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(54) **TURBOCHARGER**

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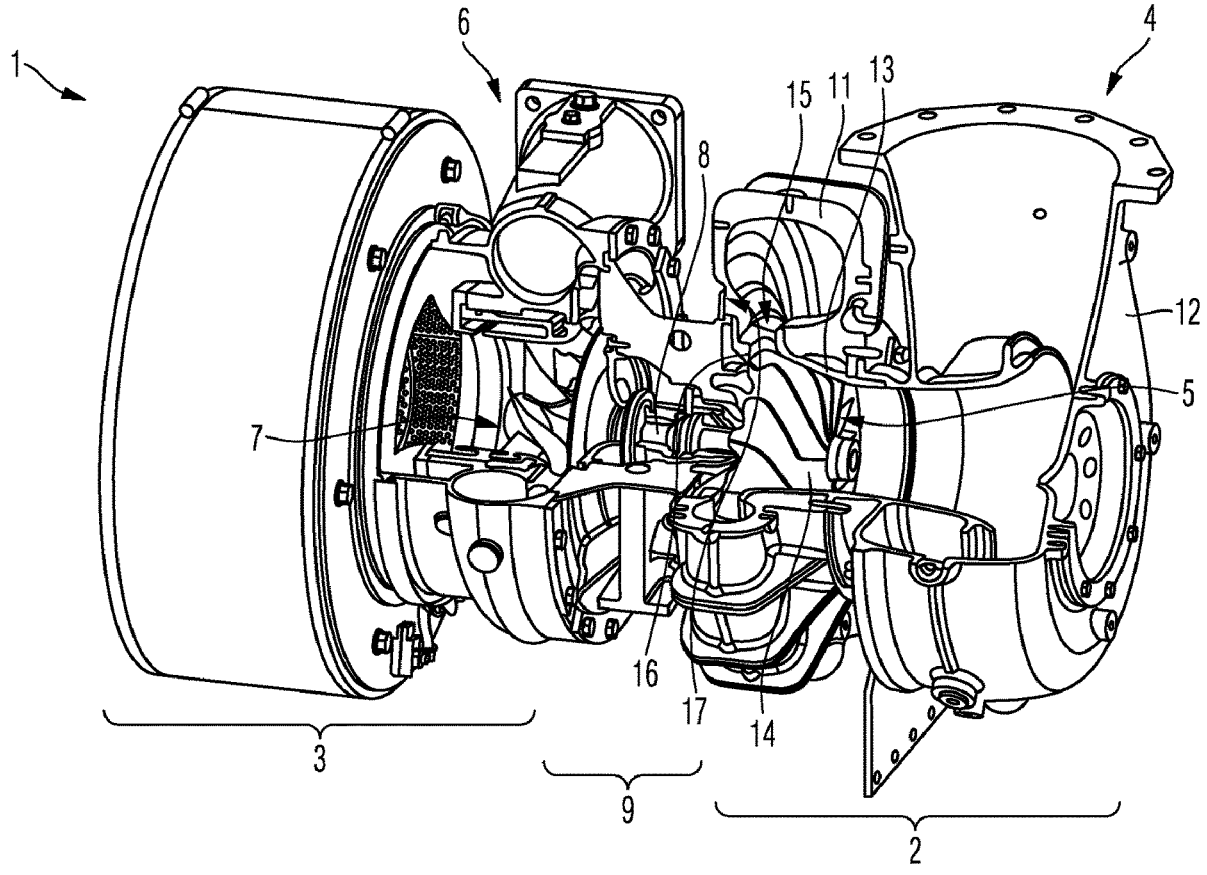
(57) **ABSTRACT**

A turbocharger, having a turbine with a turbine housing and a turbine rotor, (a compressor with a compressor housing and a compressor rotor that is coupled to the turbine rotor via a shaft, a bearing housing arranged between the turbine housing and the compressor housing, in which the shaft is mounted via a bearing. An end disc adjoins the bearing ring or the bearing bush. On an axial surface facing the bearing ring or the bearing bush of the bearing facing the turbine, a swirl chamber that is open in the direction of the bearing ring or the bearing bush is introduced into the end disc, which collects and discharges oil leaking from a lubrication gap of the bearing.



