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(71) Applicant: **Pro-Iroda Industries, Inc.**
Taichung City (TW)

(72) Inventor: **CHEN, Wei-Long**
Taichung City (TW)

(74) Representative: **Viering, Jentschura & Partner**
Patent- und Rechtsanwälte
Grillparzerstrasse 14
81675 München (DE)

(54) **Adjustable vortex flame device**

(57) An adjustable vortex flame device includes a control head (10) delimiting a through hole with an opening and including a flow guiding mechanism (20) including a plurality of vanes and a flow control head inserting in the through hole. The flow control head includes a first member and a second member detachably engaging with each other and delimiting a first chamber and a second chamber connecting to each other. The two channels extend in the first member and to an outer periphery of the flow control head and connect to the first chamber. The flow control head has two flow outlets defined at distal ends of the two channels and a flow inlet defined at a distal end of the second chamber. A hollow and transparent shield (40) is disposed above the control head and delimits a space fluidly connecting to the through hole.

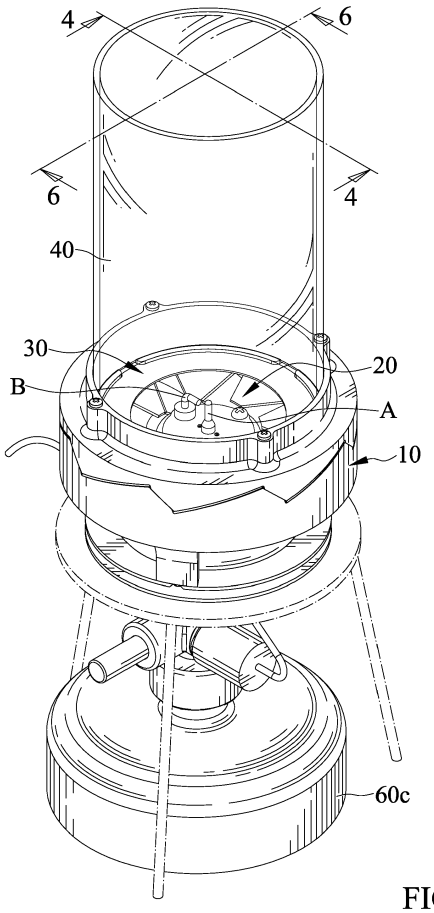

FIG. 1

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Description

Background of the Invention

1. Field of the Invention

[0001] The present invention relates to a vortex flame device and, particularly to an adjustable vortex flame device.

2. Description of the Related Art

[0002] U.S. Patent No. 7,097,448 shows a vortex type gas lamp for producing an upwardly directed vortex flame inside a surrounding and confined boundary of rotating body of air. An interface is located between the body of air which is devoid of gas and a central region of gas which is bounded by the interface during the operation of the gas lamp. All of the combustion of gas substantially occurs inside the interface. The gas lamp has a central axis and includes a base supplying combustible gas without air at and nearly adjacent to the central axis. A shield includes first and second axially extending sections structurally attached to the base in a fluid sealing relationship. The first and second sections of the shield are substantially identical and transparent to light and each includes an impermeable wall having an arcuate inner surface and an arcuate outer surface. Each of the first and second sections of the shield has first and second edges extended axially. The gas lamp further includes first and second walls alternately overlapping one another. The first and second walls are adjacent to their edges and are spaced from one another so as to form tangentially directed ports, thereby forming an axially extending mixing chamber open at its side only through the ports. The first and second sections are arranged that at the base they surround the entry of combustible gas and which receives air for combustion only through the ports, whereby a flame results from the combustion process is spaced from the inner surfaces, and the peripheral body of air is devoid of gas entering through the ports. Generally, if no air is supplied for combustion, a flame will extinguish. Unfortunately, it is not easy to prevent excess air from entering the chamber through the ports and creates a stable swirling flame during combustion since the ports are directly open to air. Furthermore, height and swirling pattern of the flame are greatly disturbed by excess airflow through the ports due to wind, if the device is placed under an environment with wind. Notwithstanding, the base of the chamber is also heated during combustion and if there is no enough airflow through the base to provide cooling, the top surface of the base can be very hot and not safe to touch.

[0003] U.S. Design Patent No. 621,873 shows a fire tornado lamp. A base includes a plurality of ports disposed circumferentially. A shield is transparent to light and hollow and includes a passage. The base and the shield are connected to each other. Each port extends radially with respect to and is in communication with the passage. Each port is configured that it induces air into the passage in a direction substantially tangential to a circumference of the passage. Likewise, it is not easy to preclude excess air from entering through the ports and winds easily disturb a flame of the fire tornado lamp. Also, the guided air flow that provides for combustion and cooling can only enters the chamber through the ports above the bottom of burning flame at an angle perpendicular to the flame direction. This configuration can generate a swift swirling flame and induce strong convection during combustion, but it is difficult to control the swirling speed and pattern of the flame and the base of the device can be very hot.

[0004] In addition, a user can't interact with either of the two set forth devices to adjust the size of vortex flames of the devices.

[0005] The present invention is, therefore, intended to obviate or at least alleviate the problems encountered in the prior art.

Summary of the Invention

[0006] According to the present invention, an adjustable vortex flame device includes a control head delimiting a through hole with an opening. The control head includes a flow guiding mechanism including a plurality of vanes disposed around a circumference of the opening one after another, and two adjacent vanes includes a spiral air passage formed therebetween. A flow control head inserts in the through hole. The flow control head includes a first member and a second member detachably engaging with the first member. The flow control head delimits a first chamber and a second chamber connecting to the first chamber. Two channels extend in the first member and to an outer periphery of the flow control head. The two channels connect to the first chamber. The flow control head has two flow outlets defined at distal ends of the two channels and a flow inlet defined at a distal end of the second chamber. The adjustable vortex flame device in use includes a fuel reservoir fluidly connecting to the flow inlet of the flow control head. The first chamber extends longitudinally along a first axis. The two channels are disposed symmetrically with respect to the first axis. Each of the two channels extends longitudinally along a second axis. The second axis offsets radially from the first axis. A hollow and transparent shield is disposed above the control head and delimits a space fluidly connecting to the through hole.

[0007] It is therefore an object of the present invention to provide a vortex flame device that produces a stable vortex flame.

[0008] Other objects, advantages, and new features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanied drawings.

Brief Description of the Drawings

[0009]

Fig. 1 is a perspective view of an adjustable vortex flame device in accordance with a first embodiment of the present invention.

Fig. 2 is a partial, exploded perspective view of the adjustable vortex flame device of Fig. 1.

Fig. 3 is an exploded perspective view of a flow control head of the adjustable vortex flame device of Fig. 1.

Fig. 4 is a partial, cross-sectional view taken along line 4-4 of Fig. 1.

Fig. 5 is a partial, enlarged view of Fig. 4.

Fig. 6 is partial, cross section view taken along line 6-6 of Fig. 1.

Fig. 7 is a perspective view of an adjustable vortex flame device in accordance with a second embodiment of the present invention.

Fig. 8 is a partial, exploded perspective view of the adjustable vortex flame device of Fig. 7.

Fig. 9 is a perspective view of a first member of a flow control head of the adjustable vortex flame device of Fig. 7.

Fig. 10 is a partial, cross-sectional view taken along line 10-10 of Fig. 7.

Fig. 11 is a partial, cross-sectional view taken along line 11-11 of Fig. 7, with the adjustable vortex showing the adjustable vortex flame device producing a vortex flame, and with arrows indicating air flows.

Fig. 12 is a perspective view of the adjustable vortex flame device of Fig. 7, with the adjustable vortex flame device producing a vortex flame, and with arrows indicating air flows.

