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(54) **Charging device**

(57) The present invention relates to a charging device (1), preferentially an exhaust gas turbocharger (1') for a combustion engine, with a compressor (2), comprising a compressor wheel (4) which radially displaces axially onflowing fluid, particularly air. Here it is substantial to the invention that an adjusting device (10) is provided, which in a first position exclusively conducts the displayed fluid to a spiral housing (6) of the charging device (1), while the adjusting device (10) in a second position exclusively conducts the air displaced by the compressor wheel (4) into a recirculation channel (12).

The invention furthermore relates to a combustion engine having such a charging device (1).

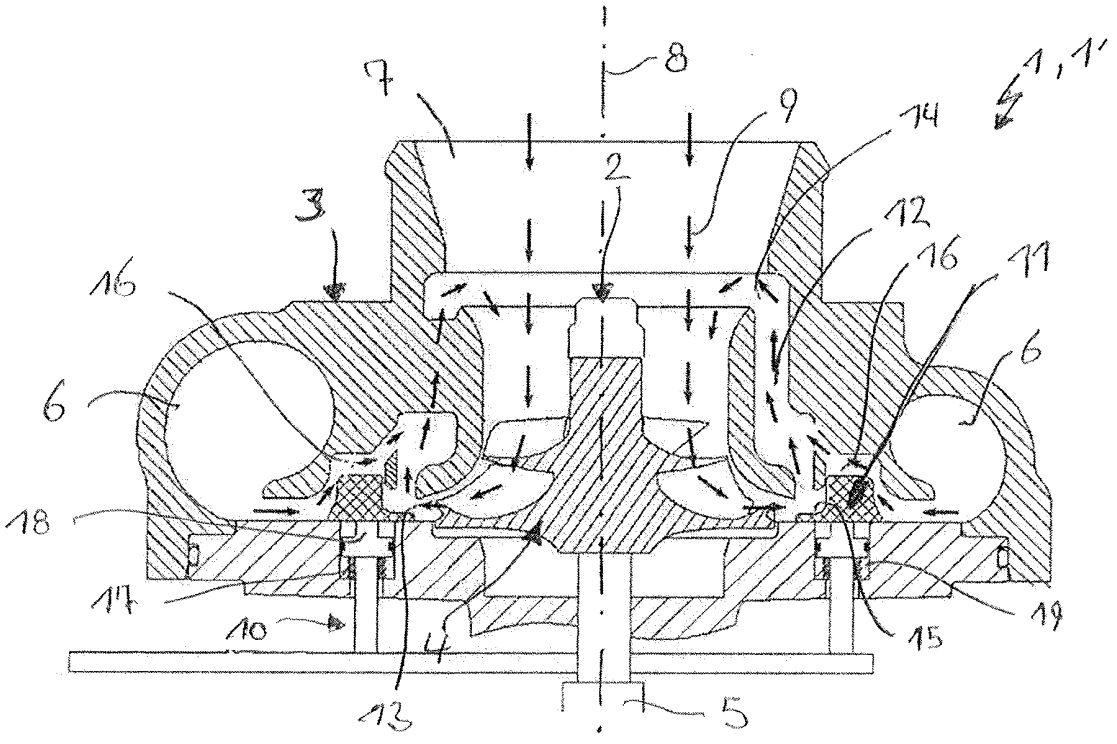

Fig. 2

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Description

[0001] The present invention relates to a charging device, in particular an exhaust gas turbocharger for a combustion engine with the features of the preamble of Claim 1. The invention furthermore relates to a combustion engine with such a charging device.

[0002] A charging device, particularly an exhaust gas turbocharger, serves to increase the power of a combustion engine and is thoroughly known. Such a charging device comprises a compressor wheel subjected to an axial onflow, which compresses and radially displaces the air. In the case of an exhaust gas turbocharger the radially displaced air usually enters a spiral housing of the charging device and subsequently the associated combustion engine. The pressure thus established in the compressed air can, under certain conditions, for example when a valve device in the air supply of the combustion engine is closed, reach a value that is greater than the desired or needed pressure. This excess pressure of the air constitutes a major load for the charging device.

