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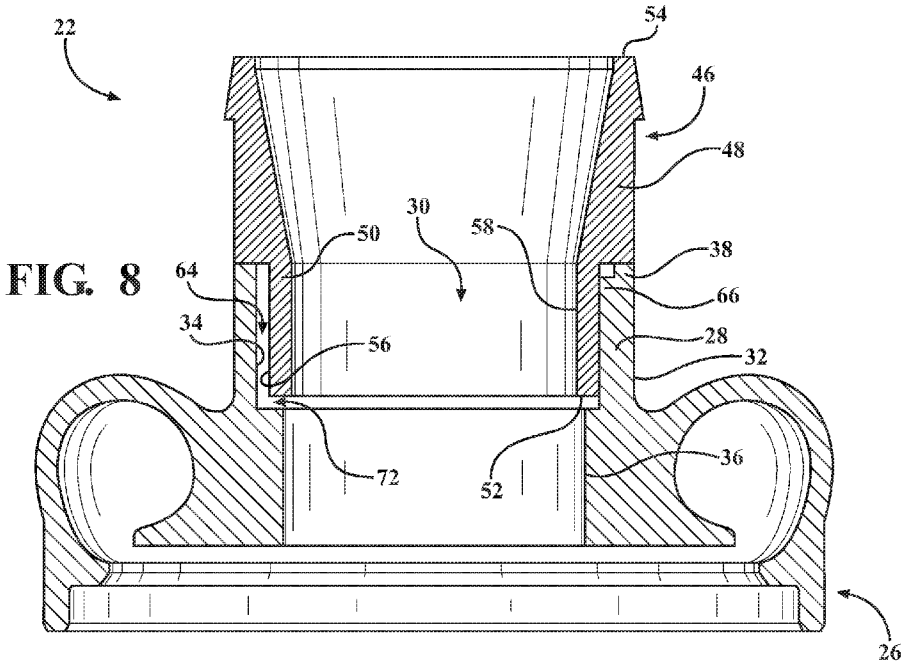
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(54) Title: COMPRESSOR HOUSING ASSEMBLY AND TURBOCHARGER INCLUDING THE SAME

FIG. 8



(57) Abstract: A compressor housing assembly houses a compressor wheel of a turbocharger. The compressor housing includes a first housing component and a second housing component. The first housing component includes a first housing component wall disposed about and extending along an axis and defining a compressor housing inlet. The second housing component includes a body portion and a second housing component wall. The body portion is disposed about the axis and is coupled to the first housing component wall. The first and second housing component walls collectively define a resonator cavity for reducing noise within the compressor housing inlet. A resonator orifice fluidly couples the resonator cavity to the compressor housing inlet. The resonator orifice is configured to allow air from the compressor housing inlet to flow to the resonator cavity and air from the resonator cavity to flow to the compressor housing inlet.

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COMPRESSOR HOUSING ASSEMBLY AND TURBOCHARGER INCLUDING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention generally relates to a compressor housing assembly for a turbocharger, and to a turbocharger including the compressor housing assembly.

2. Description of the Related Art

[0002] Turbochargers receive exhaust gas from an internal combustion engine and deliver compressed air to the internal combustion engine. Turbochargers are used to increase power output of the internal combustion engine, lower fuel consumption of the internal combustion engine, and reduce emissions produced by the internal combustion engine. Delivery of compressed air to the internal combustion engine by the turbocharger allows the internal combustion engine to be smaller, yet able to develop the same or similar amount of horsepower as larger, naturally aspirated internal combustion engines. Having a smaller internal combustion engine for use in a vehicle reduces the mass and aerodynamic frontal area of the vehicle, which helps reduce fuel consumption of the internal combustion engine and improve fuel economy of the vehicle.

[0003] Turbochargers include a compressor housing. Conventional compressor housings are a one-piece component that is disposed about and extends along an axis. The compressor housing defines a compressor housing inlet for delivering intake air to a compressor wheel. The compressor wheel is disposed in the compressor housing downstream of the compressor housing inlet for compressing the intake air received from the compressor housing

inlet. The compressed air is then delivered to the internal combustion engine via a volute that is also defined by the compressor housing.

[0004] During turbocharger operation, intake air travels within the compressor housing from the compressor housing inlet to the compressor wheel, producing undesirable noise, vibration, and harshness (NVH) characteristics of the compressor housing. These undesirable NVH characteristics of the compressor housing are commonly referred to as whoosh. In addition, because the compressor housing is a one-piece component, access to an interior of the compressor housing for machining features that would improve the NVH characteristics of the compressor housing is limited by a size/width (i.e., the dimensions) of the compressor housing inlet.

[0005] As such, there remains a need to provide an improved compressor housing.

SUMMARY OF THE INVENTION AND ADVANTAGES

[0006] A compressor housing assembly houses a compressor wheel of a turbocharger. The compressor housing assembly includes a first housing component and a second housing component. The first housing component includes a first housing component wall disposed about and extending along an axis and defining a compressor housing inlet. The second housing component includes a body portion and a second housing component wall. The body portion is disposed about the axis and is coupled to the first housing component wall. The second housing component wall extends from the body portion about the axis at least partially within the first housing component wall. The second housing component wall further defines the compressor housing inlet and extends along the axis from a first wall end adapted to be proximal to the compressor wheel to a second wall end adapted to be distal to the compressor wheel. The first and second housing component walls collectively define a resonator cavity for reducing noise within

the compressor housing inlet. A resonator orifice is defined by one of: both of the first and second housing components, only the first housing component, and only the second housing component. The resonator orifice fluidly couples the resonator cavity to the compressor housing inlet. The resonator orifice is configured to allow air from the compressor housing inlet to flow to the resonator cavity and air from the resonator cavity to flow to the compressor housing inlet.

[0007] Accordingly, the resonator cavity that is collectively defined by the first and reduces whoosh, thereby improving noise, vibration, and harshness (NVH) characteristics of the of the compressor housing assembly during operation of the turbocharger, particularly when the turbocharger is used in automotive applications. Moreover, various features for reducing the NVH characteristics of the compress housing assembly can be readily and efficiently machined into each of the first and second housing components because the first and second components are manufactured independently of each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Other advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0009] FIG. 1 is a schematic representation of a turbocharger;

[0010] FIG. 2 is an isometric view of a first housing component according to one embodiment;

[0011] FIG. 3 is a top view of the first housing component of FIG. 2;

[0012] FIG 4 is an isometric view of a second housing component according to one embodiment;

[0013] FIG. 5 is an exploded view of a compressor housing assembly according to one embodiment, with the compressor housing assembly including the first housing component of FIG. 2 and the second housing component of FIG. 4;

[0014] FIG. 6A is a cross-sectional view of the compressor housing assembly of FIG. 5 showing the first and second housing components collectively defining a resonator cavity and a resonator orifice;

[0015] FIG. 6B is a close-up view of a portion of FIG. 6A showing both the first and second housing components defining the resonator orifice;

[0016] FIG. 6C is a close-up cross-sectional view of another embodiment of the compressor housing assembly, with only the first housing component defining a resonator orifice;

[0017] FIG. 6D is a close-up cross-sectional view of another embodiment of the compressor housing assembly, with only the second housing component defining a resonator orifice;

[0018] FIG. 7 is a partial section view of another embodiment of the first housing component, with the first housing component having a first housing component wall including a plurality of protrusions;

[0019] FIG. 8 is a cross-sectional view of another embodiment of the compressor housing assembly, with the compressor housing assembly including the first housing component of FIG. 7 and the second housing component of FIG. 4, and with the first and second housing components collectively defining the resonator cavity;

[0020] FIG. 9 is an isometric view of another embodiment of the second housing component, with the second housing component having a second housing component wall defining a plurality of grooves;

[0021] FIG. 10 is a cross-sectional view of another embodiment of the compressor housing assembly, with the compressor housing assembly including the first housing component of FIG. 2 and the second housing component of FIG. 9, and with the first and second housing components collectively defining the resonator cavity;

[0022] FIG. 11. is a cross-sectional view of another embodiment of the first housing component, with the first housing component having a first housing component wall and including a shroud wall, with the shroud wall and the first housing component wall collectively defining a recess, and with the recess having an annular configuration;

[0023] FIG. 12 is a cross-sectional view of another embodiment of the compressor housing assembly, with the compressor housing assembly including the first housing component of FIG. 11 and another embodiment of the second housing component, and with the first and second housing components collectively defining the resonator cavity;

[0024] FIG. 13 is a top view of another embodiment of the first housing component, with the shroud wall and the first housing component wall collectively defining the recess, and with the recess having an arcuate configuration; and

[0025] FIG. 14 is a cross-sectional view of another embodiment of the compressor housing assembly, with the compressor housing assembly including the first housing component of FIG. 13 and the second housing component of FIG. 12, and with the first and second housing components collectively defining the resonator cavity.

DETAILED DESCRIPTION OF THE INVENTION

[0026] With reference to the Figures, wherein like numerals indicate like parts throughout the several views, a schematic representation of a turbocharger 20 for receiving exhaust

gas from an internal combustion engine (not shown) and delivering compressed air to the internal combustion engine is shown in FIG. 1. Although not required, the turbocharger 20 is typically used in passenger and commercial automotive applications. However, it is to be appreciated that the turbocharger 20 may be used in non-automotive applications such as heavy equipment applications, non-automotive diesel engine applications, non-automotive motor applications, and the like. The turbocharger 20 includes a compressor housing assembly 22 and a compressor wheel 24. The compressor wheel 24 is disposed in the compressor housing assembly 22.

[0027] With continued reference to FIG. 1, the turbocharger 20 typically includes a turbine wheel 74, a shaft 76, and a bearing housing 78. During operation of the turbocharger 20, the turbine wheel 74 receives exhaust gas from the internal combustion which causes the turbine wheel 74 to rotate. The shaft 76 is coupled to and rotatable by the turbine wheel 74. The compressor wheel 24 is coupled to the shaft 76 and is rotatable by the shaft 76 for delivering compressed air to the internal combustion engine. The bearing housing 78 extends about the shaft 76 between the turbine wheel 74 and the compressor wheel 24. The turbocharger 20 also typically includes bearings 80 disposed about the shaft 76 and within the bearing housing 78 for rotatably supporting the shaft 76. The turbocharger 20 further typically includes a turbine housing 82, with the turbine wheel 74 disposed within the turbine housing 82.

[0028] With reference to FIGS. 2-4, the compressor housing assembly 22 includes a first housing component 26. The first housing component 26 has a first housing component wall 28. The first housing component wall 28 is disposed about an axis A. As shown in FIG. 2, the first housing component wall 28 extends along the axis A and defines a compressor housing inlet 30. Although not required, typically the first housing component wall 28 has a cylindrical configuration, as shown in FIGS. 2 and 3. However, it is to be appreciated that the first housing

component wall 28 may have any configuration suitable for facilitating air flow from the compressor housing inlet 30 to the compressor wheel 24. The first housing component 26 may be comprised of any suitable metal or plastic. Although not required, typically the first housing component 26 is comprised of a metal.

[0029] With reference again to FIG. 2, the first housing component wall 28 has an outer surface 32 and an inner surface 34. The outer surface 32 faces away from the axis A. The inner surface 34 faces the axis A and is radially spaced from the outer surface 32 such that the inner surface 34 is disposed between the axis A and the outer surface 32.

[0030] In some embodiments, the inner surface 34 of the first housing component wall 38 may have a first portion 36 and a second portion 38 axially spaced from the first portion 36 with respect to the axis A, as shown in FIG. 2. When present, the first and second portions 36, 38 face the axis A. The first portion 36 is proximal to the compressor wheel 24 and the second portion 38 is distal to the compressor wheel 24.

