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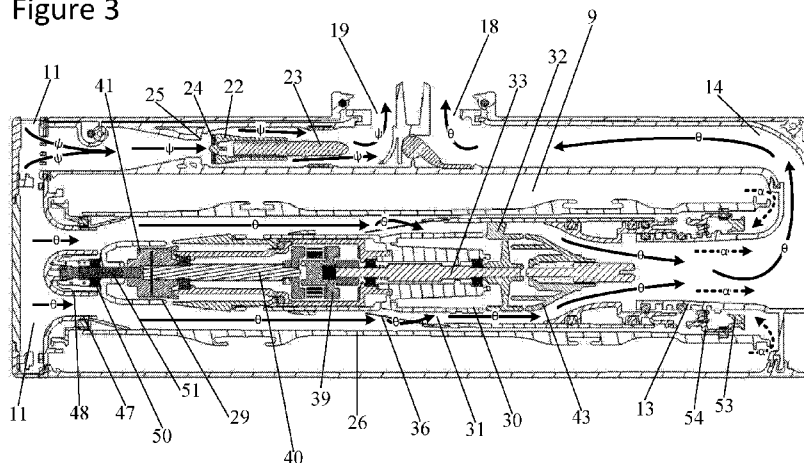
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Figure 3



(57) Abstract: 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 and an outlet through which the dirt-laden fluid and the ancillary fluid are discharged. The cleaner head further comprising a brushbar, a turbine assembly, and a bypass valve. The turbine assembly is housed inside the brushbar and the ancillary fluid flows through the brushbar and drives the turbine assembly. The bypass valve is used to regulate the flow rate of the ancillary fluid in response to changes in the flow rate of the dirt-laden fluid.

FLOOR TOOL 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 floor tools with surface agitators is getting a satisfactory balance and stability in the movement of the surface agitator during operation. When the turbine or motor is housed within a brushbar, it can be quite difficult to ensure that the balance of the internal parts is balanced so as to provide responsive user control as well as an improved cleaning performance.

In a first aspect, the present invention provides a cleaner head comprising: a casing; a brushbar housed within the casing; and a turbine assembly housed within the brushbar; wherein the casing comprises a first brushbar mount and a second brushbar mount, the brushbar is 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, and the turbine assembly is mounted at a first end to the internal frame and at a second end to the second brushbar mount.

The mounting arrangement of the turbine assembly from a first end of the brushbar to the second end of the brushbar allows for the components of the turbine assembly to be spaced along the longitudinal axis of the brushbar to allow for improved load balancing. In particular, the configuration means that the heavier components of the turbine assembly can be carefully positioned so that they are balanced by the other components. An additional advantage is that the internal space within the brushbar is utilised efficiently by the balanced configuration of the turbine assembly.

The torque generated by the turbine assembly may be transmitted to the brushbar via the internal frame. The internal frame of the brushbar can serve as both a mounting point for the turbine assembly, and also the means for delivering the torque provided by the turbine assembly to the brushbar.

A fluid for driving the turbine assembly may be drawn through the brushbar in a direction from the first end to the second end. The draw of fluid through the brushbar in this direction also means that the fluid flows from the first end to the second end of the turbine assembly.

The second end of the turbine assembly may be fixedly mounted to the second brushbar mount. In this embodiment, the second end of the turbine assembly is also mounted to the casing. The second end of the turbine assembly is therefore fixed, relative to the rotation of the brushbar.

The turbine assembly may comprise a transmission and an impeller, the transmission being located upstream of the impeller and mounted to the internal frame of the brushbar. The fluid flow path over the transmission means that the transmission can be used to accelerate the fluid prior to the fluid turning the brushbar.

The transmission may comprise a drive dog and a gearbox connected together by a transmission shaft, the drive dog being located upstream of the gearbox, and the drive dog being secured within the internal frame. The provision of a transmission shaft allows for the gearbox to be located away from the drive dog, so that the loading of the turbine assembly can be balanced.

The turbine assembly may comprise a shaft connecting the gearbox to the impeller, such that the gearbox is supported on a first side by the transmission shaft and on a second side by the shaft. The provision of a further shaft connecting the impeller to the gearbox allows for the gearbox to be located away from both the drive dog and the impeller. The loading of the turbine assembly can therefore be balanced. In addition, the shafts allow

for the gearbox to be supported centrally within the brushbar without the need for the gearbox to directly contact the brushbar.

The turbine assembly may comprise an overspeed device, the overspeed device being located downstream of the impeller and comprising a housing, the housing being mounted to the second brushbar mount. During use, the fluid drawn through the turbine may increase, causing an increase in torque delivered to the brushbar. This may damage to the components of the turbine assembly, or the brushbar itself. The rotation speed of the impeller is therefore restricted by an overspeed device. The overspeed device forms part of the turbine assembly, and the housing of the overspeed device forms the mounting point for the second end of the turbine assembly.

The cleaner head may comprise a primary fluid inlet and a secondary fluid inlet; a dirt-laden fluid being drawn into the cleaner head through the primary fluid inlet; an ancillary fluid being drawn into the cleaner head through the secondary fluid inlet; and the ancillary fluid being drawn through the brushbar and drives the turbine assembly. The provision of a secondary fluid inlet prevents dirt-laden fluid from being drawn through the brushbar.

In a second aspect, the present invention provides a cleaner head comprising: a casing; a brushbar housed within the casing; and a turbine assembly housed within the brushbar, wherein the turbine assembly comprises an impeller and a transmission, the impeller is driven by fluid drawn through the brushbar, the transmission transmits torque generated by the impeller to the brushbar, the transmission comprises a gear box and a drive dog, the drive dog is attached to the brushbar, and the gearbox is located in a central region of the brushbar.

The central location of the gearbox balances the weight loading of the turbine assembly within the brushbar. The entire length of the brushbar therefore has an improved contact with the surface to be cleaned. The brushbar also rotates with an even weight loading at high rotational speed.

