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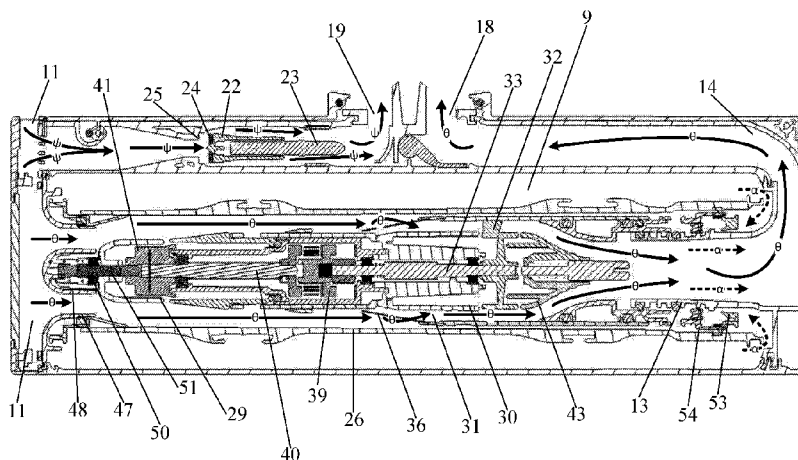


Figure 3

(57) **Abstract:** A cleaner head comprising a casing and a brushbar housed within the casing. The cleaner head has a turbine assembly housed within the brushbar. The casing comprises a first brushbar mount and a second brushbar mount with the brushbar being rotatably mounted at a first end to the first brushbar mount and at a second end to the second brushbar mount. The brushbar comprises an internal frame positioned at the first end. The turbine assembly is mounted at a first end to the internal frame and at a second end to the second brushbar mount.

CLEANER HEAD FOR A VACUUM CLEANER

The present invention relates to a cleaner head for a vacuum cleaner.

Cleaner heads can include a surface agitator, for instance a rotary brushbar, which is driven by an electric motor or a turbine. The turbine or motor may be housed within the brushbar so that the overall size of the cleaner head can be reduced.

A problem associated with such cleaner heads is the efficiency of drive delivery to brushbar, for instance, loss of power from the turbine or motor. The reliability and protection of the brushbar and the degree of maintenance required by the user in order to keep the brushbar moving and functioning can also present difficulties. For instance, when a turbine is used to drive the brushbar, the fluid drawn into the cleaner head to drive the turbine can be dust-laden and cause the turbine to become clogged or obstructed. The user can then be required to disassemble and/or clean the parts of the cleaner head in order to restore the movement of the brushbar. When the turbine or motor is housed within the brushbar, it can prove difficult to disassemble and clean the cleaner head. Thus, a cleaner head with a rotary brushbar driven by a motor or turbine that has a reduced level of user-maintenance is desired.

The present invention provides a cleaner head for a vacuum cleaner comprising: a primary inlet through which a dirt-laden fluid is drawn into the cleaner head; a secondary inlet through which an ancillary fluid is drawn into the cleaner head; an outlet through which the dirt-laden fluid and the ancillary fluid are discharged; a brushbar; a turbine assembly; and a bypass valve, wherein the turbine assembly is housed inside the brushbar, the ancillary fluid flows through the brushbar and drives the turbine assembly, and the bypass valve regulates the flow rate of the ancillary fluid in response to changes in the flow rate of the dirt-laden fluid.

During use, a dirt-laden fluid is drawn into the cleaner head via the primary inlet which is in contact with the surface to be cleaned. In addition, the ancillary fluid is drawn into

the cleaner head through a secondary inlet, the ancillary fluid being used to drive the turbine housed inside the brushbar. The entry point on the cleaner head for this ancillary fluid is different to the primary inlet and is located away from the surface to be cleaned so that the ancillary fluid is not entrained with dirt or dust that could obstruct or get trapped within the turbine parts housed within the brushbar. Typically the secondary inlet is located on a top or a side surface of the cleaner head.

The bypass valve is used to regulate the ancillary fluid flowing through the turbine such that the rotational speed of the brushbar can be controlled to prevent overspeed or damage to the cleaner head. Conversely, stalling of the brushbar due to a lack of ancillary fluid can also be prevented.

The bypass valve is also used as a safeguard to maintain a flow of fluid to the vacuum cleaner in the event that a blockage occurs within the cleaner head. The vacuum cleaner motor relies on a flow of fluid through it to keep it turning at a safe speed and operating temperature.

The bypass valve may reduce the flow rate of the ancillary fluid in response to a reduction in the flow rate of the dirt-laden fluid. The flow of ancillary fluid through the turbine housed inside the brushbar can be reduced, which in turn reduces the rotational speed of the brushbar and allows for any debris or blockages to be removed from the cleaner head. This also means that the rotational speed of the brushbar can be slowed or the brushbar can be immobilised whilst there is a blockage in the cleaner head, preventing tangling or snagging of the blockage around the brushbar, or any damage happening to the cleaner head casing.

The bypass valve may move between a closed position and an open position, the bypass valve being biased in the closed position, the bypass valve reducing the flow rate of the ancillary fluid when in the open position, and the bypass valve moves to the open position in response to a reduction in the flow rate of the dirt-laden fluid. Thus, the bypass valve moves to the open position when the flow rate of the dirt-laden fluid is less

than a threshold flow rate. The bypass valve is configured so that it is opened by an excessive suction force generated at the outlet. In other words, when the pressure on one side of the bypass valve drops to a threshold value, the bypass valve overcomes the biasing force of the spring and move to an open position.

A bypass fluid may be drawn into the cleaner head when the bypass valve is in the open position, the bypass fluid flowing through the bypass valve and being discharged through the outlet. The bypass fluid provides an additional fluid feed to the vacuum cleaner and vacuum cleaner motor in the event that the flow paths of the dirt-laden fluid and/or ancillary fluid become obstructed and cannot provide enough fluid into the vacuum.

The bypass fluid may be drawn in through the secondary inlet. The fluid drawn in through the secondary inlet therefore splits in two to form the ancillary fluid and the bypass fluid. The ancillary fluid then follows a first flow path through the cleaner head, whilst the bypass fluid follows a second, different flow path. More particularly, the ancillary fluid flows through the brushbar, whilst the bypass fluid flows through the bypass valve. The ancillary fluid flow path may extend from the secondary inlet through the brushbar to the outlet, and the bypass fluid flow path may extend from the secondary inlet through the bypass valve to the outlet. By having at least two clearly defined supplemental fluid flow paths in the cleaner head, the bypass valve is able to open in response to a blockage at the primary inlet or a blockage occurring within the brushbar. In addition, since the bypass valve and the brushbar turbine share the second inlet and an outlet, fluid flowing through the brushbar turbine can be diverted once the bypass valve has opened to avoid excess fluid flowing through the turbine. Once open, the bypass valve provides a low resistance pathway for fluid through the cleaner head.

The outlet may be partitioned into three sectors, the dirt-laden fluid being discharged through a first sector, the ancillary fluid being discharged through a second sector, and the bypass fluid being discharged through a third sector. Blockages occurring near or around the outlet of the cleaner head could potentially disturb or prevent the fluid

flowing through the cleaner head from either the primary or secondary inlets. However, partitioning the outlet into three sectors allows for a separate pathway for the fluid flowing through the cleaner head for each of the primary and secondary inlets. Thus, if a large piece of debris is caught and clogs the first sector, the bypass valve is still able to open and provide bypass fluid to the vacuum cleaner. By further dividing the outlet between the bypass valve and turbine assembly into two separate sectors, the size of the sector for the turbine assembly could be restricted so that a maximum volume and velocity of fluid flowing through the turbine may be attained, thereby also imposing a customised restriction on the maximum rotational speed of the brushbar. Alternatively, the size of the sector for the bypass valve could be minimised, such that the required amount of bypass fluid, for instance to cool the motor or prevent motor overspeed, may be admitted to the vacuum cleaner if a blockage in the cleaner head occurs.

The flow of the ancillary fluid through the brushbar may be parallel to the flow of the bypass fluid through the bypass valve. A cleaner head with a smaller footprint, height and size can be achieved if the bypass valve is arranged to allow, when opened, a parallel bypass fluid flow relative to the ancillary fluid flow through the brushbar. Furthermore, the bypass valve may move in a direction parallel to the rotational axis of the brushbar. This also presents a space efficient way of having a bypass valve on a cleaner head without increasing the overall size of the cleaner head.

The bypass valve may be housed outside the brushbar. As a result, the bypass valve would be unaffected by any blockages or obstructions that occur in the brushbar. In addition, if a fault or obstruction occurs with the moving parts of the bypass valve then the user would not have to take apart the entire cleaner head and/or brushbar assembly to repair the valve or remove the obstruction or fix the bypass valve.

