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(54) **MULTI-PREMIXER FUEL NOZZLE**

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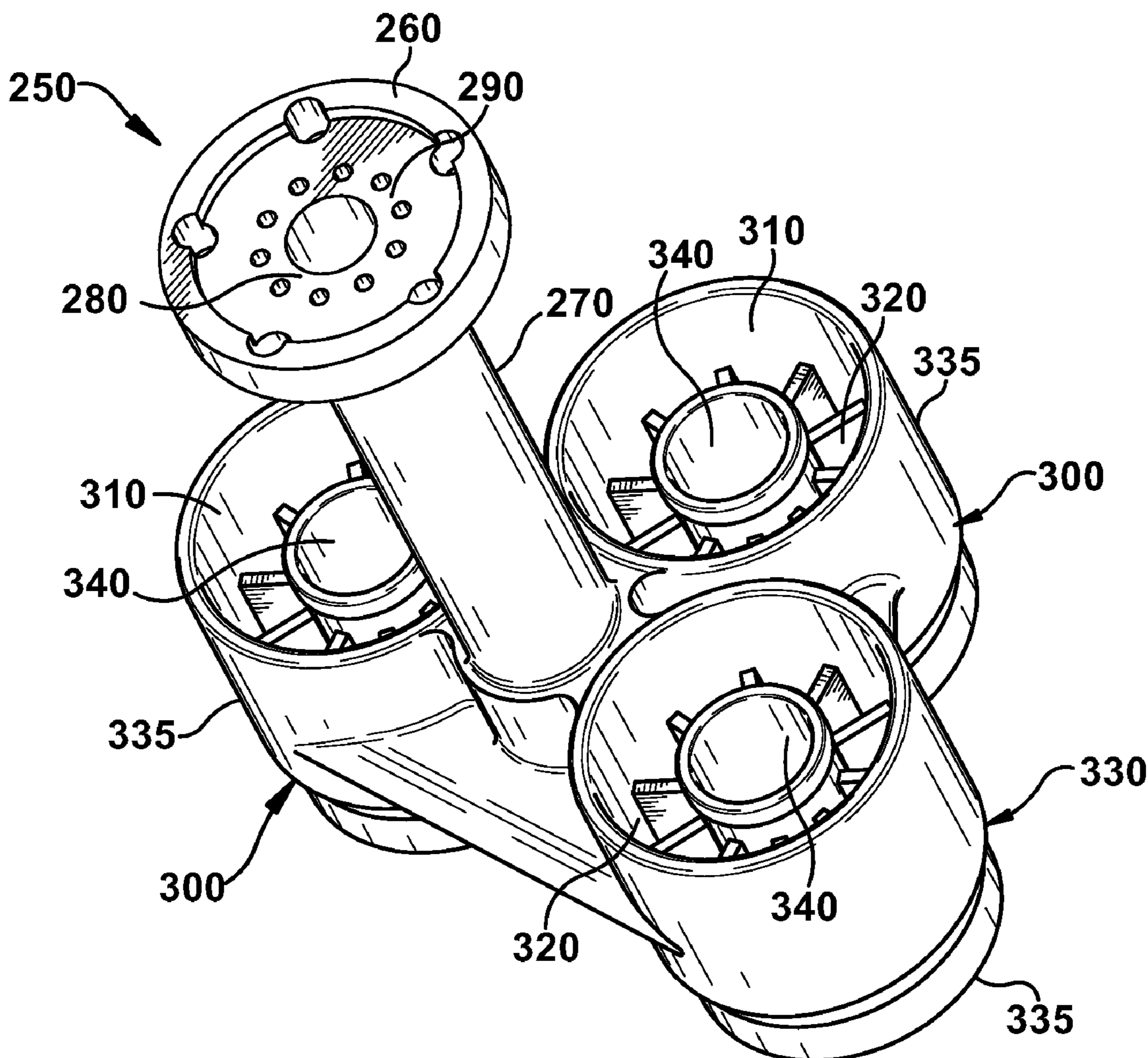
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(57) **ABSTRACT**

The present application provides a fuel nozzle for use in a gas turbine. The fuel nozzle may include a mounting flange, a number of premixers attached to each other, and a number of gas pathways extending from the mounting flange to the number of premixers.