Detailed Description of the Invention

[0010] Figs. 1 through 6 show an adjustable vortex flame device in accordance with a first embodiment of the present invention. The adjustable vortex flame device includes a control head 10. The control head 10 delimits a through hole with an opening 13 with a diametrical size. The control head 10 includes a base having an inner periphery thereof delimiting the opening 13. The flow guiding and control mechanisms 20 and 30 are mounted on the base. The base includes a first base member 11 and a second base member 12 joined to the first base member 11. The opening 13 defines a first orifice 111 extending through the first base member 11 and a second orifice 121 extending through the second base member 12, respectively. The first base member 11 has a first engaging end 112 and the second base member 12 has a second engaging end 122 engaging with the first engaging end 112. The first engaging end 112 forms a plurality of first ridges each include first and second edges 1121 and 1122 and an apex defined therebetween and the second engaging end 122 forms a plurality of second ridges each include third and fourth edges 1221 and 1222 and an apex defined therebetween respectively, and the first and second edges 1121 and 1122 of one of the plurality of first ridges correspondingly face the third and fourth edges 1221 and 1222 of one of the plurality of second ridges. The first and second edges 1121 and 1122 of one of the plurality of first ridges have an included angle of greater than 90 degrees. The third and fourth edges 1121 and 1122 of one of the plurality of second ridges have an included angle of greater than 90 degrees. At least one fastener 15c is used to secure the first and second base members 11 and 12 together. The at least one fastener 15c includes outer threads and the first and second base members 11 and 12 each include at least one engaging hole having inner threads, and the at least one fastener 15c engages in and in thread engagement with the engaging holes of the first and second member 11 and 12. A flow control head 14c inserts in the through hole delimited by the control head 10. The flow control head 14c includes a first member 141c and a second member 142c detachably engaging with the first member 141c. The first member 141c is disposed above the second member 142c in a vertical direction. The first and second members 141c and 142c are secured by a fastening means 143c. The fastening means 143c are bolts. Two bolts 143c are used to secure the first and second members 141c and 142c together. The first member 141c includes two first holes 1413c extending therethrough. The second member 142c includes two second holes 1423c extending therein. The first and second members 141c and 142c are secured together with the two bolts 143c respectively inserting through the two first holes 1413c and engaging in the two second holes 1423c. Each of the two bolts 143c has outer threads. A platform 144c bears the second member 142c of the flow control head 14c. The flow control head 14c delimits a first chamber 1421c and a second chamber 1422c connecting to the first chamber 1421c. Two channels 1411c extend in the first member 141c and to an outer periphery of the flow control head 14c and connect to the first chamber 1421c. The flow control head 14c has two flow outlets defined at distal ends of the two channels 1411c and a flow inlet defined at a distal end of the second chamber 1422c. The adjustable vortex flame device in use includes a fuel reservoir 60c fluidly connecting to the flow inlet of the flow control head 14c. The first chamber 1421c is disposed between and interconnects the two channels 1411c and the second chamber 1422c. The first chamber 1421c extends longitudinally along a first axis L1. The two channels 1411c are disposed symmetrically with respect to the first axis L1. Each of the two channels 1411c extends longitudinally along a second axis L2. The second axis L2 offsets radially from the first axis L1. Each of the flow outlets radially offsets from the first axis L1 at a first radial distance. The first member 1421c is substitutable with another first member 1421c which includes each of flow outlets radially offsetting from the first axis L1 at a second radial distance different from the first radial

distance. The second chamber 1422c extends longitudinally along a third axis L3. The third axis L3 is parallel to the first axis L1. The third axis L3 is offset radially from the first axis L1.

[0011] The control head 10 includes a flow guiding mechanism 20 including a plurality of vanes 21. The flow guiding mechanism 20 is disposed below the opening 13. The plurality of vanes 21 are disposed around a circumference of the opening 13 one after another, with two adjacent vanes 21 including a spiral air passage 22 formed therebetween. Each of the plurality of vanes 21 has a first extension 211 secured between the first edge 1121 of one of the plurality of first ridges and the third edge 1221 of one of the plurality of second ridges and a second extension 212 extending from the first extension 211, and the air passage 22 between two adjacent vanes 21 are delimited by the second extensions 212 thereof. Each of the plurality of vanes 21 includes the second extension 212 extending from the first extension 211 obliquely. The first and second extensions 211 and 212 have an included angle of greater than 90 degrees. The plurality of vanes 21 are held securely between the first and second base members 11 and 12 with a plurality of joints 1223 which insert through the first extensions 211 of the plurality of vanes 21 and fixed to the plurality of securing sections 1123. The plurality of securing sections 1123 are formed on the first base member 11 and the plurality of joints 1223 extend from the second base member 12, respectively. The plurality of securing sections 1123 define a plurality of apertures and the plurality of joints 1223 define a plurality of projections, respectively, but not limiting. The plurality of vanes 21 include a plurality of cavities 2111 the plurality of joints 1223 insert through. Therefore, the plurality of joints 1223 insert through the plurality of vanes 21.

[0012] The control head 10 includes a control mechanism 30 delimiting a hole 31. The control mechanism 30 is an annular member secured to the first base member 11, and the hole 31 is delimited by an inner periphery of the annular member. The first base member 11 has at least one first fixing end 113 connecting with the opening 13, and the control mechanism 30 has at least one second fixing end 32 engaging with the at least one first fixing end 113. Fig. 2 shows the first base member 11 includes a plurality of first fixing ends 113 defining a plurality of slots and the control mechanism 30 includes a plurality of second fixing ends 32 defining a plurality of projections respectively. In addition, the plurality of first fixing ends 113 are spaced apart one another circumferentially along the inner periphery of the first base member 11. Likewise, the plurality of second fixing ends are spaced apart one another circumferentially along the inner periphery of the control mechanism 30. The hole 31 has a diametrical size and which varies with respect to a size of a vortex flames of the adjustable vortex flame device. The hole 31 corresponds to and in communication with the opening 13. The hole 31 is in a smaller diametrical size than the opening 13. The hole 31 of the control mechanism 30 has a first diametrical size. The control mechanism 30 is substitutable with another control mechanism 30 which includes the hole 31 thereof having a second diametrical size different from the first diametrical size, thereby influencing a size of a vortex flame of the adjustable vortex flame device.

[0013] A hollow and transparent shield 40 is disposed above the control head 10 and adjacent to the control mechanism 30. The shield 40 delimits a space 41 in communication with the hole 31 of the control mechanism 30. The space 41 fluidly connects to the through hole delimited by the control head 10. The shield 40 has two opposite open ends 42. The space 41 is between the two open ends 42.

[0014] A seat 50 with at least one auxiliary air inlet 51 is fixed to and bears the base and with which a fuel reservoir 60 is adapted to connect. The base includes at least one connecting section 123 with which the seat 50 is engaged to mount securely on the seat 50.

[0015] A heat detecting system A adapted to detect a temperature of a vortex flame of the adjustable vortex flame device inserts through the flow control head 14c. The first member 141c includes a third hole 1414c extending therethrough. The second member 142c includes a fourth hole 1424c extending therethrough. The heat detecting system A inserts through the flow control head 14c from the third and fourth hole 1414c and 1424c. When the first and second members 141c and 142c are secured together, the third and fourth holes 1414c and 1424c correspond to each other. Centers of the third and fourth holes 1414c and 1424c are disposed on the first axis L1.

[0016] An ignition system B also extends through the flow control head 14c. The first member 141c includes a fifth hole 1415c extending therethrough. The second member 142c includes a sixth hole 1425c extending therethrough. The ignition system B extends through the flow control head 14c from the fifth and sixth holes 1415c and 1425c. When the first and second members 141c and 142c are secured together, the fifth and sixth holes 1415c and 1425c correspond to each other. Centers of the fifth and sixth holes 1415c and 1425c are disposed on the first axis L1.

[0017] A pipe E can deliver fuel in the fuel reservoir 60c to the flow control head 14c. The pipe E has a first end fluidly engaging with the fuel reservoir 60c and a second end inserting in the second chamber 1422c. The second end of the pipe E protrudes into the first chamber 1421c.

[0018] Figs. 7 through 12 show an adjustable vortex flame device in accordance with a second embodiment of the present invention. The second embodiment is similar to the first embodiment. A control head 10d includes a base having an inner periphery thereof delimiting an opening 13. A flow guiding and control mechanisms 20d and 30d are mounted on the base. The base includes a first base member 11d and a second base member 12d joined to the first base member 11d. The first base mem-

ber 11d has a first engaging end and the second base member 12d has a second engaging end engaging with the first engaging end. The first engaging end forms a plurality of first ridges each include first and second edges and an apex defined therebetween and the second engaging end forms a plurality of second ridges each include third and fourth edges and an apex defined therebetween respectively. The first and second edges of one of the plurality of first ridges correspondingly face the third and fourth edges of one of the plurality of second ridges. The first and second edges of one of the plurality of first ridges have an included angle of greater than 90 degrees. The third and fourth edges of one of the plurality of second ridges have an included angle of greater than 90 degrees.

[0019] At least one fastener 15d is used to secure first and second base members 11d and 12d together. The at least one fastener 15d includes outer threads and the first and second base members 11b and 12d each include at least one engaging hole having inner threads, and the at least one fastener 15d engages in and in thread engagement with the engaging holes of the first and second member 11d and 12d.

[0020] A flow control head 14d inserts in a through hole delimited by a control head 10d. The flow control head 14d includes a first member 141d and a second member 142d detachably engaging with the first member 141d. The first member 141 d is disposed above the second member 142d in a vertical direction. The first and second members 141c and 142c are secured by a fastening means 143c. The fastening means 143d defines outer threads on the outer periphery of the first member 141 d and inner threads on the inner periphery of the second chamber 1422d. The first and second members 141d and 142d are secured together with the outer thread 143b engaging with the inner threads 143d. The first member 142d includes an outer periphery thereof including at least one ear 1416d protruding therefrom. It is effort saving and convenient that a user can grip and apply a force on the ear 1416d to join the first member 141d to the second member 142d. The flow control head 14d delimits a first chamber 1421d and a second chamber 1422d connecting to the first chamber 1421d. Two channels 1411d extend in the first member 141d and to an outer periphery of the flow control head 14d and connect to the first chamber 1421d. The flow control head 14d has two flow outlets defined at distal ends of the two channels 1411d and a flow inlet defined at a distal end of the second chamber 1422d. The adjustable vortex flame device in use includes a fuel reservoir 60d fluidly connecting to the flow inlet of the flow control head 14d. The first chamber 1421 d is disposed between and interconnects the two channels 1411d and the second chamber 1422d. The first chamber 1421d extends longitudinally along a first axis L1. The two channels 1411d are disposed symmetrically with respect to the first axis L1. Each of the two channels 1411d extends longitudinally along a second axis L2. The second axis L2 offsets radially from the first axis L1. Each of the flow outlets radially offsets from the first axis L1 at a first radial distance. The first member 1421d is substitutable with another first member 1421d which includes each of flow outlets radially offsetting from the first axis L1 at a second radial distance different from the first radial distance. The second chamber 1422d extends longitudinally along a third axis L3. The third axis L3 is parallel to the first axis L1. The third axis L3 is offset radially from the first axis L1. Each of the two channels 1411d extending obliquely from the first chamber 1421d to the outer periphery of the flow control head 14d. The two channels 1411d extend divergently from each other from the first chamber 1421d to the outer periphery of the flow control head 14d. The second axis L2 tilts from the first axis L1 at a first angle α. The first angle α is less than 90 degrees. The first angle α is 17.5 degrees.

