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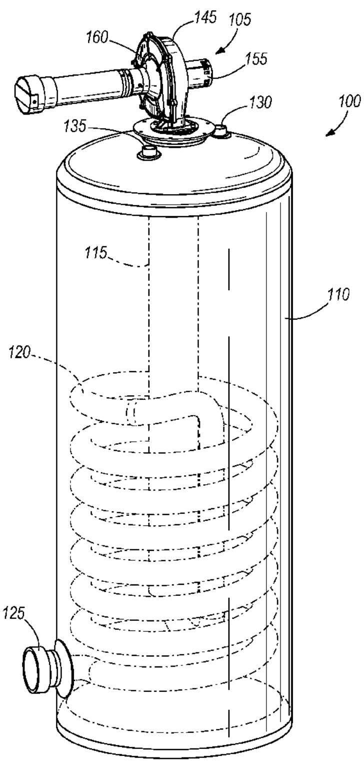
(54) Title: BLOWER ASSEMBLY FOR USE WITH GAS POWERED APPLIANCE

FIG. 1



(57) Abstract: A blower assembly for supplying a combustible mixture to a burner of a gas-fired appliance, the blower assembly including a housing defining an interior space, an impeller, a motor operatively interconnected with the impeller to drive the impeller, an elongated blower conduit, a single-piece venturi, a gas supply space, and a gas supply port. The single-piece venturi includes a converging portion having a wide end and a narrow end, a diverging portion integrally formed with the converging portion and having a wide end and a narrow end, and multiple entrainment openings in the diverging portion proximate the narrow end of the diverging portion. The flow of combustion air over the entrainment openings draws gaseous fuel through the entrainment openings from the gas supply space. Gaseous fuel is entrained in the flow of combustion air and mixed with the combustion air in the diverging portion to create the combustible mixture.

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BLOWER ASSEMBLY FOR USE WITH GAS POWERED APPLIANCE

RELATED APPLICATIONS

[0001] This application claims priority to co-pending U.S. Provisional Patent Application No. 61/359,628 filed on June 29, 2010, the entire content of which is incorporated herein by reference.

BACKGROUND

[0002] The present invention relates to blower assemblies for use with gas powered appliances.

SUMMARY

[0003] In one embodiment, the invention provides a blower assembly for supplying a combustible mixture to a burner of a gas-fired appliance. The blower assembly includes a housing defining an interior space, an impeller supported for rotation within the interior space, a motor operatively interconnected with the impeller to drive rotation of the impeller within the interior space, an elongated blower conduit, a single-piece venturi, a gas supply space, and a gas supply port. The elongated blower conduit has a blower conduit wall having an outer surface and an inner surface. The blower conduit wall has a free end and a second end, opposite the free end, interconnected with the housing. Combustion air flows into the blower conduit in response to rotation of the impeller. The single-piece venturi includes a converging portion having a wide end and a narrow end, a diverging portion integrally formed with the converging portion and having a wide end and a narrow end, and multiple entrainment openings in the diverging portion proximate the narrow end of the diverging portion. The single-piece venturi includes a flow path from the wide end of the converging portion to the wide end of the diverging portion. The single-piece venturi includes an outer surface. The single-piece venturi is received within the elongated blower conduit with the wide end of the converging portion having a first interference fit with the blower conduit, such that all combustion air flowing into the blower conduit flows into the converging portion, and the wide end of the diverging portion having a second interference fit with the inner surface of the inlet wall. The gas supply space is defined between the outer surface of the single-piece venturi and the inner surface of the blower conduit wall, and bounded on one side by the first interference fit and on an opposite side by the second interference fit. The gas supply port extends through the blower conduit wall and communicates with the gas supply space for the provision of gaseous fuel to the gas supply space. The entrainment openings in the diverging portion communicate between the gas supply space and the flow path within the single-piece venturi. The combustion air flows along the flow path under the influence of rotation of the impeller. The flow of combustion air over the entrainment openings draws gaseous fuel through the entrainment openings from the gas supply space. Gaseous fuel is entrained in the flow of combustion air and mixed with the combustion air in the diverging portion to create the combustible mixture. The combustible mixture flows through the blower under the influence of the rotating impeller and is delivered to a burner for combustion.

[0004] In another embodiment, the invention provides a method for assembling a blower and burner assembly. The method includes the following steps. Providing a blower that includes a blower conduit. Providing a single-piece venturi comprising a converging portion and a diverging portion, each of the converging and diverging portions including a wide end and a narrow end, the narrow end of the converging portion being interconnected to the narrow end of the diverging portion. Inserting the single-piece venturi into the blower conduit of the blower. Creating an interference seal between the wide end of the converging portion and the blower conduit and between the wide end of the diverging portion and the blower conduit. Defining a gas supply space between an inner surface of the blower conduit and an outer surface of the single-piece venturi, and bounded at opposite ends by the interference seals. Providing a gas supply port through a wall of the blower conduit and in communication with the gas supply space. Attaching a source of gaseous fuel to the gas supply port for the delivery of gaseous fuel to the gas supply space. Providing multiple entrainment openings in the diverging portion of the single-piece venturi, the entrainment openings communicating with the gas supply space for permitting gaseous fuel in the gas supply space to be entrained with a flow of combustion air through the single-piece venturi across the entrainment openings, such that the gaseous fuel is entrained with and mixed with the flow of combustion air to create a combustible mixture. Providing a burner. Interconnecting the burner downstream of the blower conduit for combustion of the combustible mixture.

