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(54) **PRESWIRL GUIDE DEVICE**

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(57) **ABSTRACT**

The preswirl guide device for generating a preswirl in the intake region of a compressor comprises a multiplicity of guide vanes, which are pivotable about a respective vane shank connected to the guide vane, and a pivotable adjusting ring and adjusting levers for transmitting torque from the adjusting ring to the vane shank of each guide vane. The vane shank and the adjusting lever of the respective guide vanes are of one-piece design. The casing in which the guide vanes are rotatably mounted consists of at least two parts joined together in the region of the bearings of the guide vanes. Due to the one-piece design of the guide vane, the number of components to be fitted is reduced. This simplifies the fitting and possible service work on the guide device.

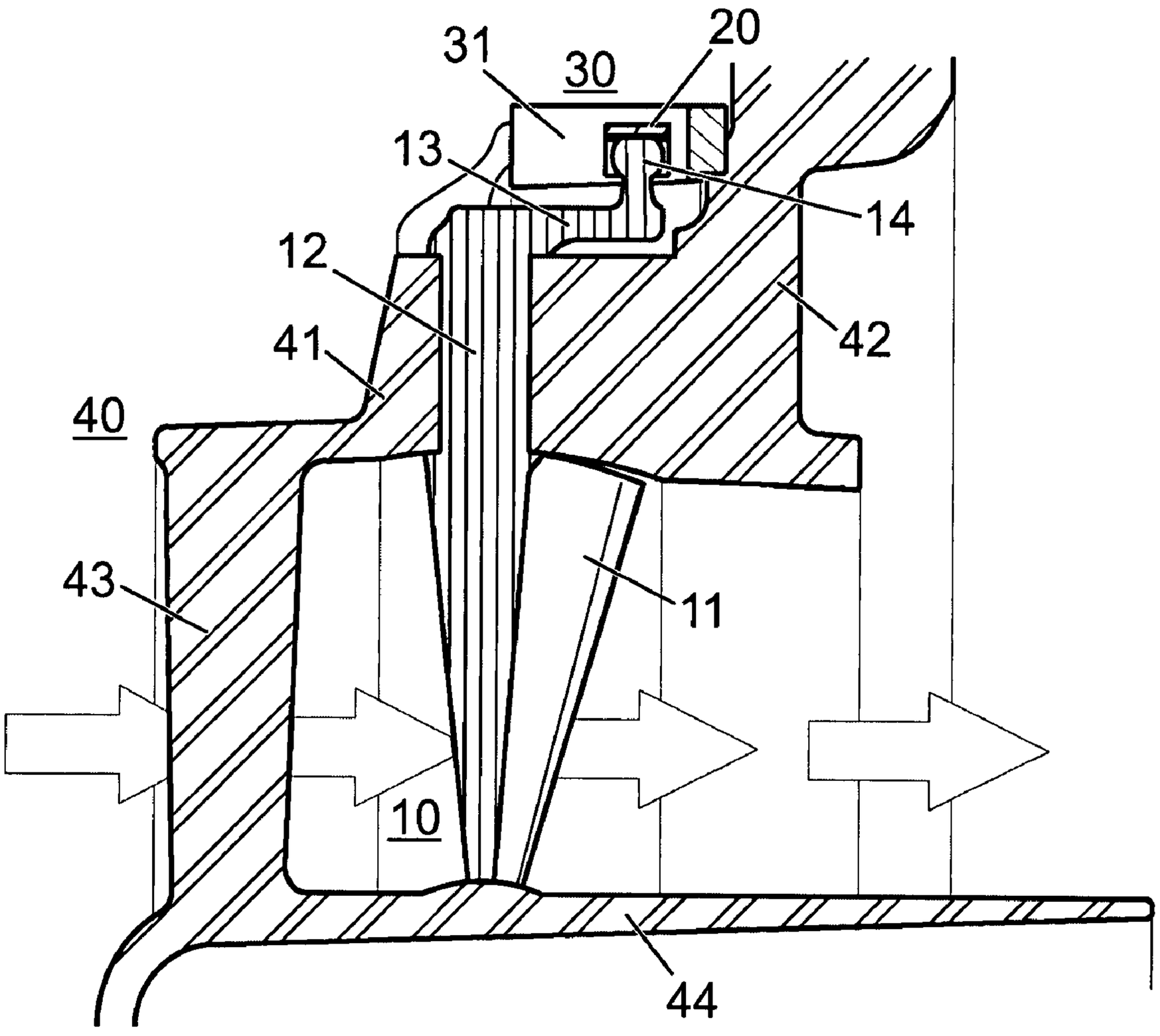
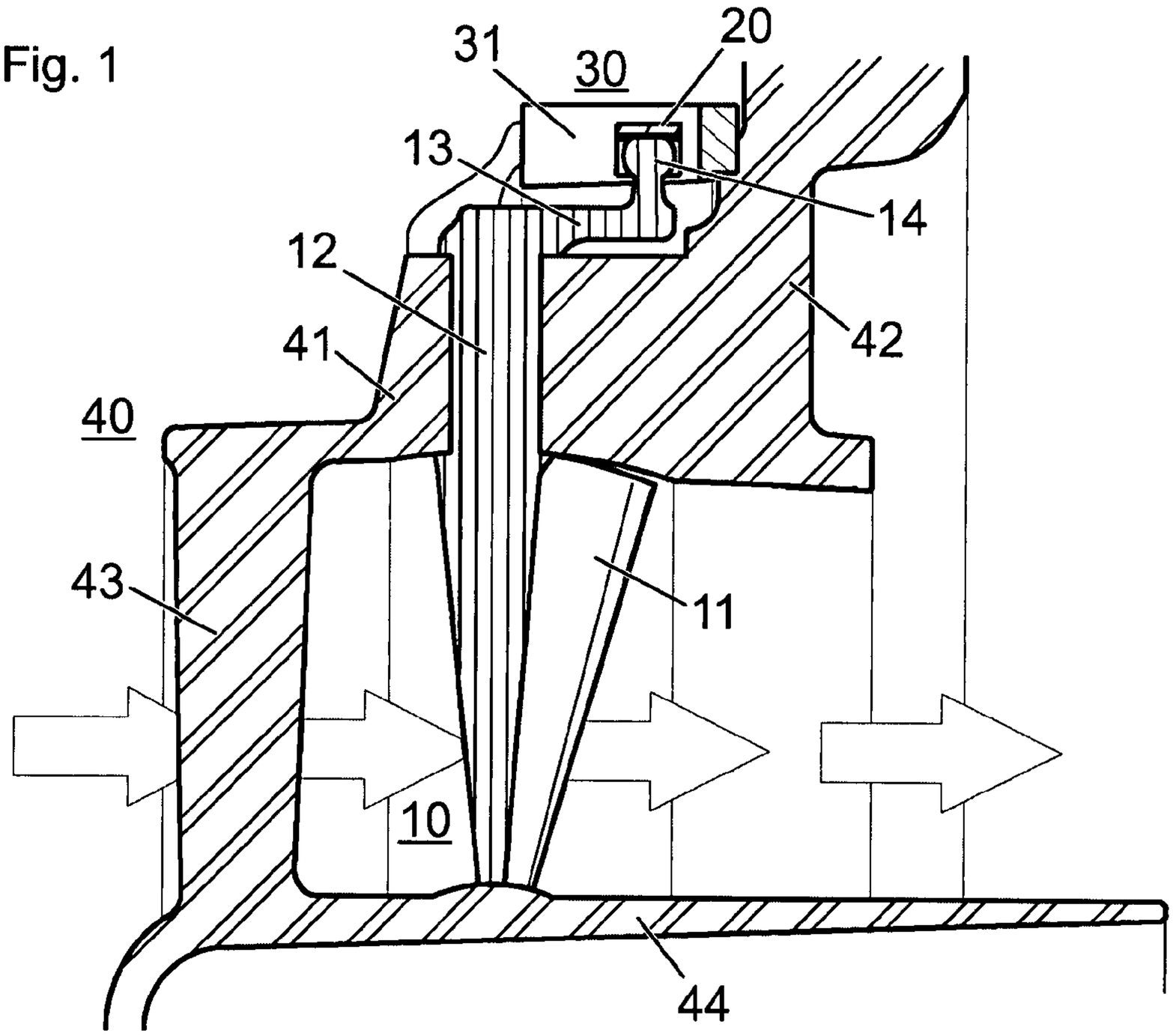