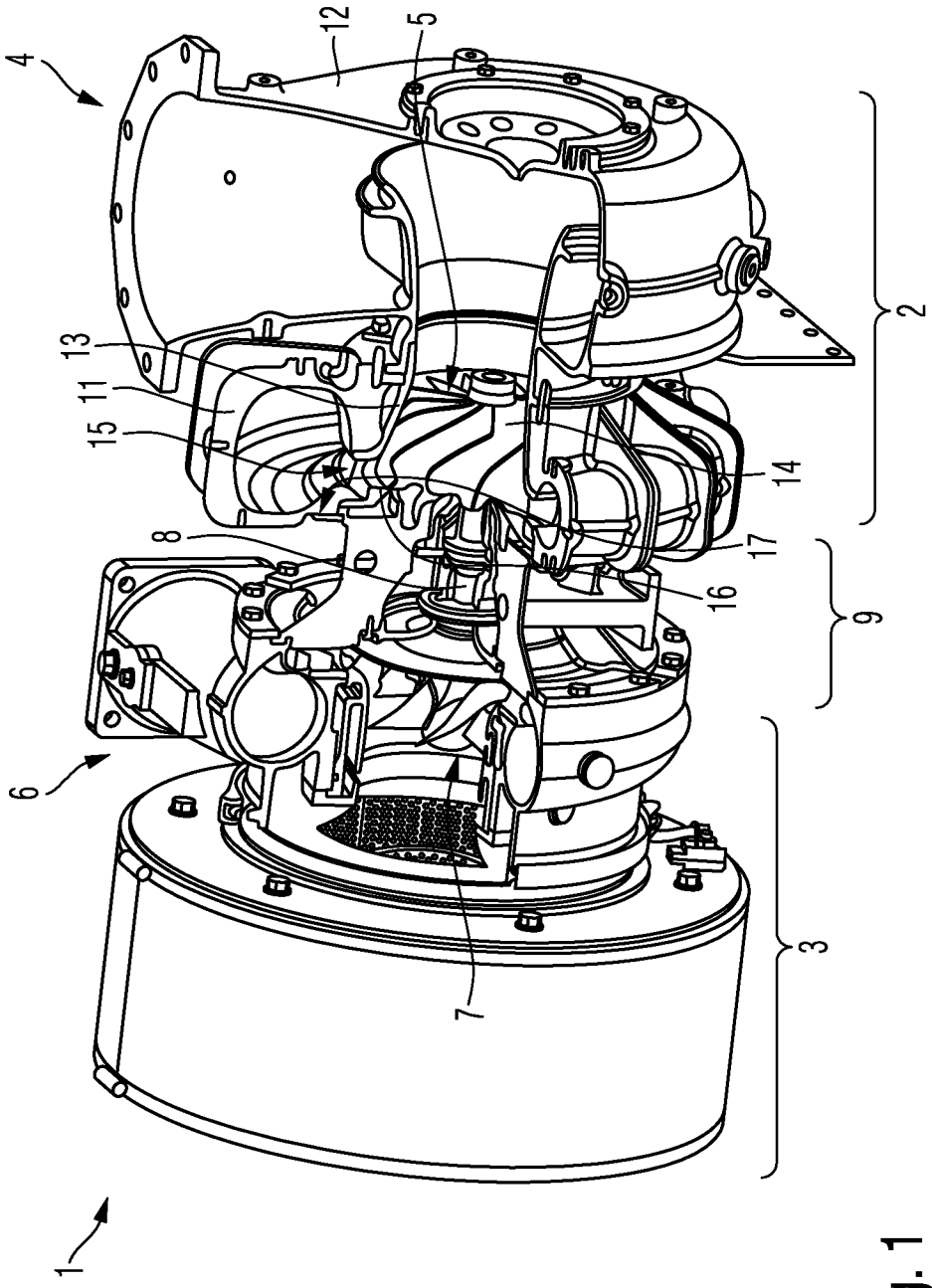


Fig. 1

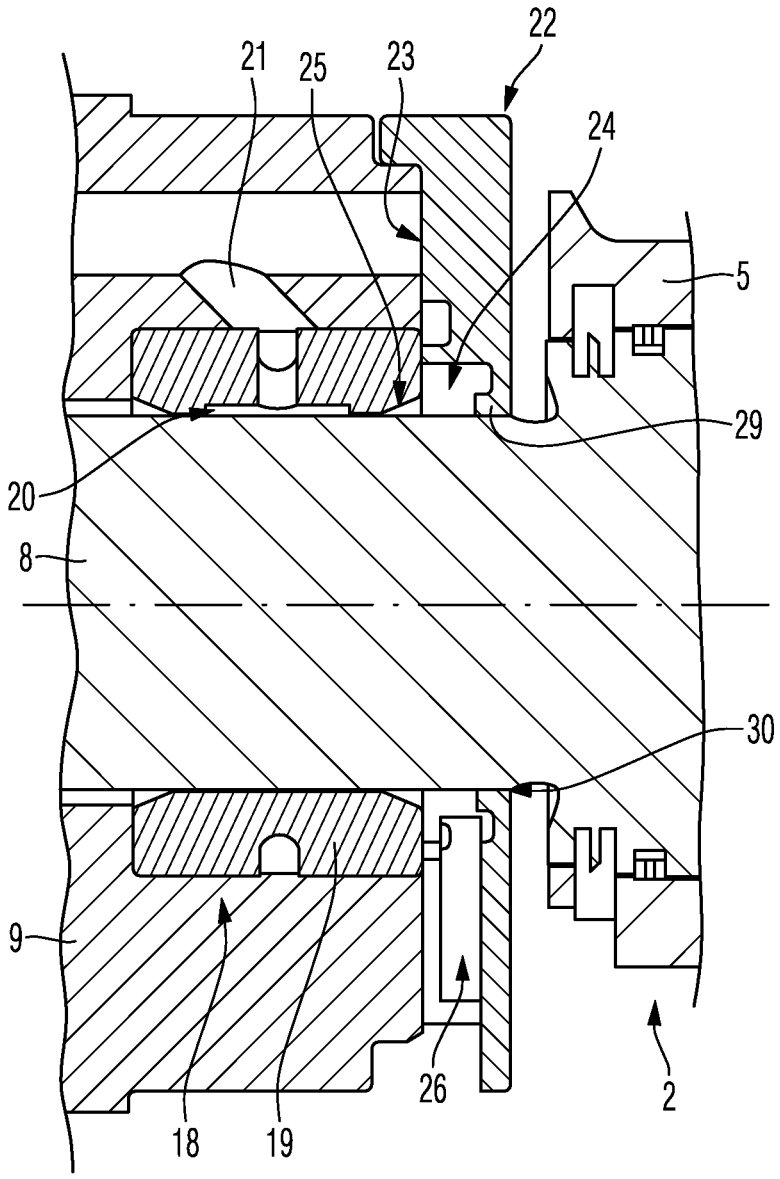


Fig. 2

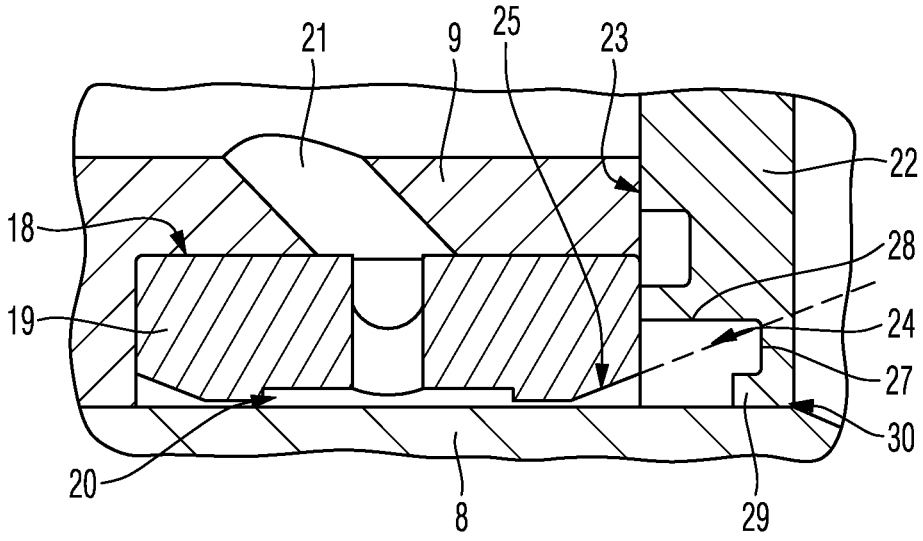


Fig. 3

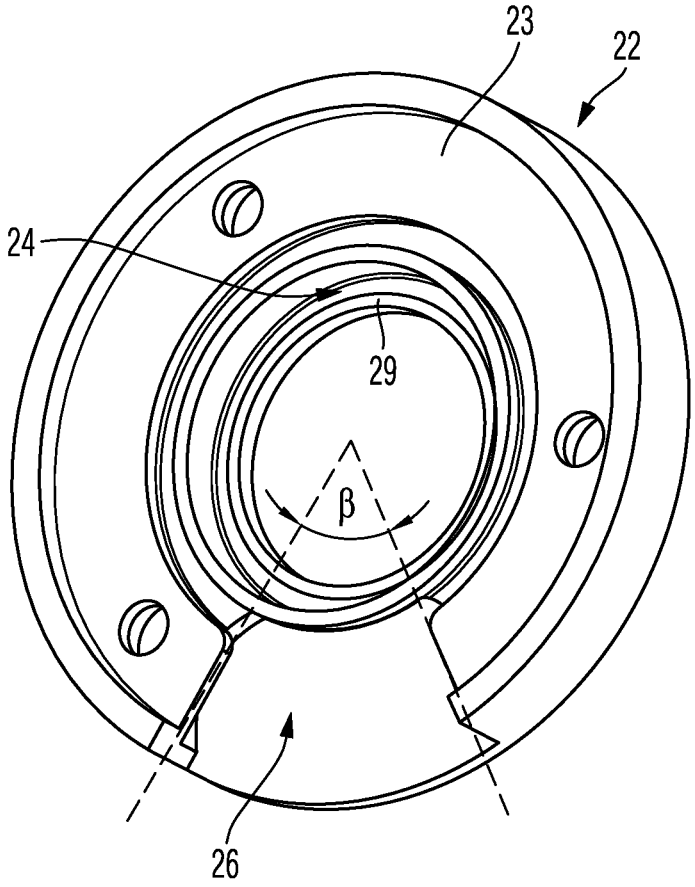


Fig. 4

TURBOCHARGER

BACKGROUND OF INVENTION

1. Field of the Invention

[0001] The invention relates to a turbocharger.

2. Description of Related Art

[0002] The fundamental construction of a turbocharger is known to a person skilled in the art addressed here. A turbocharger comprises a turbine in which a first medium is expanded. Furthermore, a turbocharger comprises a compressor in which a second medium is compressed, utilising energy extracted in the turbine during the expansion of the first medium. The turbine of the turbocharger comprises a turbine housing and a turbine rotor. The compressor of the turbocharger comprises a compressor housing and a compressor rotor. Between the turbine housing of the turbine and the compressor housing of the compressor a