[0005] In another embodiment, the invention provides a method of operating a power burner. The method includes the following steps. Providing a blower that includes a housing with a blower conduit, and an impeller supported for rotation within the housing. Mounting a burner to the blower downstream of the blower conduit. Providing a single-piece venturi, the single-piece venturi comprising a converging portion and a diverging portion, each of the converging and diverging portions including a wide end and a narrow end, the narrow end of the converging portion being interconnected to the narrow end of the diverging portion, the single-piece venturi including entrainment openings proximate the narrow end of the diverging portion. Inserting the single-piece venturi into the blower conduit of the blower. Creating an interference seal between the wide end of the converging portion and the blower conduit and between the wide end of the diverging portion and the blower conduit. Defining a gas supply space between an inner surface of the blower conduit and an outer surface of the single-piece venturi. Supplying gaseous fuel to the gas supply space. Rotating the impeller at a first speed to draw combustion air through the blower conduit and into the single-piece venturi. In response to combustion air flowing across the entrainment openings, drawing gaseous fuel from the gas supply space into the single-piece venturi and entraining the gaseous fuel into the flow of combustion air to create a first volumetric flow of a combustible mixture having a first fuel-to-air ratio. Delivering the combustible mixture under the influence of the rotating impeller to the burner through the outlet of the blower. Combusting the combustible mixture with the burner.

[0006] Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a perspective view of a water heater and a blower assembly.

[0008] FIG. 2 is a perspective view of the blower assembly of FIG. 1.

[0009] FIG. 3 is a partially exploded perspective view of the blower assembly of FIG. 2.

[0010] FIG. 4 is a sectional view of the blower assembly of FIG. 2 along line 4-4.

[0011] FIG. 5 is a perspective view of a venturi.

[0012] FIG. 6 is a sectional view of the venturi of FIG. 5 along line 6-6.

DETAILED DESCRIPTION

[0013] Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways.

[0014] Figure 1 illustrates a gas-fired appliance 100 and a blower assembly 105. The gas-fired appliance 100 is shown as a water heater 100. The water heater 100 is conventional and includes a water storage tank 110, a combustion chamber 115, a flue 120, an exhaust outlet 125, a cold water inlet 130, and a hot water outlet 135. A burner 140 (shown in FIG. 2) is positioned in the combustion chamber 115. The blower assembly 105 provides a combustible mixture to the burner 140 for combustion. The hot products of combustion flow from the combustion chamber 115, through the flue 120, and exit through the exhaust outlet 125 while heating the water stored in the water storage tank 110. The cold water inlet 130 supplies water to the water storage tank 110. The hot water outlet 135 supplies hot water to an end-use location, for example, a faucet.

[0015] Figures 2-3 illustrate the blower assembly 105 and the burner 140. The combination of the blower assembly 105 and the burner 140 is also known as a power burner. The blower assembly 105 includes a housing 145, a fan or impeller 150 (shown in FIG. 4), a motor 155, an inlet 160, a venturi 165, and an outlet 167. As shown in FIG. 4, the housing 145 defines an interior space 170 in which the impeller 150 is supported for rotation. The motor 155 is operatively interconnected with the impeller 150 to drive rotation of the impeller 150 within the interior space 170. The inlet 160 extends along a longitudinal axis 175 from a first end 180 to an opposing second end 185. The first end 180 defines an inlet opening 190 and the second end is interconnected with the housing 145 such that the inlet 160 communicates with the interior space 170. The inlet 160 includes an inlet wall 195 having an outer surface 200 and an inner surface 205. The inlet wall 195 is symmetrical about the longitudinal axis 175. The inlet wall 195 has a cylindrical portion 207 that includes the first end 180 and a frustoconical portion 209 that includes the second end 185. Alternatively, the inlet wall 195 is entirely cylindrical in shape. A gas supply port 211 extends through the inlet wall 195. The gas supply port 211 communicates with a gas supply valve (not shown). A pressure sensor aperture 213 extends through the inlet wall 195 and is adapted to accommodate a pressure sensor 217. The venturi 165 is positioned in the inlet 160. The burner 140 is connected to the outlet 167.

[0016] Figures 5-6 illustrate the venturi 165. The venturi 165 is formed as a single, unitary piece and includes a converging portion 210 and a diverging portion 215. The converging portion 210 includes a wide end 220 and a narrow end 225. The inner and outer surfaces of the converging portion 210 are frustoconical in shape. A rim 230 and a shoulder 235 are formed near the wide end 220. The outer diameter of the shoulder 235 is less than the outer diameter of the rim 230. The diverging portion 215 is integrally formed with the converging portion 210 and includes a wide end 240 and a narrow end 245. The inner and outer surfaces of the diverging portion 215 are frustoconical in shape. The venturi 165 includes a flow path from the wide end 220 of the converging portion 210 to the wide end 240 of the diverging portion 215. Multiple entrainment openings 250 are formed in the diverging portion 215. The entrainment openings 250 are evenly spaced around the diverging portion 215. The intersection of the converging portion 210 and the diverging portion 215 defines a throat 255. The venturi 165 includes a venturi wall 260 having an outer surface 265 and an inner surface 270. The venturi 165 extends along a longitudinal axis 275 and is symmetrical about the longitudinal axis 275. The converging portion 210 communicates with the atmosphere. Preferably, the venturi 165 is injection molded plastic and the plastic inhibits the formation of an electrostatic layer along any surface of the venturi 165 to reduce the likelihood of sparks.

[0017] As shown in FIG. 4, the venturi 165 is inserted or positioned in the inlet 160 so that the longitudinal axis 275 of the venturi 165 is substantially collinear with the longitudinal axis 175 of the inlet 160. A gas supply space 280 is formed between the outer surface 265 of the venturi 165 and the inner surface 205 of the inlet 160. The gas supply space 280 is an annular space extending 360° around the venturi 165 between the inner surface 205 of the inlet 160 and the outer surface 265 of the venturi 165. The entrainment openings 250 communicate with the gas supply space 280 and the gas supply port 211 communicates with the gas supply space 280. The pressure sensor 217 is exposed to pressure within the gas supply space 280. The wide end

220 of the converging portion 210 fits within the inlet opening 190 with an interference fit or seal between the wide end 220 and the inlet 160. The shoulder 235 contacts the inner surface 205 and the rim 230 contacts and covers the first end 180. This interference fit causes all of the combustion air drawn through the inlet 160 to flow through the venturi 165. The wide end 240 of the diverging portion 215 is positioned within the inlet 160 with an interference fit or seal between the wide end 240 and the inlet 160. The gas supply space 280 is bounded at opposite ends by the interference fit between the wide end 220 of the converging portion 210 and the inlet 160 and the interference fit between the wide end 240 of the diverging portion 215 and the inlet 160. The distance between the rim 230 and the wide end 240 is selected such that the gas supply port 211 is aligned with the gas supply space 280 when the venturi 165 is inserted into the inlet 160 with the rim 230 against the first end 180. The venturi 165 is positioned within the cylindrical portion 207 of the inlet 160 and the frustoconical portion 209 of the inlet 160 is downstream from the wide end 240 of the diverging portion 215.

