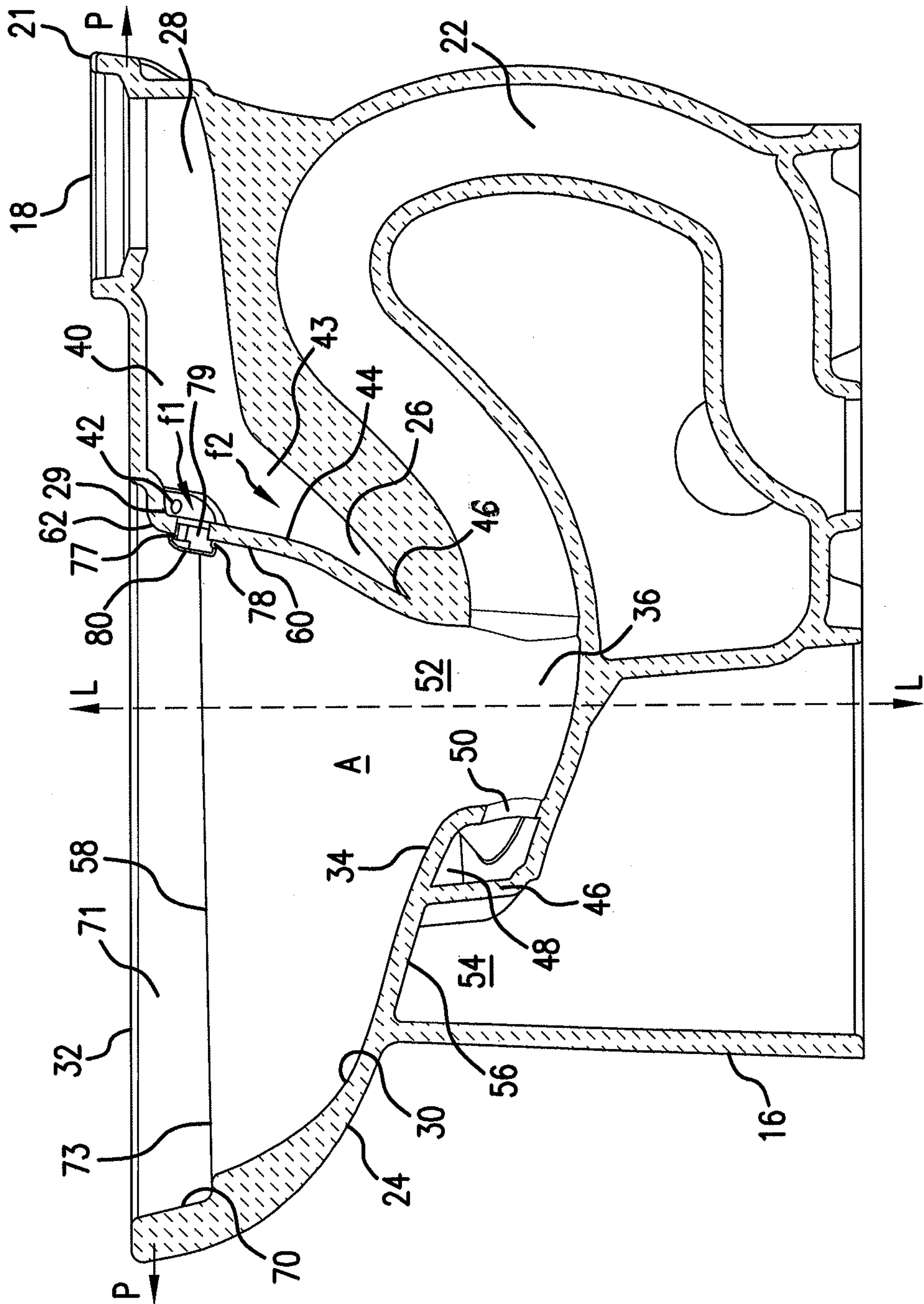


FIG. 2

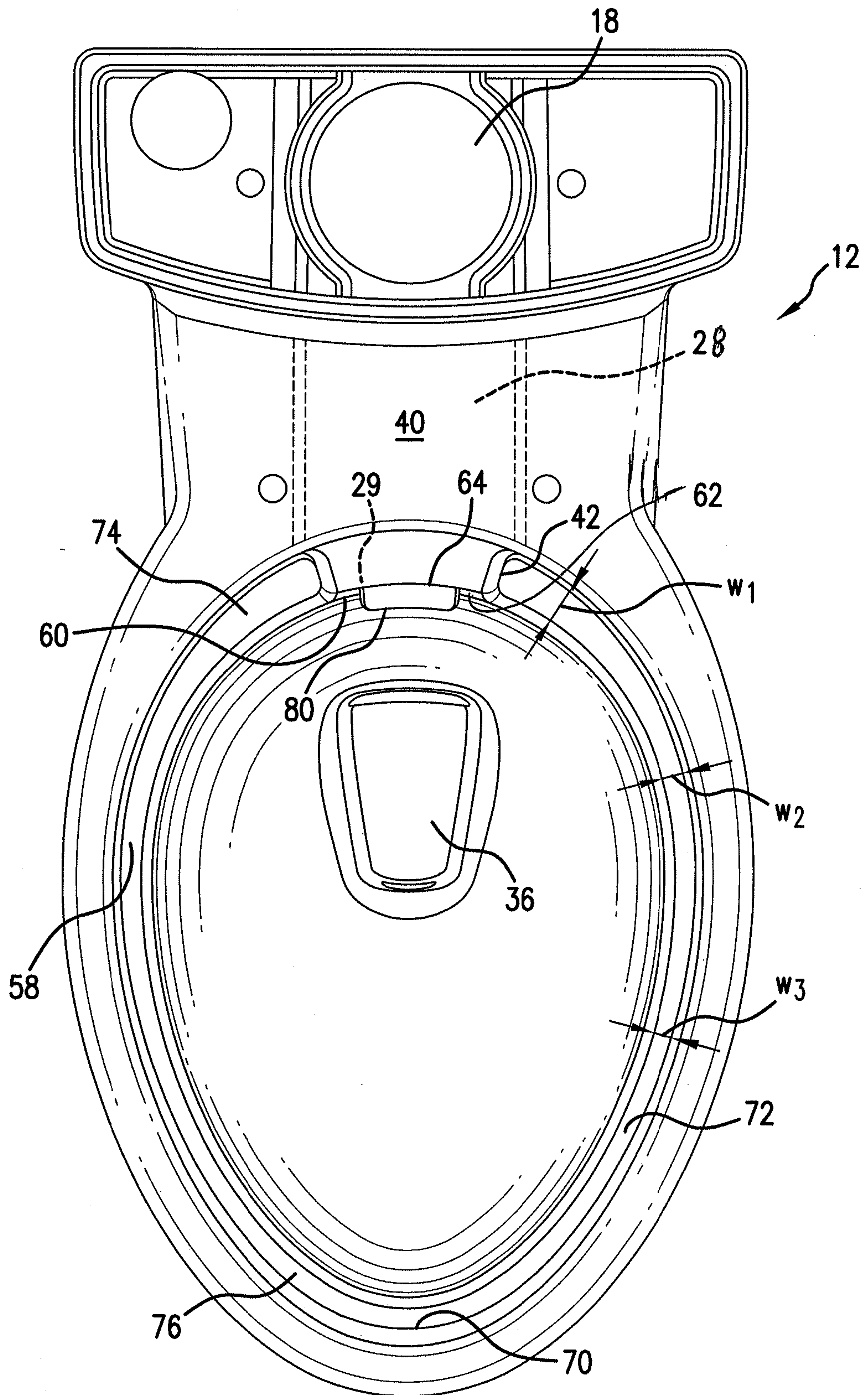


FIG. 3

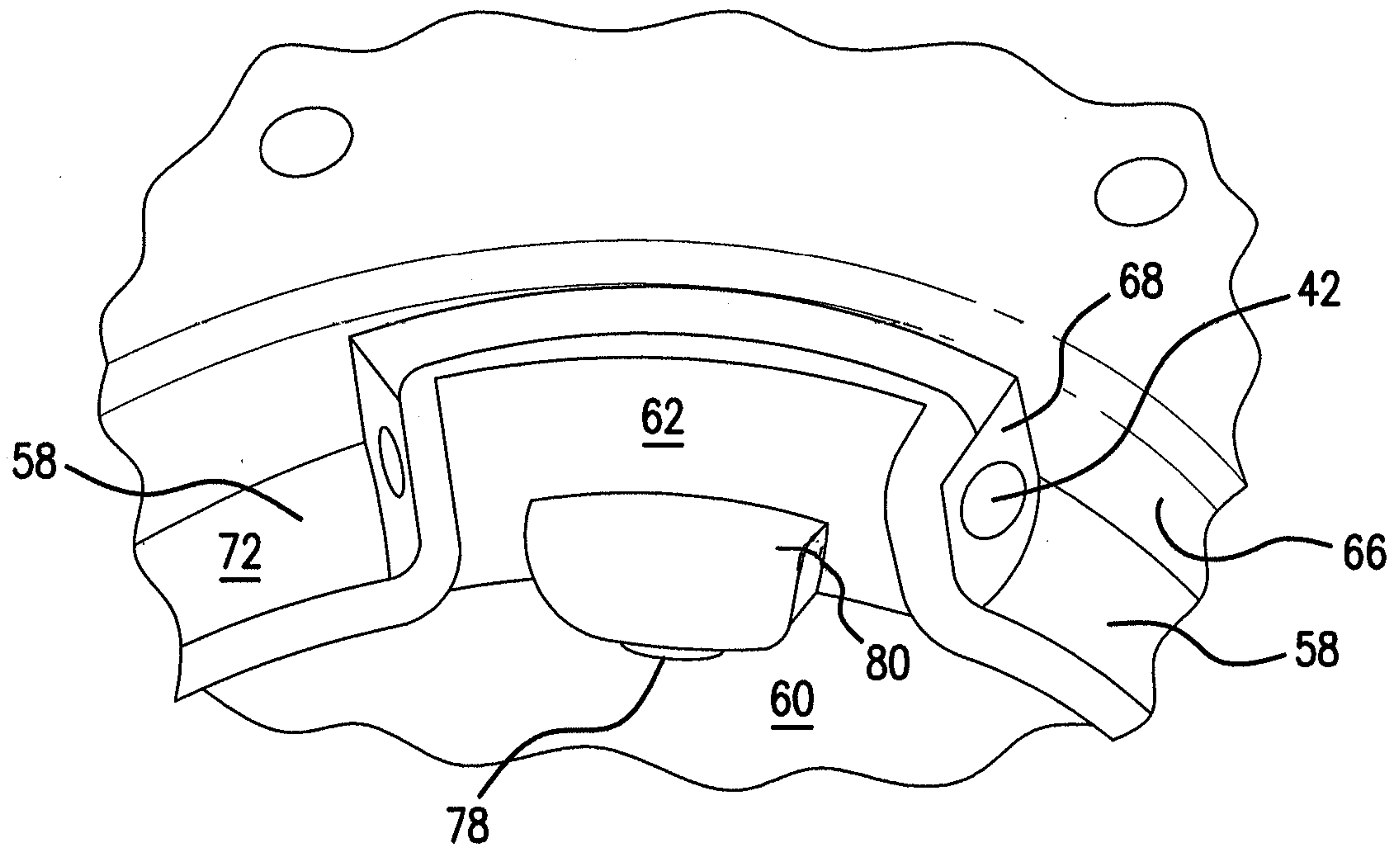


FIG. 4

