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- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
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(54) Title: EXHAUST-GAS TURBOCHARGER WITH THERMALLY INSULATED CASING

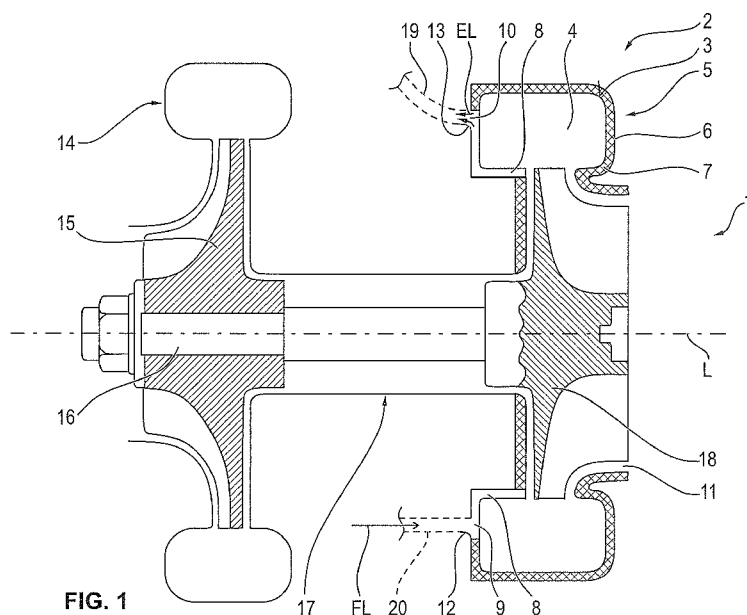


FIG. 1

(57) Abstract: The invention relates to an exhaust-gas turbocharger (1) having a turbine housing (2) which has a turbine housing outer surface (3) and which has a spiral (4) and a turbine housing outlet (11), and having turbine housing thermal insulation (5) which has an outer shell (6) and a thermal insulation layer (7) between outer shell (6) and turbine housing outer surface (3), characterized in that, between the turbine housing outer surface (3) and the thermal insulation layer (7), there is arranged at least one flow duct (8) which has an inlet opening (9) and an outlet opening (10) which are arranged in the outer shell (6).



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EXHAUST-GAS TURBOCHARGER WITH THERMALLY INSULATED CASING**DESCRIPTION**

5 The invention relates to an exhaust-gas turbocharger according to the preamble of claim 1.

 The turbine housing of an exhaust-gas turbocharger of said type must, depending on its installation position, be equipped with turbine housing thermal insulation which, depending on the usage situation, may also be complete thermal
10 insulation of the entire turbine housing. Tests carried out in the context of the invention have shown that, despite afterrunning of an afterrun pump and of the fan of the cooler after the engine has been shut down, a situation may arise in which the heat that is still present in the turbine housing migrates into the bearing housing and can cause the cooling water that is present in the bearing housing to boil. This can cause damage in
15 the bearing housing and deterioration of the cooling water, if present. In the case of cooling water deterioration, this may necessitate an exchange interval.

 It is therefore an object of the present invention to provide an exhaust-gas turbocharger of the type specified in the preamble of claim 1, with which it is possible for the heat flow from the turbine housing into the water-cooled bearing housing to be
20 reduced, and thus for boiling of the cooling medium in the bearing housing to be prevented.

 This object is achieved by the features of claim 1.

 The exhaust-gas turbocharger according to the invention has, as is conventional, a compressor wheel which is arranged in a compressor housing. The
25 compressor wheel is fastened to one end of a shaft which is mounted in a bearing housing which is connected by one end to the compressor housing and by its other end to the turbine housing. The turbine housing of the exhaust-gas turbocharger according to the invention has a turbine housing outer surface, a spiral and a turbine housing outlet. Furthermore, turbine housing thermal insulation is provided which has an outer
30 shell and a thermal insulation layer between the outer shell and the turbine housing outer surface. To prevent an introduction of heat from the turbine housing into the bearing housing, with the associated problems discussed in the introduction, at least

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one flow duct is arranged between the turbine housing outer surface and the thermal insulation layer, which flow duct has one or more inlet openings and outlet openings which are arranged in the outer shell.

5 This arrangement yields the advantage that, for the additional cooling of the turbine housing after all of the cooling assemblies of the engine in which the exhaust-gas turbocharger according to the invention is installed have been shut down, additional cooling of the turbine housing is made possible which is based on the utilization of the so-called chimney effect. For this purpose, the inlet opening and the outlet opening are arranged on the turbine housing such that, in the installed state of
10 the exhaust-gas turbocharger, the inlet opening is arranged at the bottom, whereas the outlet opening is arranged at the top. This makes it possible to utilize the abovementioned chimney effect, which is a physical effect which gives rise to vertically directed air flows. This chimney effect is based on natural convection. For the exhaust-gas turbocharger according to the invention, this means that, even after all
15 of the cooling assemblies of the engine have been shut down, cooling air can be introduced into the inlet opening of the flow duct, which cooling air is heated as it flows through the flow duct and flows out of the outlet opening in the heated state, such that a further cooling effect is possible. Even if said cooling effect amounts to only a few degrees Celsius, it is possible for heating of the cooling medium in the
20 bearing housing to be kept below the critical temperature value, which is normally approximately 130°C.

In principle, it is possible according to the invention for the turbine housing thermal insulation to be partial insulation or full insulation. Particular advantages are attained if the insulation is complete insulation of the entire turbine housing.

25 The dependent claims contain advantageous developments of the invention.

In one embodiment, it is possible for the flow duct to be realized by way of a cutout of the thermal insulation layer adjacent to the turbine housing outer surface, which yields the advantage that no additional components have to be used. Furthermore, the advantage is attained that said type of cutout of the flow duct is very
30 inexpensive.