The brushbar may have three equivalent regions spaced along the length of the brushbar, the drive dog being located in a first region, the gearbox being located in a second region, and the impeller being located in a third region. The spread of these components through the brushbar means that a cleaner head with improved balance can be achieved. In particular, the brushbar may have three equivalent regions arranged sequentially along the length of the brushbar, the impeller, the gearbox and the drive dog being each located in separate region. In either of these configurations, the first region may be upstream of the second region, and the second region being upstream of the third region.

The casing may comprise a first brushbar mount and a second brushbar mount, the brushbar being rotatably mounted at a first end to the first brushbar mount and at a second end to the second brushbar mount, and fluid for driving the turbine assembly is drawn through the brushbar in a direction from the first end to the second end. The draw of fluid through the brushbar in this direction also means that the fluid flows from the first end to the second end of the turbine assembly. As mentioned above, the fluid flows over the transmission so that the transmission can be used to accelerate the fluid prior to the fluid turning the brushbar.

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 comprising:
 - a casing;
 - a brushbar housed within the casing; and
 - a turbine assembly housed within the brushbar;wherein the casing comprises a first brushbar mount and a second brushbar mount, the brushbar is 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, and the turbine assembly is mounted at a first end to the internal frame and at a second end to the second brushbar mount.
2. A cleaner head according to claim 1, wherein torque generated by the turbine assembly is transmitted to the brushbar via the internal frame.
3. A cleaner head according to claim 1 or claim 2, wherein a fluid for driving the turbine assembly is drawn through the brushbar in a direction from the first end to the second end.
4. A cleaner head according to any one of the previous claims, wherein the second end of the turbine assembly is fixedly mounted to the second brushbar mount.
5. The cleaner head according to any one of the previous claims, wherein the turbine assembly comprises a transmission and an impeller, the transmission is located upstream of the impeller and is mounted to the internal frame of the brushbar.
6. The cleaner head according to claim 5, wherein the transmission comprises a drive dog and a gearbox connected together by a transmission shaft, the drive dog being located upstream of the gearbox, and the drive dog secured within the internal frame.

7. The cleaner head according to claim 6, wherein the turbine assembly comprises a shaft connecting the gearbox to the impeller, such that the gearbox is supported on a first side by the transmission shaft and on a second side by the shaft.
8. The cleaner head according to any one of the previous claims, wherein the turbine assembly comprises an overspeed device, the overspeed device being located downstream of the impeller and comprising a housing, the housing being mounted to the second brushbar mount.
9. The cleaner head according to any one of the previous claims, wherein the cleaner head comprises a primary fluid inlet and a secondary fluid inlet; a dirt-laden fluid is drawn into the cleaner head through the primary fluid inlet; an ancillary fluid is drawn into the cleaner head through the secondary fluid inlet; and the ancillary fluid is drawn through the brushbar and drives the turbine assembly.
10. A cleaner head comprising:
a casing;
a brushbar housed within the casing; and
a turbine assembly housed within the brushbar,
wherein the turbine assembly comprises an impeller and a transmission, the impeller is driven by fluid drawn through the brushbar, the transmission transmits torque generated by the impeller to the brushbar, the transmission comprises a gear box and a drive dog, the drive dog is attached to the brushbar, and the gearbox is located in a central region of the brushbar.
11. The cleaner head according to claim 10, wherein the brushbar has three equivalent regions spaced along the length of the brushbar, the drive dog is located in a first region, the gearbox is located in a second region, and the impeller is located in a third region.

12. The cleaner head according to claim 10, wherein the brushbar has three equivalent regions arranged sequentially along the length of the brushbar, the impeller, the gearbox and the drive dog are each located in separate region.

13. The cleaner head according to claim 11 or 12, wherein the first region is upstream of the second region, and the second region is upstream of the third region.

14. The cleaner head according to claim 13, wherein the casing comprises a first brushbar mount and a second brushbar mount, the brushbar is rotatably mounted at a first end to the first brushbar mount and at a second end to the second brushbar mount, and fluid for driving the turbine assembly is drawn through the brushbar in a direction from the first end to the second end.

15. The cleaner head according to any one of claims 10 to 14, wherein the turbine assembly comprises a shaft connecting the gearbox to the impeller, and a transmission shaft connecting the drive dog to the gearbox such that the gearbox is supported on a first side by the transmission shaft and on a second side by the shaft.