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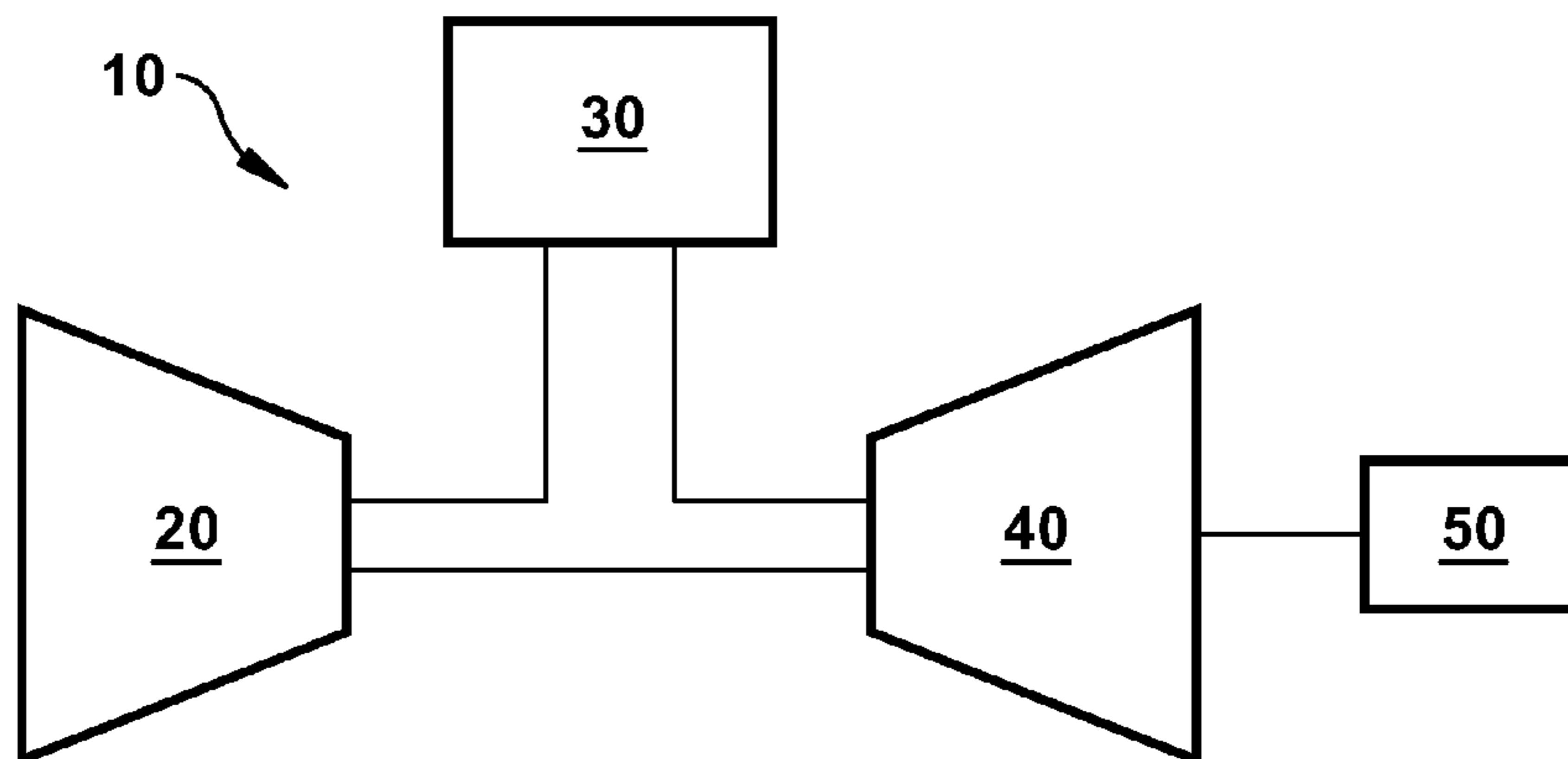


