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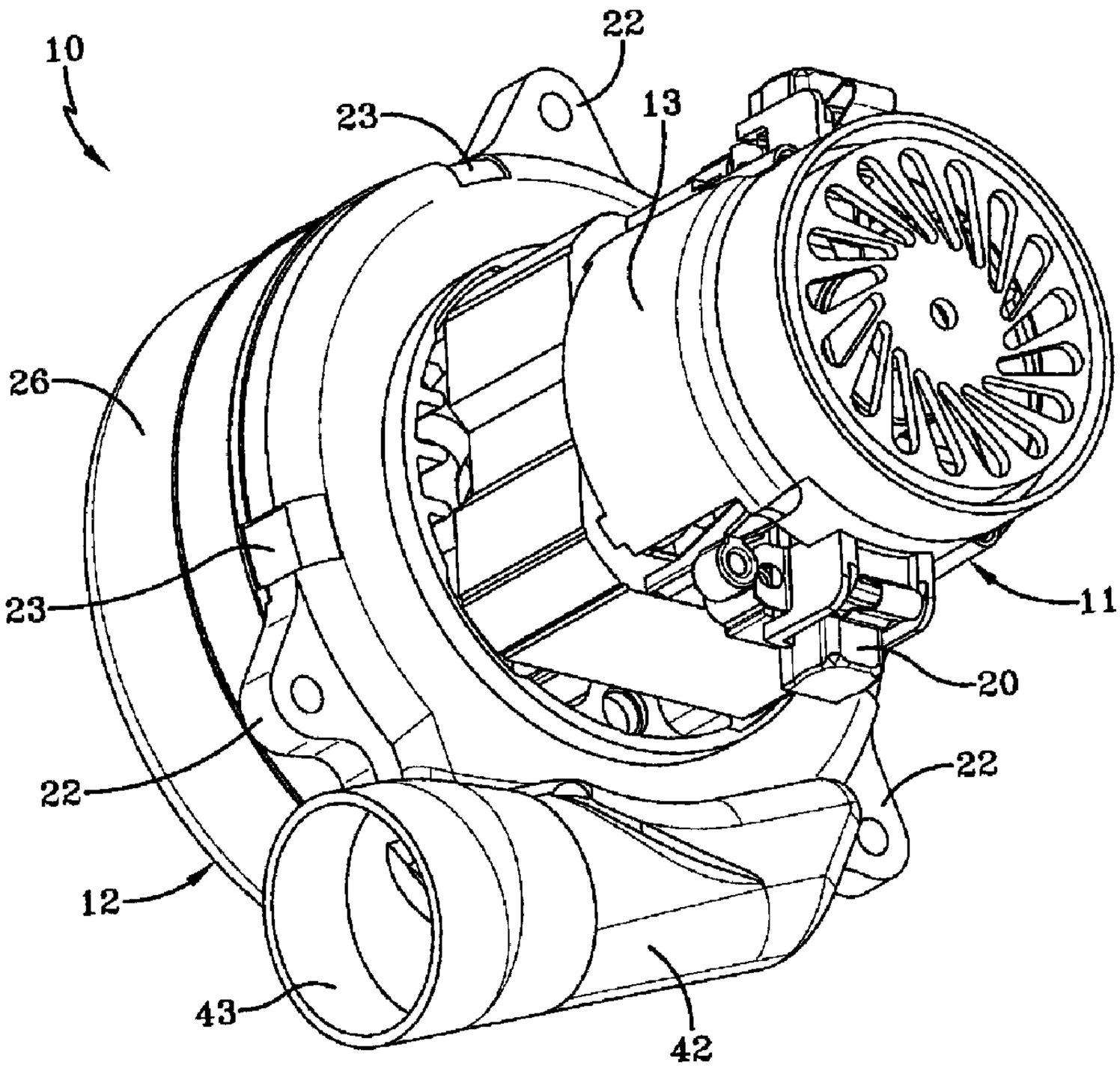
(54) Titre : PIECE RAPPORTEE POUR ENSEMBLE MOTEUR-VENTILATEUR
(54) Title: INSERT FOR FAN-MOTOR ASSEMBLY



(57) Abrégé/Abstract:
A fan assembly includes an end bracket which is coupled to a motor assembly. The end bracket includes a circumferential channel which is interrupted by an opening. A fan is provided which includes a plurality of blades. A shroud at least partially encloses the fan

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(57) Abrégé(suite)/Abstract(continued):
and defines a chamber. An insert, which may or may not be an integral part of the end bracket, is received in the chamber and includes a circumferential ramp. The circumferential ramp is configured to provide the chamber with an internal cross-sectional area which varies circumferentially so as to improve airflow efficiency.

ABSTRACT OF THE DISCLOSURE

A fan assembly includes an end bracket which is coupled to a motor assembly. The end bracket includes a circumferential channel which is interrupted by an opening. A fan is provided which includes a plurality of blades. A shroud at least partially encloses the fan and defines a chamber. An insert, which may or may not be an integral part of the end bracket, is received in the chamber and includes a circumferential ramp. The circumferential ramp is configured to provide the chamber with an internal cross-sectional area which varies circumferentially so as to improve airflow efficiency.

INSERT FOR FAN-MOTOR ASSEMBLY

TECHNICAL FIELD

The present invention is generally directed to motor assemblies. In particular, the present invention is directed to a fan insert for a shrouded fan-motor assembly which increases motor efficiency and air flow characteristics. Specifically, the present invention is related to an insert which is received in a cavity created by a fan end bracket and shroud and is adaptable to fit in existing designs.

BACKGROUND ART

Vacuum motors employing a tangential bypass are used in many applications such as vacuum manipulators, packaging equipment, bag filling, cutting tables, appliances and exhaust air removal, to name just a few. Such vacuum motor designs generally include a cylindrical housing, or shroud, which encloses a motor-driven fan rotating about an axis. Air is drawn into the housing via an aperture at the top axial center of the housing above the fan. As the fan rotates, the air is accelerated in the circumferential and radially outward direction. The housing provides an outlet located on the side of the fan opposed to the aperture. The outlet is a generally cylindrical opening disposed tangentially on the radially outer edge of the housing so that air traveling circumferentially along the radial outer edge is expelled through the outlet in the tangential direction. Such fans are efficient and have a small profile which enables them to fit in apparatuses which require a thin fan motor assembly.

As with most fan designs, efficiency is an important concern. Current housing designs do not direct airflow in it's most efficient path within the housing. Specifically, unwanted turbulence and dead zones are believed to be generated by the uncontrolled path of the airflow from where the air is expelled from the rotating fan to where the air exits the outlet. The fan creates significant kinetic energy in the air by imparting tangential speed. The air must be decelerated in a controlled manner in order to convert the kinetic energy back to pressure. Sudden changes in cross-section may caus eddies and turbulence which dissipates the kinetic energy as heat instead of recovering it as pressure. The total pressure (or vacuum) created by the motor/fan assembly is thus negatively affected by allowing ar to exit the fan in an uncontrolled manner. Therefore, there is a need to better manage air

flow in order to achieve greater fan efficiency. Further, such an improvement should not only be applicable to new fan assemblies, but also in a form which can be installed in fan assemblies which are already built, or in which the manufacturer already has mold tooling and does not want to modify.

Therefore, there exists a need in the art for an insert which may be placed in the fan housing of a vacuum motor employing a tangential bypass which directs airflow and increases efficiency.

SUMMARY OF THE INVENTION

In view of the foregoing, it is a first aspect of the present invention to provide a fan insert which achieves improved efficiency.

Still another aspect of the present invention is to provide a fan assembly comprising an end bracket which couples to a motor assembly, the end bracket including a circumferential channel which is interrupted by an opening, a fan which includes a plurality of blades, a shroud which at least partially encloses the fan and defines a chamber, an insert received in the chamber, the insert including a circumferential ramp which is received in the channel, wherein the circumferential ramp is configured to provide the channel with a cross-sectional area which varies circumferentially.