[0003] In order to reduce this excess pressure, GB 2 077 354 A proposes a recirculation channel which fluidically connects the spiral housing with a supply to the compressor wheel. Within the recirculation channel a slide is additionally provided, which can close and open the recirculation channel when required, so that with the opened recirculation channel the compressed air can return to the compressor inlet. Disadvantageous here is that even in the opened state of the recirculation channel a part of the air compressed by the compressor can continue to leave the spiral housing and enter the air supply of the associated combustion engine.

[0004] The present invention deals with the problem of stating an improved embodiment for a charging device of the generic type which is particularly characterized by an improved possibility for the pressure removal of the fluid compressed by a compressor wheel of the charging device.

[0005] According to the invention, this problem is solved through the features of the independent claims. Advantageous embodiments are the subject of the dependent claims.

[0006] The present invention is based on the general idea of equipping a charging device, particularly an exhaust gas turbocharger for a combustion engine, with an adjusting device and/or designing a recirculation channel of the charging device in such a manner that the adjusting device in a predefined position exclusively supplies the fluid compressed by a compressor wheel of the charging device to the recirculation channel. The adjusting device thus prevents in particular that the fluid compressed by the compressor wheel or by a compressor enters a spiral housing or at least reduces the quantity of the compressed fluid that leaves the charging device or that enters the spiral housing. The charging device comprises the compressor, which includes the compressor wheel, wherein the compressor wheel is subjected to axial onflow. The onflow of the compressor wheel can for example comprise an inlet which axially supplies the fluid to be compressed to the compressor wheel. With a combustion engine, the fluid to be compressed is generally air so that the term air in the following is used equivalent to the term fluid. However, it is clear that the compressor or the compressor wheel can also compress other fluids. The compressor wheel displaces the air in the radial direction. The air displaced in the radial direction and compressed enters the spiral housing from where it can be supplied to an associated combustion engine. To this end, the spiral housing can for example comprise a hollow space or an outlet channel or be designed as such. The radial and the axial directions are defined with respect to the rotary axis of the compressor wheel. The axial direction thus runs parallel to the rotary axis of the compressor wheel, while the radial direction runs orthogonally thereto. The compressor or the compressor wheel is drivingly connected to a turbine or to a turbine wheel of the turbine with the help of a shaft, so that the compressor wheel is driven by the turbine wheel. The compressor wheel driven by the turbine thus compresses the air dependent on a rotation of the turbine wheel. In the process, the pressure of the air compressed by the compressor wheel can exceed a needed or desired pressure. According to the invention, the adjusting device is now provided which comprises a slide which in a first position closes off the recirculation channel and thus exclusively supplies the compressed air to the spiral housing. This is particularly the case when the pressure in the air compressed by the compressor wheel does not reach the needed or desired pressure. In addition, the slide can be slid into a second position, wherein the slide in the second position exclusively supplies the air compressed by the compressor wheel to the recirculation channel, so that the compressed air cannot enter the spiral housing, at least not directly. The recirculation channel thus conducts the compressed air particularly to the inlet of the charging device. In addition, the recirculation of the air through the recirculation channel results in that a flow velocity of the air axially flowing onto the compressor wheel decreases, by which the air rate displaced by the compressor wheel is also reduced. The recirculation channel is preferentially formed in a compressor housing of the compressor and/or in the spiral housing. The slide of the adjusting device is preferentially brought into the second position when the pressure of the air in the spiral housing exceeds a desired or required or predefined value.