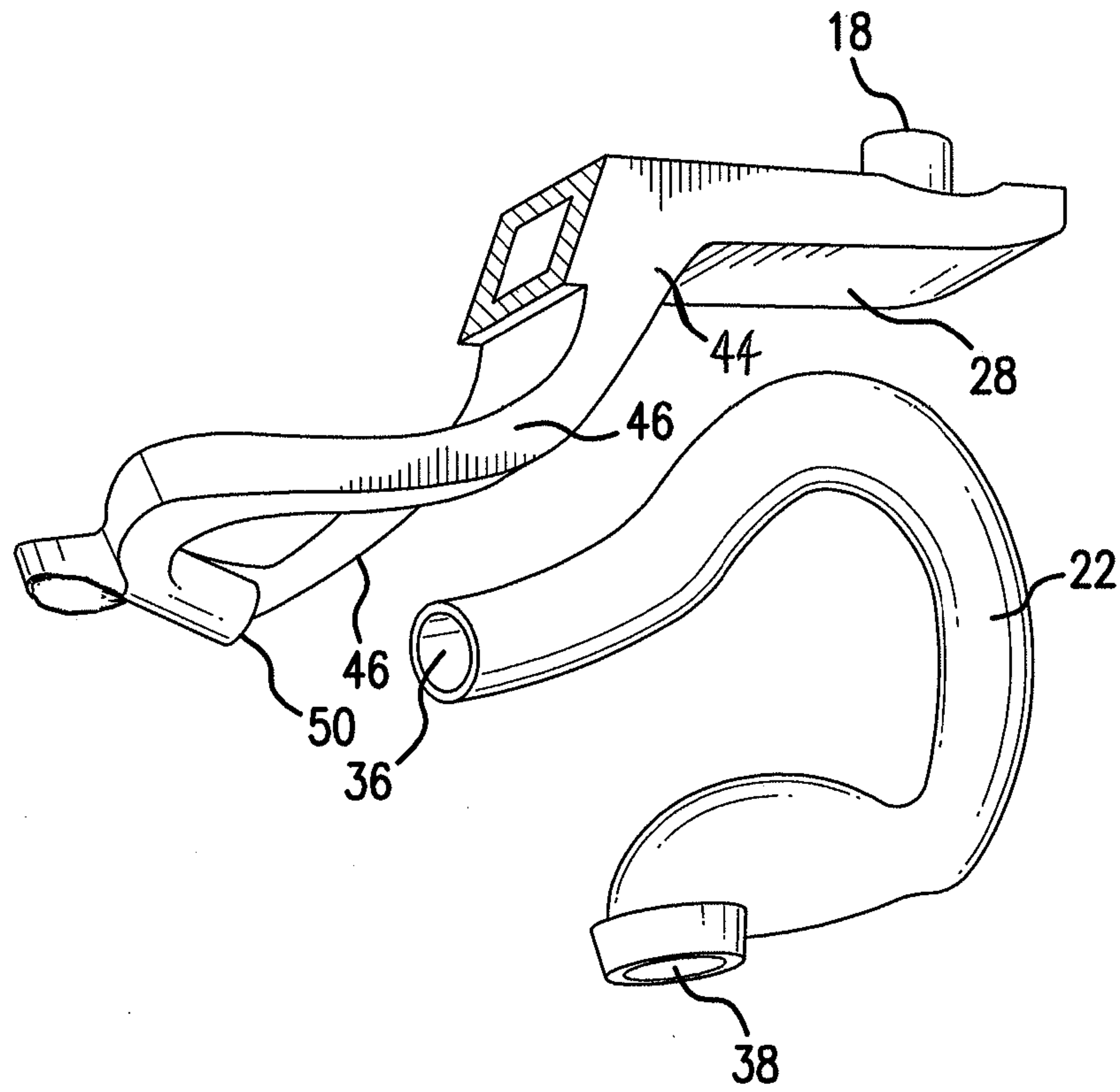


FIG. 5

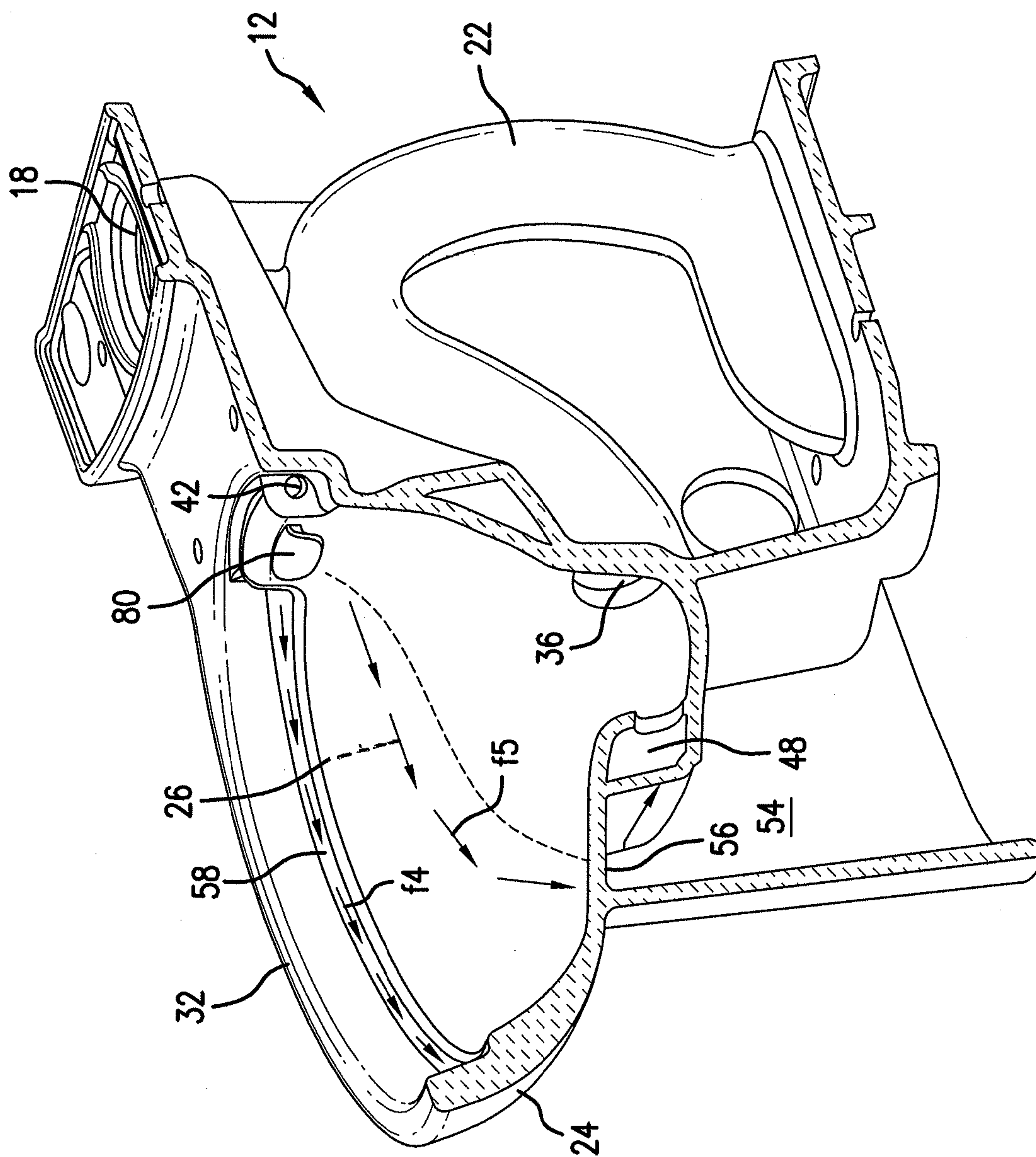


FIG. 5A

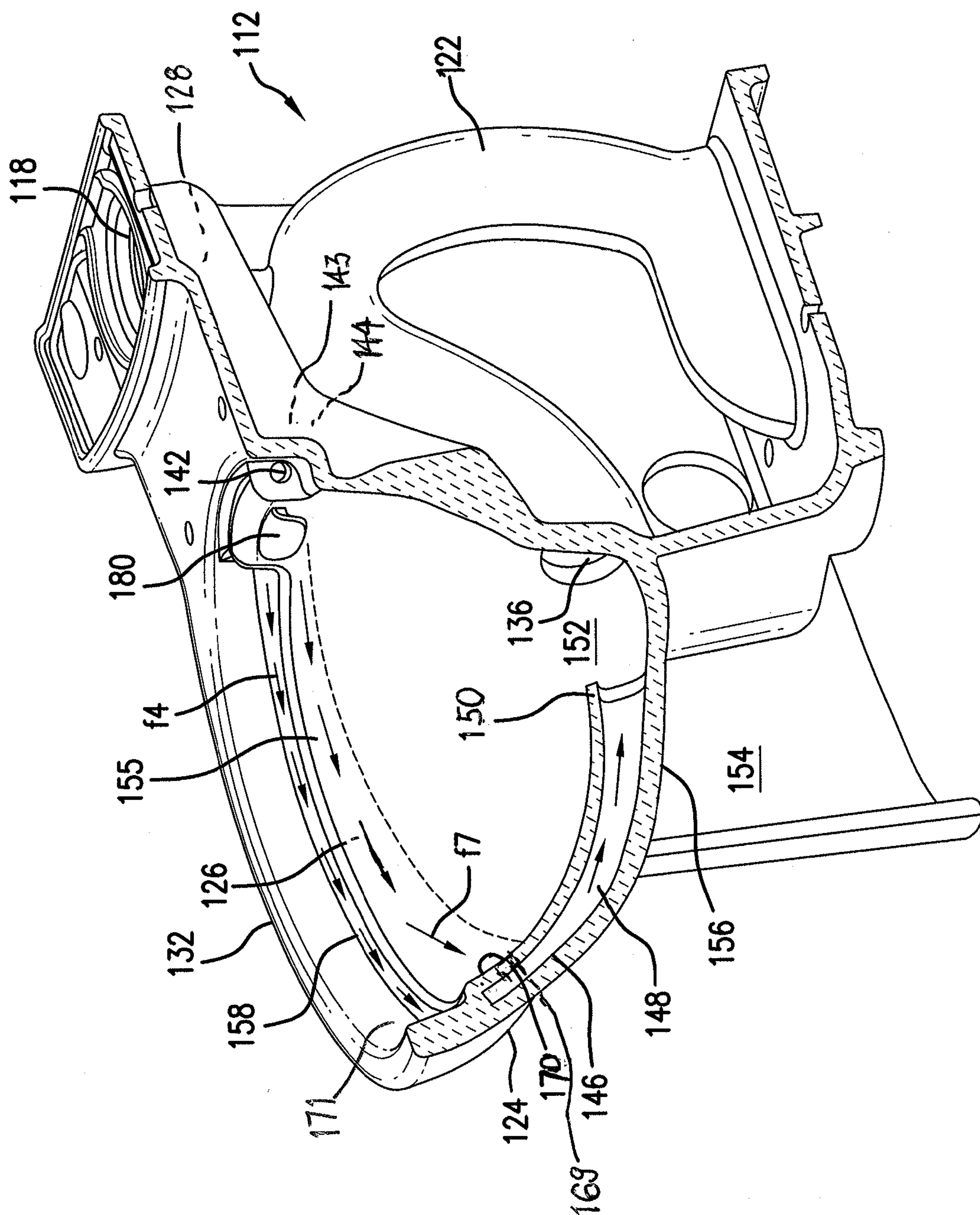


FIG. 6