[0031] As shown in FIGS. 2 and 5, the second portion 38 may be radially recessed from the first portion 36 with respect to the axis A. However, it is to be appreciated that the first portion 36 may be radially recessed from the second portion 38 with respect to the axis A. As shown in FIG. 3, in some embodiments, the second portion 38 is completely radially recessed from the first portion 36 with respect to the axis A. However, it is to be appreciated that only a region of one of the first and second portions 36, 38 may be radially recessed from the other of the first and second portions 36, 38 with respect to the axis A. In other words, the first and second portions 36, 38 may be spaced an equal distance radially from the axis A but for a region of one of the first and second portions 36, 38. The significance of one of the first and second portions 36, 38 being

radially recessed from the other of the first and second portions 36, 38 with respect to the axis A will be described in detail below.

[0032] With reference to FIG. 11, in some embodiments, the first housing component 26 may further include a shroud wall 40 disposed about the axis A. When present, the shroud wall 40 is disposed radially inward from the first housing component wall 28 with respect to the axis A. Typically, the shroud wall 40 extends along the axis A from a first end 42 adapted to be adjacent to the compressor wheel 24 to a second end 44 spaced from the first end 42. The first end 42 of the shroud wall 44 may be coupled to the first housing component wall 28. In some embodiments, as shown in FIG. 11, the first end 42 of the shroud wall 40 is integral with the first housing component wall 28. However, it is to be appreciated that the first end 42 of the shroud wall 40 may not be integral with the first housing component wall 28 and instead, the shroud wall 40 may be coupled to the first housing component wall 28 in any suitable manner.

[0033] With reference to FIG. 4, the compressor housing assembly 22 further includes a second housing component 46. The second housing component 46 includes a body portion 48 and a second housing component wall 50. The body portion 48 of the second housing component 46 is disposed about the axis A and is coupled to the first housing component wall 28. In some embodiments, as shown in FIGS. 6 and 12, the body portion 48 is disposed outside of and abuts the first housing component wall 28. Although not shown, in other embodiments, the body portion 48 of the second housing component 46 may be disposed in and coupled to the inner surface 34 of the first housing component wall 28. The body portion 48 of the second housing component 46 may be coupled to the first housing component wall 28 via press-fitting, interference fitting, welding, fasteners, adhesive bonding, complementary screw threads, and the like. The

second housing component 46 may be comprised of any suitable metal or plastic. Although not required, typically the second housing component 46 is comprised of a metal.

[0034] With reference to FIG. 6A, the second housing component wall 50 extends from the body portion 48 and about the axis A at least partially within the first housing component wall 28. With reference to FIG. 4, the second housing component wall 50 extends along the axis A from a first wall end 52 proximal to the compressor wheel 24 to a second wall end 54 distal to the compressor wheel 24. The second housing component wall 50 further defines the compressor housing inlet 30. In other words, the first and second housing component walls 28, 50 collectively define the compressor housing inlet 30. Although not required, typically the second housing component wall 50 has a cylindrical configuration, as shown in FIGS. 4 and 5. However, it is to be appreciated that the second housing component wall 50 may have any configuration suitable for facilitating air flow from the compressor housing inlet 30 to the compressor wheel 24.

[0035] In some embodiments, the body portion 48 of the second housing component 46 extends along the axis A between the first and second wall ends 52, 54 of the second housing component wall 50, as shown in FIGS. 12 and 14. In other embodiments, as shown in FIG. 4, the body portion 48 of the second housing component 46 extends along the axis A from a point between the first and second wall ends 52, 54 to the second wall end 54. In still other embodiments, the body portion may extend along the axis A from a point between the first and second wall ends 52, 54 to the first wall end 52.

[0036] With reference again to FIG. 4, the second housing component wall 50 has an outer surface 56 and an inner surface 58. The outer surface 56 faces away from the axis A. The inner surface 58 faces the axis A and is radially spaced from the outer surface 56 such that the inner surface 58 is disposed between the axis A and the outer surface 56. With reference to FIG.

6A, when the inner surface 34 of the first housing component wall 28 includes first and second portions 36, 38, the outer surface 56 of the second housing component wall 50 at least partially faces the second portion 38 of the first housing component wall 28.

[0037] With continued reference to FIG. 6A, and any embodiment where the second housing component wall 50 is cylindrical, the inner surface 58 of the second housing component wall 50 has a first diameter 60 at the first wall end 52 and a second diameter 62 at the second wall end 54. The first and second diameters 60, 62 may be the same or different. In the illustrated embodiment, the first diameter 60 is smaller than the second diameter 62. When the first diameter 60 is smaller than the second diameter 62, the inner surface 58 of the second housing component wall 50 facilitates efficient delivery of air to the compressor wheel 24.

[0038] As shown in FIG. 6A, the first and second housing component walls 28, 50 collectively define a resonator cavity 64 for reducing noise within the compressor housing inlet 30 during operation of the turbocharger 20. Although various geometrical configurations for the resonator cavity 64 will be described in detail below, the resonator cavity 64 may have any configuration suitable for reducing noise within the compressor housing inlet 30 during operation of the turbocharger 20, so long as the resonator cavity 64 is collectively defined by the first and second housing component walls 28, 50.

[0039] With continued reference to FIG. 6A, when the first housing component wall 28 includes the second portion 38 of the inner surface 34 radially recessed from the first portion 36 of the inner surface 34 with respect to the axis A, the second portion 38 of the inner surface 34 of the first housing component wall 28 and the outer surface 56 of the second housing component wall 50 may collectively define the resonator cavity 64 therebetween. In other words, the outer surface 56 of the second housing component wall 50 may be spaced radially inward from

the second portion 38 of the inner surface 34 of the first housing component wall 28, thereby defining the resonator cavity 64 therebetween. In such embodiments, the resonator cavity 64 may have an annular configuration. However, it is to be appreciated that a portion of the outer surface 56 of the second housing component wall 50 may abut the second portion 38 of the first housing component wall 28 such that the resonator cavity has an arcuate configuration. It is to be further appreciated that the resonator cavity 64 may have any configuration suitable for reducing noise within the compressor housing inlet 30 during operation of the turbocharger 20.

[0040] In some embodiments, when the first housing component wall 28 includes the second portion 38 of the inner surface 34 radially recessed from the first portion 36 of the inner surface 34 with respect to the axis A, one of the second portion 38 of the inner surface 34 of the first housing component wall 28 and the outer surface 56 of the second housing component wall 50 may include a protrusion 66 that in part defines the resonator cavity 64 for reducing noise within the compressor housing inlet 30 during operation of the turbocharger 20. When present, the protrusion 66 abuts the other of the second portion 38 of the inner surface 34 of the first housing component wall 28 and the outer surface 56 of the second housing component wall 50. As shown in FIGS. 7 and 8, in the illustrated embodiment, the second portion 38 of the inner surface 34 of the first housing component wall 28 includes the protrusion 66. The protrusion 66 may have any suitable configuration. When the protrusion 66 is present, the protrusion 66, the second portion 38 of the inner surface 34 of the first housing component wall 28, and the outer surface 56 of the second housing component wall 50 collectively define the resonator cavity 64. In some embodiments, as shown in FIG. 7, the one of the one of the second portion 38 of the inner surface 34 of the first housing component wall 28 and the outer surface 56 of the second housing component wall 50 may include a plurality of protrusions 66.

[0041] In other embodiments, when the first housing component wall 28 includes the second portion 38 of the inner surface 34 radially recessed from the first portion 36 of the inner surface 34 with respect to the axis A, one of the second portion 38 of the inner surface 34 of the first housing component wall 28 and the outer surface 56 of the second housing component wall 50 may define a groove 68 that in part defines the resonator cavity 64 for reducing noise within the compressor housing inlet 30 during operation of the turbocharger 20. When the groove 68 is present, the groove 68 and the other of the second portion 38 of the inner surface 34 of the first housing component wall 28 and the outer surface 56 of the second housing component wall 50 collectively define the resonator cavity 64, as shown in FIG. 10. With reference to FIGS. 9 and 10, in the illustrated embodiment, the outer surface 56 of the second housing component wall 50 defines the groove 68, and the groove 68 and the second portion 38 of interior surface 34 of the first housing component wall 28 collectively define the resonator cavity 64. The groove 68 may have any suitable configuration. As shown in FIG. 9, in some embodiments, the one of the one of the second portion 38 of the inner surface 34 of the first housing component wall 28 and the outer surface 56 of the second housing component wall 50 may define a plurality of grooves 68.

[0042] When the first housing component 26 includes the shroud wall 40, the shroud wall 40, the first housing component wall 28, and the second housing component wall 50 may collectively define the resonator cavity 64. For example, with reference to FIGS. 11 and 13, the shroud wall 40 and the first housing component wall 28 may collectively define a recess 70 therebetween that in part defines the resonator cavity 64 for reducing noise within the compressor housing inlet 30 during operation of the turbocharger 20. The recess 70 may have an annular configuration, as best shown in FIG. 11. Alternatively, the recess 70 may have an arcuate configuration, as best shown in FIG. 13. When the recess 70 is present and the first and second

housing components 26, 46 are coupled together, the shroud wall 40, the first housing component wall 28, and the second housing component wall 50 collectively define the resonator cavity 64, as best shown in FIGS. 12 and 14. It is to be appreciated that the recess 70 may have any configuration suitable for reducing noise within the compressor housing inlet 30 during operation of the turbocharger 20 when first and second housing components 26, 46 are coupled together.

[0043] With reference to FIGS. 6A-6D, a resonator orifice 72 is defined by one of: both of the first and second housing components 26, 46, as shown in FIGS. 6A and 6B, only the first housing component 26, as shown in FIG. 6C, and only the second housing component 46, as shown in FIG. 6D. The resonator orifice 72 fluidly couples the resonator cavity 64 to the compressor housing inlet 30. The resonator orifice 72 is configured to allow air from the compressor housing inlet 30 to flow to the resonator cavity 64 and air from the resonator cavity 64 to flow to the compressor housing inlet 30. In other words, air flows into the resonator cavity 64 and out of the resonator cavity 64 through the resonator orifice 72. Although various geometrical configurations for the resonator orifice 72 will be described in detail below, the resonator orifice 72 may have any configuration suitable for allowing air from the compressor housing inlet 30 to flow to the resonator cavity 64 and air from the resonator cavity 64 to flow to the compressor housing inlet 30.

[0044] With reference to FIGS. 6A, 6B, 8, and 10, in some embodiments, when the first housing component wall 28 includes the second portion 38 of the inner surface 34 radially recessed from the first portion 36 of the inner surface 34 with respect to the axis A, the second housing component wall 50 and the first portion 36 of the inner surface 34 of the first housing component wall 28 collectively define the resonator orifice 72. In such embodiments, the first wall end 52 of the second housing component wall 50 is axially spaced from the first portion 36

of the first housing component wall 28, as shown in FIGS. 6A and 6B, thereby defining the resonator orifice 72. In the illustrated embodiment, the resonator orifice 72 has an annular configuration. However, it is to be appreciated that the resonator orifice 72 may have an arcuate configuration. For example, only a portion of the first wall end 52 of the second housing component wall 50 may be axially spaced from the first portion 36 of the first housing component wall 28, with the other portion of the first wall end 52 of the second housing component wall 50 abutting the first portion 36 of the first housing component wall 28.

