



US 20220354075A1

(19) **United States**

(12) **Patent Application Publication**  
**Vandegrift**

(10) **Pub. No.: US 2022/0354075 A1**

(43) **Pub. Date: Nov. 10, 2022**

(54) **HIGH FLOW VENTURI NOZZLE, SYSTEM,  
METHOD OF MANUFACTURE AND  
METHOD OF USE**

**Publication Classification**

(51) **Int. Cl.**  
*A01G 31/02* (2006.01)  
*A01G 7/06* (2006.01)

(52) **U.S. Cl.**  
 CPC ..... *A01G 31/02* (2013.01); *A01G 7/06*  
 (2013.01); *C02F 1/4676* (2013.01)

(71) Applicant: **Gideon Vandegrift**, Sarasota, FL (US)

(72) Inventor: **Gideon Vandegrift**, Sarasota, FL (US)

(21) Appl. No.: **17/585,541**

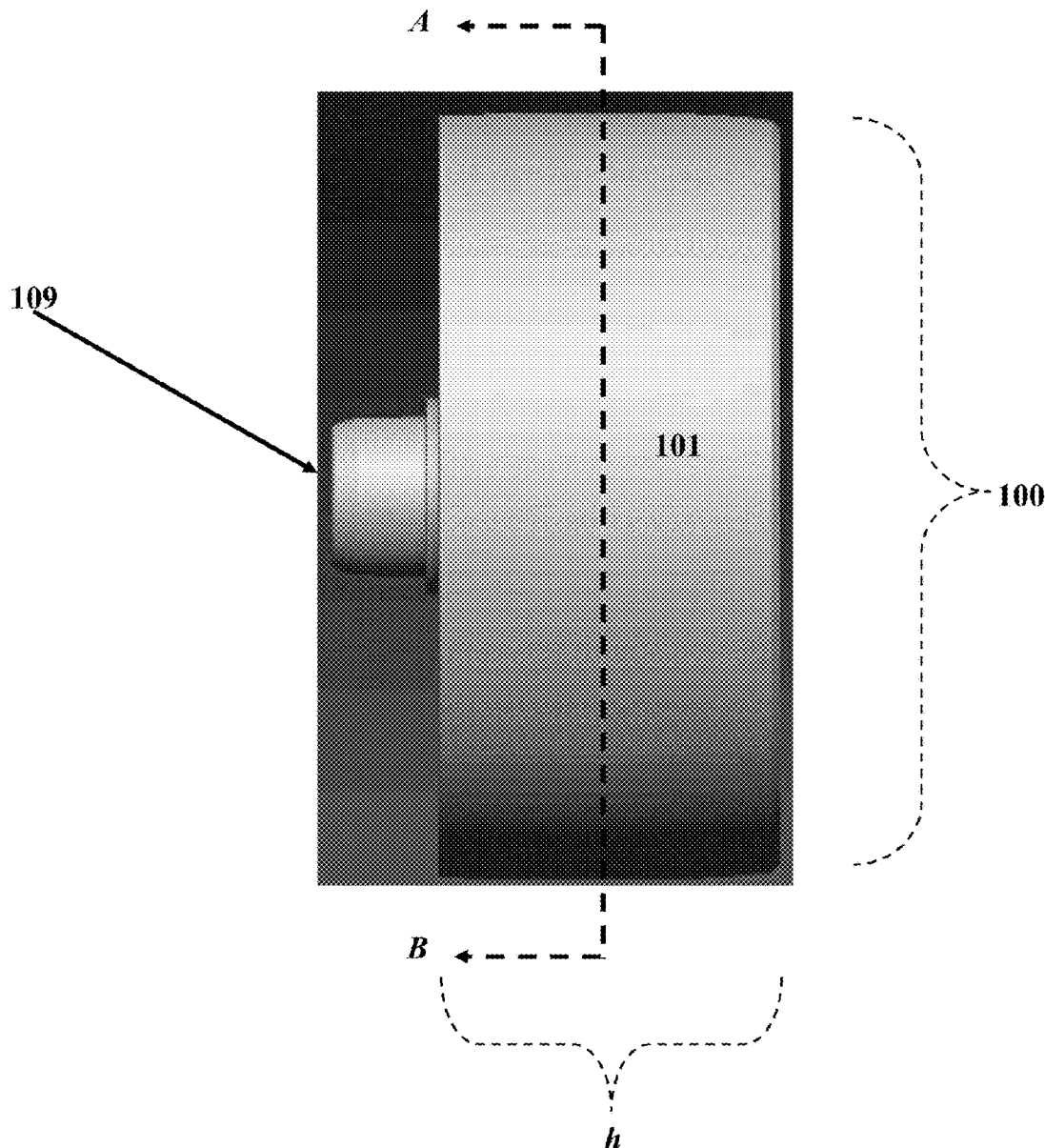
(22) Filed: **Jan. 26, 2022**

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 17/308,742,  
filed on May 5, 2021.

(57) **ABSTRACT**

The primary object of the present invention is directed to a High Flow Venturi Nozzle capable of diffusing gas into a large quantity of fast-moving liquid. A secondary object of the present invention is directed to a two-piece High Flow Venturi Nozzle assembly. Lastly, a third object of the present invention is directed to a method of manufacturing and using the two embodiments noted above.