[0018] In use, the motor 155 rotates the impeller 150, which draws combustion air into the venturi 165. The gas valve supplies a gaseous fuel to the gas supply space 280. The gaseous fuel is a combustible gas, for example, natural gas or propane. The passage of the combustion air through the venturi 165 creates a vacuum or pressure drop across the entrainment openings 250 so that the gaseous fuel is drawn from the gas supply space 280 into the diverging portion 215 and the gaseous fuel is entrained with the combustion air. The entrainment openings 250 are formed in the diverging portion 215 proximate the narrow end 245. As used herein, the term "proximate" means closer to the narrow end 245 than the wide end 240 of the diverging portion 215, and near enough to the narrow end 245 that a sufficient vacuum or pressure drop is created across the entrainment openings 250 in response to the flow of combustion air through the venturi 165 to draw a sufficient amount of gaseous fuel from the gas supply space 280 to create a combustible mixture of combustion air and gaseous fuel to support combustion within the burner 140. The negative air pressure created by the impeller 150 ensures that the only route through which the gaseous fuel exits the gas supply space 280 is through the entrainment openings 250. The gaseous fuel and combustion air mix in the diverging portion 215 to form the combustible mixture. Turbulence within the diverging portion 215 helps to mix the gaseous fuel and the combustion air. Additional mixing can occur in the frustoconical portion 209 of the inlet 160.

The combustible mixture is supplied to the burner 140 for combustion. The venturi 165 causes the gaseous fuel and combustion air to be mixed more evenly when the combustible mix reaches the second end of the inlet 160 than in a blower assembly without the venturi 165. Preferably, the diameter of the throat 255 is optimized to a preferred air flow rate produced by the impeller 150 so that the air flow rate through the venturi 165 can be maximized.

[0019] The burner fire rate can be modulated by varying the air flow rate through the venturi 165. One way to vary the air flow rate is to vary the rotation speed of the impeller 150. The rotation speed of the impeller 150 is varied by changing the speed of the motor 155. The speed of the motor 150 can be varied by using a variable frequency drive (VFD), pulse-width modulation, or other appropriate method. The operation of the venturi 165 causes the fuel-to-air ratio of the combustible mixture to remain constant even as the air flow rate through the venturi 165 is varied. This allows the burner fire rate to be modulated by changing the rotation speed of the impeller 150. At a first rotational speed of the impeller 150, a first volumetric flow of the combustible mixture having a first fuel-to-air ratio is delivered to the burner 140 for combustion. At a second rotational speed of the impeller 150, a second volumetric flow of the combustible mixture having a second fuel-to-air ratio is delivered to the burner 140 for combustion. The second volumetric flow is different than the first volumetric flow. Preferably, the first fuel-to-air ratio is the equal to the second fuel-to-air ratio. Modulating the burner fire rate allows for the reduction of the water heater 100 fuel input (typically measured in BTU/hr or kilowatts) in comparison to a burner that is not modulated. A modulated burner 140 allows for the burner fire rate to vary in order to more closely match the heat input required to reach a water temperature set point. Modulating the burner fire rate reduces cycling of the burner 140 and therefore increases efficiency. Alternatively, the air flow rate through the venturi 165 can be varied by other means, including a damper positioned upstream of the venturi 165.

[0020] Although the illustrated embodiment shows the single-piece venturi 165 positioned in the inlet 160 of the blower assembly 105, the single-piece venturi 165 could in alternative embodiments be positioned in the outlet 167 of the blower assembly 105. In this regard, the inlet 160 and outlet 167 of the blower assembly 105 may each be referred to as a "blower conduit." Both the inlet 160 and the outlet 167 have a free end, which is the end opposite the end connected to or integrally formed with the blower housing 145. In the case of the inlet 160, the free end is the first end 180 (which is the inlet end), through which the combustion enters the blower assembly 105. In the case of the outlet 167, the free end is the outlet end through which the combustible mixture flows into the burner 140. In embodiments in which the single-piece venturi 165 is positioned within the outlet 167, the single-piece venturi would be modified such that the rim 230 and shoulder 235 are on the wide end 240 of the diverging portion 215. In such embodiments, the rim 230 would abut the free end of the outlet 167 to properly position the gas supply port 211 in communication with the gas supply space 280.