Fig. 1

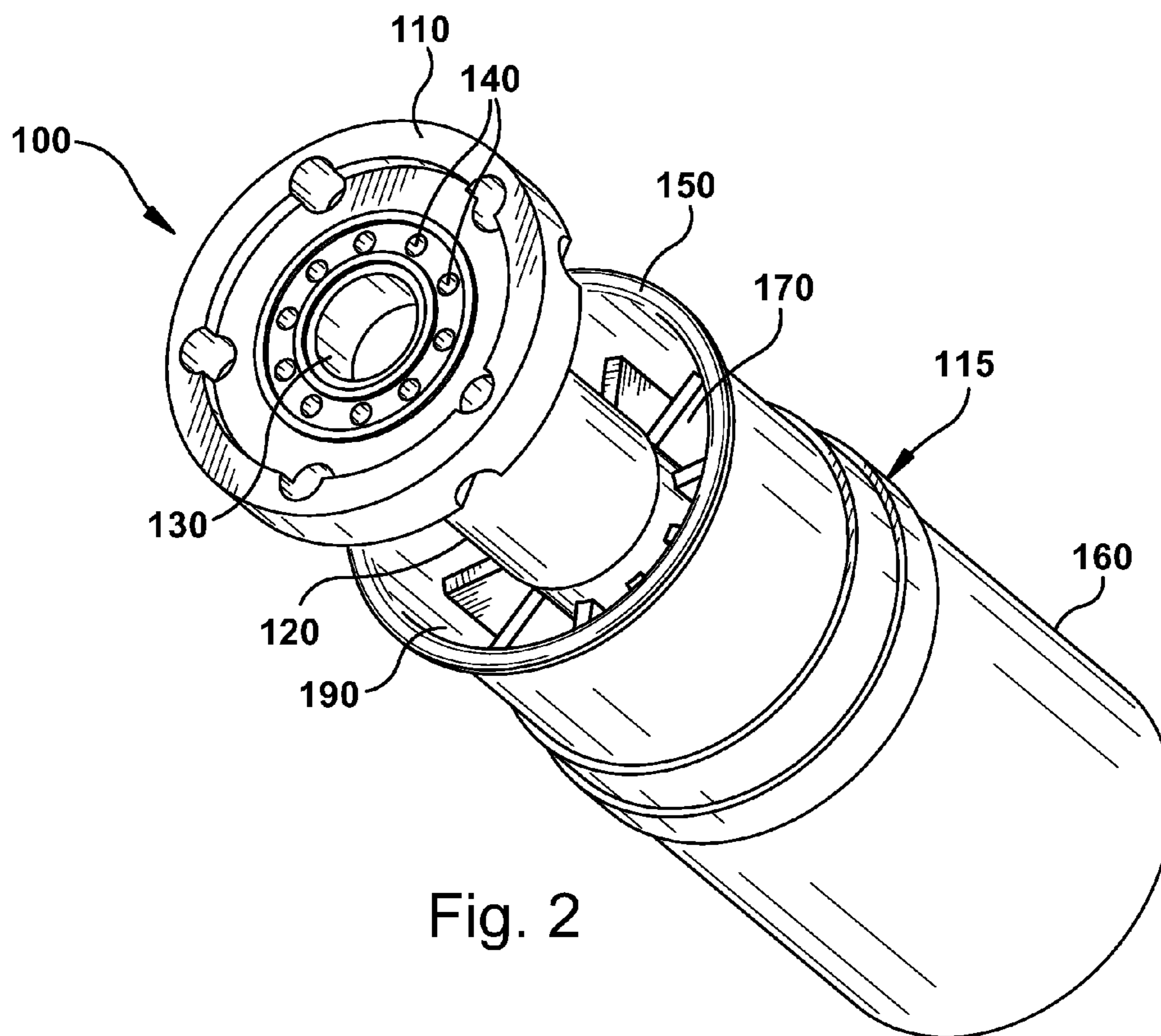