The turbine assembly may comprise an overspeed protection device, and the overspeed protection device reduces the flow rate of the ancillary fluid when the flow rate of the ancillary fluid exceeds a threshold. The provision of a bypass valve serves primarily as a fluid controlling means for the cleaner head. However, the bypass valve also offers an

additional means for protecting the turbine from causing damage from excessive rotational speed. The fluid admitted into the cleaner head has an alternative bypass fluid flow path in order to reduce the amount of fluid that is drawn in as ancillary fluid through the turbine assembly.

In order that the present invention may be more readily understood, an embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a cleaner head of the present invention;

Figure 2 is an exploded view of the cleaner head;

Figure 3 is plan sectional view of the cleaner head, the section being taken in the horizontal plane;

Figure 4 is a front elevation cross-sectional view of the cleaner head with a bypass valve in a closed position, the cross-section being taken in a vertical plane;

Figure 5 is a front elevation cross-sectional view of the cleaner head with the bypass valve in an open position, the cross-section being taken in a vertical plane;

Figure 6 is a perspective view of the casing showing the first brushbar mount;

Figure 7 is a perspective exploded view of the bottom part of the casing and brushbar showing the second brushbar mount;

Figure 8 is a sectional view of the turbine assembly with the overspeed device in the rest state;

Figure 9 is a sectional view of the turbine assembly with the overspeed device in the triggered state;

Figure 10 is an exploded view of the overspeed device; and

Figure 11 is a perspective view of the overspeed device.

Figures 1 to 5 illustrate a cleaner head 1 for a vacuum cleaner (not shown). The cleaner head 1 comprises a casing 2, a bypass valve 3, a brushbar assembly 4, and a turbine assembly 5.

The casing 2 comprises a bottom part 6, a top part 7 and a rear part 8. The parts 6,7,8 fit together to form a central cavity 9 in the casing 2 where the brushbar assembly 4 is located.

The bottom part 6 shown primarily in Figures 2, 6 and 7 comprises a primary inlet 10, a secondary inlet 11, a first brushbar mount 12, a second brushbar mount 13, a channel 14, a bypass valve mount 15 and an outlet 16. The primary inlet 10 is located on the underside of the bottom part 6 for drawing a dirt-laden fluid into the cleaner head 1 from a surface to be cleaned. The secondary inlet 11 is provided on a top surface of the bottom part 6 of the casing 2 that is exposed to ambient air. The secondary inlet 11 is used for drawing clean fluid into the cleaner head 1. The secondary inlet 11 is covered by mesh (not shown) to prevent the admission of dirt and debris. The first brush bar mount 12 and second brushbar mount 13 are located on either side edges of the bottom part 6 and face into the central cavity 9. The first and second brushbar mount 12,13 support the brushbar assembly 4 within the cleaner head 1, this will be described in more detail later. The channel 14 has a bottom and side walls and is positioned along a part of the rear working edge of the bottom part 6. The channel 14 guides a fluid that exits the brushbar assembly 4 through the second brushbar assembly mounting 13 towards the outlet 16. The bypass valve mount 15 is also located along the rear working edge of the bottom part 6 but on the other side of the outlet 16 to the channel 14. More

specifically, the bypass valve mount 15 is located between the secondary inlet 11 and the outlet 16. The bypass valve 3 is affixed to the bottom part 6 on the bypass valve mount 15, as will be described later. The outlet 16 is partitioned into three sectors 17,18,19. The three sectors 17,18,19 of the outlet 16 are used to draw three fluid flows through the cleaner head, which is described in more detail below.

The first sector 17 of the outlet 16 is for dirt-laden fluid exiting the cleaner head 1 having been drawn in from the primary inlet 10. The second sector 18 of the outlet 16 is for an ancillary fluid traveling on an ancillary fluid flow path (arrows θ in Figure 3). The ancillary fluid is drawn in at the secondary inlet 11, and travels through the brushbar assembly 4 and turbine assembly 5, and continuing to travel along channel 14, before exiting through the second sector 18. The third sector 19 of the outlet 16 is for bypass fluid traveling on a bypass fluid flow path (arrows ψ in Figure 3). The bypass fluid is drawn in at the secondary inlet 11, traveling through the bypass valve 3, before exiting through the third sector 19. All three fluid flows combine in a wand or hose after exiting the cleaner head 1 via the outlet 16. The details of the various fluid flow paths is described in more detail later on.

The top part 7 fits over the bottom part 6 to provide a roof to the central cavity 9 for housing the brushbar assembly 4. The top part 7 comprises a bypass valve housing 20 and a bypass fluid entry point 21. The top part 7 fits to the bottom part 6 to seal the bypass valve housing 20. The bypass fluid entry point 21 allows for the admission of bypass fluid from the secondary inlet 11 to the bypass valve housing 20 so that bypass fluid can flow through to the third sector 19 of the outlet 1 when the bypass valve is open. The top part 7 also fits over as a roof to conceal and seal the channel 14 for the fluid for fluid flowing towards the second sector 18 of the outlet 16.

The rear part 8 is used to connect the cleaner head 1 to a wand or hose assembly (not shown) via the outlet 16. In addition, the rear part 8 is used to seal and conceal the bypass valve housing 20 and to provide an additional point of connection between the bottom part 6 and the top part 7 of the casing 2.

The bypass valve 3 is best shown in Figures 3 to 5 and comprises a stationary part 22, a moving part 23, a sealing member 24 and a spring (not shown). The stationary part 22 is fixed within the bypass valve housing 20 at the fixing point 15 of the bottom part 6. The stationary part 22 is an extended cylinder shaped component. The moving part 23 is an extended cylinder that is open at one end and has a larger radius than the cylinder of the stationary part 22. The moving part 23 is placed around, and is slidable lengthways over, the stationary part 22. The sealing member 24 is an annular piece of rubber or foam and is fixed to the closed end of the moving part cylinder 23. In the closed position, the spring biases the movable part 23 and the sealing member 24 against the walls of a vent 25 located in the bypass valve housing 20. To move into the open position, the moving part 23 and sealing member 24 overcome the bias of the spring and slide lengthways over the stationary part 22 towards the outlet 16. The bypass valve 3 is shown as open in Figures 3 and 5, and closed in Figure 4.

As explained above, the brushbar assembly 4 is located within the central cavity 9 of the casing 2. The brushbar assembly 4 comprises a brushbar 26 which is a cylindrical tube configured to house the turbine assembly 5. The brushbar assembly 4 is held in place at a first end by a first brushbar mount 12 and at a second end by a second brushbar 13. Both the first and second brushbar mounts 12,13 are tubular in nature so that they can be inserted into the tubular shape of the brushbar 26. The first and second brushbar mounts 12,13 allow fluid to be drawn through them and also provide support to the inner surface of the brushbar 26. In addition, the first and second brushbar mounts 12,13 allow for the passage of ancillary fluid into or out of the brushbar 26, respectively. The mounting of the brushbar onto the first and second brushbar mounts 12,13 will be explained in more detail later.

The brushbar 26 is fitted with two flexible helically arranged agitators 27 on its outside surface which are used to disturb dust and dirt on a surface to be cleaned. The agitators 27 can be an array of bristles or a continuous strip of plastic or felt projecting from the brushbar 26. The brushbar 26 also has an internal spoked frame 28 with a central hub 29

located at the first end of the brushbar 26 near the first brushbar mount 12 (best shown in Figure 7). The internal spoked frame 28 provides a point of connection for the turbine assembly 5 to the brushbar 26, as will now be explained.

The turbine assembly 5 is best shown in Figures 3, 8 and 9 and comprises a frame 30, a turbine inlet 31, an impeller 32, a shaft 33, a transmission 34 and an overspeed device 35. The turbine inlet 31 draws ancillary fluid into the turbine assembly 5 for rotation of the impeller 31. The turbine inlet 31 is covered with a mesh 36 that prevents the ingress of dirt and debris into the turbine assembly 5. The mesh 36 is angled against the frame 30 of the turbine assembly 5 relative to the longitudinal axis of the brushbar 26. The impeller 32 comprises a number of fins that are positioned in the ancillary fluid flow path through the turbine assembly. The impeller 32 is connected to the shaft 33, such that torque generated by the impeller causes the shaft 33 to turn. The shaft is connected at the other end to the transmission 34. The shaft 33 is mounted on two bearings 33a and has a middle stepped section 37 which has a larger radius than the ends of the shaft 33 that connect to the impeller 32 and the transmission 34. The frame 30 also includes an internal wall with an aperture 38 through which the shaft 33 passes. The shaft 33 is biased against the wall by a spring (not shown) so that a shoulder of the stepped section 37 occludes the aperture 38. The two bearings 33a are positioned either side of the aperture 38. The transmission 34 comprises a gearbox 39, a transmission shaft 40 and a drive dog 41. The gearbox 39 is an epicyclical gear train gearbox which is driven by the torque delivered from the shaft 33. The output side of the gearbox 39 is connect to the transmission shaft 40 and causes the transmission shaft 40 to rotate. The gearbox 39 is used to reduce the torque delivered to the transmission shaft 40 that is initially delivered from the impeller 31. The transmission shaft 40 is mounted on two bearings 40a and is connected at the other end to the drive dog 41. The drive dog 41 sits within and engages the central hub 29 of the spoked frame 28 of the brushbar assembly 4. The drive dog 41 is fixed within the central hub 29 of the brushbar assembly 4, such that rotation of the drive dog 41 causes the brushbar 26 to rotate.