CLAIMS

What is claimed is:

1. A blower assembly for supplying a combustible mixture to a burner of a gas-fired appliance, the blower assembly comprising:

a housing defining an interior space;

an impeller supported for rotation within the interior space;

a motor operatively interconnected with the impeller to drive rotation of the impeller within the interior space;

an elongated blower conduit having a blower conduit wall having an outer surface and an inner surface, the blower conduit wall having a free end and a second end, opposite the free end, interconnected with the housing, combustion air flowing into the blower conduit in response to rotation of the impeller;

a single-piece venturi comprising a converging portion having a wide end and a narrow end, a diverging portion integrally formed with the converging portion and having a wide end and a narrow end, and a plurality of entrainment openings in the diverging portion proximate the narrow end of the diverging portion, the single-piece venturi including a flow path from the wide end of the converging portion to the wide end of the diverging portion, the single-piece venturi including an outer surface, the single-piece venturi being received within the elongated blower conduit, the wide end of the converging portion having a first interference fit with the blower conduit, such that all combustion air flowing into the blower conduit flows into the converging portion, and the wide end of the diverging portion having a second interference fit with the blower conduit;

a gas supply space defined between the outer surface of the single-piece venturi and the inner surface of the blower conduit wall, and bounded on one side by the first interference fit and on an opposite side by the second interference fit; and

a gas supply port extending through the blower conduit wall and communicating with the gas supply space for the provision of gaseous fuel to the gas supply space;

wherein the entrainment openings in the diverging portion communicate between the gas supply space and the flow path within the single-piece venturi;

wherein combustion air flows along the flow path under the influence of rotation of the impeller;

wherein the flow of combustion air over the entrainment openings draws gaseous fuel through the entrainment openings from the gas supply space;

wherein gaseous fuel is entrained in the flow of combustion air and mixed with the combustion air in the diverging portion to create the combustible mixture; and

wherein the combustible mixture flows under the influence of the rotating impeller and is delivered to a burner for combustion.

2. The blower assembly of claim 1, wherein one of the wide end of the converging portion and the wide end of the diverging portion includes a shoulder and a rim, the shoulder having an outer diameter that is less than an outer diameter of the rim; wherein the shoulder provides one of the first interference fit and the second interference fit with the inner surface of the blower conduit wall and the rim covers the free end of the blower conduit wall.

3. The blower assembly of claim 2, wherein the distance between the rim and an opposite end of the single-piece venturi is selected such that the gas supply port is aligned with the gas supply space when the single-piece venturi is inserted into the blower conduit with the rim against the free end of the blower conduit.

4. The blower of claim 1, wherein at least a portion of the inner surface of the blower conduit is cylindrical; wherein the outer surface of each of the converging portion and diverging portion is frusto-conical; and wherein the gas supply space is an annular space extending 360° around the single-piece venturi between the cylindrical inner surface and the frusto-conical outer surfaces.

5. The blower of claim 1, wherein the single-piece venturi is injection molded as a single piece from a plastic material that inhibits the formation of an electrostatic layer along any surface of the single-piece venturi.

6. The blower of claim 1, further comprising a pressure sensor aperture in the blower conduit, adapted to accommodate a pressure sensor such that the pressure sensor is exposed to pressure within the gas supply space.

7. The blower of claim 1, wherein the blower conduit is the inlet of the blower.

8. A method for assembling a blower and burner assembly, comprising the steps of:

providing a blower that includes a blower conduit;

providing a single-piece venturi comprising a converging portion and a diverging portion, each of the converging and diverging portions including a wide end and a narrow end, the narrow end of the converging portion being interconnected to the narrow end of the diverging portion;

inserting the single-piece venturi into the blower conduit of the blower;

creating an interference seal between the wide end of the converging portion and the blower conduit and between the wide end of the diverging portion and the blower conduit;

defining a gas supply space between an inner surface of the blower conduit and an outer surface of the single-piece venturi, and bounded at opposite ends by the interference seals;

providing a gas supply port through a wall of the blower conduit and in communication with the gas supply space;

attaching a source of gaseous fuel to the gas supply port for the delivery of gaseous fuel to the gas supply space;

providing a plurality of entrainment openings in the diverging portion of the single-piece venturi, the entrainment openings communicating with the gas supply space for permitting gaseous fuel in the gas supply space to be entrained with a flow of combustion air through the single-piece venturi across the entrainment openings, such that the gaseous fuel is entrained with and mixed with the flow of combustion air to create a combustible mixture;

providing a burner; and

interconnecting the burner downstream of the blower conduit for combustion of the combustible mixture.

9. The method of claim 8, wherein providing a single-piece venturi includes providing a shoulder and a rim in the wide end of one of the diverging portion and the converging portion, the shoulder having an outer diameter that is less than an outer diameter of the rim; wherein inserting the single-piece venturi includes covering and abutting a free end of the blower conduit

with the rim; and wherein creating an interference seal includes creating an interference seal between the shoulder and an inner surface of the blower conduit.

10. The method of claim 9, wherein providing a single-piece venturi includes setting a distance between the rim and an opposite end of the single-piece venturi such that the gas supply port is aligned with the gas supply space when the single-piece venturi is inserted into the blower conduit with the rim against the free end of the blower conduit.

11. The method of claim 8, wherein providing a blower includes defining a cylindrical inner surface within the blower conduit; wherein providing a single-piece venturing includes defining frusto-conical outer surfaces of each of the converging portion and diverging portion; and wherein defining a gas supply space includes defining an annular space extending 360° around the single-piece venturi between the cylindrical inner surface and the frusto-conical outer surfaces.

12. The method of claim 8, wherein providing a single-piece venturi includes injection molding the single-piece venturi as a single piece from a plastic material that inhibits the formation of an electrostatic layer along any surface of the single-piece venturi.

13. The method of claim 8, further comprising providing a pressure sensor in the blower conduit such that the pressure sensor is exposed to pressure within the gas supply space.

14. A method of operating a power burner, comprising:

providing a blower that includes a housing with a blower conduit, and an impeller supported for rotation within the housing;

mounting a burner to the blower downstream of the blower conduit;

providing a single-piece venturi, the single-piece venturi comprising a converging portion and a diverging portion, each of the converging and diverging portions including a wide end and a narrow end, the narrow end of the converging portion being interconnected to the narrow end of the diverging portion, the single-piece venturi including entrainment openings proximate the narrow end of the diverging portion;

inserting the single-piece venturi into the blower conduit of the blower;

creating an interference seal between the wide end of the converging portion and the blower conduit and between the wide end of the diverging portion and the blower conduit;

defining a gas supply space between an inner surface of the blower conduit and an outer surface of the single-piece venturi;

supplying gaseous fuel to the gas supply space;

rotating the impeller at a first speed to draw combustion air through the blower conduit and into the single-piece venturi;

in response to combustion air flowing across the entrainment openings, drawing gaseous fuel from the gas supply space into the single-piece venturi and entraining the gaseous fuel into the flow of combustion air to create a first volumetric flow of a combustible mixture having a first fuel-to-air ratio;

delivering the combustible mixture under the influence of the rotating impeller to the burner; and

combusting the combustible mixture with the burner.