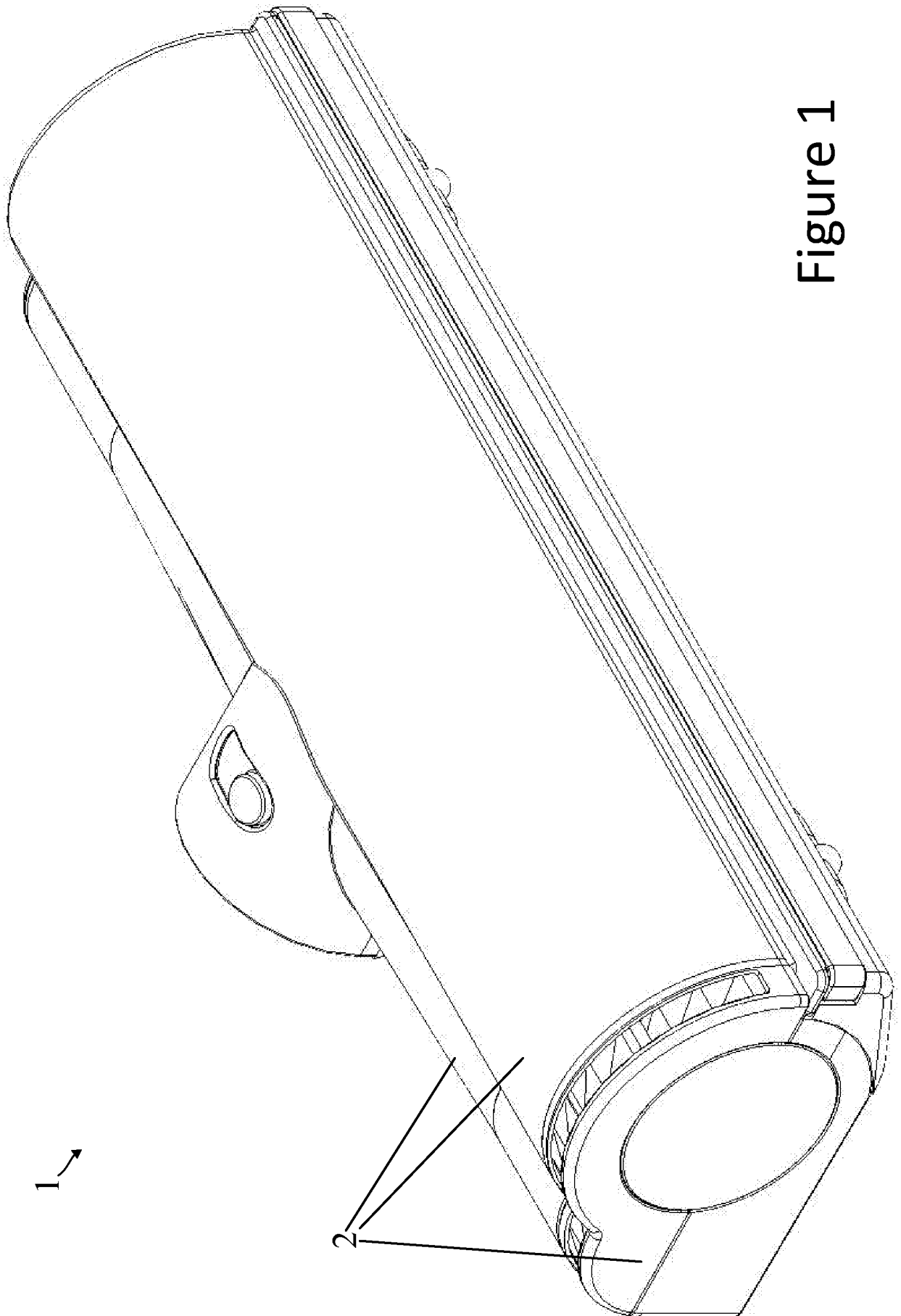
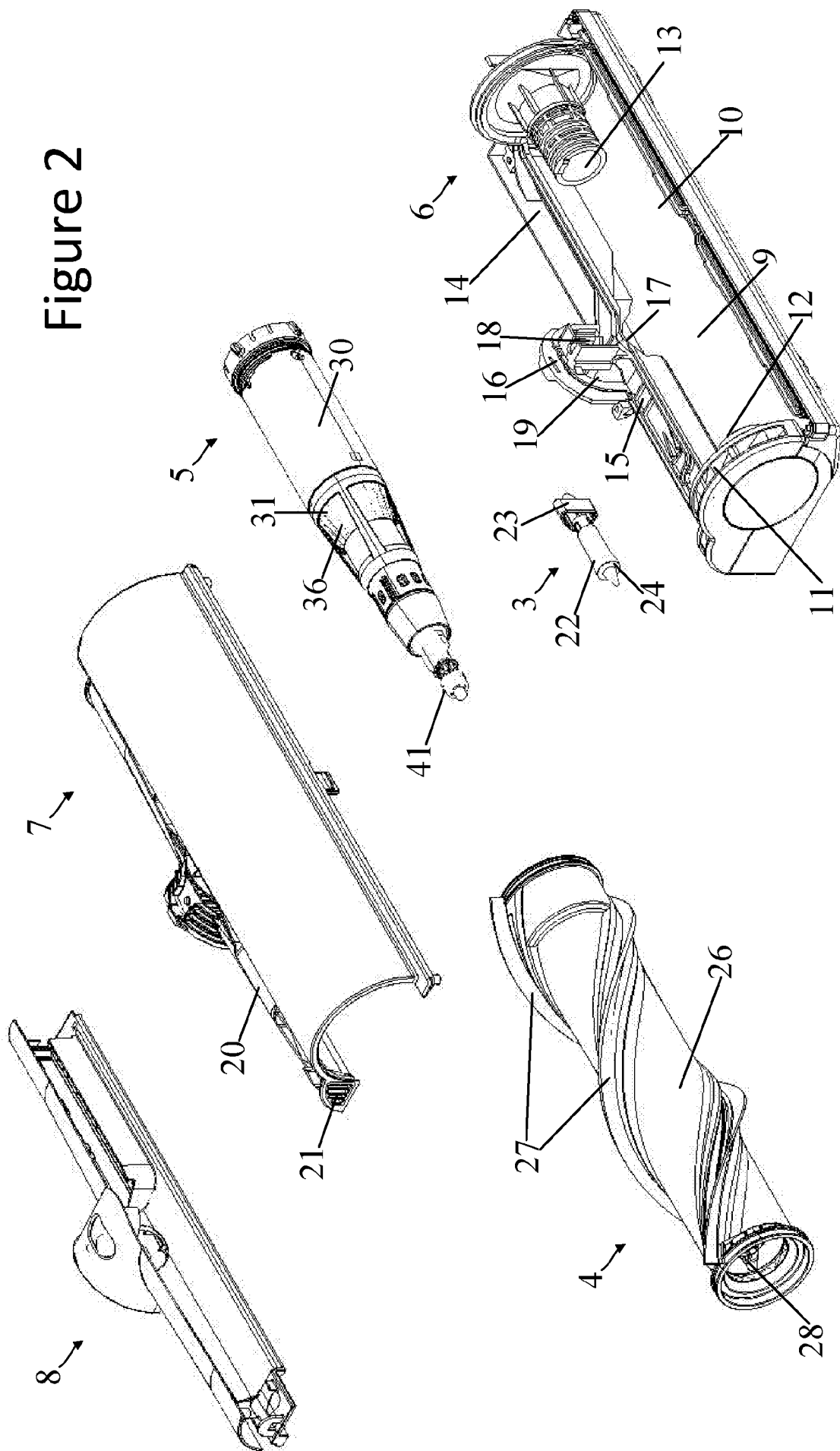