Yet another aspect of the present invention is attained by a fan assembly comprising an end bracket and insert which is generally cylindrical and has a central axis wherein the insert includes a circumferential ramp which is disposed in a helical orientation relative to the axis, a shroud coupled to the end bracket and defining a chamber therebetween, and a fan selectively rotatable by a shaft, the fan is positioned within the chamber and generates an airflow that is forced along the circumferential ramp.

BRIEF DESCRIPTION OF THE DRAWINGS

For a complete understanding of the objects, techniques and structure of the invention, reference should be made to the following detailed description and accompanying drawings, wherein:

Fig. 1 is perspective view of a fan/motor assembly made in accordance with the concepts of the present invention;

Fig. 2 is a partial cross-sectional view of the fan/motor assembly made in accordance with the concepts of the present invention;

Fig. 3 is an exploded view of an end bracket and an insert made in accordance with the concepts of the present invention;

Fig. 4 is a top elevated view of the end bracket;

Fig. 5 is a top elevated view of the end bracket with the insert installed;

Fig. 5A is a top elevated view of the insert;

Fig. 6 is perspective view of the insert showing the underside thereof; and

Fig. 7 is a perspective view of the end bracket with the insert installed.

BEST MODE FOR CARRYING OUT THE INVENTION

A fan insert according to the concepts of the present invention, generally indicated by the numeral 80 in the accompanying drawings, is used in conjunction with a motor/fan assembly generally indicated by the numeral 10 in the accompanying drawings. Since the insert 80 may be used in connection with a number of other similarly constructed motor/fan assemblies, only general reference will be made to the motor/fan assembly components other than those directly involved with the insert 80.

As best seen in Figs. 1 and 2, the motor/fan assembly 10 of the present invention includes a motor sub-assembly 11 and a fan sub-assembly 12. It should be appreciated that, except for the fan end bracket, designated generally by the numeral 21 and described below in greater detail, the motor sub-assembly 11 may be of any suitable conventional construction. In one particular embodiment, the motor-subassembly 11 includes a housing 13. The housing 13 may carry a concentrically positioned bearing 14 which receives a shaft 15 therein. The shaft 15 supports an armature 16 and a commutator 17 thereon. Shaft 15 further carries a cooling fan 18, which is positioned on the end of shaft 15 opposed from the fan-subassembly 12. Cooling fan 18 provides air flow over the internal motor components promoting heat dissipation. The motor sub-assembly further includes a plurality of field coils 19 as well as a plurality of brushes 20. As is known in the art, these motor components interact to cause shaft 15 to selectively rotate. As will be hereinafter described, shaft 15 drives the working components of the fan sub-assembly.

In one embodiment, an end bracket 21 is provided on the end of motor sub-assembly 11 opposite the housing 13. End bracket 21 may be generally circular and is provided to

enable fan components to be coupled to the motor sub-assembly 11. Additionally, end bracket 21 separates the motor sub-assembly 11 from the fan sub-assembly 12 by sealing around the shaft 15 in such a way that airflow generated by the fan sub-assembly is not contaminated by air or other matter from the motor sub-assembly. End bracket 21 may be provided with a plurality of ears 22 or notches 23 by which an associated apparatus may be fastened and indexed into a position selected for it by an end use manufacturer. End bracket 21 includes an outer flange 24 which defines the radially outer surface thereof. Outer flange 24 may be provided with a raised shoulder 25 which projects radially from and circumferentially around outer flange 24. Shoulder 25 is provided as a stop, against which is seated a rim of a shroud 26. In this manner, shroud 26 is received around outer flange 24 forming a generally airtight seal. As will be discussed later in greater detail, shroud 26, in cooperation with end bracket 21 forms a first chamber 27 which receives some of the working fan components.

End bracket 21 is further provided with an inner plate 28 which is generally circular and extends radially, facing first chamber 27. Inner plate 28 terminates at its radial outer edge at an inner flange 29 which extends perpendicularly from inner plate 28. The inner flange 29 also extends beyond inner plate 28 and provides a shoulder 30 which may support the insert 80 as will be hereinafter described. Inner flange 29, along with outer flange 24 provides the two generally opposed side walls of a circumferential channel 31. Channel 31 is annular shaped, having a generally U-shaped cross section with a bottom surface 32 and side walls defined by flanges 24 and 29. A pair of radiused edges 33 may transition between bottom surface 32 and flanges 24 and 29. Inner plate 28 also includes a shaft aperture 33 therethrough. The channel 31 is interrupted for a portion of its outer periphery and extends into an opening 41 (best seen in Fig. 4) which is formed by a tangential horn 42, which may be integrally molded or otherwise extend from the bracket 21. The horn 42 preferably extends beyond the outer flange 24 and terminates at a tubular portion 43 which may receive a discharge hose for working air driven though the fan sub-assembly 12.

The inner flange 29 and inner plate 28 serve as a common wall between fan sub-assembly 12 and motor sub-assembly 11 and through which extends the common shaft 15 which is operatively coupled to the above mentioned motor elements. Accordingly, a support ring 45, which faces the motor sub-assembly 11, is provided at the center of inner plate 28 around shaft aperture 33, both of which are adapted to receive a bearing 46 therein.

Bearing 46 is adapted to receive and support shaft 15 which rotates therein. Support ring 45 also extends axially from inner plate 28, defining a boss 47 which extends into first chamber 27. A seal 48 may be captured between bearing 46 and support ring 45 and/or boss 47 to prevent contamination of the air passing through the fan sub-assembly. The seal 48 may be in any number of forms. Indeed, the seal could utilize the teachings of U.S. Patent Nos. 5,482,378 and/or 6,472,786, both of which are incorporated by reference.

Fan end bracket 21 is further provided with a plurality of alignment tabs 50 which are circumferentially spaced and extend radially inward from outer flange 24 into channel 31. Further, inner plate 28 may be provided with a plurality of holes 51 which are each adapted to receive a securing means. In the present embodiment the securing means is disclosed as a threaded screw 52, although other securing means may be used such as rivets, adhesive, snap-fits, clips, deflectable tabs, and frictional interfaces. As will be more fully discussed later, tabs 50 and holes 51 are provided to align and secure insert 80 within first chamber 27.

Shroud 26 is provided with a port 60 which is substantially concentric with the shaft 15. Port 60 is provided to allow working air to enter the fan sub-assembly 12. The shroud 26 encloses at least one or a plurality of fans, the one more nearly adjacent bearing 46 being a rotating centrifugal fan 61. This fan 61 is comprised of a plurality of relatively radially short blades 62 mounted on a disc 63, the latter having a central bore which permits the fan 61 to mount to shaft 15. The disc 63 abuts against and rotates with a first centrifugal working air fan 64 which has a plurality of blades 65 which extend radially outwardly. The blades 65 are retained between a disc 66 and a ring 99, wherein disc 66 has a central bore permitting the first working fan 64 to be mounted to the shaft 15. Ring 99 has an airflow aperture 100 extending therethrough. In the event an air seal construction is utilized, as disclosed in U.S. Patent No. 5,482,378, then the disc 66 may be provided with one or more apertures that are circumferentially spaced in relation to the shaft. These apertures function to draw moisture away from the bearing in such a manner that it is drawn into the working air flow and exhausted.