15. The method of claim 14, further comprising modifying the rotational speed of the impeller to a second speed different from the first speed; and in response to rotation of the impeller at the second speed, creating a second volumetric flow of the combustible mixture that is different from the first volumetric flow, the second volumetric flow having a fuel-to-air ratio equal to the first fuel-to-air ratio.

16. The method of claim 14, wherein providing a single-piece venturi includes providing a shoulder and a rim in the wide end of one of the diverging portion and the converging portion, the shoulder having an outer diameter that is less than an outer diameter of the rim; wherein inserting the single-piece venturi includes covering and abutting a free end of the blower conduit with the rim; and wherein creating an interference seal includes creating an interference seal between the shoulder and an inner surface of the blower conduit.

17. The method of claim 16, wherein providing a blower includes defining a gas supply port in the blower conduit for the supply of gaseous fuel to the gas supply space; and wherein providing a single-piece venturi includes setting a distance between the rim and the wide end of the diverging portion such that the gas supply port is aligned with the gas supply space when the single-piece venturi is inserted into the blower conduit with the rim against the free end of the blower conduit.

18. The method of claim 14, wherein providing a blower includes defining a cylindrical inner surface within the blower conduit; wherein providing a single-piece venturing includes defining frusto-conical outer surfaces of each of the converging portion and diverging portion; and wherein defining a gas supply space includes defining an annular space extending 360° around the single-piece venturi.

19. The method of claim 14, wherein providing a single-piece venturi includes injection molding the single-piece venturi as a single piece from a plastic material that inhibits the formation of an electrostatic layer along any surface of the single-piece venturi.

20. The method of claim 14, further comprising providing a pressure sensor in the blower conduit such that the pressure sensor is exposed to pressure within the gas supply space.