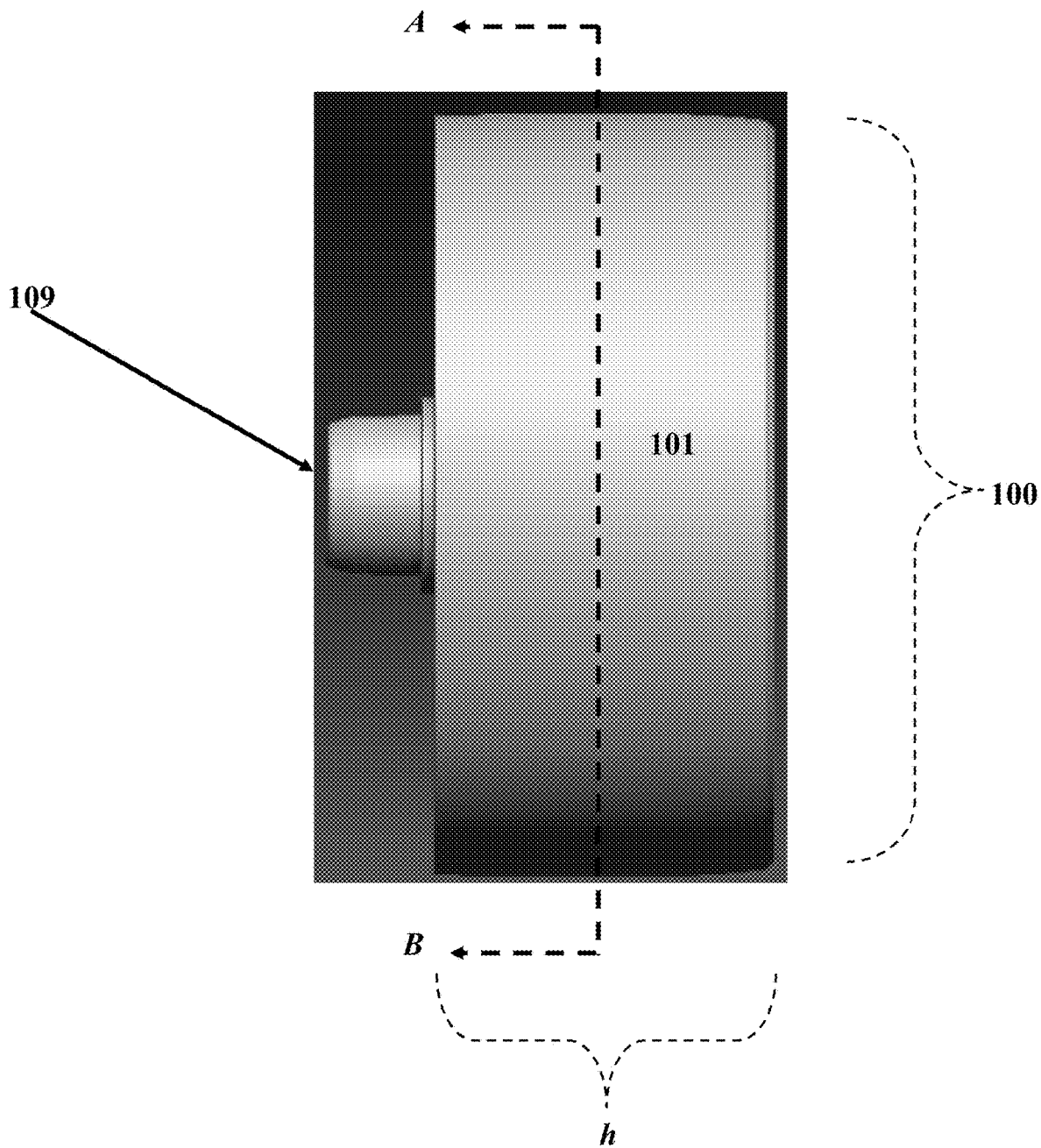


Figure 1

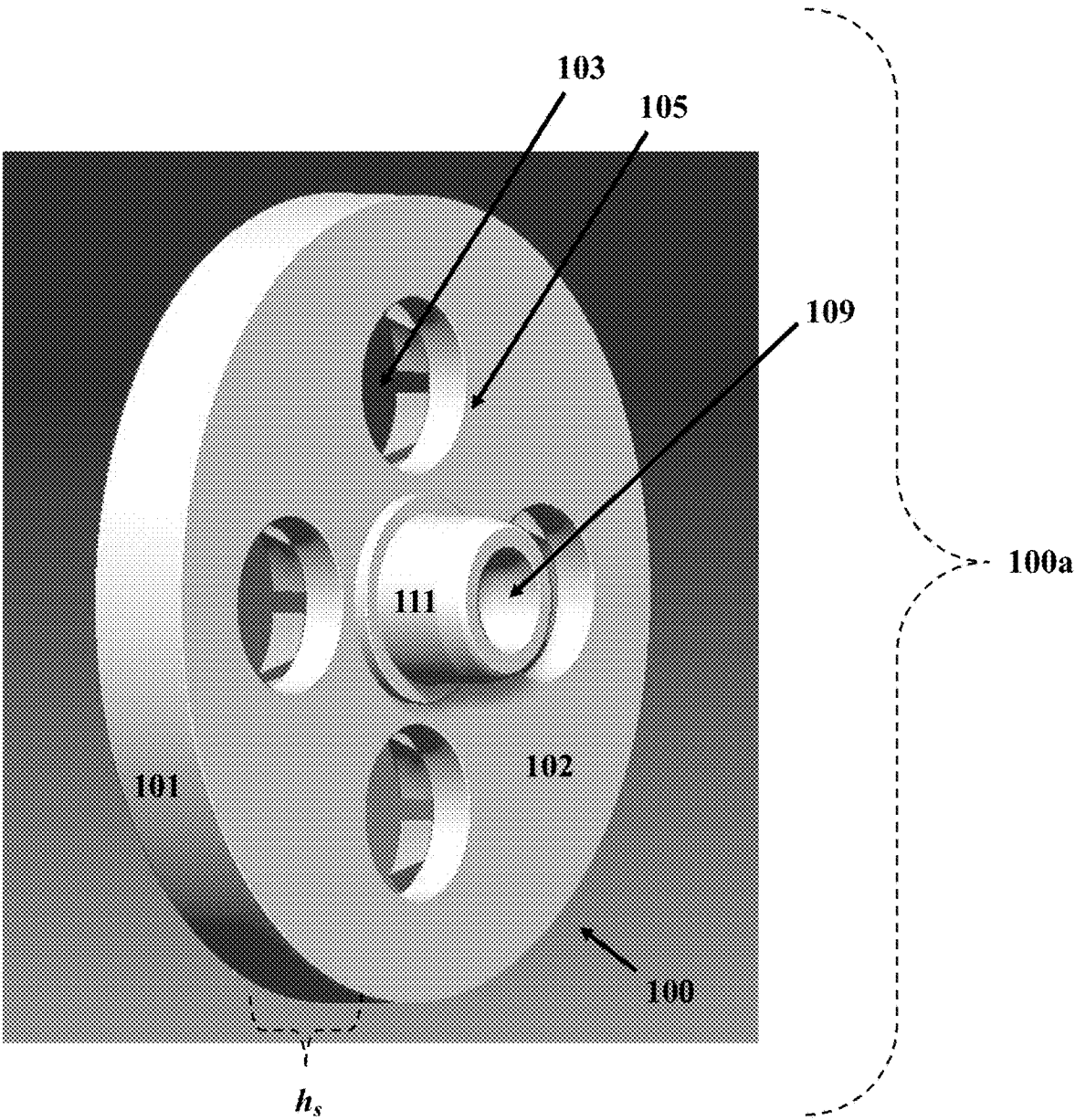


Figure 2

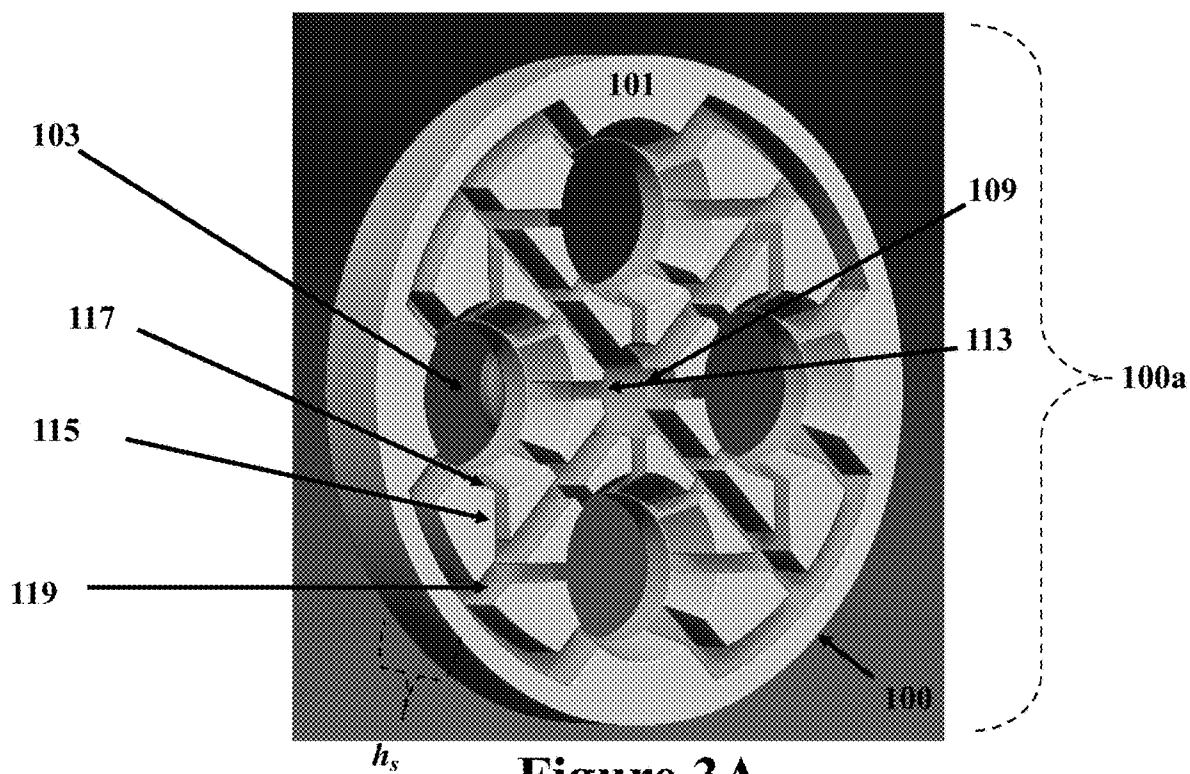


Figure 3A

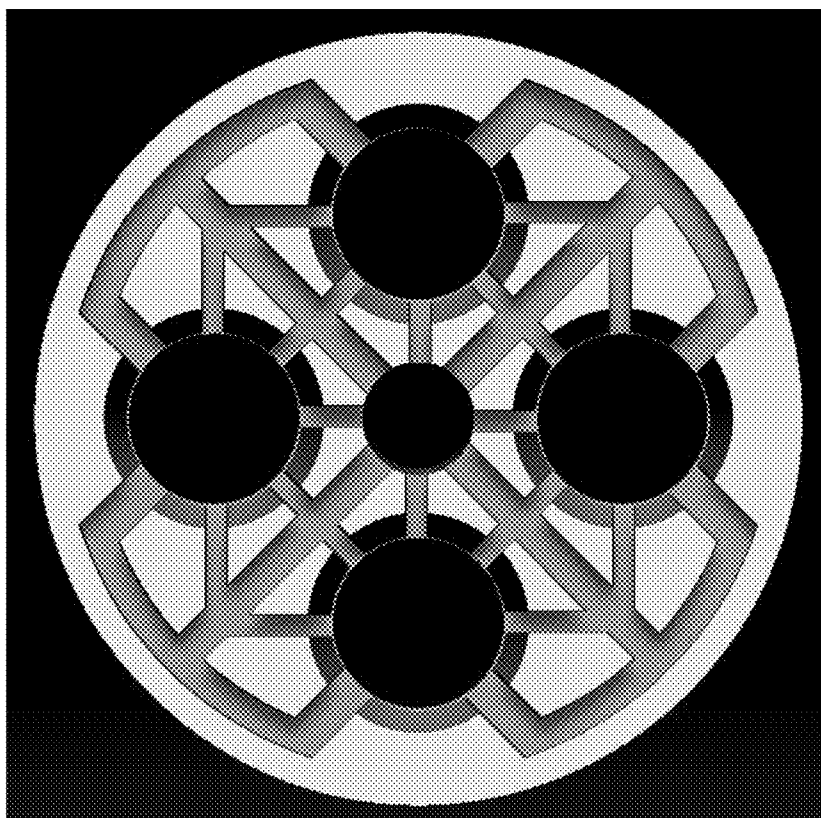


Figure 3B