Figure 1

Figure 2



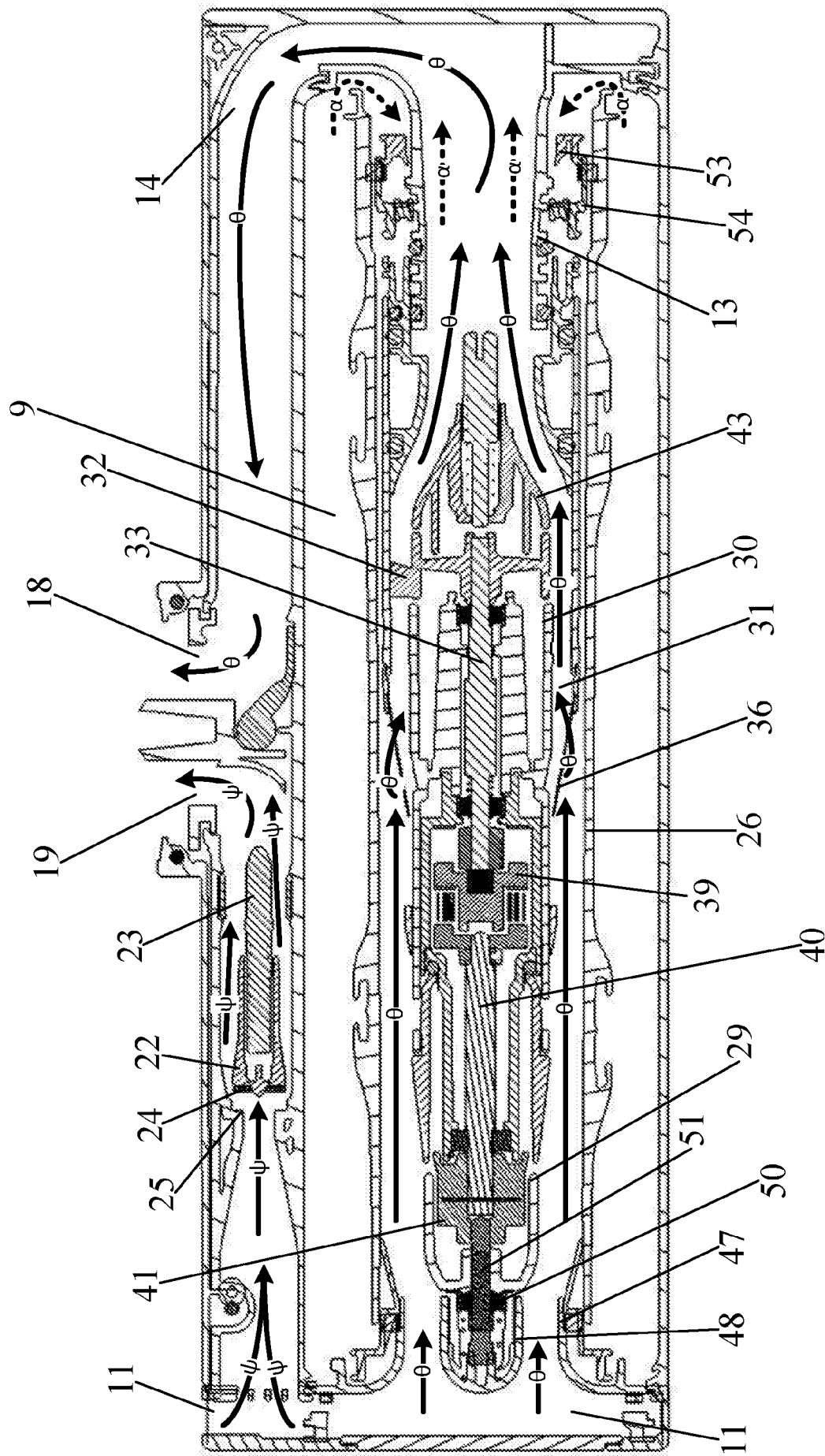


Figure 3