In the embodiment shown, the shroud 26 encloses not only fans 61 and 64, but additional fans for drawing working air into the fan sub-assembly 12. This multi-stage embodiment is possible by providing the shroud 26 with a dividing wall 67 which extends radially inwardly from the radially outer wall of shroud 26. Dividing wall 67 is provided

with an opening 68 which leads into airflow aperture 100 of working fan 64. In this manner dividing wall 67 separates the interior of fan sub-assembly into first chamber 27 and a second chamber 69. Dividing wall 67 supports, radially outward of the opening 68, the radially extending fixed blades 70 of an intermediate "stationary fan" 71. A second centrifugal working fan 72 is provided proximate to port 60 and includes a plurality of blades 73 which extend radially. The blades 73 are carried between a disc 74 having a central bore permitting the fan 72 to be mounted to the shaft 15 and a ring 104 having an eye 106 that is substantially concentric with the port 60 in the shroud 26. Although multistage fans are shown in this embodiment, it will be appreciated that the insert to be discussed could be used with a single stage fan, or any configuration which receives air axially and then exhausts the air tangentially, or vice versa.

In the present embodiment, the aforementioned fans are spaced and coupled to the shaft 15 by a plurality of elements. A first spacer 75 extends inwardly through shaft aperture 33 in support ring 45 and bears against an inner race of bearing 46. First spacer 75 may have a generally L-shaped cross section to provide an enlarged transverse surface against which the disc 63 of fan 61 may bear. Positioned between working air fans 64 and 72 is a second spacer 76 which is received on shaft 15 and, in a radial cross-section, may generally have an hour-glass configuration. A nut 77 may be provided at the end of shaft 15 which may be tightened against a washer 78 which in turn bears against disc 74 of fan 72. This in turn clamps together the inner race of the bearing 46, first spacer 75, second spacer 76, fans 61, 64, and 72 and washer 78 so that all turn as one unit with the shaft 15 as it is driven by the motor sub-assembly 11.

In this manner, when shaft 15 rotates, air is drawn into second chamber 69 via port 60. As second working fan 72 rotates, air is drawn through eye 106 and is urged radially outwardly by blades 73. Once the air is ejected radially outwardly past blades 73, blades 70 of the stationary fan 71 direct the air flow radially inwardly toward opening 68. As is evident from Fig. 2, opening 68 directs the air flow into first chamber 27 via the airflow aperture 100. As fan 64 rotates, blades 65 urge the air radially outwardly. The air flow which is ejected radially from blades 65 has both a radial and tangential component. In other words, air particles travel radially outwardly while at the same time spin with the fan 64. Thus, when the air exits the fan 64, if the fan is traveling in a counter-clockwise direction (as envisioned in the present embodiment), the air correspondingly travels

circumferentially in a counter-clockwise direction around chamber 27 and likewise channel 31. Because of the pressure differential between the outside atmosphere and the first chamber 27, the air exits chamber 27 and channel 31 via opening 41. Thus, as described above, air is drawn into port 60 and out of tubular portion 43 upon rotation of shaft 15. Such systems are particularly useful in common household vacuums, but may also find applications in many other fields. While the aforementioned design works adequately for many applications, an ever present desire exists to increase efficiency in such devices. Particularly, it has been found that the nature of the air flow within channel 31 leads to efficiency losses as described in the Background Art. In order to increase efficiency, an insert 80 is provided which directs air flow after it exits fan 64. Insert 80 may come pre-installed on a motor/fan assembly, or due to it's compact and simple design, may be installed in an after-market fashion. Or, the insert 80 and end bracket 21 may be formed as a single piece and mate with the motor sub-assembly and fan sub-assembly in much the same manner as the separate components described herein. Regardless of whether the insert 80 is provided as a separate piece or as a single piece integral construction with the end bracket 21, the seal 48 or its equivalent is provided to ensure that moisture is kept away from the bearing 46.

Insert 80 is generally cup shaped and includes a facing wall 81 which is disc shaped and centered about shaft 15. Facing wall is sized to fit over and cover inner plate 28 when installed. A tapered boss 82 is provided which is raised to allow boss 47 to fit underneath. Tapered boss 82 projects from the concentric center of facing wall 81 towards fan 64 and includes a bore 83 which allows shaft 15 to project therethrough. Facing wall 81 further includes a plurality of counterbored holes 84 which are each adapted to receive screw 52 therethrough. When assembled, the threaded portion of screw 52 projects through wall 81 and into holes 51 provided in inner plate 28. Further, the head of screw 52 is received in the counterbore of holes 84 so that no part of the screw extends above the surface of facing wall 81. In this manner, once screws 52 are tightened, the insert 80 is secured to end bracket 21.

Facing wall 81 terminates at a circumferential flange 85 which extends axially inwardly from the radial edge of facing wall 81 towards end bracket 21. Flange 85 is sized to fit around inner flange 29. Positioned on the radially outer surface of circumferential flange 85 is a ramp 86. Ramp 86 is adapted to be received in channel 31 and is configured

to define a gradually circumferentially changing depth. To that end, the ramp 86 includes an angled wall 87 which extends radially from flange 85 towards the outer flange 24 of end bracket 21. Angled wall 87 is disposed at an angle relative to bottom surface 32 so that as angled wall 87 wraps around facing wall 81 it defines an upper end 88 and a lower end 89. Put another way, angled wall 87 is disposed in a helical fashion around facing wall 81. Upper end 88 is disposed relatively further away from bottom surface 32 of channel 31 as compared to lower end 89 which is closer to bottom surface 32. In the present embodiment, lower end 89 is nearly flush with bottom surface 32. It should be appreciated that, while the present embodiment discloses an angled wall 87 having a constant angle relative to bottom surface 32, this disclosure is not limited to such embodiments. Specifically, the relative angle may vary circumferentially in a linear or logarithmic fashion.

The angled wall 87 is further supported by a pair of legs which terminate in channel 31. Specifically, an inner leg 90 is positioned on the inner radial edge of angled wall 87 and extends axially towards the bottom surface 32 of channel 31. Further, an outer leg 91 is positioned on the radially outer edge of angled wall 87 and extends axially towards bottom surface 32 of channel 31. Each leg is provided with radiused ends 92, which are adapted to generally match the radiused corners 33 of channel 31. As is evident from Fig. 6, the height of legs 90 and 91 vary circumferentially. Specifically, when the angled wall 87 is disposed closer to bottom surface 32, the legs 90 and 91 are correspondingly shorter, likewise, when the angled wall 87 is disposed further from bottom surface 32, the legs 90 and 91 are relatively longer.

Positioned proximate to upper end 88 is a terminating wall 93, which extends downward from angled wall 87 toward bottom surface 32 of channel 31. When aligned properly, terminating wall 93 may be disposed at an angle generally parallel with horn 42. In order to properly align and maintain the proper positioning of insert 80, the outer legs 91 include a plurality of slots 94 which are adapted to slidably receive the tabs 50 of end bracket 21. When so inserted, the insert 80 may be properly indexed and oriented. Finally, insert 80 includes a projection 95 which extends a distance along the radially outer edge of angled wall 87, beginning at upper end 88 and extending circumferentially. Projection 95 restricts the cross-section at the upper end of the ramp. This helps control the deceleration of air leaving fan 64 and also to induce more air at the bottom of the ramp to leave through horn 42, rather than continuing to circle through the shroud.

As is evident from Fig. 5, tapered ramp 86 does not extend around the entire circumference of channel 31. When properly installed, this interruption in tapered ramp 86 is aligned with the interruption in channel 31 defined by opening 41. In other words, terminating wall 93 is positioned proximate to a first end 108 of the opening 41 and the bottom end 89 of angled wall 87 is positioned near a second end 109. In this manner, the insert 80 is thus secured to end bracket 21, and when positioned correctly, changes the profile and cross-sectional area of channel 31 as a function of circumferential position.

When shaft 15 is rotating, thus driving working air fan 64, the air which is propelled from blades 65 is more efficiently directed to opening 41 on end bracket 21. Specifically, when installed as shown in the present embodiment, in the counter-clockwise direction the effective cross-sectional area of channel 31 gradually increases starting at the upper end 88. The effective cross-sectional area of channel 31 is at it's greatest at the interrupted portion of insert 80 which corresponds to opening 41. By varying the cross-section in such a manner, the kinetic energy stored in the moving air can be converted more completely into static pressure rather than turbulence induced heat, due to the reduction of eddies as the air leaves the rotating fan.