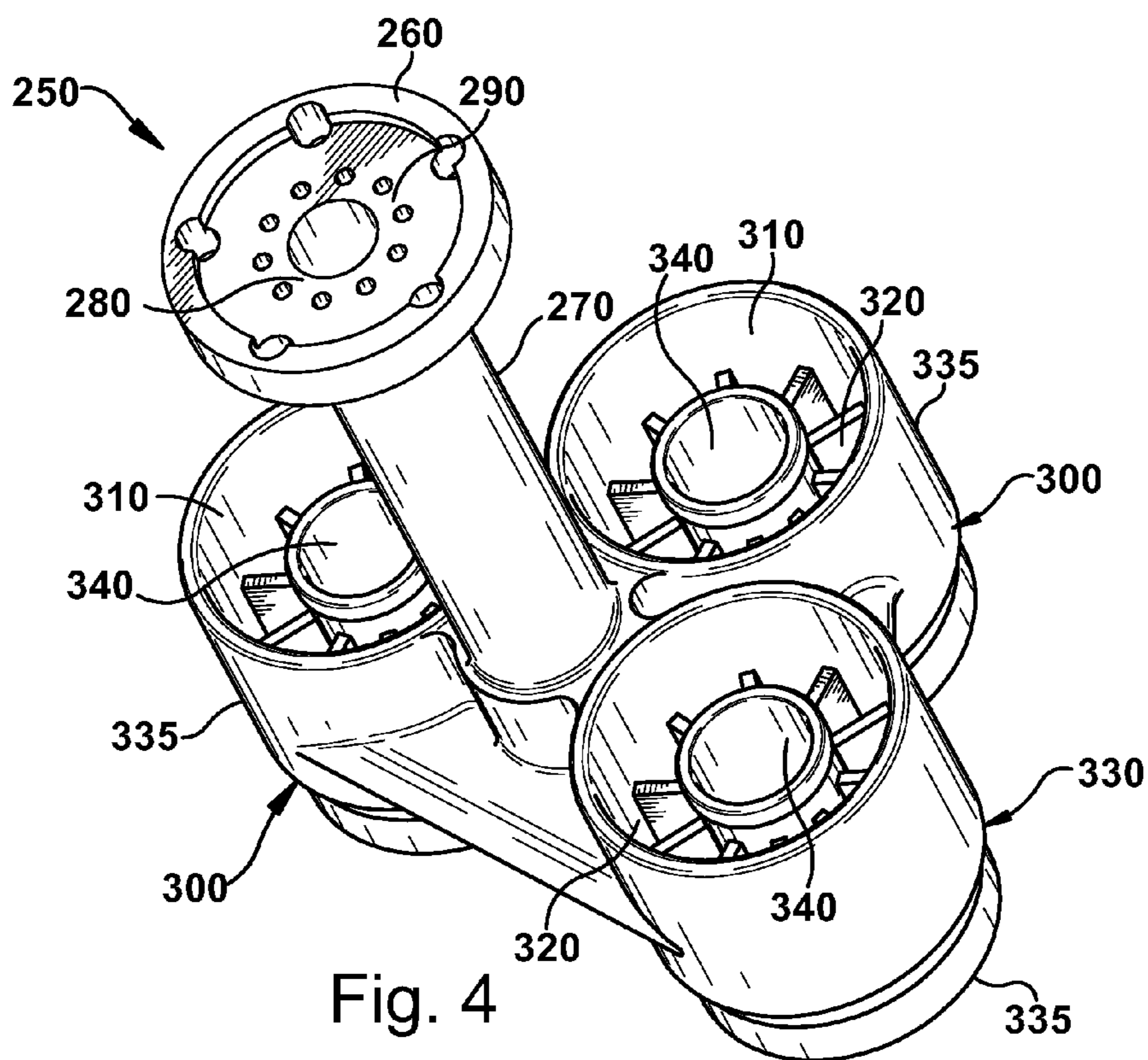
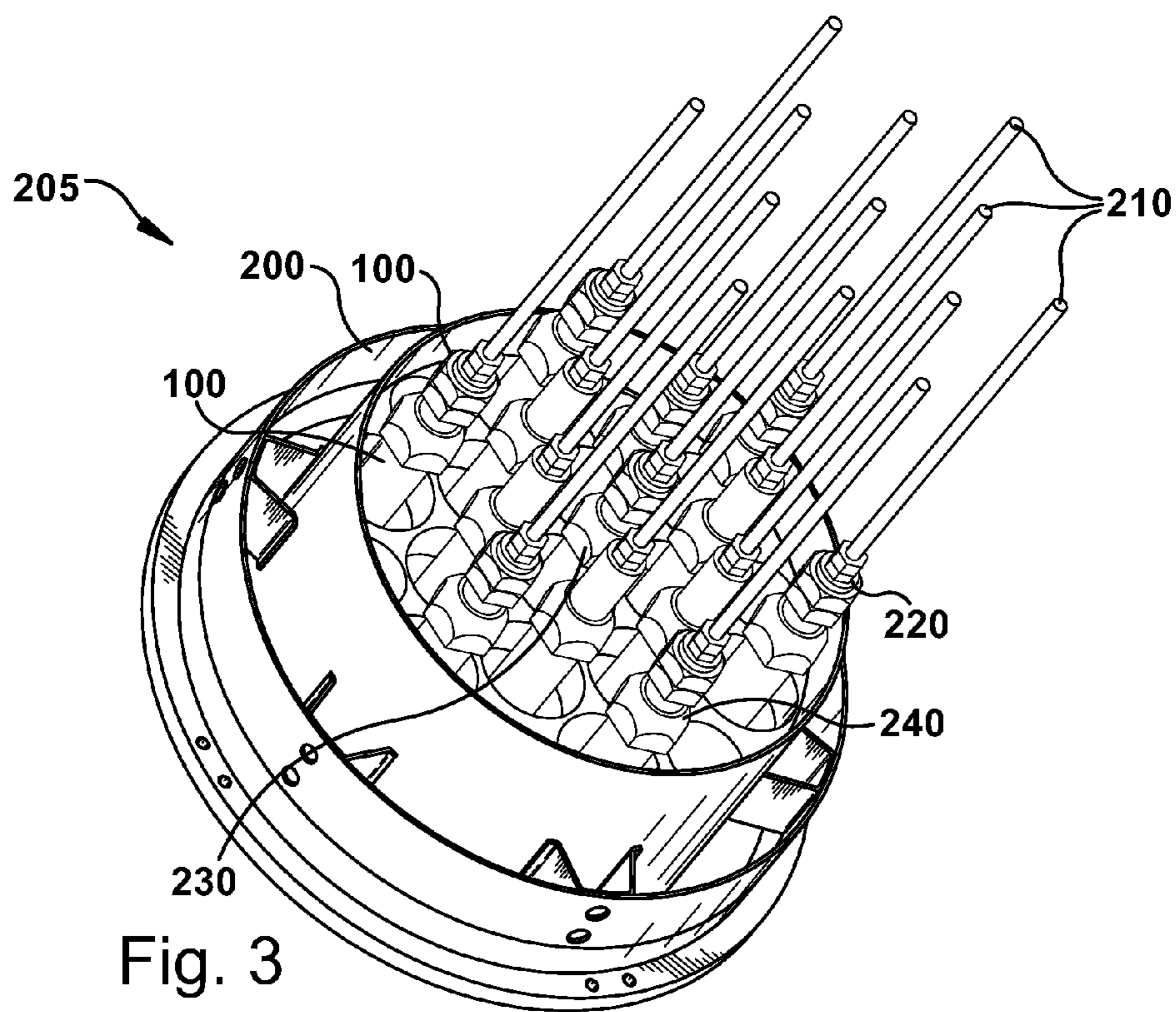