[0021] Each of the plurality of vanes 21d has a first extension secured between the first edge of one of the plurality of first ridges and the third edge of one of the plurality of second ridges and a second extension 212d extending from the first extension 211d. An air passage 22d between the two adjacent vanes 21d are delimited by the second extensions 212d thereof. Each of the plurality of vanes 21d includes the second extension 212d thereof extending from the first extension 211d. The second extension 212d defines a surface and a tangent plane of the surface tilts from the first axis L1 at a second angle β. The second angle β is greater than 45 degrees. The second angle β is less than 90 degrees.

[0022] A seat 50d with at least one auxiliary air inlet 51d is fixed to and bears the base. The at least one auxiliary air inlet 51d is disposed below the flow guiding mechanism 20d. The seat 50d includes a first seat member 52d and a second seat member 53d incorporating together to delimit the at least one auxiliary air inlet 51d. The first seat member 52d is an annular member and includes an inner periphery thereof delimiting a through hole 521d. The first seat member 52d includes at least two legs separating from each other, with a gap defined between the at least two legs. The second seat member 53d bears the first seat member 52d. The second seat member 53d is in a form of a platform. The second seat member 53d bears first seat member 52d from the at least two legs of the first seat member 52d. Air flows through the at least one auxiliary air inlet 51d flow through the gap between the at least two legs. The second seat member includes an orifice 531d extending therethrough.

[0023] In view of the forgoing, the stack effect occurs in each of the adjustable vortex flame devices, and the negative pressure due to the stack effect in the shield 40 can induce the outside air into the adjustable vortex flame device. The Coanda effect also occurs in each of the adjustable vortex flame devices, with the outside air in the adjustable vortex flame device guided by the plurality of vanes 21 and 21d of the flow guiding mechanisms 20 and 20d to flow spirally in the shield 40 and to attach to an inner peripheral wall of the shield 40. With the flow

guiding mechanisms 20 and 20d, the Coanda effect in the adjustable vortex flame devices is effective, so a flame of the adjustable vortex flame device is stable and smooth. Furthermore, the control mechanisms 30 delimit the holes 31 which vary with respect to different sizes of vortex flames of the adjustable vortex flame device, and each of the holes 31 is in a smaller diametrical size than the opening 13 so it is obvious to see vorticities of a vortex flame of each of the adjustable vortex flame devices. Furthermore, the flow control heads 14c and 14d enable the adjustable vortex flame device that produces a stable vortex flame. Each of the flow outlets radially offsets from the first axis L1 at the first radial distance, and Each of the first members 1421c and 1421d is substitutable with another first member 1421c and 1421d which includes each of flow outlets radially offsetting from the first axis L1 at the second radial distance different from the first radial distance with respect to a size of a vortex flame of the adjustable vortex flame device.

Claims

1. An adjustable vortex flame device comprising:

a control head (10, 10d) delimiting a through hole with an opening (13) and including a flow guiding mechanism (20, 20d), with the flow guiding mechanism (20, 20d) including a plurality of vanes (21, 21d), with the plurality of vanes (21, 21d) disposed around a circumference of the opening (13) one after another, with two adjacent vanes (21, 21d) including a spiral air passage (22, 22d) formed therebetween, and including a flow control head (14c, 14d), with the flow control head (14c, 14d) inserting in the through hole, with the flow control head (14c, 14d) including a first member (141c, 141d) and a second member (142c, 142d) detachably engaging with the first member (141c, 141 d) and delimiting a first chamber (1421c, 1412d) and a second chamber (1422c, 1422d) connecting to the first chamber (1421c, 1421d), with two channels (1411c, 1411d) extending in the first member (141c, 141d) and to an outer periphery of the flow control head (14c, 14d) and connecting to the first chamber (1421c, 1421d), with the flow control head (14c, 14d) having two flow outlets defined at distal ends of the two channels (1411c, 1411 d) and a flow inlet defined at a distal end of the second chamber (1422c, 1422d), with the adjustable vortex flame device in use including a fuel reservoir (60, 60c, 60d) fluidly connecting to the flow inlet of the flow control head (14c, 14d), with the first chamber (1421c, 1421d) extending longitudinally along a first axis (L1), with the two channels (1411c, 1411d) disposed symmetrically with respect to the first axis (L1), with each of the two channels (1411c, 1411d) extending longitudinally along a second axis (L2), and with the second axis (L2) offsetting radially from the first axis (L1); and

a hollow and transparent shield (40) disposed above the control head (10, 10d) and delimiting a space (41) fluidly connecting to the through hole.

2. The adjustable vortex flame device as claimed in claim 1, wherein each of the flow outlets radially offsets from the first axis (L1) at a first radial distance, and wherein the first member (1421c, 1421d) is substitutable with another first member (1421c, 1421d) which includes each of flow outlets radially offsetting from the first axis (L1) at a second radial distance different from the first radial distance.

3. The adjustable vortex flame device as claimed in claim 1, wherein each of the two channels (1411d) extending obliquely from the first chamber (1421d) to the outer periphery of the flow control head (14d).

4. The adjustable vortex flame device as claimed in claim 3, wherein the two channels (1411d) extend divergently from each other from the first chamber (1421d) to the outer periphery of the flow control head (14d), with the second axis (L2) tilting from the first axis (L1) at a first angle (α), and with the first angle (α) less than 90 degrees.

5. The adjustable vortex flame device as claimed in claim 4, wherein the first angle (α) is 17.5 degrees.

6. The adjustable vortex flame device as claimed in any of claims 1 and 2, wherein a heat detecting system (A) adapted to detect a temperature of a vortex flame of the adjustable vortex flame device inserts through the flow control head (14c).

7. The adjustable vortex flame device as claimed in any of claims 1, 2 and 6, wherein the control head (10) includes a control mechanism (30) delimiting a hole (31), wherein the hole (31, 31a, 31b) has a diametrical size and which varies with respect to a size of a vortex flame of the adjustable vortex flame device, wherein the hole (31, 31a, 31b) corresponds to and in fluid communication with the opening (13), and wherein the hole (31, 31a, 31b) is in a smaller diametrical size than the opening (13).

8. The adjustable vortex flame device as claimed in claim 7, wherein the control mechanism (30, 30a) is an annular member secured to the first base member (11), and the hole (31, 31a) is delimited by an inner periphery of the annular member.

9. The adjustable vortex flame device as claimed in any

of claims 1 and 7, wherein the control head (10) includes a base having an inner periphery thereof delimiting the opening (13), and wherein the flow guiding and control mechanisms (20, 30) are mounted on the base.

10. The adjustable vortex flame device as claimed in claim 9, wherein the base includes a first base member (11, 11d) and a second base member (12, 12d) joined to the first base member (11, 11d), wherein the first base member (11, 11d) has a first engaging end (112) and the second base member (12, 12d) has a second engaging end (122) engaging with the first engaging end (112), wherein the first engaging end (112) forms a plurality of first ridges each include first and second edges (1121, 1122) and an apex defined therebetween and the second engaging end (122) forms a plurality of second ridges each include third and fourth edges (1221, 1222) and an apex defined therebetween respectively, wherein the first and second edges (1121, 1122) of one of the plurality of first ridges correspondingly face the third and fourth edges (1221, 1222) of one of the plurality of second ridges, wherein the first and second edges (1121, 1122) of one of the plurality of first ridges have an included angle of greater than 90 degrees, and wherein the third and fourth edges (1121, 1122) of one of the plurality of second ridges have an included angle of greater than 90 degrees.

11. The adjustable vortex flame device as claimed in claim 10, wherein each of the plurality of vanes (21, 21d) has a first extension (211, 211d) secured between the first edge (1121) of one of the plurality of first ridges and the third edge (1221) of one of the plurality of second ridges and a second extension (212, 212d) extending from the first extension (211, 211d), wherein the air passage (22, 22d) between the two adjacent vanes (21, 21d) are delimited by the second extensions (212, 212d) thereof.

12. The adjustable vortex flame device as claimed in claim 11, wherein each of the plurality of vanes (21) includes the second extension (212) thereof extending from the first extension (211) obliquely, with the first and second extensions (211) having an included angle of greater than 90 degrees.

13. The adjustable vortex flame device as claimed in claim 11, wherein each of the plurality of vanes (21d) includes the second extension (212d) thereof extending from the first extension (211d), and wherein the second extension (212d) defines a surface and a tangent plane of the surface tilts from the first axis (L1) at a second angle (β), and with the second angle (β) greater than 45 degrees.

14. The adjustable vortex flame device as claimed in any of claims 1 through 13 further comprising a seat (50, 50d) with at least one auxiliary air inlet (51, 51d) fixed to and bearing the base.