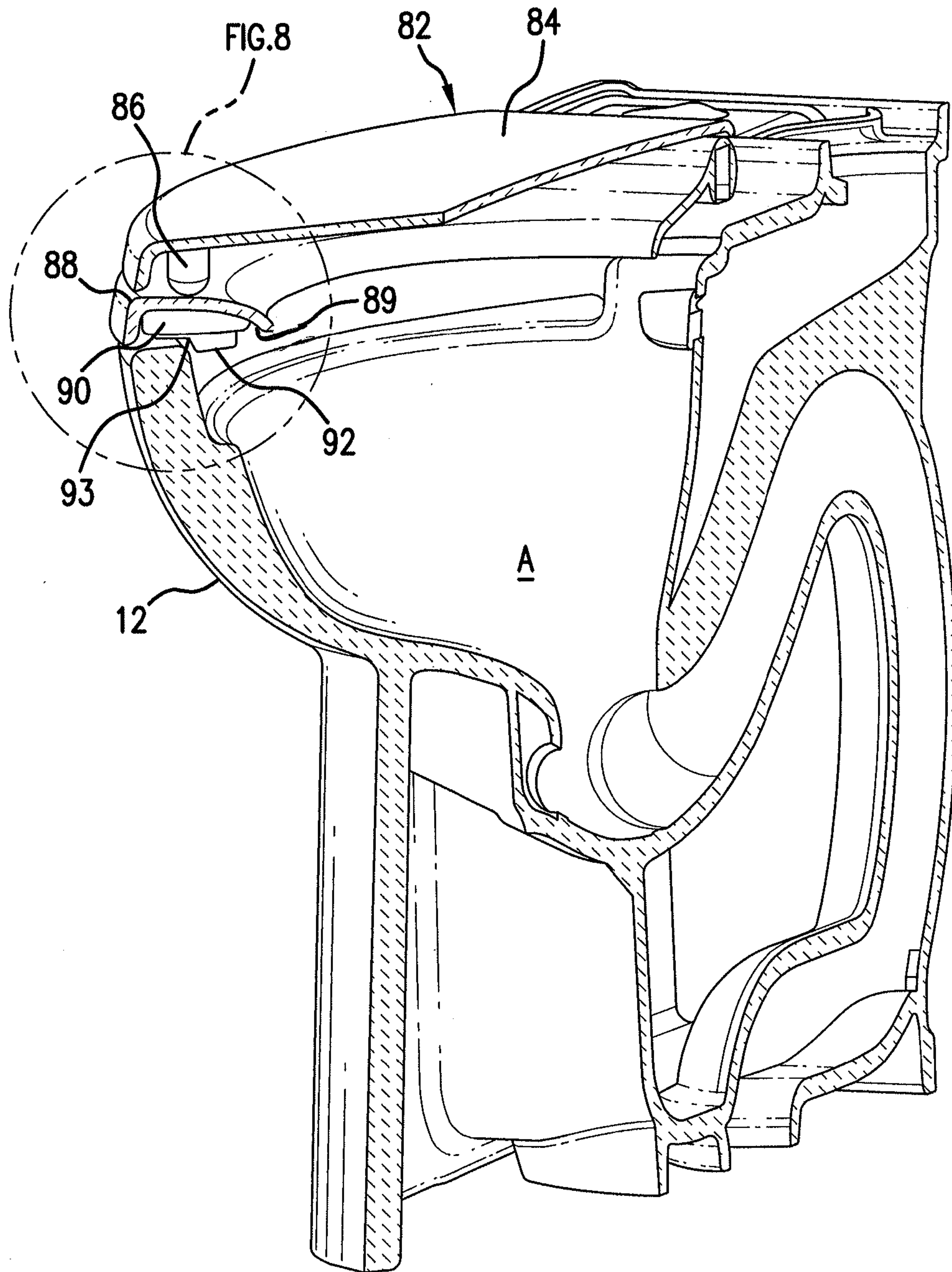


FIG. 7

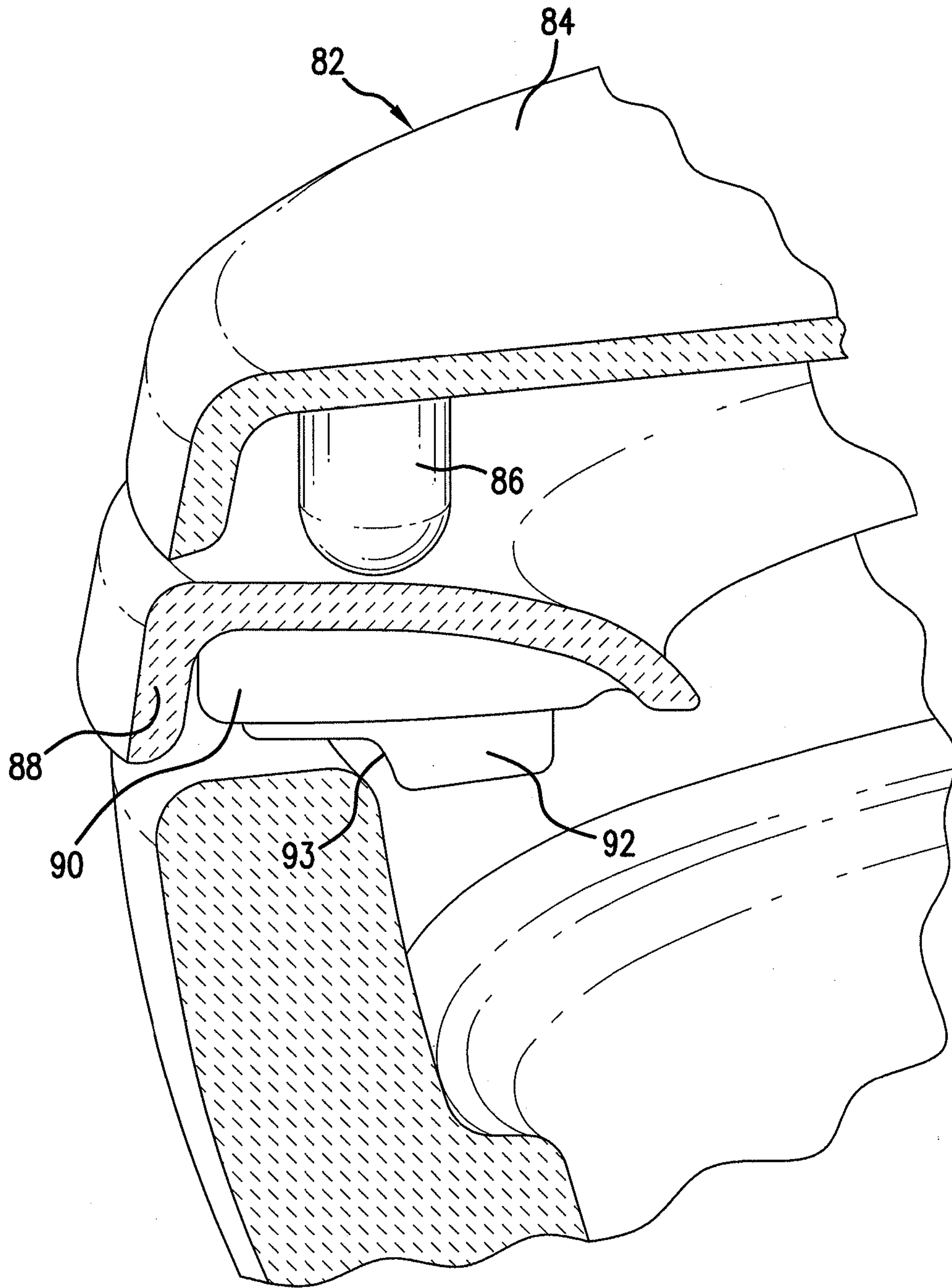


FIG. 8

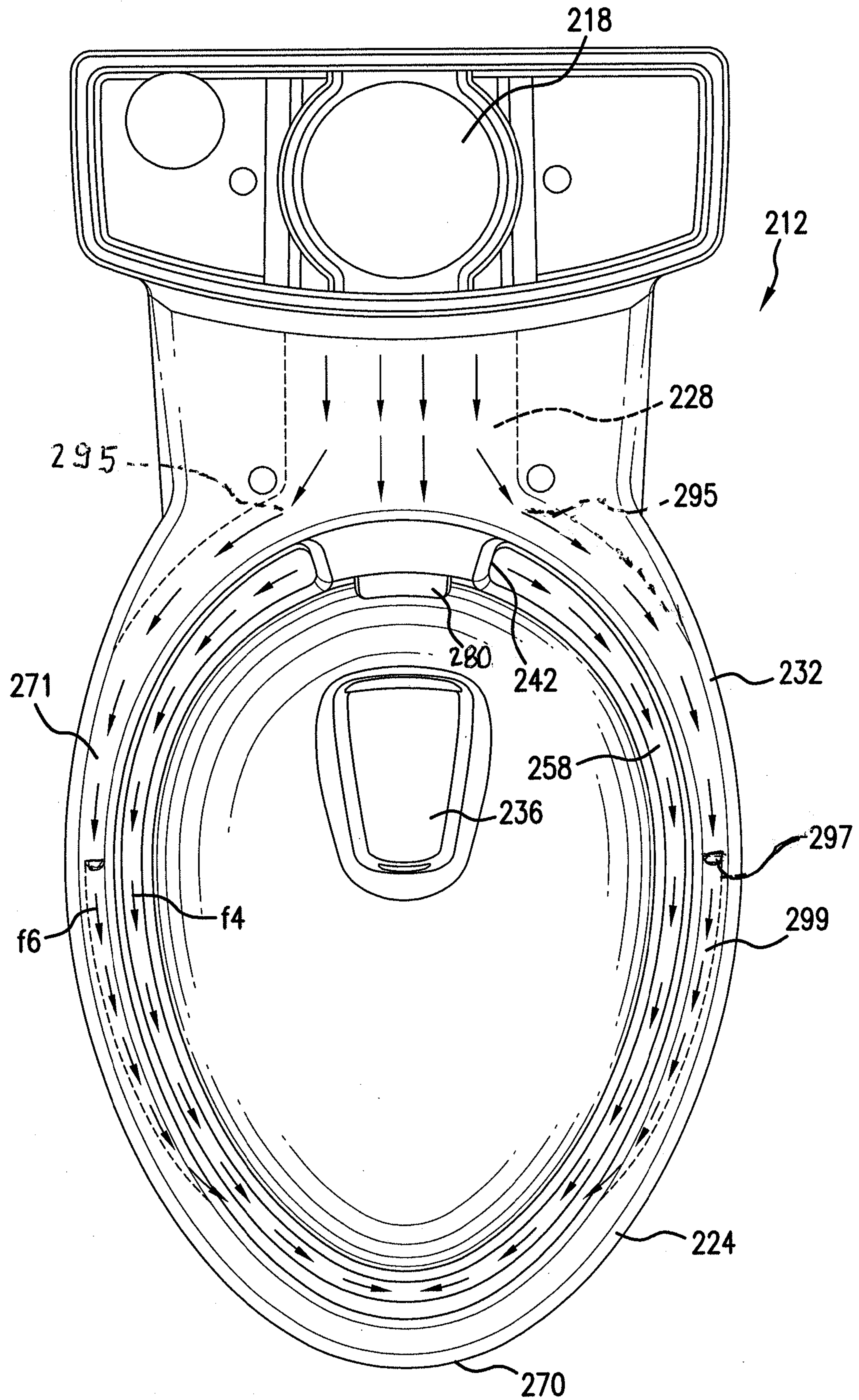


FIG. 9