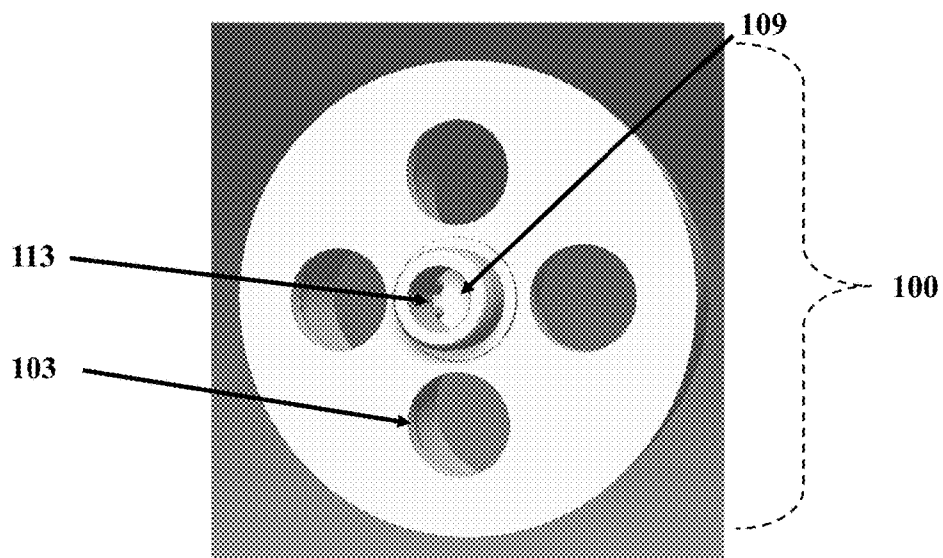


Figure 4A

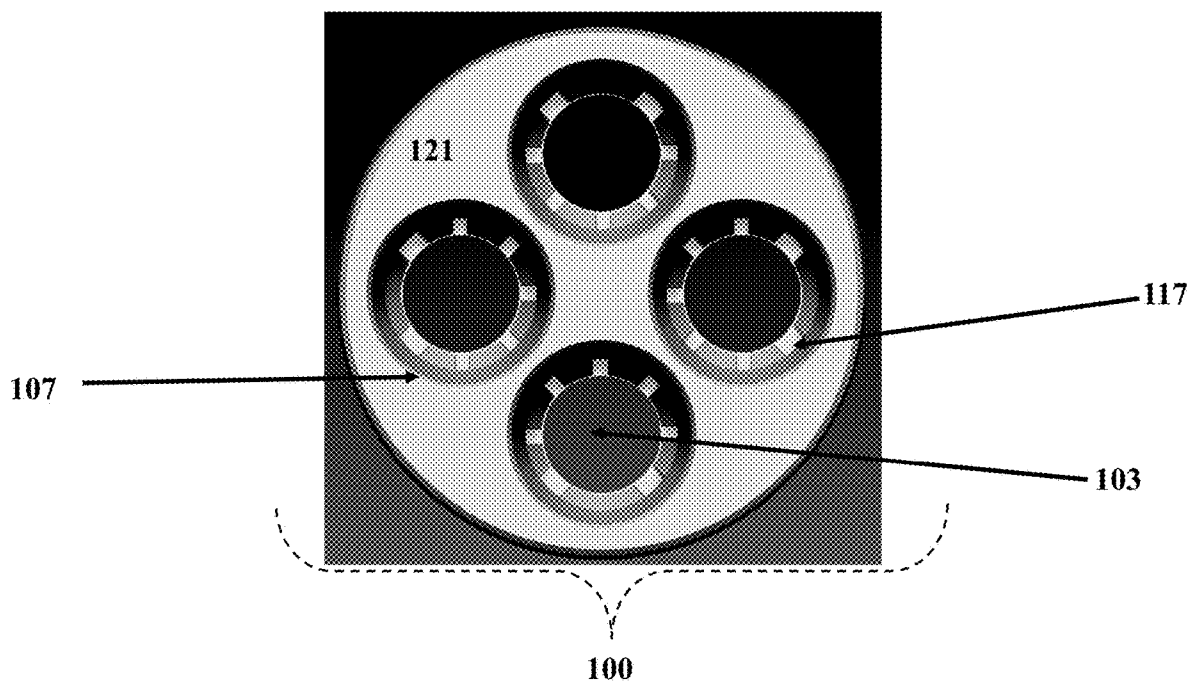


Figure 4B

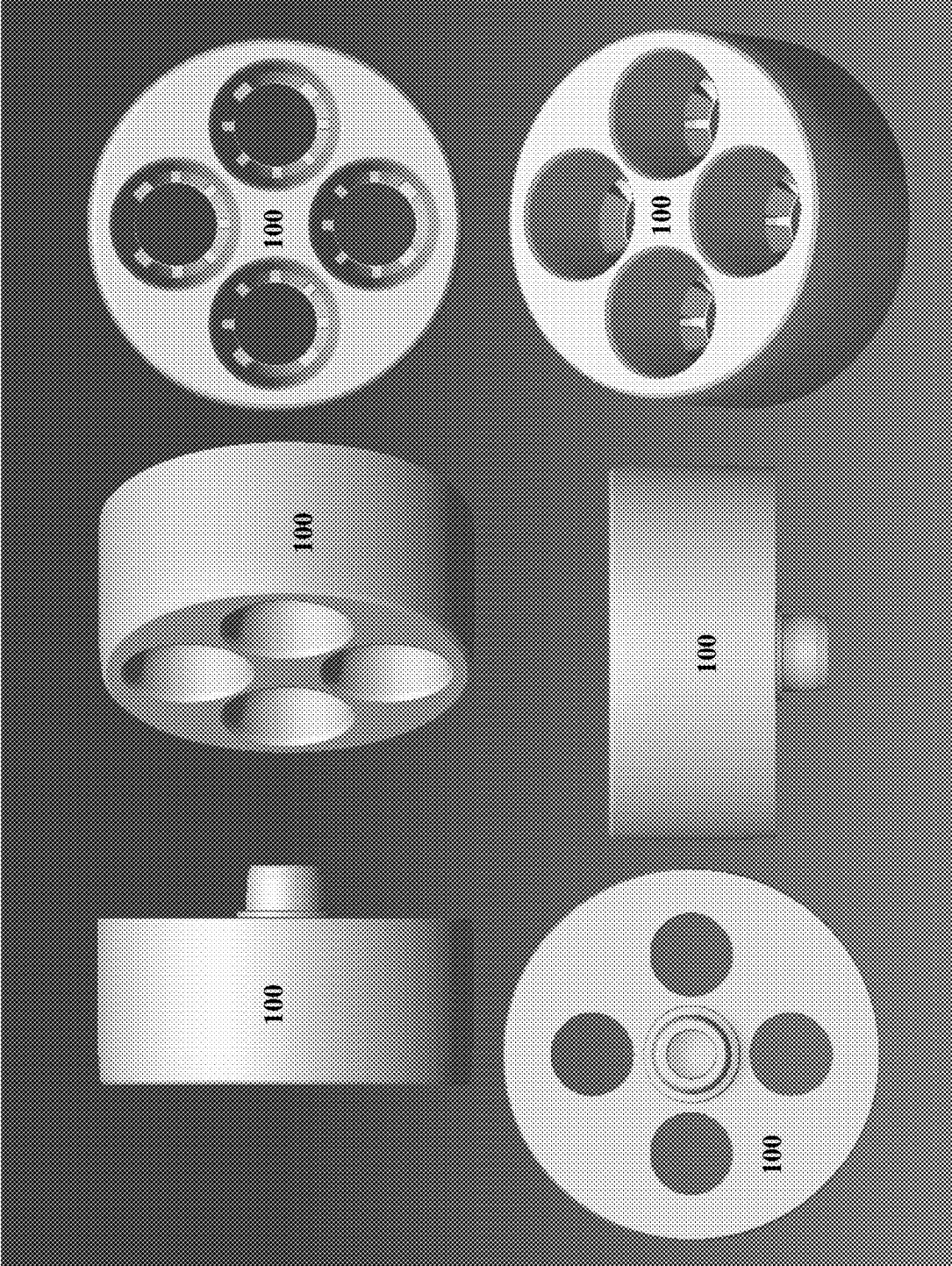


Figure 5

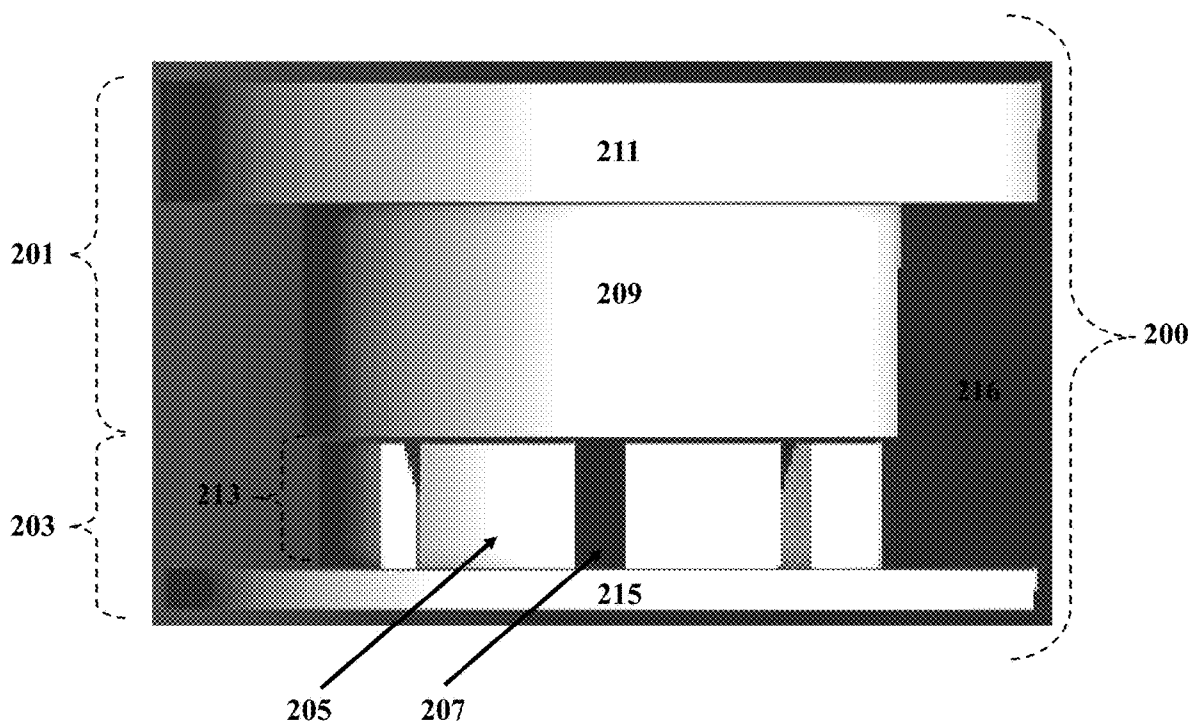


Figure 6A