[0007] The slide, according to a preferred embodiment, allows in its second position a return flow of air present in the spiral housing into the recirculation channel. The slide and/or the recirculation channel are thus designed or activated in such a manner that the slide in the second position on the one hand exclusively conducts the air delivered by the compressor wheel into the recirculation channel and on the other hand permits the return flow of the air present in the spiral housing. One thus succeeds to efficiently and briskly remove the pressure

of the air in the spiral housing if required and simultaneously prevent a flow of air into the spiral housing, provided the pressure in the recirculation channel does not exceed the pressure in the spiral housing. However, this can be avoided for example through the arrangement of a suitable valve, particularly of a non-return valve. The simultaneous return flow can for example be realised through a return channel that fluidically connects the spiral housing to the recirculation channel, wherein the return channel and the recirculation channel can coincide at least in regions. In particular, it is also possible that the return channel directly connects the spiral housing fluidically to the inlet of the charging device, that is without fluidic connection to the recirculation channel.

[0008] To improve the air circulation with the slide located in the second position, the recirculation channel can annularly surround the compressor wheel. Thus, the recirculation channel has a larger volume or a larger cross section, so that the air delivered by the compressor wheel can be better and more efficiently recirculated. Alternatively or additionally it is also possible that said return channel follows an annular course in order to guarantee an improved flow of air present in the spiral housing.

[0009] Practically, the slide is of an annular design. Embodiments are also conceivable, wherein a plurality of slides are provided, which are arranged annularly about the compressor wheel. The annularly designed recirculation channel and/or the annularly designed return channel and/or the annularly designed slide can in particular be broken through or interrupted by the compressor housing.

[0010] The adjusting device preferentially comprises a safety device, which adjusts the adjusting device or the associated slide in the event of a failure of the adjusting device into the first position. This means that the adjusting device is designed or equipped in such a manner that the supply of the air compressed by the compressor wheel to the spiral housing is guaranteed in the event of a failure of the adjusting device. This safety device can for example be a spring device or designed as spring device, which slides or adjusts the slide into its second position in the event of the failure of the adjusting device.

[0011] Preferably, the slide is designed in such a manner and/or arranged in such a manner that it can be adjusted or slid transversely to the flow direction of the air. Because of this, the force required for adjusting the slide and the corresponding loading of the adjusting device, particularly compared to a sliding of the slide parallel to the flow direction, is reduced.

[0012] The slide can have any size and shape, provided the air compressed by the compressor wheel in the first position of the slide exclusively reaches the spiral housing, while the air displaced or compressed by the compressor wheel in the second position of the slide exclusively reaches the recirculation channel or can flow back from the spiral housing. In particular, the slide can have a guiding contour radially directed to the inside, which in the first position closes off the recirculation channel and in the second position diverts the air onflowing from the compressor wheel into the recirculation channel. To this end, the guiding contour of the slide is more preferably designed or shaped complementarily to an inlet of the recirculation channel.

[0013] In general, the slide can be produced of any material. More preferably, the slide can be produced of metal or of a metallic material and/or of plastic. In particular, the slide can have a surface produced from plastic, which in the relevant positions of the slide improves a fluidic sealing with the help of the slide. Analogously to this, the slide can comprise a sealing element which guarantees the sealing property.

[0014] The recirculation channel can lead into the inlet at any point and in any way. However, preferred is an embodiment wherein the recirculation channel leads into the feeder parallel to the axis of the compressor or tangentially to the compressor wheel. This in particular results in that a braking of the compressor wheel with the help of the recirculated air does not bring about any abrupt stoppage of the compressor wheel or any unfavourable onflow of the compressor wheel.

[0015] It is to be understood that the slide of the adjusting device is freely slidable between the first position and the second position. In particular, the slide can be adjusted into any intermediate position between the first and the second position, so that a metering of the air supplied to the spiral housing and the recirculated air and/or the air returned from the spiral housing is possible.

[0016] According to an advantageous further development of the solution according to the invention the charging device is arranged in a combustion engine. An air supply of the combustion engine in this case is fluidically connected to the spiral housing, while an exhaust discharge of the combustion engine is fluidically connected to the turbine wheel.