[0045] With reference to FIG. 6C, in other embodiments, when the first housing component wall 28 includes the second portion 38 of the inner surface 34 radially recessed from the first portion 36 of the inner surface 34 with respect to the axis A, only the first portion 36 of the first housing component wall 28 defines the resonator cavity 72. In such embodiments, the first wall end 52 of the second housing component wall 50 abuts the first portion 36 of the first housing component wall 28, as shown in FIG. 6C. The resonator orifice 72 may have an annular configuration or an arcuate configuration.

[0046] With reference to FIG. 6D, in still other embodiments, when the first housing component wall 28 includes the second portion 38 of the inner surface 34 radially recessed from the first portion 36 of the inner surface 34 with respect to the axis A, only the second housing component wall 50 defines the resonator cavity 72. In such embodiments, the first wall end 52 of the second housing component wall 50 abuts the first portion 36 of the first housing component wall 28, as shown in FIG. 6D. The resonator orifice 72 may an annular configuration or an arcuate configuration.

[0047] When the first housing component 26 includes the shroud wall 40, the second housing component wall 50 and the shroud wall 40 of the first housing component wall 28

may collectively define the resonator orifice 72. In such embodiments, the first wall end 52 of the second housing component wall 50 is axially spaced from the shroud wall 40, as shown in FIGS. 12 and 14, thereby defining the resonator orifice 72. In the illustrated embodiment, the resonator orifice 72 has an annular configuration. However, it is to be appreciated that the resonator orifice 72 may have an arcuate configuration. For example, only a portion of the first wall end 52 of the second housing component wall 50 may be axially spaced from the shroud wall 40, with the other portion of the first wall end 52 of the second housing component wall 50 abutting the shroud wall 40 of the first housing component wall 28.

[0048] With reference to FIG. 11, when the shroud wall 40 is included in the first housing component 26, the shroud wall 40 may be continuous between the first and second ends 42, 44. When the shroud wall 40 is continuous between the first and second ends 42, 44, the shroud wall 40 does not define any resonator orifices on its own. Instead, the shroud wall 40 of the first housing component 26 and the second housing component wall 50 collectively define the resonator orifice 72, as described above. In other embodiments, the shroud wall 40 may be continuous between the first and second ends 42, 44 and only the second housing component 46 may define the resonator orifice 72. For example, only the second housing component wall 50 may define the resonator orifice 72. In some embodiments, the shroud wall 40 may be continuous between the first and second ends 42, 44 and only first housing component wall 28 may define the resonator orifice 72.

[0049] In other embodiments, when the shroud wall 40 is included in the first housing component 26, only the shroud wall 40 defines the resonator orifice 72. In other words, the shroud wall 40 may not be continuous between the first and second ends 42, 44 and instead may define the resonator orifice 72.

[0050] With reference again to FIG. 4, the second housing component wall 50 may be continuous between the first and second wall ends 52, 54. When the second housing component wall 50 is continuous between the first and second wall ends 52, 54, the second housing component wall 50 does not define any resonator orifices on its own. Instead, the second housing component wall 50 collectively defines the resonator orifice 72 with the first housing component 26. Specifically, the second housing component wall 50 may collectively define the resonator orifice 72 with the second portion 38 of the first housing component wall 28 or the shroud wall 40 of the first housing component 26, as described above. In other embodiments, the second housing component wall 50 may be continuous between the first and second wall ends 52, 54 and the first housing component 26 alone may define the resonator orifice 72. In such embodiments, only the first housing component wall 28 and/or the shroud wall 40 of the first housing component 26 may define the resonator orifice 72. In still other embodiments, only the second housing component wall 50 defines the resonator orifice 72. In other words, the second housing component wall 50 may not be continuous between the first and second wall ends 52, 54 and instead may define the resonator orifice 72.

[0051] During operation of the turbocharger 20, air flows through the compressor housing inlet 30, through the resonator orifice 72 and into the resonator cavity 64 where the air vibrates within the resonator cavity 64 before flowing back through the resonator orifice 72 to the compressor housing inlet 30. Moreover, the resonator orifice 72 and the resonator cavity 64 are dimensioned to receive air from the compressor housing inlet 30 having particular acoustic wavelengths. For example, the resonator orifice 72 and the resonator cavity 64 may be dimensioned to receive air from the compressor housing inlet 30 having acoustic wavelengths typically associated with whoosh (i.e., undesirable noise and/or vibrations that occur as air flows

through the compressor housing inlet 30 to the compressor wheel 24). In this manner, the resonator orifice 72 and the resonator cavity 64 improves noise, vibration, and harshness (NVH) characteristics of the turbocharger 20 during operation of the turbocharger 20, particularly when the turbocharger 20 is used in automotive applications.

[0052] As described above, the resonator orifice 72 and the resonator cavity 64 may be dimensioned to receive air having particular acoustic wavelengths. For this reason, it is to be appreciated that the resonator orifice 72 and the resonator cavity 64 may dimensioned based on the particular application of the turbocharger 20 and the deleterious noises and vibrations associated with the particular application. In other words, a cross-sectional flow area of the resonator orifice 72 and a volume of the resonator cavity 64 may be selected based on particular acoustic wavelengths that are intended to be filtered so that the particular acoustic wavelengths no longer produce deleterious noises and vibrations during operation of the turbocharger 20.

[0053] Although not required, in some embodiments, the compressor housing assembly 22 is free of any additional resonator orifices fluidly coupling the resonator cavity 64 to the compressor housing inlet 30 other than the resonator orifice 72. In other words, only the resonator orifice 72 fluidly couples the resonator cavity 64 to the compressor housing inlet 30. In such embodiments, air from the compressor housing inlet 30 can only flow into and out of the resonator cavity 64 via the resonator orifice 72.

[0054] In some embodiments, the compressor housing assembly 22 is free of any additional resonator orifices axially spaced from the resonator orifice 72 with respect to the axis A and fluidly coupling the resonator cavity 64 to the compressor housing inlet 30. For example, with reference to FIGS. 6A and 6B, when the second housing component wall 50 and the second portion 38 of the first housing component wall 28 define the resonator orifice 72, neither the second

housing component wall 50 nor first housing component wall 28 define any additional resonator orifices axially spaced from the resonator orifice 72 and fluidly coupling the resonator cavity 64 to the compressor housing inlet 30.

[0055] When the compressor housing assembly 22 is free of any additional resonator orifices axially spaced from the resonator orifice 72 with respect to the axis A, it is to be appreciated that the first housing component wall 28, the second housing component wall 50, and/or the shroud wall 40 may, collectively or independently, define additional resonator orifices circumferentially spaced from the resonator orifice 72 that fluidly couple the resonator cavity 64 to the compress housing inlet 30.

[0056] Although not shown, in some embodiments the resonator cavity 64 and the resonator orifice 72 are further defined as a first resonator cavity 64 and a first resonator orifice 72, respectively. In such embodiments, the first and second housing component walls 28, 50, may collectively define a second resonator cavity for reducing noise within the compressor housing inlet 30 during operation of the turbocharger 20. Moreover, a second resonator orifice is defined by one of: both of the first and second housing components 26, 46, only the first housing component 26, and only the second housing component 46. The second resonator orifice fluidly couples the second resonator cavity to the compressor housing inlet 30. The second resonator orifice is configured to allow air from the compressor housing inlet 30 to flow to the second resonator cavity and air from the second resonator cavity to flow to the compressor housing inlet 30. In other words, air flows into the second resonator cavity and out of the second resonator cavity through the second resonator orifice. It is to be appreciated that the second resonator cavity and the second resonator orifice may have any of the configurations described above for the first resonator cavity 64 and the first resonator orifice 72.

[0057] It is to be further appreciated that the second resonator cavity and the second resonator orifice may be dimensioned to receive air from the compressor housing inlet 30 having the same or different acoustic wavelengths as air received from the compressor housing inlet 30 by the first resonator cavity 64 and the first resonator orifice 72. In this manner, the first resonator cavity and resonator orifice 64, 72, and the second resonator cavity and resonator orifice may cooperate to reduce deleterious noise and vibrations during turbocharger operation, thereby improving the NVH characteristics of the turbocharger 20.

[0058] In some embodiments, the compressor housing assembly 22 may include more than two resonator cavities and two resonator orifices. For example, the compressor housing assembly 22 may include three, four, five, or six resonator cavities and a corresponding three, four, five, or six resonator orifices.

[0059] The first and second housing components 26, 46 are manufactured independently of each other. As such, various features (e.g. protrusions 66 and/or grooves 68) of the first and second housing components 26, 46 may be readily machined into the first and second housing components 26, 46 prior to coupling the first and second housing components 26, 46. For example, when the plurality of protrusions 66 are included on the inner surface 34 of the first housing component wall 28, the protrusions 66 may be machined into the first housing component wall 28 prior to coupling the first and second housing components 26, 46. In this manner, the first and second housing components 26, 46 facilitate efficient manufacturing and assembly of the compressor housing assembly 22.

[0060] Although various features of the first and second housing components 26, 46 may be machined, it is to be appreciated that the various features of the first and second housing components 26, 46 may be cast into the first and second housing components 26, 46. Alternatively,

the various features of the first and second housing components 26, 46 may be formed via a combination of casting and machining. In still other embodiments, the first and second housing components 26, 46 may be formed via 3D printing.

[0061] It is to be appreciated that an air hose may be coupled to the first and/or second housing components 26, 46 for delivering air to the compressor housing inlet 30. The air hose may be coupled to the first and/or second housing components 26, 46 in any suitable manner.

[0062] The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation. Many modifications and variations of the present invention are possible in light of the above teachings, and the invention may be practiced otherwise than as specifically described.

CLAIMS

What is claimed is:

1. A compressor housing assembly for a compressor wheel of a turbocharger, said compressor housing assembly comprising:

a first housing component having a first housing component wall disposed about and extending along an axis and defining a compressor housing inlet; and

a second housing component comprising,

a body portion disposed about said axis and coupled to said first housing component wall, and

a second housing component wall extending from said body portion about said axis at least partially within said first housing component wall, with said second housing component wall further defining said compressor housing inlet, and with said second housing component wall extending along said axis from a first wall end adapted to be proximal to the compressor wheel to a second wall end adapted to be distal to the compressor wheel;

wherein said first and second housing component walls collectively define a resonator cavity for reducing noise within said compressor housing inlet, and

wherein a resonator orifice is defined by one of:

both of said first and second housing components,

only said first housing component, and

only said second housing component,

with said resonator orifice fluidly coupling said resonator cavity to said compressor housing inlet and configured to allow air from said compressor housing inlet to flow to said resonator cavity and air from said resonator cavity to flow to said compressor housing inlet.

2. The compressor housing assembly as set forth in claim 1, wherein said first housing component wall has an outer surface facing away from said axis and an inner surface facing said axis and radially spaced from said outer surface such that said inner surface is disposed between said axis and said outer surface, with said inner surface having a first portion facing said axis and a second portion axially spaced form said first portion with respect to said axis and facing said axis, with said second portion of said inner surface radially recessed from said first portion of said inner surface with respect to said axis.

3. The compressor housing assembly as set forth in claim 2, wherein said second housing component wall has an outer surface at least partially facing said second portion of said inner surface of said first housing component wall and away from said axis and an inner surface facing said axis and radially spaced from said outer surface of said second housing component wall such that said inner surface of said second housing component wall is disposed between said axis and said outer surface of said second housing component wall.

4. The compressor housing assembly as set forth in claim 3, wherein said second portion of said inner surface of said first housing component wall and said outer surface of said second housing component wall collectively define said resonator cavity therebetween.