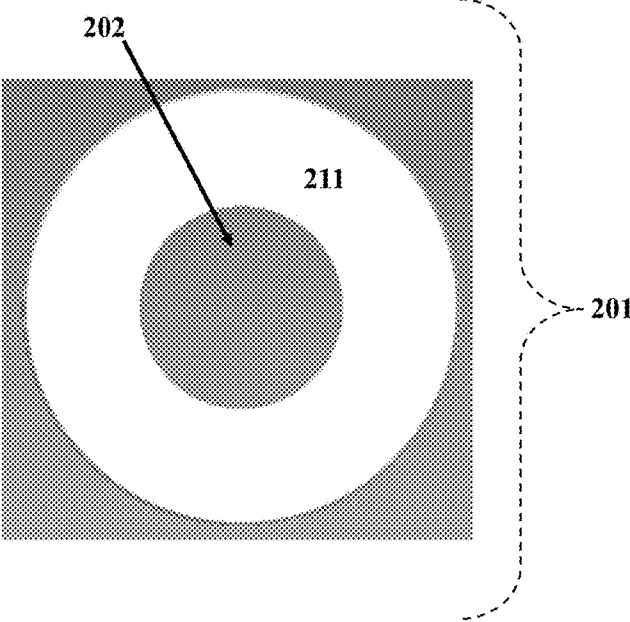


Figure 6B

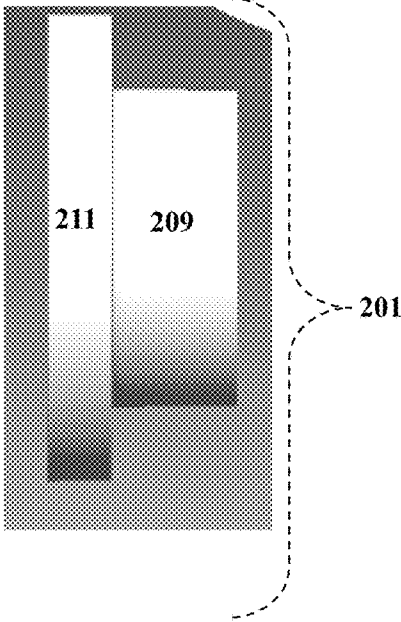


Figure 6C

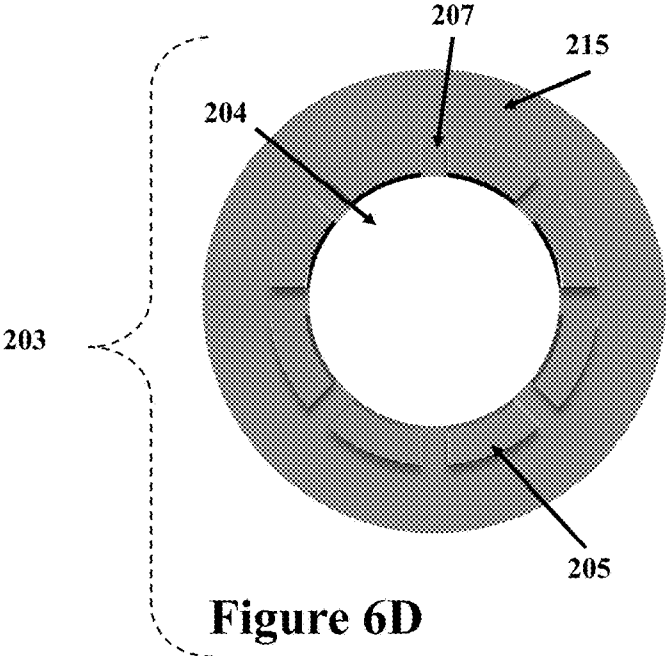


Figure 6D

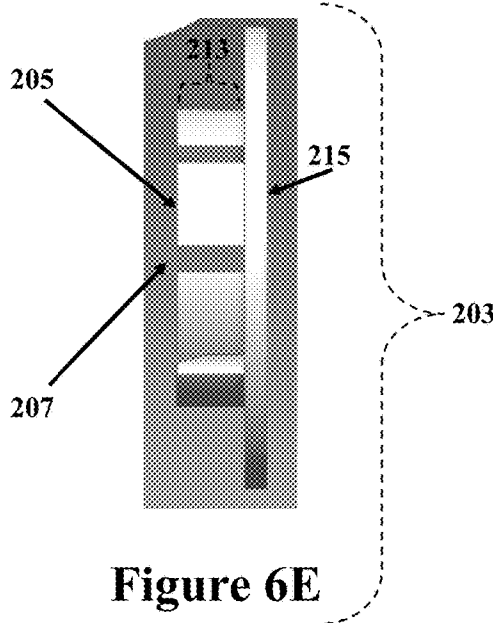


Figure 6E