It is however alternatively possible for the flow duct to be connected to a conduit pipe which can be prefabricated, which in turn yields the advantage that, here,

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the profile and shaping of the conduit pipe can be influenced in a highly precise manner. The conduit pipe can discharge hot exhaust air at a suitable position in the engine bay. It is furthermore possible for a conduit pipe to be provided at the inlet opening, as this yields better admission of air in the ventilation phase (post-heating phase). If multiple inlets openings are provided, it is likewise possible for each of said inlet openings to be equipped with a corresponding conduit pipe. The provision of such conduit pipes yields the advantage that these can be positioned optimally in the air flow from the fan, and thus an improved inflow can be realized. This is particularly advantageous because the packaging in the engine bay is normally so dense that the flow from the fan does not optimally arrive at the inlets or inlet openings.

If the inlet opening faces toward the bearing housing and the outlet opening is arranged adjacent to the spiral of the turbine housing, this yields the advantage that the flow duct can be in the form of an annular duct, which in turn yields the advantage of very good heat discharge.

If the inlet opening has a larger cross section than the outlet opening, this yields the advantage that the chimney effect can be intensified, which in turn yields the advantage of improved heat discharge.

It is furthermore possible for the inlet opening to be equipped with a flow-guiding spoiler, which yields the advantage of an improved supply of air into the flow duct.

Alternatively or in addition to this, it is also possible for the outlet opening to be equipped with a flow-guiding spoiler of said type, which yields the advantage that a negative pressure can be generated at the outlet, which in turn improves the chimney effect and thus the heat discharge.

To yet further improve the heat discharge, it is furthermore possible for a multiplicity of flow-guiding ducts, in particular two flow-guiding ducts, to be provided.

In principle, however, it is also possible for a greater number of flow-guiding ducts to be provided, said number being dependent in particular on the structural form and size of the exhaust-gas turbocharger and the installation location thereof.

Claims 13 and 14 define a turbine housing according to the invention as an object which can be marketed independently.

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Further details, advantages and features of the present invention can be found in the following description of exemplary embodiments with reference to the drawing, in which:

Figure 1 shows a schematically greatly simplified illustration of an embodiment of an exhaust-gas turbocharger according to the invention,

Figure 2 shows a schematically greatly simplified basic illustration for explaining the mode of operation according to the invention,

Figures 3A and 3B show a plan view and a side view of the turbine housing according to the invention for explaining the form of an annular duct, and

Figures 4-8 show different views of the exhaust-gas turbocharger according to the invention for explaining the possible arrangements of inlet openings and outlet openings of a flow duct.

Figure 1 shows a schematically greatly simplified basic illustration of an embodiment of an exhaust-gas turbocharger 1 according to the invention. Adjacent to a compressor housing 14, in which a compressor wheel 15 is mounted on one end of a shaft 16, the exhaust-gas turbocharger 1 has a bearing housing 17 which serves for the mounting of the shaft 16 and which is connected at one side to the compressor housing 14 and at the other side to a turbine housing 2 of the exhaust-gas turbocharger 1, in which turbine housing a turbine wheel 18 is arranged.

The turbine housing 2 has a turbine housing outer surface 3, a spiral 4 and a turbine housing outlet 11.

As shown by the embodiment in Figure 1, the turbine housing 2 is equipped with thermal insulation 5, which has an outer shell 6 and a thermal insulation layer 7. In this case, the thermal insulation layer 7 is arranged between the outer shell 6 and the outer surface 3 of the turbine housing 2. In the embodiment in Figure 1, the thermal insulation 5 is in the form of partial thermal insulation. According to the invention, it is however also possible for the thermal insulation 5 to encase the entire turbine housing 2, wherein the advantages of the operating principles according to the invention are brought particularly to bear in the case of such full thermal insulation 5.

As is also shown in Figure 1, in the example, a flow duct 8 is provided between the outer surface 3 and the thermal insulation layer 7. The flow duct 8 has an inlet opening 9 and an outlet opening 10 which are formed in the outer shell 6. In the

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installed state of the exhaust-gas turbocharger 1 according to the invention, the inlet opening 9 constitutes a lower opening, whereas the outlet opening 10 constitutes an opening situated at the top.

5 In the embodiment illustrated in Figure 1, the inlet opening 8 is arranged adjacent to the turbine outlet 11, whereas the outlet opening 10 is provided adjacent to the spiral 4.

Even though only one such flow duct 8 is provided in Figure 1, it is also possible according to the invention for two or more such flow ducts 8 to be provided around the turbine housing 2.

10 The operating principle of the arrangement according to the invention becomes clear when viewing Figures 1 and 2 together.

To permit heat discharge from the turbine housing 2 even after cooling systems of the engine in which the exhaust-gas turbocharger 1 is used have been shut down, the described flow duct 8 with its inlet opening 9 and its outlet opening 10 is provided. In
15 this case, viewing Figures 1 and 2 together, it can be seen that fresh air, symbolized by the arrows FL, can enter the inlet opening 9, for which purpose said inlet opening may preferably be provided with a flow-guiding spoiler 12 which facilitates the introduction of the fresh air FL.

After the fresh air FL has entered the inlet opening 9, it flows through the flow
20 duct 8 and warms up. Owing to the chimney effect that is generated, said flow is realized without further auxiliary means.

After flowing through the flow duct 8, the heated air, which is symbolized in Figures 1 and 2 by the double arrows EL, emerges from the outlet opening 10. To permit flow guidance and to make it possible for a negative pressure to be generated at
25 the outlet opening 10, said outlet opening is preferably equipped with a flow-guiding spoiler 13. As indicated in Figure 1 by the dashed lines, it is possible for a conduit pipe 19 to be connected to the outlet opening 10 of the flow duct 8, which conduit pipe can discharge the heated exhaust air EL at a suitable position in the engine bay, in order that the cooling effect can be brought even more effectively to bear. As is also shown
30 in Figure 1, it is also possible for a conduit pipe 20 to be connected to the inlet opening 9 in order to improve the inflow of fresh air FL, in particular in the case of the exhaust-

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gas turbocharger 1 according to the invention being installed in densely packaged engine bays.