Based upon the foregoing, the advantages of the constructions described above are readily apparent. In particular, the insert 80 is configured to provide a more efficient path for air to travel within fan sub-assembly 12. When insert 80 is installed fan efficiency is increased, thus requiring less energy to provide the same air flow. Further, the insert 80 is configured to be readily installable in preexisting fan sub-assembly designs and may be used in single or multi-stage devices (as shown in the present embodiment). Thus, the invention disclosed represents a great improvement in the art of fan assemblies.

Thus, it can be seen that the objects of the invention have been satisfied by the structure presented above. While in accordance with the Patent Statutes, only the best mode and preferred embodiment has been presented and described in detail, it is to be understood that the invention is not limited thereto or thereby. Accordingly, for an appreciation of the true scope and breadth of the invention, reference should be made to the following claims.

What is claimed is:

1. A fan assembly, comprising:

an end bracket which couples to a motor assembly, said end bracket including a circumferential channel which is interrupted by an opening;

at least one fan which includes a plurality of blades;

a shroud which at least partially encloses said fan and defines a chamber; and

an insert received in said chamber, said insert includes a circumferential ramp which is received in said channel, wherein said circumferential ramp is configured to provide said channel with a cross-sectional area which varies circumferentially.

2. The fan assembly according to claim 1, wherein said ramp includes an angled surface and said channel includes a bottom surface, said ramp angled surface is disposed at an angle relative to said channel bottom surface.

3. The fan assembly according to claim 2, wherein said angle is circumferentially constant.

4. The fan assembly according to claim 1, wherein said angle varies dependant upon the circumferential location.

5. The fan assembly according to claim 1, wherein said insert is disposed between said fan and said end bracket.

6. The fan assembly according to claim 1, wherein said circumferential ramp does not extend the entire circumference of said channel thus defining an gap and wherein said gap is circumferentially aligned with said opening.

7. The fan assembly according to claim 6, wherein said channel includes a bottom surface and said circumferential ramp includes an upper end and a lower end and said opening has a first end and second end, said upper end is relatively further from said

bottom surface than said lower end, said upper end is positioned proximate to said first end and said lower end is proximate to said second end.

8. The fan assembly according to claim 1, wherein said channel includes at least one tab and said insert includes at least one slot which is adapted to receive said tab thereby positioning said insert within said chamber.

9. The fan assembly according to claim 1 further comprising a horn, said horn terminates at said opening and projects tangentially therefrom relative to said channel.

10. The fan assembly according to claim 1, wherein said cross-sectional area increases circumferentially in the direction of flow

11. The fan assembly according to claim 1, further comprising:

a rotatable shaft extending from said motor assembly;

a bearing carried by said end bracket and receiving said rotatable shaft; and

a seal disposed between said bearing and said end bracket.

12. A fan assembly, comprising:

an end bracket and insert which is generally cylindrical and has a central axis, wherein said insert includes a circumferential ramp which is disposed in a helical orientation relative to said axis;

a shroud, coupled to said end bracket and defining a chamber therebetween; and

a fan selectively rotatable by a shaft, said fan is positioned within said chamber and generates an airflow that is forced along said circumferential ramp.

13. The fan assembly according to claim 12, wherein said end bracket and insert is disposed adjacent said fan.

14. The fan assembly according to claim 12, wherein said end bracket insert includes a facing wall which is circular and projects radially from said axis, said circumferential ramp is positioned on the radial outer edge of said facing wall.

15. The fan assembly according to claim 12, wherein said ramp surface includes a first end and a second end, wherein said first end is disposed further from said fan than said second end.

16. The fan assembly according to claim 15, wherein the circumferential distance between said first end and said second end define a gap, said gap is aligned with said opening of said channel.

17. The fan assembly according to claim 15, wherein said end bracket and insert further comprises a horn, said horn communicating and aligned with said circumferential ramp and wherein said horn projects tangentially from said circumferential ramp.

18. The fan assembly according to claim 17, wherein said shroud has an inlet for drawing air in upon rotation of said fan, and wherein the air is exhausted along said circumferential ramp and exhausted out said horn.

19. The fan assembly according to claim 12, further comprising:

a bearing carried by said end bracket and insert, said bearing receiving said rotatable shaft; and

a seal disposed between said bearing and said end bracket and insert.