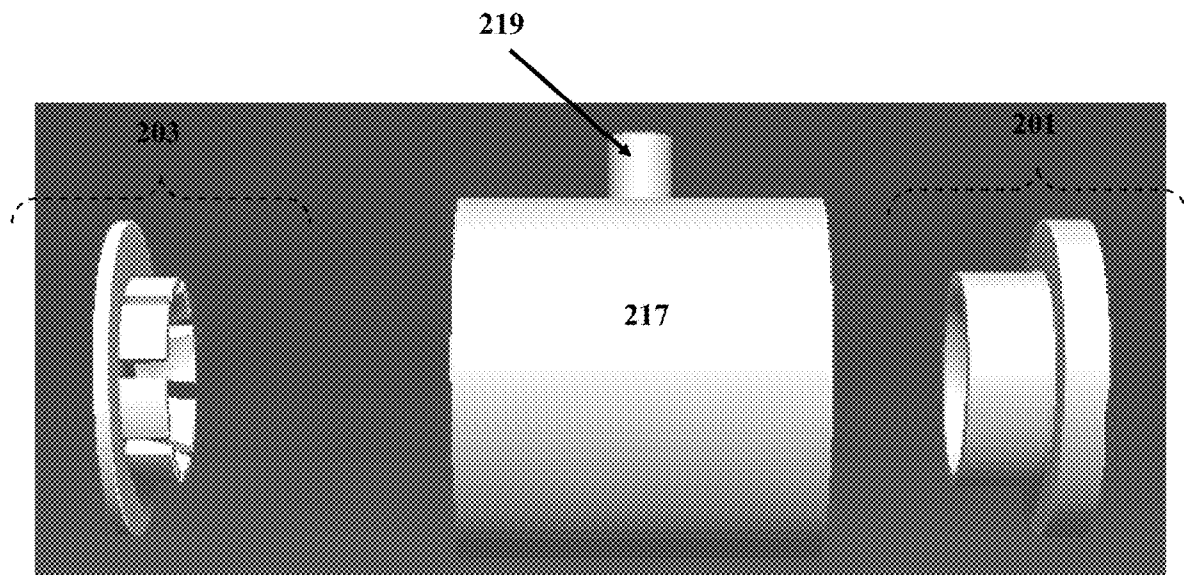


Figure 7A

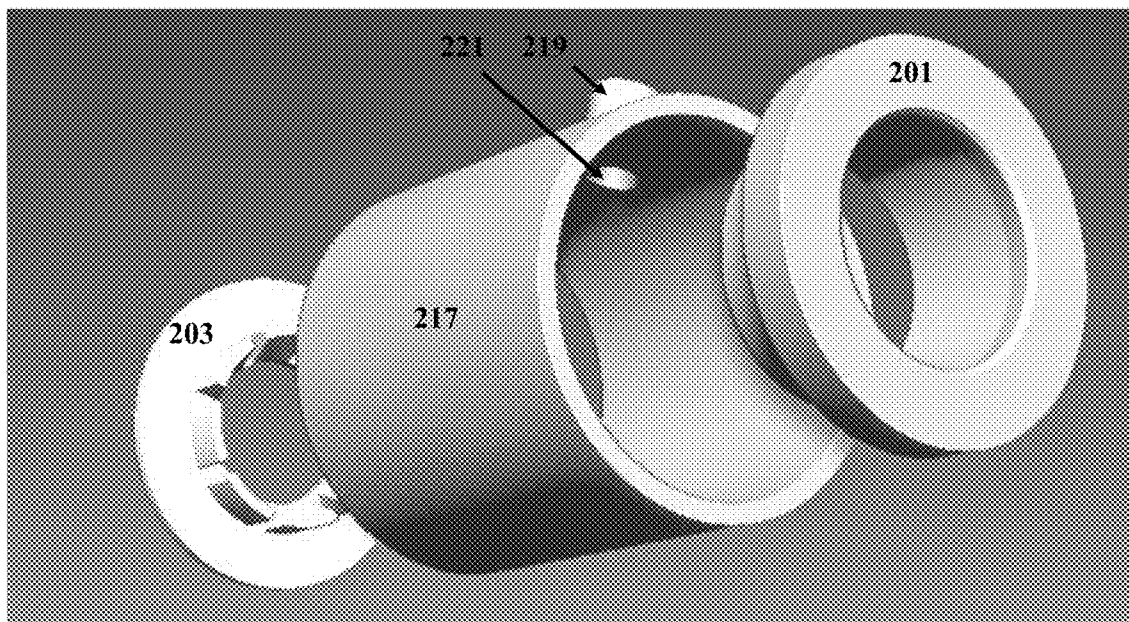


Figure 7B

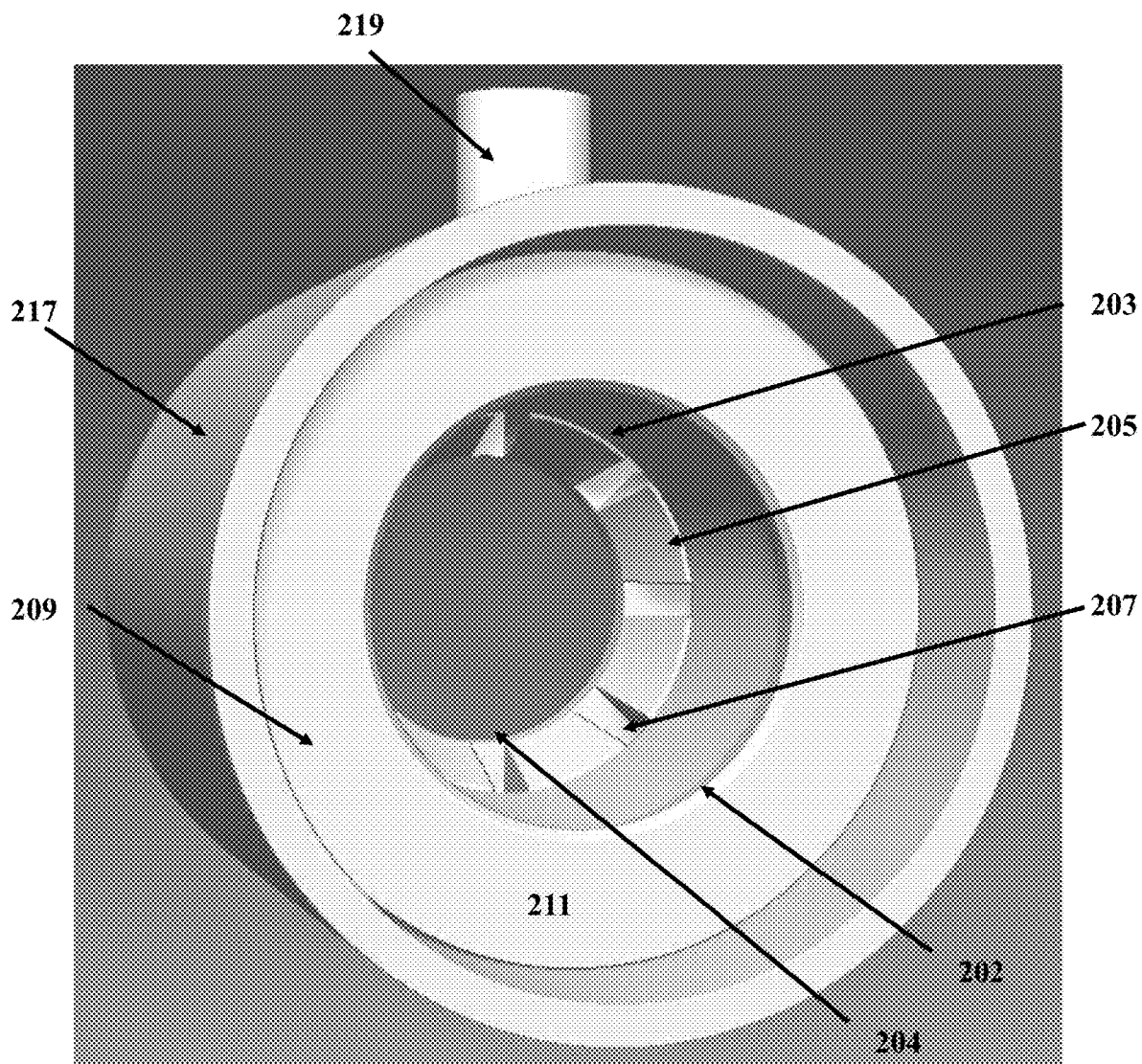
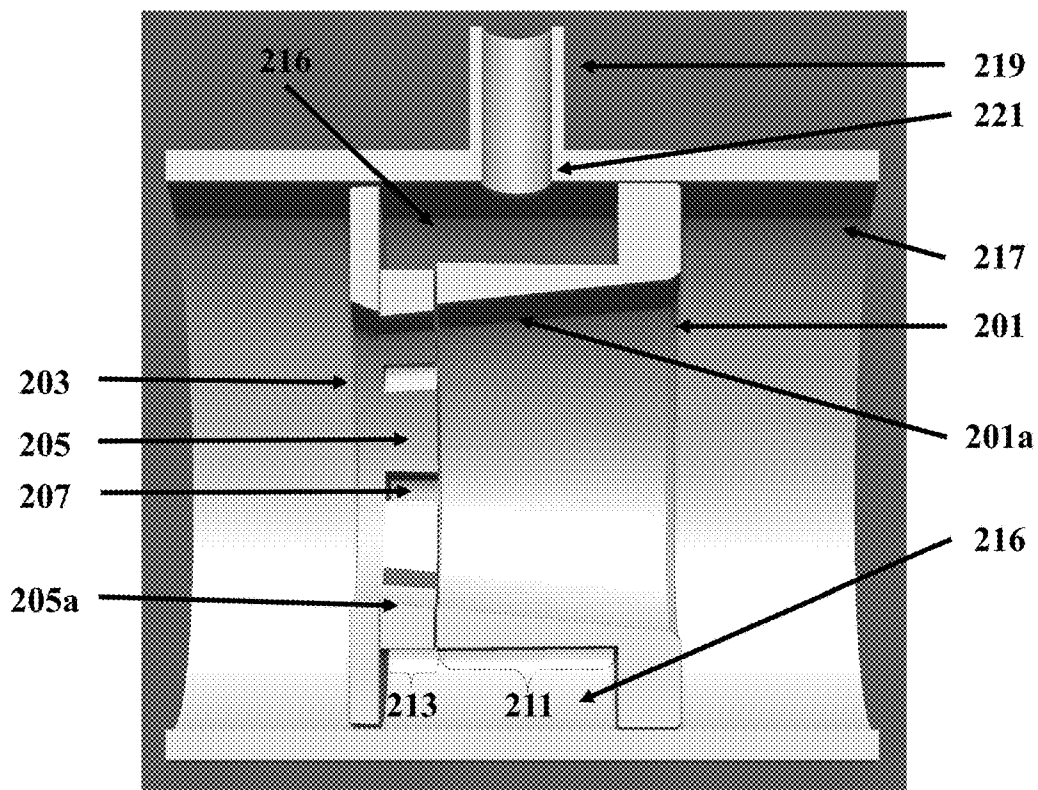
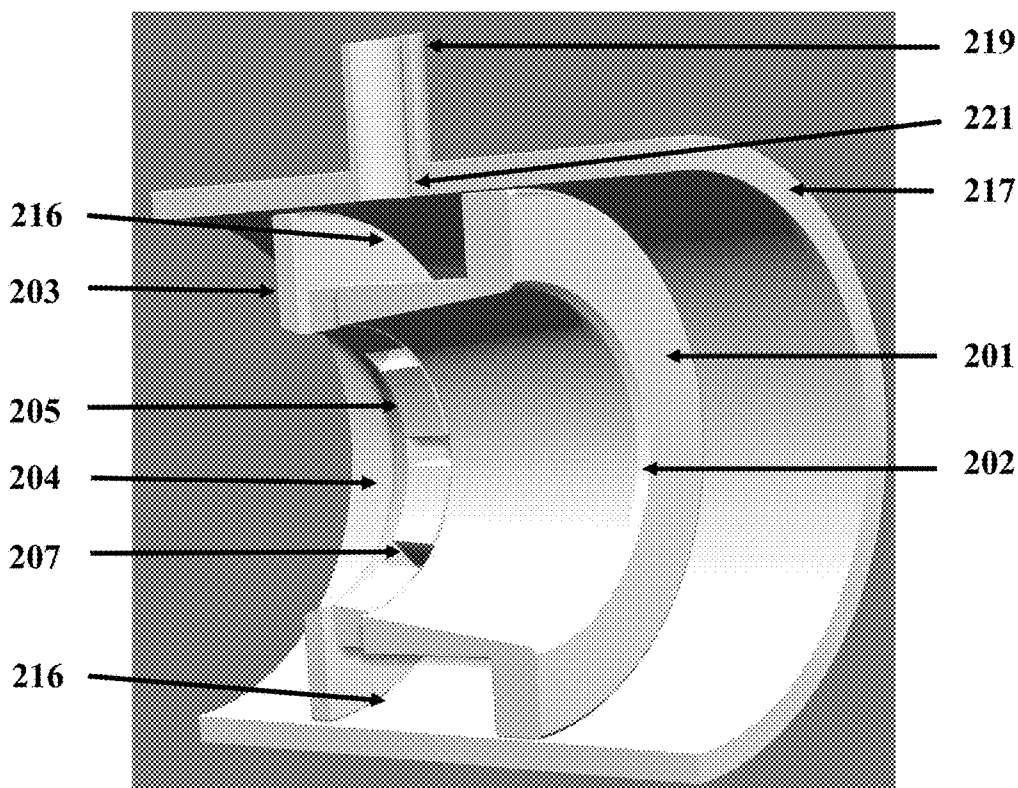