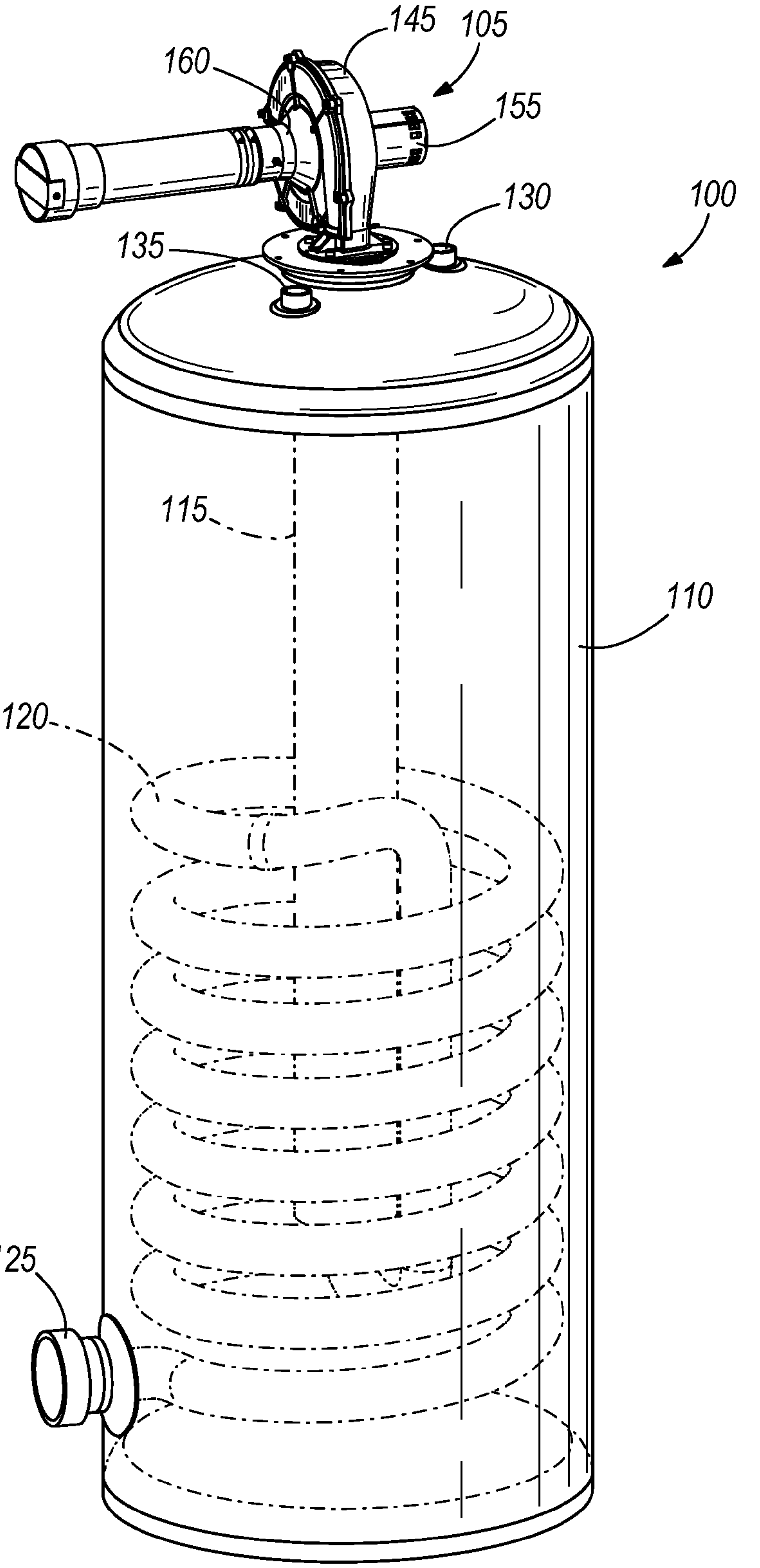

FIG. 1

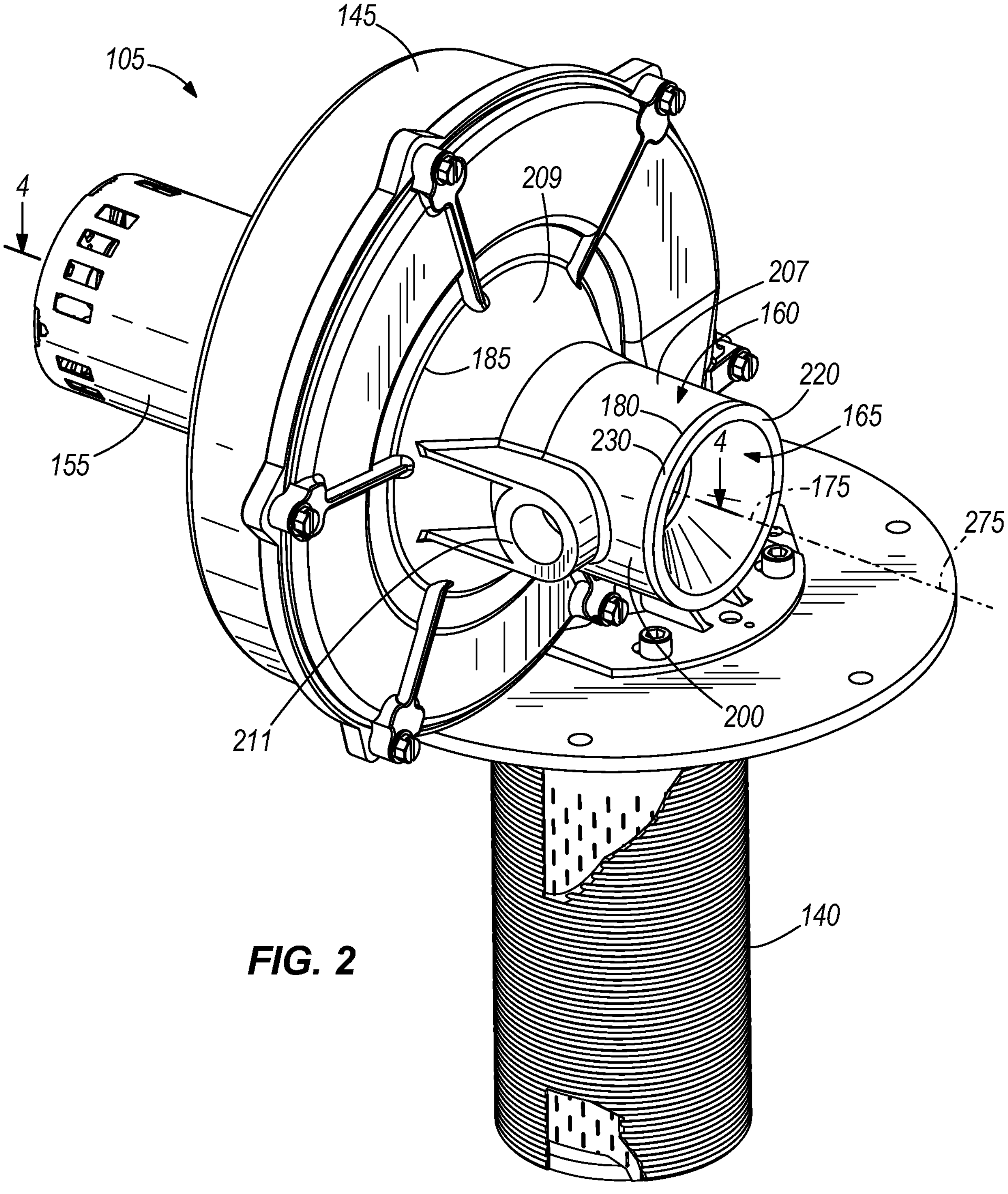
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