By means of this arrangement or by means of these operating principles, it is possible, even after the cooling systems of the engine have been shut down, for residual heat to be discharged from the turbine housing 2 in order to prevent the turbine housing 2 heating the cooling medium therein owing to the connection of said turbine housing to the bearing housing 17, which in the prior art has, in extreme cases, led to boiling of the cooling medium.

As discussed in the introduction, it is possible for the flow duct 8 to be produced adjacent to the outer surface 3 by removal of material of the thermal insulation layer 7. This may be performed at the factory or may also be performed retroactively on existing turbine housings 2.

Viewing Figures 3A and 3B together, it is clear that the flow duct 8 may be in the form of an annular duct 8R. Said annular duct 8R in turn also has an inlet opening 9 situated at the bottom and an outlet opening 10 situated at the top, this in turn being the case in the installed state of the exhaust-gas turbocharger 1.

Figure 4 shows a part of the turbine housing 2 with a two-channel spiral or volute 4, wherein the flow-guiding duct 8 is in turn realized by the cutting-out of a part of the thermal insulation material 7 of the turbine housing thermal insulation 5.

Figure 5 shows another view of the turbine housing 2 as per Figure 4, wherein the flow duct 8 is again realized by the cutting-out of the thermal insulation layer 7, and the inlet opening 9 is shown, at the bottom in the installed state of the turbocharger 1, into which inlet opening fresh air FL can flow, whereafter the fresh air FL flows through the flow-guiding duct 8 to the outlet opening 10.

Figure 6 shows another view of the turbine housing 2 as per Figure 5, in order to illustrate that, in this embodiment, a second inlet 9' is provided which leads to a second flow duct which is not visible in Figure 6, as it is possible according to the invention to provide either only one flow duct 8 or a greater number of flow ducts in the turbine housing 2.

Figures 7 and 8 show the turbine housing 2 as per Figures 5 and 6, wherein, in Figures 7 and 8, the outlet openings 10 and 10' with their associated flow-guiding spoilers 13 and 13' can be seen. Here, Figure 7 shows the second outlet opening 10' of

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the associated second flow duct 8', whereas Figure 8 illustrates the first outlet opening 10 of the associated flow duct 8. In these embodiments, too, the outlet openings 10 and 10' are arranged at the top in the installed state of the turbine housing 2 or of the exhaust-gas turbocharger 1.

5 Figures 3-8 illustrate possible arrangements for the inlet opening and outlet opening and for the provision of two flow ducts.

 In addition to the above written description of the invention, reference is hereby explicitly made, for additional disclosure thereof, to the diagrammatic illustration of the invention in Figures 1 to 8.

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LIST OF REFERENCE SIGNS

	1	Exhaust-gas turbocharger
	2	Turbine housing
	3	Turbine housing outer surface
5	4	Spiral
	5	Turbine housing thermal insulation
	6	Outer shell
	7	Insulation layer
	8, 8'	Flow duct
10	8A	Cutout in the thermal insulation layer 7
	8R	Annular duct
	9, 9'	Inlet opening
	10, 10'	Outlet opening
	11	Turbine housing outlet
15	12, 13	Flow-guiding spoiler
	14	Compressor housing
	15	Compressor wheel
	16	Shaft
	17	Bearing housing
20	18	Turbine wheel
	19, 20	Conduit pipes
	L	Longitudinal axis of the exhaust-gas turbocharger
	FL	Arrow for fresh air
	EL	Arrow for heated air
25		

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CLAIMS

1. An exhaust-gas turbocharger (1)
 - having a turbine housing (2)
 - 5 - which has a turbine housing outer surface (3) and
 - which has a spiral (4) and a turbine housing outlet (11),
and
 - having turbine housing thermal insulation (5),
characterized
 - 10 - in that, between the turbine housing outer surface (3) and an outer shell (6) of the turbine housing thermal insulation (5), there is arranged at least one flow duct (8) which has an inlet opening (9) and an outlet opening (10) which are arranged in the outer shell (6).
- 15 2. The exhaust-gas turbocharger as claimed in claim 1, characterized in that the flow duct (8) is formed by a cutout (8A) in a thermal insulation layer (7) of the turbine housing thermal insulation (5).
- 20 3. The exhaust-gas turbocharger as claimed in claim 1, characterized in that the flow duct (8) can be connected to a conduit pipe (19) which can be connected to the outlet opening (10).
- 25 4. The exhaust-gas turbocharger as claimed in one of claims 1 to 3, characterized in that the inlet opening (9) is arranged so as to face toward a bearing housing (17) which is attached to the turbine housing (2).
5. The exhaust-gas turbocharger as claimed in one of claims 1 to 4, characterized in that the outlet opening (10) is arranged adjacent to the spiral (4).

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6. The exhaust-gas turbocharger as claimed in one of claims 1 to 5, characterized in that the inlet opening (9) has a larger cross section than the outlet opening (10).

5 7. The exhaust-gas turbocharger as claimed in one of claims 1 to 6, characterized in that the flow duct is in the form of an annular duct (8R).

8. The exhaust-gas turbocharger as claimed in one of claims 1 to 7, characterized in that the inlet opening (9) is equipped with a flow-guiding spoiler (12).

10

9. The exhaust-gas turbocharger as claimed in one of claims 1 to 8, characterized in that the outlet opening (10) is equipped with a flow-guiding spoiler (13).