15. The adjustable vortex flame device as claimed in claim 14, wherein the at least one auxiliary air inlet (51, 51 d) is disposed below the flow guiding mechanism (20, 20d).

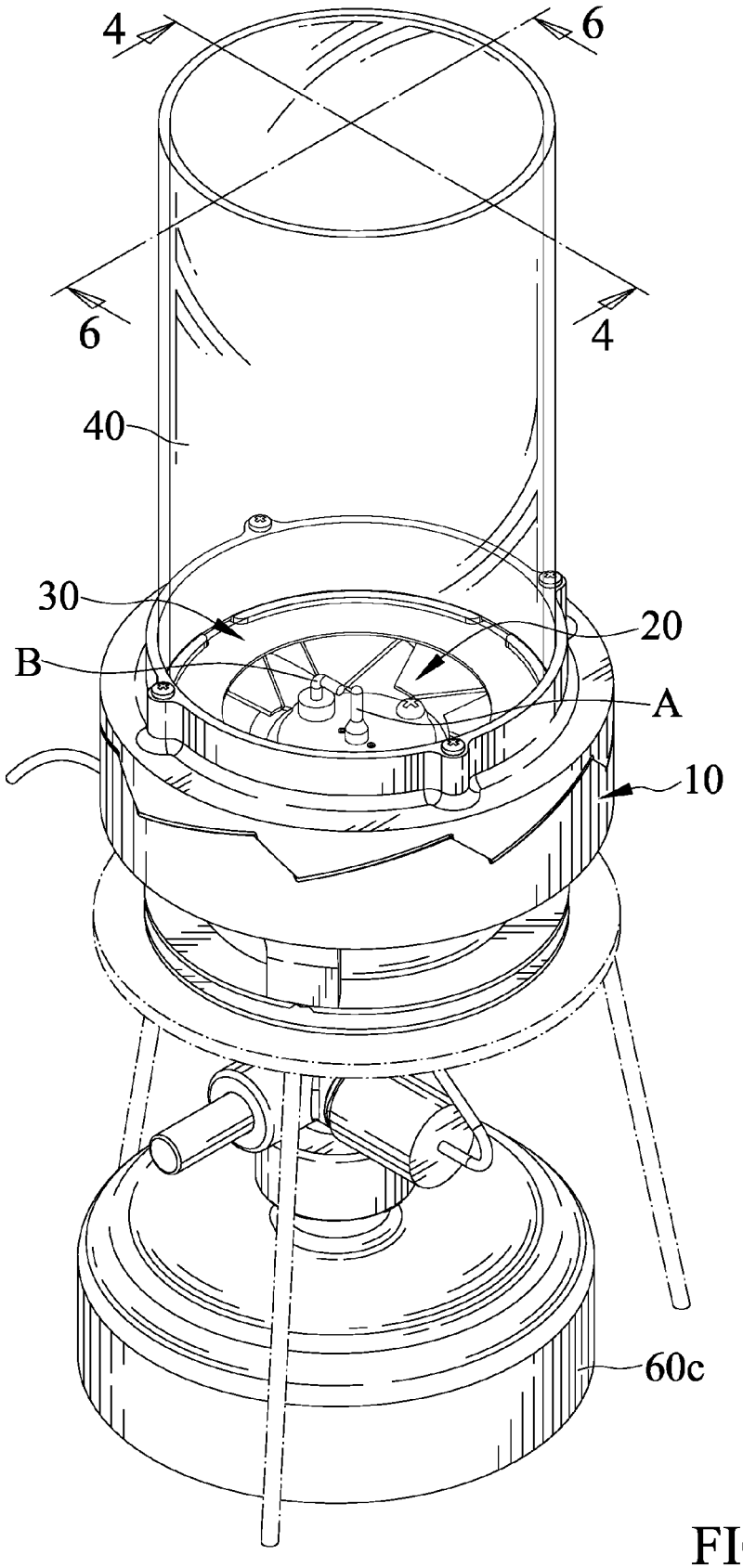
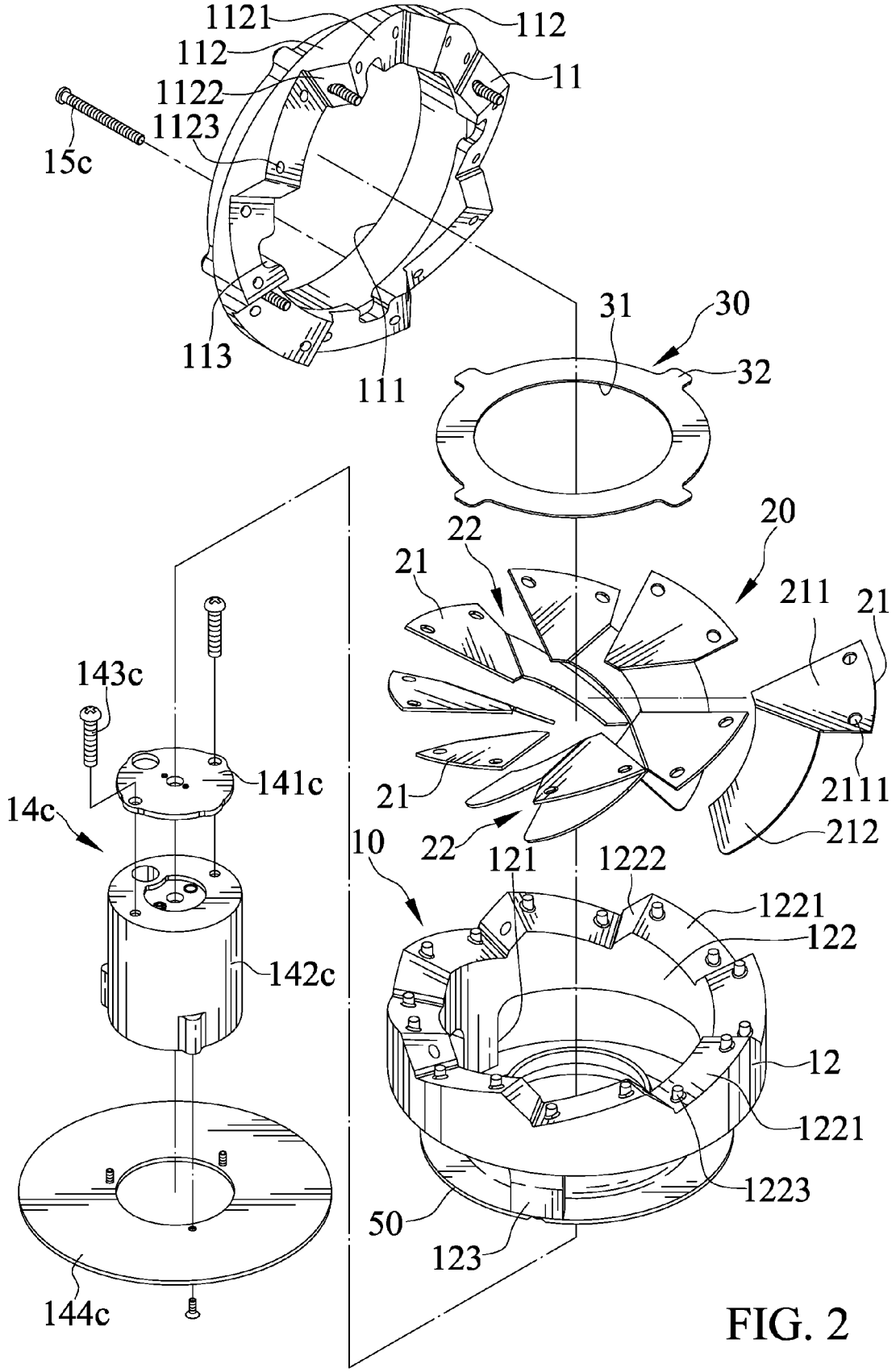


FIG. 1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143c
141c
14c
142c
144c
10
22
121
1222
1221
122
12
1221
1223
50
123