The overspeed device 35 is best shown in Figures 8 to 11. More specifically the overspeed device 35 is shown in a rest (or unrestricted) state in Figure 8 and in a triggered (or restricted) state in Figure 9. The overspeed device 35 comprises a housing part 42 and a traveling part 43. The housing part 42 is cylindrical in shape and comprises a tapered duct 44 and a central mounting rod 45 supported by radial limbs 46 which connect to the inner surface of the tapered duct 44. The traveling part 43 has a conical surface which follows the taper of the tapered duct 44. The traveling part 43 is mounted onto the central mounting rod 45 so that it can move along the central mounting rod 45, in and out of the tapering duct 44. The traveling part 43 is biased away from the tapering duct 44 by a spring (not shown) around the central mounting rod 45 such that the flow of ancillary fluid through the tapering duct 44 is usually unrestricted when the overspeed device 35 is in the rest state. The profile of the conical shape of the traveling part 43 follows the taper of the tapered duct 44, such that movement of the traveling part 43 along the central mounting rod 45 towards the tapered duct 44 reduces or restricts the possible flow of fluid through the overspeed device 35, and therefore the possible flow of ancillary fluid through the turbine assembly 5. This is when the overspeed device 35 is said to be in a triggered state. However, the movement of the traveling part 43 towards the tapering duct 44 along the central mounting rod 45 is restricted by the radial limbs 46, which prevent the complete restriction or obstruction of the tapering duct 44 by the traveling part 43 when the overspeed device 35 is in the triggered state. The radial limbs 46 are best shown in Figures 10 and 11.

As mentioned above, the drive dog 41 is mounted within the central hub 29 of the brushbar 26. The other end of the turbine assembly 5 comprising the overspeed device 35 is mounted around the second brushbar mount 13. More particularly, the cylindrical housing part 42 is fixedly mounted around the outside surface of the second brushbar mount 13. In other words, the housing part 42 does not rotate as the impeller 32 and drive dog 41 turn within the brushbar 26. The housing part 42 also provides an exhaust for the ancillary fluid exiting the turbine assembly 5 and the brushbar assembly 4. As

mentioned previously, the ancillary fluid is directed into the channel 14 after leaving the brushbar assembly 26.

As described above, the brushbar 26 is mounted at a first end on the first brushbar mount 12, and at a second end on the second brushbar mount 13, which are best shown in Figures 6 and 7, respectively. The first brushbar mount 12 is positioned adjacent to the secondary inlet 11 and comprises, a collar 47, and a central cup 48 which are connected together by a number of spurs 49. The first end of the brushbar 26 fits over the collar 47, and the spurs 49 allow for the passage of ancillary fluid flow through the first brushbar mount 12 and into the brushbar 26. The central cup 48 is located within the ancillary fluid flow path and has a closed end which is facing the flow of ancillary fluid drawn through the brushbar 26 (see Figure 7). The central cup 48 accommodates a first bearing 50 and a spindle 51, the first bearing 50 surrounding the spindle 51 such that the inner race of the first bearing 50 contacts the spindle 51. The closed end of the central cup 48 protects the first bearing 50 from the ancillary fluid flow. The spindle 51 slots into a hole 52 in the internal spoked frame 29 of the brushbar 26. The brushbar 26 is therefore supported by the inner race of the first bearing 50 by the spindle 51, as well as surrounding the collar 47 of the first brushbar mount 12.

The second brushbar mount 13 is positioned at the other end of the brushbar 26 and essentially is a hollow tube over which the other end of the brushbar 26 is mounted. A second bearing 53 and a second bearing mount 54 are secured to the outer surface of the second brushbar mount 13 to support the brushbar 26 and aid its rotation. The second bearing 53 fits around the second brushbar mount 13 and is positioned outside of the ancillary fluid flow path whilst maintaining contact with the brushbar 26 on its outer race. The second bearing mount 54 is shaped to divert the flow of a fluid over the second bearing 53. A surface of the second bearing mount 54 has raised sections or is castellated to allow the passage of a dirt or debris containing fluid over the second bearing mount 54, in order to prevent any dirt and debris from contacting the second bearing 53.

In use, the cleaner head 1 is manoeuvred over a floor surface to be cleaned. The brushbar 26 rotates and the flexible helically arranged agitators 27 disturb any dust and dirt on the surface to be cleaned. The dust and dirt is entrained into a dirt-laden fluid that is drawn into the primary inlet 10 of the cleaner head 1. This dirt-laden fluid travels toward the first sector 17 of the outlet 16 and passes out of the cleaner head 1 into a vacuum cleaner.

When connected to a vacuum cleaner, the second and third sectors 18,19 of the outlet 16 also draw a fluid into the cleaner head 1 via the secondary inlet 11. This fluid serves both the turbine assembly 5 and the bypass valve 3, each of which will now be described in turn.

Firstly, the secondary inlet 11 draws an ancillary fluid to the turbine assembly 5. The ancillary fluid is drawn into the cleaner head 1 via secondary inlet 11 and then flows into the brushbar 26 through the space between the spurs 49 of the first brushbar mount 12 and over and around the central cup 48, which housing the first bearing 50. Once inside the brushbar 26, the ancillary fluid flows over the transmission 34 of the turbine assembly 5. The fluid is then drawn into the turbine assembly 5 through the mesh 36 covering the turbine inlet 31. Ancillary fluid then flows over the blades of the impeller 32 causing it to rotate, creating a torque which is delivered to the shaft 33. This is transferred through the gearbox 39 to the transmission shaft 40 which is connected to the drive dog 41. As mentioned above, the drive dog 41 sits within and engages the spoked frame 28 of the brushbar 26, and so rotation of the drive dog 41 causes the brushbar 26 to rotate.

Any pressure differentials within the brushbar 26 or turbine assembly 5 can cause grease and lubricant to be pulled out of the transmission 34, especially the gearbox 39, into the impeller 32 and vacuum cleaner. The shaft 33 is provided with a stepped section 37. The stepped section 37 in cooperation with the frame 30 helps to reduce the amount of lubricant or grease being drawn out of the transmission 34. The shaft 33 passes through an internal wall of the frame 30 with an aperture 38 downstream of the

transmission 34, relative to the flow of ancillary fluid through the brushbar 26. The shoulder of the stepped section 37 is biased against the wall of the aperture 38 in the by a spring so as to occlude the aperture 38 and seal off the transmission 34, thereby protecting the transmission 34 from pressure differentials or any suction forces acting within the in the brushbar 26 or turbine assembly 5.

If excess ancillary fluid is drawn through the turbine assembly 5, then the rotational speed of the impeller 32 increases, and hence the rotational speed of the brushbar 26. At a high enough rotational speed or torque the transmission 34 and the spoked frame 29 can be damaged. The rotational speed of the impeller 32 is restricted by an overspeed device 35 which can act to reduce or restrict the flow of ancillary fluid through the brushbar 26, thereby reducing the speed of the impeller 32. As described above, the overspeed device 35 in a rest state has a spring that biases the traveling part 43 towards the impeller 42 and against the flow of ancillary fluid drawn through the brushbar 26. In this state, the tapered duct 44 is considered unrestricted in terms of the amount of ancillary fluid exiting the turbine assembly 5. However if, for instance, a part other than the second sector 18 of the outlet 16 gets blocked, then more ancillary fluid will be drawn through the turbine assembly 5. This creates a pressure differential which acts as a lifting force on the conical surface of the traveling part 43. If this lifting force overcomes the biasing force of the spring, then the traveling part 43 is pulled along the central mounting rod 45. The ancillary fluid flow path is considered to become restricted as the traveling part 43 moves along the central mounting rod 45 due to the conical shape surface of the traveling part 43 matching the narrowing of the tapered duct 44. The flow of ancillary fluid is therefore considered restricted once a threshold level of flow rate and pressure differential is reached. Movement of the traveling part 43 is limited along the central mounting rod 45 so as to prevent the surfaces of the moving part 43 and tapering duct 44 contacting and creating a complete restriction (or shut-off) of ancillary fluid flowing through the cleaner head 1. This is to be prevented as this could cause the transmission 39 to jam or the brushbar 26 to stall. The central mounting rod 45 is provided with radial limbs 46 which limit the travel of the moving part 43 and prevent contact between the moving part 43 and the tapered duct 44 when the overspeed

device 35 is in the triggered state. In addition, the conical shape of the surface of the moving part 43 and the profile of the tapered duct 44 are not perfectly matched to prevent the two parts from locking together if an excessive and sudden pressure drop were to occur causing one or more of the radial limbs 46 to break off from the central mounting rod 45. Once the ancillary fluid has travelled through the overspeed device 35 it exits the second end of the brushbar 26 via the second brushbar assembly mounting 13. The ancillary fluid is then directed into the channel 14 which leads to the second sector 18 of the outlet 16.