15 10. The exhaust-gas turbocharger as claimed in one of claims 1 to 9, characterized in that a multiplicity of flow ducts (8) is provided.

11. The exhaust-gas turbocharger as claimed in one of claims 2 to 10, characterized in that the thermal insulation layer (7) is arranged between the outer shell (6) and the turbine housing outer surface (3).

20

12. The exhaust-gas turbocharger as claimed in one of claims 1 to 11, characterized in that the turbine housing (2) is equipped with full thermal insulation (5).

25

13. A turbine housing (2) of an exhaust-gas turbocharger (1),
- which has a turbine housing outer surface (3) and
 - which has a spiral (4) and a turbine housing outlet (11), and
 - which is equipped with turbine housing thermal insulation (5),

30

characterized

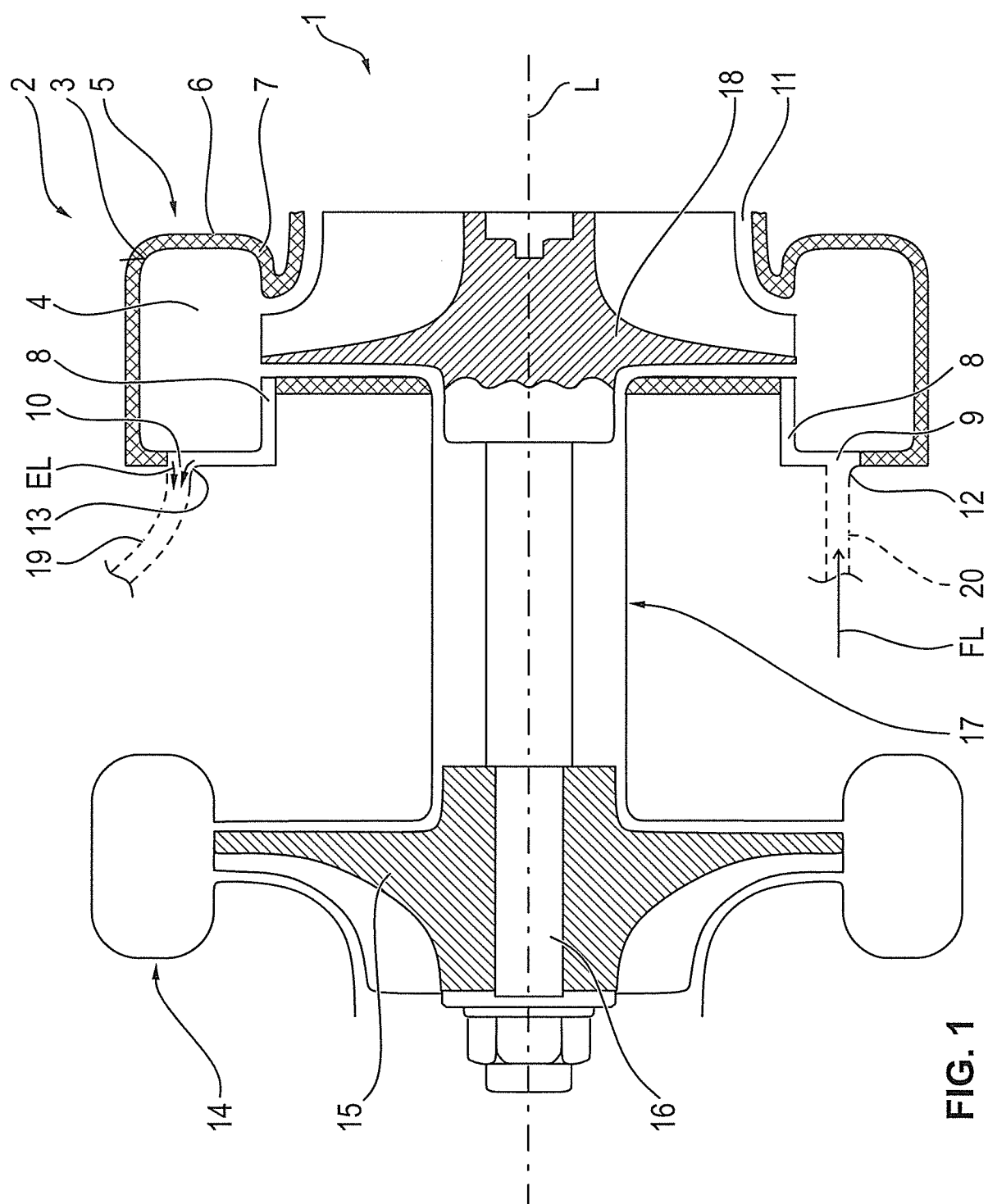
- in that, between the turbine housing outer surface (3) and an outer shell (6) of the turbine housing thermal insulation (5), there is arranged at least one flow

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duct (8) which has an inlet opening (9) and an outlet opening (10) which are arranged in the outer shell (6).