Fig. 1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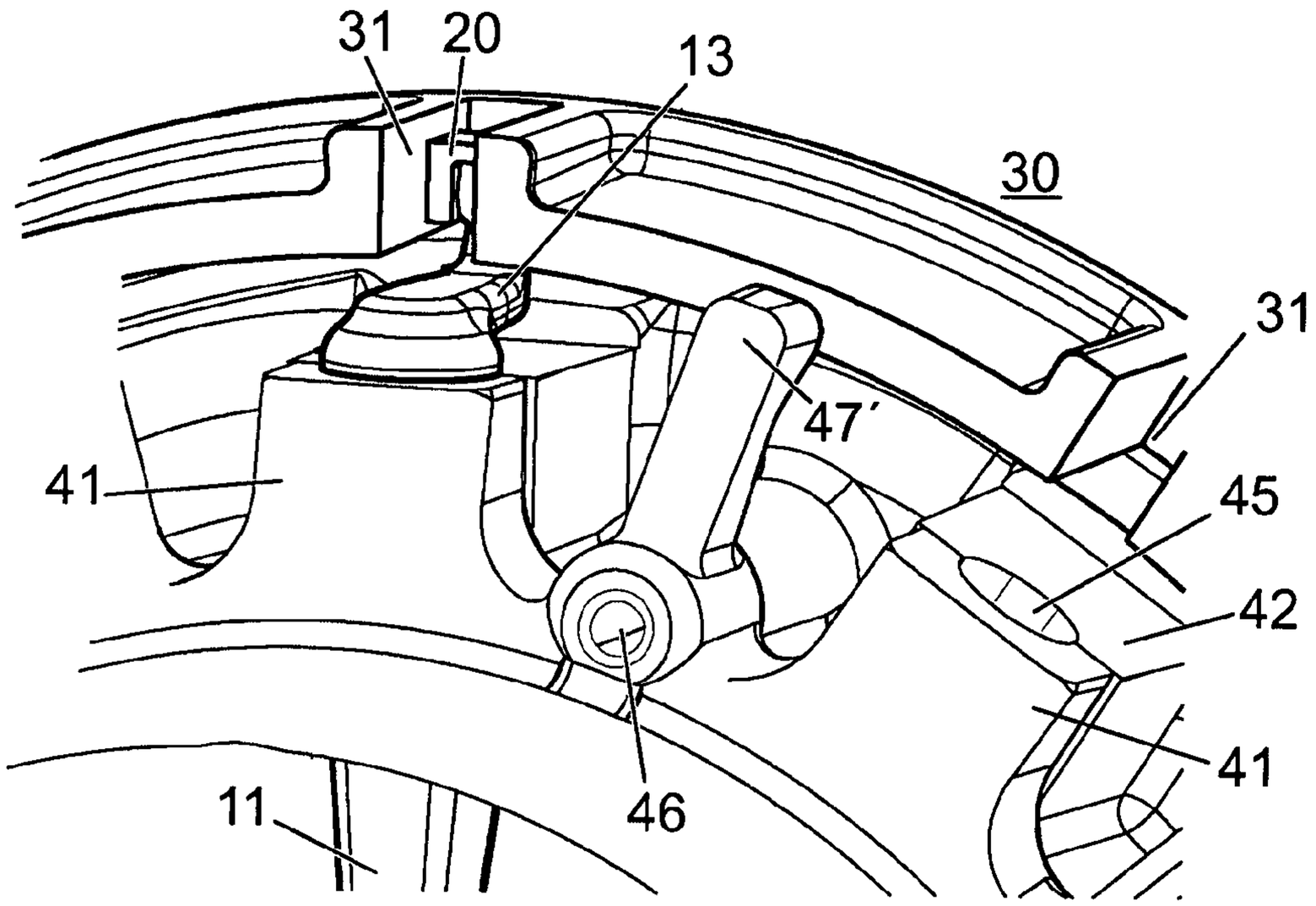
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Fig. 2