Fig. 2



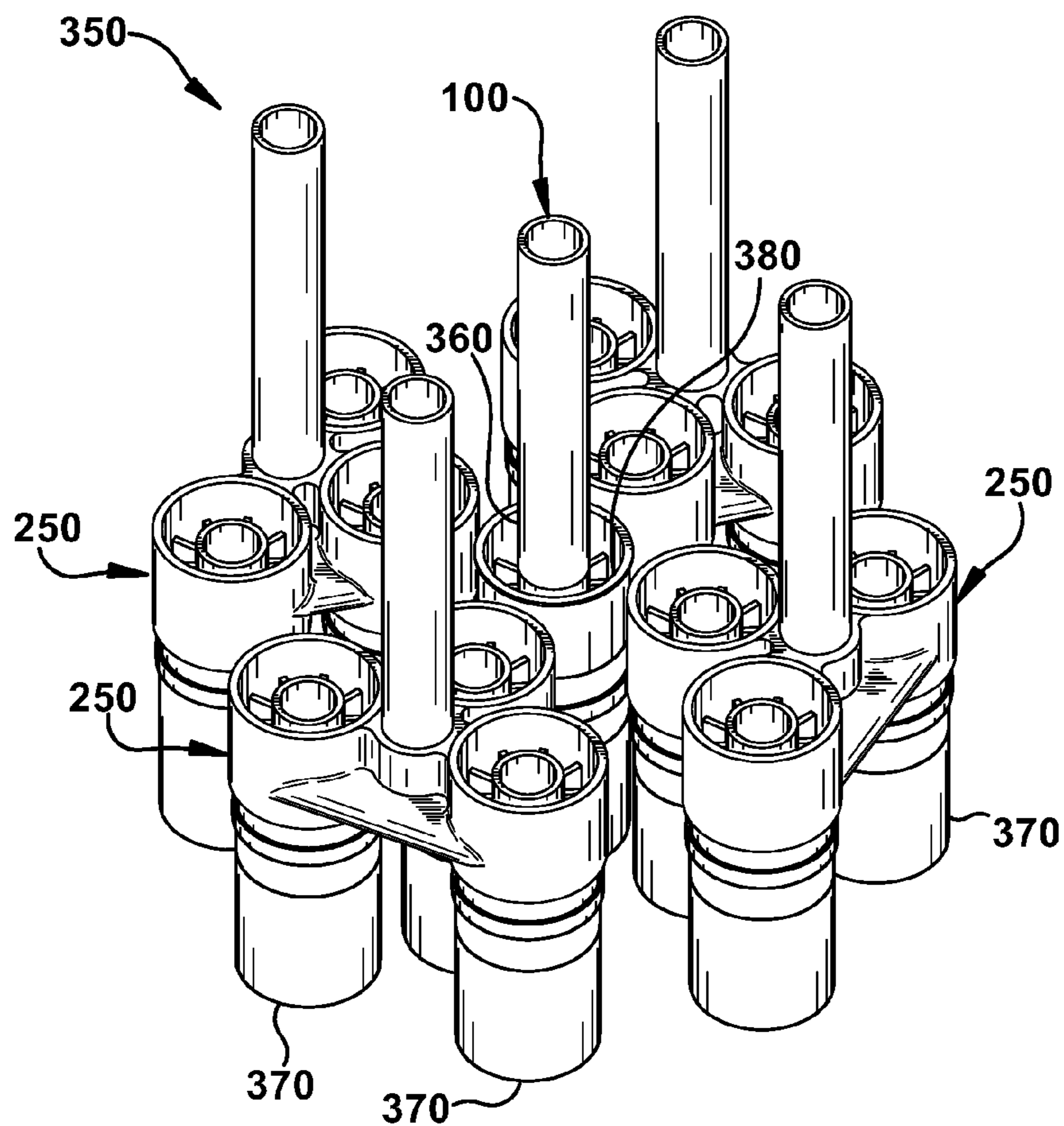


Fig. 5

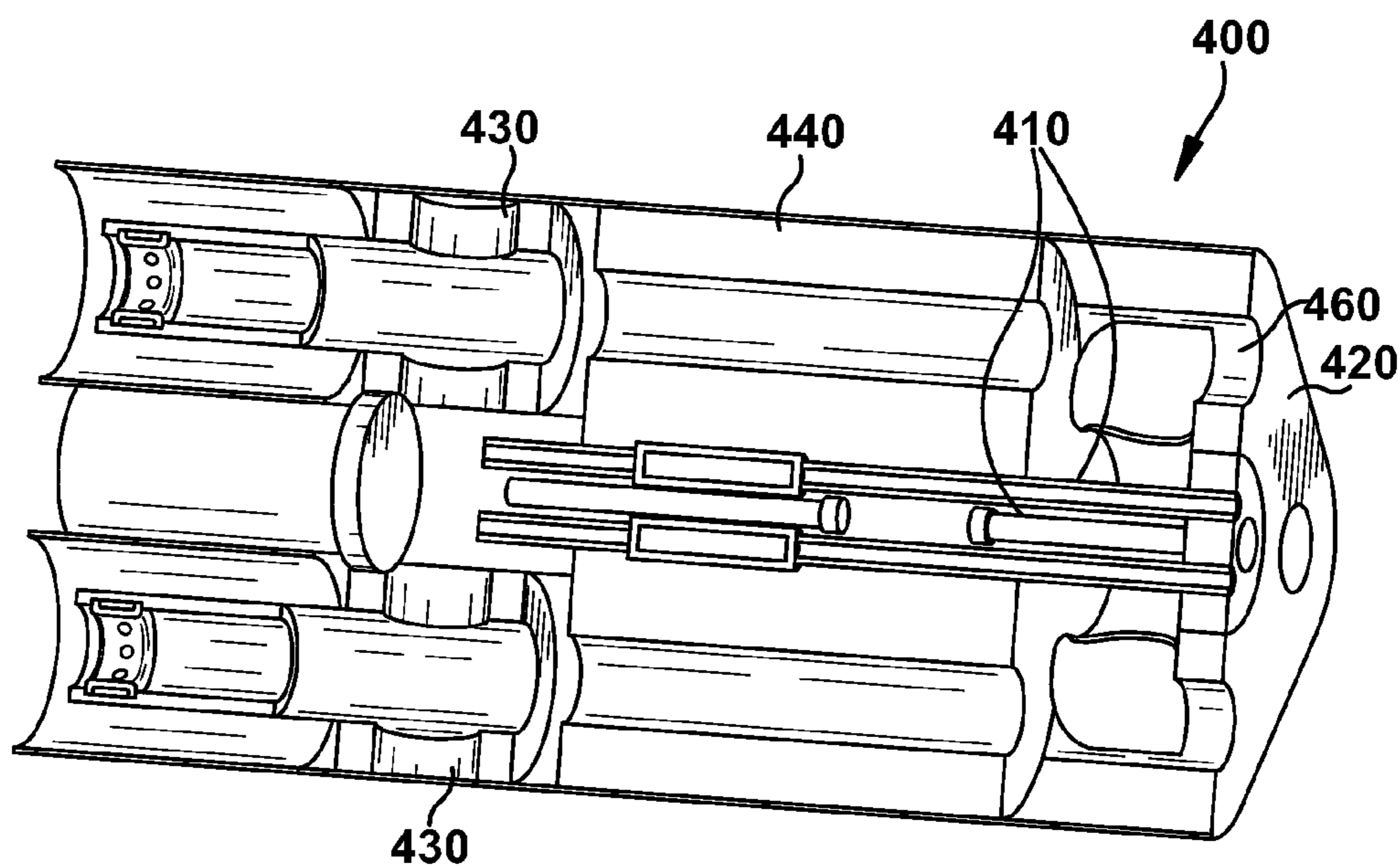


Fig. 6

MULTI-PREMIXER FUEL NOZZLE

TECHNICAL FIELD

[0001] The present application relates generally to gas turbine engines and more particularly relates to the use of fuel nozzles with one fuel supply and mounting column and multiple premixers for premixing prior to combustion.

BACKGROUND OF THE INVENTION

[0002] Current fuel nozzle designs for gas turbine combustion systems generally include one central mounting and fuel supply center body per fuel nozzle or a separate fuel supply. Several fuel and air circuits may be contained within the center body. When the fuel nozzle counts is in the range of about four to six nozzles, current combustion chambers with the center bodies generally present no problem from the standpoint of distributing airflow to the more central nozzles.

[0003] As the fuel nozzle count increases, however, the center bodies begin to restrict airflow to the more central nozzles. This restriction may cause unacceptable variations in the airflow uniformity between the center and outer fuel nozzles and between adjacent nozzles. This variation may cause uneven fuel air mixing and may result in decreased flame holding margins and non-uniform flame temperatures within the within the combustion chamber. Further, these uneven temperatures may lead to increased emissions and durability concerns.

[0004] There is thus a desire therefore for a gas turbine combustion system with more even airflow distribution about the center and the outer nozzles, regardless of the nozzle count. Such a combustion system should maintain reduced emissions while providing flame holding margins and low combustion dynamics response over a variety of operating conditions.

SUMMARY OF THE INVENTION

[0005] The present application thus provides a fuel nozzle for use in a gas turbine. The fuel nozzle may include a mounting flange, a number of premixers attached to each other, and a number of gas pathways extending from the mounting flange to the number of premixers.

[0006] The present application further provides a combustion chamber. The combustion chamber may include a center nozzle with a fuel passage and a pre-mixer and a number of outer nozzles. Each of the outer nozzles may include a number of fuel passages and a number of premixers.

[0007] The present application further provides a fuel nozzle for use in a gas turbine. The fuel nozzle may include a mounting flange, a number of premixers attached to each other, a number of gas tubes extending from the mounting flange to the premixers, and an outer shell surrounding the fuel tubes.

[0008] These and other features of the present application will become apparent to one of ordinary skill in the art upon review of the following detailed description when taken in conjunction with the several drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a schematic view of a gas turbine engine.

