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

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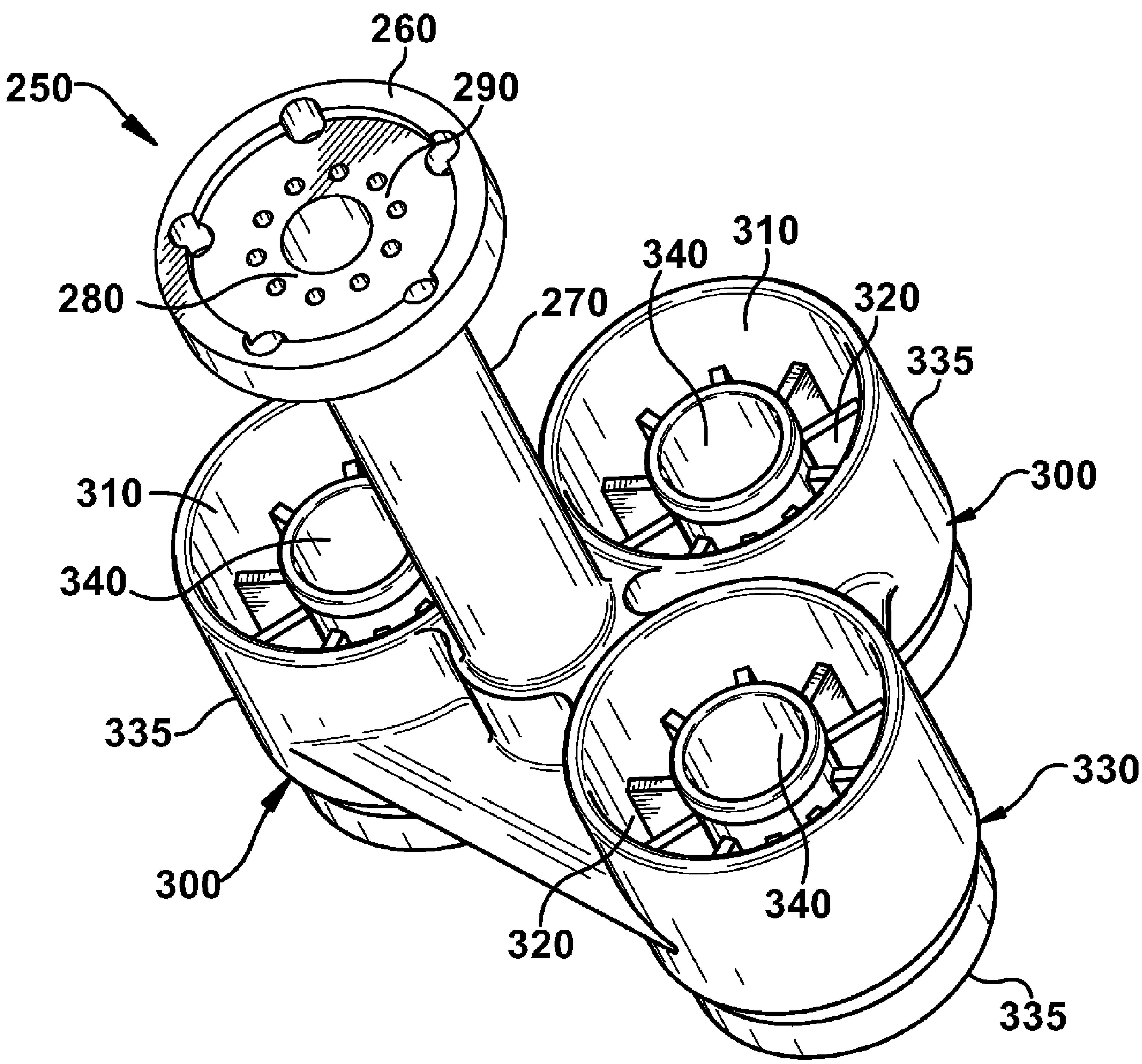
(57) **ABSTRACT**

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.