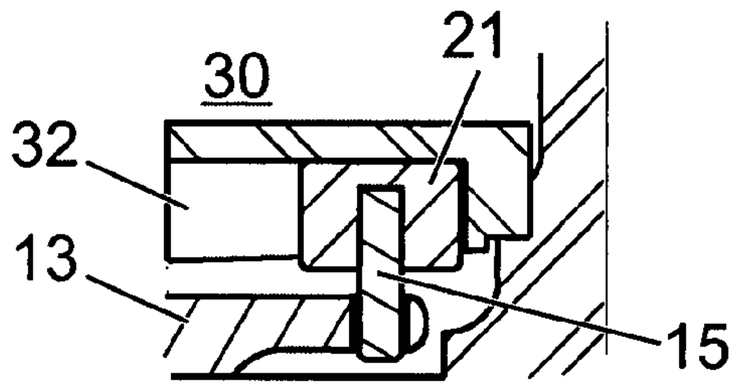


Fig. 9

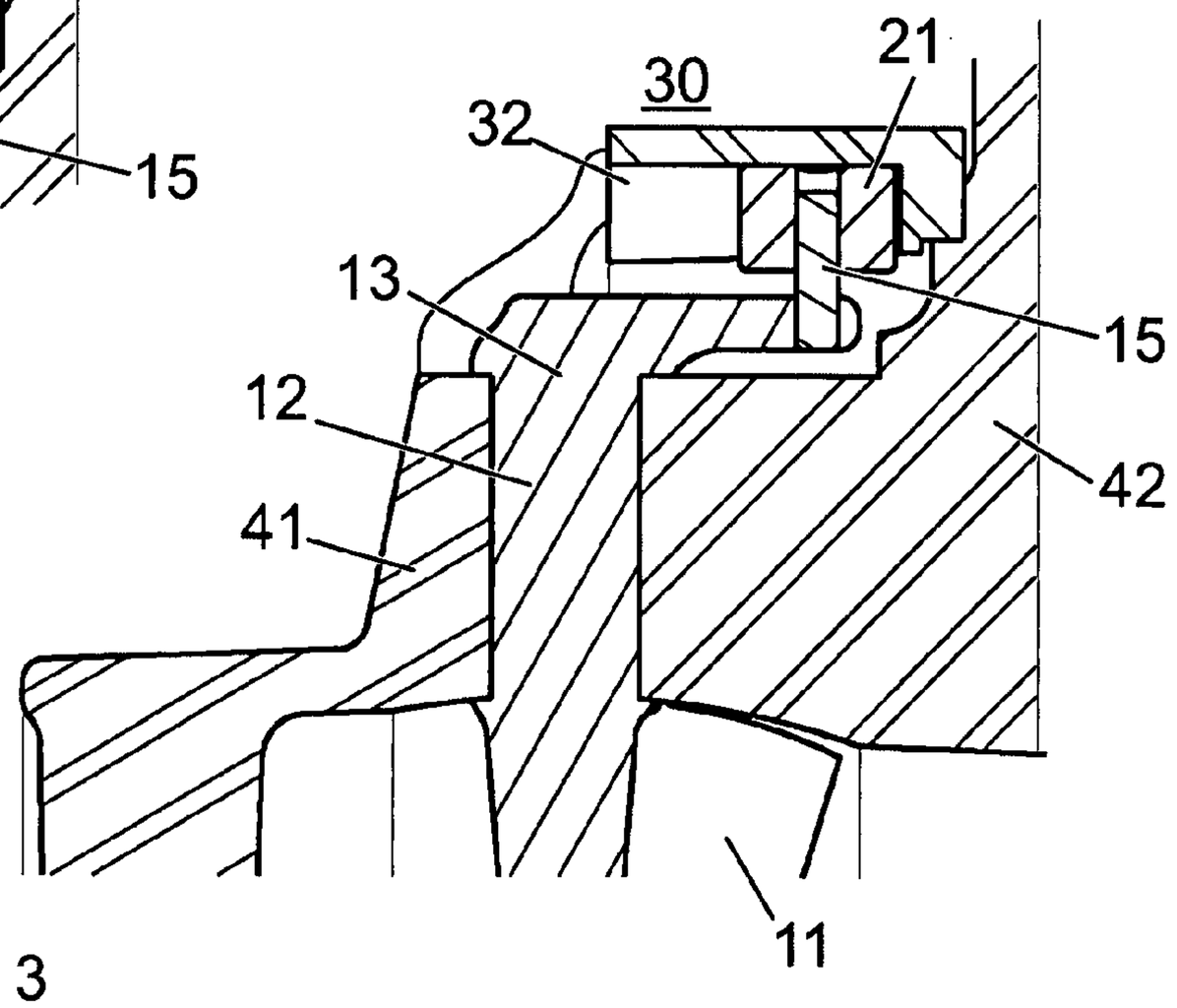