[0017] In addition, a valve device, particularly a throttle valve, can be provided, which is more preferably arranged between the spiral housing and the combustion engine, preferentially in the air supply of the combustion engine. The valve device in this case regulates the rate of air to be supplied to the combustion engine. In a closed state of the valve device the air displaced by the charging device consequently increases the pressure of the air between the compressor wheel and the valve device. Through the adjusting of the adjusting device or of the slide into the second position, this excess pressure can be prevented or removed, and/or does not result in the backflow of air to the compressor wheel.

[0018] Further important features and advantages of the invention are obtained from the subclaims, from the drawings and from the associated Figure description by means of the drawings.

[0019] It is to be understood that the features mentioned above and still to be explained in the following cannot only be used in the respective combination stated but also in other combinations or by themselves without

leaving the scope of the present invention.

[0020] Preferred exemplary embodiments of the invention are shown in the drawings and are explained in more detail in the following description, wherein same reference characters refer to same or similar or functionally same components.

[0021] Here it shows, in each case schematically,

Fig. 1 a cross section through a charging device with a first position of an adjusting device,

Fig. 2 a cross section through the charging device with a second position of an adjusting device.

[0022] According to the shown Figures, a charging device 1, which can in particular be designed as an exhaust gas turbocharger 1' for a combustion engine, comprises a compressor 2, which is arranged in a compressor housing 3 of the charging device 1. The compressor 2 comprises a compressor wheel 4, which is driveconnected with a turbine wheel of the turbine with the help of a shaft 5. The compressor wheel 4 is surrounded by a spiral housing 6, wherein the spiral housing 6 is formed in the compressor housing 3 of the charging device 1. For the sake of simplified description, it is assumed in the following that the spiral housing 6 at its fluidic end distant from the compressor wheel 4 is connected to an associated combustion engine.

[0023] The charging device 1 additionally comprises a compressor inlet 7 or simply an inlet 7, which axially supplies a fluid, particularly air, to be compressed by the compressor 2, axially to the compressor wheel 4. The axial direction 8 in this case relates to the longitudinal direction of the shaft 5 or to a rotary axis of the compressor wheel 4.

[0024] A flow path of the air is indicated by arrows 9. As is evident in Figure 1, the compressor wheel 4 is subjected to axial onflow, wherein the compressor wheel 4 displaces the onflowing air in radial direction into the spiral housing 6 with the help of the drive transmitted by the turbine. Here, the air in the spiral housing 6 can have a pressure that is higher than a permitted or desired or predefined pressure. In this case it is desirable to reduce or to limit the pressure of the air located in the spiral housing 6. To this end, the charging device 1 comprises an adjusting device 10, which comprises at least one slide 11, wherein the shown adjusting device 10 merely comprises one such slide 11, which annularly surrounds the compressor wheel 4. In addition, a recirculation channel 12 is provided, which fluidically connects the inlet 7 to a radial outlet 13. The slide 11 of the adjusting device 10 is shown in a first position in the view shown in Figure 1. With this first position of the slide 11, the fluidic connection of the recirculation channel 12 to the radial outlet region 13 is closed off by the slide 11, so that the air radially displaced by the compressor wheel 4 exclusively enters the spiral housing 6.

[0025] If a pressure removal in the spiral housing 6 is now desired or it is necessary not to displace any additional compressed air into the spiral housing 6, the slide 11 is adjusted into a second position, which is shown in the Figure 2. Here, the fluidic connection between the radial outlet region 13 and the recirculation channel 12 is opened, so that the air displaced by the compressor wheel 4 exclusively enters the recirculation channel 12. Accordingly, no additional pressure increase of the air present in the spiral housing 6 is affected by this. The air flowing through the recirculation channel 12 thus enters the inlet 7, wherein this recirculated air has a flow direction other than the air flow arriving in the inlet 7 upstream of a junction point 14 of the recirculation channel 12. Accordingly, the airflow arriving upstream of the junction point 14 is braked through the recirculated air, as a result of which an additional reduction of the air displaced by the compressor wheel 4 is achieved.