[0010] FIG. 2 is a perspective view of a known standard single center body fuel nozzle.

[0011] FIG. 3 is a perspective view of a known combustion chamber with a number of nozzles having a single pre-mixer per center body.

[0012] FIG. 4 is a perspective view of a multiple pre-mixer fuel nozzle as is described herein.

[0013] FIG. 5 is a perspective view of a combustion chamber with a number of nozzles having multiple premixers per center body as is shown in FIG. 4.

[0014] FIG. 6 is side cross-section view of an alternative embodiment of a multiple pre-mixer fuel nozzle as is described herein.

DETAILED DESCRIPTION

[0015] Referring now to the drawings, in which like numbers refer to like elements throughout the several views, FIG. 1 shows a schematic view of a gas turbine engine 10. As is known, the gas turbine engine 10 may include a compressor 20 to compress an incoming flow of air. The compressor 20 delivers the compressed flow of air to a combustor 30. The combustor 30 mixes the compressed flow of air with a compressed flow of fuel and ignites the mixture. (Although only a single combustor 30 is shown, the gas turbine engine 10 may include any number of combustors 30.) The hot combustion gases are in turn delivered to a turbine 40. The hot combustion gases drive the turbine 40 so as to produce mechanical work. The mechanical work produced in the turbine 40 drives the compressor 20 and an external load 50 such as an electrical generator and the like. The gas turbine engine may use natural gas, various types of syngas, and other types of fuels.

[0016] Other types of gas turbine engines 10 may be used herein. The gas turbine engine 10 may have other configurations and may use other types of components. Multiple gas turbine engines 10, other types of turbines, and other types of power generation equipment may be used herein together.

[0017] FIG. 2 shows a known fuel nozzle 100. Generally described, the fuel nozzle 100 may include a flange 110 on one end that leads to a pre-mixer 115. The nozzle 100 may include a center body tube 120 that extends from the flange 110 and through the pre-mixer 115. Positioned within the center body tube 120 may be a purge air pathway 130 extending therethrough. A number of fuel pathways 140 may encircle the purge air pathway 130 and may extend from the flange 110 through the center body tube 120. The fuel nozzle 100 also may include a swirler 150 positioned with the center body tube 120 of the pre-mixer 115. The swirler 150 may extend from the center body tube 120 to a burner tube 160. The swirler 150 may include a number of vanes 170. The fuel pathways 140 may extend from the flange 110 through the center body tube 120 in-part and may exit via the vanes 170 of the swirler 150. The pre-mixer 115 of the fuel nozzle 100 also may include an inlet section 190 for the admission of air through the swirler 150. Other configurations of the fuel nozzle 100 and the components thereof may be used herein.

[0018] In use, gas may enter the flange 110, pass into the pre-mixer 115, and exit from the vanes 170 of the swirler 150. The gas flow may mix with an incoming airflow from the inlet section 190. The gas and air flows thus may mix within the pre-mixer 115 and then may be ignited downstream of the fuel nozzle 100.

[0019] As is shown in FIG. 3, multiple fuel nozzles 100 may be mounted within an end cover assembly 200 of a combustion chamber 205. As is shown, each of the nozzles has a single fuel supply tube 210. The use of the multiple nozzles 100, however, may create a circuitous path 220 for the airflow, at least with respect to one or more center nozzles 230. This restricted airflow between the center nozzles 230 and a number of outer fuel nozzles 240, however, may cause unacceptable variations in the airflow. These variations may cause uneven temperatures within the combustion chamber 205 as a whole. As described above, these uneven temperatures may lead to increase emissions and durability concerns.

[0020] FIG. 4 shows a multiple pre-mixer fuel nozzle 250 as is described herein. The multiple pre-mixer fuel nozzle 250 also may include a flange 260 leading to a center body tube 270. Likewise, a purge pathway 280 may extend from the flange 260 and through the center body tube 270. Similarly, a number of fuel pathways 290 may extend from the flange 260 and through the center body tube 270. Other configurations may be used herein.

[0021] The multiple pre-mixer fuel nozzle 250 may include a number of pre-mixers 300. Although three (3) pre-mixers 300 are shown, any number of pre-mixers 300 may be used. Each pre-mixer 300 may include a swirler 310 positioned therein. As described above, each swirler 310 may include a number of vanes 320. The fuel pathways 290 may pass through the flange 260, through the center body tube 270 in part, into each pre-mixer 300, and exit about the vanes 320 of the swirler 310. Each pre-mixer 300 also may include a burner tube 335 positioned about the swirler 310 and an air inlet section 340 in a manner similar to that described above.

[0022] In use, gas flows through the fuel pathways 290 and then into the vanes 320 of the swirler 310 of each pre-mixer 300. Likewise, air passes through the inlet sections 340 and the swirlers 310 so as to mix with the gas within the burner tube 335. The mixed pathways are then ignited downstream of the multiple pre-mixer fuel nozzle 250.