bearing housing is positioned. The bearing housing is connected on the one hand to the turbine housing and on the other hand to the compressor housing. In the bearing housing a shaft is mounted via which the turbine rotor is coupled to the compressor rotor.

[0003] From DE 10 2010 038 527 A1 a turbocharger having a compressor, a turbine, and a bearing housing is known. In the bearing housing, a shaft, via which the turbine rotor is coupled to the compressor rotor is mounted, namely by way of a plurality of sliding bearings. A sliding bearing, which serves for mounting the shaft in the bearing housing, faces the turbine. A further sliding bearing, which serves for mounting the shaft in the bearing housing, faces the compressor. The bearing facing the turbine is followed by an end disc, which, in particular when the sliding bearing comprises a floating bearing ring or a floating bearing bush, restricts the axial displacement of the bearing ring or of the bearing bush in the direction of the turbine, and which in particular when the bearing bush or the bearing ring are fixed, serves for retaining the bearing bush or the bearing ring.

[0004] A substantial requirement with regard to the operational safety of a turbocharger consists in the oil tightness of the mounting of the shaft, in particular towards the turbine wheel of the turbine. Especially on the hot turbine side there is the risk that oil leaking from the bearing housing can ignite. For this reason, shaft seals for mounting the shaft in the bearing housing are essential components for the operational safety of turbochargers.

SUMMARY OF THE INVENTION

[0005] There is thus a need for a turbocharger, with which an oil tightness for the mounting of the shaft in the bearing housing in particular adjoining the turbine can be safely and reliably provided. Starting out from this, one aspect of the present invention is based on creating a new type of turbocharger.