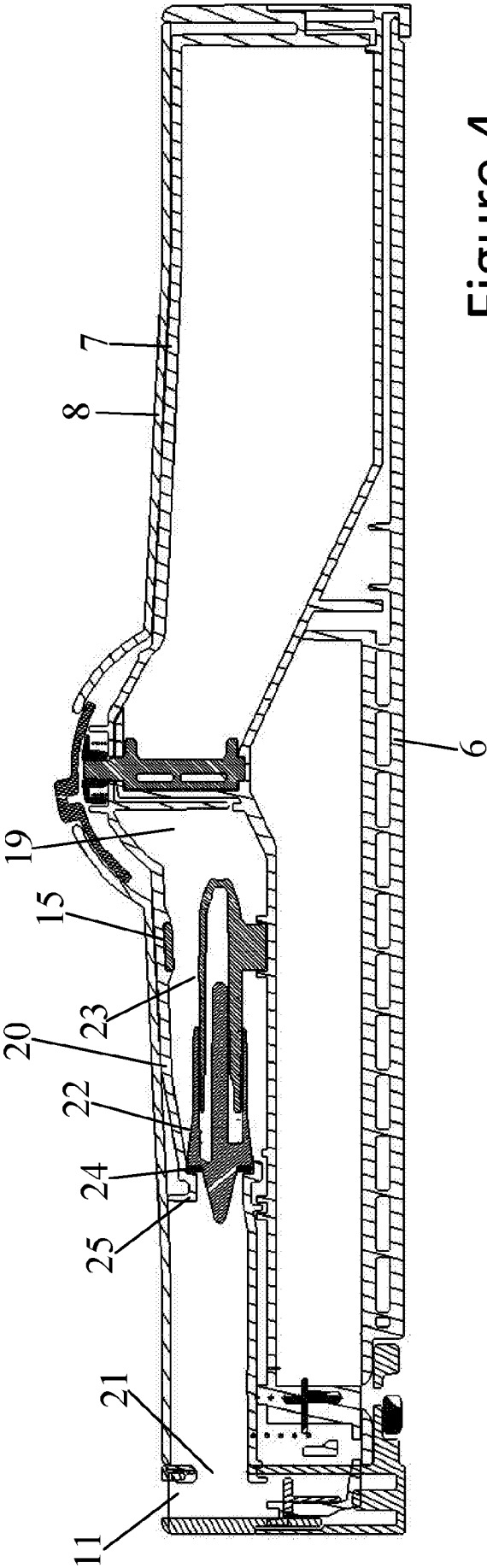


Figure 4

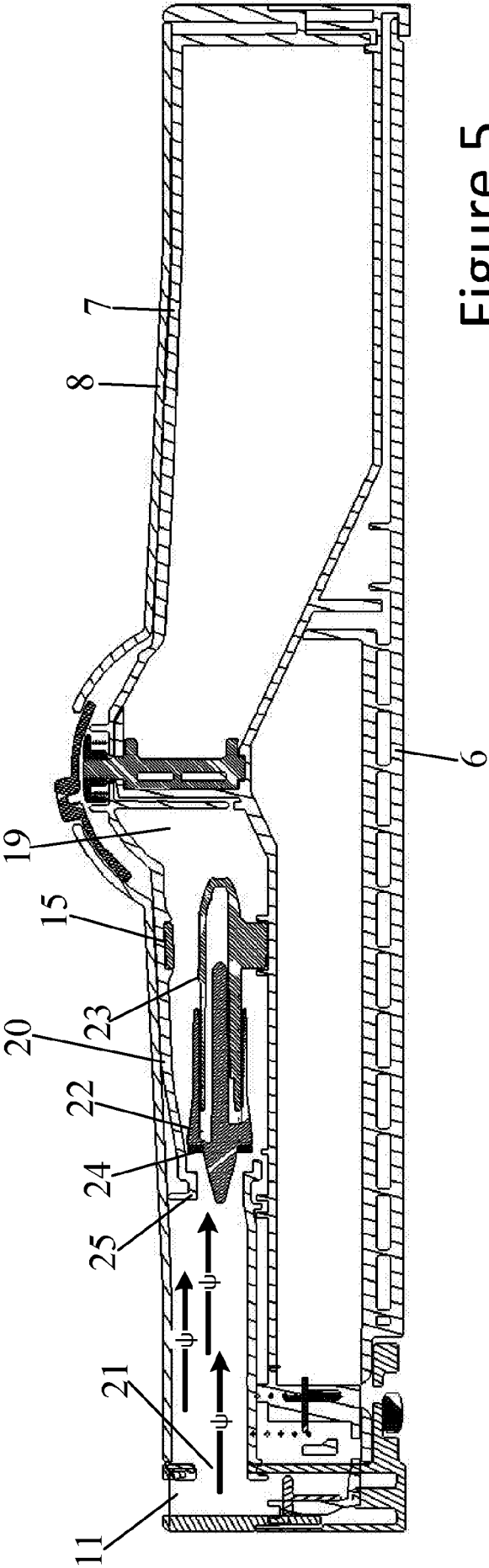


Figure 5