[0026] The slide 11 is designed in such a manner that it diverts the air flowing out of the radial outlet point 13 into the recirculation channel 12. To this end, the slide has a corresponding guiding contour 15 radially directed to the inside.

[0027] As is visible in particular in Figure 2, a return channel 16 is additionally provided which fluidically connects spiral housing 6 to the recirculation channel 12. In addition, the slide 11 is shaped or designed in such a manner that it opens the fluidic connection between the return channel 16 and the recirculation channel 12 in the second position of the slide 11, so that air located in the spiral housing 6 can flow out of the spiral housing 6 through the return channel 16 and via the recirculation channel 12, as a result of which the pressure of the air present in the spiral housing 6 is reduced. As is evident in Figure 1, the slide 11 in its first position closes off the fluidic connection between the spiral housing 6 and the recirculation channel 12, so that the air present in the spiral housing 6 cannot flow out of the spiral housing 6 via the return channel 16 or via the recirculation channel 12.

[0028] With the adjusting device 10 or the associated slide 11 and the recirculation channel 12 as well as the return channel 16 shown here it is possible in particular to supply the air delivered or displaced by the compressor wheel 4 in the first position of the slide 11 exclusively to the spiral housing 6. It is possible in addition to exclusively conduct the air displaced by the compressor wheel 4 in the second position of the slide 11 exclusively into the recirculation channel 12 and simultaneously with the same slide 11 make possible that the air present in the spiral housing 6 flows out into the inlet 7.

[0029] The adjusting device 10 in this case is able to adjust the slide 11 also in intermediate positions between the first position shown in Figure 1 and the second position shown in Figure 2, so that a metering of the air displaced by the compressor wheel 4 to the spiral housing 6 or to the recirculation channel 12 is also possible. Here, the adjustment takes place in the manner known per se, wherein the adjusting device 10 in particular can be con-

nected to a control and/or a sensor device, so that the adjusting device 10 can be adjusted dependent on the pressure in the flow path 9 of the air, particularly in the spiral housing 6, and/or dependent on state variables of the associated combustion engine.

[0030] In addition, the adjusting device 10 is designed in such a manner that the slide 11 in the event of a failure of the adjusting device 10 is adjusted to the first position, so that the air displaced by the compressor wheel 4 is conducted into the spiral housing 6. To this end, the adjusting device comprises a spring device 17 interacting with the slide 11, which tensions a pin 18 of the adjusting device 12 in axial direction 8. In the first position, the pin 18, as evident in Figure 1, is arranged in the flow path 9 of the air, wherein the slide 11 on its side facing the pin 18 is designed flat in order to make possible a preferably frictionless flow of the air into the spiral housing 6. In the second position the pin 18 is retracted into a recess 19 in the compressor housing 3, wherein the plane side of the slide 11 facing the pin 18 bears against the compressor housing 3 and closes off the recess 19. Thus, the slide 11 is adjusted transversely to the flow direction of the air. Upon a failure of the adjusting device 10, the spring device 17 thus adjusts the slide 11 into the first position and thus ensures the flow of the compressed air into the spiral housing 6.

[0031] If the slide 11 is produced of a plastic or if the slide 11 has a plastic material, the sealing function of the recirculation channel 12 or of the return channel 16 shown in Figure 1 can be improved.

Claims

1. A charging device (1), particularly an exhaust gas turbocharger (1') for a combustion engine, with a compressor (2) having a compressor wheel (4) subjected to axial onflow which radially displaces compressed air, **characterized in that**

   - a recirculation channel (12) is provided
   - an adjusting device (10) with a slide (11) is provided, which in a first position closes off the recirculation channel (12) and because of this conducts the compressed air exclusively to a spiral housing (6) of the charging device (1) and which in a second position exclusively conducts the air delivered by the compressor wheel (4) into the recirculation channel (12).