[0006] According to one aspect of the invention a swirl chamber that is open in the direction of the bearing ring or the bearing bush is introduced into the end disc on an axial surface facing the bearing ring or the bearing bush of the bearing facing the turbine, which collects and discharges oil that leaks from the lubrication gap of the bearing. According to one aspect of the invention it is proposed that the end disc, which follows the bearing ring or the bearing bush of the bearing of the shaft facing the turbine adjoining the turbine, comprises a swirl chamber, which is open in the direction of the bearing ring or the bearing bush. Oil that leaks from the lubrication gap of the bearing can enter the swirl chamber that is open in the direction of the bearing ring or the bearing bush and collected and calmed there. The swirl chamber discharges collected and calmed oil, namely in the direction of an oil drain in the region of the bearing housing. By way of this, an oil tightness for the mounting of the shaft in the bearing housing in particular adjoining the turbine can be ensured. The operational safety of the turbocharger can thus be increased with simple elements.

[0007] According to a further development of the invention, the swirl chamber of the end disc that is open in the direction of the bearing ring is bounded on a side facing away from the bearing ring or the bearing bush by a closed axial wall and on a radially outer side by a closed radial wall. The swirl chamber of the end disc that is open in the direction of the bearing ring or the bearing bush is bounded on a radially inner side facing the shaft by a web emanating from the axial wall, which bounds the open swirl chamber on the side facing away from the bearing ring or the bearing bush and extends in the axial direction of the axial surface facing the bearing ring or the bearing bush and ends, spaced apart, in front of this axial surface. Such a contouring of the swirl chamber of the end disc that is open in the direction of the bearing ring or the bearing bush is particularly preferred in order to safely collect and calm the oil that leaks from the lubrication gap of the bearing.

[0008] Preferably, the open swirl chamber is contoured such that an extension of the chamfer of the bearing ring or of the bearing bush facing the swirl chamber intersects the closed axial wall. These details also serve for the safe collecting and calming of that oil that leaks from the lubrication gap of the bearing.

[0009] The web, which bounds the swirl chamber radially inside, defines a sealing gap to the shaft, the axial length of which preferably amounts to between 0.1 times and 0.7 times the axial thickness of the end disc and/or the radial width of which amounts to preferentially between 2 times and 20 times the radial bearing gap between the bearing ring or the bearing bush and the shaft. These details of the end disc, namely of the web bounding the swirl chamber radially inside in portions are advantageous in order to safely collect the oil that leaves the lubrication gap.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Preferred further developments of the invention are obtained from the subclaims and the following description. Exemplary embodiments of the invention are explained in more detail by way of the drawing without being restricted to this.

[0011] In the drawings:

[0012] FIG. **1** is a cross section through a turbocharger;

[0013] FIG. **2** is a detail of a turbocharger;

[0014] FIG. **3** is a detail of FIG. **2**; and

[0015] FIG. **4** is a further detail of a turbocharger.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

[0016] FIG. **1** shows the fundamental construction of a turbocharger **1**. A turbocharger **1** comprises a turbine **2** for expanding a first medium, in particular for expanding

exhaust gas of an internal combustion engine. Furthermore, a turbocharger **1** comprises a compressor **3** for compressing a second medium, in particular charge air, namely utilising energy extracted in the turbine **2** during the expansion of the first medium.

[0017] The turbine **2** comprises a turbine housing **4** and a turbine rotor **5**. The compressor **3** comprises a compressor housing **6** and a compressor rotor **7**. The compressor rotor **7** is coupled to the turbine rotor **5** via a shaft **8**, which is mounted in a bearing housing **9**. The bearing housing **9** is positioned between the turbine housing **4** and the compressor housing **5** and is connected to both the turbine housing **4** and the compressor housing **5**.

[0018] The turbine housing **4** of the turbine **2** comprises an inflow housing **11** and an outflow housing **12**. By way of the inflow housing **11**, the first medium to be expanded in the region of the turbine can be fed to the turbine rotor **5**. By way of the outflow housing **12**, first medium expanded in the region of the turbine rotor **5** flows away from the turbine **2**.

[0019] Besides the inflow housing **11** and the outflow housing **12**, the turbine housing **4** comprises an insert piece **13**, wherein the insert piece **13** runs in particular in the region of the inflow housing **11**, namely adjacent to the turbine rotor **5** radially outside adjoining moving blades **14** of the turbine rotor **5**.

[0020] The turbine housing **4**, furthermore, comprises a nozzle ring **15**. The nozzle ring **15** is also referred to as turbine guide apparatus.