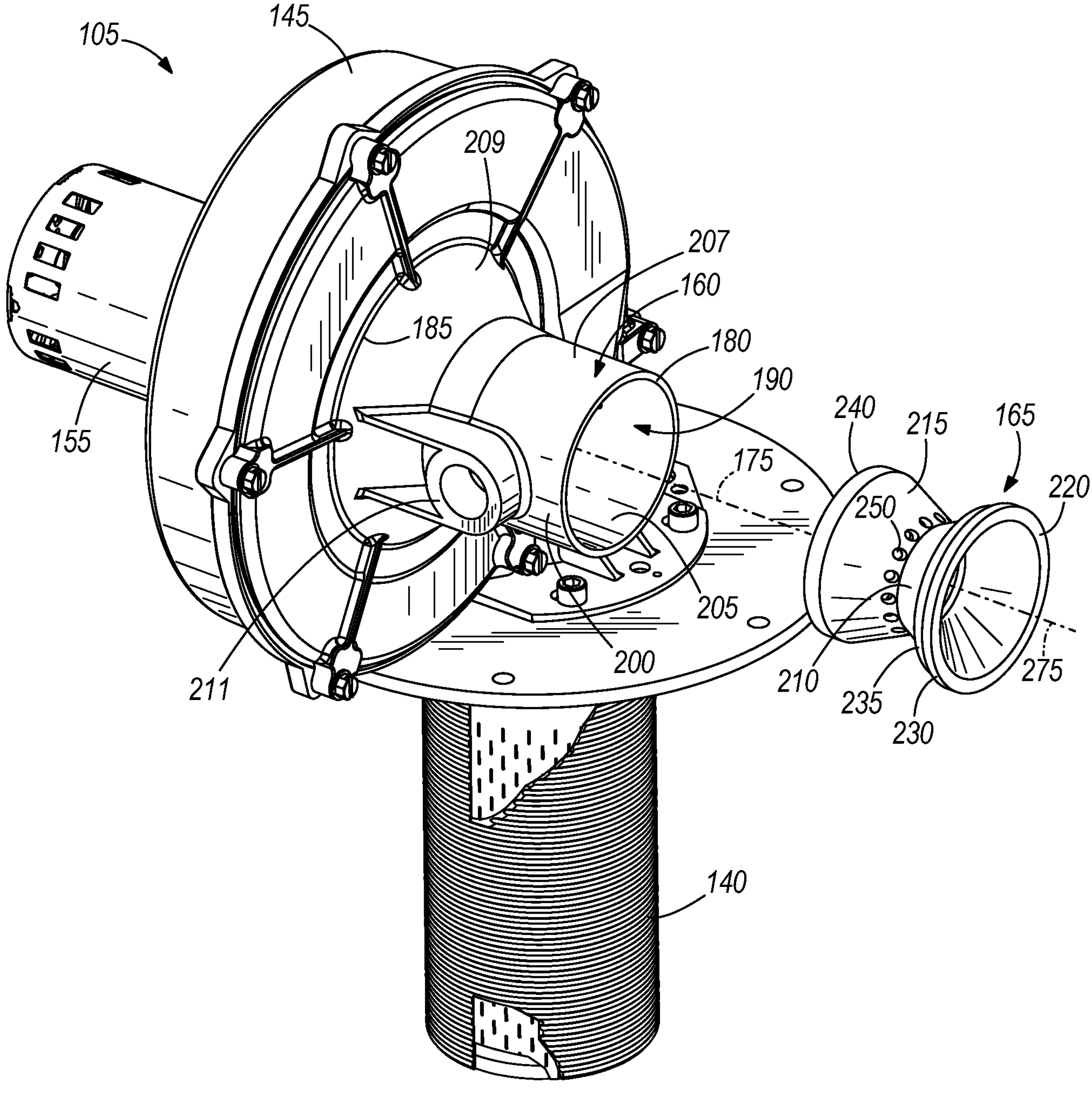
FIG. 2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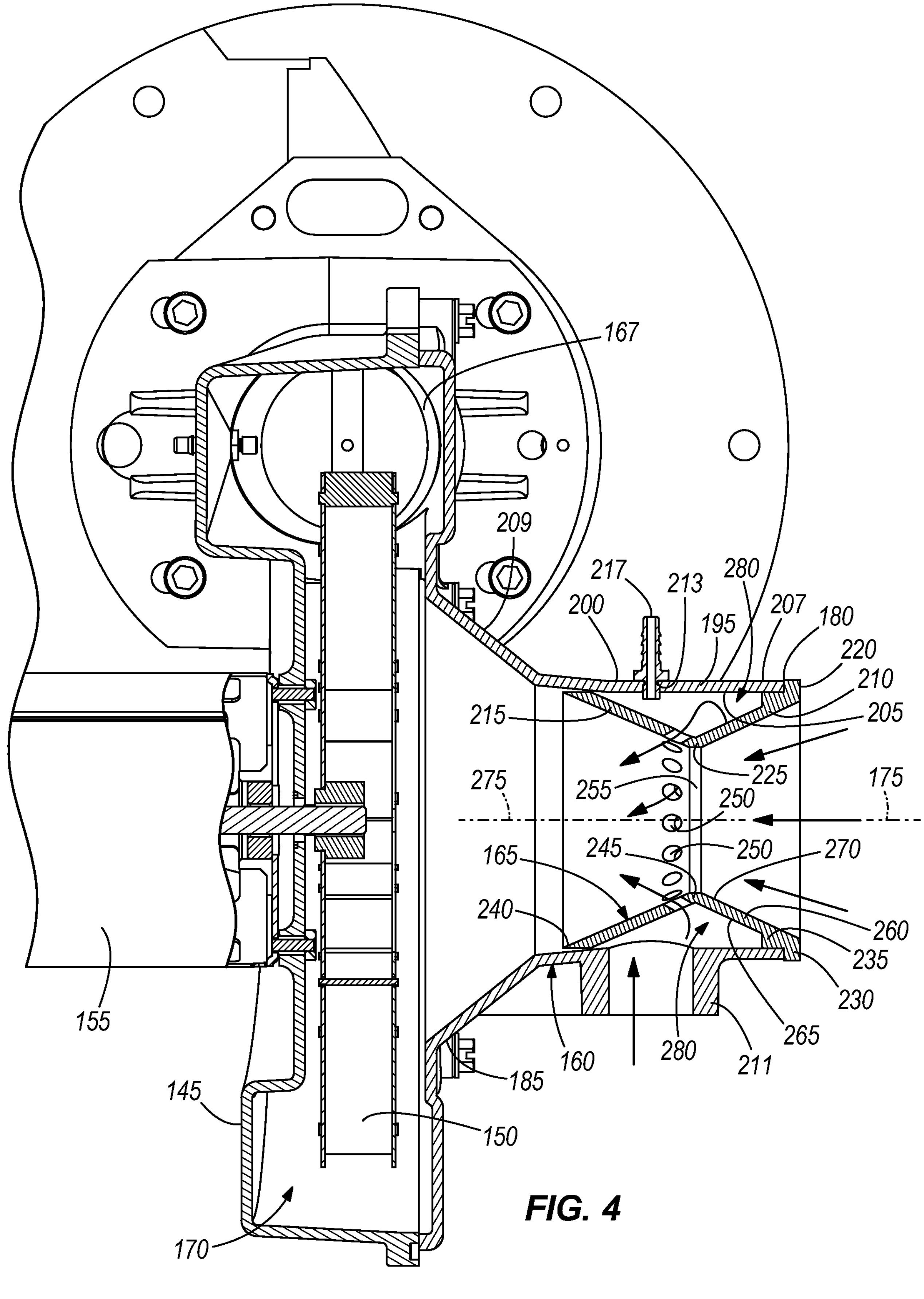
140