Fig. 3

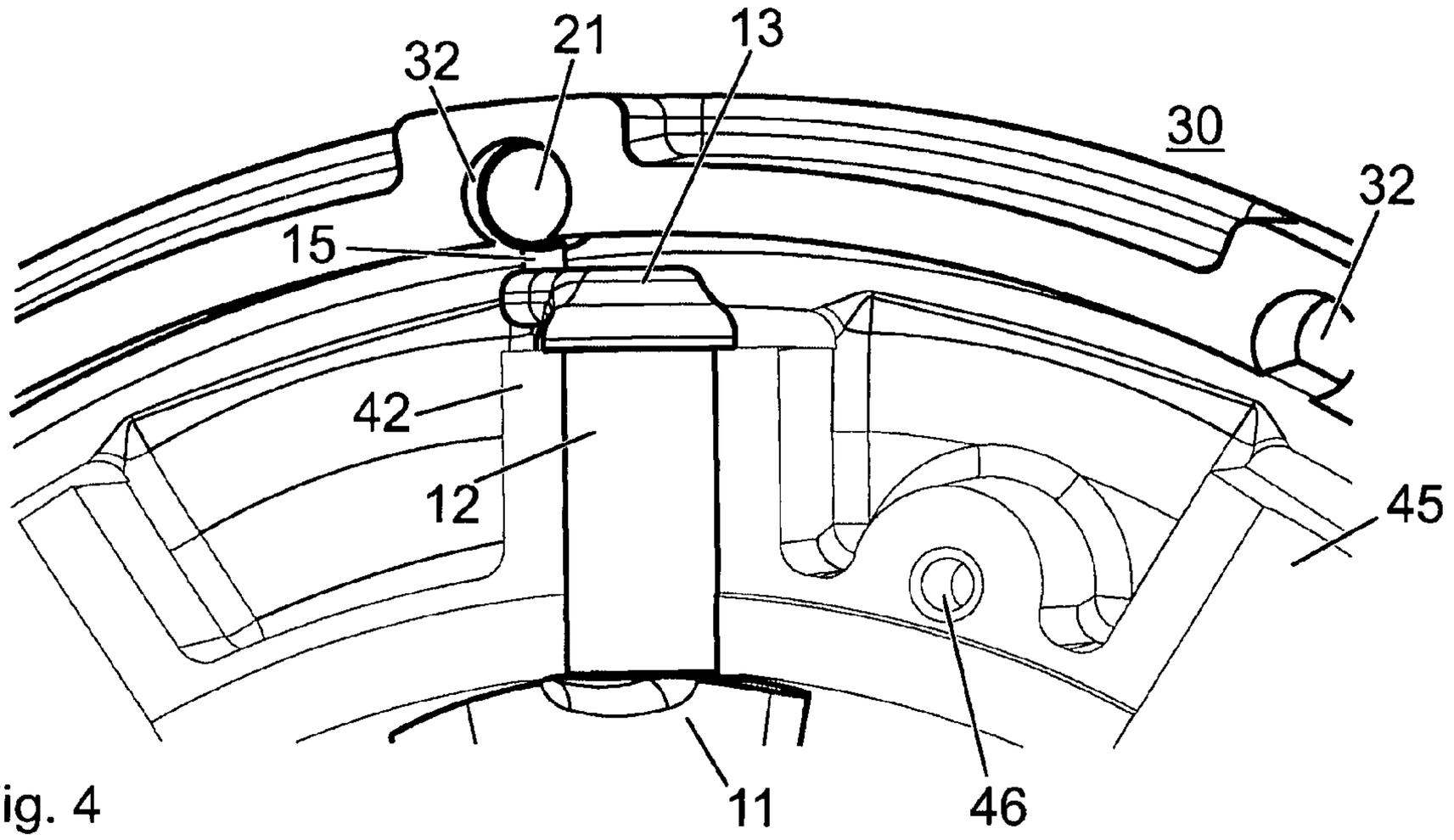


Fig. 4

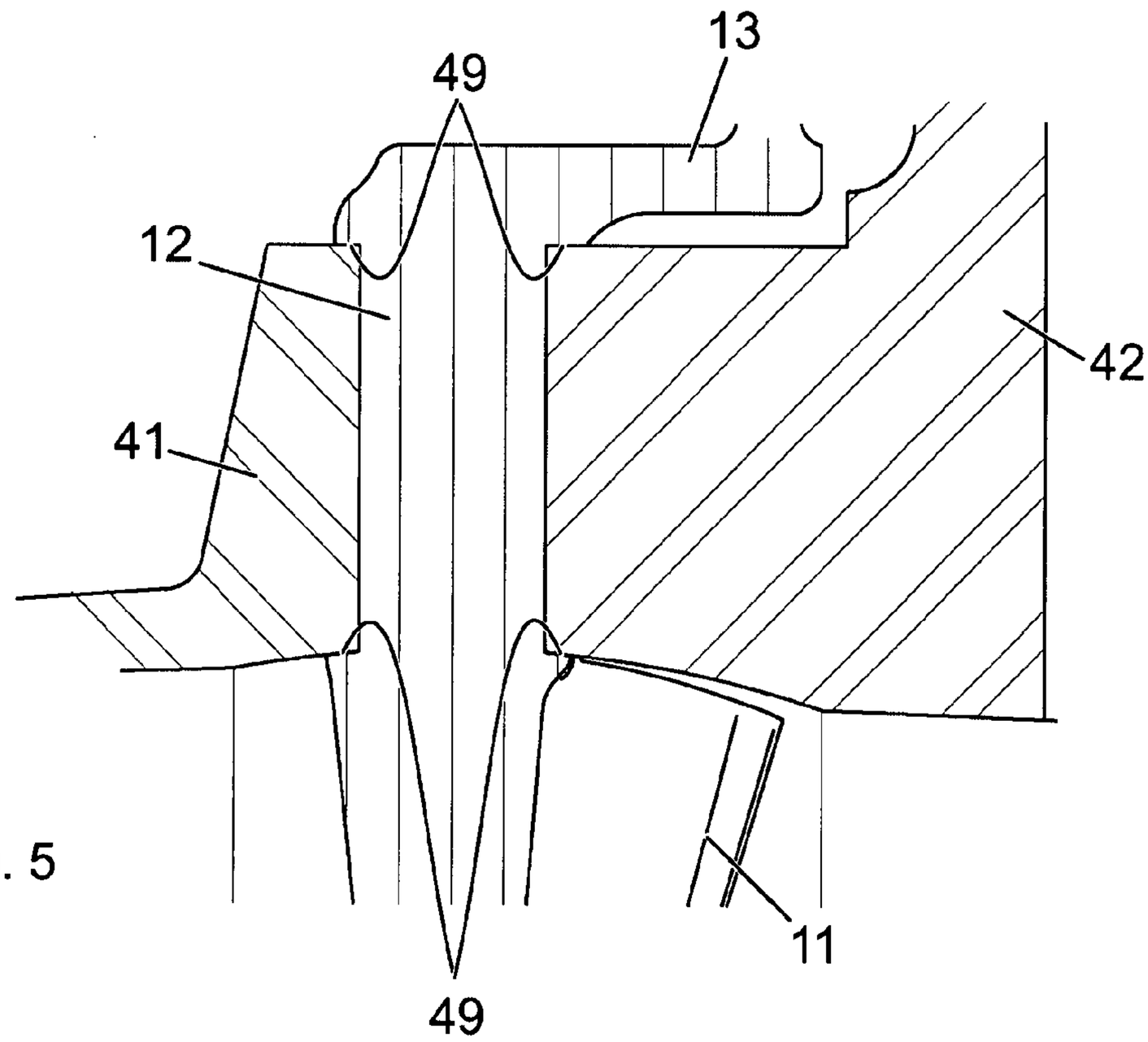