Figure 7C



**Figure 8A**



**Figure 8B**

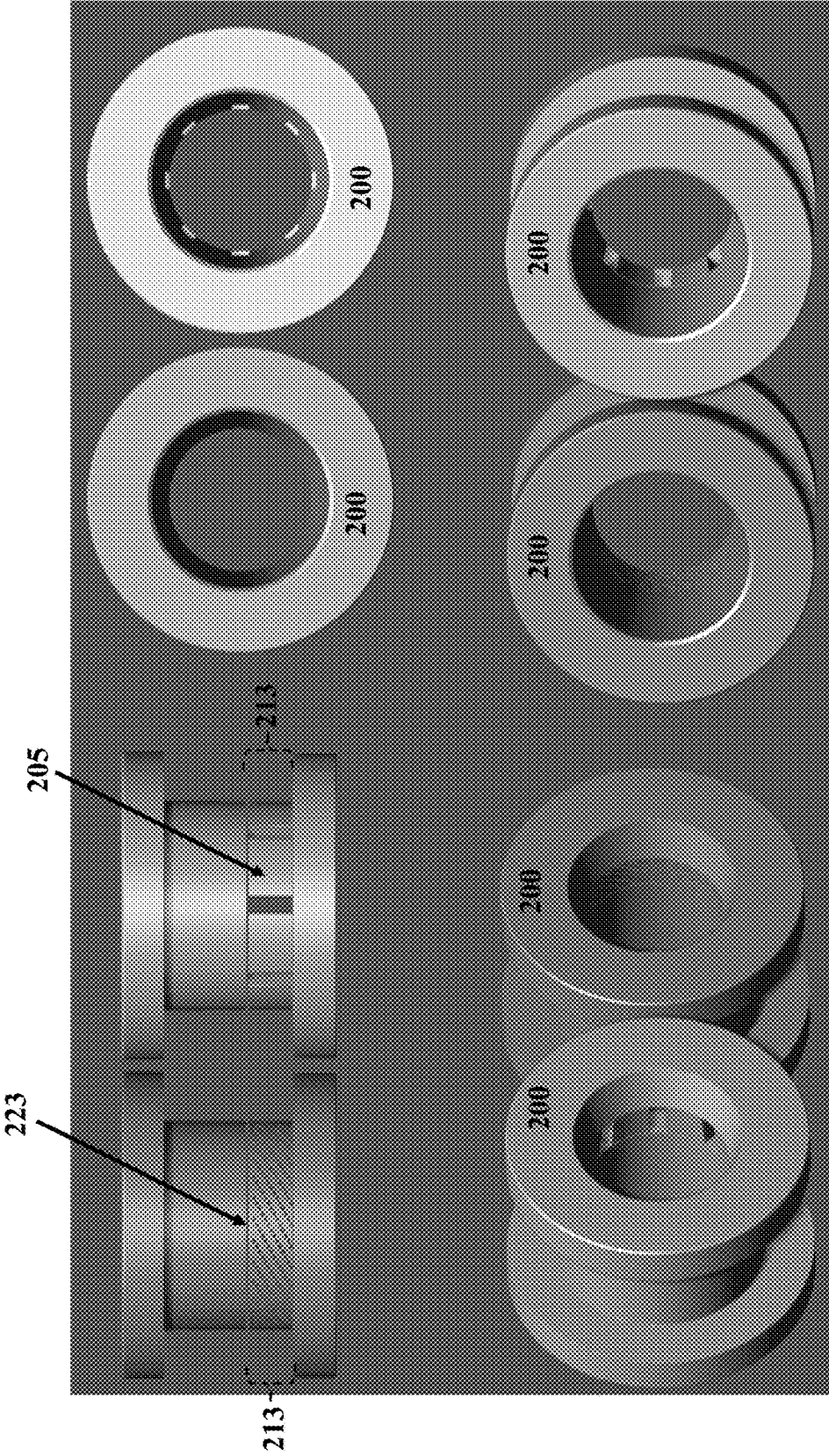


Figure 9A

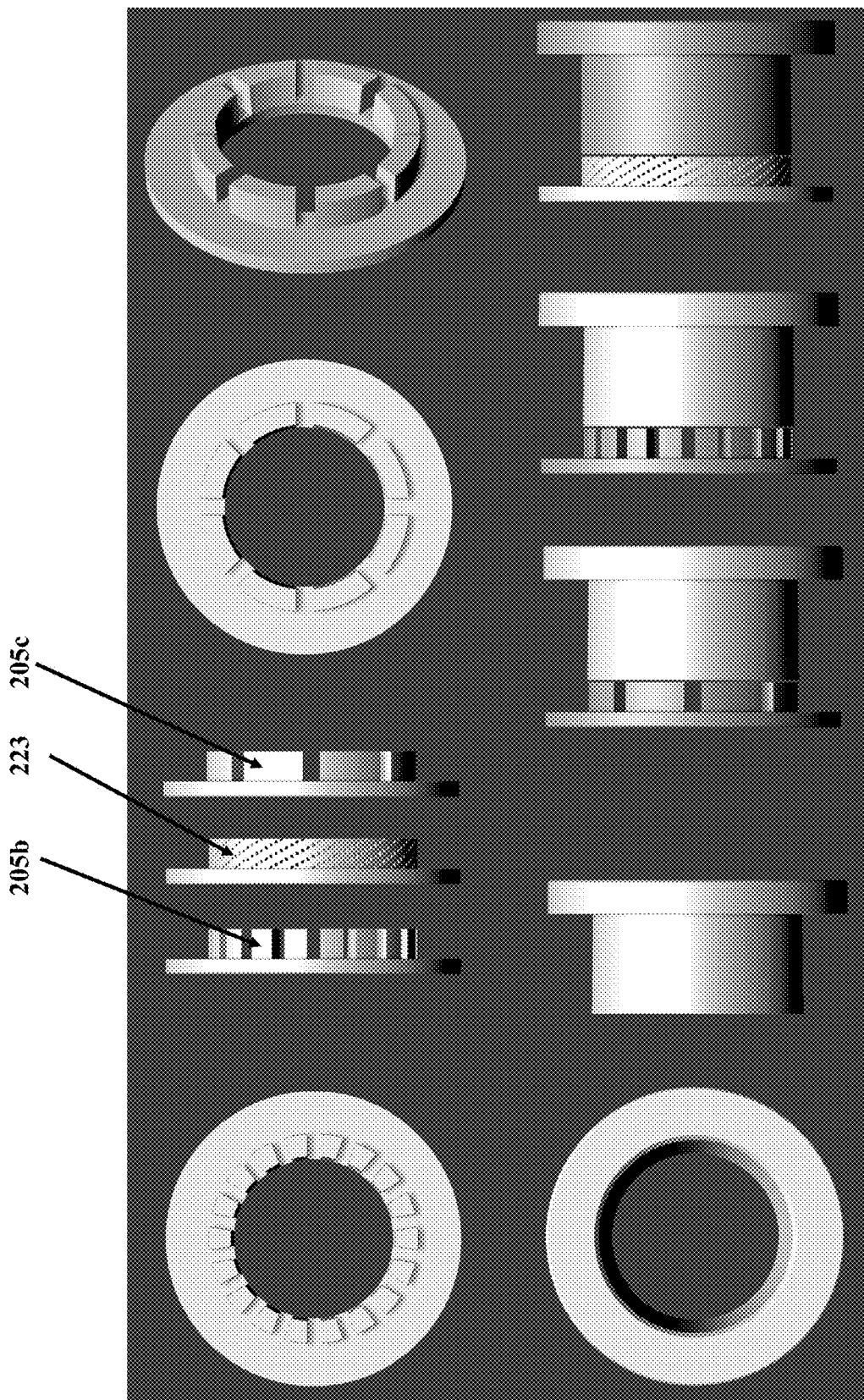
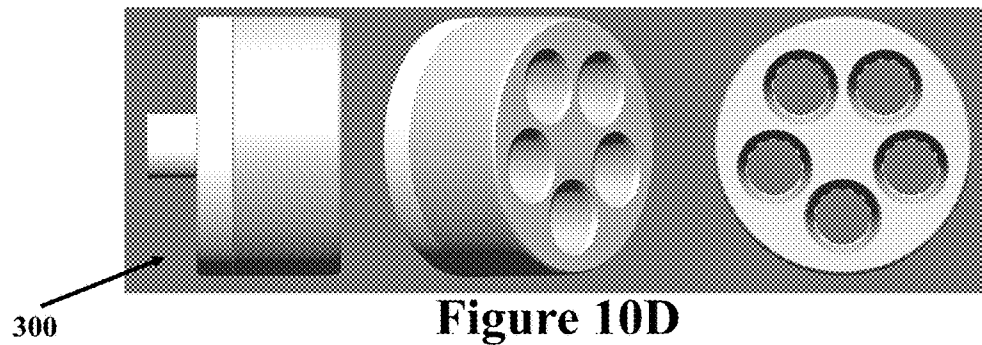
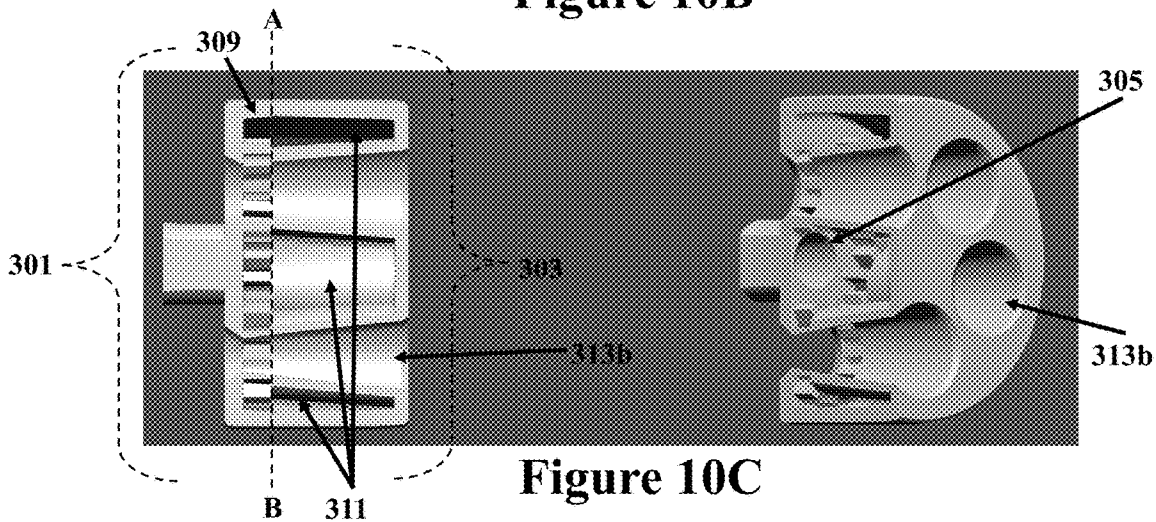
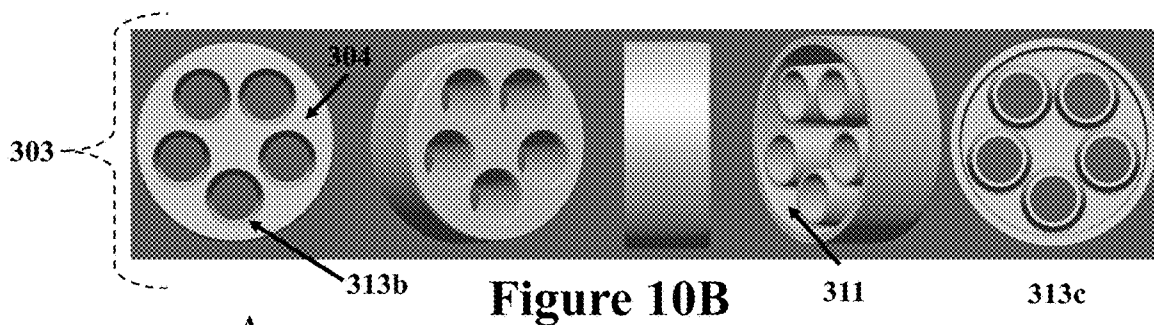
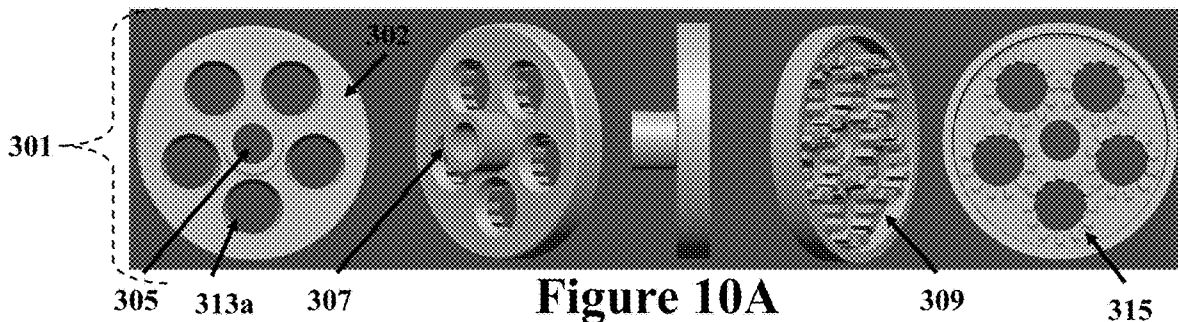


Figure 9B



**HIGH FLOW VENTURI NOZZLE, SYSTEM,  
METHOD OF MANUFACTURE AND  
METHOD OF USE**

**CROSS-REFERENCE TO RELATED  
APPLICATIONS**

**[0001]** This application is a continuation-in-part of U.S. patent application Ser. No. 17/308,742 filed on May 5, 2021 (pending) entitled “Multiple-Venturi Nozzle, System, Method of Manufacture and Method of Use.” The entire disclosure of that application is hereby incorporated herein by reference.

**BACKGROUND OF THE INVENTION**

**[0002]** First discovered by the Italian physicist Giovanni Battista Venturi in 1797, the “Venturi effect” is the name for a natural phenomenon that sees a reduction in fluid pressure when a fluid flows through a constricted section (or choke) of a pipes. In an idealize state, an incompressible fluid’s: (a) velocity must increase as it passes through a constriction under the principle of mass continuity; and (b) static pressure must decrease as it passes through a constriction under the principle of conservation of mechanical energy (i.e., Bernoulli’s principle). Put another way, any “gain” in kinetic energy a fluid attains by its increased velocity through a constriction is balanced by a “drop” in pressure.

**[0003]** As noted above, this application is a continuation-in-part of U.S. patent application Ser. No. 17/308,742 (the “Parent Application”). In the Parent Application, a novel multiple-venturi nozzle was disclosed (along with a system, method of manufacture and method of using same). This multiple-venturi nozzle was designed to create a high degree of gas diffusion into a liquid while maintaining a relatively low flow rate: perfect for applications such as oxygenating water in hydroponic applications where high dissolved oxygen and low flow rate are ideal conditions.

**SUMMARY OF THE INVENTION**

**[0004]** The primary object of the present invention is directed to a High Flow Venturi Nozzle (“HFVN”) apparatus capable of diffusing gas into a large quantity of fast-moving liquid. For example, in many water-treatment and aquacultural applications, it is necessary to diffuse air (or other gasses) into a fast-moving stream of water. As noted above, Traditional Venturi Nozzles generally are unable to do this; however, the present invention is capable of accommodating a high flow rate while still accomplishing the task of diffusing gas into the high-flow liquid.

**[0005]** Another object of the present invention is an embodiment of the HFVN generally comprising: (a) a body having at least one choke extending through said body; (b) a manifold (to which an outside gas supply can be connected); (c) at least one manifold outlet connected to each choke; and (d) an internal “path” system connecting the manifold to each manifold outlet (and, thus, to each choke). In this way, when a gas is connected to the manifold (e.g., by connecting a gas supply to the manifold via a tube and using a manifold nipple), the gas will flow from the manifold, through the internal “path” system and out into the choke through the manifold outlets. Thus, when a fluid (especially a fluid which is flowing quickly) is passed through the chokes, a venturi effect will occur at each manifold outlet.

**[0006]** Another object of the present invention is an HFVN Assembly generally comprising: (a) a female cap; and a (b) male cap; which is designed to be inserted into a pipe with a tee having a tee opening (commonly known as a “reducing tee”). The female cap has a body and a protruding flange. The female cap also has a centrally located hole which extends throughout both the body and the flange. The male cap likewise has a body, a protruding flange and a centrally located hole which extends throughout both the body and the flange. However, the male body further comprises at least one (preferably a plurality) of fins and manifold outlets. When the male and female caps are joined together inside a pipe: (i) they define a pocket of space whereby the tee opening is in fluid communion with the manifold outlets; and (ii) they form a type of “choke” since the female cap opening and the male cap opening align to form one continuing opening. This allows water (or some other liquid) to flow through the pipe—creating a venturi effect at the manifold outlets. When the tee is connected to a gas source (e.g., air), such gas will be drawn into the pocket and through the manifold outlets where it will be diffused into the water (or other liquid).

**[0007]** Another object of the present invention is an HFVN Assembly wherein the manifold outlets further comprise a plurality of pinhole manifold outlets.

**BRIEF DESCRIPTION OF THE DRAWINGS**

**[0008]** FIG. 1 is a side view of an HFVN having a height  $h$  showing a plane  $\overline{AB}$  through the body of the HFVN.

**[0009]** FIG. 2 is a front perspective view of an HFVN segment (taken along plane  $\overline{AB}$  from FIG. 1) having a height  $h_s$  and having a plurality of chokes and a single manifold.

**[0010]** FIG. 3A is a rear perspective view of an HFVN segment (taken along plane  $\overline{AB}$  from FIG. 1) showing the interior structure of the HFVN.

**[0011]** FIG. 3B is a rear view of an HFVN segment (taken along plane  $\overline{AB}$  from FIG. 1) showing the interior structure of the HFVN.

**[0012]** FIG. 4A is a front perspective view of an HFVN having a plurality of chokes and a single manifold.

**[0013]** FIG. 4B is a rear view of an HFVN having a plurality of chokes and a single manifold.

**[0014]** FIG. 5 is a compilation showing several views of an HFVN having a plurality of chokes and a single manifold.

**[0015]** FIG. 6A is a side view of an HFVN assembly having a plurality of fins and manifold outlets.

**[0016]** FIG. 6B is a front view of a female cap portion of an HFVN assembly.

**[0017]** FIG. 6C is a side view of a female cap portion of an HFVN assembly.

**[0018]** FIG. 6D is a front rear view of a male cap portion of an HFVN assembly.

**[0019]** FIG. 6E is a side view of a male cap portion of an HFVN assembly.

**[0020]** FIG. 7A is a side exploded view of an HFVN assembly and a pipe having a tee.

**[0021]** FIG. 7B is a perspective exploded view of an HFVN assembly and a pipe having a tee.

**[0022]** FIG. 7C is a perspective view of an HFVN assembly attached to a Pipe having a Tee.

**[0023]** FIG. 8A is a side cutaway view of an HFVN assembly (comprising a female cap and a male cap).

**[0024]** FIG. 8B is a perspective cutaway view of an HFVN assembly (comprising a female cap and a male cap).

[0025] FIG. 9A is a compilation showing several different views of two embodiments of HFVN assemblies.

[0026] FIG. 9B is a compilation showing several different views of three embodiments of HFVN assemblies.

[0027] FIG. 10A is a compilation of different front, side and perspective views of a top piece of a two-piece HFVN.

[0028] FIG. 10B is a compilation of different front, side and perspective views of a bottom piece of a two-piece HFVN.