Secondly, the secondary inlet 11 provides a bypass fluid to the bypass valve 3. During normal operation, the bypass valve 3 remains closed, as shown in Figure 4. As described above, when the bypass valve 3 is closed, the moving part 23 and the sealing member 24 are biased against the walls of the vent 25. Thus, no bypass fluid can be drawn into the cleaner head 1 as the bypass fluid flow path is obstructed. If, for instance, a part other than the third sector 19 of the outlet 16 is blocked, then the pressure drop caused by the vacuum cleaner forces the moving part 23 of the bypass valve 3 to overcome the bias of the spring, causing the moving part 23 to slide along the stationary part 22 and draw the sealing member 24 away from the walls of the vent 25. The bypass valve 3 is now in an open position (as shown in Figures 3 and 5). A bypass fluid flow path from the secondary inlet 11, into the bypass valve housing 20, through the fluid entry point 19 and towards the outlet 16 is provided. The bypass fluid then exits the cleaner head 1 via the third sector 19 of the outlet duct 16.

During use, the bypass valve 3 ensures that the vacuum cleaner has a constant supply of fluid for cooling the motor and also preventing the overspeed of the vacuum motor. The bypass valve 3 also safeguards against too much fluid being drawn through the brushbar assembly 4 and turbine assembly 5. The constant flow of any fluid through the vacuum cleaner also helps to agitate any flexible parts within the vacuum cleaner, for instance flexible tips on a cyclonic separator.

The cleaner head 1 can be used on a variety of different surfaces. It will be appreciated that for some surfaces, such as carpeted floors, the primary inlet 10 should not clamp onto the surface to be cleaned due to fluid traveling through the fibres of carpet. However, when cleaning smoother surfaces, such as wooden or tiled floors, the primary inlet 10 can become clamped onto the surface, sealing the cleaner head 1 around the surface to be cleaned. The clamping action can present a problem in that a negative pressure difference can be created within the central cleaning cavity 9 of the cleaner head 1 and the brushbar 26. This gives rise to an undesired diverted fluid comprising a fraction of the dirt-laden fluid, which flows from within the central cavity 9 to the inside of the brushbar 26. Specifically, the diverted fluid flow path travels through any gaps between the brushbar 26 and the first and second brushbar mounts 12,13. A particularly undesired diverted fluid flow path (shown by arrows labelled α in Figure 3) passes from the primary inlet 10, around the second bearing 53 and into the brushbar 26. In this instance, the diverted fluid flows into the brushbar in a direction contra to the flow of ancillary fluid through the brushbar 26. This additional diverted dirt-laden fluid can cause dirt and dust to get caught within the races of the second bearing 53. However, the second bearing 53 is protected by a second bearing mount 54 so that the diverted fluid can be directed over the second bearing 53. Specifically the second bearing mount 54 has undulating indentations or is castellated around its outer circumference to provide a low resistance pathway for any items of dirt and debris. These items of dirt or debris are free to flow into the brushbar 26, preventing them from being drawn through the second bearing 53. The diverted fluid and ancillary fluid mix in the brushbar 26. In addition, the turbine inlet 31 is covered with a mesh 36 that prevents the ingress of dirt and debris from the diverted fluid to prevent damage to the impeller 36 and other parts of the turbine assembly 5.

Claims

1. A cleaner head for a vacuum cleaner comprising:
a primary inlet through which a dirt-laden fluid is drawn into the cleaner head; a secondary inlet through which an ancillary fluid is drawn into the cleaner head; an outlet through which the dirt-laden fluid and the ancillary fluid are discharged; a brushbar; a turbine assembly; and a bypass valve,
wherein the turbine assembly is housed inside the brushbar, the ancillary fluid flows through the brushbar and drives the turbine assembly, and the bypass valve regulates the flow rate of the ancillary fluid in response to changes in the flow rate of the dirt-laden fluid.
2. A cleaner head according to claim 1, wherein the bypass valve reduces the flow rate of the ancillary fluid in response to a reduction in the flow rate of the dirt-laden fluid.
3. A cleaner head according to claim 1 or 2, wherein the bypass valve moves between a closed position and an open position, the bypass valve is biased in the closed position, the bypass valve reduces the flow rate of the ancillary fluid when in the open position, and the bypass valve moves to the open position in response to a reduction in the flow rate of the dirt-laden fluid.
4. A cleaner head according to claim 3, wherein a bypass fluid is drawn into the cleaner head when the bypass valve is in the open position, and the bypass fluid flows through the bypass valve and is discharged through the outlet.
5. A cleaner head according to claim 4, wherein the bypass fluid is drawn in through the secondary inlet.
6. A cleaner head according to claim 4 or 5, wherein the outlet is partitioned into three sectors, the dirt-laden fluid is discharged through a first sector, the ancillary fluid

is discharged through a second sector, and the bypass fluid is discharged through a third sector.

7. A cleaner head according to any one of claims 4 to 6, wherein the flow of the ancillary fluid through the brushbar is parallel to the flow of the bypass fluid through the bypass valve.

8. A cleaner head according to any one of claims 3 to 7, wherein the bypass valve moves in a directional parallel to the rotational axis of the brushbar.

9. A cleaner head according to any one of the preceding claims, wherein the bypass valve is housed outside the brushbar.

10. A cleaner head according to any one of the preceding claims, wherein the turbine assembly comprises an overspeed protection device, and the overspeed protection device reduces the flow rate of the ancillary fluid when the flow rate of the ancillary fluid exceeds a threshold.