Fig. 5

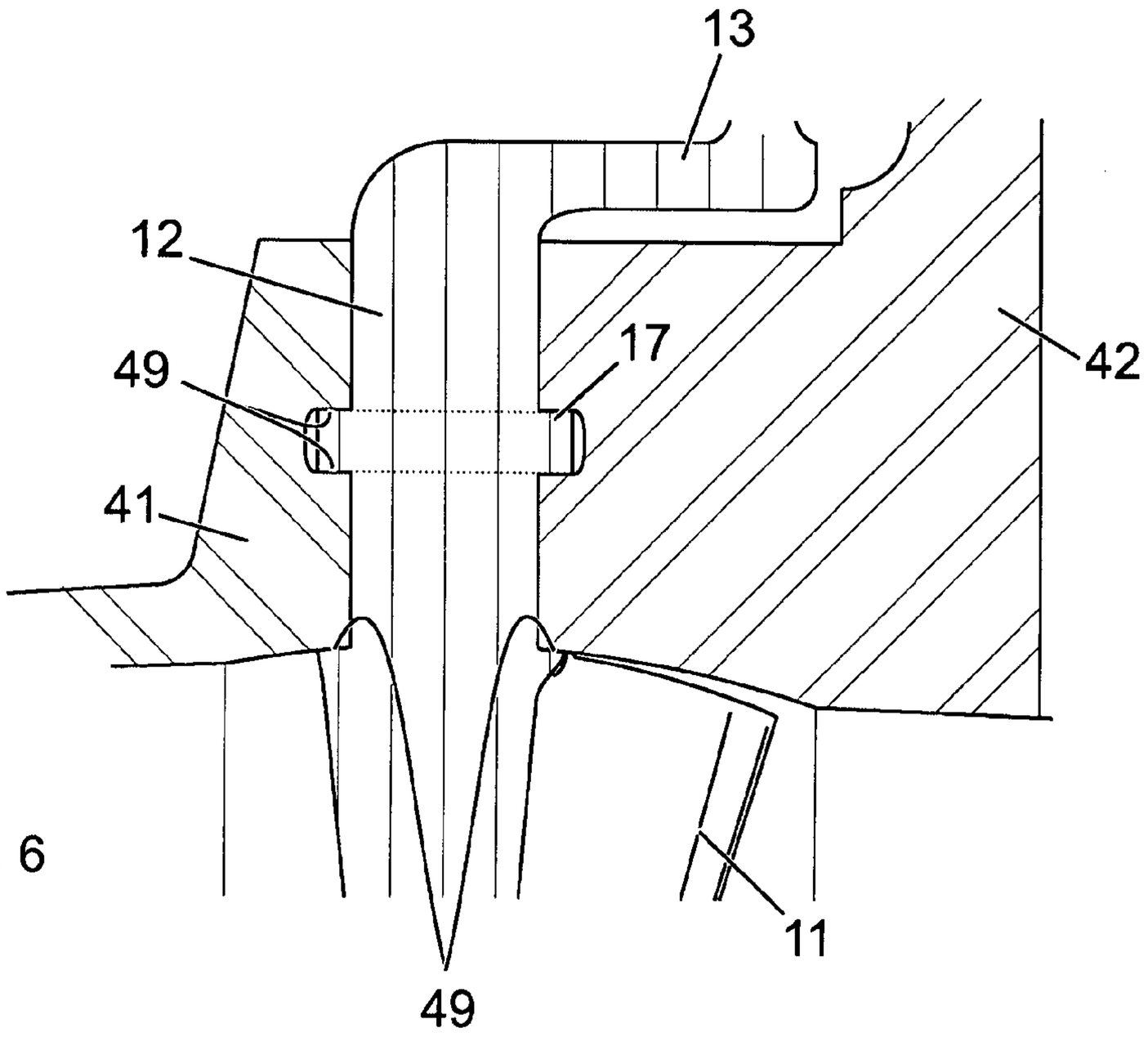
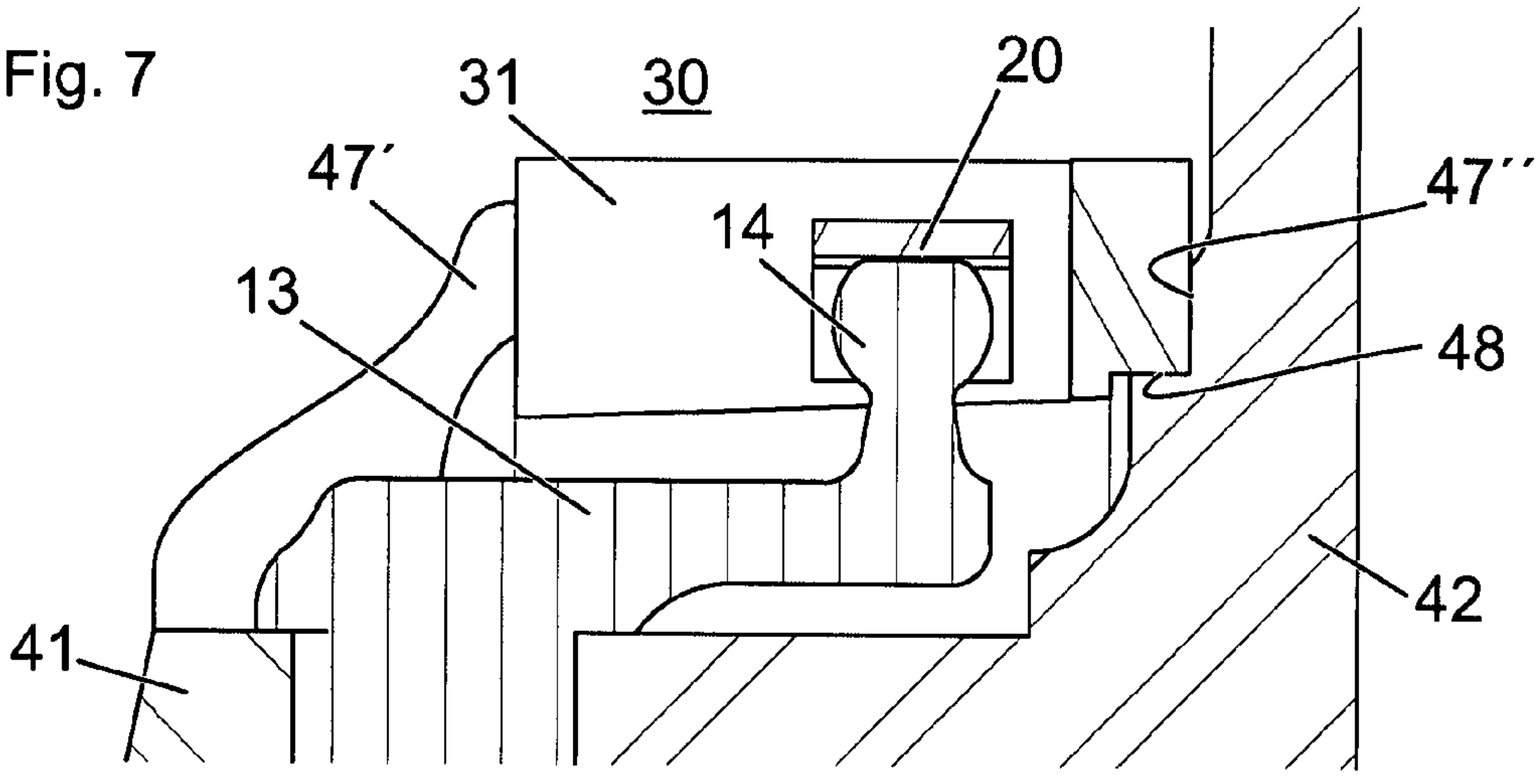