5. The compressor housing assembly as set forth in claim 3, wherein one of said first second of said inner surface of said first housing component wall and said outer surface of said second housing component wall comprises a protrusion abutting the other of said second portion of said inner surface of said first housing component wall and said outer surface of said second housing component wall, and wherein said protrusion, said second portion of said inner surface of said first housing component wall, and said outer surface of said second housing component wall collectively define said resonator cavity.

6. The compressor housing assembly as set forth in claim 3, wherein one of said second portion of said inner surface of said first housing component wall and said outer surface and second housing component wall defines a groove, and wherein said groove and the other of said second portion of said inner surface of said first housing component wall and said outer surface and second housing component wall collectively define said resonator cavity.

7. The compressor housing assembly as set forth in any one of claims 3-6, wherein said inner surface of said second housing component wall has a first diameter at said first wall end and a second diameter at said second wall end, with said first diameter smaller than said second diameter.

8. The compressor housing assembly as set forth in any one of claims 2-7, wherein said second housing component wall and said first portion of said inner surface of said first housing component wall collectively define said resonator orifice.

9. The compressor housing assembly as set forth in claim 1, wherein said first housing component further comprises a shroud wall disposed about said axis radially inward from said first housing component wall with respect to said axis, with said shroud wall extending along said axis from a first end adapted to be adjacent the compressor wheel to a second end spaced from said first end along said axis, with said shroud wall coupled to said first housing component wall at said first end.

10. The compressor housing assembly as set forth in claim 9, wherein said shroud wall, said first housing component wall, and said second housing component wall collectively define said resonator cavity.

11. The compressor housing assembly as set forth in any one of claims 9 and 10, wherein said second housing component wall and said shroud wall of said first housing component collectively define said resonator orifice.

12. The compressor housing assembly as set forth in any one of claims 9-11, wherein said second housing component wall has an outer surface facing said first housing component wall and away from said axis and an inner surface facing said axis and radially spaced from said outer surface of said second housing component wall such that said inner surface of said second housing component wall is disposed between said axis and said outer surface of said second housing component wall, and wherein said inner surface of said second housing component wall has a first diameter at said first wall end and a second diameter at said second wall end, with said first diameter smaller than said second diameter.

13. The compressor housing assembly as set forth in any one of claims 9-12, wherein said shroud wall of said first housing component is continuous between said first and second ends of said shroud wall.

14. The compressor housing assembly as set forth in any one of claims 1-13, wherein said second housing component wall is continuous between said first and second wall ends of said second housing component wall.

15. The compressor housing assembly as set forth in any one of claims 1-14, which is free of any additional resonator orifices axially spaced from said resonator orifice with respect to said axis and fluidly coupling said resonator cavity to said compressor housing inlet

16. A turbocharger for receiving exhaust gas from an internal combustion engine and for delivering compressed air to the internal combustion engine, said turbocharger comprising:

a turbine housing;

a turbine wheel disposed in said turbine housing for receiving exhaust gas from the internal combustion engine;

a shaft coupled to and rotatable by said turbine wheel;

a compressor wheel coupled to and rotatable by said shaft for delivering compressed air to the internal combustion engine; and

a compressor housing assembly for said compressor wheel, said compressor housing assembly comprising,

a first housing component having a first housing component wall disposed about and extending along an axis and defining a compressor housing inlet, and

a second housing component comprising,

a body portion disposed about said axis and coupled to said first housing component wall, and

a second housing component wall extending from said body portion about said axis at least partially within said first housing component wall, with said second housing component wall further defining said compressor housing inlet, and with said second housing component wall extending along said axis from a first wall end adapted to be proximal to the compressor wheel to a second wall end adapted to be distal to the compressor wheel,

wherein said first and second housing component walls collectively define a resonator cavity for reducing noise within said compressor housing inlet, and

wherein a resonator orifice is defined by one of:

both of said first and second housing components,

only said first housing component, and

only said second housing component,

with said resonator orifice fluidly coupling said resonator cavity to said compressor housing inlet and configured to allow air from said compressor housing inlet to flow to said resonator cavity and air from said resonator cavity to flow to said compressor housing inlet.