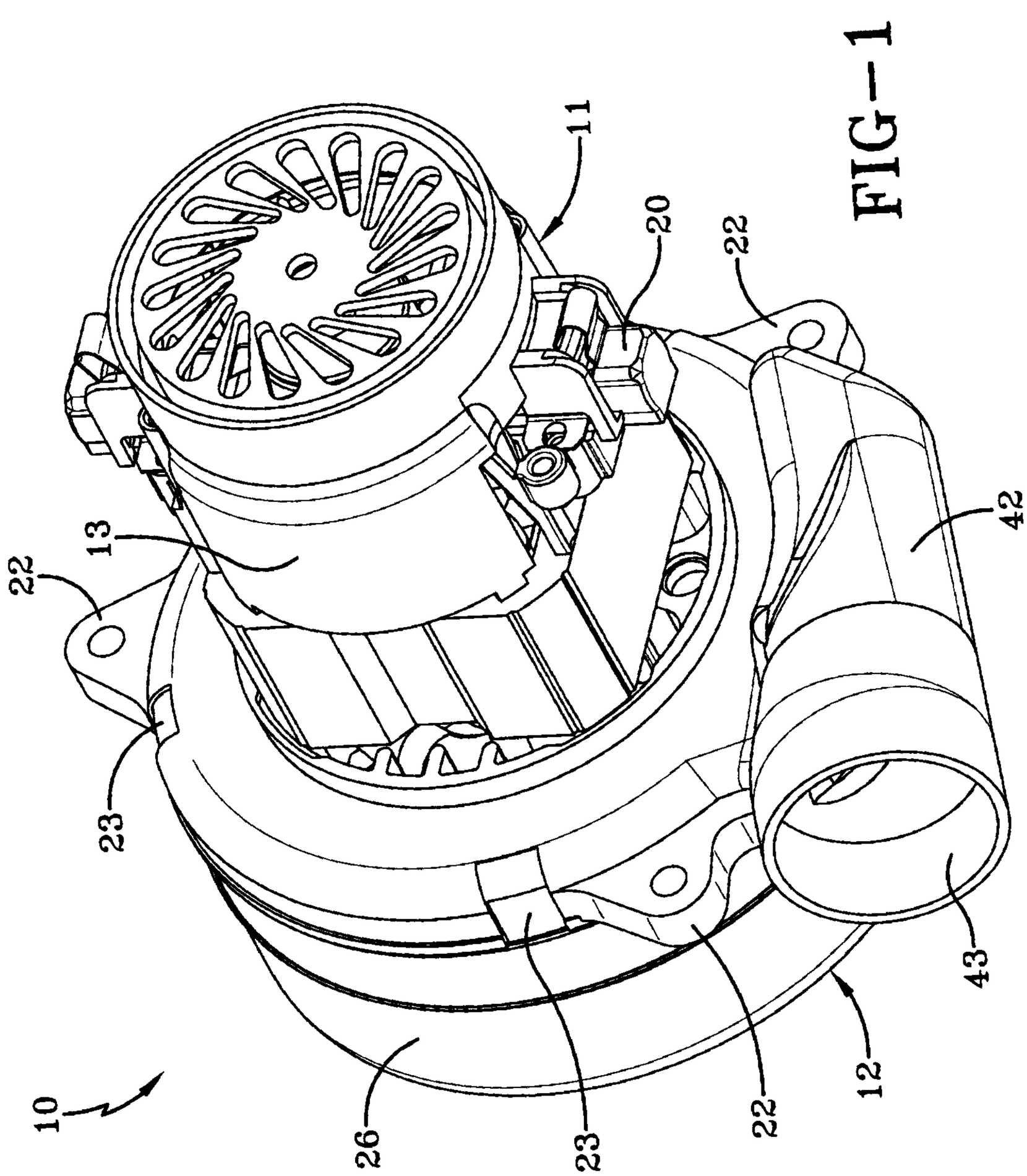

FIG-1

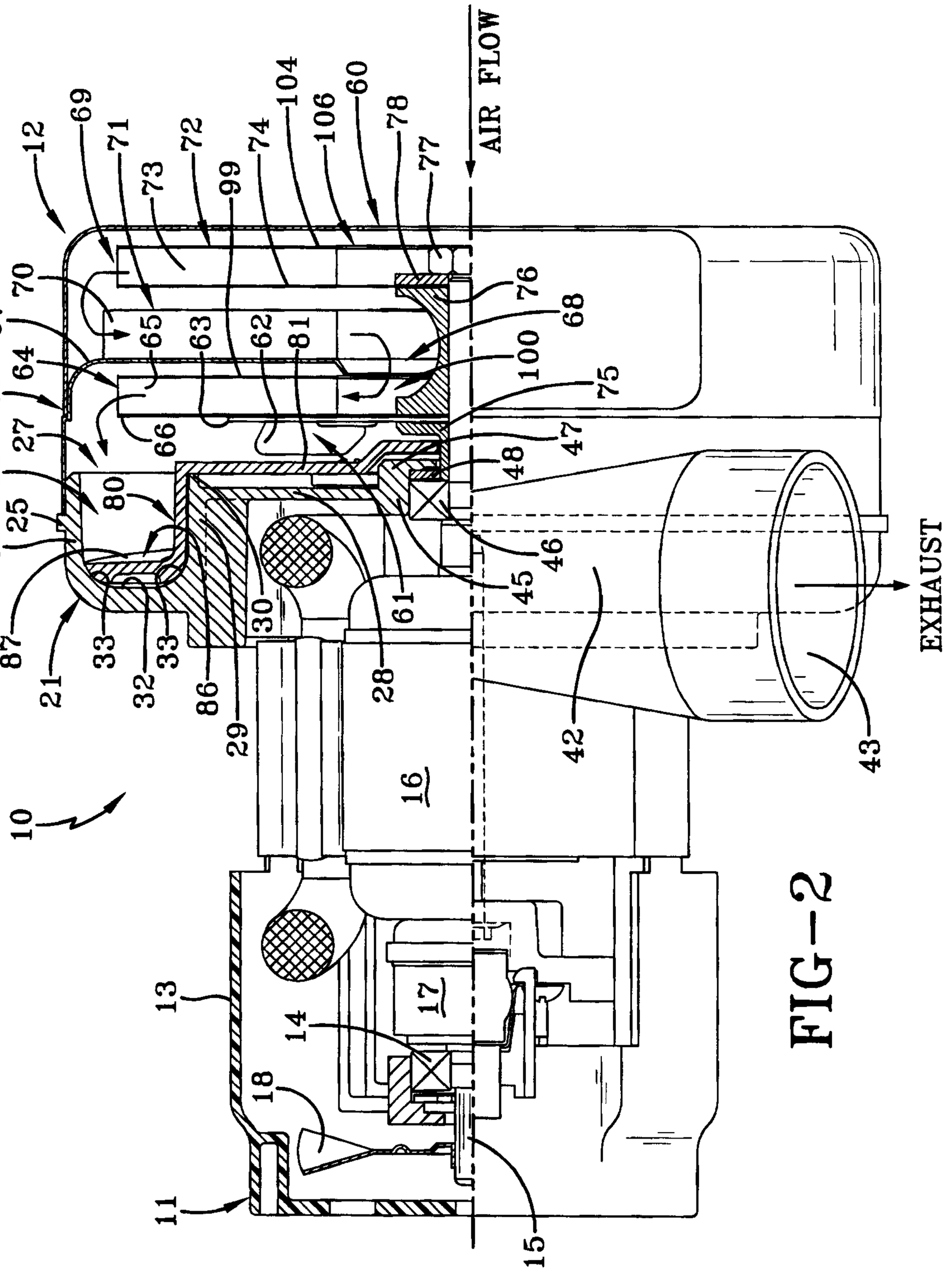
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FIG-2

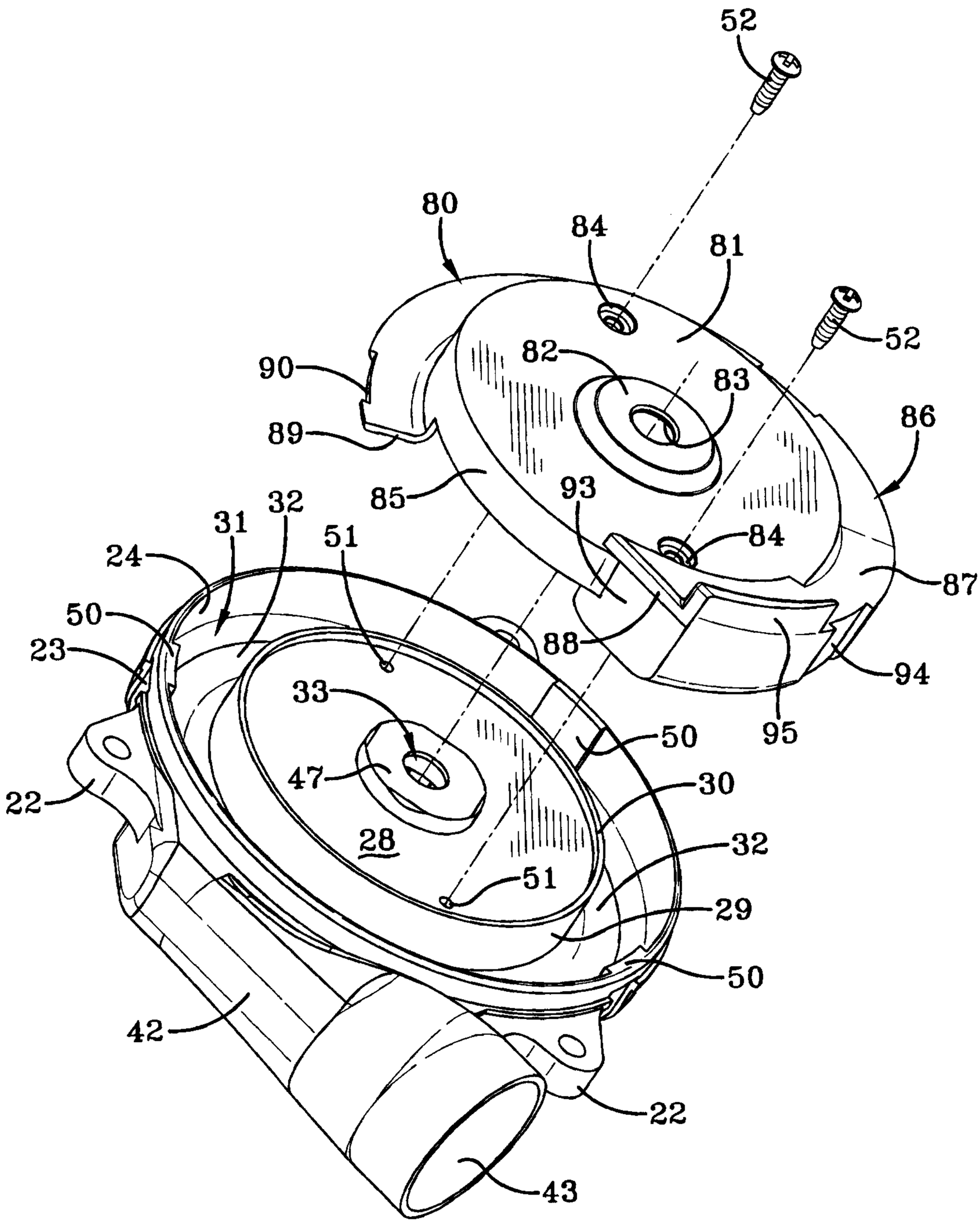
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FIG-3