FIG. 2

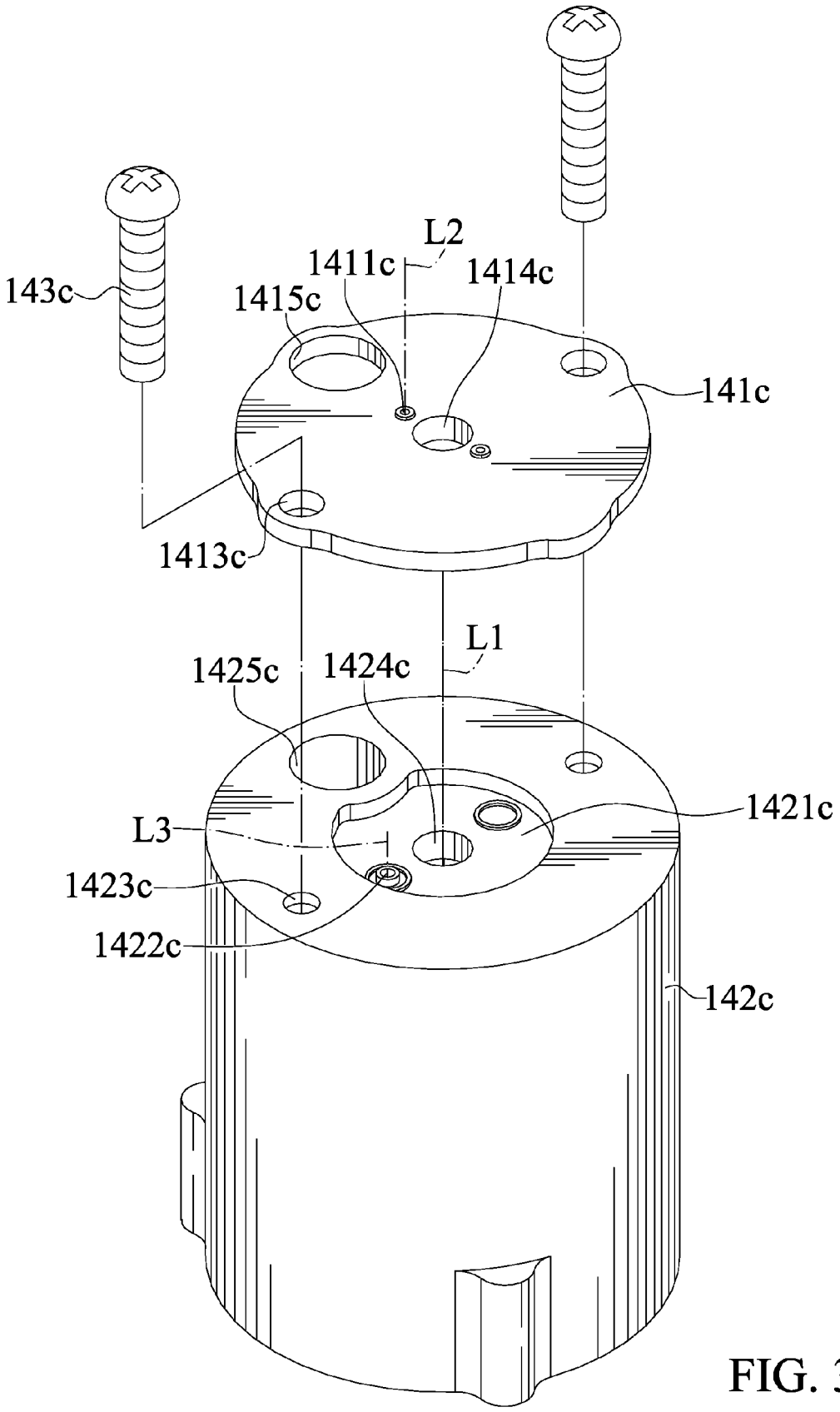

143c
L2
1411c
1414c
1415c
141c
1413c
L1
1425c
1424c
1421c
L3
1423c
1422c
142c

FIG. 3

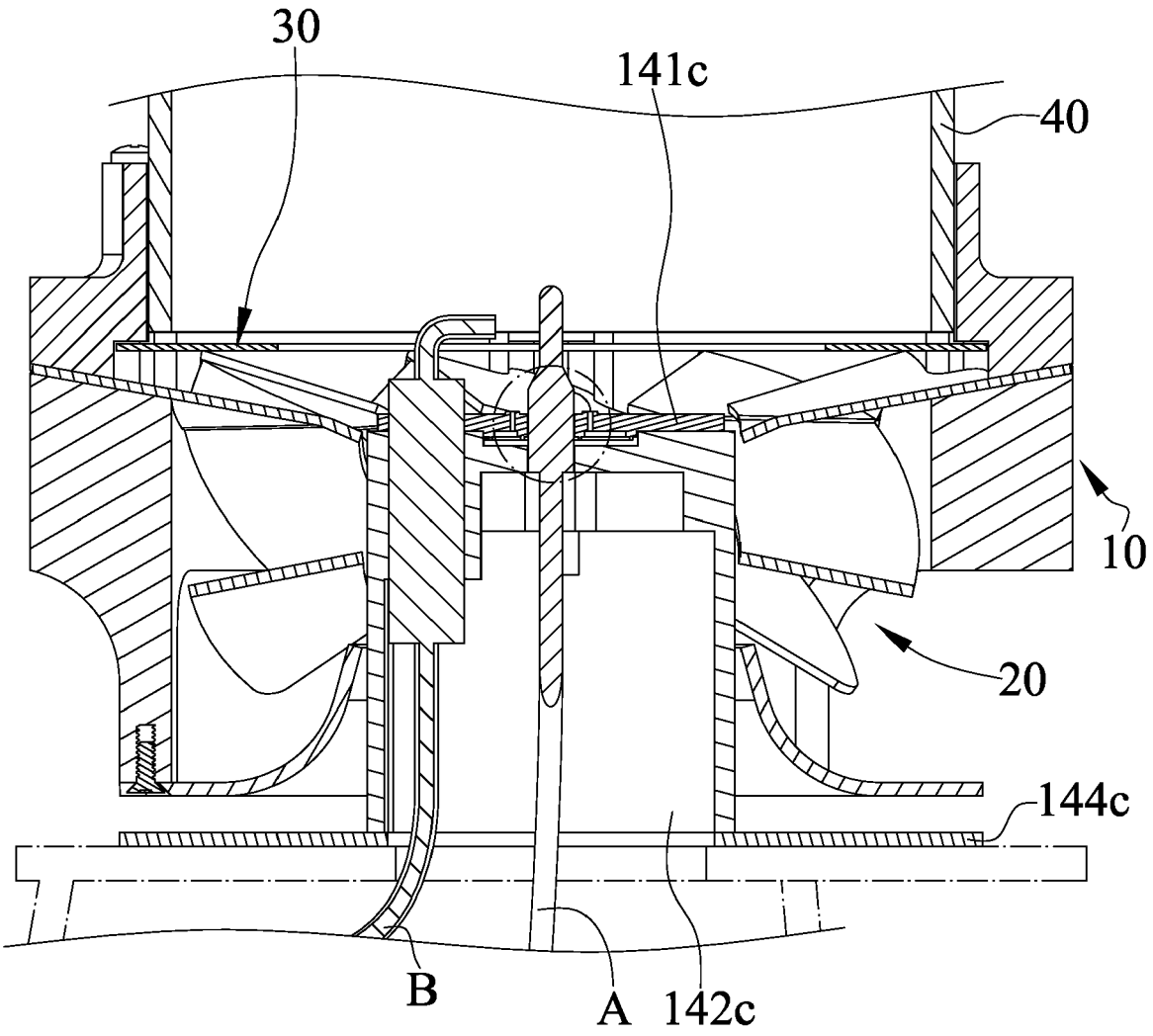


FIG. 4