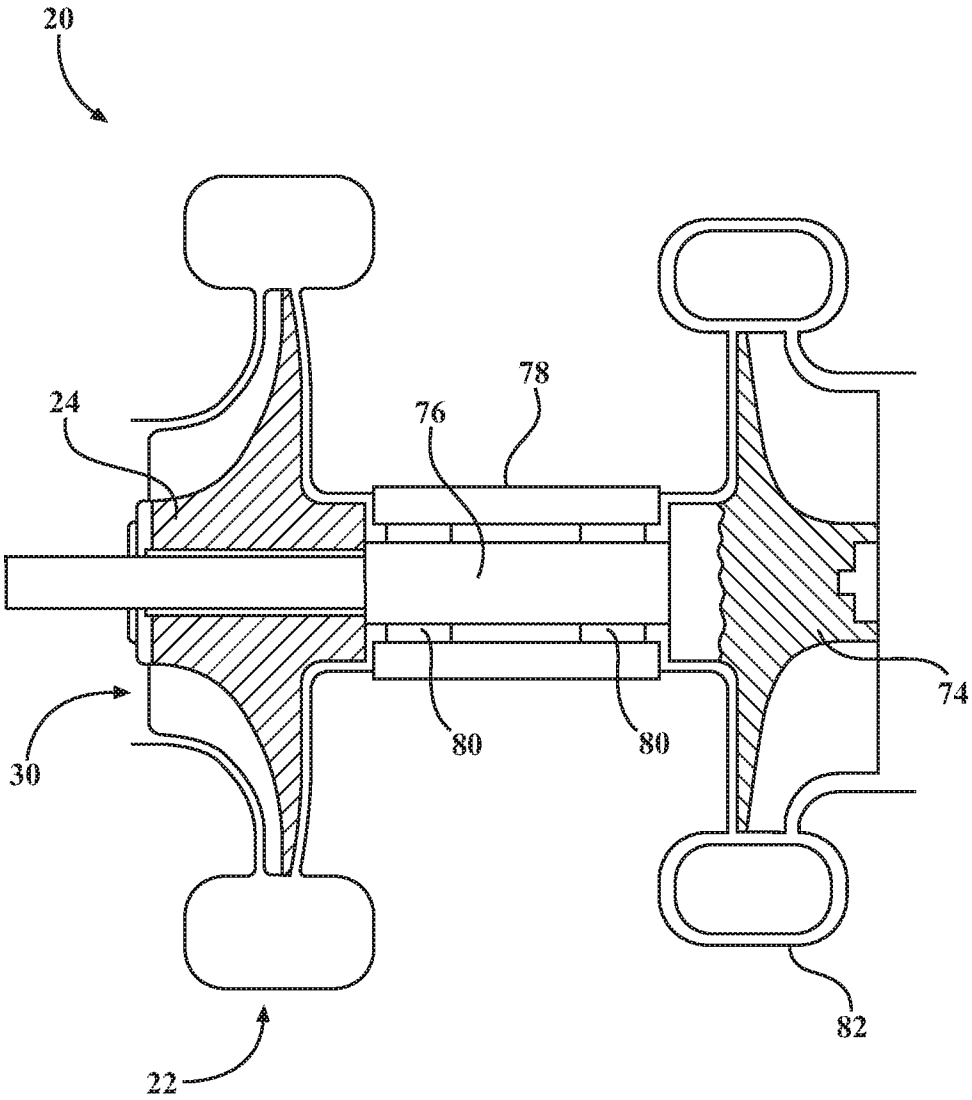


FIG. 1

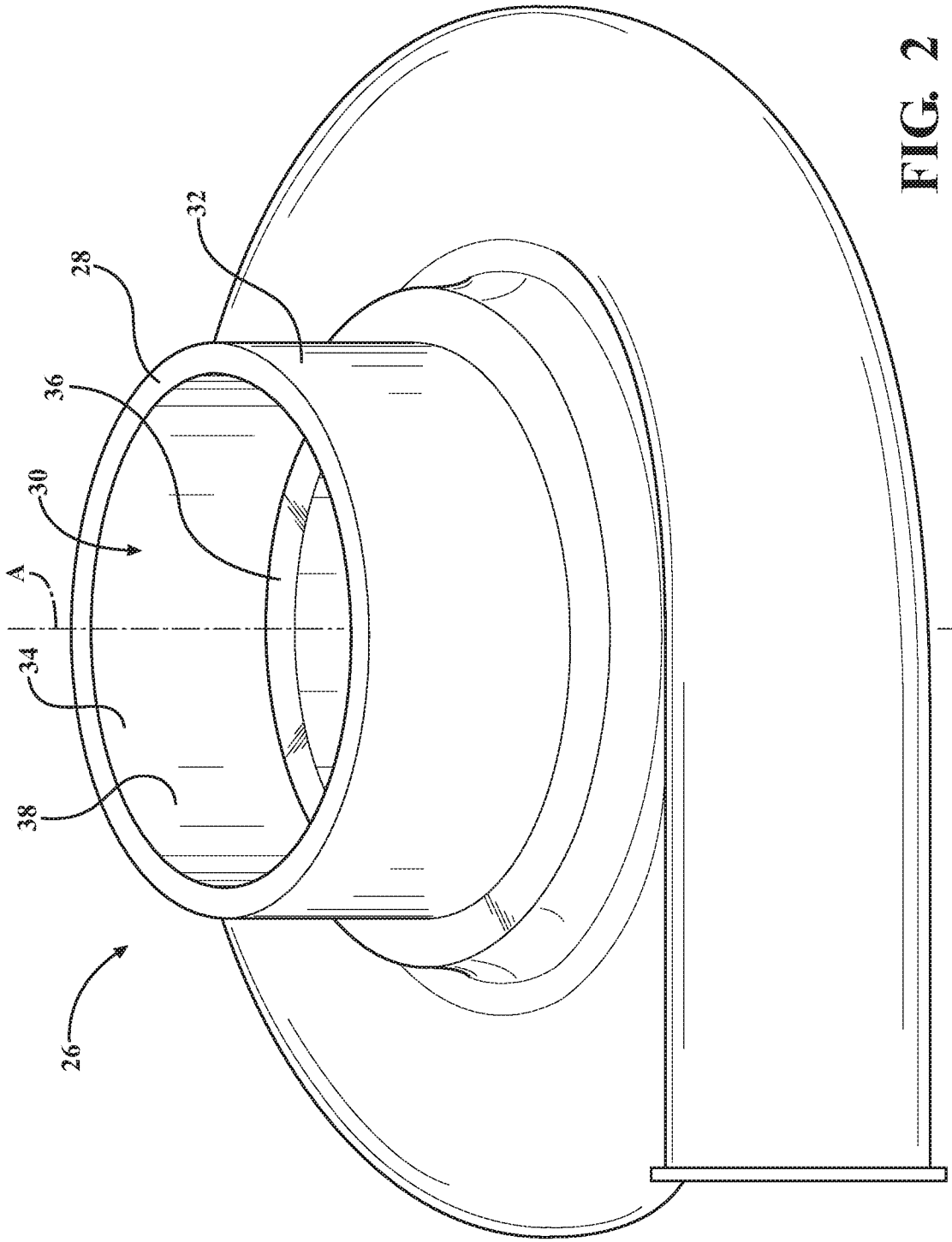


FIG. 2

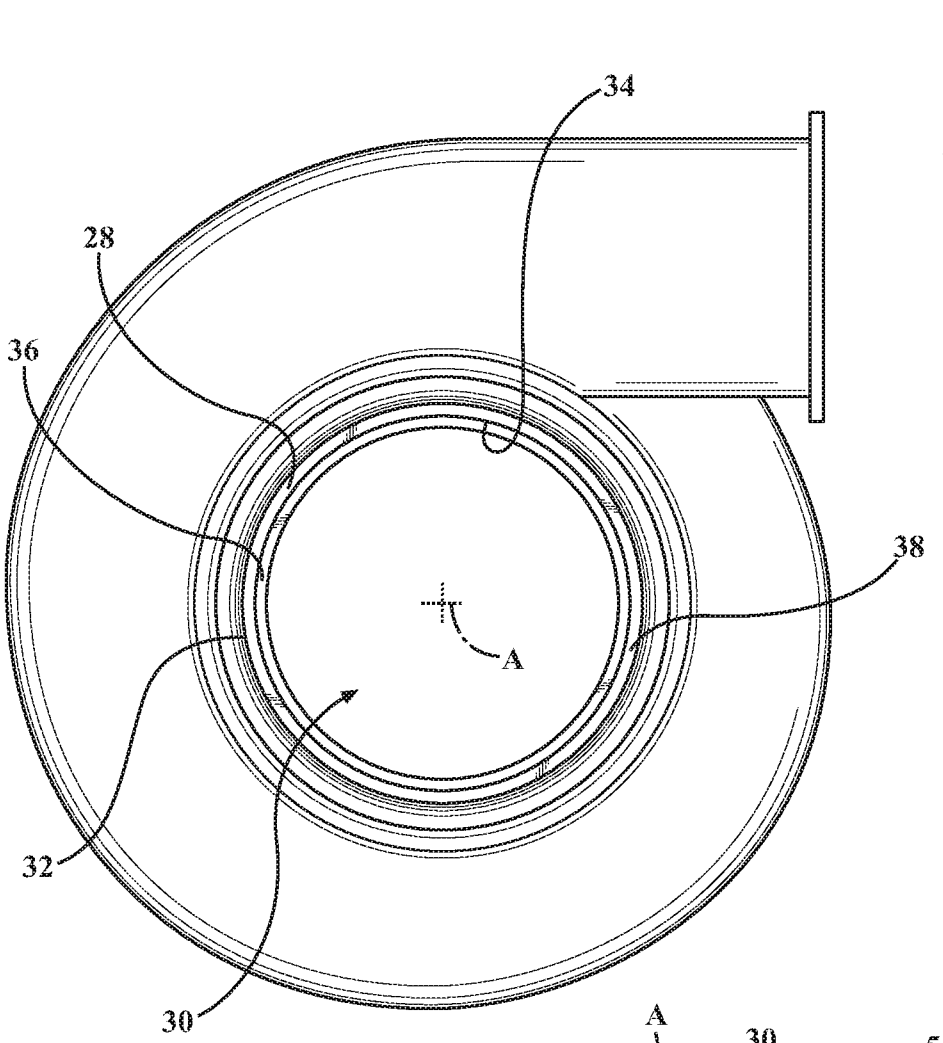


FIG. 3

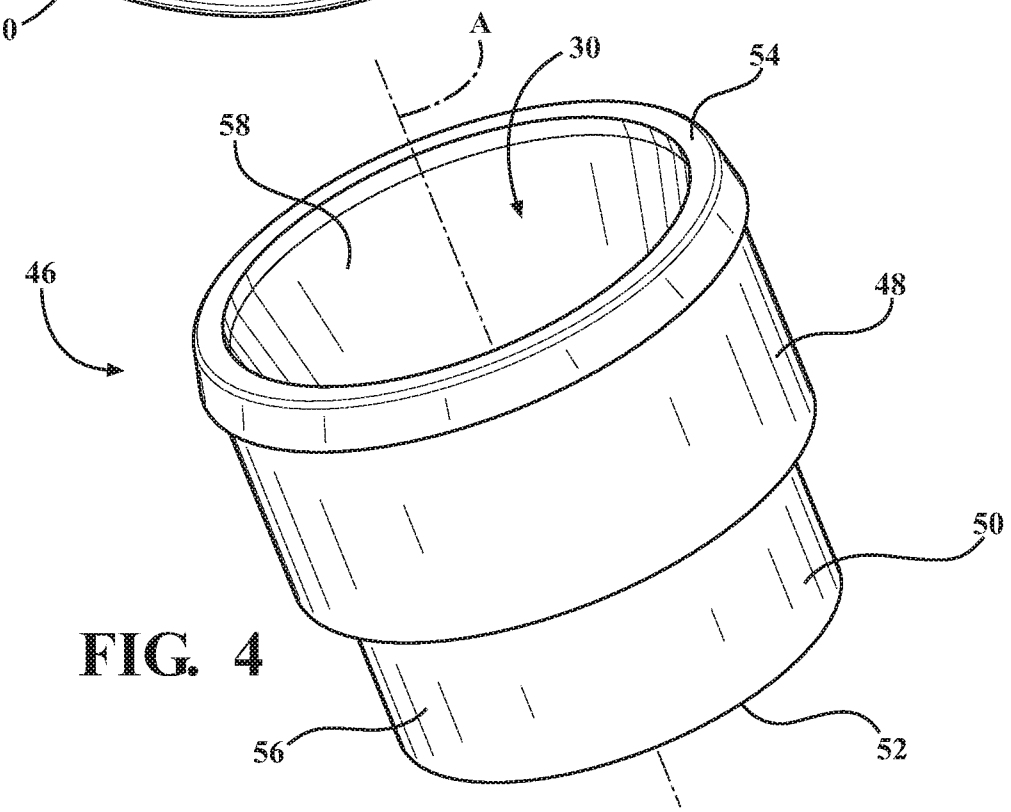


FIG. 4

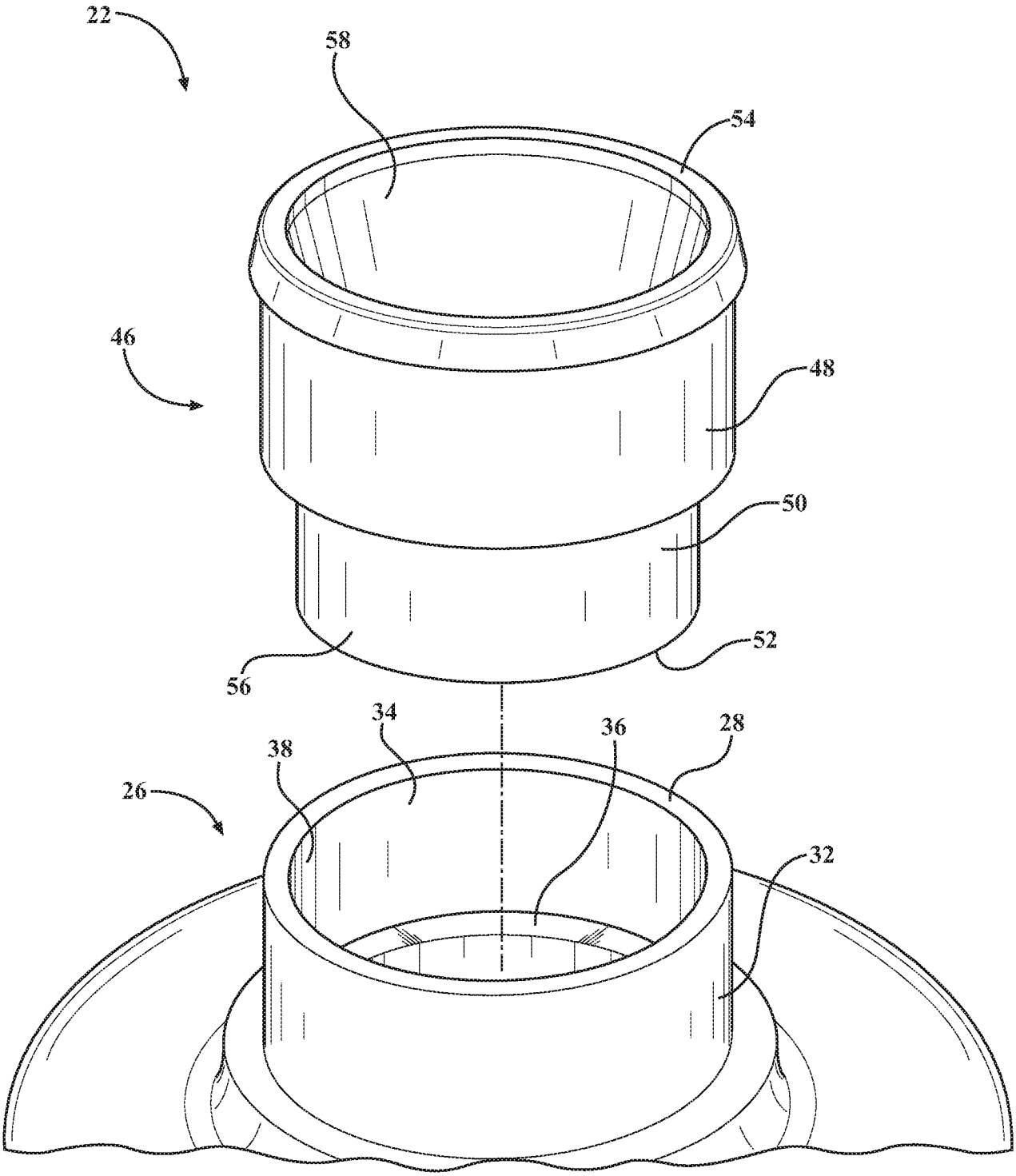


FIG. 5

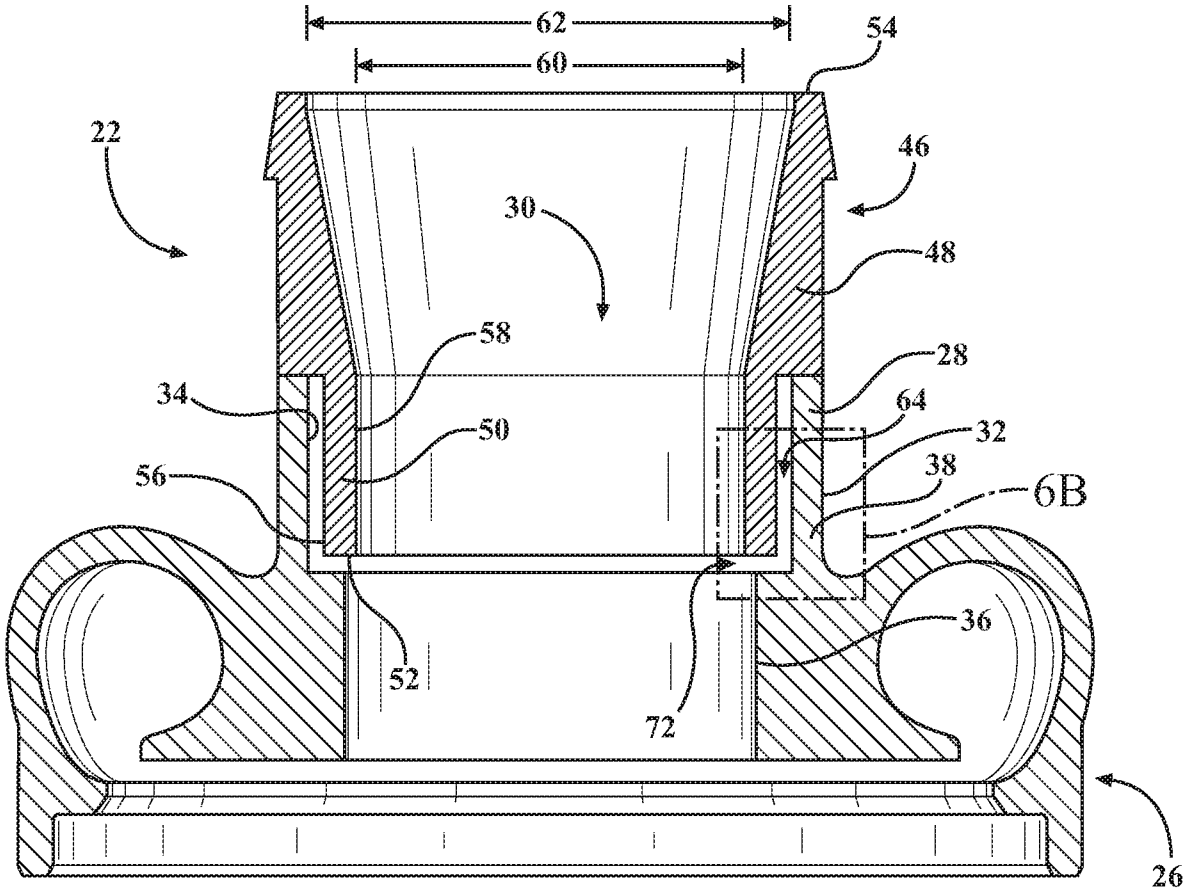

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FIG. 6A

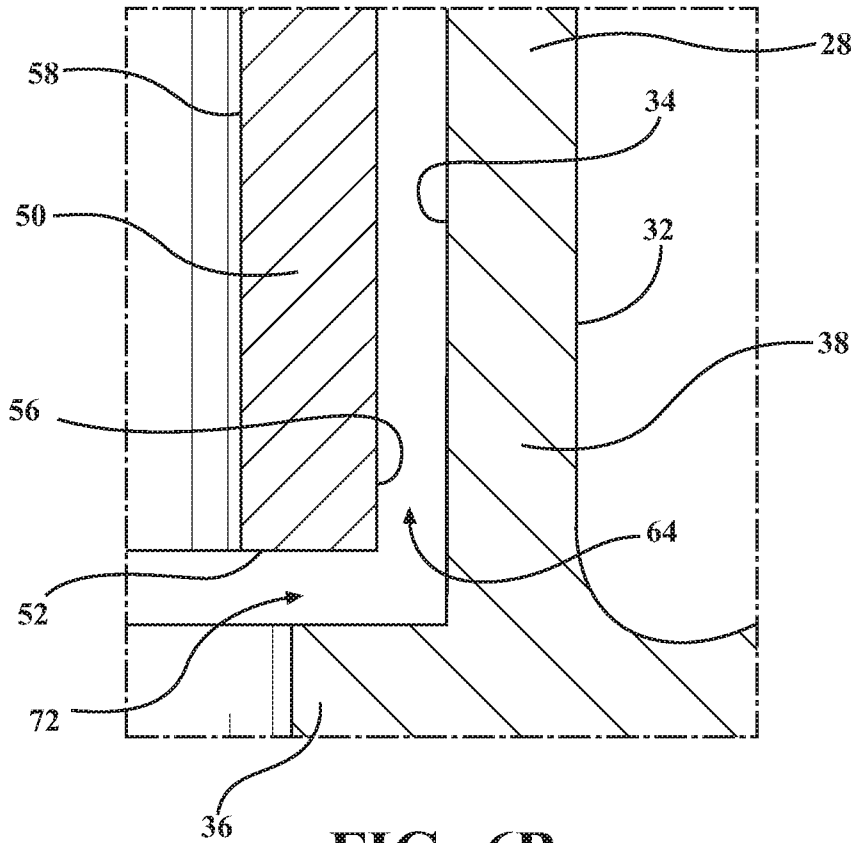

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FIG. 6B

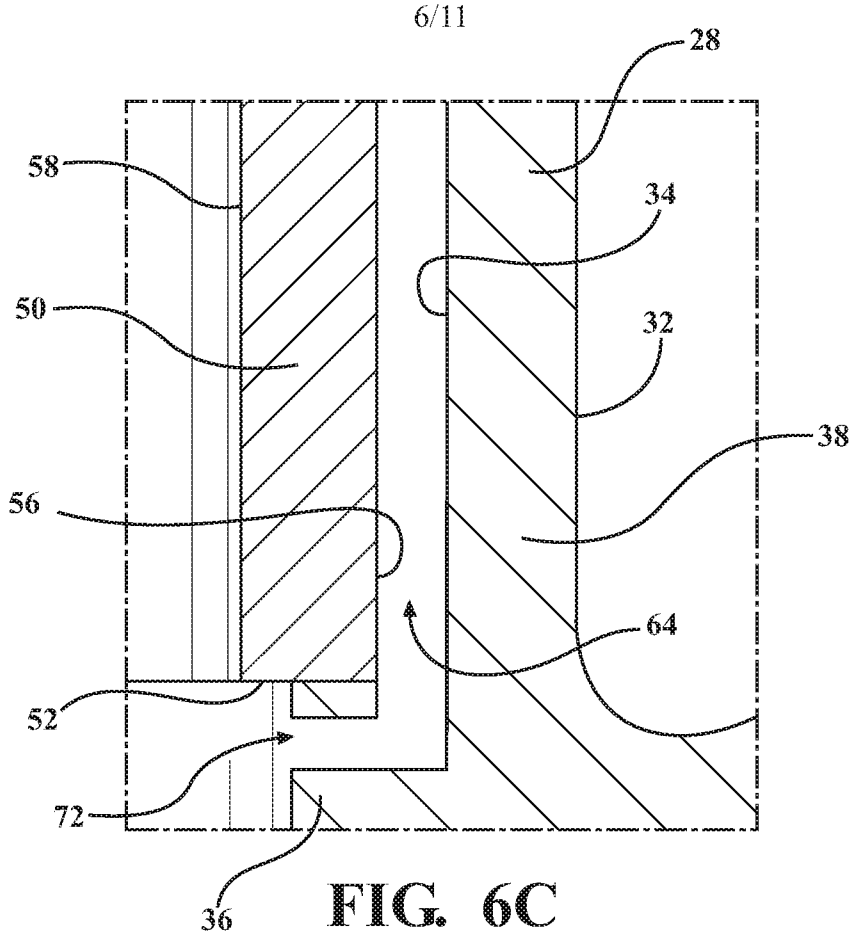


FIG. 6C

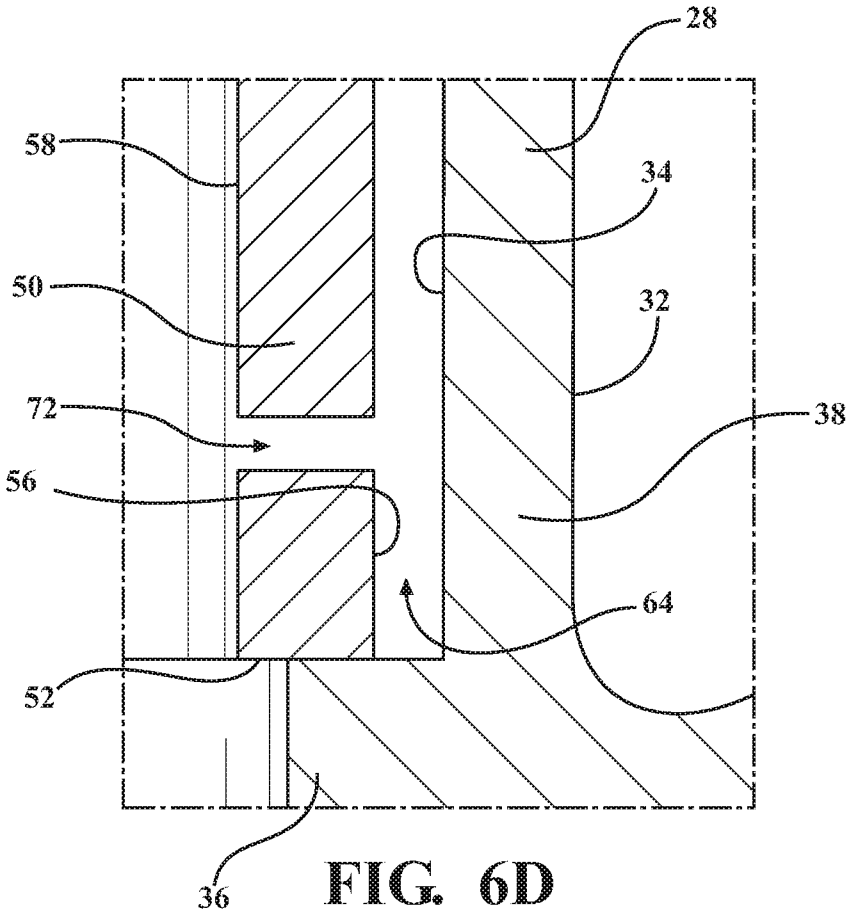


FIG. 6D

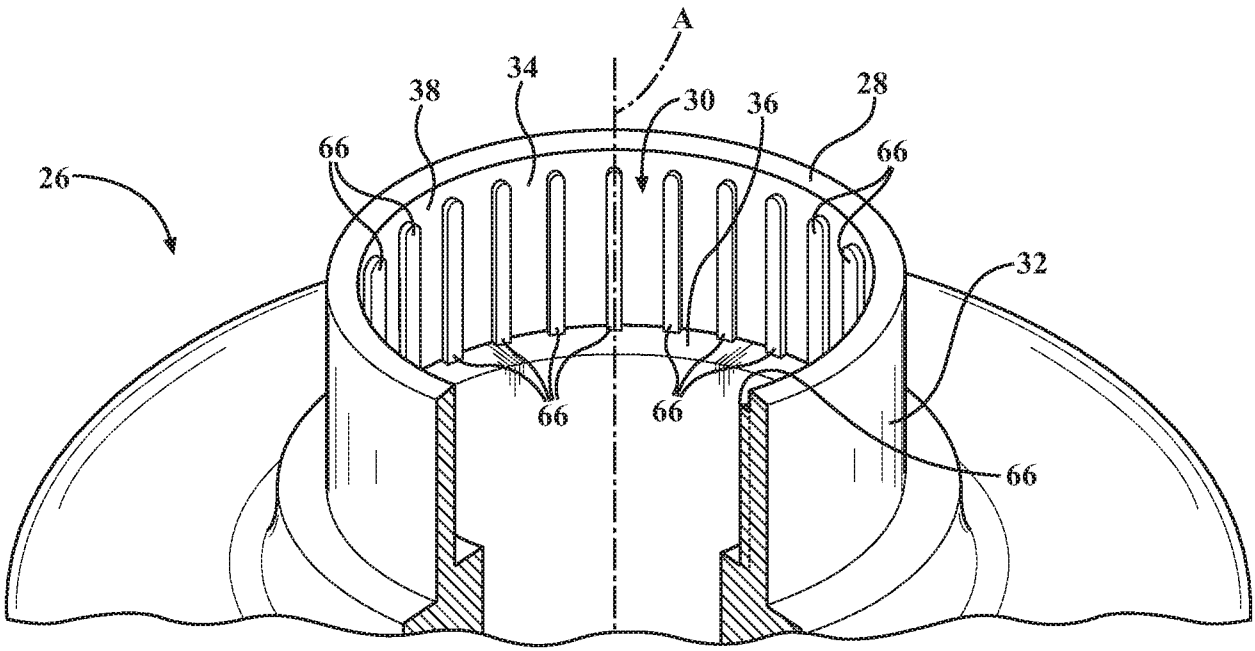


FIG. 7