2. The charging device according to Claim 1, **characterized in that** the slide (11) in its second position allows a return flow of air present in the spiral housing (6) into the recirculation channel (12).

3. The charging device according to Claim 1 or 2, **characterized in that** the recirculation channel (12) annularly surrounds the compressor wheel (4).

4. The charging device according to any one of the Claims 1 to 3, **characterized in that** a spring device (17) is provided, which in the event of a failure of the adjusting device (10) adjusts the slide (11) into its first position.

5. The charging device according to any one of the Claims 1 to 4, **characterized in that** the adjusting device (10) adjusts the slide (11) transversely to the flow direction of the air.

6. The charging device according to any one of the Claims 1 to 5, **characterized in that** the slide (11) comprises a guiding contour (15) directed radially to the inside, which in the first position closes off the recirculation channel (12) and in the second position diverts the onflowing air from the compressor wheel (4) into the recirculation channel (12).

7. The charging device according to any one of the Claims 1 to 6, **characterized in that** the slide (11) is formed of metal or of plastic.

8. The charging device according to any one of the Claims 1 to 7, **characterized in that** the recirculation channel (12) leads into a compressor inlet (7) of the compressor (2) tangentially to compressor wheel (4) or parallel to an axis (8) of the compressor wheel (4).

9. A combustion engine having a charging device (1) according to any one of the Claims 1 to 8.

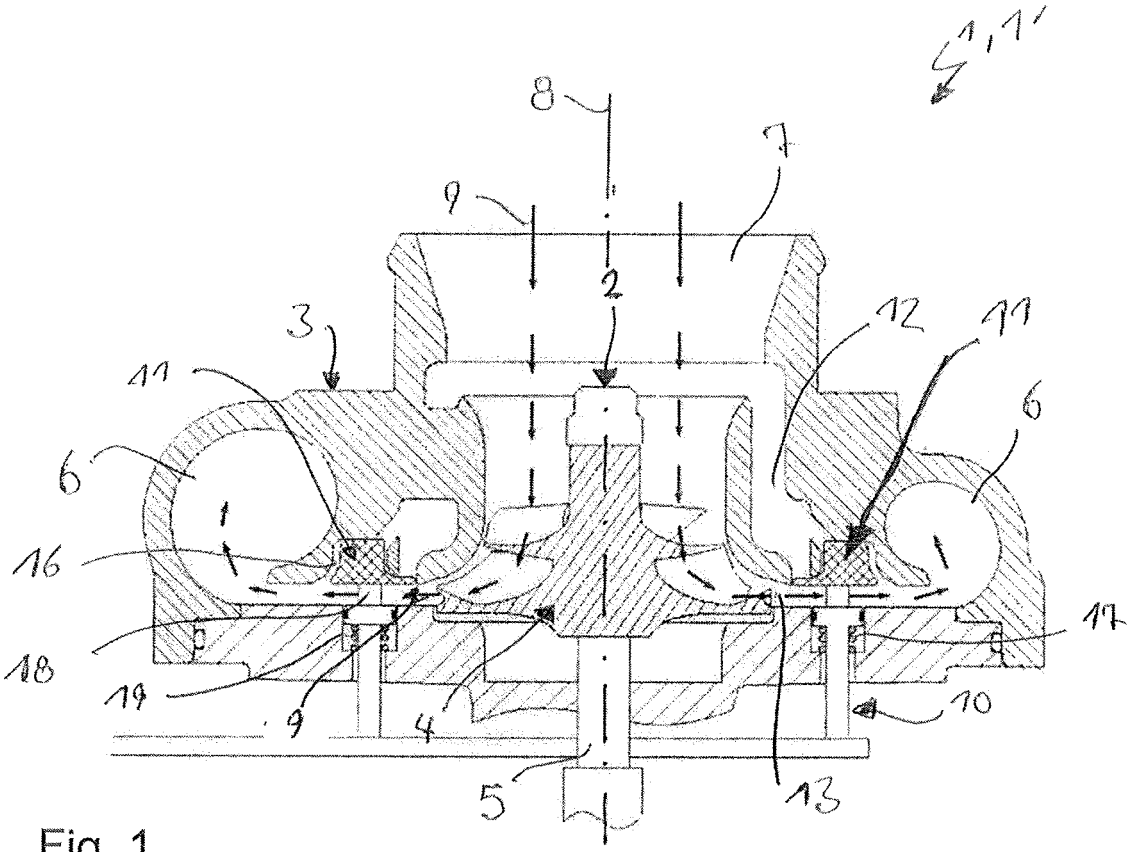
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Fig. 1