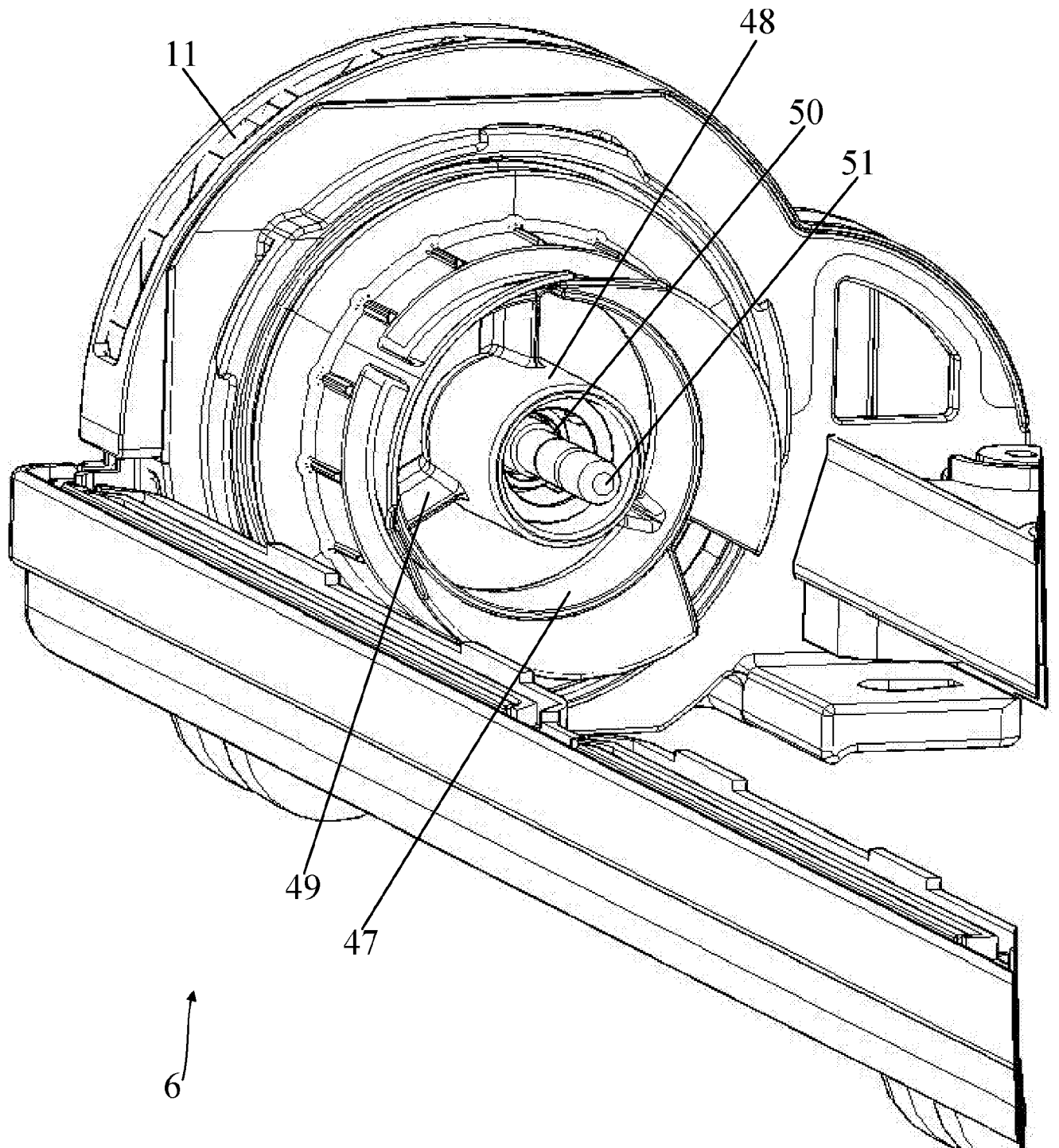
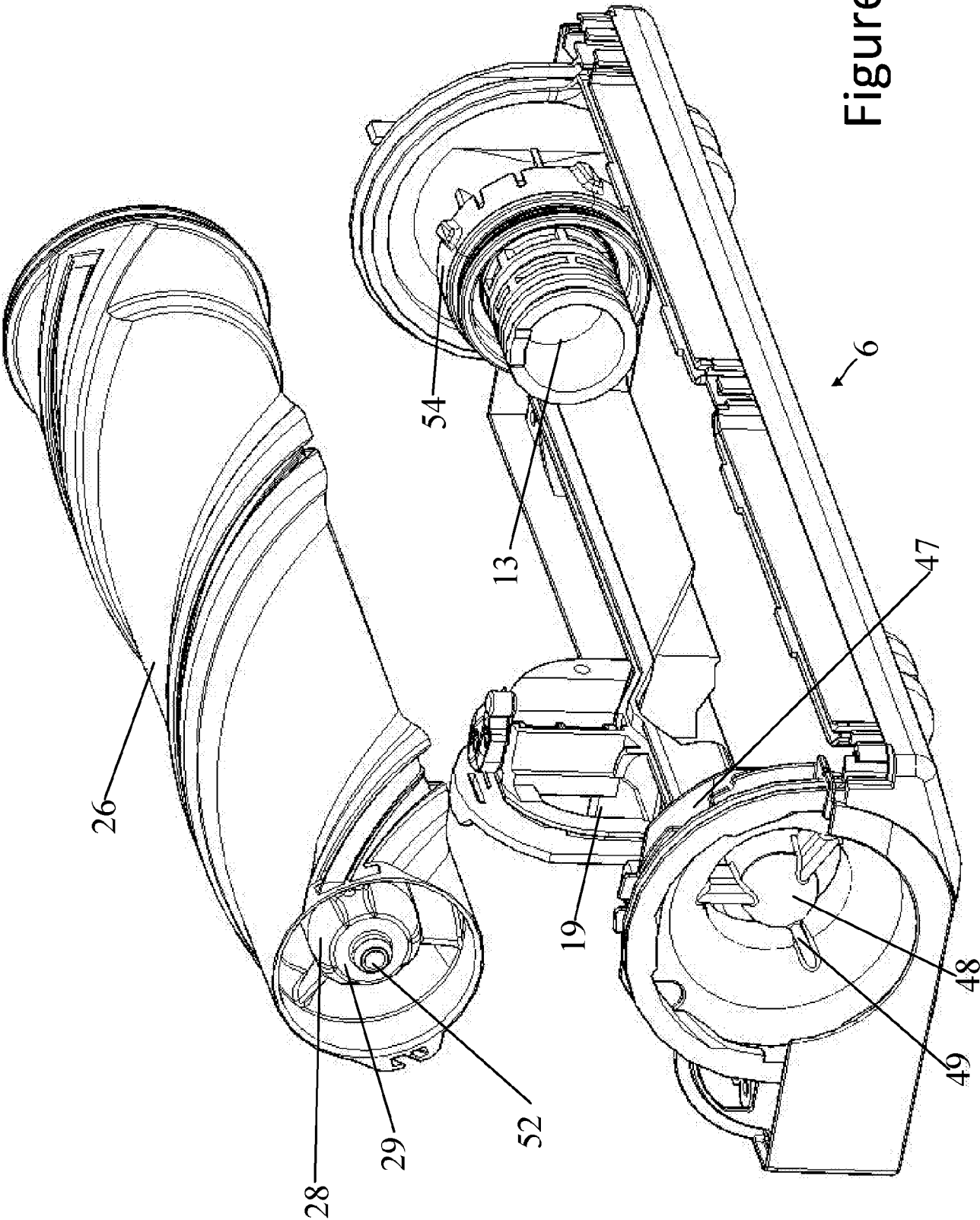