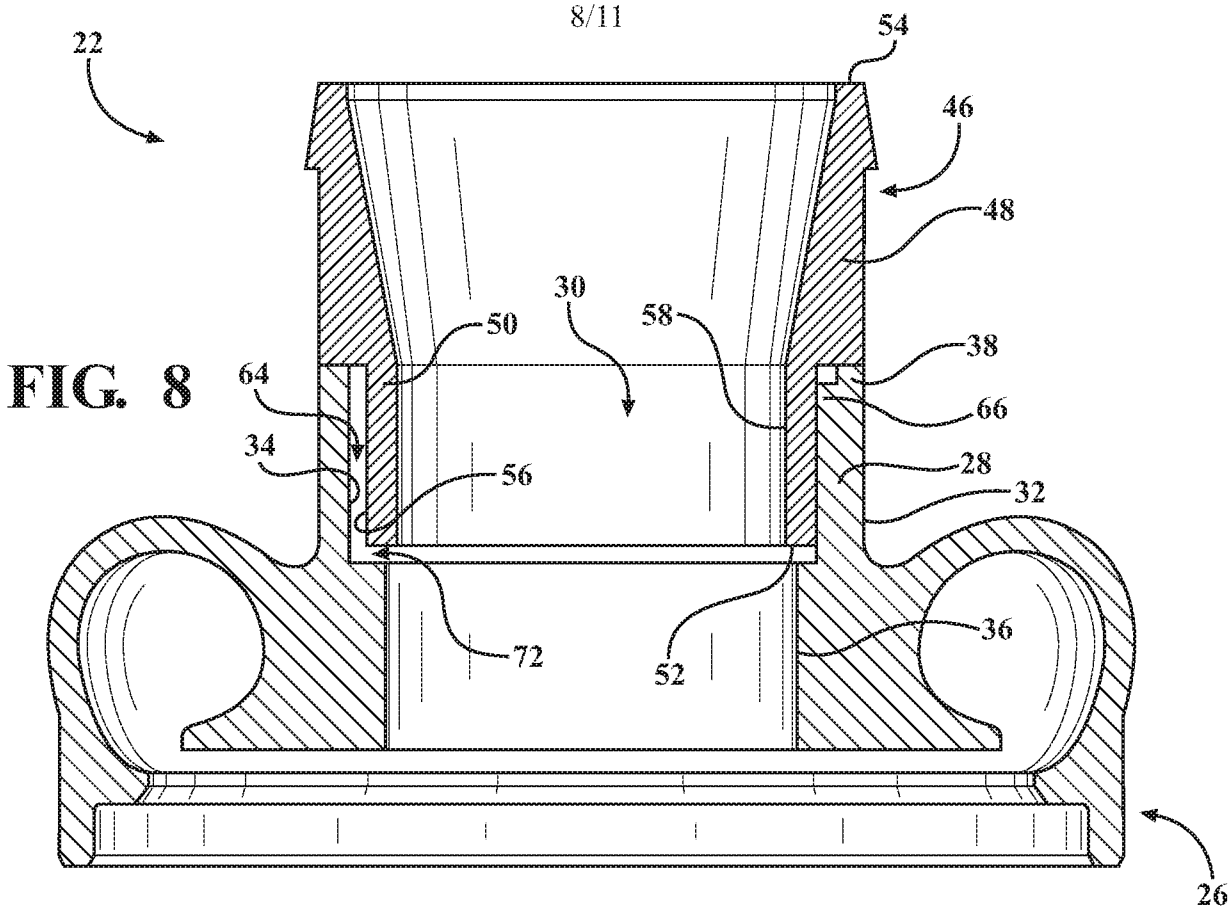

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FIG. 8

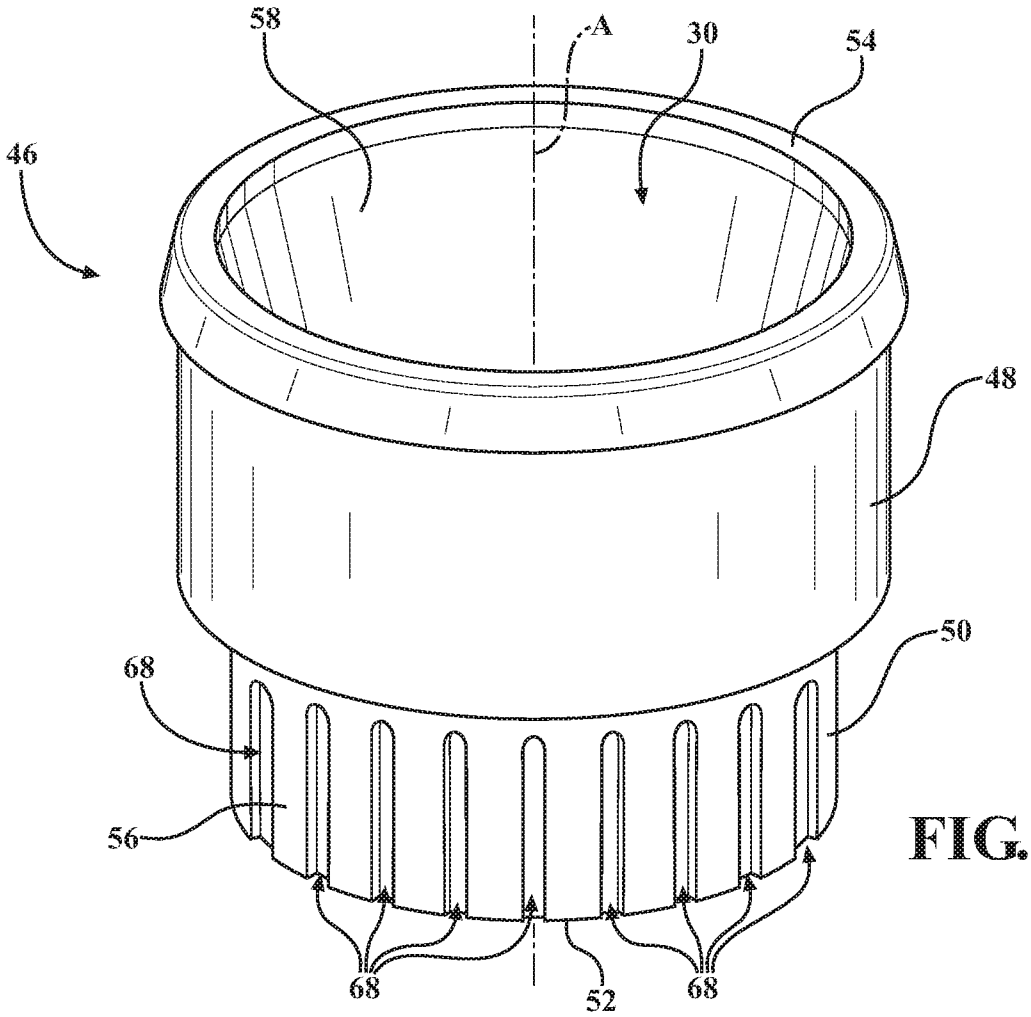

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FIG. 9

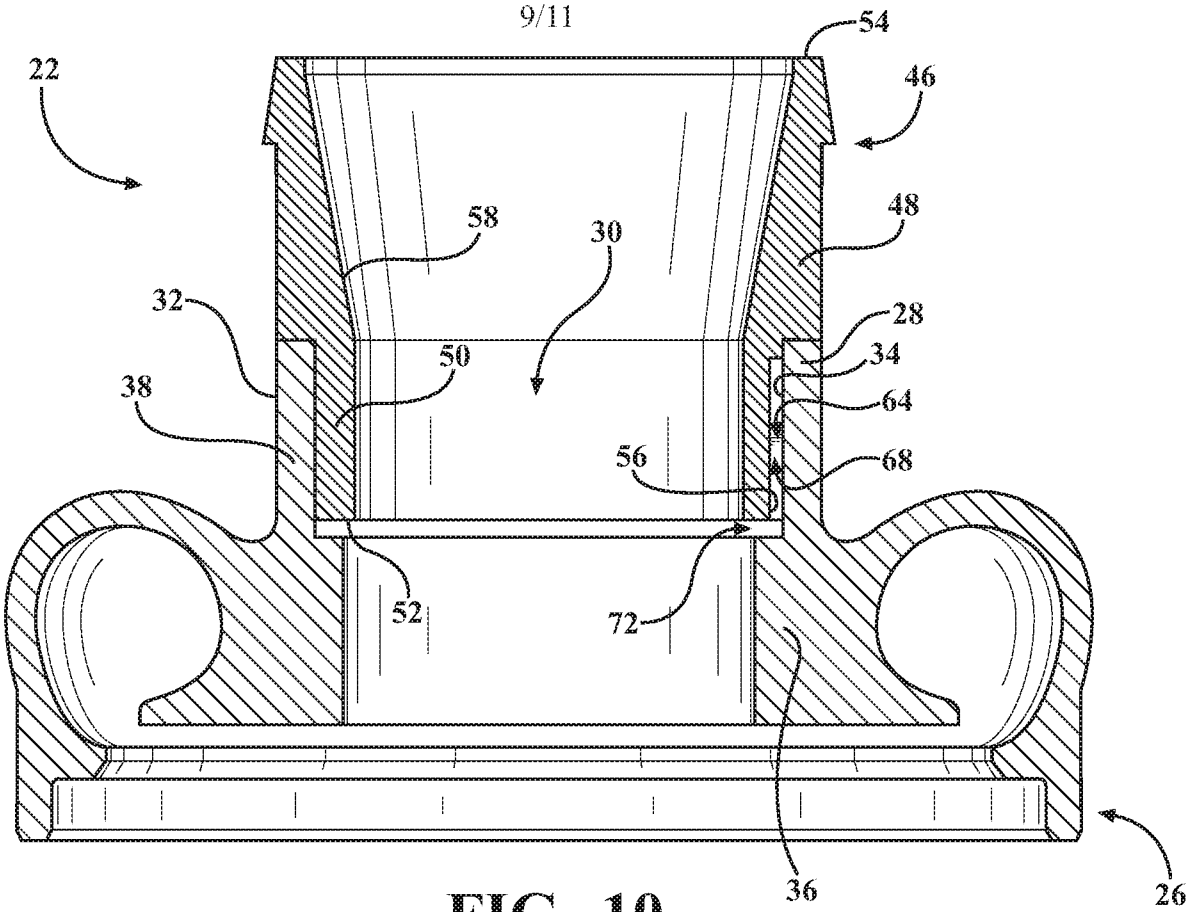

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FIG. 10

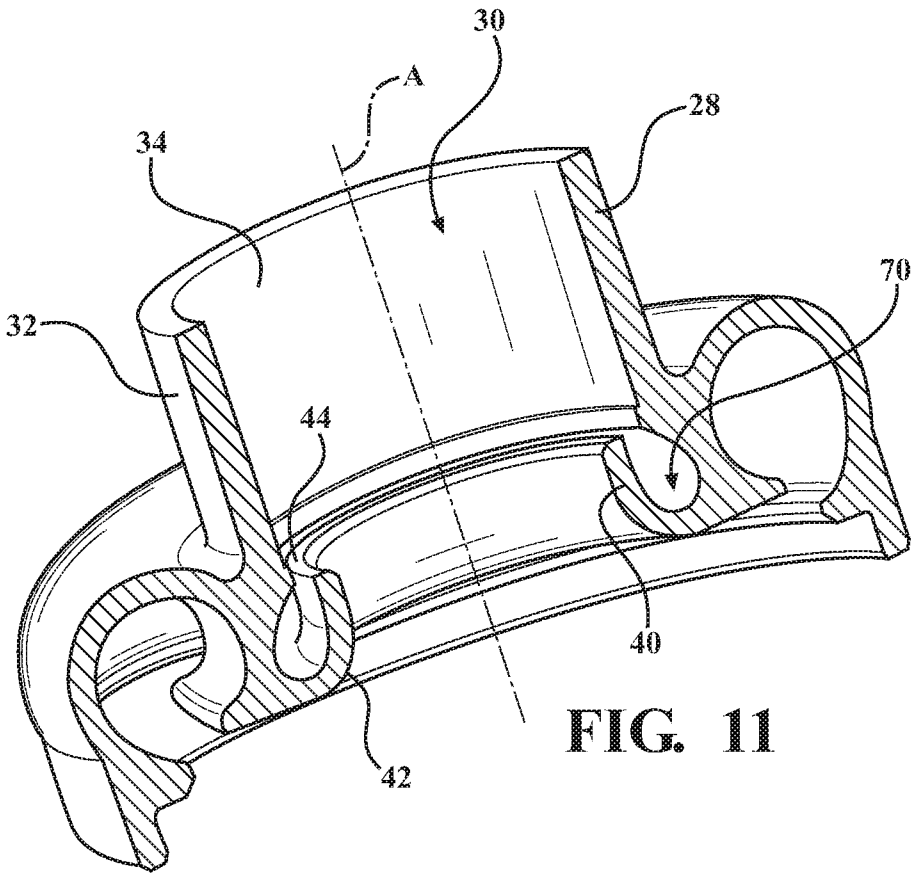

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FIG. 11

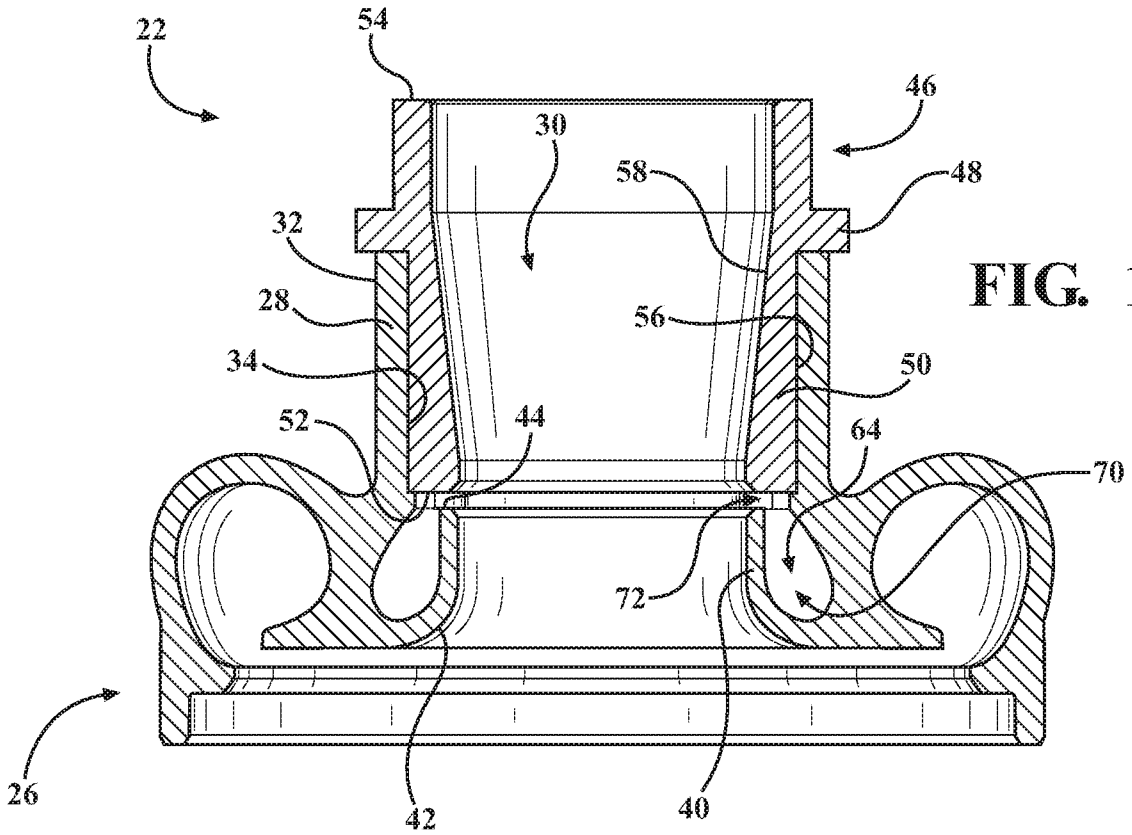

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FIG. 12

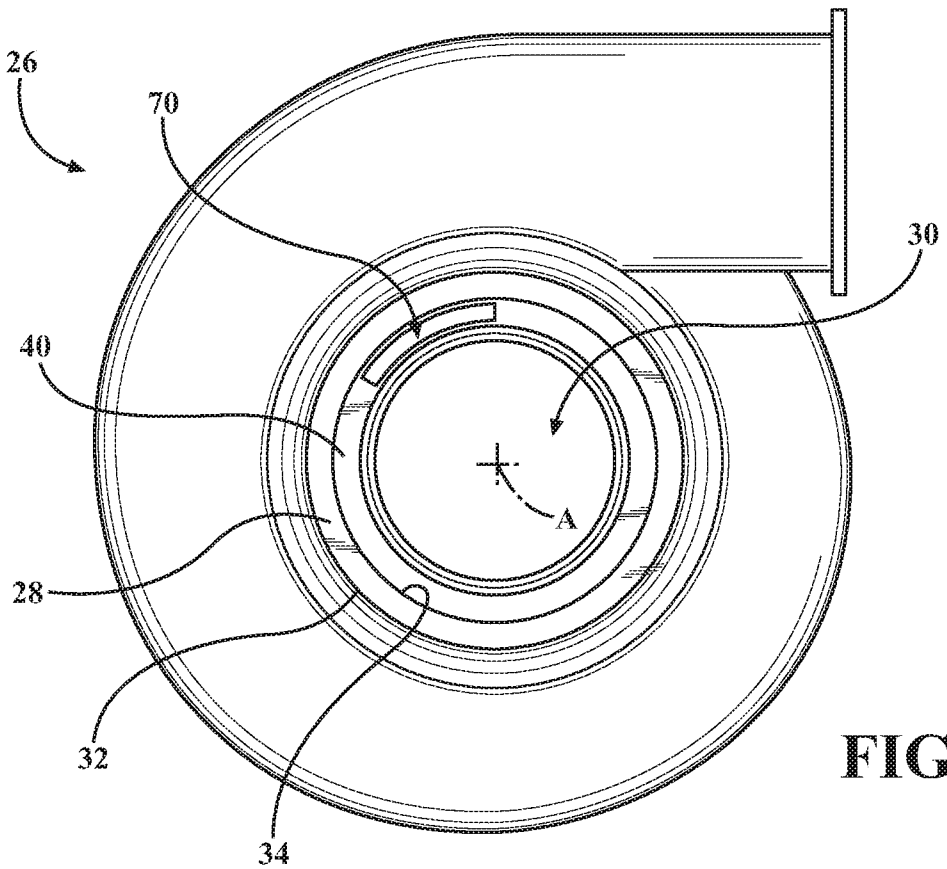

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FIG. 13

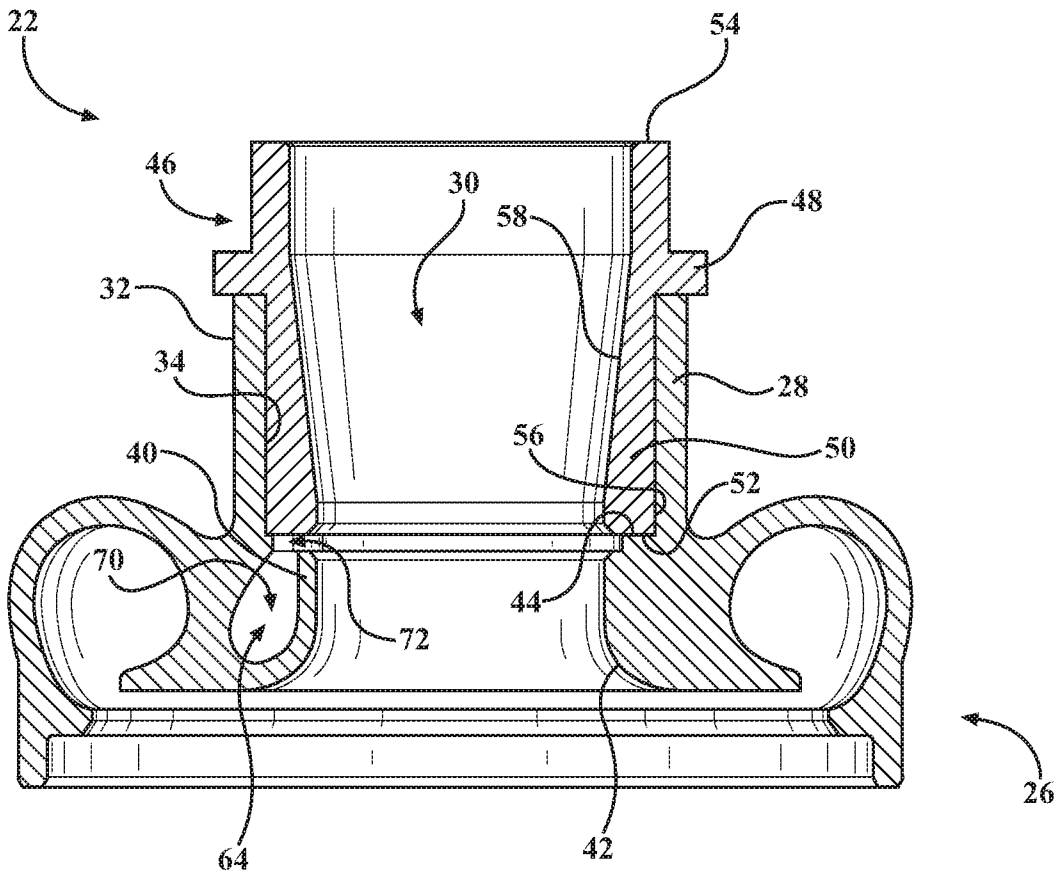


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/014959

A. CLASSIFICATION OF SUBJECT MATTER
INV. F02M35/12 F02C6/12 F02C7/045 F04D29/42 F04D29/66
ADD. F02B37/00

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)
F02M F04D F02K F02B F02C

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.
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X	WO 2015/084593 A1 (BORGWARNER INC [US]) 11 June 2015 (2015-06-11) abstract figures 1-17 page 2 - page 15	1-16
X	WO 2015/066301 A1 (BORGWARNER INC [US]) 7 May 2015 (2015-05-07) abstract figure 7 page 2 - page 11	1-4,6-16

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"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	Date of mailing of the international search report
20 September 2019	27/09/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Juvenelle, Cyril

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/014959

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	WO 2006/090152 A1 (CUMMINS TURBO TECH LTD [GB]; CLAY DAVID CHRISTOPHER [GB] ET AL.) 31 August 2006 (2006-08-31) abstract figures 1-12 claims 1-3 page 1 - page 9 -----	1-4,6-16

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Information on patent family members

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