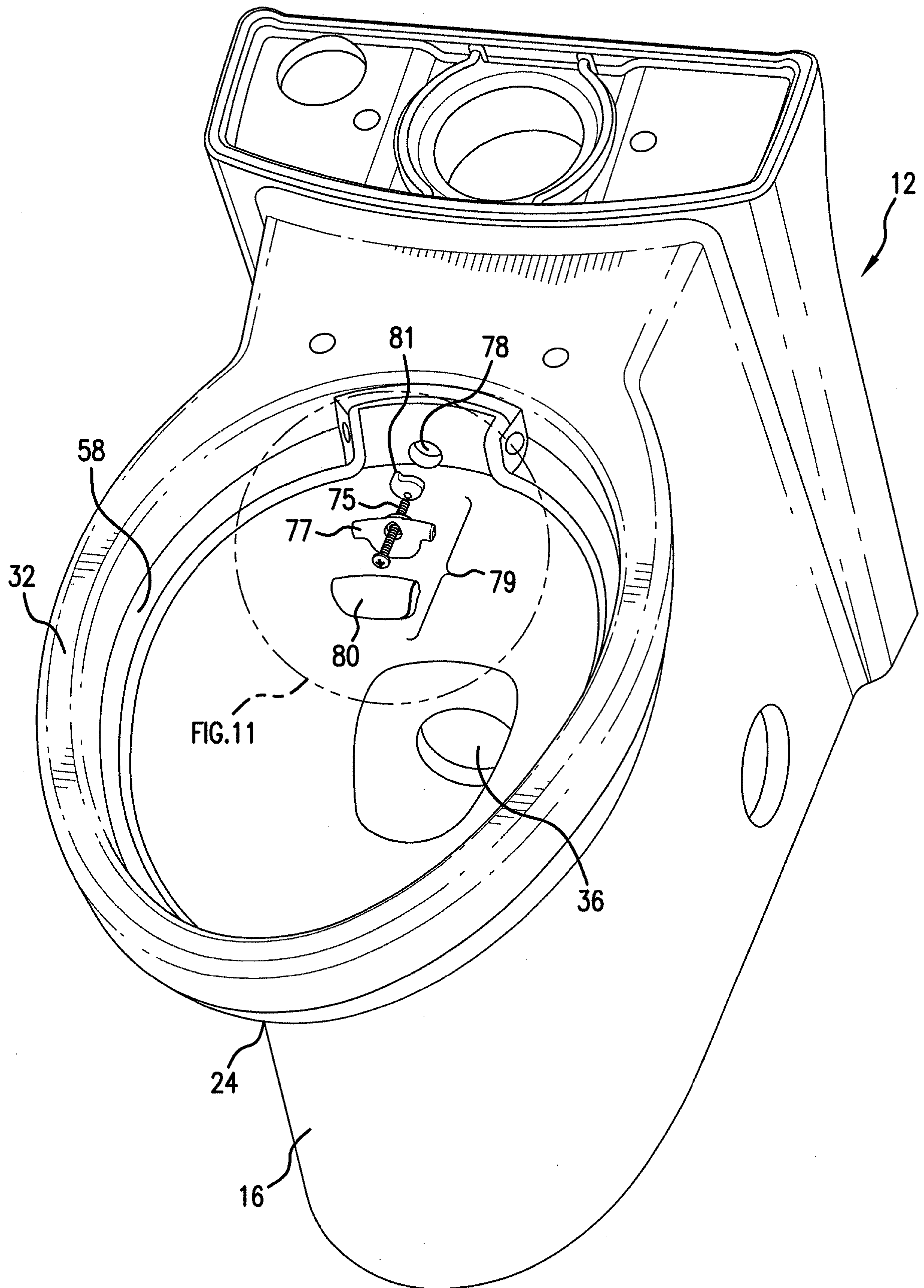


FIG. 10

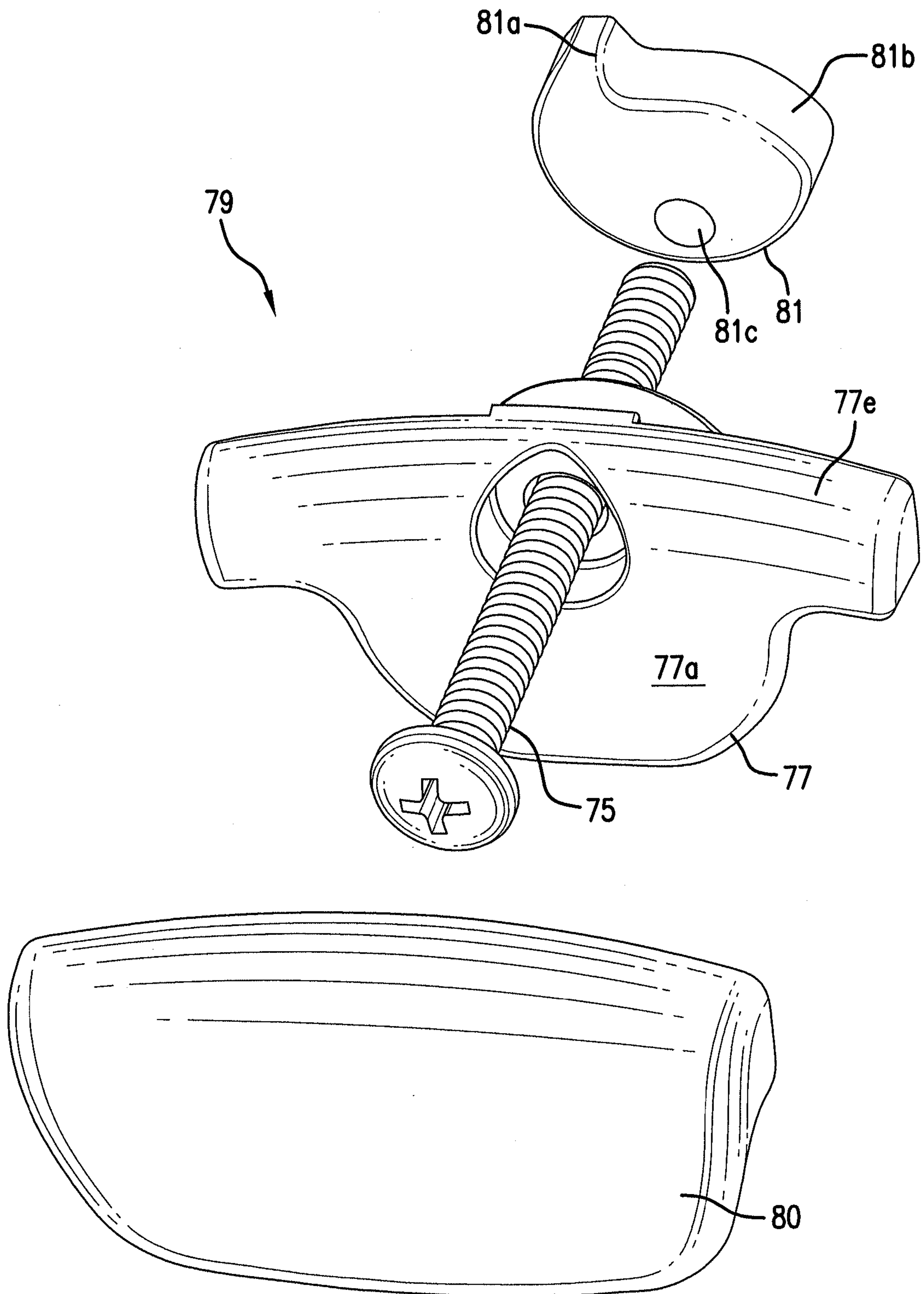


FIG. 11

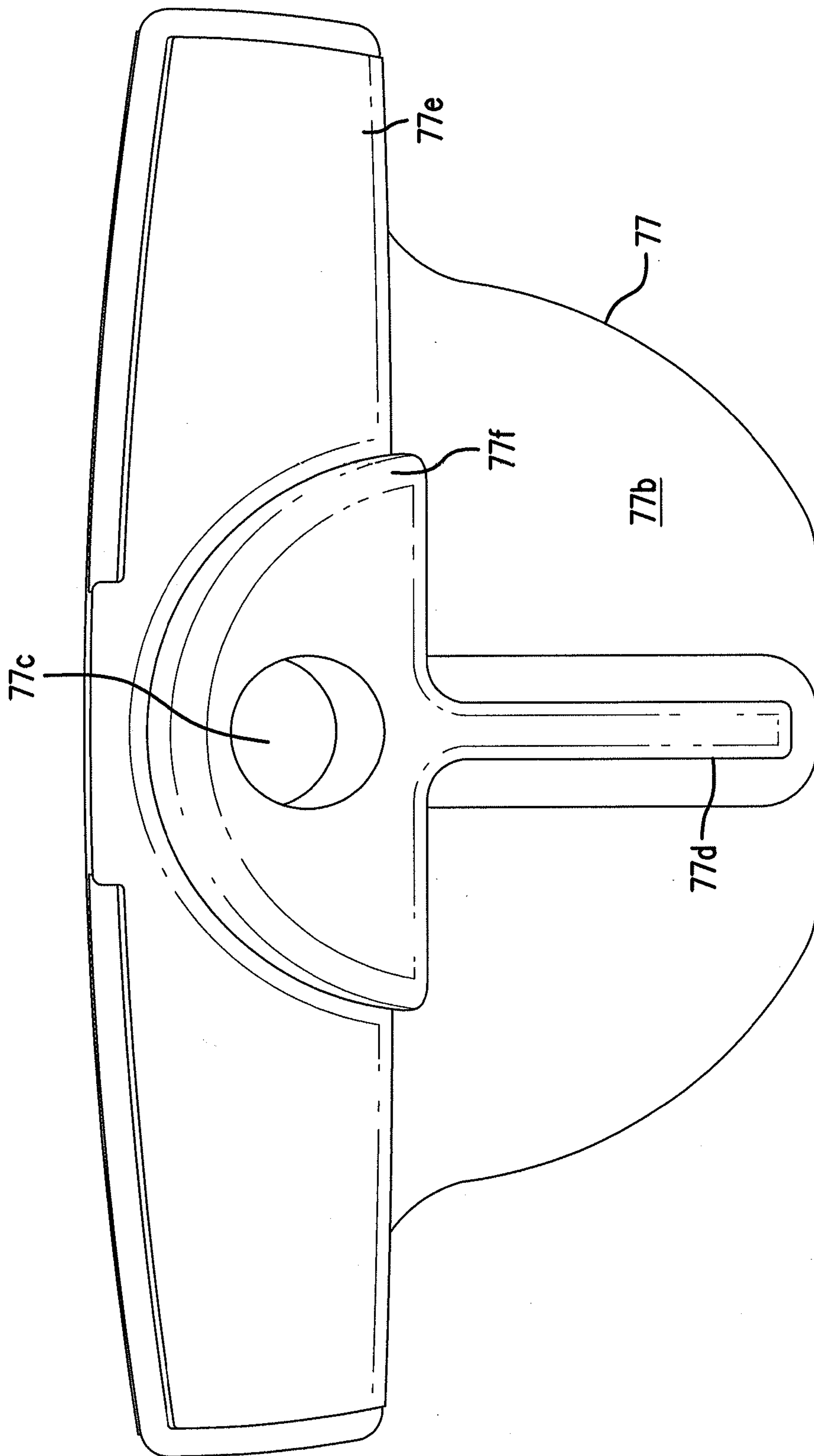


FIG. 12