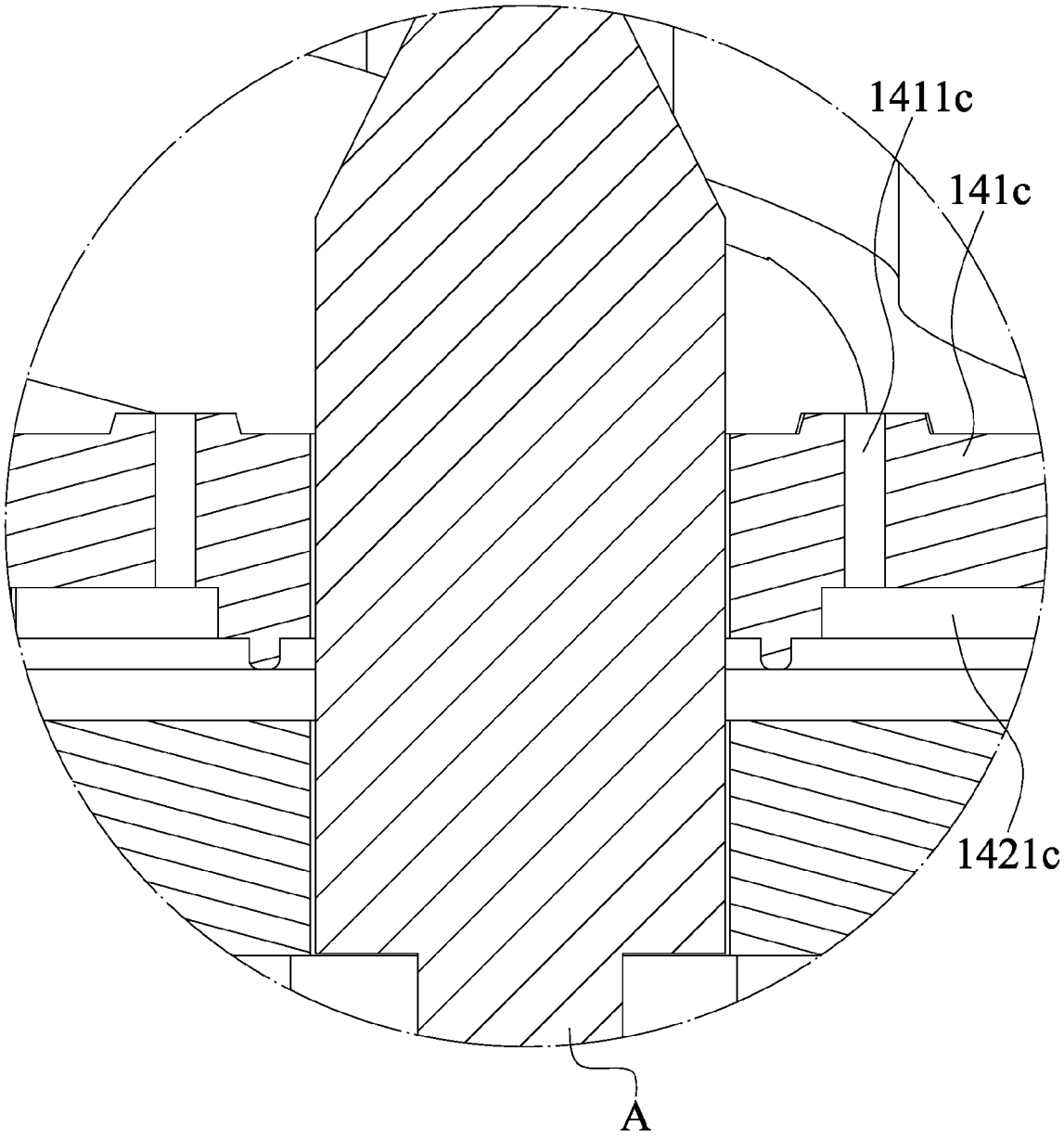


FIG. 5

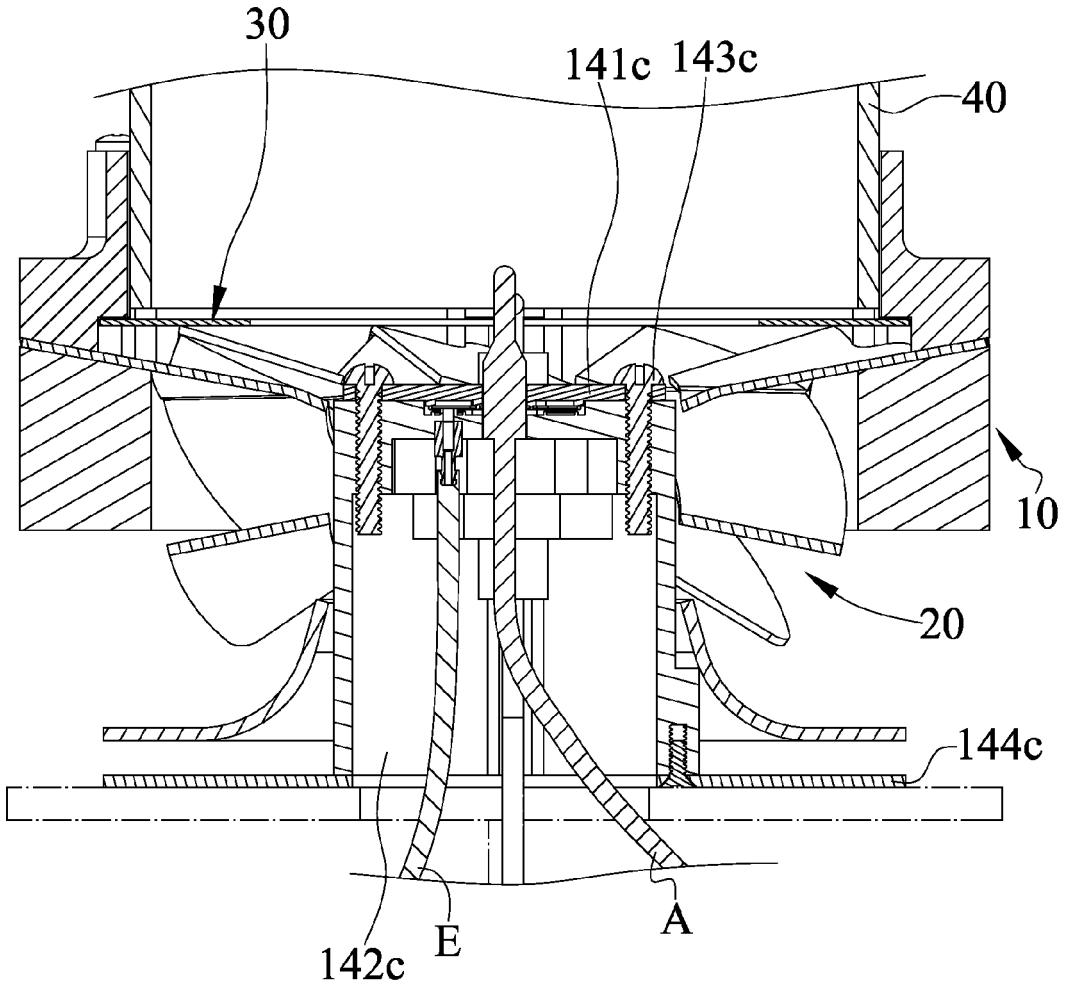


FIG. 6

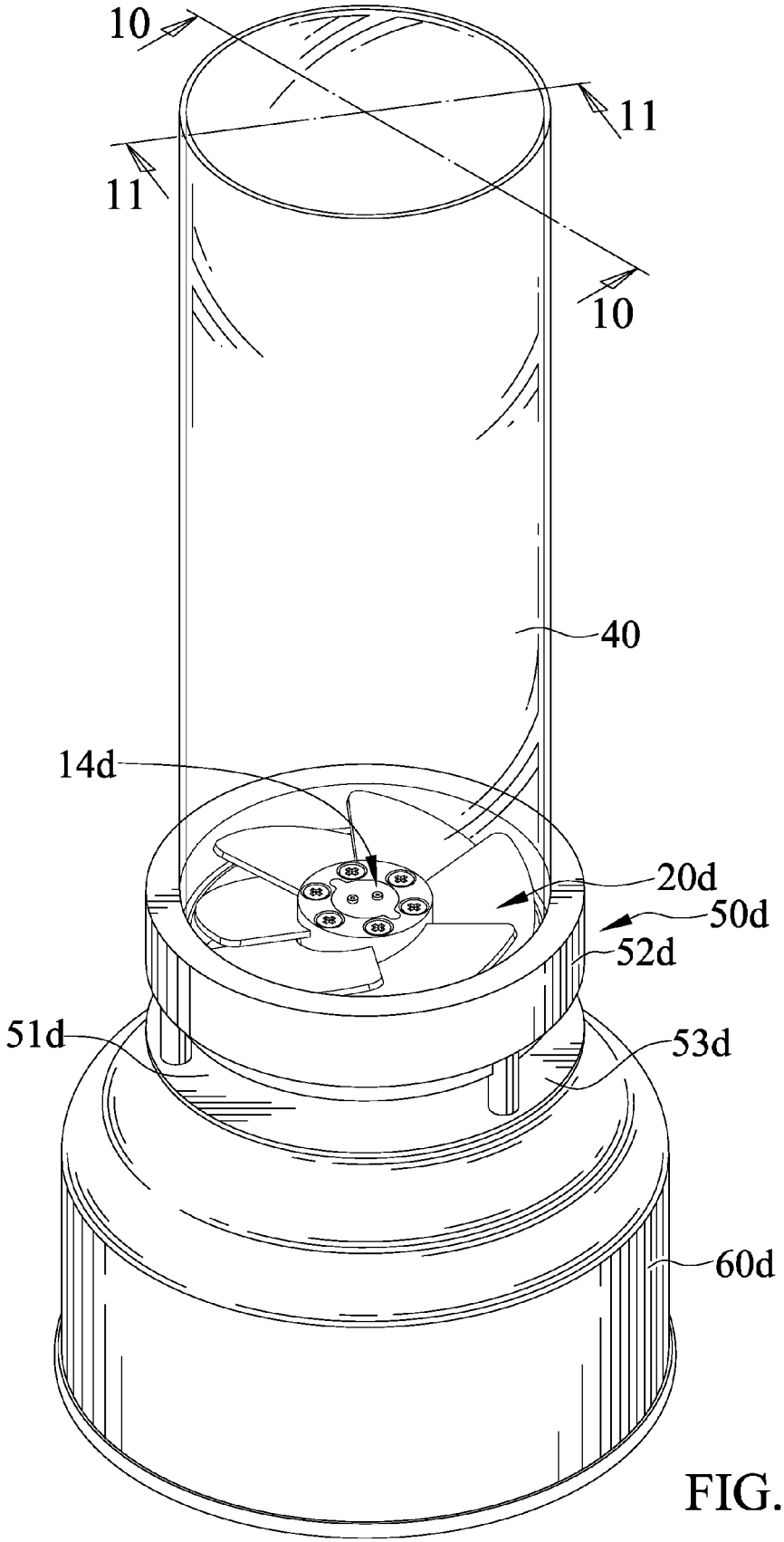
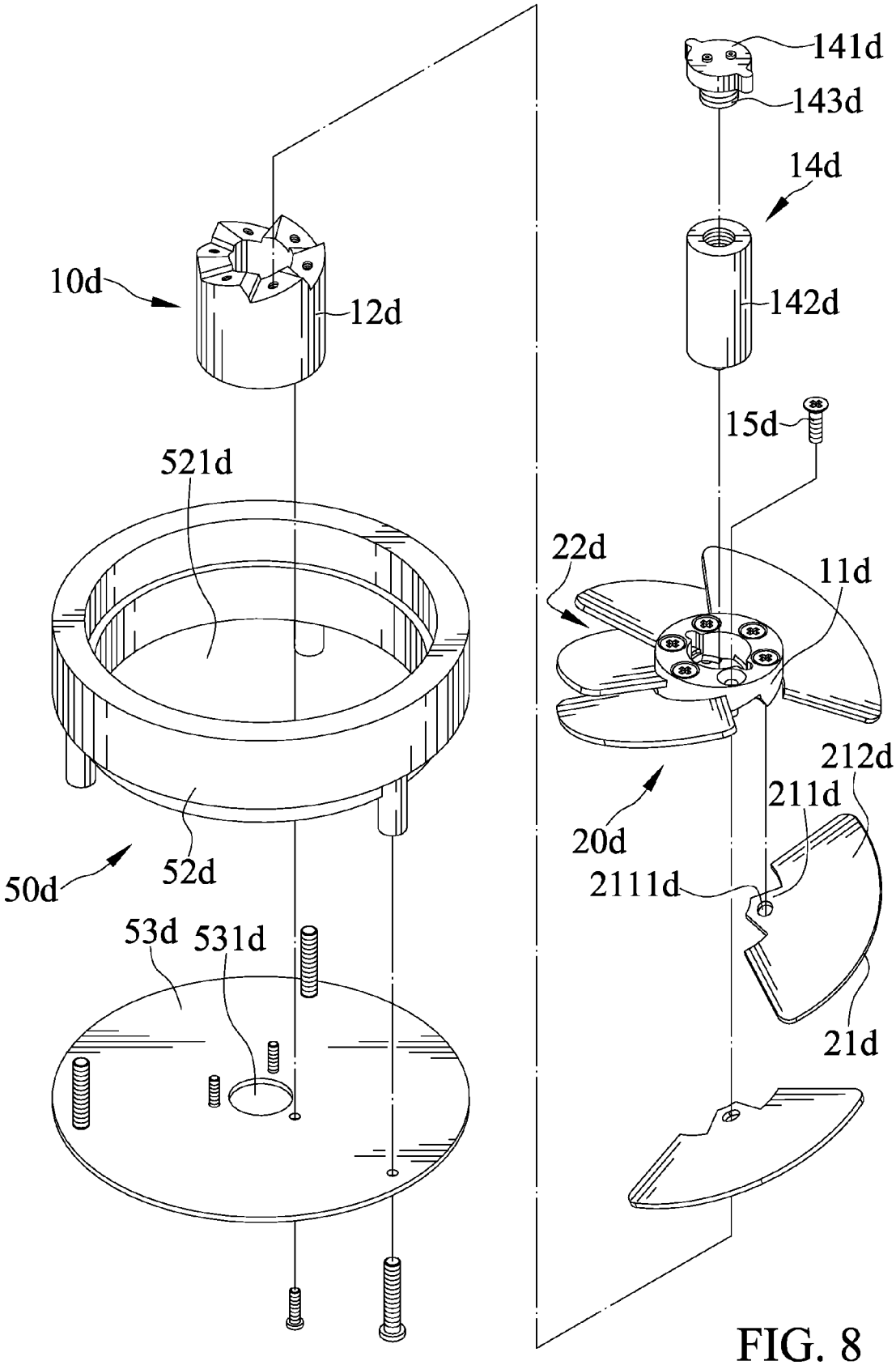