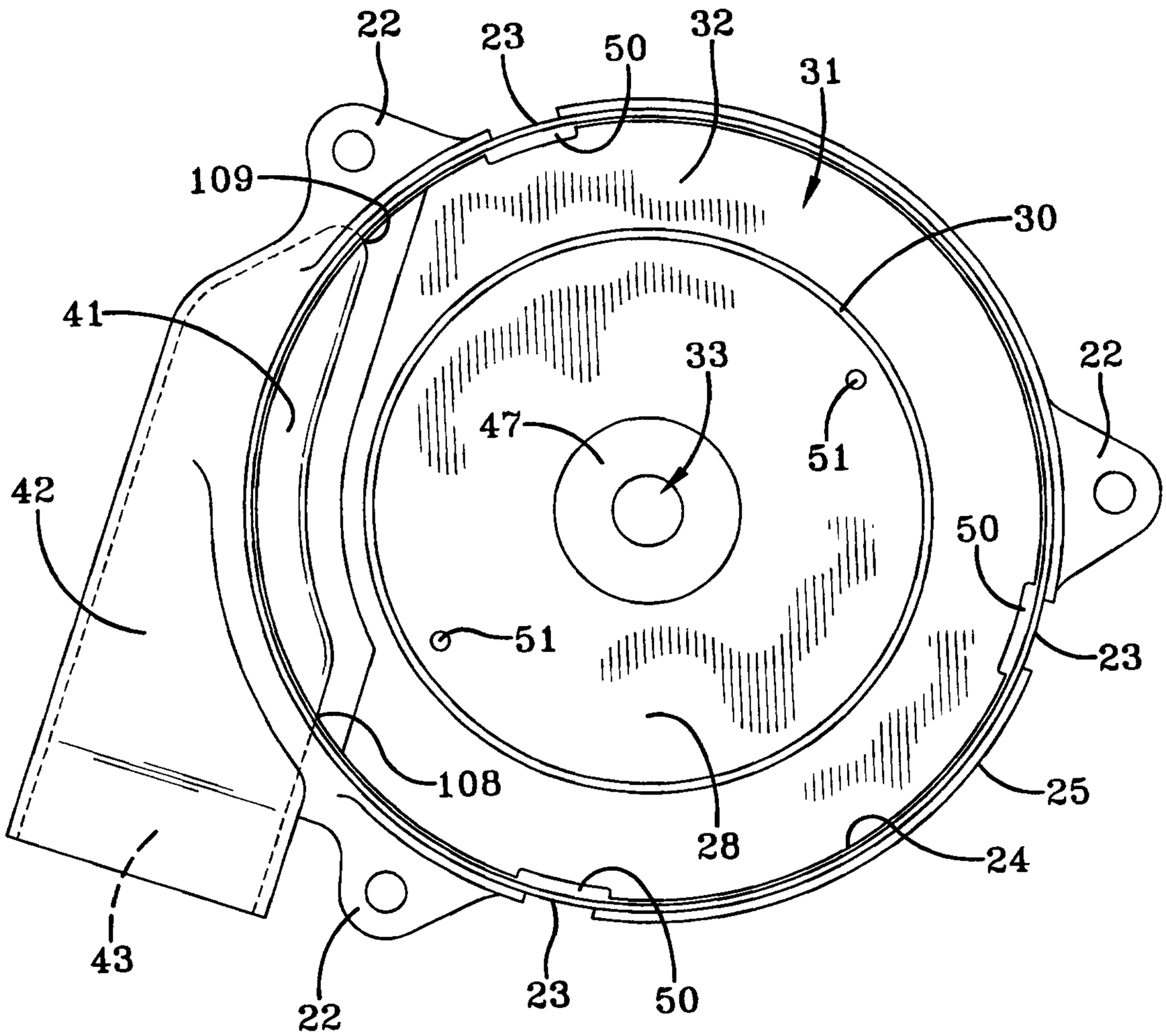
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FIG-4