[0023] FIG. 5 shows the use of the multiple pre-mixer fuel nozzles 250 within a combustion chamber 350. As is shown, a single fuel nozzle 100 is used as a center nozzle 360 while a number of the multiple pre-mixer fuel nozzles 250 are used as a number of outer fuel nozzles 370. As is shown, the combustor chamber 350 has a simplified airflow path 380 to the center nozzle 360 in particular. Specifically, the airflow path 380 may have fewer restrictions as compared to the design of FIG. 3. Further, less restricted air access also is available to the air inlet sections 340 of each pre-mixer 300 of the outer fuel nozzles 370.

[0024] The use of the multiple pre-mixer fuel nozzles 250 thus not only provides an even airflow distribution among the nozzles 100, 250 so as to increase the overall efficiency of the gas turbine engine 10, but use of the multiple pre-mixer fuel nozzles 250 also should provide a cost reduction relative to the single center body designs of the fuel nozzles 100. Moreover, the overall design of the combustion chamber 350 also may be simplified.

[0025] FIG. 6 shows a cross-sectional view of an alternative embodiment of a multiple pre-mixer fuel nozzle 400. Instead of use of the center body tube 270, the multiple pre-mixer fuel nozzle 400 may include a number of fuel tubes 410 that extend from a flange 420 to a number of pre-mixers 430. The space between the flange 420 and the pre-mixers 430 may be encased in an outer shell 440. The outer shell 440 provides structure in the absence of the center body tube 270. The fuel tubes 410 thus may be made out of flexible tubing as opposed to a structural member. Each fuel tube 410 may be in communication with one of the pre-mixers 430. The flange 420 may include a number of apertures therein including a number of fuel apertures 450 and air apertures 460. The fuel apertures 450 may be in communication with the fuel tubes 410 while the air apertures 460 may direct a flow of air towards each of the pre-mixers 430. Other configurations may be used herein.

[0026] The use of the multiple fuel tubes 410 thus allows a variable flow of fuel to each of the pre-mixers 430. Depending upon the nature of the load, steady state conditions, and transient conditions, varying the flow of fuel may be desired to each of the pre-mixers 430.

[0027] It should be apparent that the foregoing relates only to certain embodiments of the present application and that numerous changes and modifications may be made herein by one of ordinary skill in the art without departing from the general spirit and scope of the invention as defined by the following claims and the equivalents thereof.

We claim:

1. A fuel nozzle for use in a gas turbine, comprising: a mounting flange; a plurality of pre-mixers attached to each other; and a plurality of gas pathways extending from the mounting flange to the plurality of pre-mixers.
2. The fuel nozzle of claim 1, further comprising a center body in communication with the mounting flange.
3. The fuel nozzle of claim 1, wherein the plurality of pre-mixers each comprise a swirler therein.
4. The fuel nozzle of claim 3, wherein the plurality of pre-mixers each comprise a burner tube downstream of the swirler.
5. The fuel nozzle of claim 3, wherein the swirler comprises a plurality of vanes.
6. The fuel nozzle of claim 5, wherein the plurality of gas pathways extend from the mounting flange to the plurality of vanes of the swirlers in the plurality of pre-mixers.
7. The fuel nozzle of claim 1, wherein the plurality of pre-mixers each comprise an air inlet section.
8. The fuel nozzle of claim 2, wherein the center body comprises a plurality of pathways therethrough.
9. The fuel nozzle of claim 1, wherein the plurality of gas pathways comprises a plurality of fuel tubes.
10. The fuel nozzle of claim 1, further comprising an outer shell surrounding the plurality of fuel tubes.
11. A combustion chamber, comprising: a center nozzle; wherein the center nozzle comprises a fuel passage and a pre-mixer; and a plurality of outer nozzles; wherein the plurality of outer nozzles comprises a plurality of fuel passages and a plurality of pre-mixers.
12. The combustion chamber of claim 11, wherein the plurality of fuel passages extend from a mounting flange to the plurality of pre-mixers.
13. The combustion chamber of claim 11, wherein the plurality of pre-mixers each comprise a swirler therein.
14. The combustion chamber of claim 13, wherein the plurality of pre-mixers each comprise a burner tube downstream of the swirler.
15. The combustion chamber of claim 13, wherein the swirler comprises a plurality of vanes.
16. The combustion chamber of claim 15, wherein the plurality of fuel passages extend from a center body to the plurality of vanes of the swirlers in the plurality of pre-mixers.
17. The combustion chamber of claim 11, wherein the plurality of pre-mixers each comprise an air inlet section.
18. A fuel nozzle for use in a gas turbine, comprising: a mounting flange; a plurality of pre-mixers attached to each other; a plurality of fuel tubes extending from the mounting flange to the plurality of pre-mixers; and an outer shell surrounding the plurality of fuel tubes.
19. The fuel nozzle of claim 18, wherein the plurality of pre-mixers each comprise a swirler therein.
20. The fuel nozzle of claim 18, wherein the swirler comprises a plurality of vanes on communication with the plurality of fuel tubes.

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