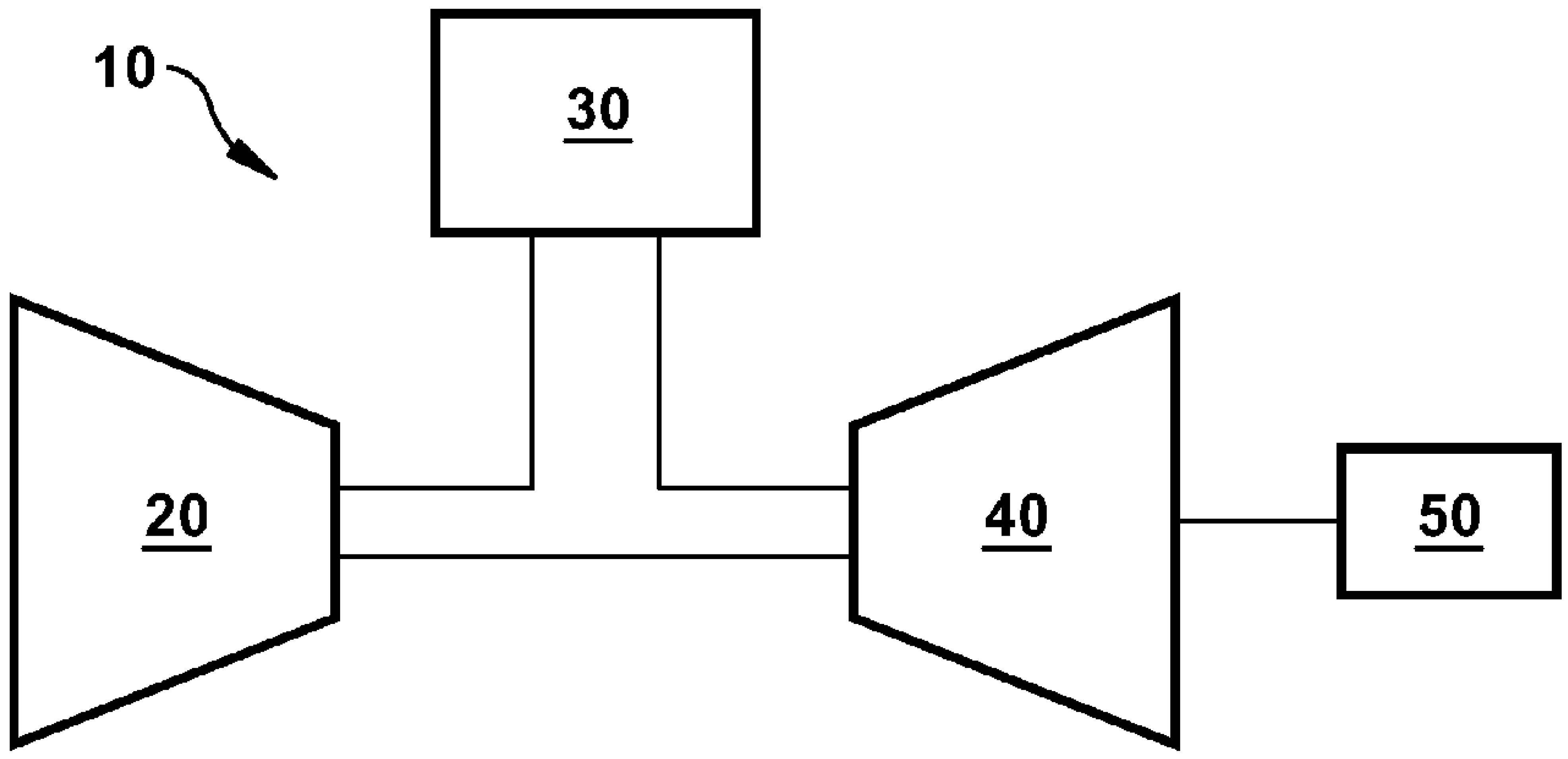


Fig. 1

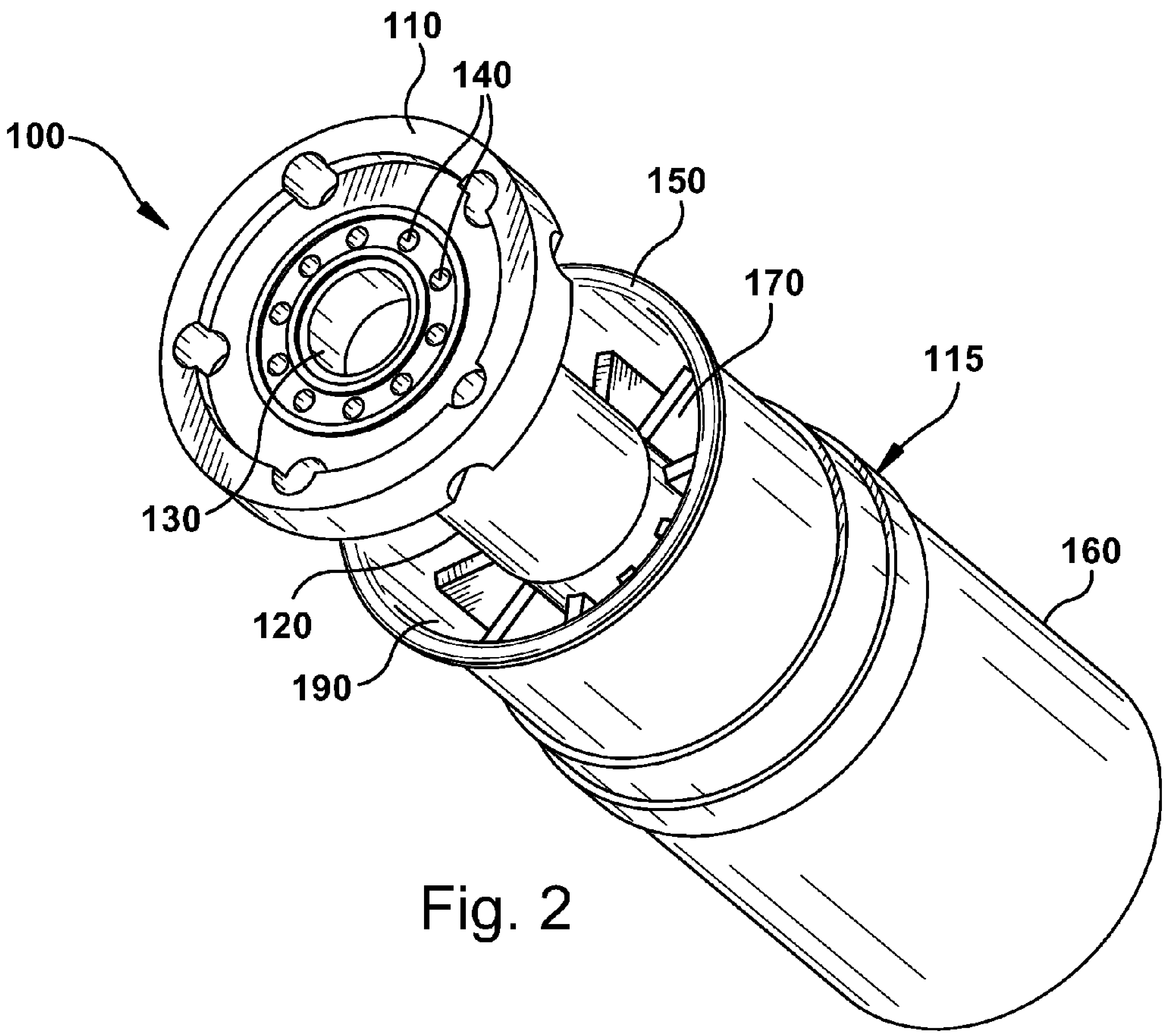


Fig. 2

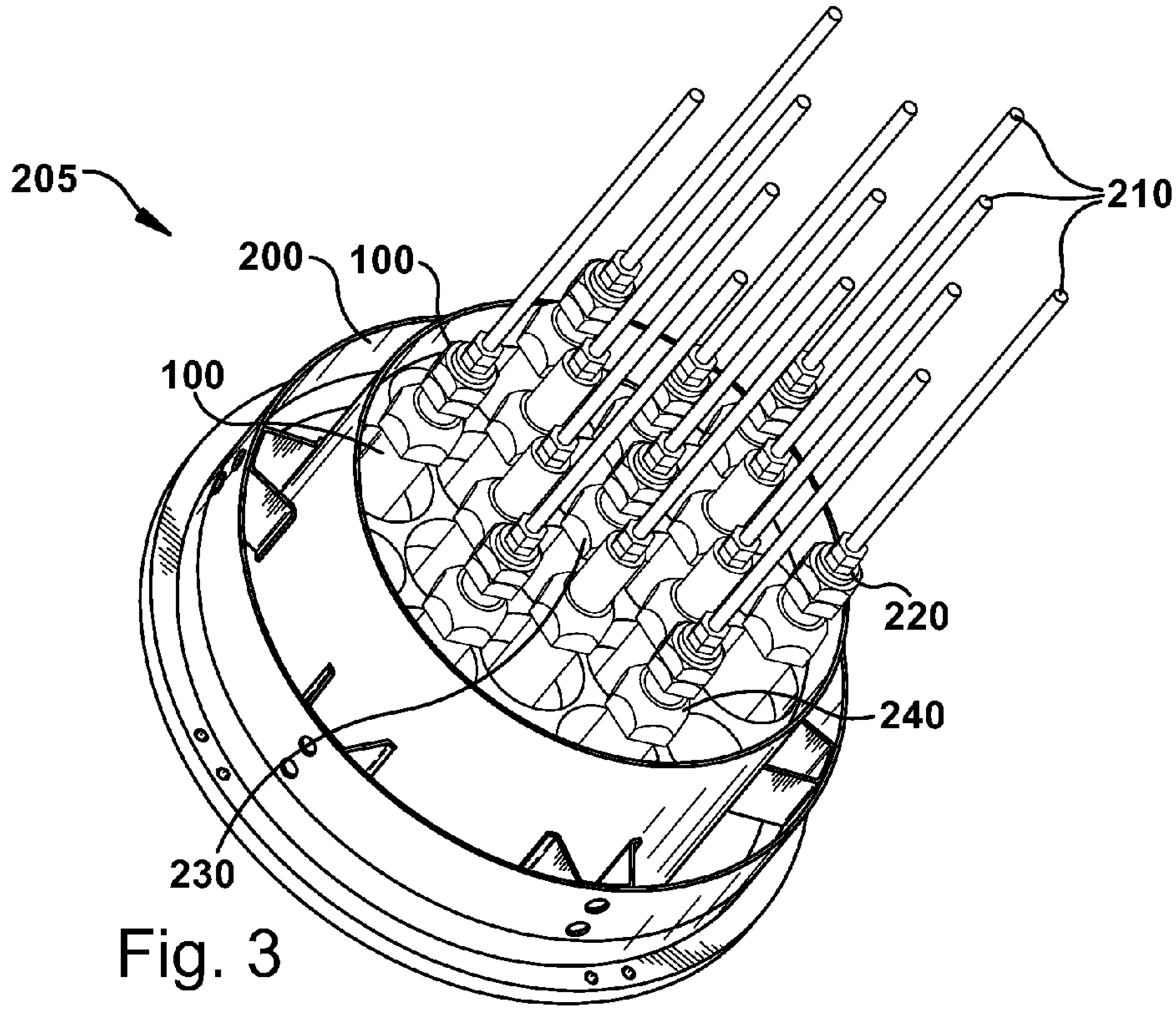

205
200
100
100
210
220
240
230

Fig. 3

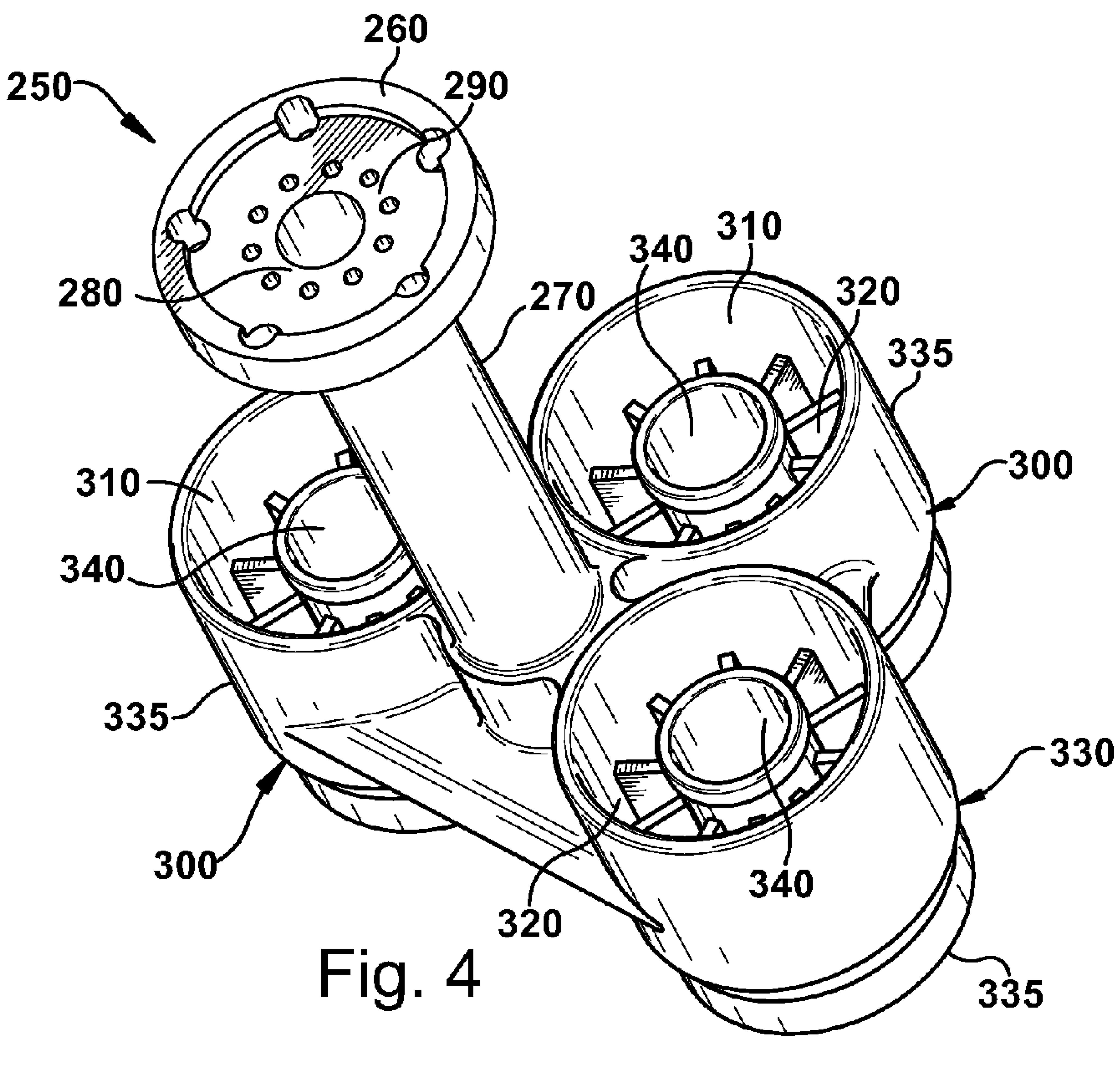

260
250
290
280
270
340
310
320
335
300
310
340
335
300
330
320
340
335

Fig. 4

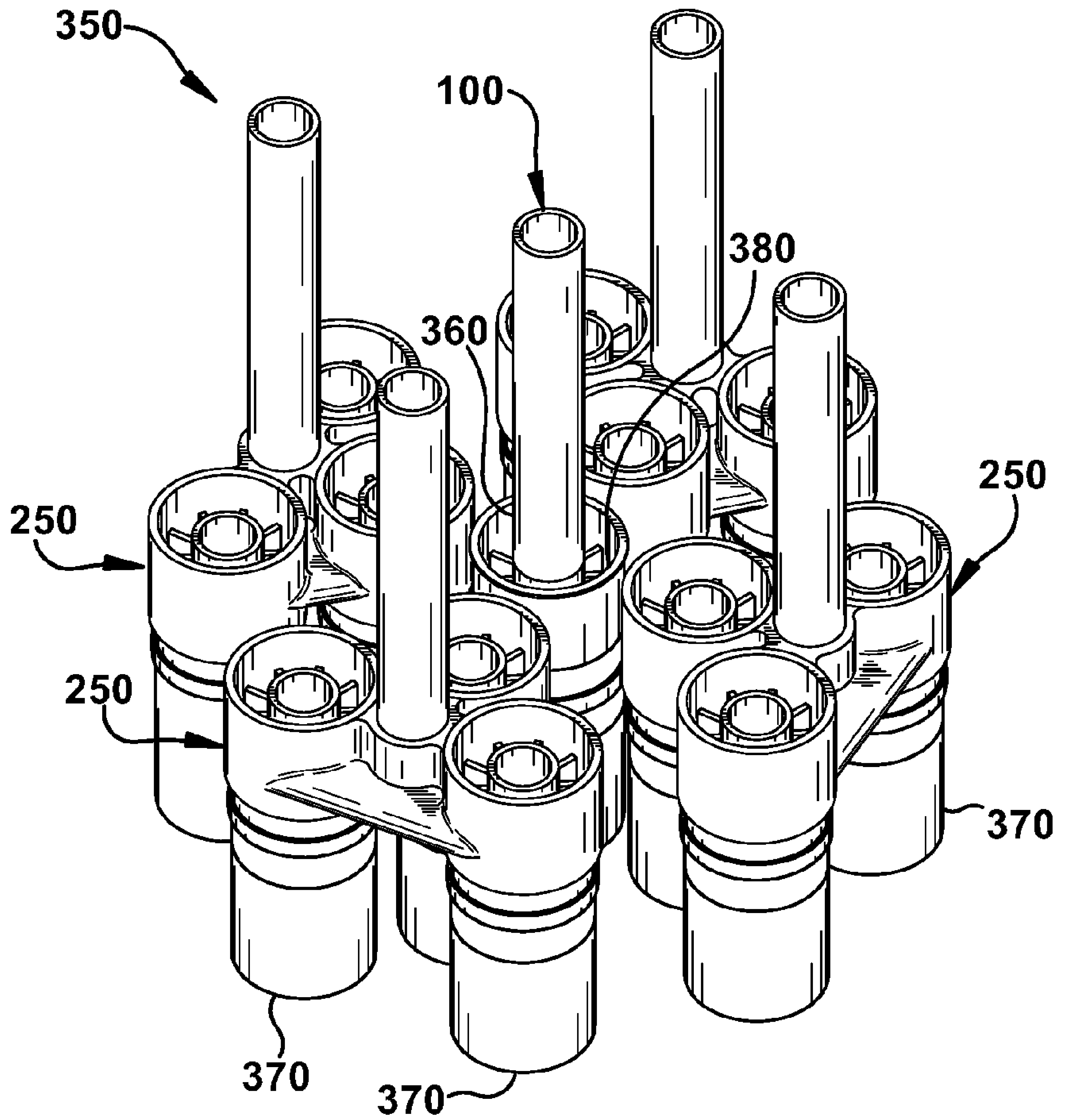

350
100
380
360
250
250
250
370
370
370

Fig. 5

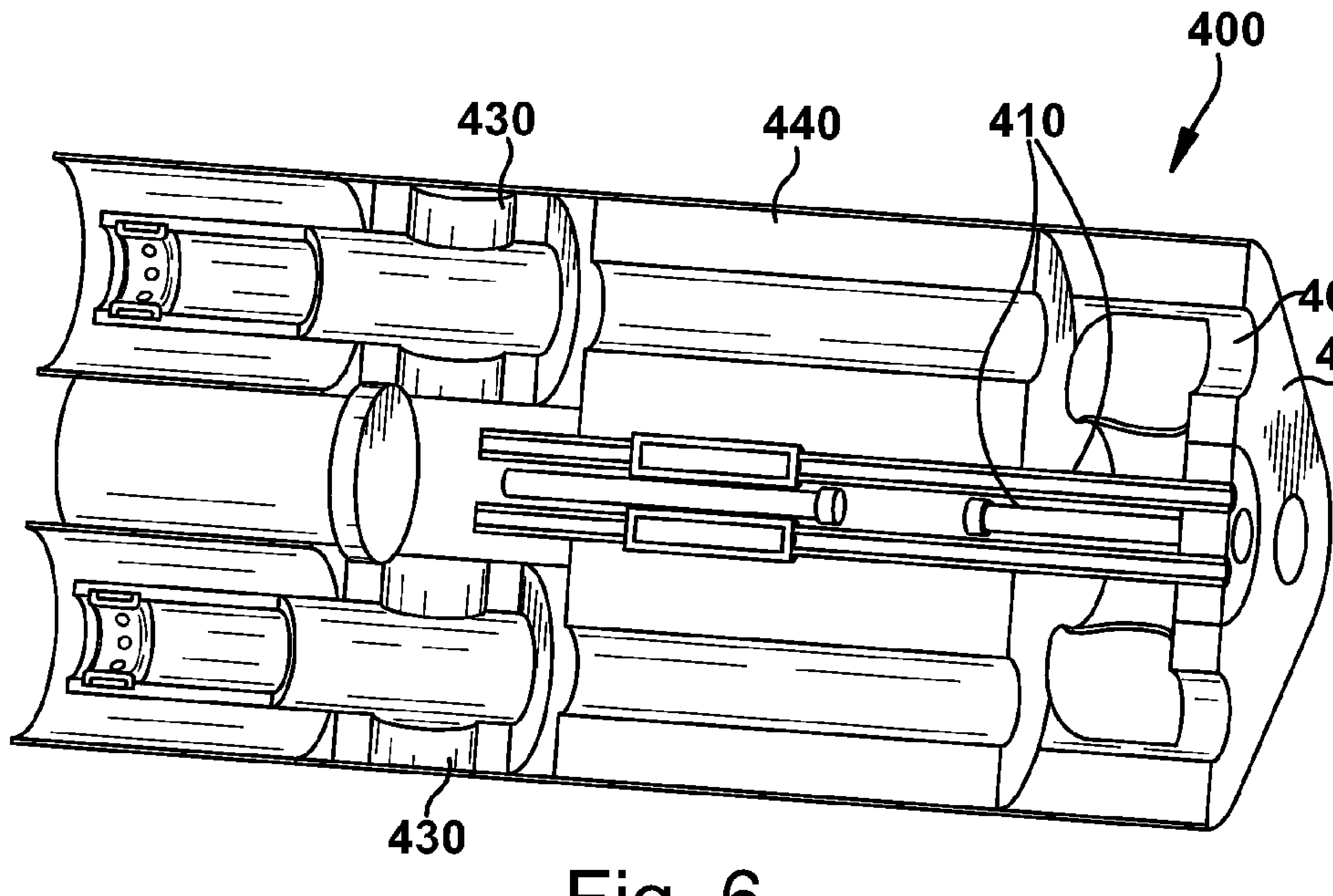

400
430
440
410
460
420
430

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 premixer 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 premixer per center body.

[0012] FIG. **4** is a perspective view of a multiple premixer 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 premixer 