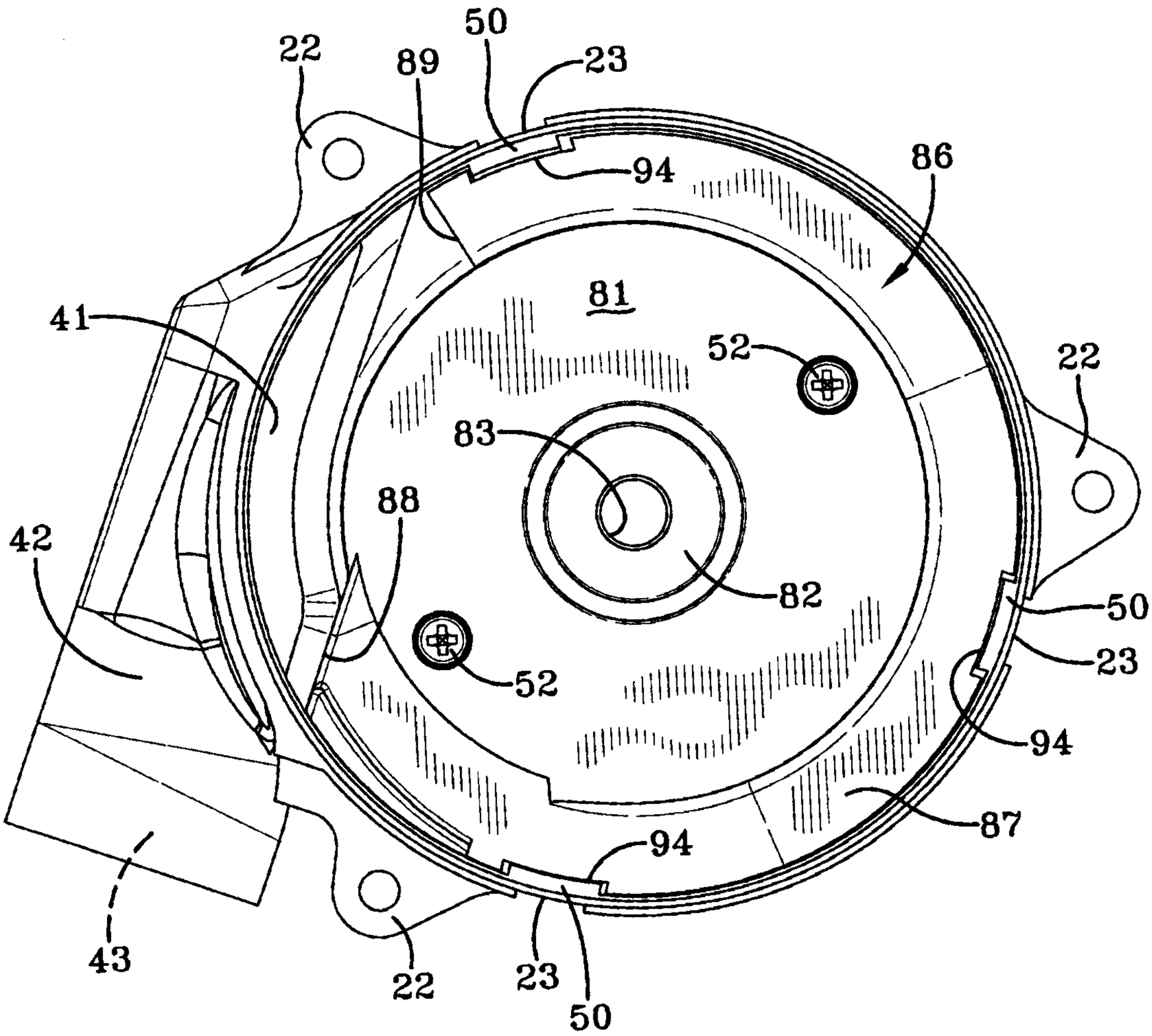
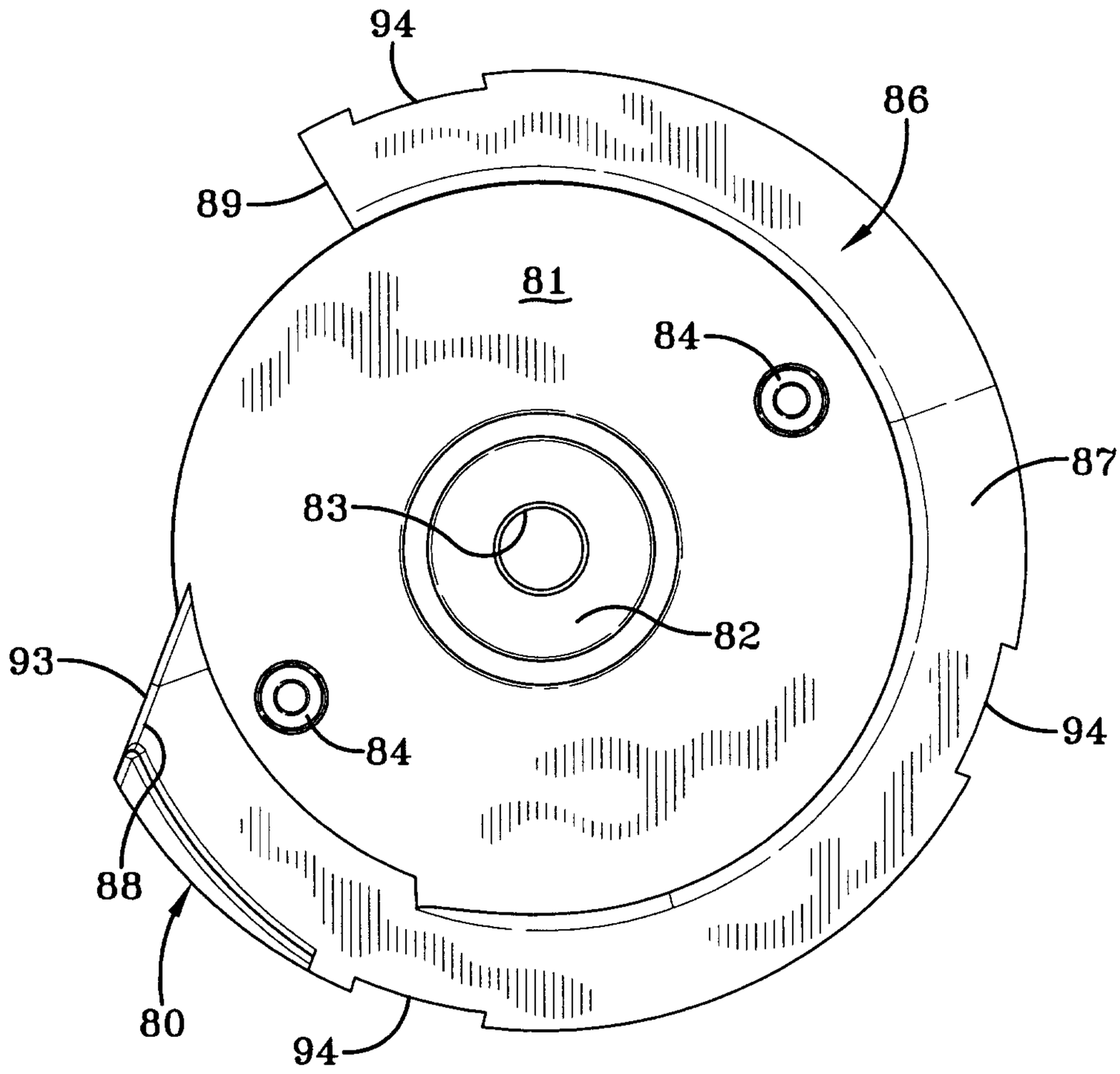
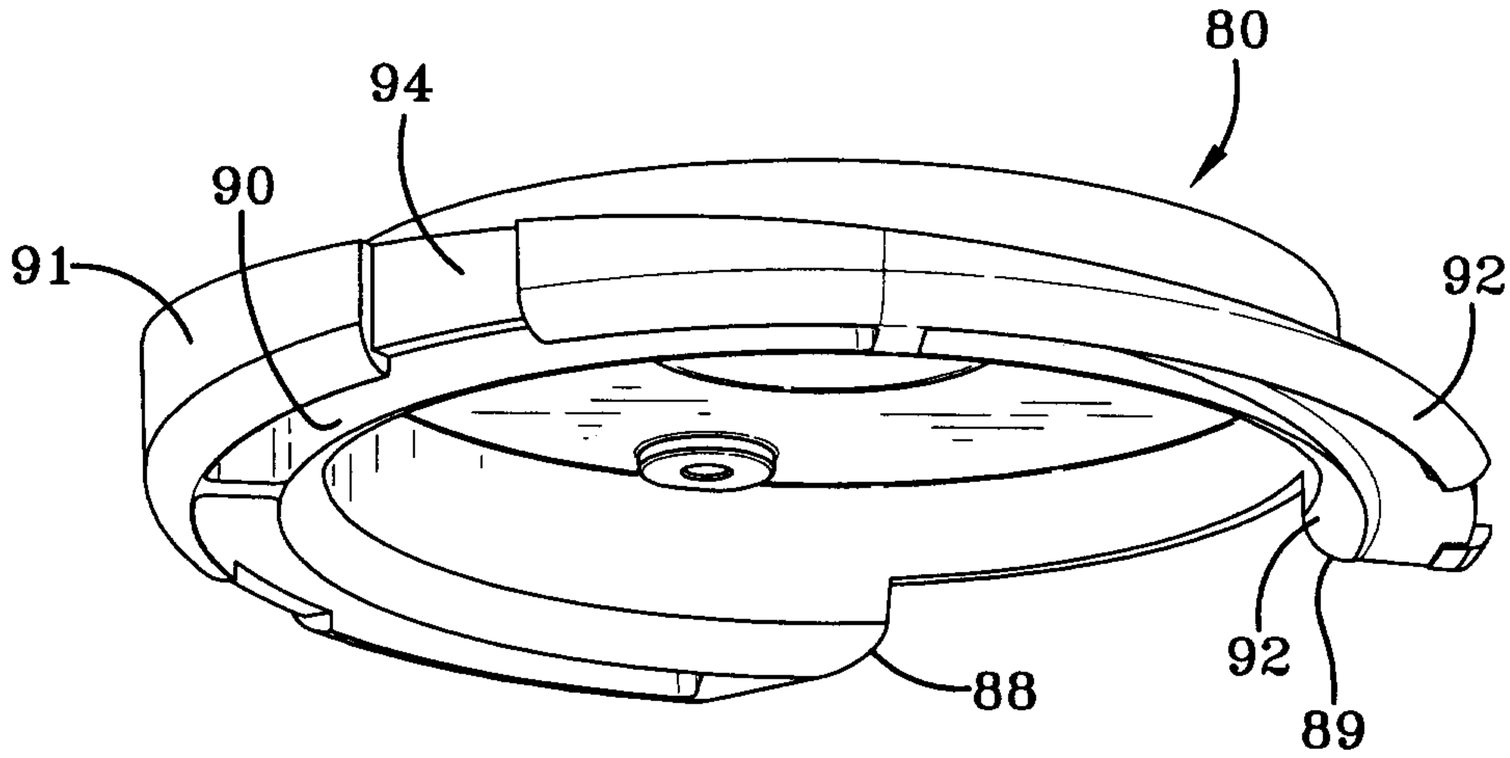