14. The turbine housing as claimed in claim 13, characterized by at least one
5 of claims 2 to 12.

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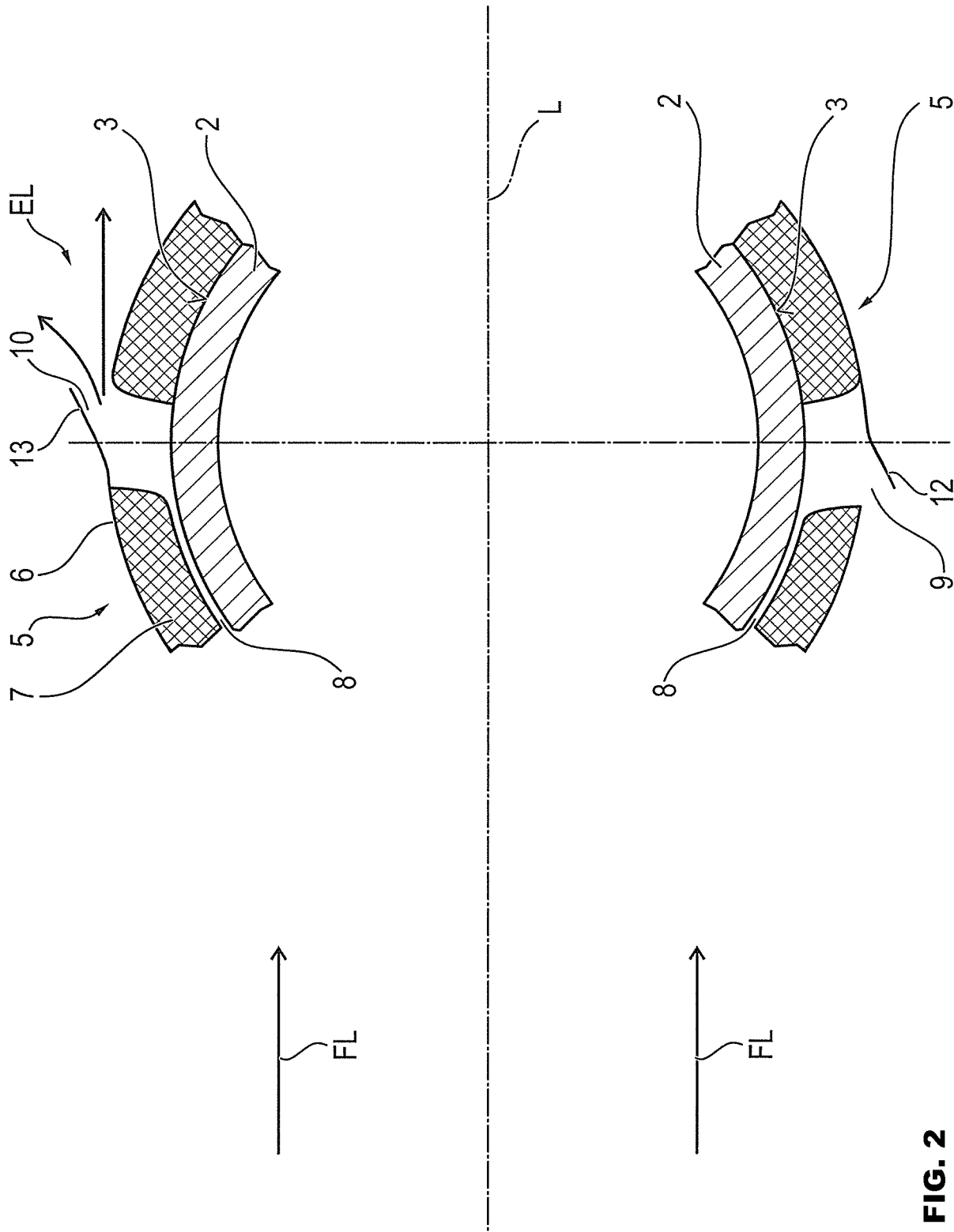