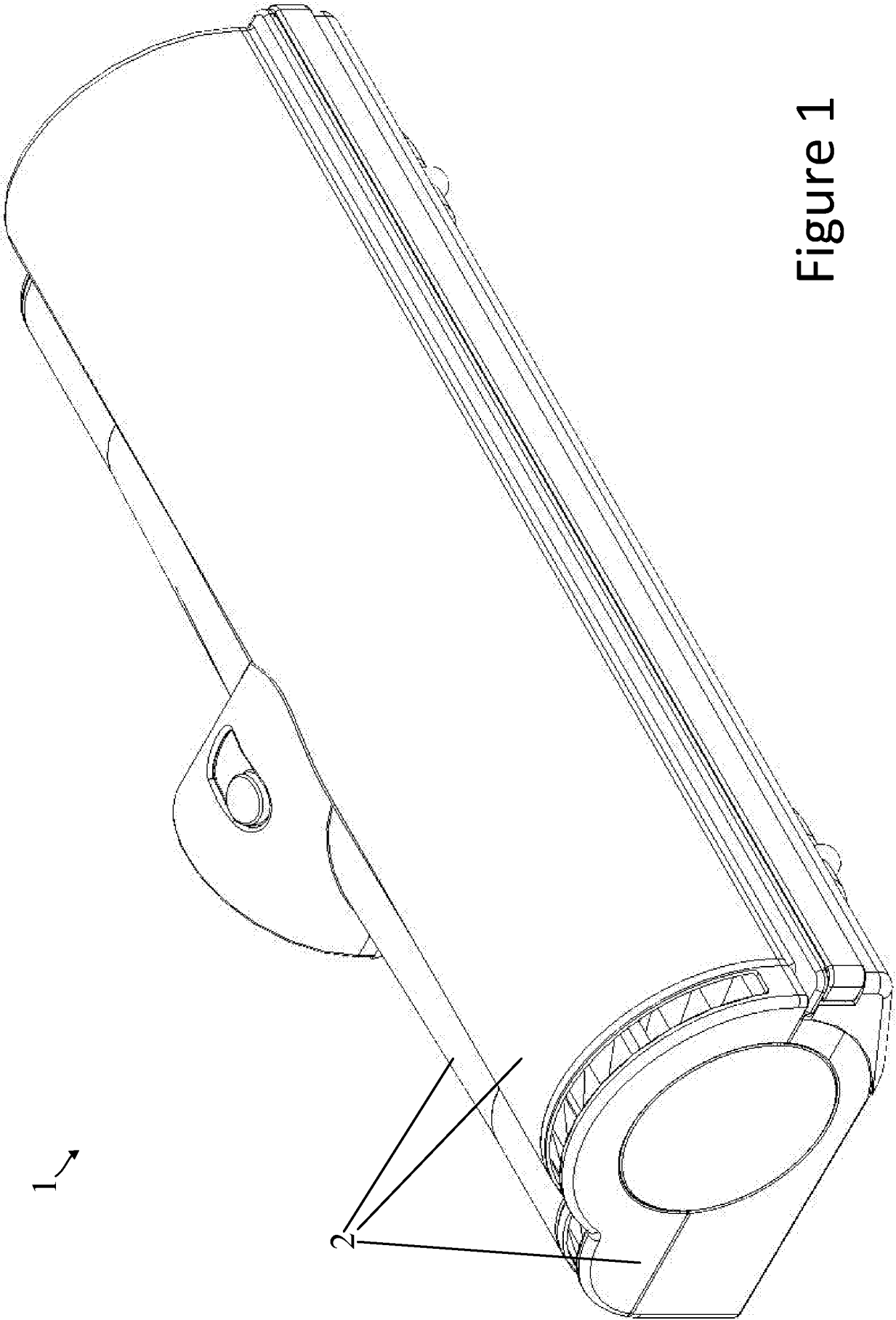
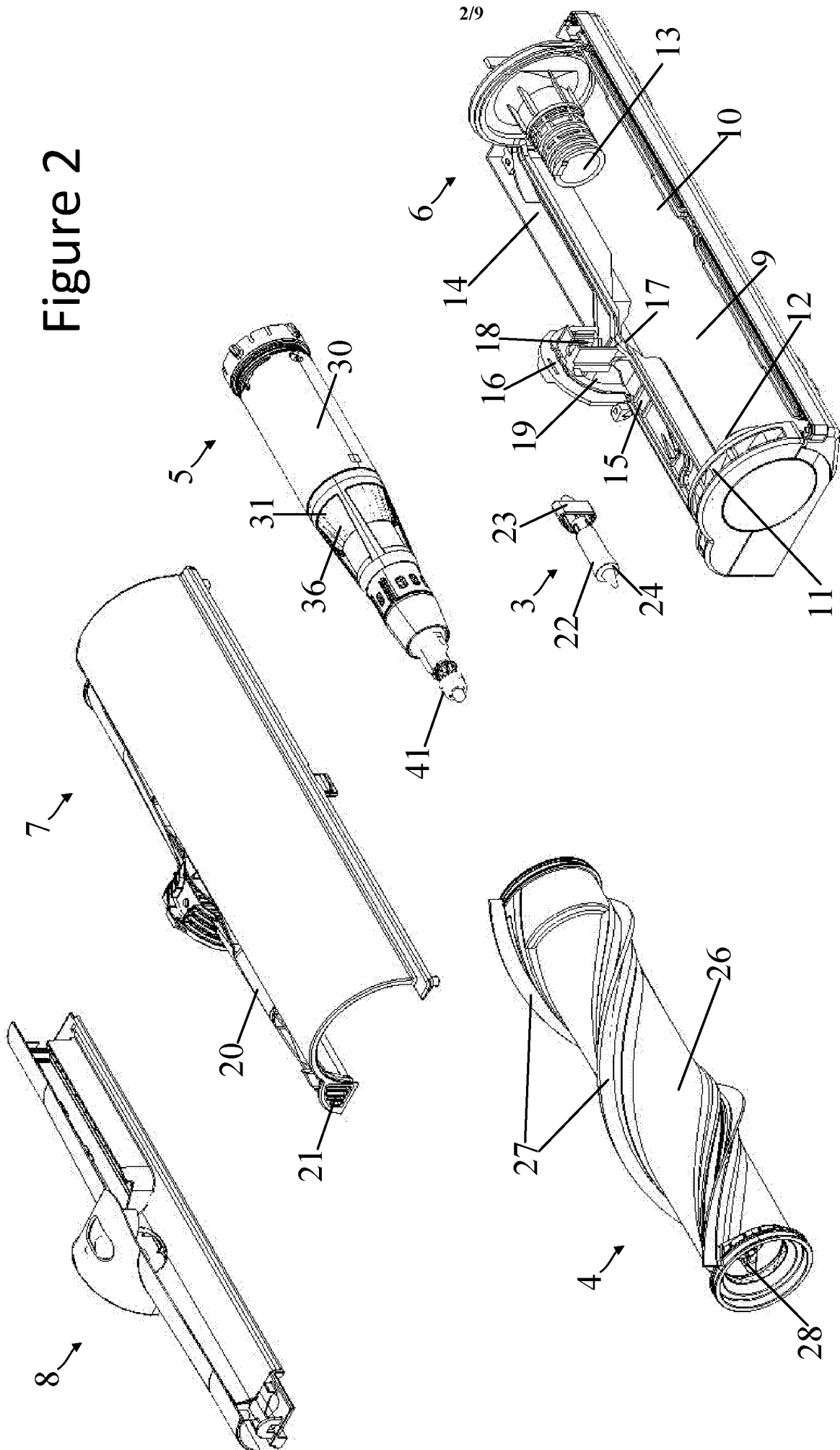