[0021] Furthermore, FIG. **1** shows a sealing cover **16** in the connecting region of inflow housing **11** and bearing housing **9**. The sealing cover **16** is also referred to as bearing housing cover or heat shield.

[0022] The inflow housing **11** of the turbine **2** is connected to the bearing housing **9** via an attachment device **17**, which is preferentially formed as a clamping claw. A radially outer portion of the sealing cover **15** is clamped in this connecting region between bearing housing **9** and inflow housing **11** of the turbine. In this connecting region, the nozzle ring is also preferentially clamped with a portion.

[0023] As already explained, the turbine rotor **5** and the compressor rotor **7** are coupled via the shaft **8**, which is mounted in the bearing housing **9**. Bearings, namely a bearing facing the turbine **2** and a bearing facing the compressor **3** serve for mounting the shaft **8** in the bearing housing **9**, in order to mount the shaft **8** along its axial extension via these bearings in at least two axial positions. FIG. **2** shows an extract from a turbocharger in the region of a bearing **18**, which serves for the mounting of the shaft **8** in the bearing housing **9** on a side of the shaft **8** or of the bearing housing **9** facing the turbine **2** or the turbine wheel **5** of the turbine **2**.

[0024] The bearing **18** facing the turbine or the turbine wheel **5** is a radial sliding bearing that comprises a bearing ring or a bearing bush **19**. Between the bearing ring or the bearing bush **19** and the shaft **8** a lubrication gap **20** is formed, which can be supplied with oil via a bore **21** in the bearing housing **9**.

[0025] On the side facing the turbine **2** or the turbine wheel **5**, the bearing ring or the bearing bush **19** of the bearing **18** is followed by an end disc **22**. In particular when the bearing ring **19** or the bearing bush of the bearing **18** are floatingly received in the bearing housing **19**, the end disc **22** limits the axial movability of the bearing ring or of the bearing bush **19**. In the case of a fixed bearing ring or fixed bearing bush **19**, the end disc **22** retains the bearing ring or the bearing bush **19** in the axial direction.

[0026] During the operation, oil can leak from the lubrication gap **20** between the bearing ring **19** or the bearing bush and the shaft **8**, namely also in the direction of the turbine wheel **5**. To ensure the oil tightness for the mounting of the shaft **8** in the bearing housing **9** in particular adjoining the turbine **2**, a swirl chamber **24** that is open in the direction of the bearing ring or the bearing bush **19** is formed according to one aspect of the invention in the end disc **22**, which is embodied in one piece or one part. Oil that leaks from the lubrication gap **20** in the region of a chamfer **25** of the bearing ring or the bearing bush **19** facing the swirl chamber can be collected in this swirl chamber **24** and calmed in the swirl chamber **24**.

[0027] The swirl chamber **24** circulates in the circumferential direction and in a circumferential position comprises an oil drain opening **26**, via which the oil collected and calmed in the swirl chamber **24** can then be discharged via an oil drain of the bearing housing **9**. This oil drain opening **26** has an opening angle β in the circumferential direction between 5° and 90°.

[0028] As already explained, the swirl chamber **24** is open in the direction of the bearing ring or the bearing bush **19** of the bearing **18**. This swirl chamber that is open in the direction of the bearing ring or the bearing bush **19** is limited on a side facing away from the bearing ring or the bearing bush **19** by a closed axial wall **27** and radially outside by a closed radial wall **28**. Emanating from the axial wall **27**, which limits the swirl chamber **24** on the side facing away from the bearing ring or the bearing bush **19** of the bearing **18**, a web **29** extends in the direction of the bearing ring or the bearing bush **19**, which limits the swirl chamber **24** radially inside adjoining the shaft **8** in portions and which ends spaced apart in front of the axial surface **23** of the end disc **22** facing the bearing ring or the bearing bush **19**. Accordingly, the web **29** has an axial length that is smaller than the axial thickness or width of the end disc **22**.

[0029] The web **29**, which defines a sealing gap **30** towards the shaft **8** has an axial length which amounts to between 0.1 times and 0.7 times of the axial thickness or axial width of the end disc **22**.

[0030] The radial width of the sealing gap **30** between the web **29** of the end disc **22** and the shaft **8** amounts to between 2 times and 20 times the radial bearing play between the bearing ring **19** of the bearing **18** and the shaft **8**.