FIG. 2

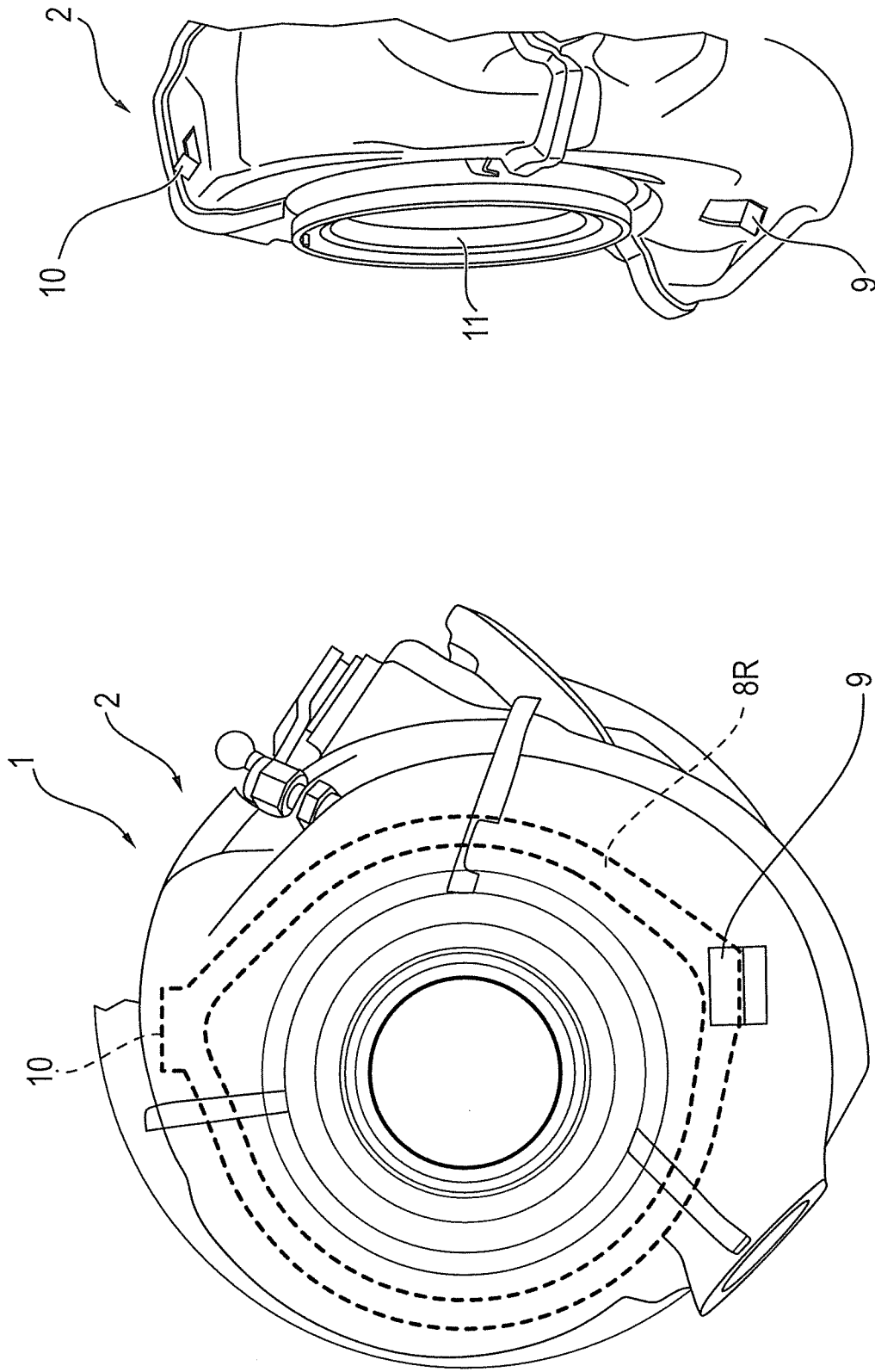


FIG. 3b

FIG. 3A

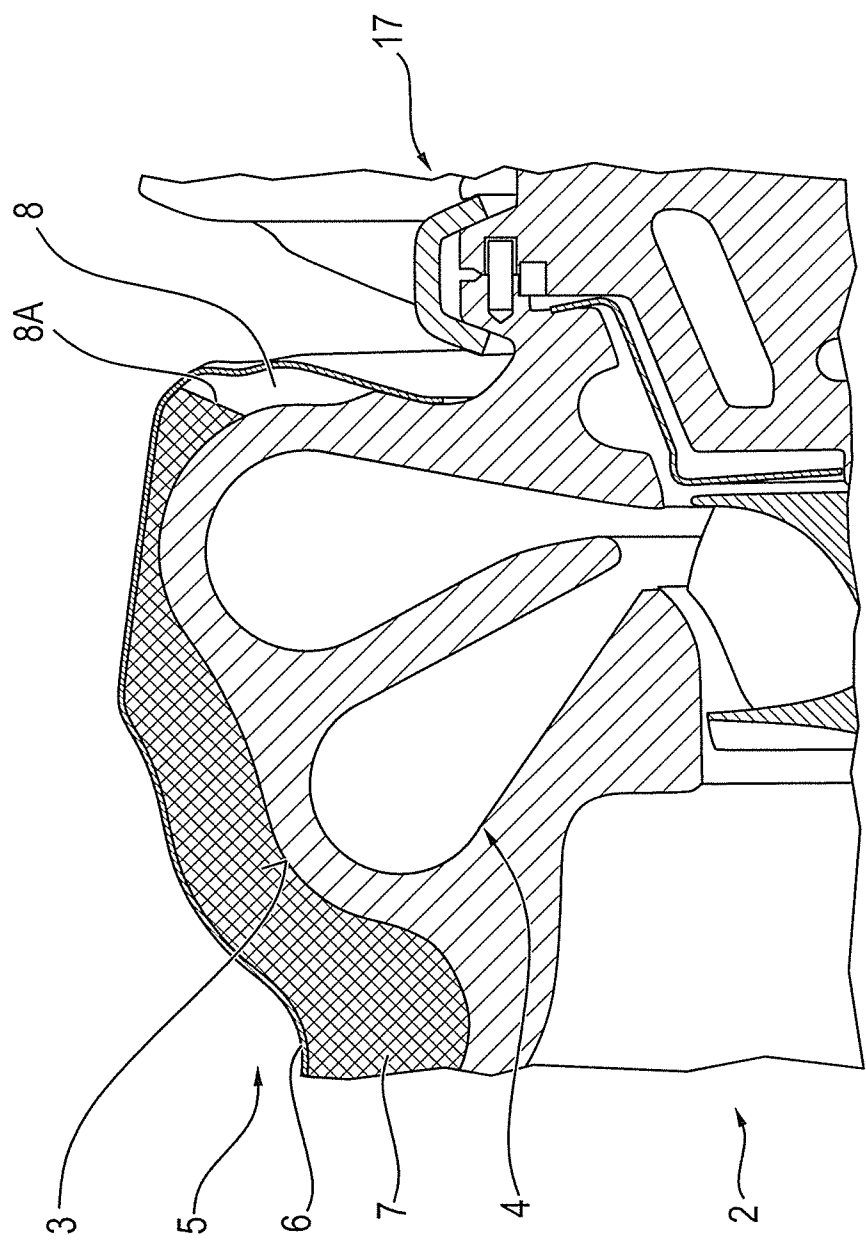