Figure 6



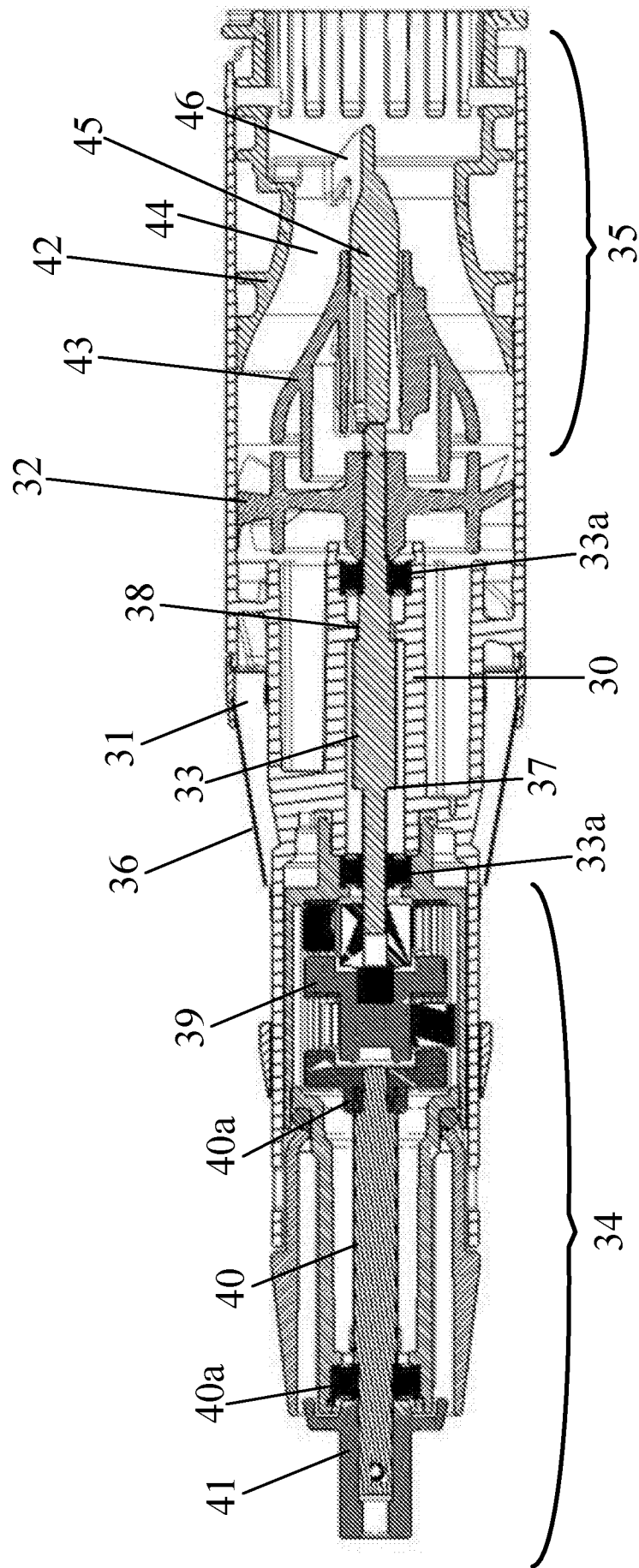


Figure 8

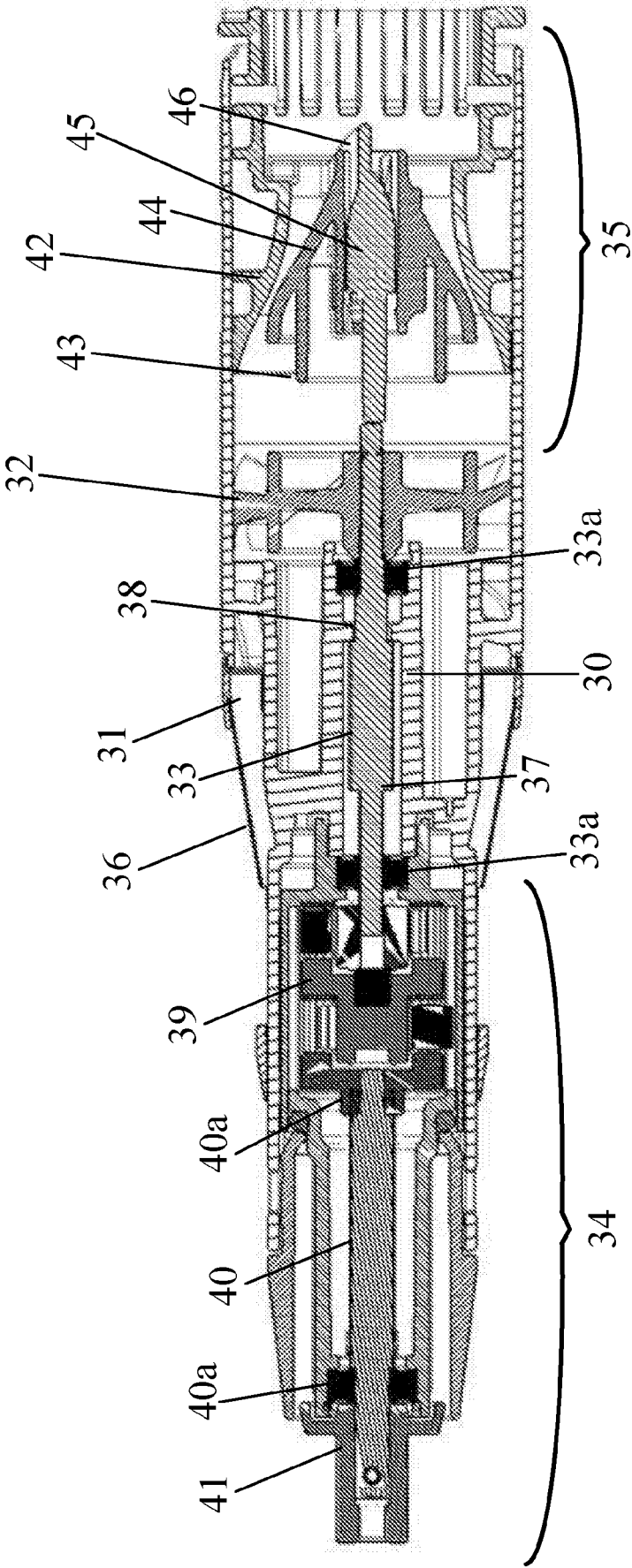


Figure 9

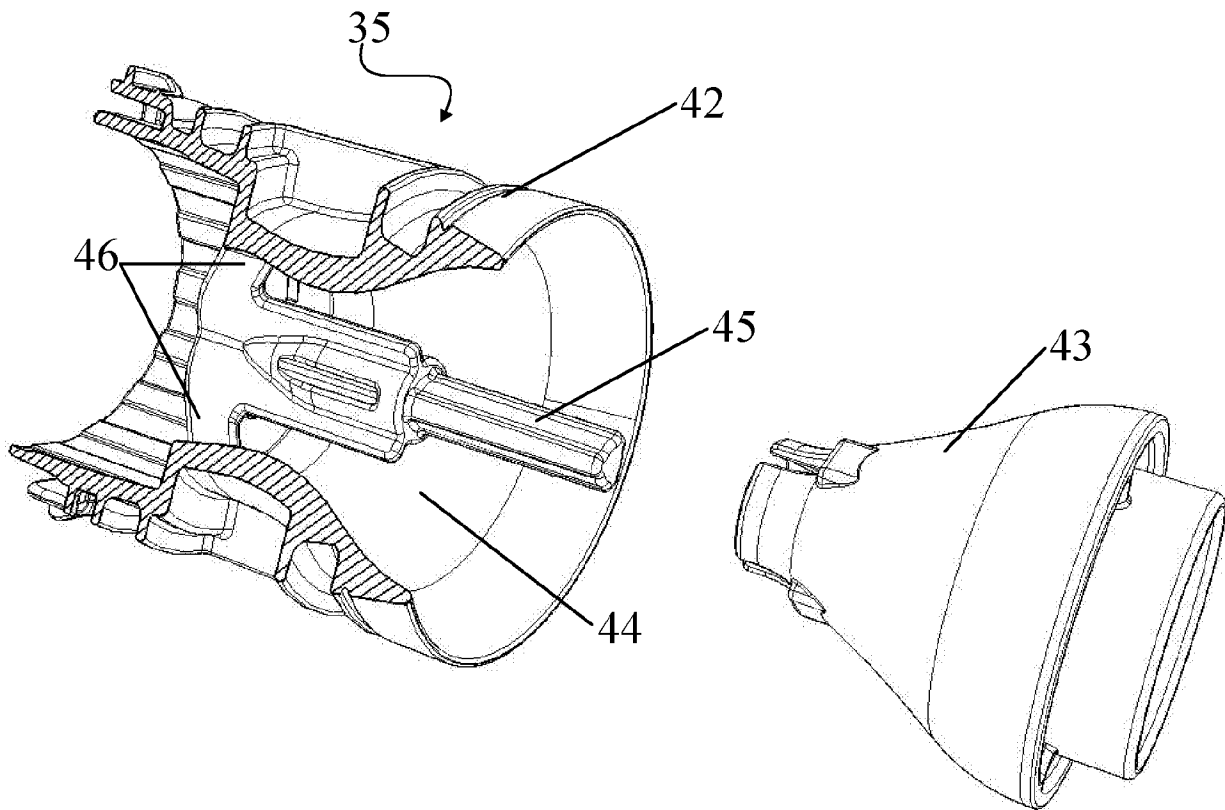


Figure 10

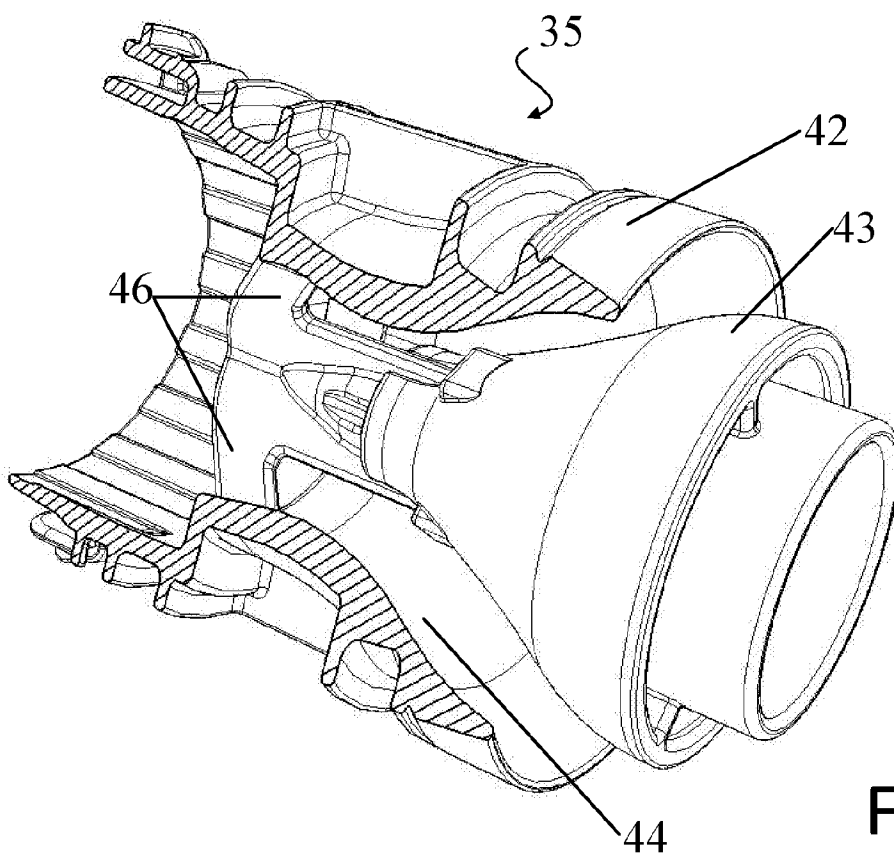


Figure 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/052950

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L9/04
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	US 2015/265116 A1 (GENN STUART LLOYD [GB] ET AL) 24 September 2015 (2015-09-24) paragraph [0051] -----	1-9
A	KR 1999 0003478 A (GWANG) 15 January 1999 (1999-01-15) figures 5-7 -----	1-9
A	JP 2002 143051 A (HITACHI LTD) 21 May 2002 (2002-05-21) abstract -----	1-9
A	US 2005/138765 A1 (LEE BYUNG-JO [KR]) 30 June 2005 (2005-06-30) figures -----	1-9



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

29 November 2016

Date of mailing of the international search report

06/02/2017

Name and mailing address of the ISA/

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Authorized officer

Eckenschwiller, A

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2016/052950

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015265116 A1	24-09-2015	AU 2015233178 A1	27-10-2016
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		WO 2015140510 A1	24-09-2015

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		GB 2409710 A	06-07-2005
		US 2005138765 A1	30-06-2005

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2016/052950

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-9

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-9

Providing bearings means for a turbine assembly in a cleaner head

2. claims: 10-15

Providing transmission means for a turbine assembly in a cleaner head