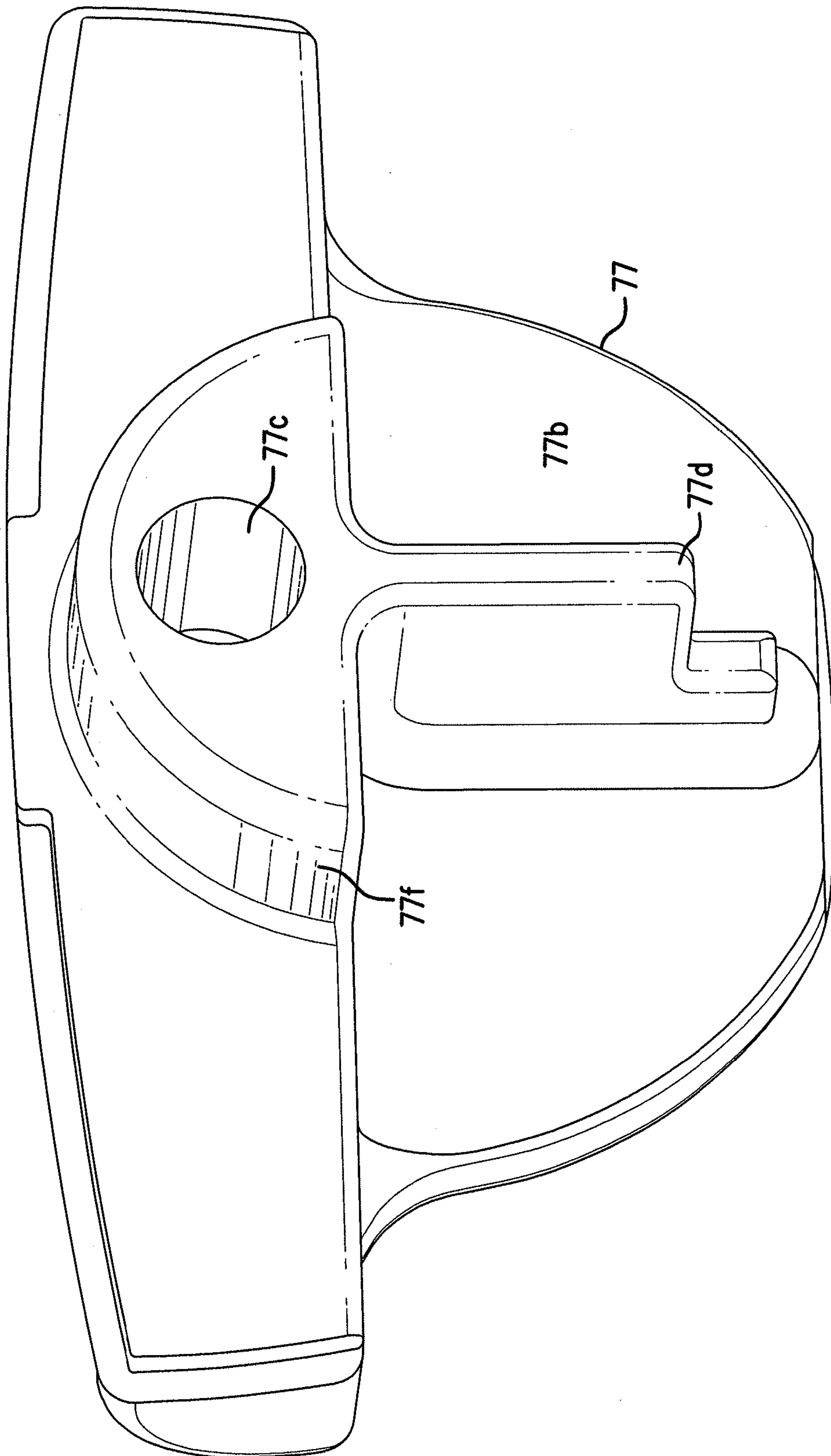


FIG. 13

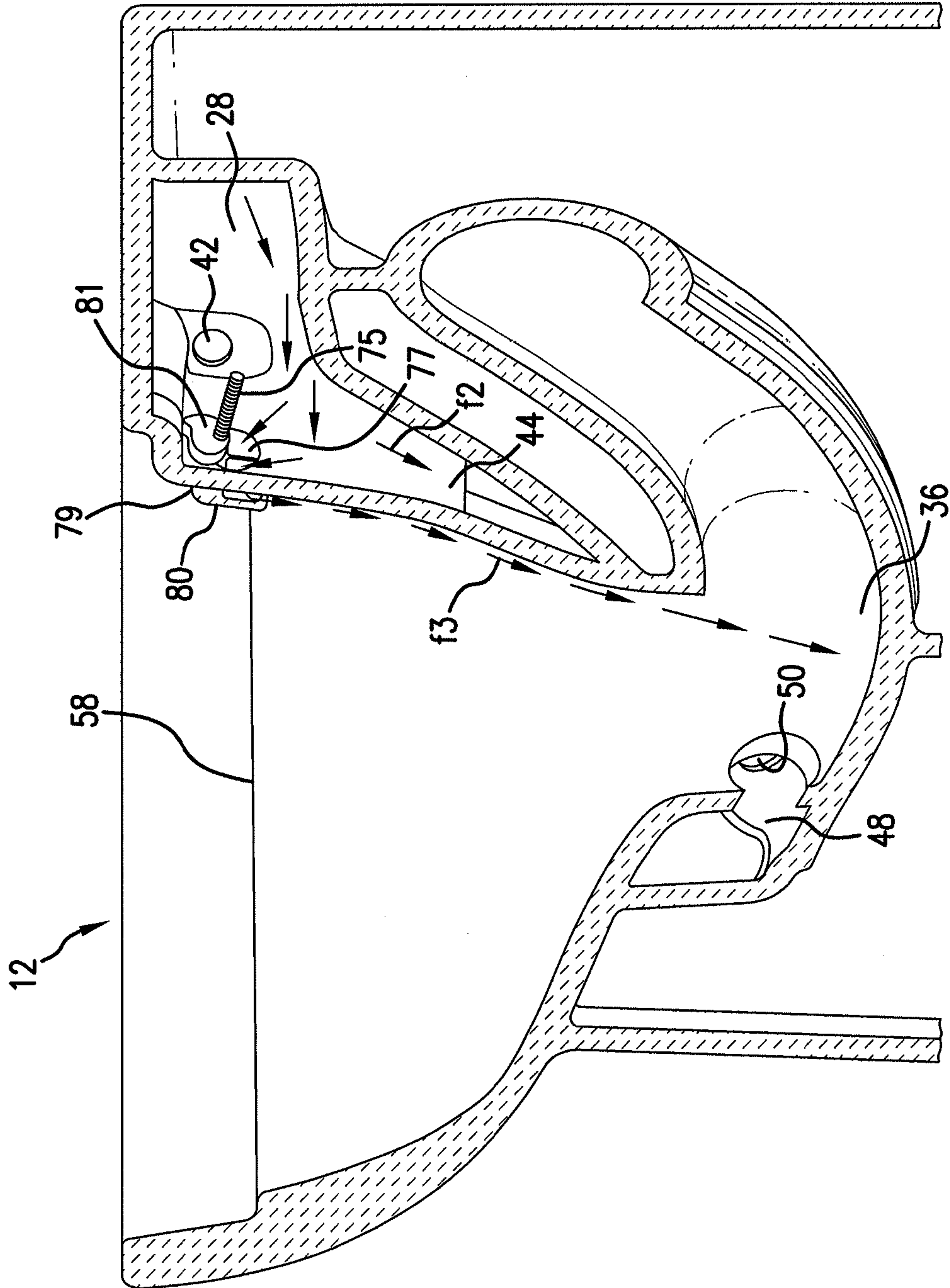
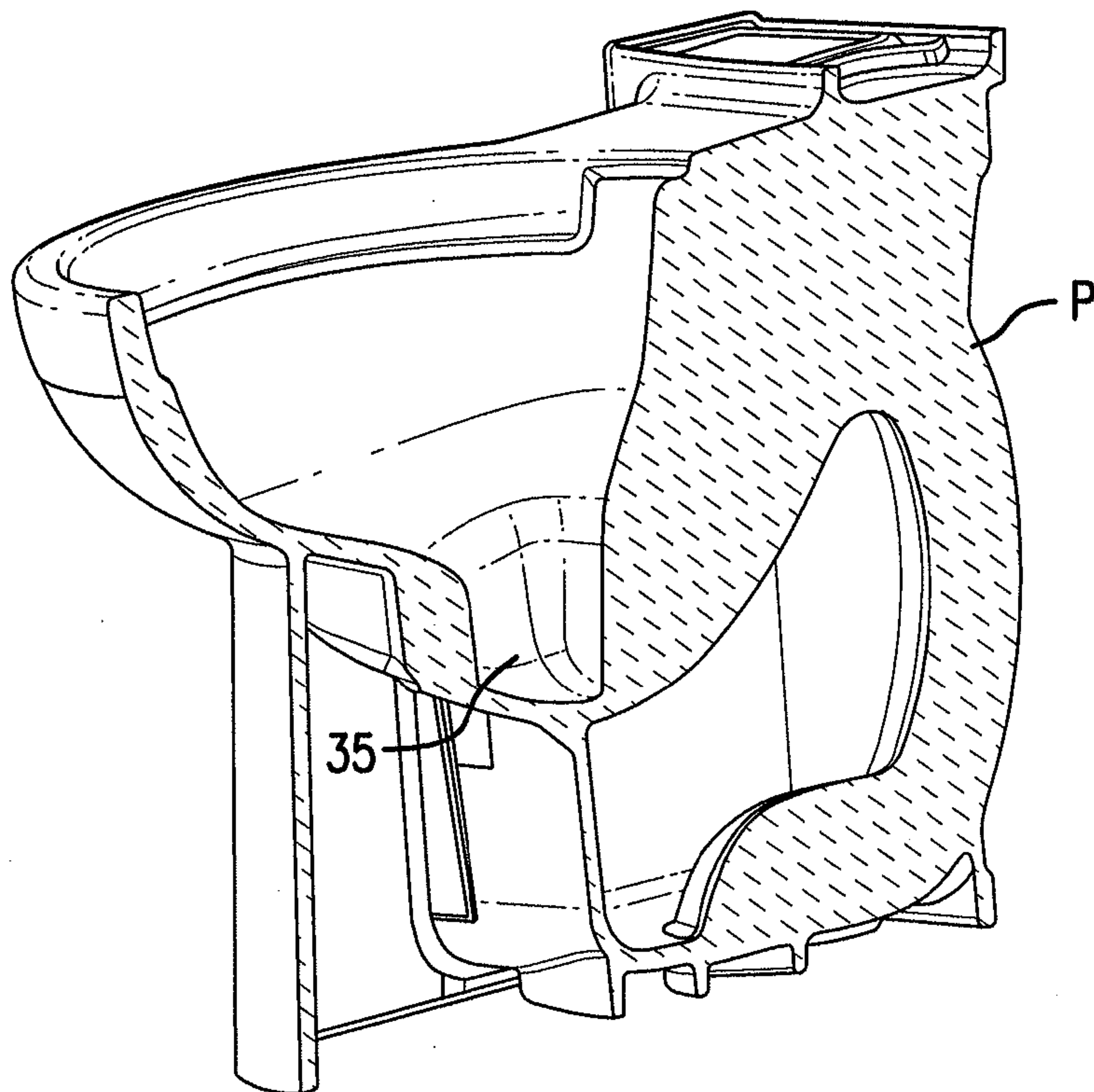
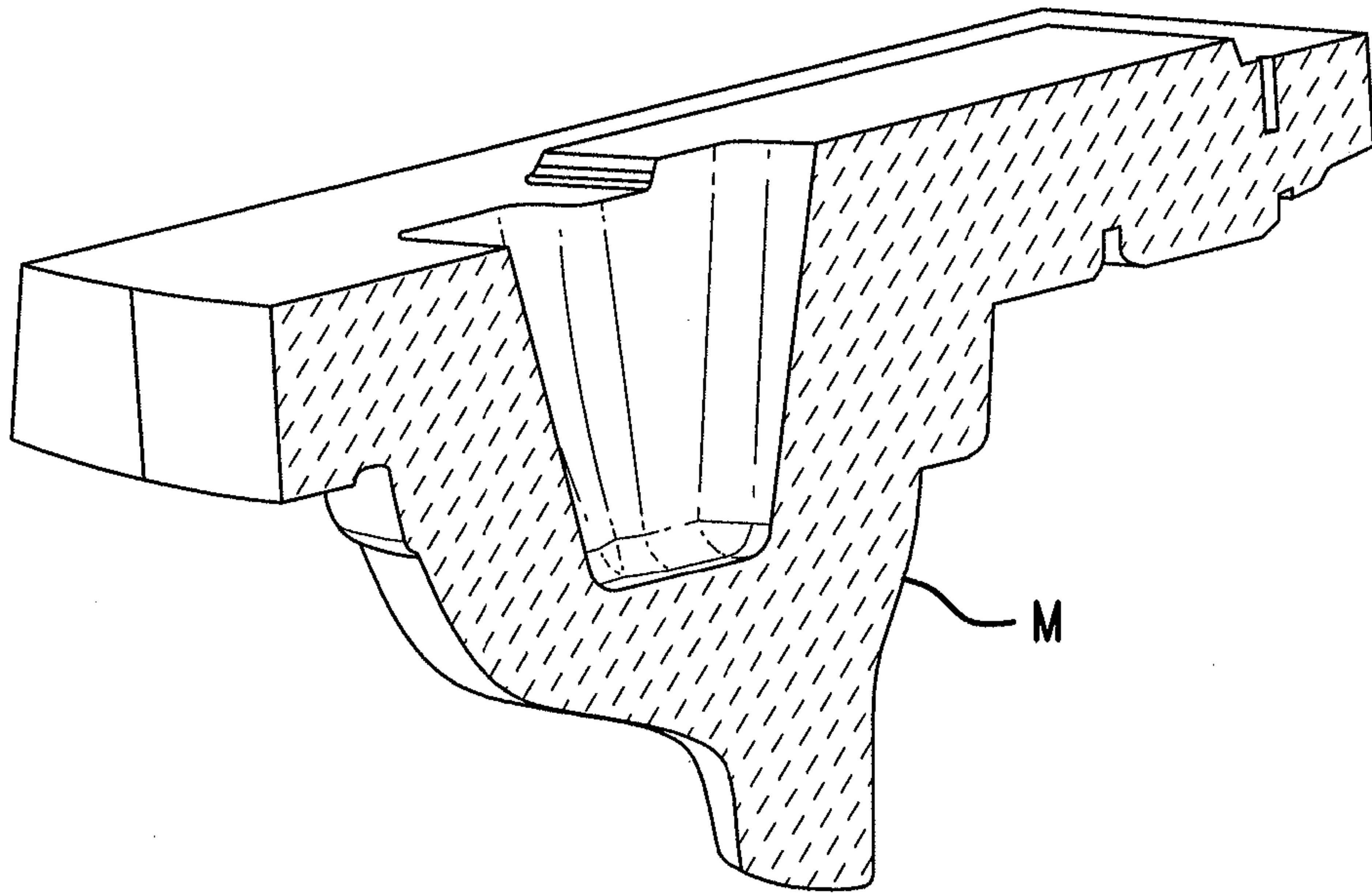