FIG. 3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200
195
207
180
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210
215
205
225
275
255
175
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245
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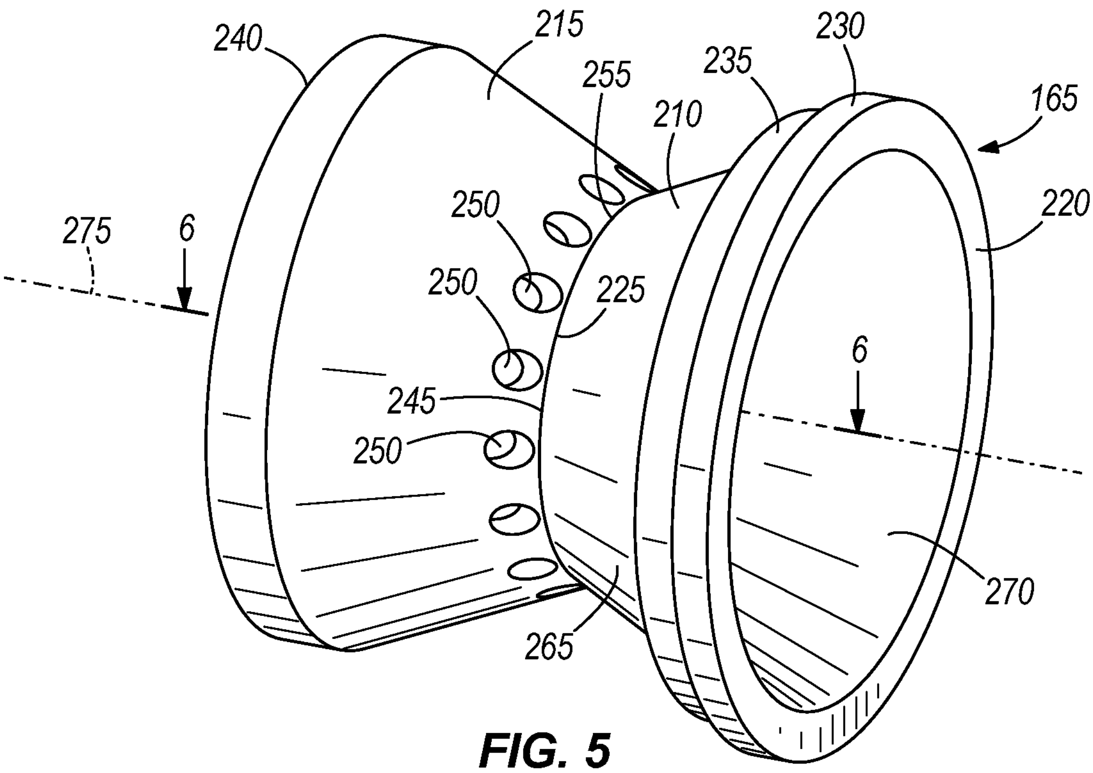
270
165
240
260
235
230
155
160
280
211
265
185
145
150
170

FIG. 4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255
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230
165
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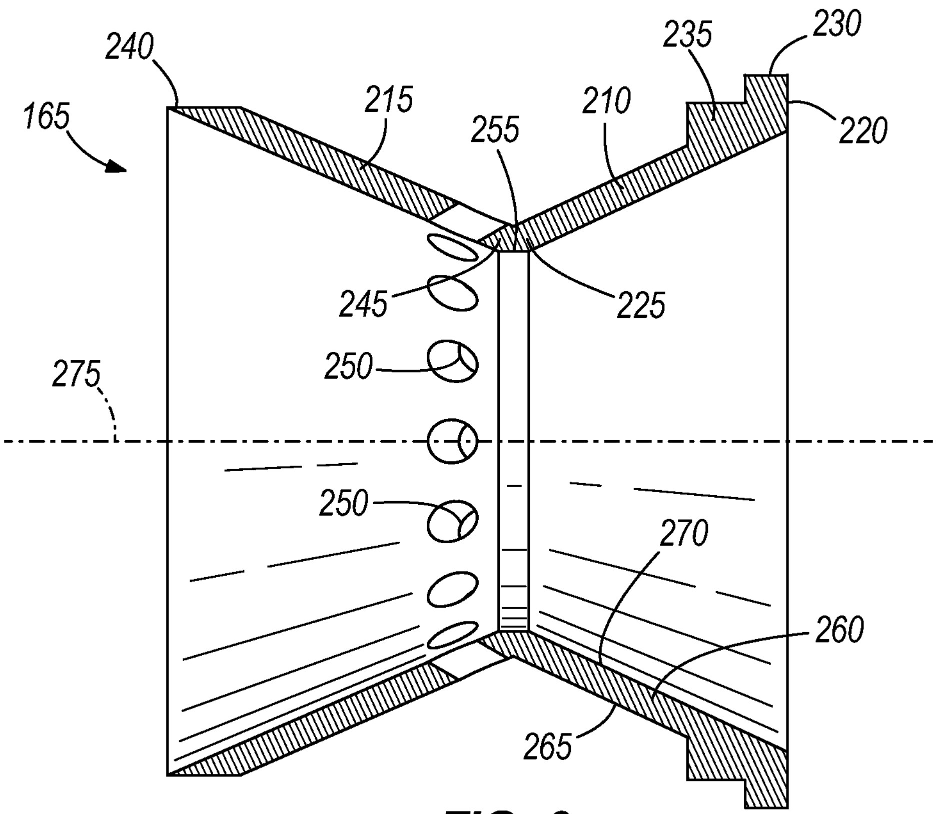
220
275
6
250
225
245
6
250
270
265

FIG. 5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235
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215
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210
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245
225
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275
250
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260
265

FIG. 6