Figure 1

Figure 2



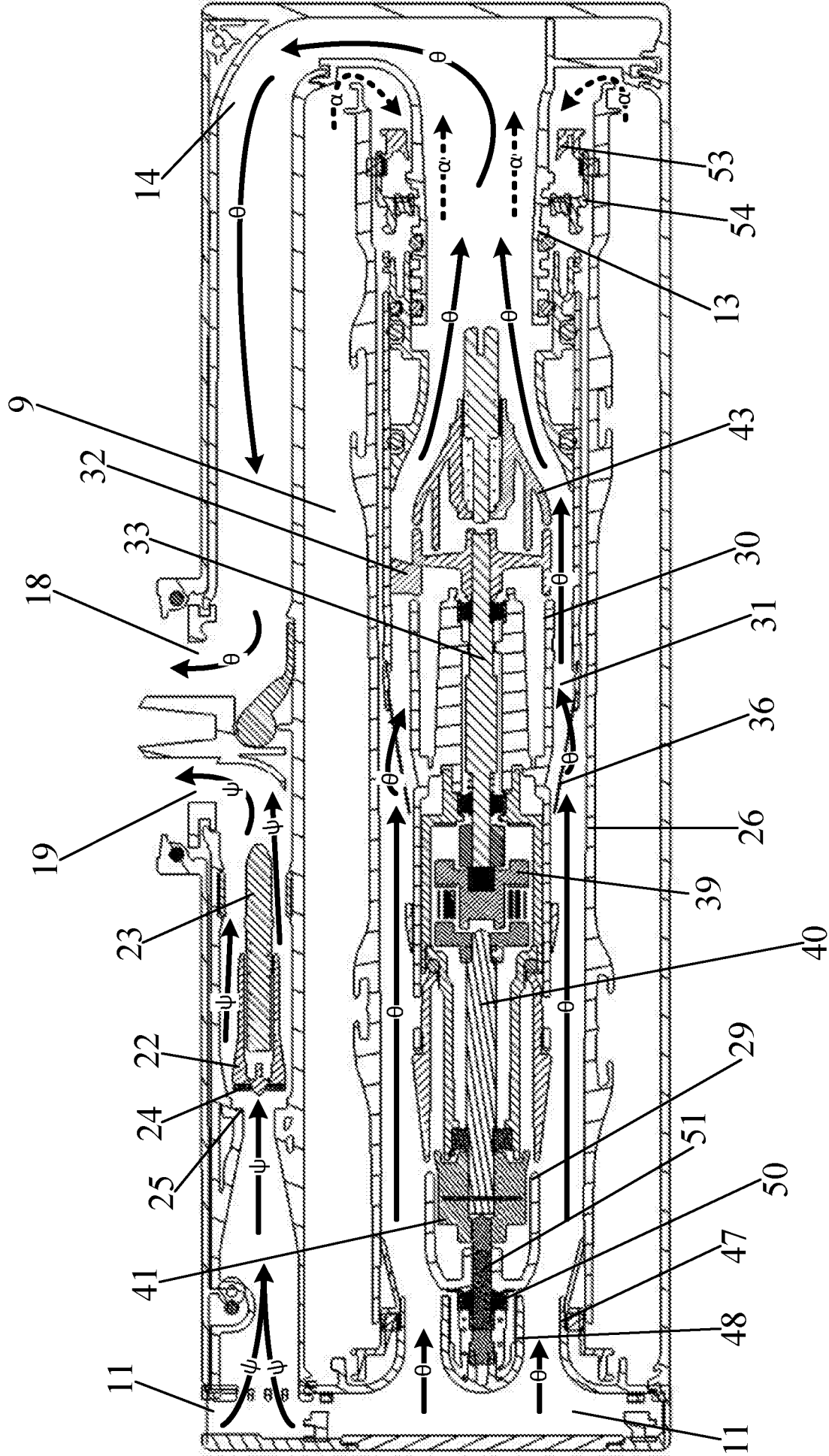


Figure 3

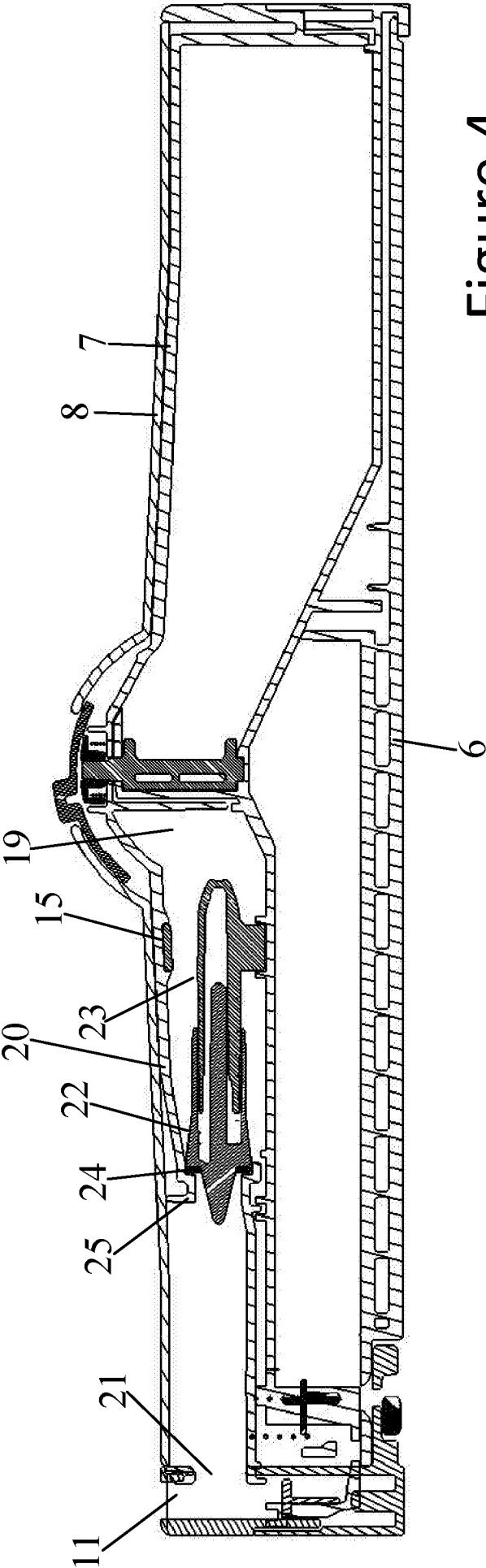


Figure 4

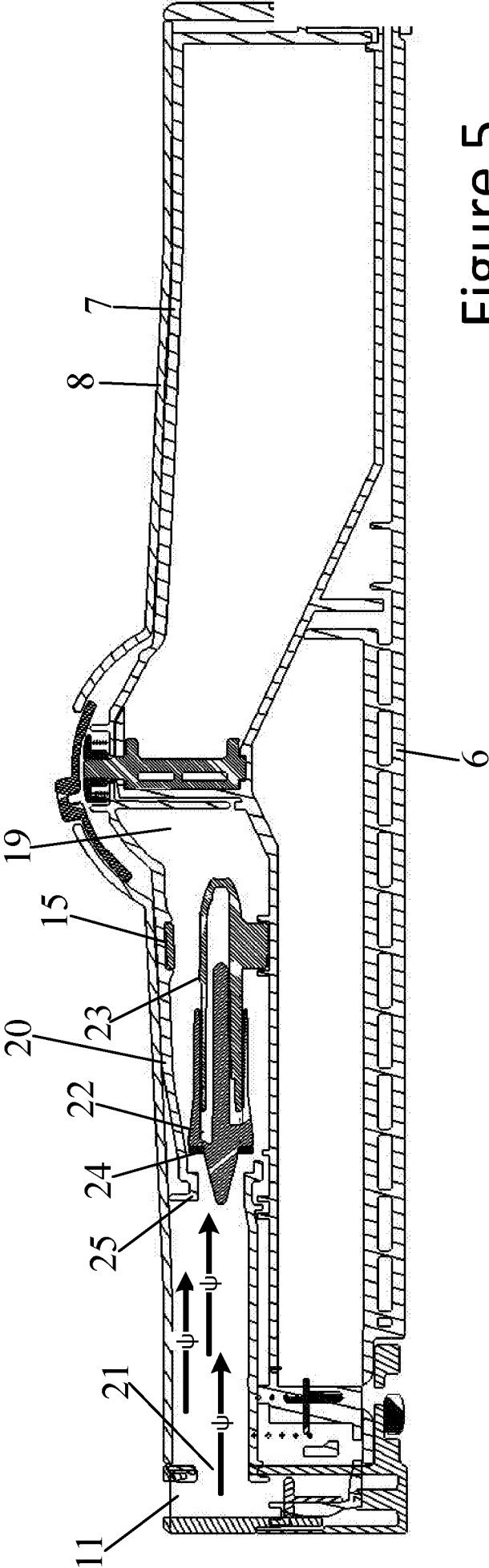


Figure 5

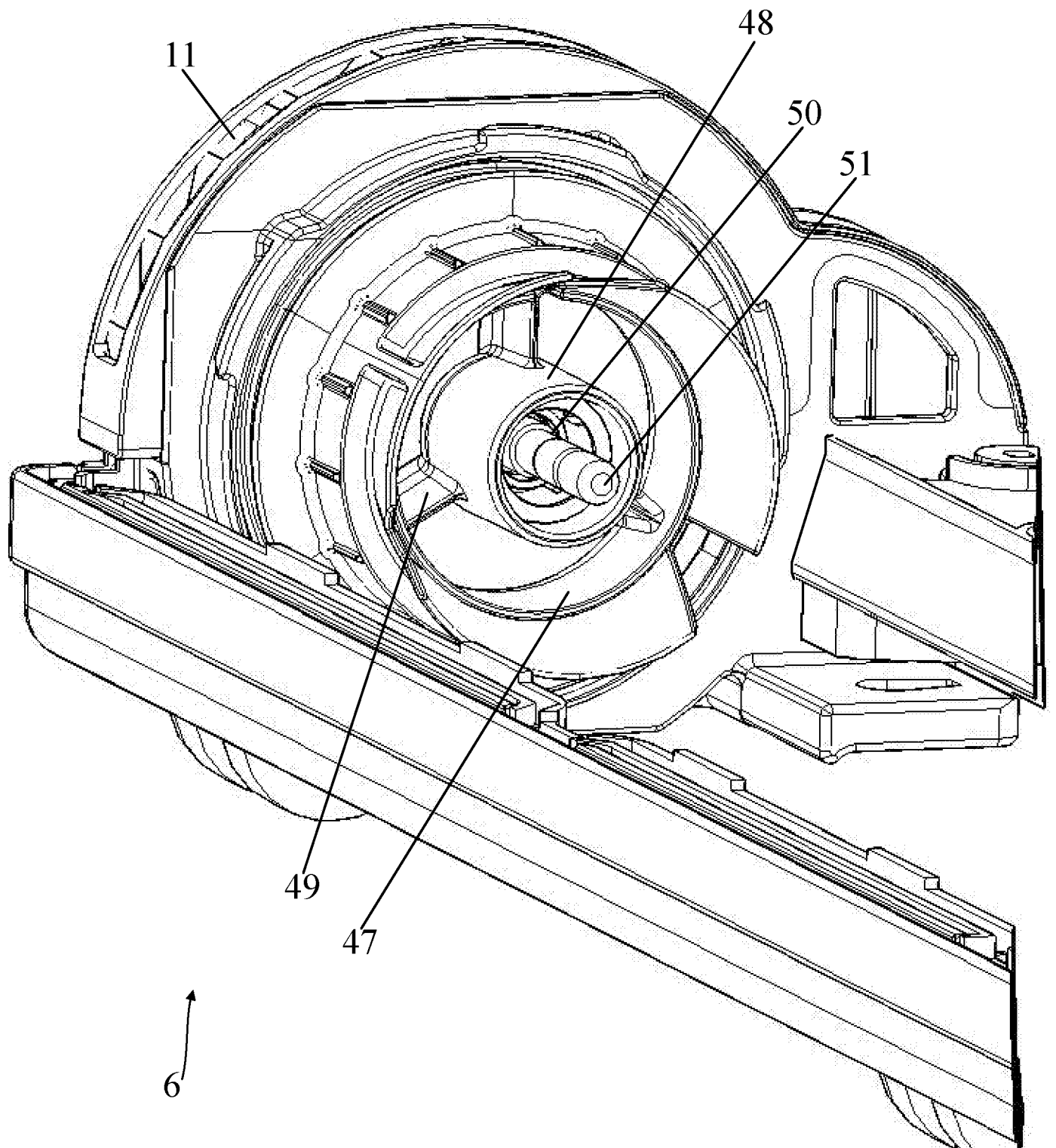


Figure 6

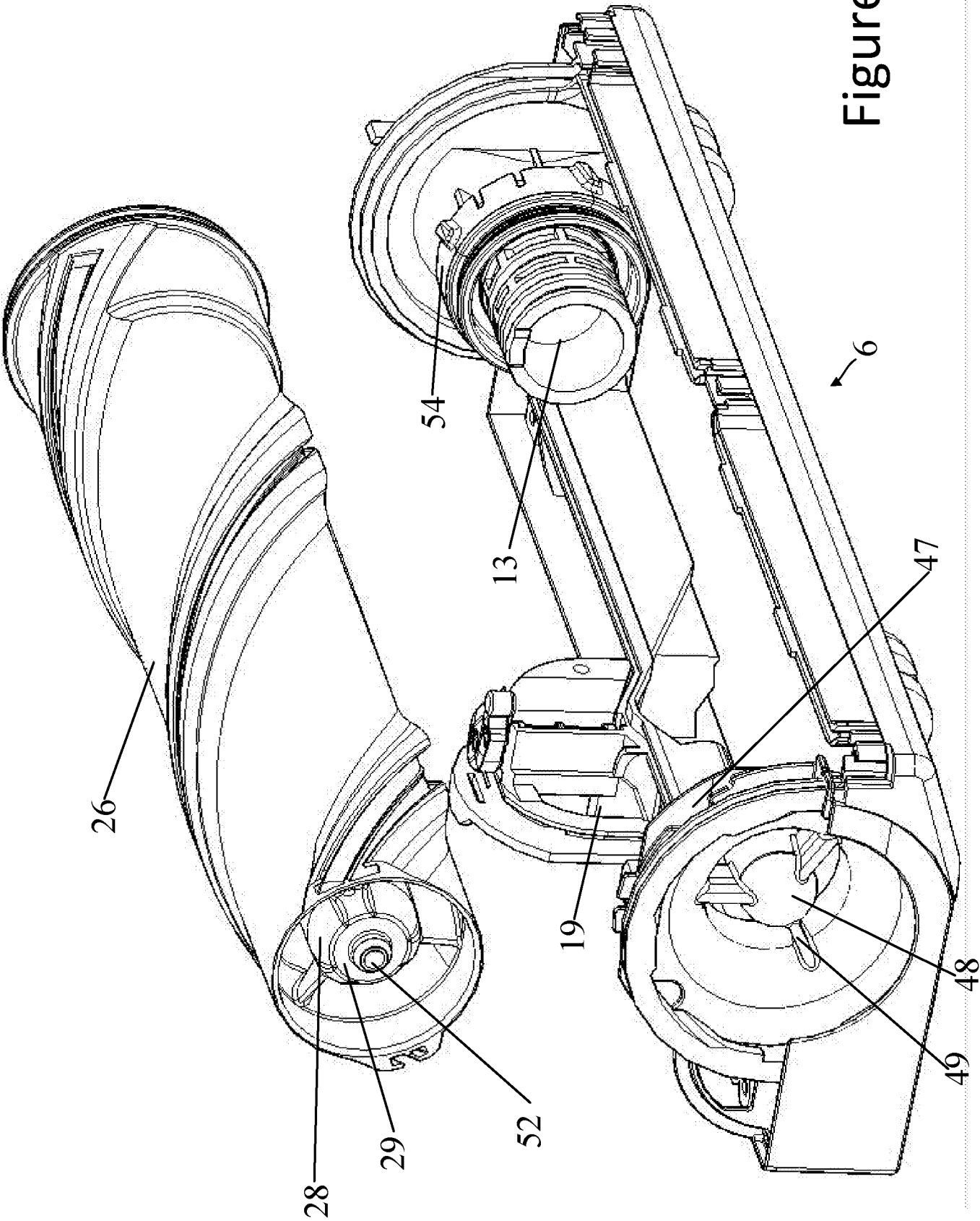


Figure 7

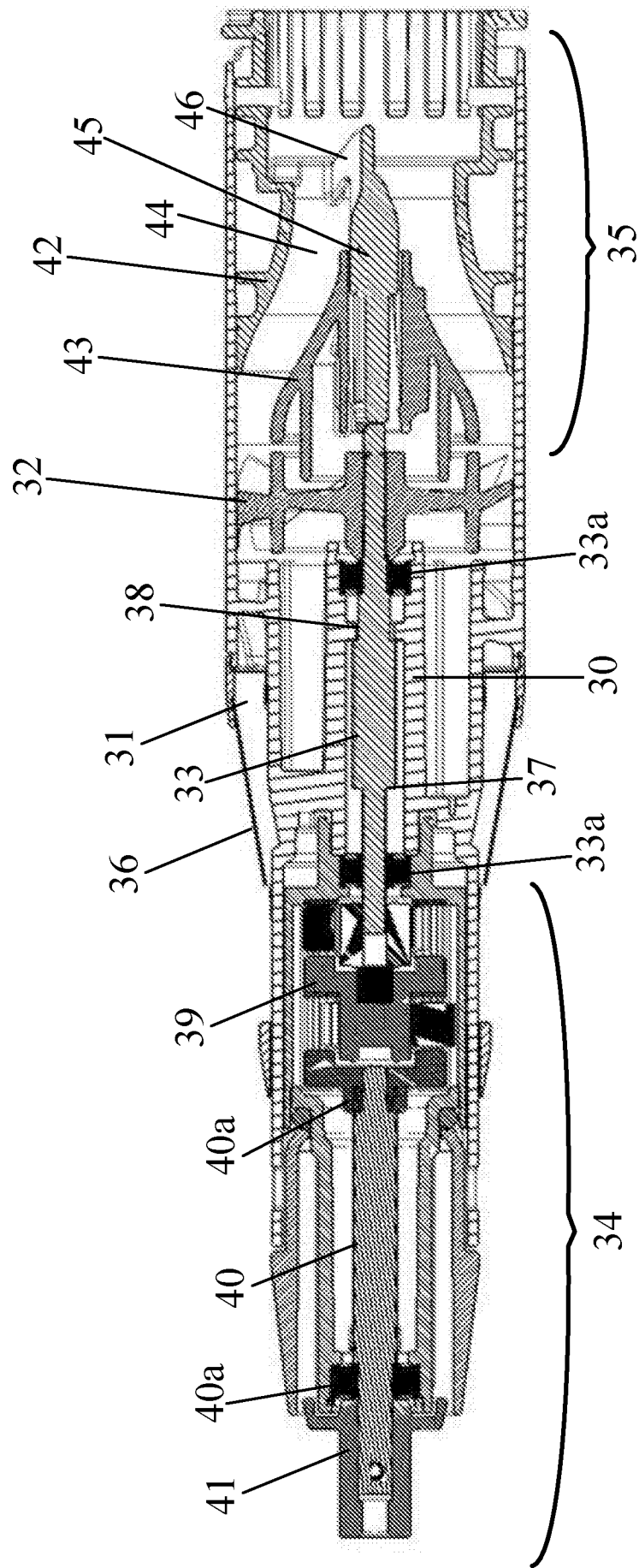


Figure 8

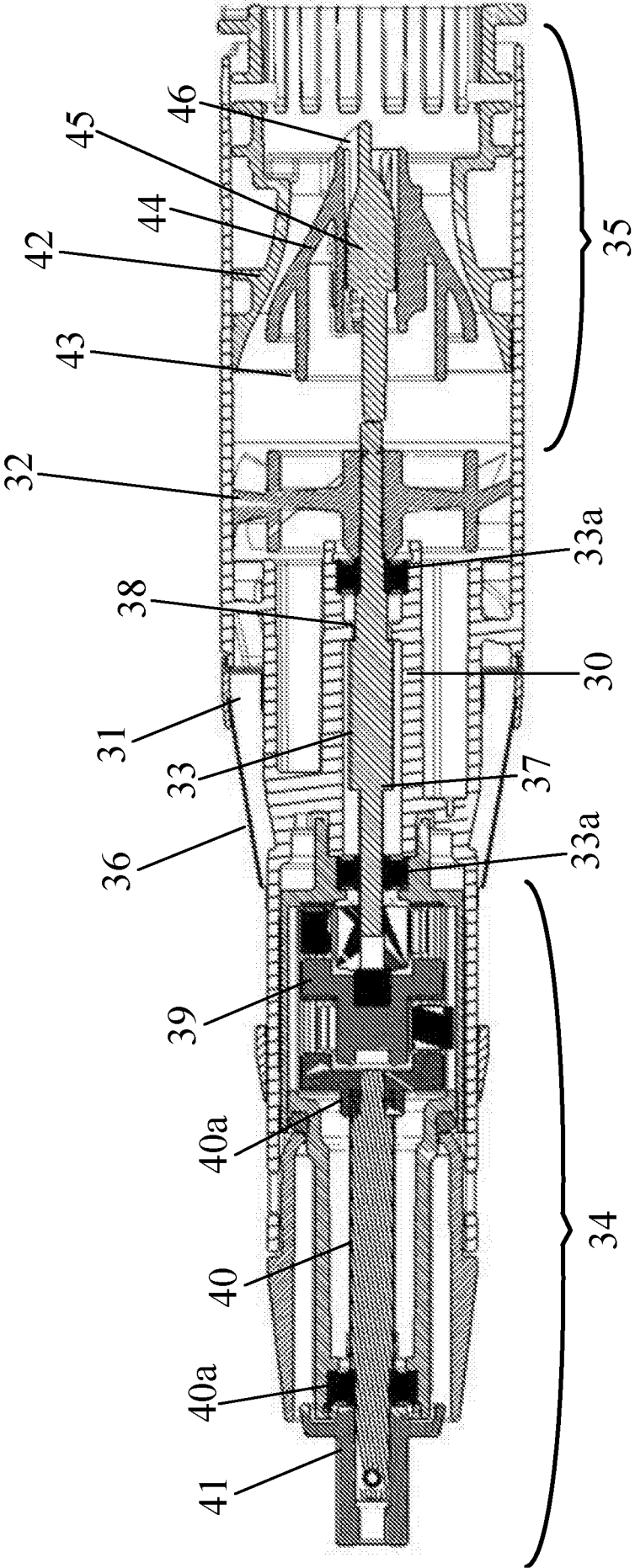


Figure 9

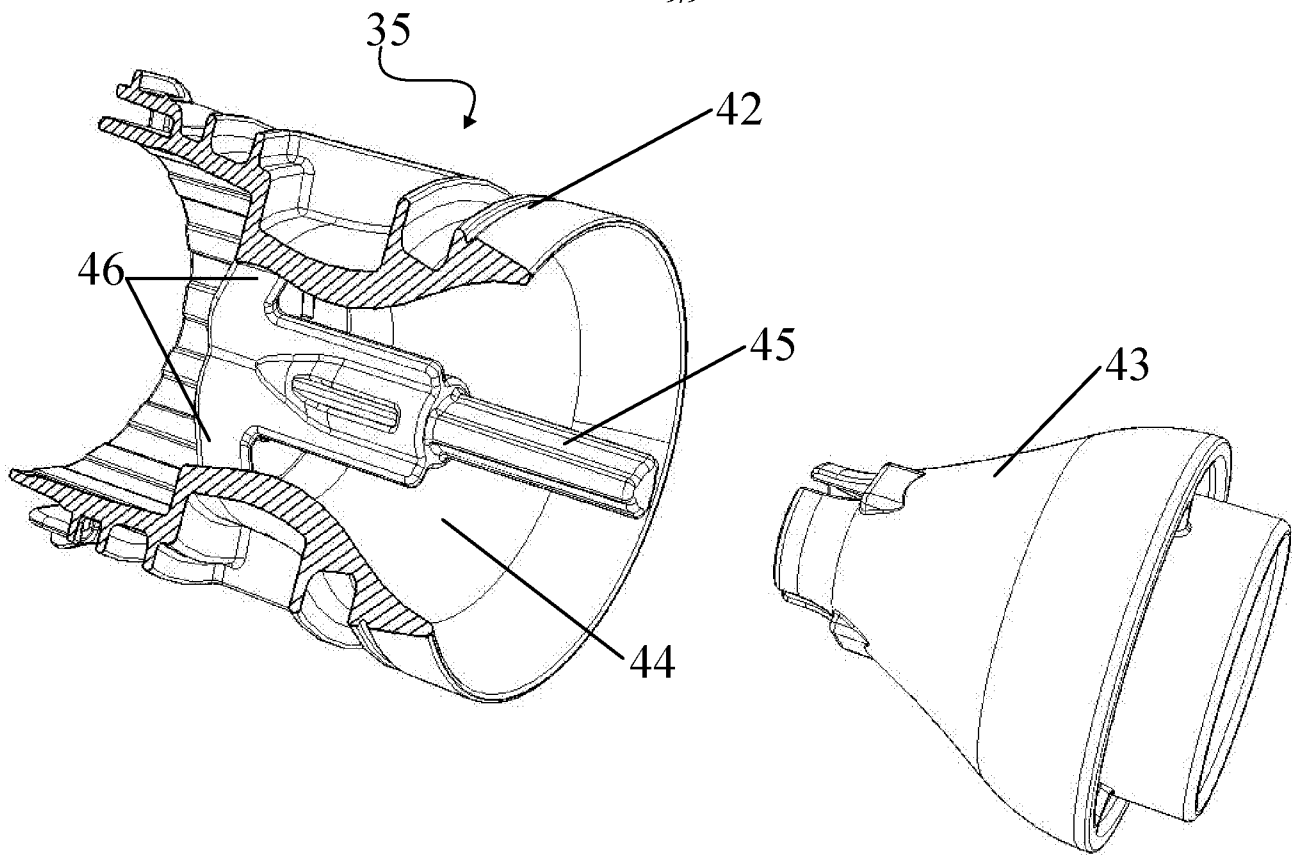