FIG. 14

**FIG. 15**

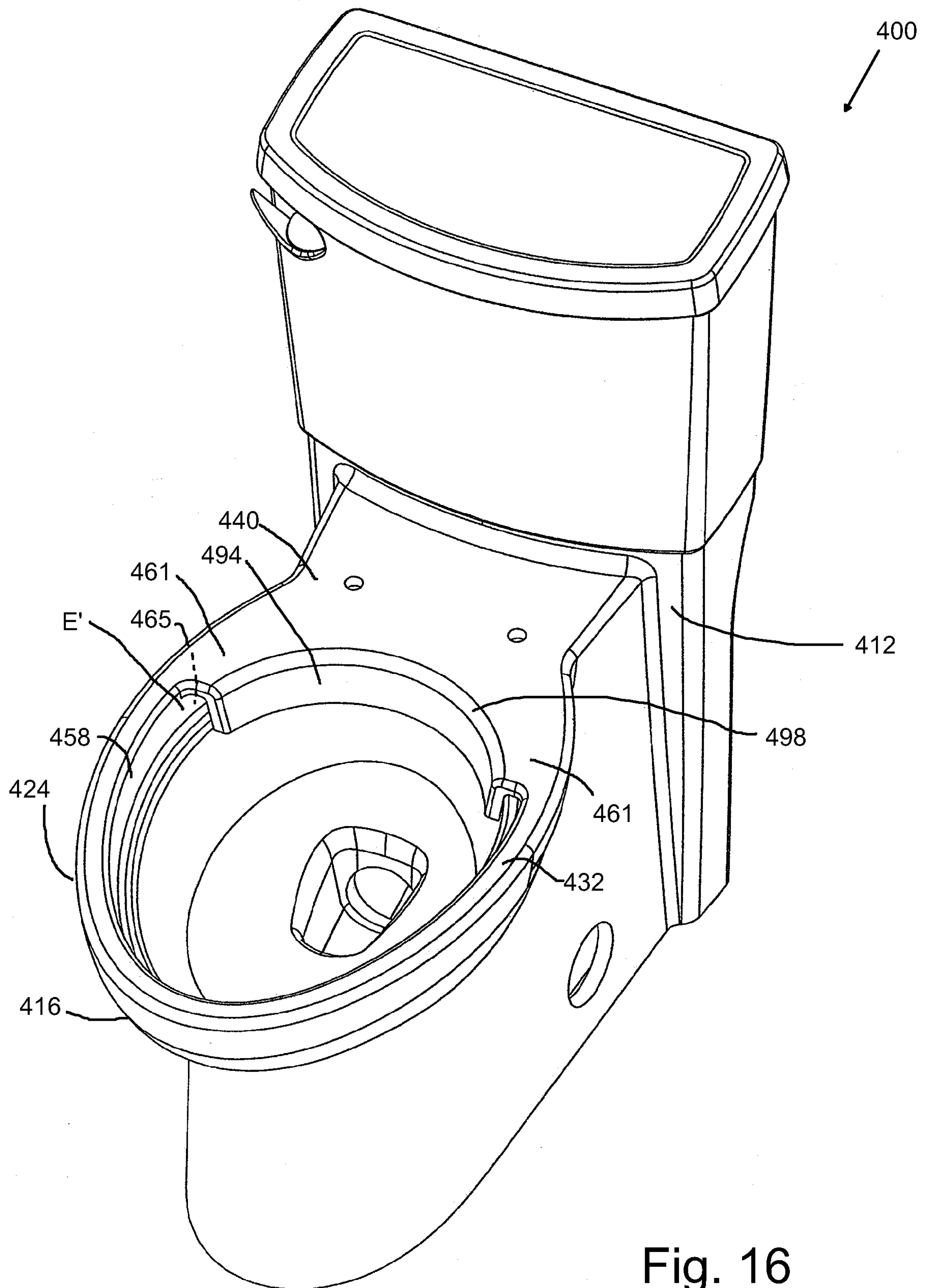


Fig. 16

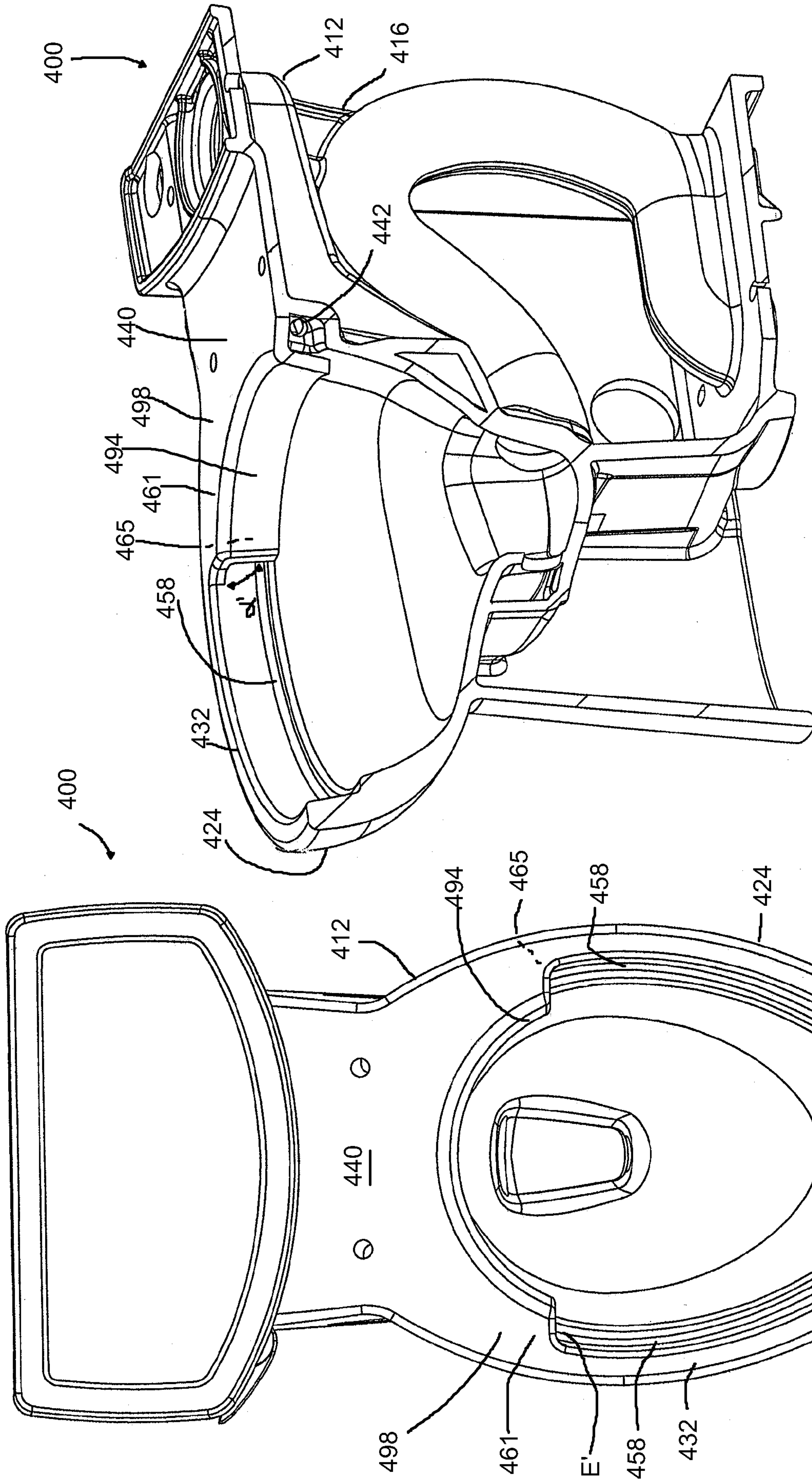


Fig. 18

Fig. 17

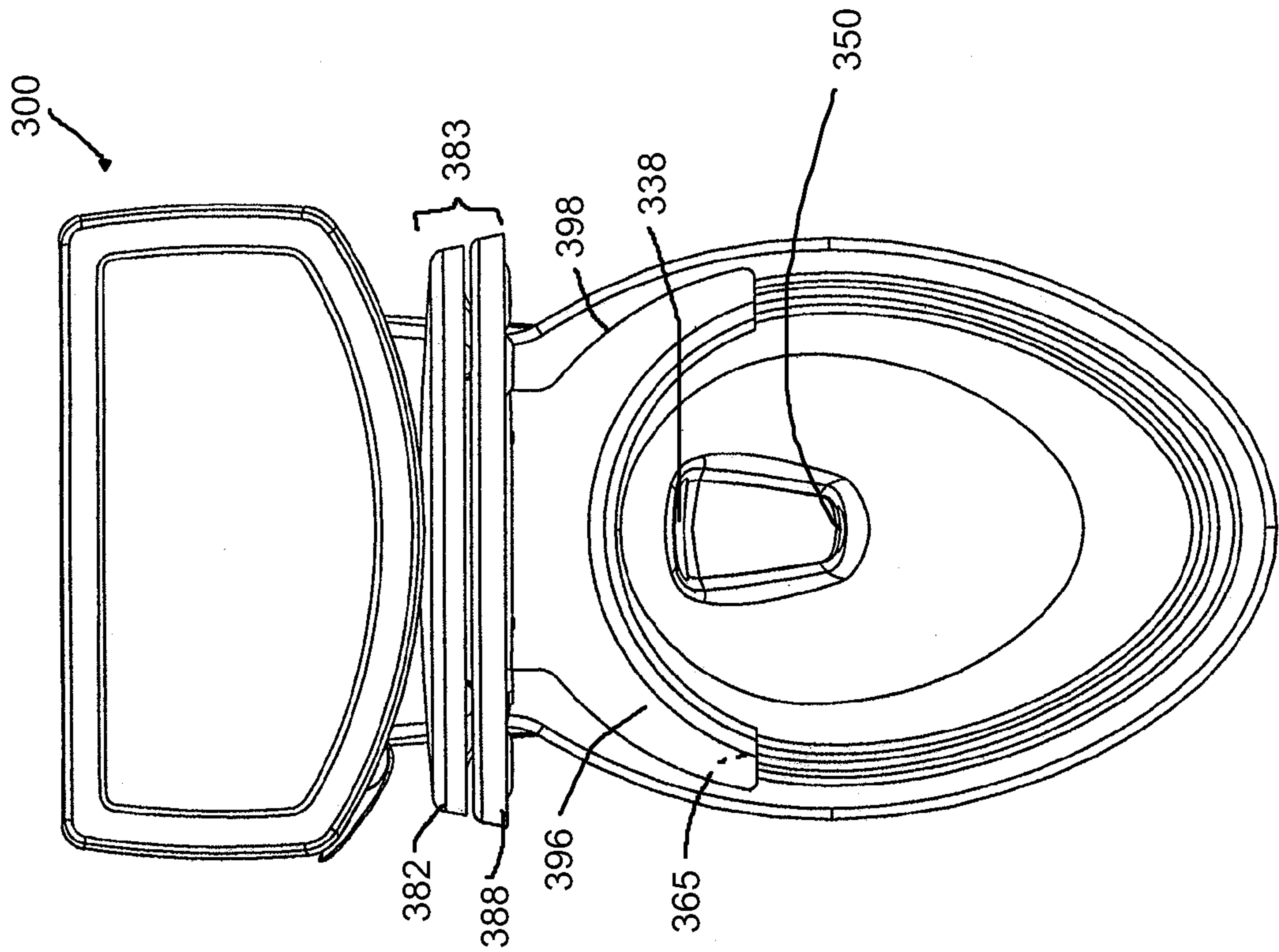
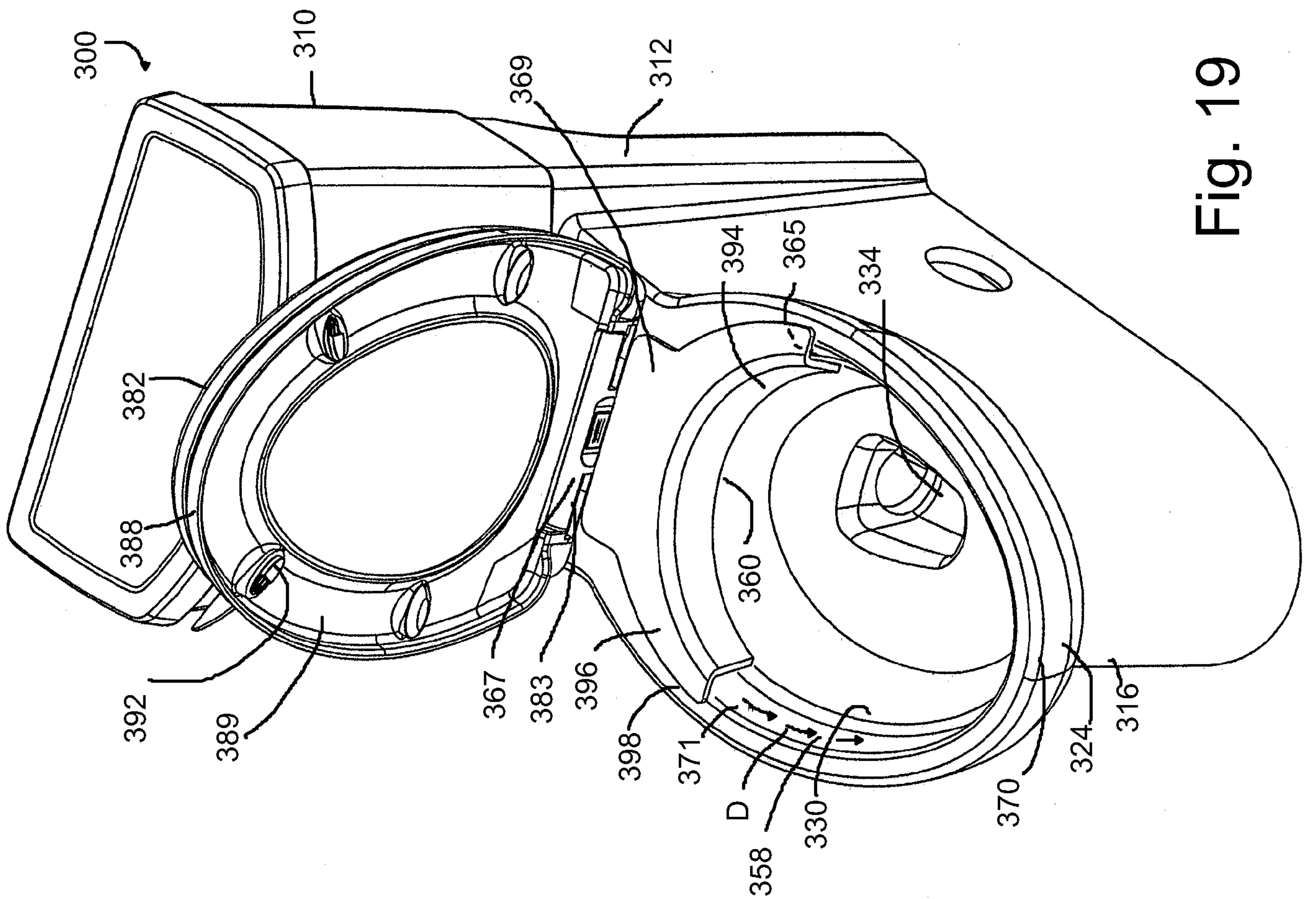