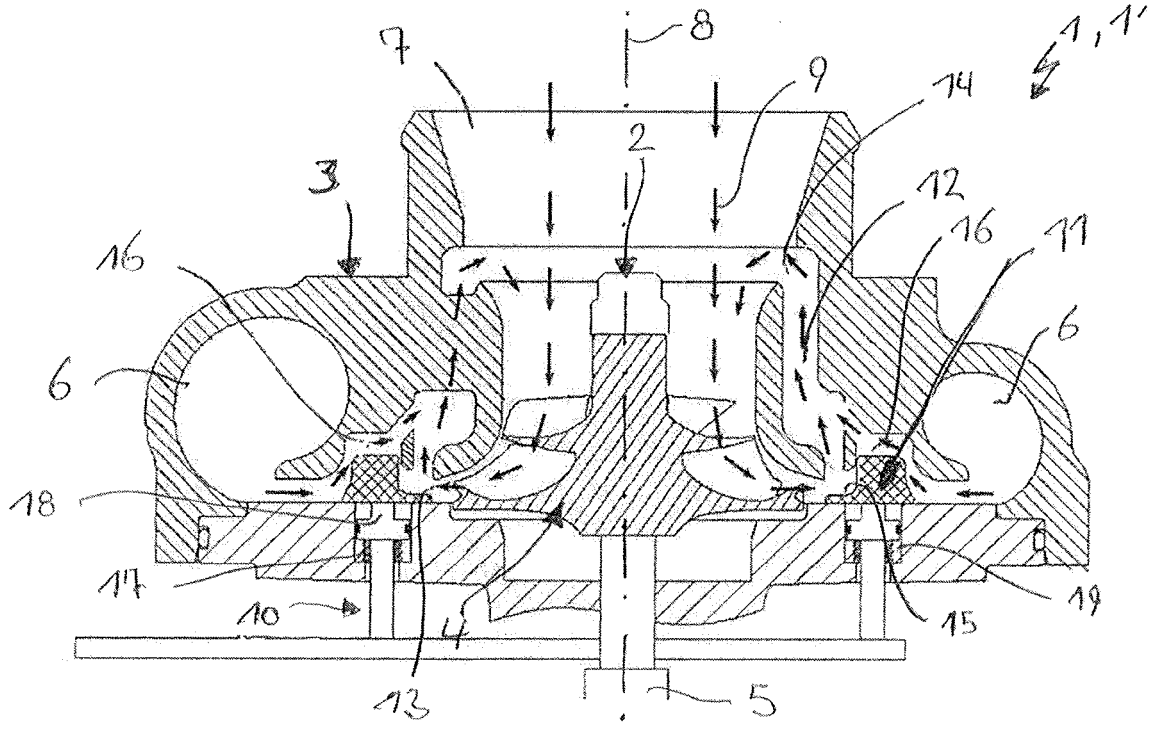
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Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 February 2012	O'Shea, Gearóid

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