Fig. 6

Fig. 7



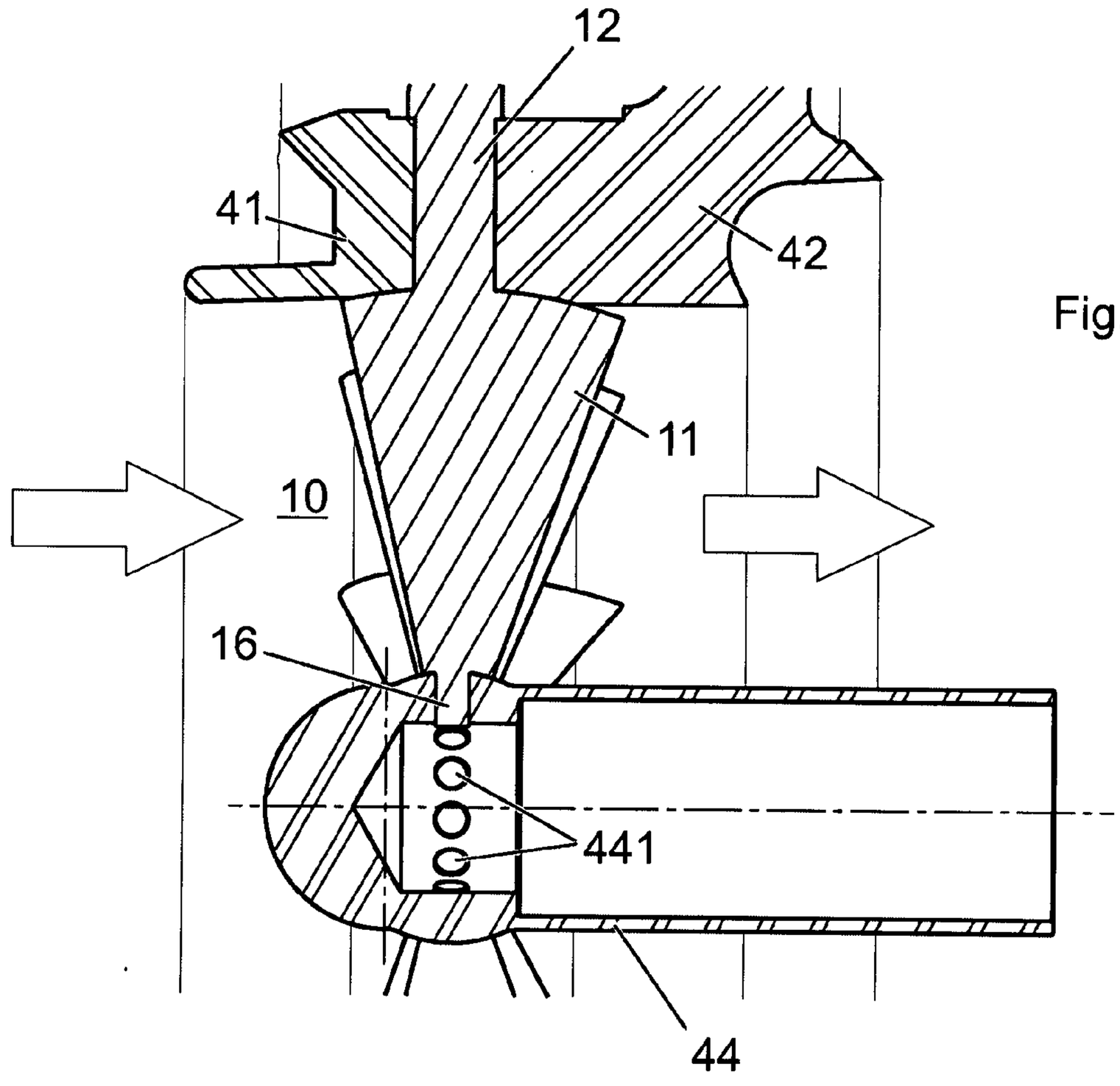


Fig. 8

PRESWIRL GUIDE DEVICE

RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. §119 to EP Application 06405137.8 filed in Europe on Mar. 31, 2006, the entire contents of which are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

[0002] The disclosure relates to the field of turbomachines to which exhaust gases of internal combustion engines are admitted. A guide device is disclosed for generating a preswirl in the intake region of a compressor and an exhaust gas turbocharger having such a preswirl guide device.

BACKGROUND INFORMATION

[0003] Exhaust gas turbochargers are used for increasing the output of internal combustion engines. In modern internal combustion engines, the adaptation of the exhaust gas turbocharger to variable operating conditions is becoming more and more difficult. What is referred to as the variable turbine and/or compressor geometry offers a widespread possibility in this respect. In the variable turbine geometry, the guide vanes of the distributor upstream of the turbine wheel are oriented more or less at a steep angle to the flow in accordance with the power requirement of the turbine. In the variable compressor geometry, the guide vanes in the diffuser downstream of the compressor wheel are oriented more or less at a steep angle to the flow.

[0004] A further possibility for adapting the exhaust gas turbocharger to the variable operating conditions is offered by preswirl guide devices, which in the intake region of the compressor generate a certain preswirl in the drawn-in air or possibly in the drawn-in air/fuel mixture, in a more or less pronounced manner depending on the operating point, in the direction of rotation of the compressor wheel or in the opposite direction.

[0005] In conventional preswirl guide devices, as are known, for instance, from DE 36 13 857 A1, the vanes are mounted in a casing which is in one piece in the bearing region. To this end, the vanes must be secured by an additional bearing bush, and the adjusting lever must be designed so as to be separable for fitting reasons. This may lead to additional costs and tolerance errors and may considerably reduce the reliability during operation.

SUMMARY

[0006] A preswirl guide device is disclosed which can function reliably for a long operating period, is simple to fit and has adjustable guide vanes.

[0007] An exemplary preswirl guide device for generating a preswirl in the intake region of a compressor comprises a plurality of guide vanes which are pivotable about a respective vane shank connected to the guide vane, the vane shanks and therefore the axes of rotation of the guide vanes being oriented essentially perpendicularly and radially relative to the shaft axis of the compressor. Furthermore, the exemplary preswirl guide device can comprise an adjusting ring, arranged coaxially to the shaft axis of the compressor and pivotable about this axis, and an adjusting lever for transmitting torque from the adjusting ring to the vane shank of each guide vane. The vane shank and the adjusting lever of each guide vane can be of one-piece design.

[0008] Due to the one-piece design of the guide vane, the number of joints can be reduced, which can have a positive effect on the material wear. In addition, the number of components to be fitted can be reduced. This simplifies the fitting and possible service work on the guide device.

[0009] The casing of the exemplary preswirl guide device, in which casing the guide vanes can be rotatably mounted, comprises at least two parts joined together in the region of the bearings of the guide vanes.

[0010] This can permit the fitting of the guide vane designed in one piece with integrated adjusting lever, and in addition it is thereby possible to mount and secure the vane with the bearing point in the axial direction with respect to the axis of rotation of each guide vane. To improve the wear resistance, the bearings can be protected with inserted bearing sleeves.

[0011] This axial mounting of the guide vanes can be effected via projections on the vane shanks and on the casing surrounding the vane shanks. These projections extend in the radial direction with respect to the axis of rotation of the guide vane. The projections engage one inside the other for the axial mounting of the guide vane.

[0012] Additionally or alternatively, grooves may also be incorporated in the casing and/or in the vane shanks, said grooves interacting with corresponding projections for axially securing the guide vane. If grooves are incorporated in both the casing and the vane shanks, the axial mounting may be effected with special bearing rings which are arranged in the grooves. The grooves and the projections may also extend only partly around the respective vane shank.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Various exemplary embodiments are explained in detail below with reference to drawings, in which:

[0014] FIG. **1** shows a section through a first exemplary embodiment of a preswirl guide device having a central body held by means of a retaining rib,

[0015] FIG. **2** shows an isometric detailed view of the exemplary preswirl guide device according to FIG. **1**,

[0016] FIG. **3** shows a section through a second exemplary embodiment of a preswirl guide device,

[0017] FIG. **4** shows an isometric detailed view of the exemplary preswirl guide device according to FIG. **3**,

[0018] FIG. **5** shows an enlarged detail of the section in FIG. **1** in the region of the guide vane shank, with a detailed illustration of a first exemplary axial mounting of the guide vanes,

[0019] FIG. **6** shows the enlarged detail of the section in FIG. **1** in the region of the guide vane shank, with a detailed illustration of a second exemplary axial mounting of the guide vanes,

[0020] FIG. **7** shows an enlarged detail of the section in FIG. **1** in the region of the adjusting lever, with details of the mounting of the adjusting ring,

[0021] FIG. **8** shows a section through an exemplary preswirl guide device having a central body held by the guide vanes, and

[0022] FIG. **9** shows a detail with an alternative variant of the second exemplary embodiment, according to FIG. **3**, of the preswirl guide device.

DETAILED DESCRIPTION

[0023] FIG. **1** shows a section through a guide device in the intake region of a compressor. As described at the beginning, such compressors are used in exhaust gas turbochargers for increasing the output of internal combustion engines. The arrows in the figure indicate the flow path of the medium to be compressed, which can be air or possibly an air/fuel mixture for the combustion process in the internal combustion engine. In addition, such guide devices can be used in any type of compressor, for example in industrial compressors driven by electric motors.