FIG. 7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143d
14d
10d
12d
142d
15d
521d
22d
11d
212d
211d
20d
2111d
50d
52d
53d
531d
21d

FIG. 8

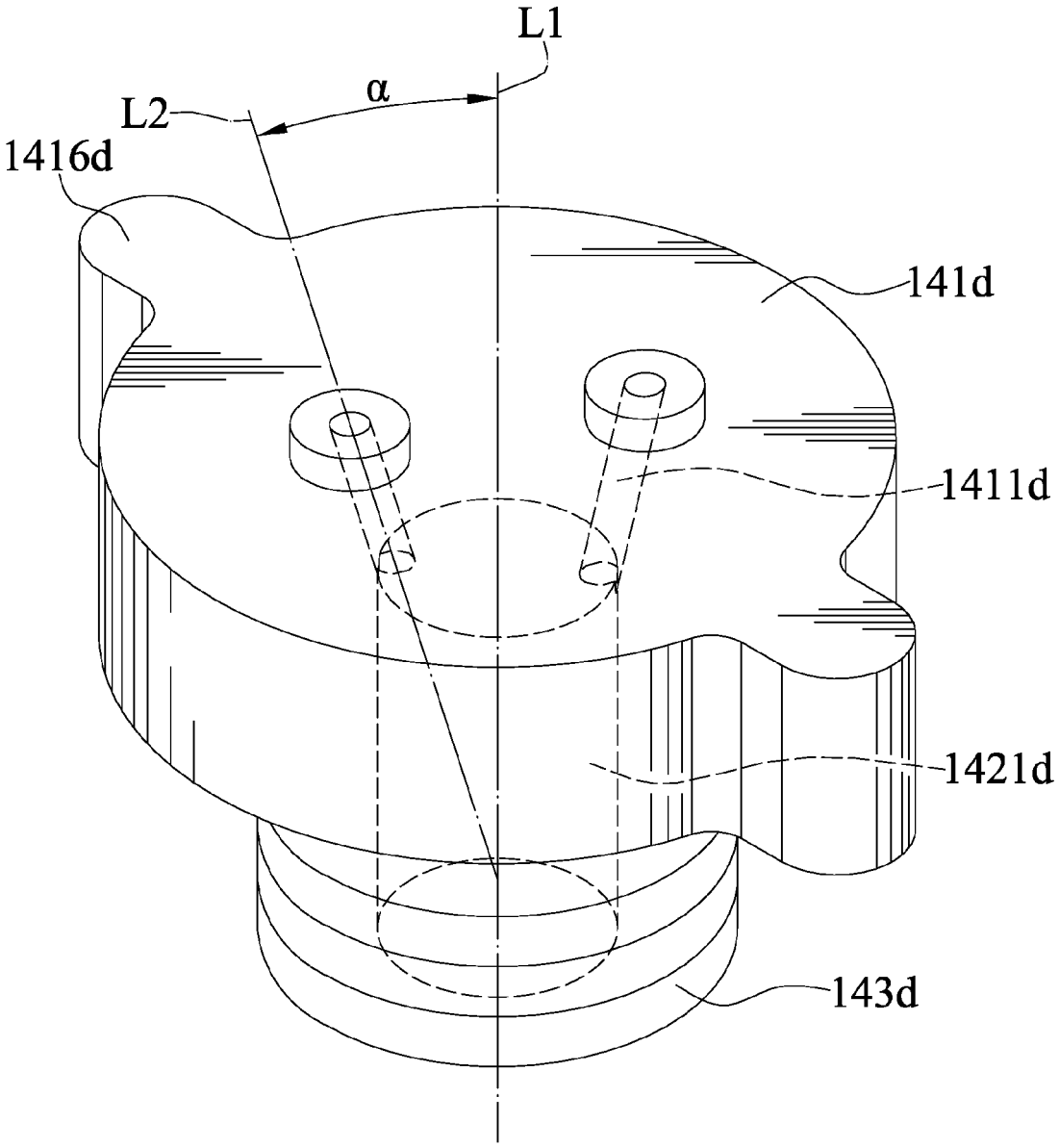

FIG. 9

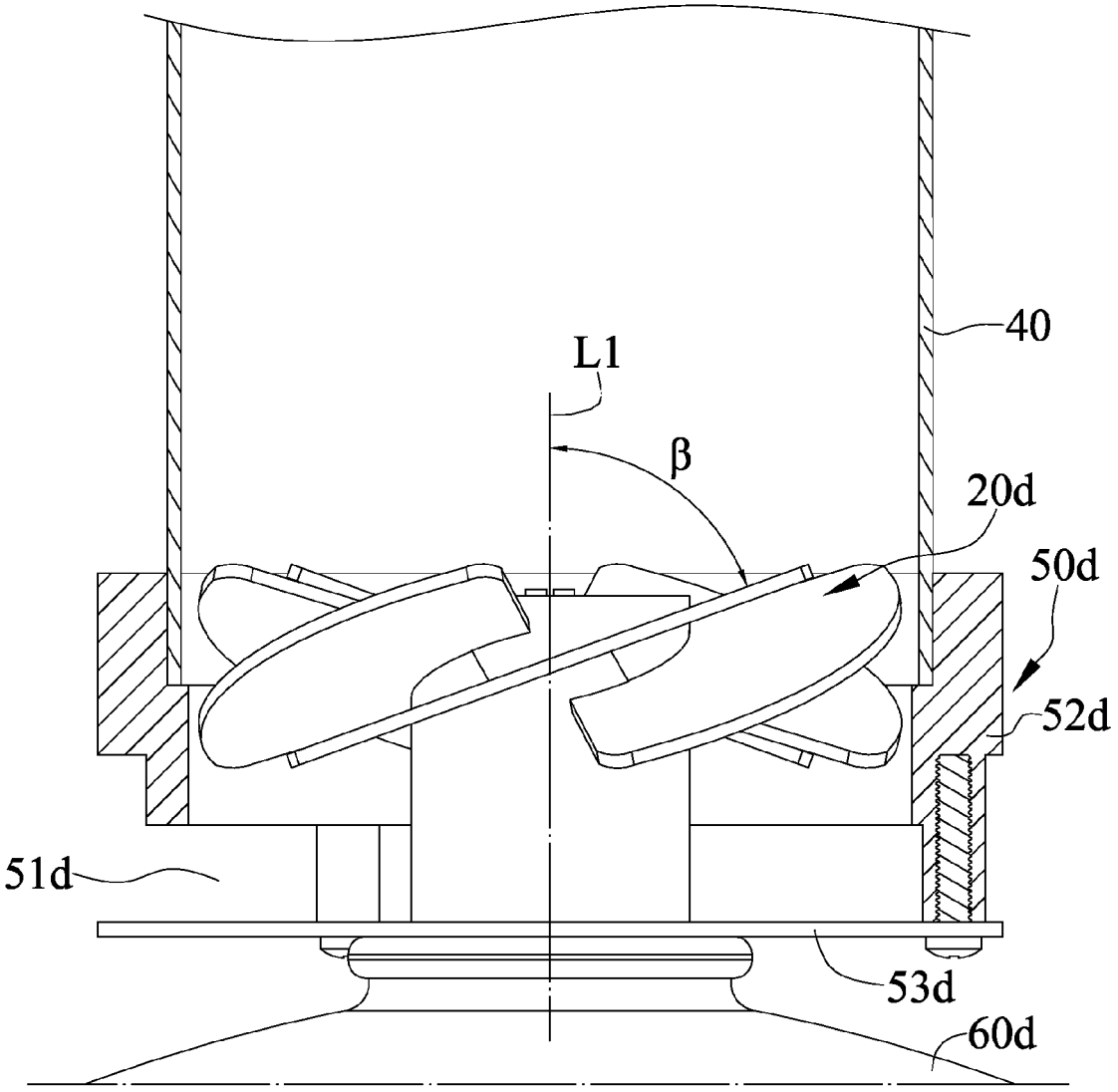