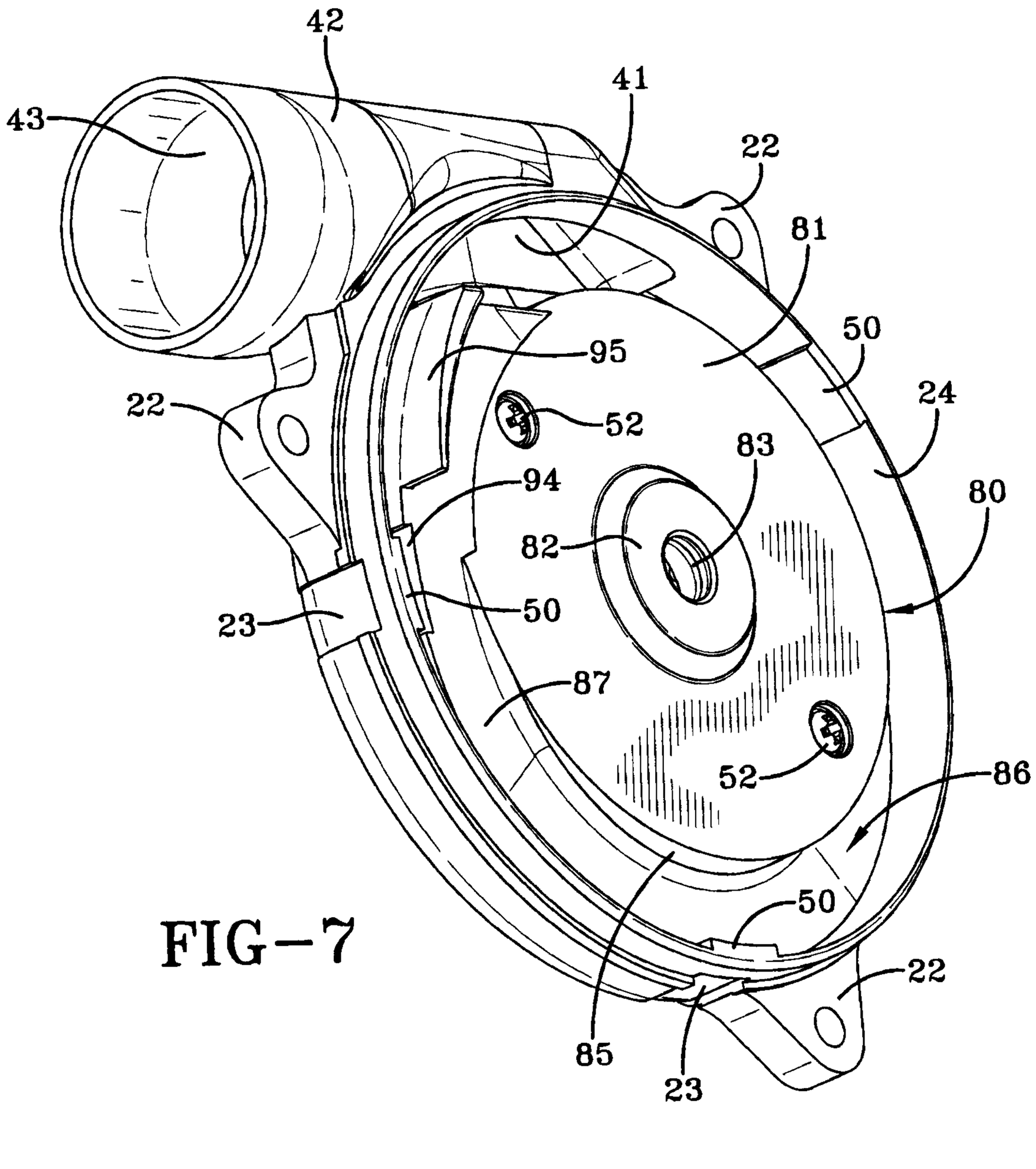
FIG-5



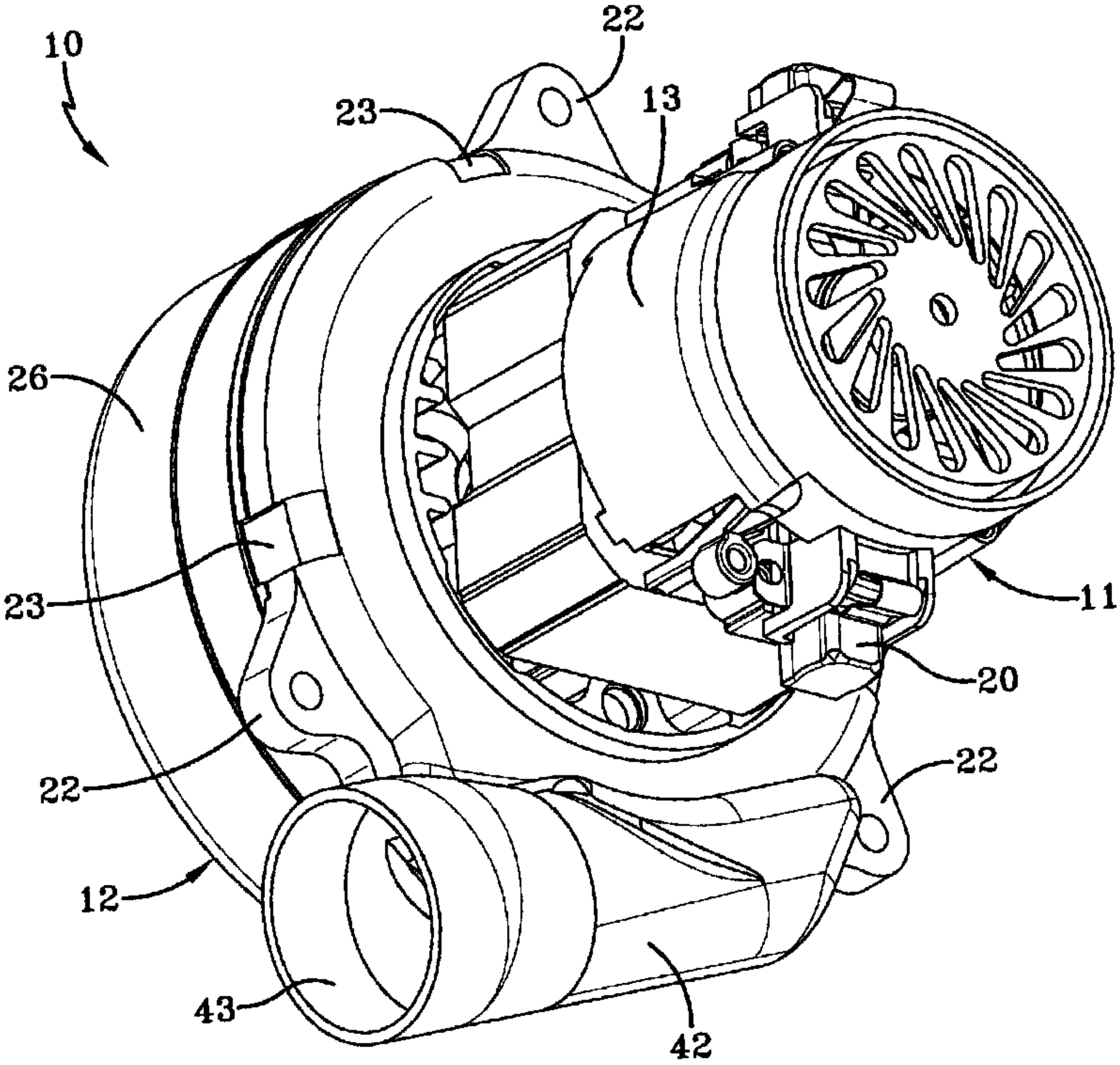
FIG–5A



FIG–6



FIG–7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