[0031] To optimally collect the oil leaking from the lubrication gap **20** of the bearing **18** in the region of the swirl chamber **24**, which is formed open in the direction of the bearing ring or the bearing bush **19**, the swirl chamber **24** is contoured in particular in such a manner that an extension of that chamfer **25** of the bearing ring or of the bearing bush **19**, which diverges in the direction of the swirl chamber **24**, intersects the closed axial wall **27** that limits the swirl chamber **24** on the side facing away from the bearing ring or the bearing bush **19**. In FIG. **3**, this extension of the chamfer **25** is shown in dashed line drawing. There, the extension of the chamfer **25** intersects the closed axial wall **27** in particular in the transition region to the closed radial wall **28**, which limits the swirl chamber **24** radially outside.

[0032] According to one aspect of the invention, a swirl chamber **24** that is open in the direction of the bearing ring or the bearing bush **19** of the bearing **18** is introduced into the end disc **22**, which is arranged between the turbine wheel

5 and the bearing **18**, which mounts the shaft **8** on the side in the bearing housing **9** facing the turbine **2**. Oil, which leaks from the lubrication gap **20** between the bearing ring or the bearing bush **19** of the bearing **18** and the shaft **8** enters the region of the swirl chamber **24**, is collected and calmed there and via the swirl chamber **24** circulating in the circumferential direction is conducted in the direction of the oil drain opening **26** of the end disc **22**. Thus, the collected oil can be discharged in a defined manner.

[0033] The swirl chamber **24** is limited radially inside by the web **29**, radially outside by the radial wall **28** and on the side facing away from the bearing ring or the bearing bush **19** by the axial wall **27**. Preferentially, an extension of the chamfer **25** of the bearing ring or of the bearing bush **19** intersects this axial wall **27**. Adjoining the bearing ring or the bearing bush **19**, the swirl chamber **24** is open.

[0034] In the region of that bearing which mounts the shaft **8** on the side facing the compressor **3**, an end disc as described above can likewise be arranged.

[0035] Thus, while there have shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that structures and/or elements and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

1. A turbocharger, comprising:

a turbine configured to expand a first medium, comprising:

a turbine housing; and

a turbine rotor;

a shaft;

a bearing facing the turbine;

a compressor configured to compress a second medium utilising energy extracted in the turbine during expansion of the first medium, comprising:

a compressor housing; and

a compressor rotor that is coupled to the turbine rotor via a shaft;

a bearing housing arranged between the turbine housing and the compressor housing in which the shaft is mounted by way of the bearing facing the turbine;

an end disc adjoins a bearing ring or a bearing bush of the bearing on a side facing the turbine; and

a swirl chamber that is open in a direction of the bearing ring or the bearing bush is provided on an axial surface facing the bearing ring or the bearing bush of the bearing facing the turbine and configured to collect and discharges oil leaking from a lubrication gap of the bearing.

2. The turbocharger according to claim **1**, wherein the end disc is formed in one piece.

3. The turbocharger according to claim **1**, wherein the swirl chamber circulates in a circumferential direction and comprises an oil drain opening in a circumferential position.

4. The turbocharger according to claim **3**, wherein the oil drain opening has an opening angle in the circumferential direction between 5° and 90°.

5. The turbocharger according to claim **1**, wherein the swirl chamber of the end disc is limited on a side facing away from the bearing ring or the bearing bush by a closed axial wall and on a radially outer side by a closed radial wall.

6. The turbocharger according to claim **5**, wherein the swirl chamber is contoured such that an extension of a chamfer of the bearing ring or the bearing bush facing the swirl chamber intersects the closed axial wall.

7. The turbocharger according to claim **6**, wherein the extension of the chamfer of the bearing ring or of the bearing bush facing the swirl chamber intersects the closed axial wall in a transition region to the closed radial wall.

8. The turbocharger according to any one of the claim **7**, wherein the swirl chamber is limited on a radially inner side facing the shaft by a web.

9. The turbocharger according to claim **8**, wherein the web, emanating from the closed axial wall, extends in a direction of the axial surface facing the bearing ring or the bearing bush and ends, spaced apart, in front of the axial surface.

10. The turbocharger according to claim **9**, wherein the web defines a sealing gap to the shaft an axial length of which amounts to between 0.1 times and 0.7 times an axial thickness of the end disc and/or a radial width of which amounts to between 2 times and 20 times a radial bearing play between the bearing ring or the bearing bush and the shaft.

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