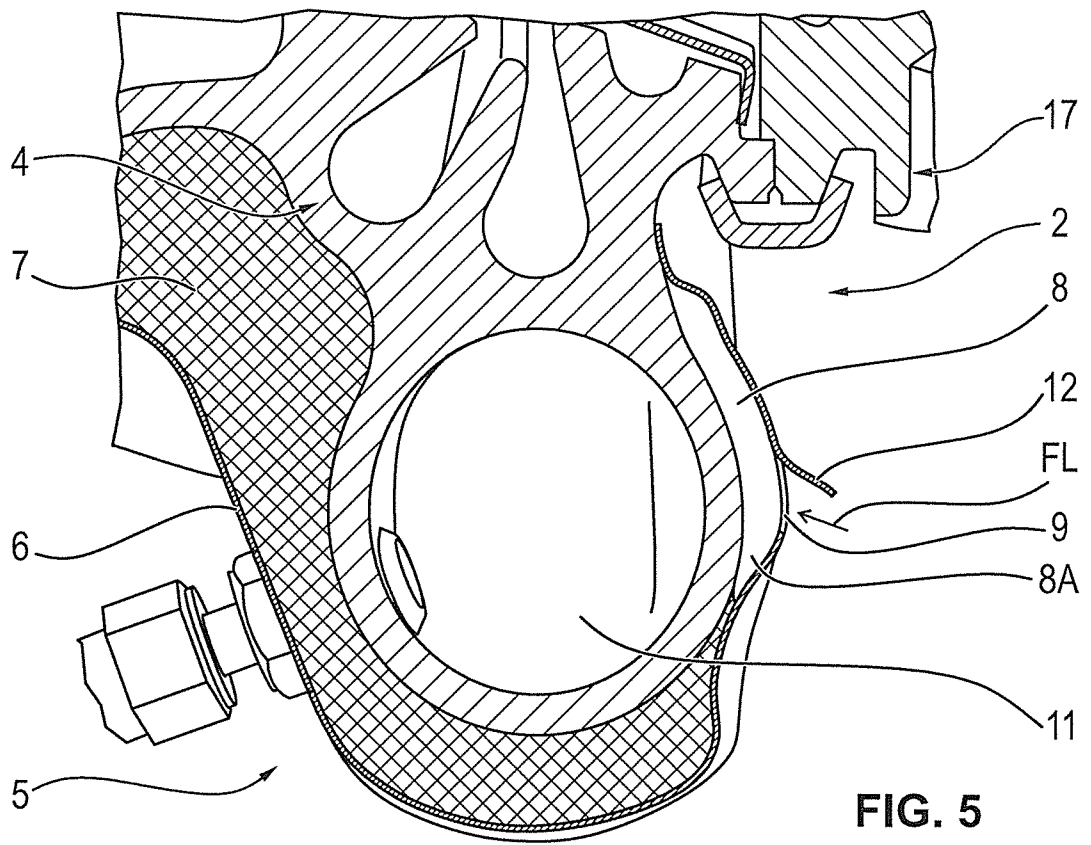
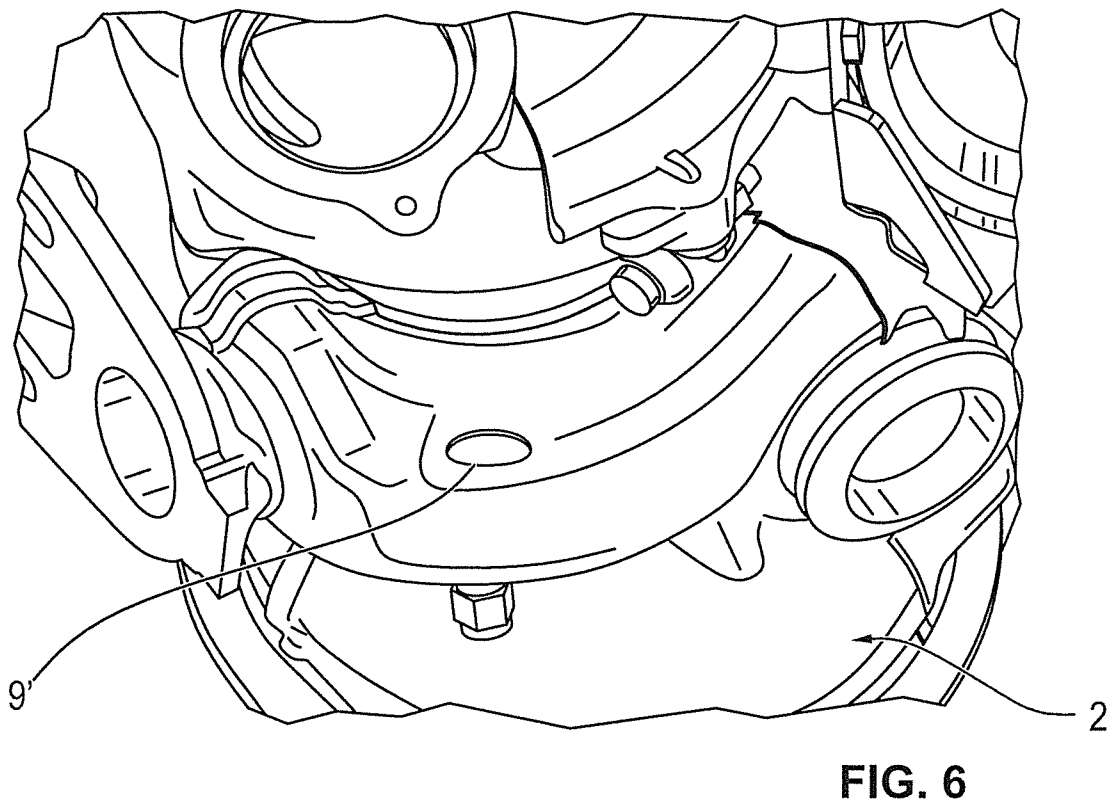