Figure 10

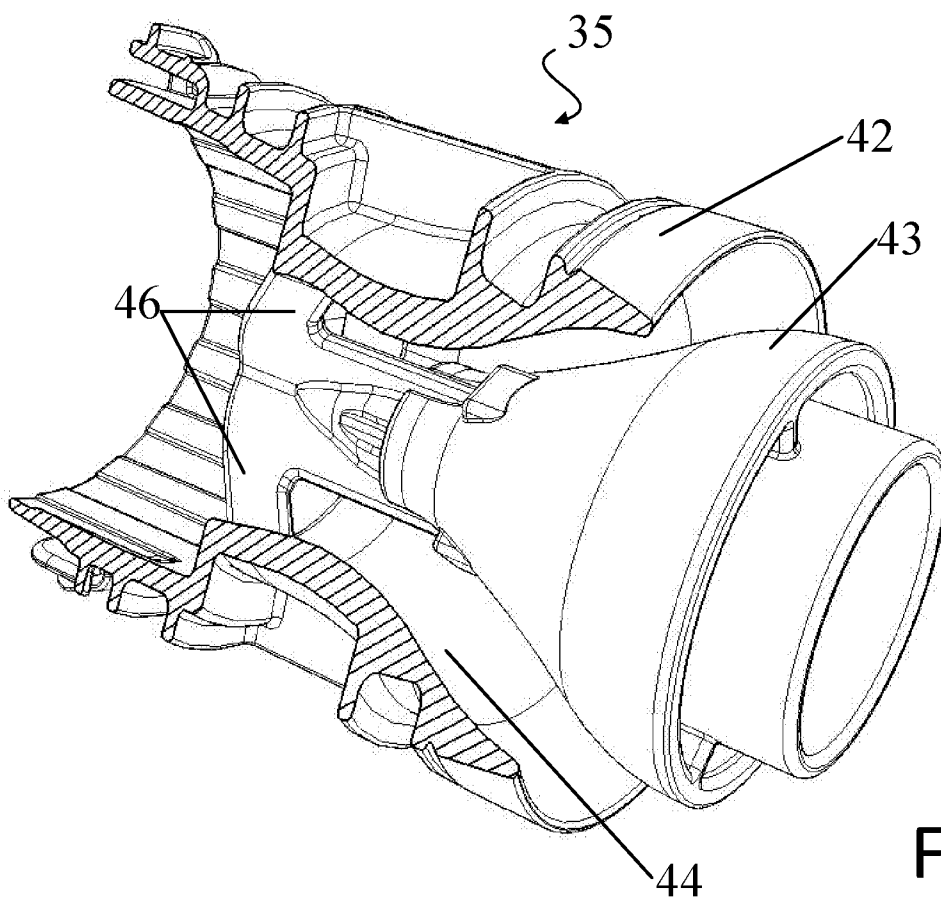


Figure 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/052948

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L9/04 A47L9/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 485 577 A (DYSON TECHNOLOGY LTD [GB]) 23 May 2012 (2012-05-23) figures 1,2 -----	1-10
A	GB 2 524 285 A (DYSON TECHNOLOGY LTD [GB]) 23 September 2015 (2015-09-23) figures 1-3 -----	1-10
A	JP H11 206642 A (SANYO ELECTRIC CO) 3 August 1999 (1999-08-03) paragraph [0046]; figures 1,4,5 -----	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

20 December 2016

Date of mailing of the international search report

04/01/2017

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Authorized officer

Trimarchi, Roberto

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2016/052948

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