Fig. 21

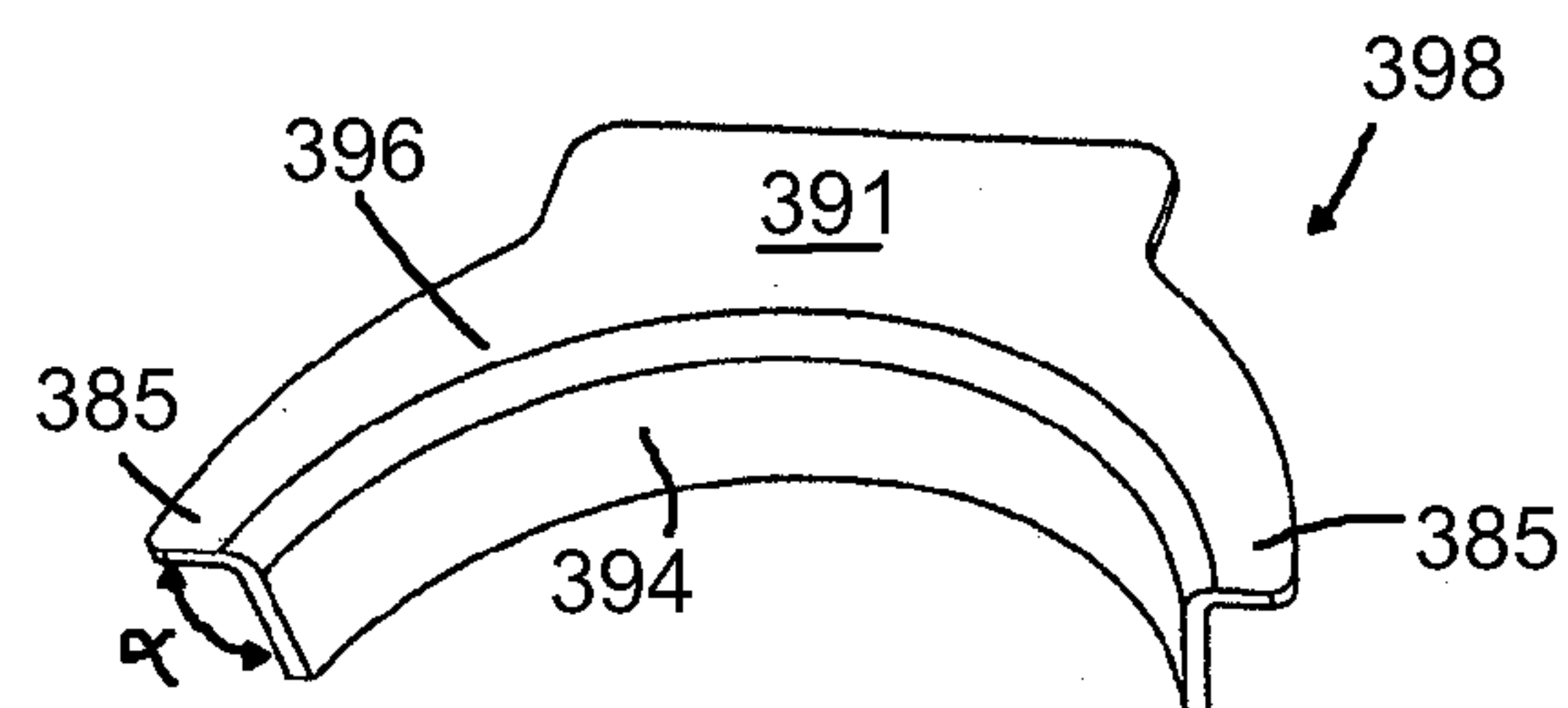
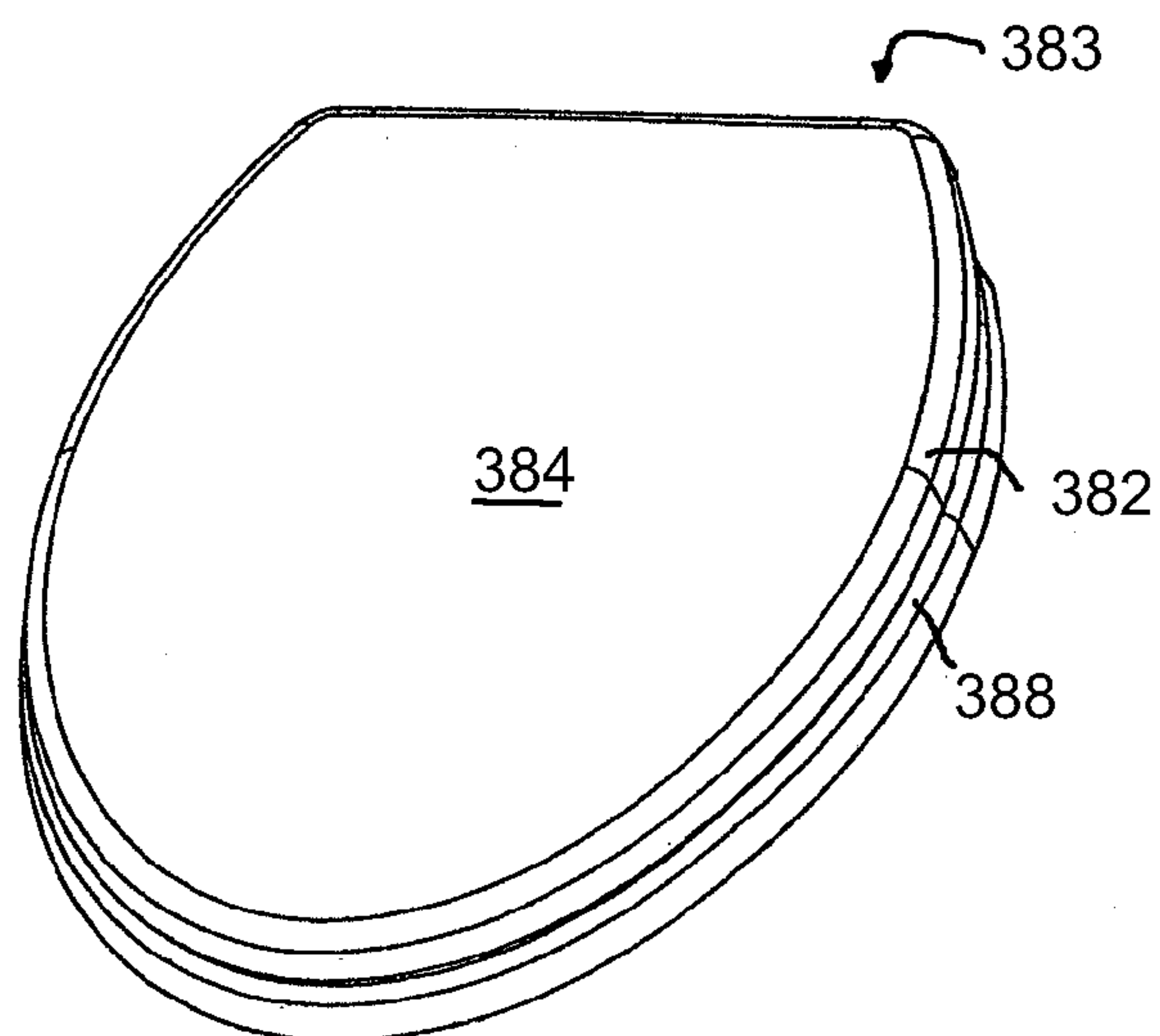