[0024] The guide device comprises a plurality of guide vanes **10** arranged so as to be oriented in the radial direction with respect to the compressor axis. Each of the guide vanes comprises, in addition to the vane profile **11** projecting into the flow duct, a vane shank **12** with which the vane profile can be rotatably mounted in a casing. The vane profile can be rotated about the axis of the vane shank via an adjusting lever **13**. An adjusting ring **30** which is arranged concentrically to the axis of the compressor is provided in order to drive the adjusting lever and thus adjust the vane profile. All the vanes can be adjusted simultaneously about the respective axes of their vane shanks by rotating the adjusting ring **30**.

[0025] In a first exemplary embodiment according to FIGS. **1** and **2**, the torque transmission from the adjusting ring **30** to the vane shank **12** can be effected via a ball head **14** arranged on the free end of the adjusting lever **13**. The ball head **14** can be guided in a groove **31** of the adjusting ring, said groove **31** having two walls running parallel to one another. In the groove, the ball head can have the translatory and rotary freedom of movement necessary for realizing the torque transmission. In order to achieve a uniform distribution of pressure over a large area in the contact region between ball head and groove wall and thus reduce the wear of the parts pressing on one another, the surface acting on the ball head of the adjusting lever for transmitting the torque from the adjusting ring to the vane shank of each guide vane can be designed like a ball socket. In this case, the ball socket is formed at least partly from a sliding shoe **20** arranged to be displaceable in a translatory manner. If the adjusting ring **30** is rotated for adjusting the guide vanes, the sliding shoe **20** is displaced by the ball head **14** in the groove **31** in the plane of the groove walls. If the adjusting ring is rotated, the position of the adjusting lever changes relative to the adjusting ring. In addition to the translatory displacement of the center of rotation of the ball head inside the groove, the adjusting lever rotates relative to the adjusting ring. The translatory displacement of the center of rotation of the ball head can be made possible by the sliding shoe sliding along the groove walls, whereas for the rotation the ball head can rotate in any desired direction in the ball socket formed by the sliding shoe. The sliding shoe may also be of two-piece design by a ball socket half having a flat, slidable rear side being arranged on each side of the groove in the adjusting ring.

[0026] In a second exemplary embodiment according to FIGS. **3** and **4**, the torque transmission from the adjusting ring **30** to the vane shank **12** can be effected via a cylindrical pin **15** arranged on the free end of the adjusting lever **13**. The pin engages in a hole of a cylindrical sliding element **21** mounted in the adjusting ring **30** likewise in a hole **32**. The sliding cylinder **21** can be rotated about its own axis in the hole **32** and can be displaced along its own axis. The hole in the sliding cylinder, this hole being provided for accommodating the pin **15**, can be perpendicular to the axis of the sliding cylinder. The pin can be rotated about its own axis in this hole and can be displaced along its own axis. This again provides for the freedom of movement necessary for realizing the torque transmission, in each case in a translatory and rotary manner at two locations. Alternatively, the pin **15**, as shown in FIG. **9**, may be fixed in the sliding cylinder **21** and may be mounted instead in a sliding manner in a corresponding hole in the free end of the adjusting lever **13** of the guide vane.

[0027] Instead of the illustrated exemplary embodiments described in more detail, further exemplary embodiments for torque transmission are conceivable, for instance having an adjusting lever which is designed as a toothed wheel segment and engages in the adjusting ring provided with a toothed rim. The vane profile **11**, the vane shank **12** and the adjusting lever **13** together with the top part necessary for the torque transmission, that is to say the ball head **14** or the pin **15**, can be formed in one piece. This means that the entire guide vane **10** with its functional components can be cast or milled in one piece or else assembled from a plurality of parts in a frictional, positive-locking or integral manner to form one piece before fitting into the casing. For example, the vane profile, the vane shank and the adjusting lever can be cast as one piece and then the ball head or the pin driven with an interference fit into an opening, provided for this purpose, in the adjusting lever or else loosely inserted and welded or cast in place.

[0028] So that the guide vane of one-piece design can be inserted into the aperture provided for it in the casing, the casing can be split in the region of the bearing points of the guide vanes.

[0029] As can be seen from FIG. **2**, at least two casing parts **41** and **42** which can be joined together in the axial direction with respect to the compressor axis can be provided. In the region of the bearing point of each guide vane, the two casing parts jointly form the aperture **45**. The two casing parts **41** and **42** can be held together, for example, with connecting elements in holes **46** provided for this purpose or via other subsequently installed casing parts.

[0030] When the casing is split in the region of the guide device, the mounting of the guide vanes and of the adjusting ring can be greatly simplified. As shown in FIG. **5**, the vane shank can thus be secured in the axial direction in a simple manner on radially projecting casing edges **49**, instead of with an additional bearing bush or with external bearing points. These casing projections **49** may be provided on both sides or on one casing part in each case at the axial ends of the bearing point of the vane shank. Additionally or alternatively, as shown in FIG. **6**, a groove extending over at least part of the circumference in the aperture between the two casing parts **41** and **42** can accommodate a projection **17** likewise extending over at least part of the circumference of the vane shank. Instead of a groove in the casing parts, the groove may also be incorporated in the vane shank in another variant and the casing parts may be provided with a corresponding projection. In a further exemplary embodiment, a groove can be incorporated in one casing part, whereas the other casing part has a projection and accord-

ingly the vane shank is provided with a respective projection and a respective groove. The rotatability of the guide vanes can also be limited in a simple manner by means of a groove that does not extend over the full circumference and a projection that extends over an even smaller part of the circumference. In a further exemplary embodiment, grooves can be incorporated in both the vane shank and the casing surrounding it. In this variant, a bearing ring arranged in the grooves provides for the axial mounting of the guide vanes. All these exemplary embodiments of the internal axial mountings can enable the axial play of the guide vanes to be reduced. To improve the sliding property in the bearing region of the guide vanes or prevent wear, the bearing components, that is to say the casing parts and/or the vane shank, may be hardened or provided with a coating of an abrasion-resistant material.

[0031] As shown in FIG. **7**, the axial and radial mounting of the adjusting ring can likewise be realized in a simple manner. Before the casing parts **41** and **42** are pushed together in the axial direction, the adjusting ring **30** can be arranged together with the guide vanes between the casing parts or on one of the two casing parts. When said casing parts are pushed together, the final orientation of the adjusting ring in the axial direction is then effected automatically. In this case, the adjusting ring **30** can be mounted in the axial direction from both sides by a corresponding bearing element **47'** and **47"**. As can also be seen from FIG. **2**, the first axial bearing element **47'** is part of the first casing part **41**, whereas the second axial bearing element **47"** is part of the second casing part **42**. The radial mounting of the adjusting ring can be achieved in a simple manner by seating the adjusting ring on a circumferential projection **48**.

[0032] As at the bearing point of the guide vane, the bearing parts of the adjusting ring may also be hardened or coated.

[0033] According to one exemplary embodiment of the guide device, a central casing body can be optionally arranged in the central region of the guide device, in which central region the tips of the plurality of guide vanes meet. This central body lies concentrically on the axis of the compressor. The central body is part of the casing, which in the region of the guide device forms the flow duct of the medium to be compressed.

[0034] As shown in FIG. **1**, the central body **44** can be positioned and held in place via one or more radially running casing ribs **43**.