FIG. 10

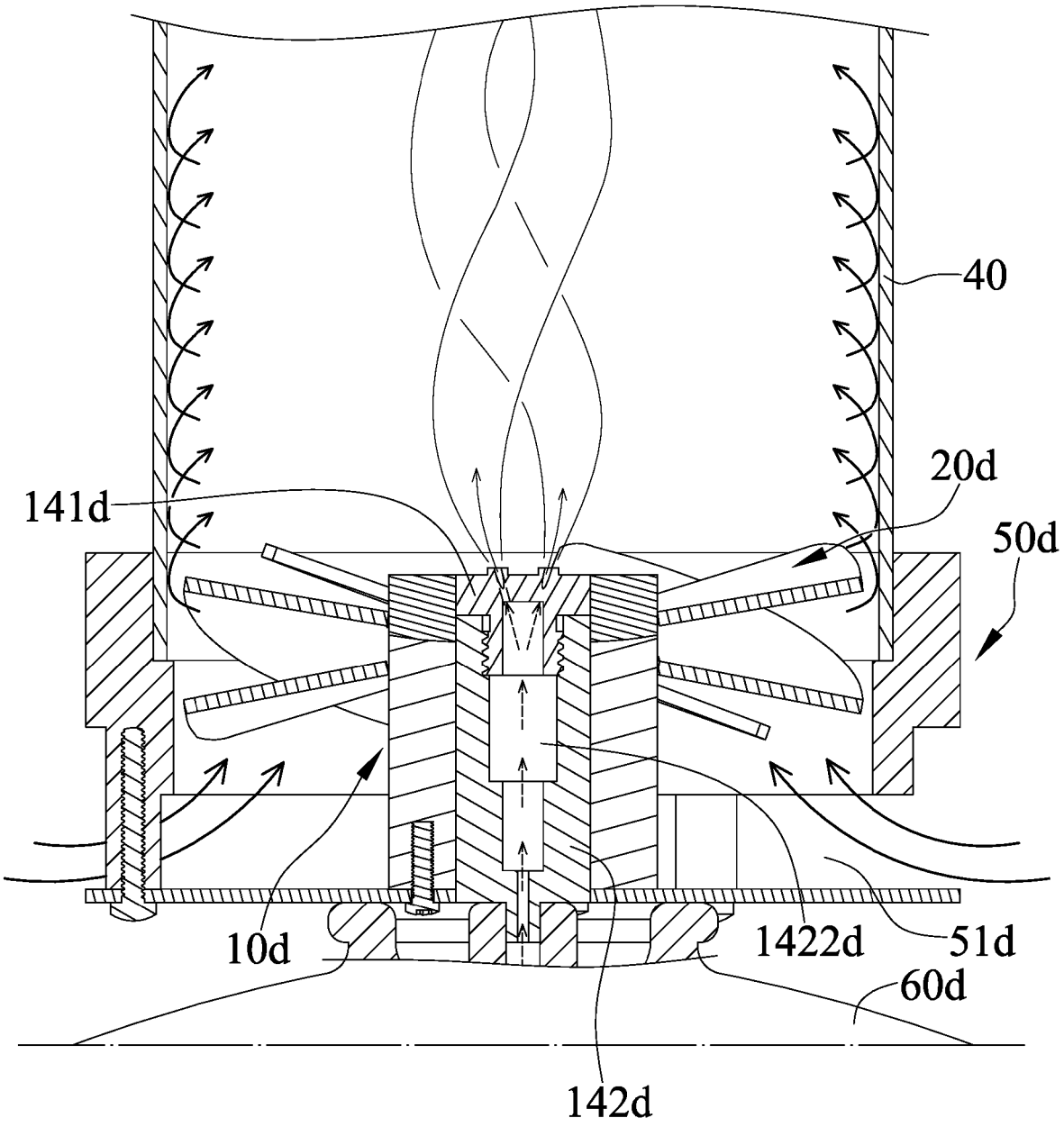

FIG. 11

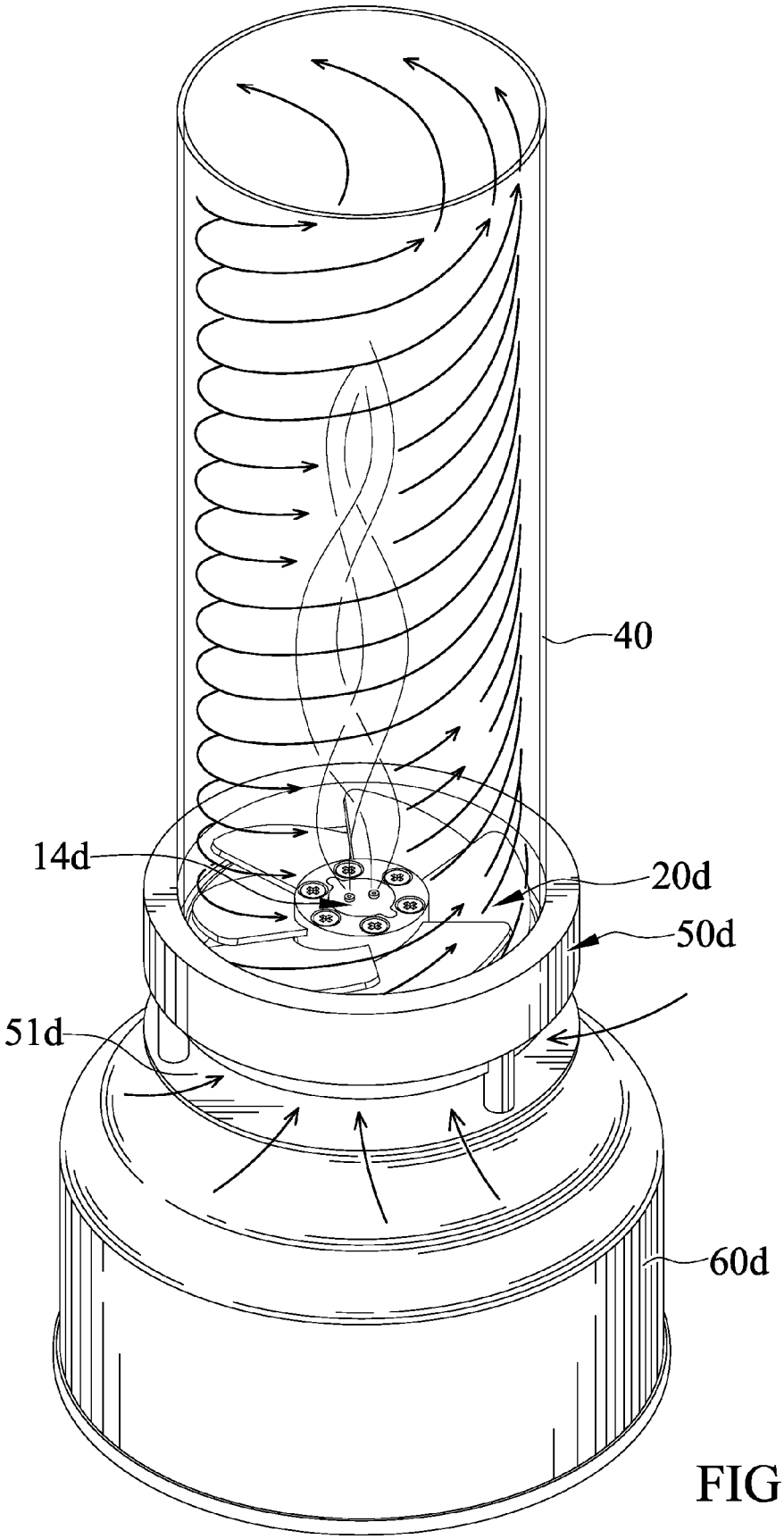

FIG. 12

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 7097448 B **[0002]**
- US 621873 A **[0003]**