[0029] FIG. 10C is a compilation of a side and perspective cutaway view of a two-piece HFVN.

[0030] FIG. 10D is a compilation of different side, perspective and rear views of an assembled two-piece HFVN.

#### REFERENCE NUMERAL CHART

[0031] For purposes of describing the preferred embodiment, the terminology used in reference to the number components in the drawings is as follows:

100	High Flow Venturi Nozzle (“HFVN”)
100a	High Flow Venturi Nozzle (“HFVN”) Segment
$h_s$	Segment Height
101	Body
102	Top Surface
103	Choke
105	Choke Inlet
107	Choke Outlet
109	Manifold
111	Manifold Nipple
113	Manifold Inlets
115	Manifold Channel
117	Manifold Outlet
119	Manifold Passage
121	Bottom Surface
H	Height
200	HFVN Assembly
201	Female Cap
201a	Female Cap Pitch
202	Female Cap Opening
203	Male Cap
204	Male Cap Opening
205	Fins
205a	Fin Pitch
205b	Small Fins
205c	Large Fins
207	Manifold Outlets
209	Female Body
211	Female Flange
213	Male Body
215	Male Flange
216	Pocket
217	Pipe
219	Tee
221	Tee Opening
223	Pinhole Manifold Outlets
300	Two-Piece HFVN
301	Top Piece
302	Top Surface
303	Bottom Piece
304	Bottom Surface
305	Manifold
307	Manifold Nipple
309	Top Chamber
311	Bottom Chamber
313a	Top Choke
313b	Bottom Choke
315	Manifold Outlet

#### DETAILED DESCRIPTION OF THE INVENTION

[0032] FIG. 1 is a side view of an HFVN 100 having a Body 101 and a height h. The HFVN 100 shown in FIG. 1

includes a centrally located Manifold 109. FIG. 1 further depicts a plane  $\overline{AB}$  through the Body 101 of the HFVN 100 and parallel to the Manifold 109.

[0033] FIG. 2 is a front perspective view of an HFVN Segment 100a (taken along plane  $\overline{AB}$  from FIG. 1) having a height  $h_s$ . The HFVN 100 has at least one Manifold 109. In the embodiment shown in FIG. 2, the HFVN 100 includes a single Manifold 109 which is centrally located in the HFVN 100. The HFVN 100 further comprises a plurality of Chokes 103; each of which has a Choke Inlet 105 and a Choke Outlet 107 (not shown in FIG. 2) and extends from a Top Surface 102 of the HFVN 100 to a Bottom Surface 121 (not shown in FIG. 2) of the HFVN 100. In the embodiment shown in FIG. 2, the HFVN 100 includes four Chokes 103 which are equidistantly distributed in a radial pattern about the Manifold 109. A Manifold Nipple 111 extends outwardly from the Top Surface 102 of the HFVN 100. This manifold Nipple 111 may be dimensionally sized to accommodate a variety of hoses/tubing which, in turn, can be connected to a gas supply such as an air supply or an oxygen supply.

[0034] FIG. 3A is a rear perspective view of an HFVN segment 100a (taken along plane  $\overline{AB}$  from FIG. 1) showing the interior structure of the HFVN 100. Each Choke 103 has a connection to the Manifold 109. In the embodiment shown in FIG. 3A, such connection is accomplished by having the Manifold 109 in fluid connection with a Manifold Inlet 113 which, in turn, is in fluid connection with a plurality of Manifold Passages 119. Each Manifold Passage 119 is connected to at least one Manifold Channel 115. Each Manifold Channel 115 is connected to one of the Chokes 103. Thus, gas being passed through the Manifold 109 is able to travel through the Manifold 109, into the Manifold Inlet 113, through a manifold passage 119 down a manifold channel 115 come on and out into the choke 103 through a manifold outlet 117. Thus, there is a continuous fluid connection between the manifold 109 and each of the chokes 103. In this way, a gas may be connected to the Manifold 109 and diffused into a liquid (not shown) which is passing through the Chokes 103. When the Manifold 109 is connected to a gas supply (e.g., air), the small opening of the Manifold Outlets 117 creates a venturi effect as liquid (e.g., water) flows through the Chokes 103. Given the relatively large diameter of the Chokes 103, a high liquid flow rate can be achieved through the Chokes 103 while, thus, still diffusing gas into the liquid by means of the venturi effect generated at the Manifold Outlets 117 inside the Chokes 103. For example, if the HFVN 100 is placed inside a pipe (not shown in FIG. 3A), water or another liquid could flow through the pipe and through the HFVN 100.

[0035] FIG. 3B is a rear view of an HFVN segment 100a (taken along plane  $\overline{AB}$  from FIG. 1) showing the interior structure of the HFVN 100. This figure is included to more clearly show the fluid collections between the Manifold 109, Manifold Inlet 113, Manifold Passages 119, Manifold Channels 115, Manifold Outlets 117 and Chokes 103.

[0036] FIG. 4A is a front perspective view of an HFVN 100 having a plurality of Chokes 103 and a single Manifold 109. As can be seen in FIG. 4A, the plurality of Manifold Inlets 113 inside the Manifold 109 has the appearance of “grooves” or “fins.” As discussed earlier herein, each of these Manifold Inlets 113 is fluidly connected to one of the Chokes 103. This allows air or another gas to pass through the Manifold 109 and into the Chokes 103.



**[0037]** FIG. 4B is a rear view of an HFVN 100 having: (a) a plurality of Chokes 103 extending from the Top Surface 102 (not shown in FIG. 4B) to the Bottom Surface 121); and (b) and a single Manifold 109 (not shown in FIG. 4B). As noted elsewhere herein, each Choke 103 includes at least one Manifold Outlet 117 which is fluidly connected to the Manifold 109. Fluid travels from the Choke inlet 105 (not shown in FIG. 4B) through the Choke 103 and exits through the Choke Outlet 107.

**[0038]** FIG. 5 is a compilation showing several views of an HFVN 100 having a plurality of Chokes 103 (not labeled in FIG. 5) and a single Manifold 109 (not shown in FIG. 5).

**[0039]** FIG. 6A is a side view of an HFVN Assembly 201 comprising: (a) a Female Cap 201 having a Female Cap Opening 202 (not shown in FIG. 6A); and (b) a Male Cap 203 having a Male Cap Opening 204 (not shown in FIG. 6A). Said Female Cap 201 further comprises a Female Body 209 connected to a Female Flange 211 that extends radially beyond the edges of the Female Body 209. Said Male Cap 203 further comprises a Male Body 213 and a Male Flange 215 that extends radially beyond the edges of the Male Body 213. The Male Body 213 further comprises a series of Fins 205 interspaced with openings (i.e., Manifold Outlets 207). When the Female Cap 201 and the Male Cap 203 are placed together, they define the boundaries of an area of space (i.e., a Pocket 216). Thus, as shown in FIG. 6A, the Pocket 216 is in fluid communion with the Manifold Outlets 207.

**[0040]** FIG. 6B is a front view of a Female Cap 201 of an HFVN Assembly 200. As shown in FIG. 6B, the Female Cap Opening 202 is centrally located in the Female Flange 211 and extends through the width of both the Female Flange 211 and the Female Body 209 (not shown in FIG. 6B).

**[0041]** FIG. 6C is a side view of a Female Cap 201 of an HFVN Assembly 200 having a Female Body 209 and a Female Flange 211.

**[0042]** FIG. 6D is a rear view of a Male Cap 203 of an HFVN Assembly 200. As shown in FIG. 6D, the Male Cap Opening 204 is centrally located in the Male Flange 215 and extends through the width of both the Male Flange 215 and the Male Body 213 (not labeled in FIG. 6D). The Male Body 213 of the Male Cap 203 comprises a plurality of Fins 205 and Manifold Outlets 207 distributed around the Male Cap Opening 204.

**[0043]** FIG. 6E is a side view of a Male Cap 203 of an HFVN Assembly 200 having: (a) a Male Body 213 comprising at least one Fin 205 and at least one Manifold Outlet 207; and (b) a Male Flange 215 extending radially beyond the edges of the Male Body 213.

**[0044]** FIGS. 7A and 7B are side and perspective exploded views, respectively, of: (a) an HFVN Assembly 200 (not labeled in FIG. 7A or 7B) comprising a Female Cap 201 and a Male Cap 203 and; (b) a Pipe 217 having a Tee 219 approximately midway along the length of the Pipe 217. The HFVN Assembly 200 is dimensionally sized to securely fit telescopically inside the Pipe 217 by a friction fit. In alternative embodiments, the HFVN Assembly 200 could be secured within the Pipe 217 by adhesive (e.g., PVC glue), sonic welding, heat welding or other permanent attachment means. The Tee 219 is hollow, i.e., having a Tee Opening 221. As shown in FIGS. 7A and 7B, the Pipe 217 having a Tee 219 is commonly referred to as a “reducing tee.” As noted above, the Manifold Outlets 207 are in fluid communion with the Pocket 216. Thus, when the Female Cap 201 is affixed on one end of the Pipe 217 and the Male Cap 203

is affixed on a distal end of the Pipe 217, the Pocket 216 will be in fluid communion with the Tee Opening 221. The HFVN Assembly 200 can thus be used “in line” with piping, e.g., for use in oxygenating water as it flows through a piping system.

**[0045]** FIG. 7C is a perspective view of an HFVN Assembly 200 attached to a Pipe 217 having a Tee 219. As shown in FIG. 7C, the Female Body 209 is shown fitted inside the Pipe 217. The Female Flange 211 is located entirely inside the Pipe 217. From the perspective view depicted in FIG. 8, the Female Flange 211 of the HFVN Assembly 200 is visible inside of the Pipe 217. Here, the Tee 219 may be connected to a gas supply (e.g., air) and a liquid (e.g., water) passed through the Pipe 217 (and, thus, through the HFVN Assembly 200 through both the Female Cap Opening 202 and the Male Cap Opening 204 which, collectively, form a sort of “choke”). As liquid flows through the HFVN Assembly 200 and the Pipe 217, the Manifold Outlets 117 create a Venturi effect as liquid (e.g., water) flows past the gas (which, in turn, flowed from the Tee Opening 221 into the Pocket 216 and into the Manifold Outlets 207). This embodiment comprises a significant improvement over prior Venturi systems inasmuch as it allows for a relatively high liquid flow rate through the Pipe 217. The perspective view shown in FIG. 7C also illustrates the plurality of Fins 205 and Manifold Outlets 207 present in the Male Cap 203. In particular, the perspective view shown in FIG. 7C shows the pitch or angle associated with the Fins 205 and the Manifold Outlets 207.

**[0046]** FIG. 8A is a side cutaway view of an HFVN Assembly 200 (comprising a Female Cap 201 and a Male Cap 203) attached to a Pipe 217 having a Tee 219. This is a side cutaway view of the same HFVN Assembly 200 and Pipe 217 shown in FIGS. 7A through 7C above. As shown in FIG. 8A, the HFVN Assembly 200 is fully fitted into the Pipe 217 in such a way that the Tee 219 and the Tee Opening 221 are located in-between the Female Flange 211 and the Male Flange 215. This space forms a Pocket 216 defined by the Female Flange 211, the Female Body 209, the Male Body 213 and the Male Flange 215. In the configuration shown in FIG. 8A, the Pocket 216 is in the general shape of a hollow cylindrical segment but could be generally toroidal in other configurations. Thus, there is a fluid connection between the Pocket 216 and the Tee Opening 221 which allows a gas (e.g., air) to be supplied to the Tee 219 and flow into the Pocket 216.