[0035] In order not to have to impair the flow in the flow duct by such ribs, the central body can also be positioned and held in place via the guide vane tips. As shown in FIG. **8**, radially directed holes **441** can be incorporated in the central body **44** for this purpose, and shanks **16** specially designed for this purpose on the vane tips engage in said holes **441**. This device having the guide vanes arranged radially around the central body also permits simplified fitting of the guide vanes, which can already be arranged around the central body **44** before insertion into one of the two casing parts **41** or **42**. The unit consisting of central body and all the guide vanes can then be directed in a single operation to the place intended for it.

[0036] Of course, corresponding holes may also be provided in the exemplary embodiment having a central body positioned and held by means of a retaining rib. They also serve in this case for simplified fitting by the guide vanes having the special vane tip shanks being inserted into the holes in the central body before they are then placed in the radially running apertures in the one casing part.

[0037] The vane tip shanks described may be fixedly connected to the tips of the guide vanes or else they may be rotatably mounted in holes provided for this purpose in the vane tips. In the second case, the shanks may also be fixedly connected to the central body, such that, during the fitting, the guide vanes can be slipped with their holes at the vane tips onto the shanks.

[0038] Of course, an exemplary embodiment of the guide device without a central body and having guide vanes running right into the center is also possible.

[0039] It will be appreciated by those skilled in the art that the present invention can be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restricted. The scope of the invention is indicated by the appended claims rather than the foregoing description and all changes that come within the meaning and range and equivalence thereof are intended to be embraced therein.

LIST OF DESIGNATIONS

[0040] **10** Guide vane
[0041] **11** Vane profile
[0042] **12** Vane shank
[0043] **13** Adjusting lever for moving the guide vanes
[0044] **14** Ball head
[0045] **15** Pin
[0046] **16** Vane tip shank for centering the central body and holding it in place
[0047] **17** Shaft projection for the axial mounting of the guide vane
[0048] **20** Sliding shoe
[0049] **21** Sliding cylinder
[0050] **30** Adjusting ring for moving the guide vanes via the adjusting lever
[0051] **31** Annular groove for accommodating the sliding shoe
[0052] **32** Annular hole for accommodating the sliding cylinder
[0053] **40** Casing
[0054] **41**, **42** Casing parts
[0055] **43** Retaining rib
[0056] **44** Central body
[0057] **441** Hole for accommodating the vane tip shank
[0058] **45** Aperture in the casing for accommodating the vane shank
[0059] **46** Hole for joining the casing parts
[0060] **47** Bearing element for the axial mounting of the adjusting ring
[0061] **48** Bearing element for the radial mounting of the adjusting ring
[0062] **49** Radial projections in the region of the aperture in the casing for the axial mounting of the guide vane

What is claimed is:

1. A preswirl guide device for generating a preswirl in the intake region of a compressor, having guide vanes which are pivotable about a respective vane shank connected to the guide vane, having a pivotable adjusting ring, and having adjusting levers for transmitting torque from the adjusting ring to the vane shank of each guide vane, wherein the vane shank and the adjusting lever of the respective guide vanes are of one-piece design.

2. The preswirl guide device as claimed in claim **1**, wherein the adjusting lever of each guide vane comprises a cylindrical pin which is guided in such a way as to be rotatable about its axis and displaceable along its axis in a hole of a cylindrical transmission element, the transmission element being guided in such a way as to be rotatable about its axis and displaceable along its axis in a hole of the adjusting ring.

3. The preswirl guide device as claimed in claim **1**, wherein the adjusting lever of each guide vane comprises a hole in which a pin projecting radially from a cylindrical transmission element is guided, the transmission element being guided in such a way as to be rotatable about its axis and displaceable along its axis in a hole of the adjusting ring.

4. The preswirl guide device as claimed in claim **1**, wherein the adjusting lever of each guide vane has an end which is designed like a ball head and which is guided in a groove of the adjusting ring, the groove having walls which run parallel to one another and between which the ball head of the adjusting lever is guided.

5. The preswirl guide device as claimed in claim **4**, wherein the ball head is rotatably guided in a ball socket of a transmission element, and in that the transmission element is displaceable along the walls running parallel to one another.

6. The preswirl guide device as claimed in claim **1**, wherein a casing in which the guide vanes are rotatably mounted is comprised of at least two parts joined together in the region of the bearings of the guide vanes.

7. The preswirl guide device as claimed in claim **1**, wherein projections extending radially with respect to the axis of rotation of the guide vanes are arranged on the vane shank and on the casing surrounding the vane shank, a projection of the vane shank and a projection of the casing engaging one inside the other for the axial mounting of the respective guide vane.

8. The preswirl guide device as claimed in claim **1**, wherein with respect to the axis of rotation of the guide vane, a radially oriented groove is incorporated in the vane shank and/or in the casing surrounding the vane shank, which groove, for the axial mounting of the guide vane, interacts with a projection, extending radially with respect to the axis of rotation of the guide vane and engaging in the groove, and/or with a bearing ring.

9. The preswirl guide device as claimed in claim **1**, wherein a central body is arranged in the region of the tips of the guide vanes arranged radially about an axis.

10. The preswirl guide device as claimed in claim **9**, wherein shanks formed on the vane tips are rotatably mounted in radially oriented holes of the central body.

11. The preswirl guide device as claimed in claim **9**, wherein the central body is fastened to an external casing part via at least one retaining rib directed radially outward.

12. The preswirl guide device as claimed in claim **10**, wherein shanks formed on the vane tips are rotatably mounted in radially oriented holes of the central body.

13. A compressor comprising a preswirl guide device as claimed in claim **1**.

14. An exhaust gas turbocharger comprising a compressor having a preswirl guide device as claimed in claim **1**.

15. The preswirl guide device as claimed in claim **5**, wherein a casing in which the guide vanes are rotatably mounted is comprised of at least two parts joined together in the region of the bearings of the guide vanes.

16. The preswirl guide device as claimed in claim **5**, wherein projections extending radially with respect to the axis of rotation of the guide vanes are arranged on the vane shank and on the casing surrounding the vane shank, a projection of the vane shank and a projection of the casing engaging one inside the other for the axial mounting of the respective guide vane.

17. The preswirl guide device as claimed in claim **5**, wherein with respect to the axis of rotation of the guide vane, a radially oriented groove is incorporated in the vane shank and/or in the casing surrounding the vane shank, which groove, for the axial mounting of the guide vane, interacts with a projection, extending radially with respect to the axis of rotation of the guide vane and engaging in the groove, and/or with a bearing ring.

18. The preswirl guide device as claimed in claim **5**, wherein a central body is arranged in the region of the tips of the guide vanes arranged radially about an axis.

19. A compressor comprising a preswirl guide device as claimed in claim **5**.

20. An exhaust gas turbocharger comprising a compressor having a preswirl guide device as claimed in claim **5**.

21. A preswirl guide device for generating a preswirl in the intake region of a compressor, comprising:

a guide vane having a shank;

a pivotable adjusting ring; and

an adjusting lever for transmitting torque from the adjusting ring to the shank of the guide vane, wherein the shank and the adjusting lever are formed of one-piece.

* * * * *