Fig. 23A

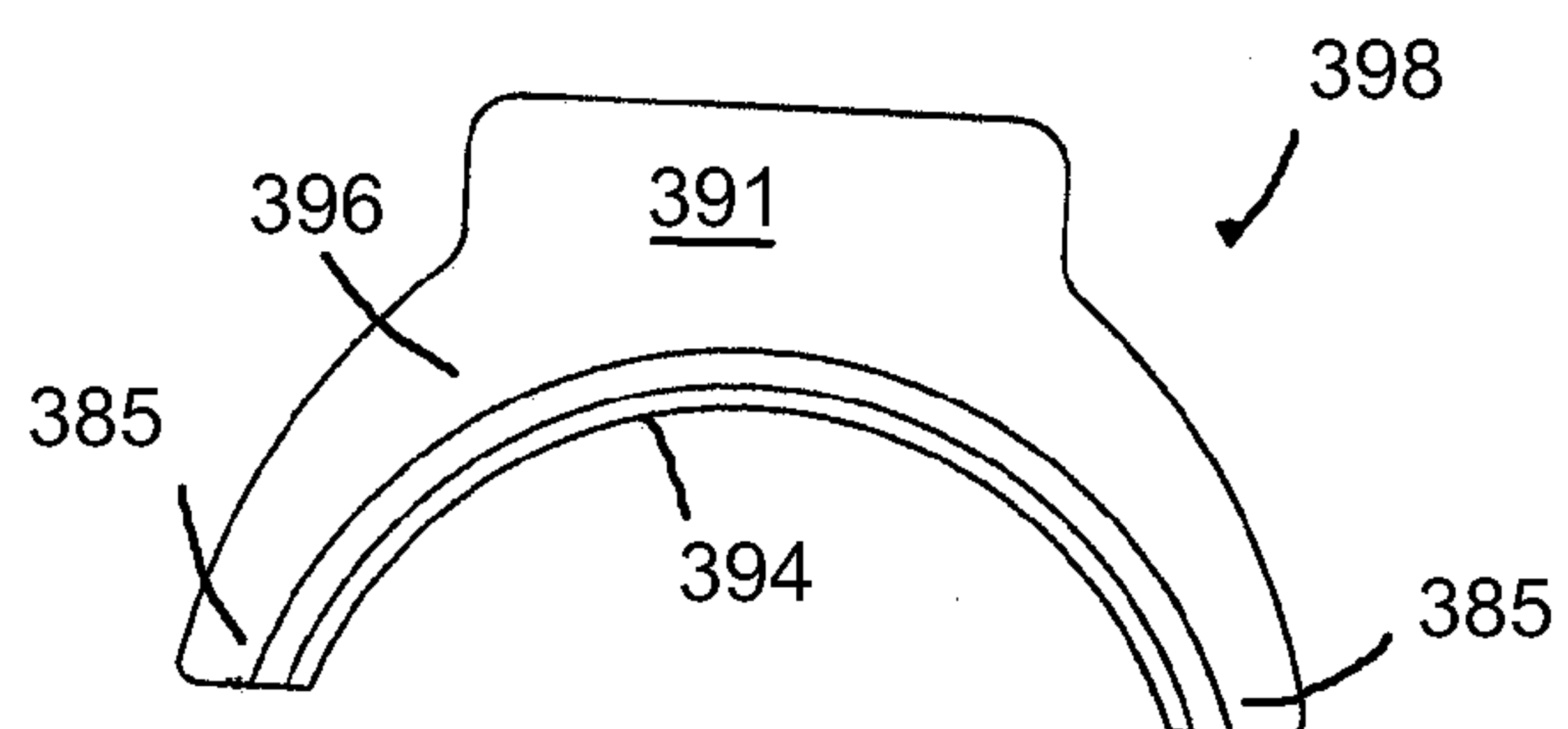


Fig. 23B

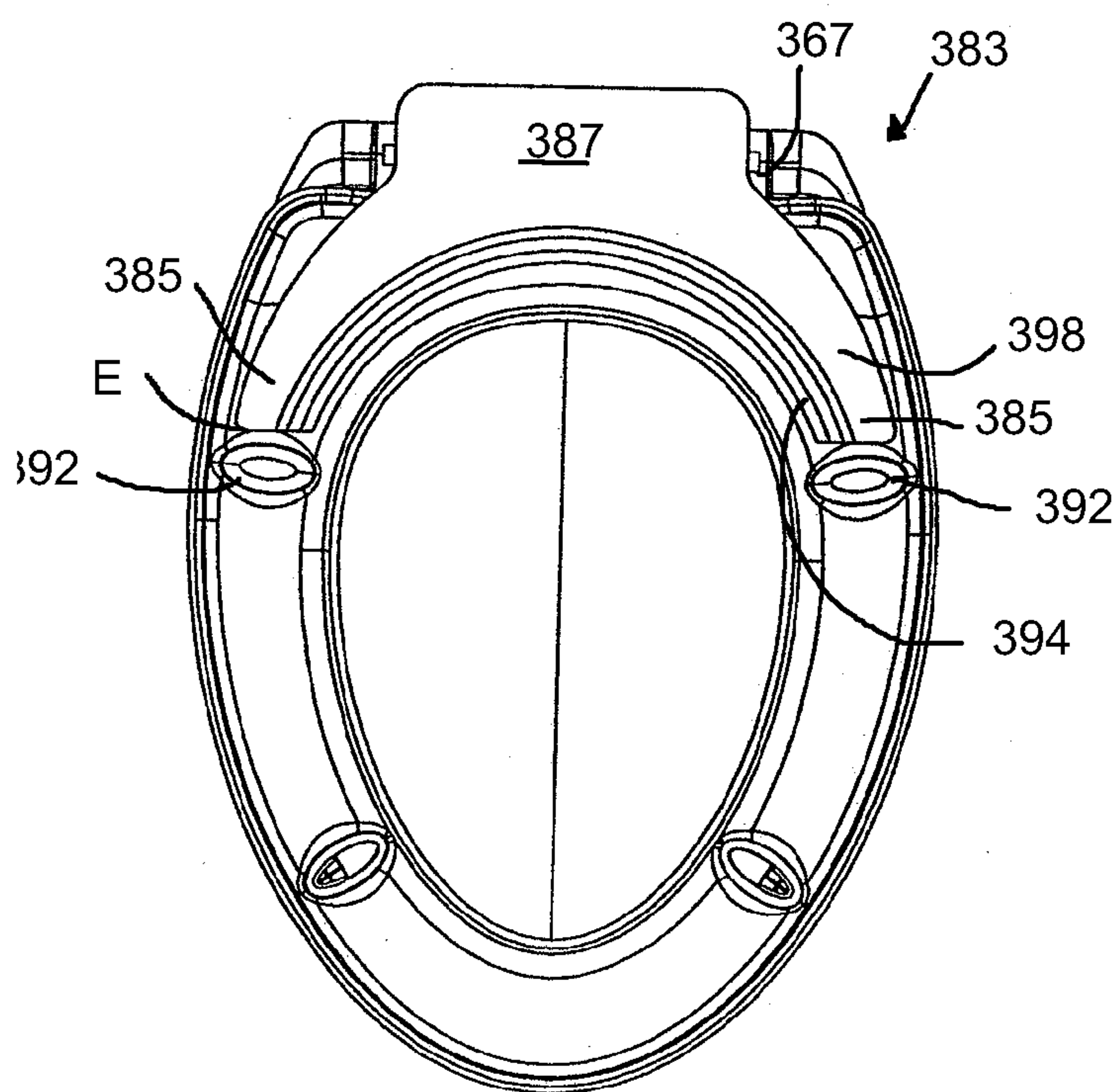


Fig. 22

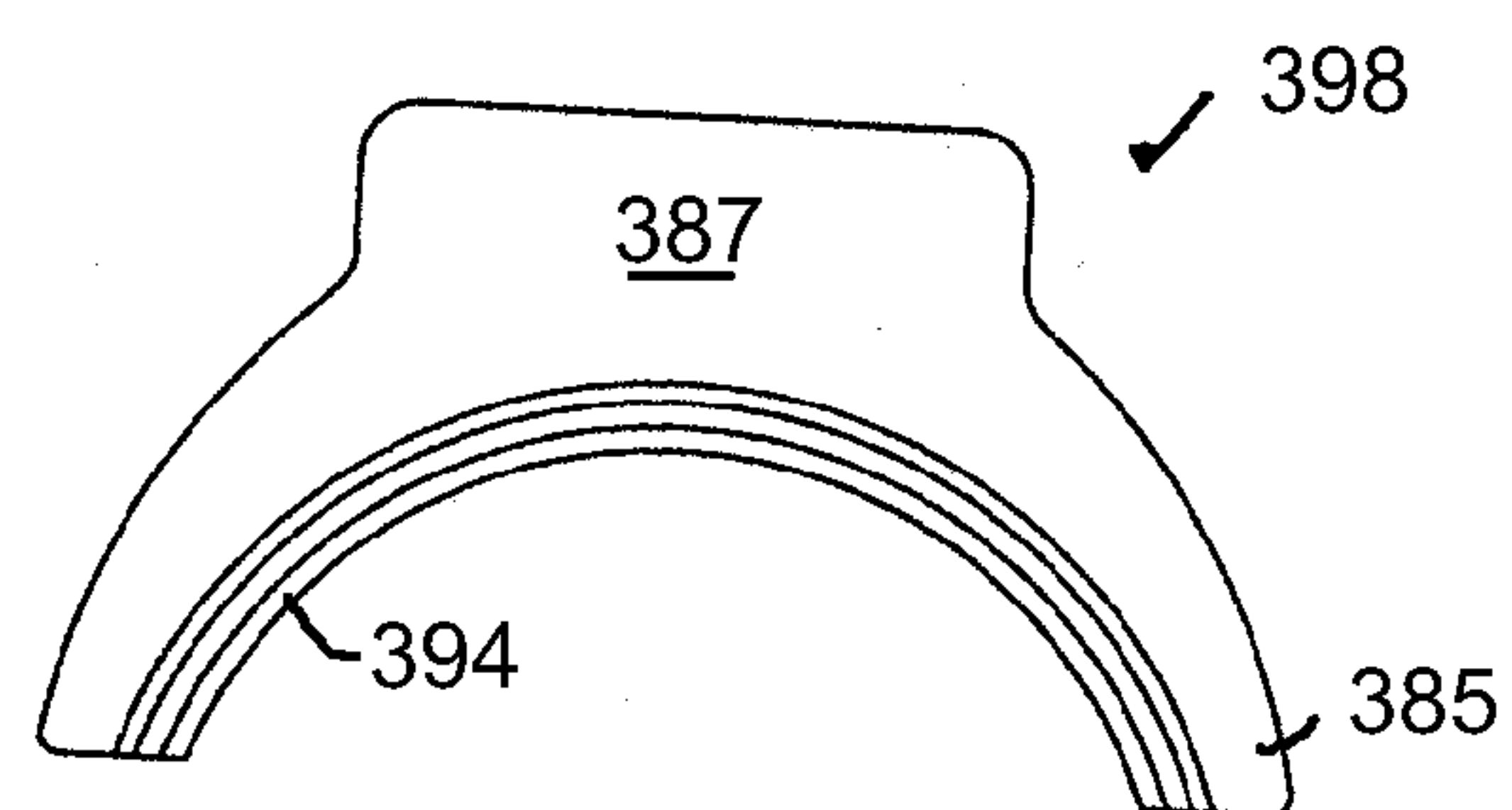


Fig. 23C

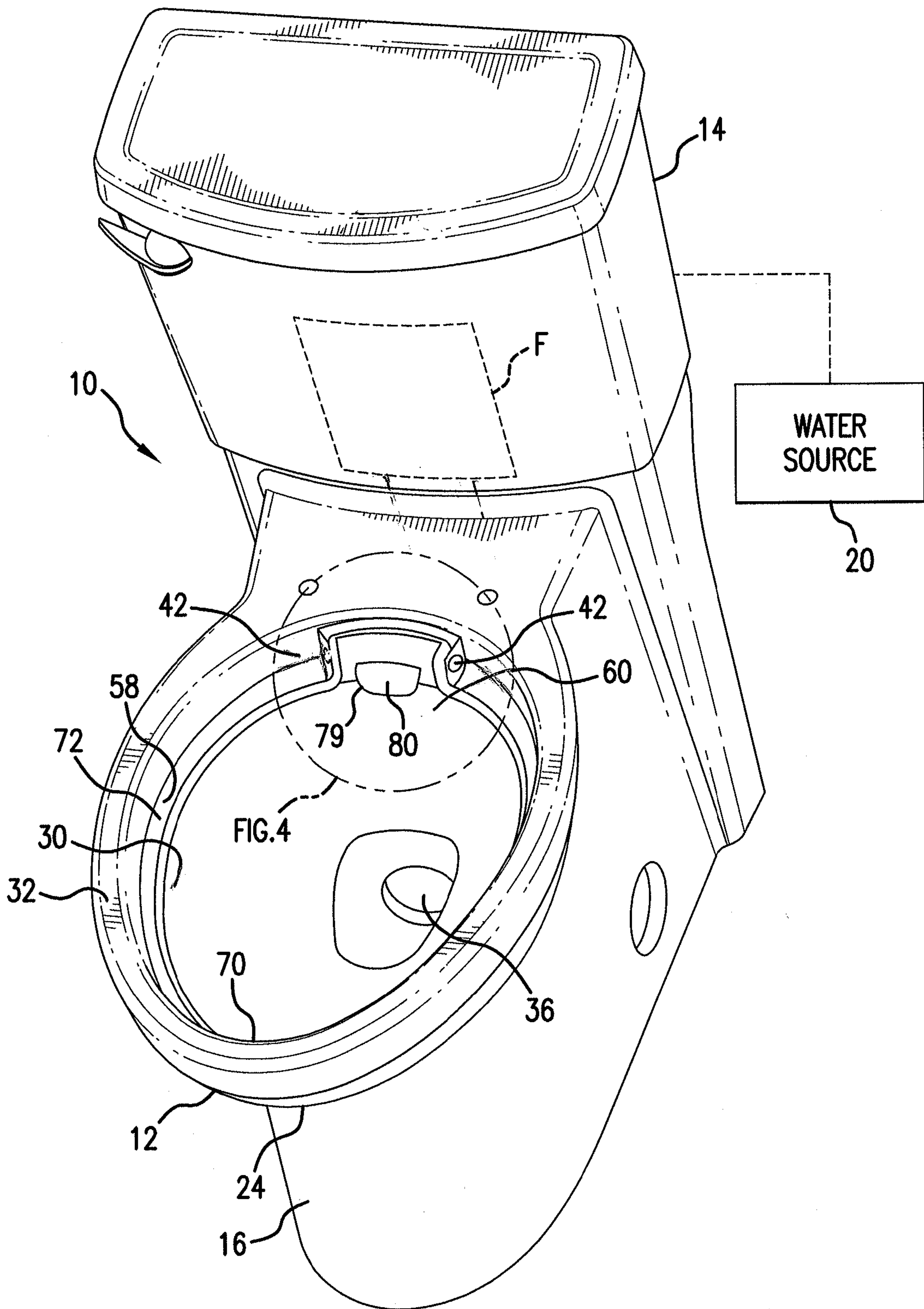


FIG. 1