**[0047]** The Male Cap 203 has a plurality of Fins 204 and Manifold Outlets 207. These Fins 204 have a Fin Pitch 205a. Each Manifold Outlet 207 is also in fluid communion with the Pocket 216. This allows a liquid (e.g., water) to be passed through the HFVN Assembly 200 while a gas (e.g., air) supplied to the Tee 219, to flow into the Pocket 216 and through each Manifold Outlet 207 where a Venturi effect occurs—thereby causing cavitation of the gas into small bubbles in the liquid—allowing for more ready diffusion of the gas into the liquid.

**[0048]** FIG. 8B is a perspective cutaway view of an HFVN Assembly 200 (comprising a Female Cap 201 and a Male Cap 203) attached to a Pipe 217 having a Tee 219. This is a perspective cutaway view of the same HFVN Assembly 200 and Pipe 217 shown in FIG. 8A above (and, thus, also the same as shown in FIGS. 7A through 7C above). As shown in FIG. 8B, the Pocket 216 is in fluid communion with the Tee Opening 221. This allows a gas (e.g., air) to be introduced into the Tee 219 via the Tee Opening 221 which

will then flow into the Pocket **216** and out of the plurality of Manifold Outlets **207** defined as the space in-between two adjacent Fins **205**. Thus, as a liquid (e.g., water) flows through a first end of the Pipe **217**, through the Female Cap Opening **202**, through the Male Cap Opening **204** and through a second end of the Pipe **217**, it will come in contact with a gas (e.g., air) introduced into the Tee **219** which gas will flow from the Tee Opening **221**, through the Pocket **216** and out of the Manifold Outlets **207**.

[0049] FIG. 9A is a compilation showing several different views of two embodiments of HFVN Assemblies **200**, namely: (a) a first embodiment having a plurality of Fins **205** in the Male Body **213** (i.e., the same HFVN Assembly **200** noted in FIGS. 6A through 8B above); and (b) a second embodiment having a plurality of Pinhole Manifold Outlets **223** in the Male Body **213**. These Pinhole Manifold Outlets **223** are relatively small and act as miniature Venturis as water or some other fluid passes through the HFVN Assembly **200**. A variety of front, back and perspective views of these two HFVN Assembly **200** embodiments are shown in FIG. 9.

[0050] FIG. 9B is a compilation showing several different views of three embodiments of HFVN Assemblies **200**, namely: (a) a first embodiment having a plurality of small Fins **205b** in the Male Body **213**; (b) a second embodiment having a plurality of Pinhole Manifold Outlets **223** in the Male Body **213**; and (c) a third embodiment having a plurality of Large Fins **205c** in the Male Body **213**. In one embodiment, the HFVN Assembly **200** may be manufactured through the use of three-dimensional printing (“3D Printing”). In particular, the manufacture of the Pinhole Manifold Outlets **223** in a Male Body **213** are ideal candidates for 3D Printing given the small size of the Pinhole Manifold Outlets **223**.

[0051] FIG. 10A is a compilation of different front, side and perspective views of a Top Piece **301** of a Two-Piece HFVN **300** (not labeled in FIG. 10A). The Top Piece **301** has a Top Surface **302** and includes a Manifold **305** and a Manifold Nipple **307** protruding outward from the Top Surface **302**. This Manifold **305** is in fluid communion with a hollow Top Chamber **309** located on a reverse side of the Top Piece **301** distal from the Manifold Nipple **307**. The Top Piece **301** further includes at least one Top Choke **313a**. In the embodiment shown in FIG. 10A, the Top Piece **301** includes a plurality of Top Chokes **313a**. Each Top Choke **313a** is an orifice which extends through the width of the Top Piece **301** and into the Top Chamber **309**. At least one Manifold Outlet **315** is formed into the reverse side of the Top Piece **301** distal from the Manifold Nipple **307**. Each Manifold Outlet **315** is connected to a Top Choke **313b**.

[0052] FIG. 10B is a compilation of different front, side and perspective views of a Bottom Piece **303** of a Two-Piece HFVN **300** (not labeled in FIG. 10B). As shown in FIG. 10B, the Bottom Piece **303** has a Bottom Surface **304** and includes a hollow Bottom Chamber **311**. The Bottom Piece **303** also includes at least one Bottom Choke **313b**. In the embodiment shown in FIG. 10B, the Bottom Piece **303** includes a plurality of Chokes **313b**. Each Bottom Choke **313b** is an orifice which extends through the width of the Bottom Piece **303** beyond the Bottom Chamber **311**.

[0053] FIG. 10C is a compilation of a side and perspective cutaway view of a Two-Piece HFVN **300** (not labeled in FIG. 10C) comprising: (a) a Top Piece **301**; and (b) a Bottom Piece **303**. As shown in FIG. 10C, the Top Piece **301** (shown

to the left of line  $\overline{AB}$ ) and the Bottom Piece **303** (shown to the right of line  $\overline{AB}$ ) detachably join together to form a single Two-Piece HFVN **300**. The Top Piece **301** and the Bottom Piece **303** may be permanently joined together by attachment means such as adhesive, PVC cement, ultrasonic welding, welding or brazing depending on the material from which they are constructed. In one embodiment, the Top Piece **301** and the Bottom Piece **303** may be constructed out of plastic using 3D printing technology. As shown in FIG. 10C, the Top Chamber **309** of the Top Piece **301** and the Bottom Chamber **311** of the Bottom Piece **303** are dimensionally sized such that the Top Chamber **309** and the Bottom Chamber **311** are in fluid communion and form a unified compartment when the Top Piece **301** and the Bottom Piece **303** are joined together. The Manifold **305** of the Top Piece **301** is, thus, also in fluid communion with the unified compartment comprised of the Top Chamber **309** and the Bottom Chamber **311**. As further shown in FIG. 10C, each Top Choke **313a** is aligned with a corresponding Bottom Choke **313b**, such that a Top Choke **313a** and a Bottom Choke **313b** join together to form a unified choke. When a gas (e.g., air or oxygen) is fed into the Manifold **305** and a fluid (e.g., water) passes through the unified choke (comprised of the Top Choke **313a** and a Bottom Choke **313b**), a Venturi effect occurs within the unified choke at each Manifold Outlet **315**. Given the layout and relative size of the unified chokes and compared to the body of the Two-Piece HFVN **300**, the apparatus shown in FIGS. 10A-10D has the ability to handle a high flow rate of fluid through the chokes while maintaining a high rate of gas diffusion through the Manifold **305** and into the fluid from the Manifold Outlets **315**.

[0054] FIG. 10D is a compilation of different side, perspective and rear views of an assembled Two-Piece HFVN **300** showing how the exterior of the Two-Piece HFVN **300** appears when the Top Piece **301** and the Bottom Piece **303** are joined together.

[0055] It is to be understood that while a preferred embodiment of the invention is illustrated, it is not to be limited to the specific form or arrangement of parts herein described and shown. It was apparent to those skilled in the art that various changes may be made without departing from the scope of the invention and the invention is not to be considered limited to what is shown and described in the specification and drawings.

Having thus described my invention, I claim:

1. A High Flow Venturi Nozzle comprising:

- (a) a body having a top surface and a distal, bottom surface;
- (b) at least one generally cylindrical choke extending through the body from the top surface to the bottom surface; each choke having a choke inlet through the top surface and a choke outlet through the bottom surface;
- (c) a manifold extending from the top surface into the body and terminating within the body; and
- (d) a connection between each choke and the manifold.

2. The High Flow Venturi Nozzle of claim 1 further comprising:

a plurality of chokes.

3. The High Flow Venturi Nozzle of claim 1 further comprising:

- (a) the body being generally cylindrical in shape and dimensionally sized to telescopingly engage within a pipe;
  - (b) at least four chokes, each of which are located equidistant from one another;
  - (c) the manifold being centrally located with respect to the top surface; said manifold having a manifold nipple extending outwardly from the top surface;
  - (d) said connection between each choke and the manifold comprising:
    - (i) at least one manifold channel having a manifold inlet and a manifold outlet; said manifold inlet connected to the manifold and said manifold outlet connected to a choke; and
    - (ii) at least one manifold channel having a manifold inlet and a manifold outlet; said manifold inlet connected to a manifold passage and said manifold outlet connected to a choke; said manifold passage connected to the manifold.
- 4.** The High Flow Venturi Nozzle of claim **1** further comprising:
- (a) the body further comprising:
    - (i) a top piece having a top chamber; and
    - (ii) a bottom piece;
 the top surface being on the top piece and the bottom surface being on the bottom piece;
  - (b) each choke further comprising: (i) a top choke which extends through the top piece; and (ii) a bottom choke which extends through the bottom piece; and
  - (c) the manifold extending from the top surface into the body and terminating within the top chamber; and
- 5.** The High Flow Venturi Nozzle of claim **4** further comprising:  
the bottom piece having a bottom chamber.
- 6.** The High Flow Venturi Nozzle of claim **4** further comprising:  
the connection between each choke and the manifold comprising a plurality of manifold outlets.
- 7.** A High Flow Venturi Nozzle assembly comprising:
- (a) a female cap having:
    - (i) a female body;
    - (ii) a female flange; and
    - (iii) a female cap opening extending through the female flange and through the female body;

- (b) a male cap having:
    - (i) a male body;
    - (ii) a male flange;
    - (iii) a male cap opening extending through the male flange and through the male body; and
    - (iv) at least one orifice in the male body; and
  - (c) a pocket defined by the female cap and the male cap when the female cap and male cap are joined together.
- 8.** The High Flow Venturi Nozzle assembly of claim **7** further comprising:  
the at least one orifice comprising a plurality of manifold outlets; the male body comprising a plurality of fins each having a fin pitch;
- 9.** The High Flow Venturi Nozzle assembly of claim **7** further comprising:  
the High Flow Venturi Nozzle assembly dimensionally sized to telescopingly fit inside a pipe; the pipe having a tee with a tee opening which is in fluid communion with the pocket;
- 10.** The High Flow Venturi Nozzle assembly of claim **7** further comprising:  
the at least one orifice comprising a plurality of small fins each having a fin pitch;
- 11.** The High Flow Venturi Nozzle assembly of claim **7** further comprising:  
the at least one orifice comprising a plurality of large fins each having a fin pitch;
- 12.** The High Flow Venturi Nozzle assembly of claim **7** further comprising:  
the at least one orifice comprising a plurality of pinhole manifold outlets;
- 13.** The High Flow Venturi Nozzle assembly of claim **12** further comprising:  
the plurality of pinhole manifold outlets arranged in a helical distribution;
- 14.** A method of using a High Flow Venturi Nozzle having a manifold and at least one choke comprising:
- (a) step one: placing the High Flow Venturi Nozzle in a pipe;
  - (b) step two: connecting a gas supply to the manifold of the High Flow Venturi Nozzle; and
  - (c) step three: passing a liquid through the at least one choke to cause a Venturi effect therein.

\* \* \* \* \*