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 premixer **115**. The nozzle **100** may include a center body tube **120** that extends from the flange **110** and through the premixer **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 premixer **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 premixer **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 premixer **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 premixer **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 premixer fuel nozzle **250** as is described herein. The multiple premixer 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 premixer fuel nozzle **250** may include a number of premixers **300**. Although three (3) premixers **300** are shown, any number of premixers **300** may be used. Each premixer **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 premixer **300**, and exit about the vanes **320** of the swirler **310**. Each premixer **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 premixer **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 premixer fuel nozzle **250**.

[0023] FIG. **5** shows the use of the multiple premixer 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 premixer 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 premixer **300** of the outer fuel nozzles **370**.

[0024] The use of the multiple premixer 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 premixer 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 premixer fuel nozzle **400**. Instead of use of the center body tube **270**, the multiple premixer fuel nozzle **400** may include a number of fuel tubes **410** that extend from a flange **420** to a number of premixers **430**. The space between the flange **420** and the premixers **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 premixers **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 premixers **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 premixers **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 premixers **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 premixers attached to each other; and
a plurality of gas pathways extending from the mounting flange to the plurality of premixers.

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 premixers each comprise a swirler therein.

4. The fuel nozzle of claim **3**, wherein the plurality of premixers 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 premixers.

7. The fuel nozzle of claim **1**, wherein the plurality of premixers 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 premixer; and
a plurality of outer nozzles;
wherein the plurality of outer nozzles comprises a plurality of fuel passages and a plurality of premixers.

12. The combustion chamber of claim **11**, wherein the plurality fuel passages extend from a mounting flange to the plurality of premixers.

13. The combustion chamber of claim **11**, wherein the plurality of premixers each comprise a swirler therein.

14. The combustion chamber of claim **13**, wherein the plurality of premixers 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 premixers.

17. The combustion chamber of claim **11**, wherein the plurality of premixers each comprise an air inlet section.

18. A fuel nozzle for use in a gas turbine, comprising:
a mounting flange;
a plurality of premixers attached to each other;
a plurality of fuel tubes extending from the mounting flange to the plurality of premixers; and
an outer shell surrounding the plurality of fuel tubes.

19. The fuel nozzle of claim **18**, wherein the plurality of premixers 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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