FIG. 4

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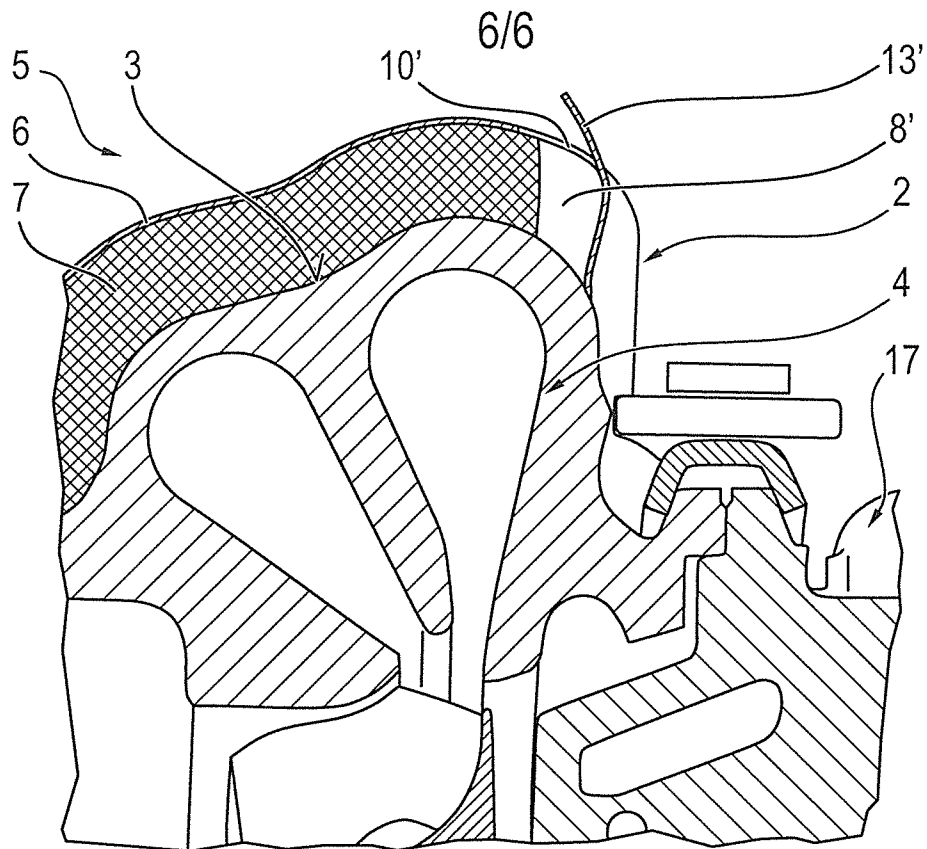


FIG. 7

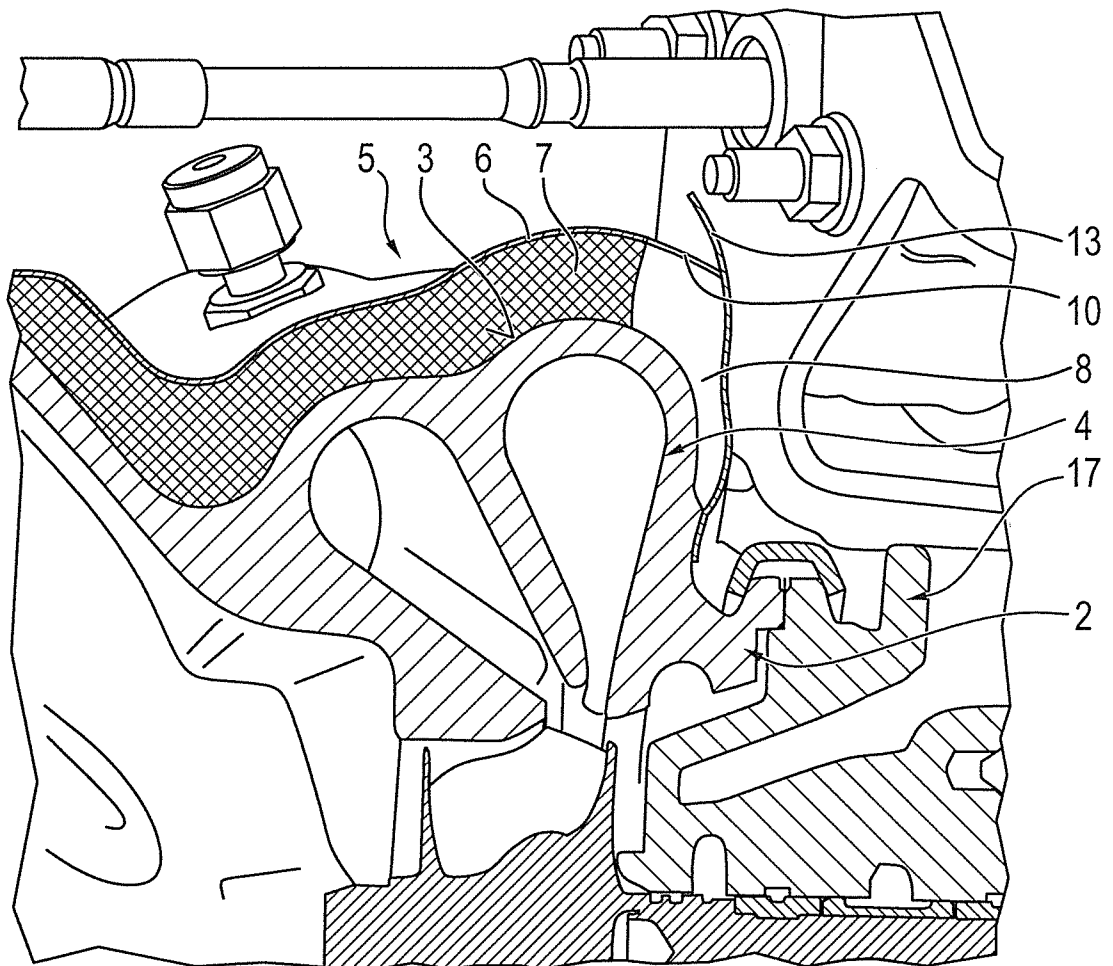


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/039913

A. CLASSIFICATION OF SUBJECT MATTER
INV. F01D25/14 F02B39/00 F02C6/12
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)

F01D 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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 4 300 349 A (HECKEL JOHANN) 17 November 1981 (1981-11-17) column 3, line 57 - column 4, line 40; figure 1 ----- -/--	1-14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Steinhauser, Udo

INTERNATIONAL SEARCH REPORT

International application No
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