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(54) **Lateral channel compressor**

(57) In order to guarantee a high degree of efficiency, even with different speeds, a lateral channel (2, 2A, 2B) with an elliptical cross-sectional surface is provided, which tapers from an aspiration side through to a pressure side. Here, the elliptical cross-sectional geometry is formed by a supporting ring (18) of an impeller (12) and by an inside wall area (28) of a casing (6, 8). The supporting ring (18) and the inside wall area (28) enclose the lateral channel (2) almost fully, the elliptically curved wall areas passing homogeneously into each other.

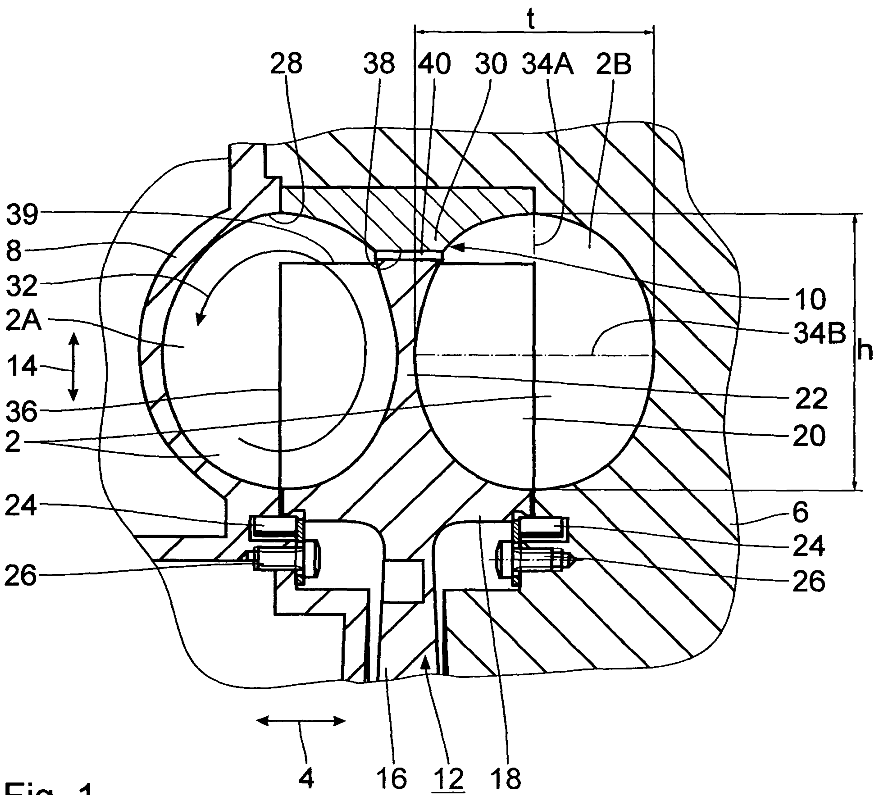

Fig. 1

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Description

[0001] The invention relates to a lateral channel compressor.

[0002] In a lateral channel compressor or gaseous ring compressor, gas that is to be compressed is set moving helically in at least one annular lateral channel by means of a rotating impeller which is actuated by a driving aggregate, in the process being compressed from an intake towards a pressure joint. The gas that is aspirated at the intake is entrained by reason of the impeller rotating in the lateral channel, then set moving helically in the peripheral direction and ejected after approximately 360° by way of the pressure joint. The lateral channel compressor can be used as a compressor as well as a vacuum pump. Owing to the simple principle of compression, the lateral channel compressor is rather solid, being used preferably in cases where high gas flow rates are involved. Special advantages of the lateral channel compressor reside in the lack of maintenance work, oil-free compression, low noises and extreme lifetime.

[0003] In some designs of a lateral channel compressor the individual impeller blades are open on three sides towards the lateral channel. Inferior efficiency is obtained as compared to designs with "closed" impellers, in which the blades are open towards the lateral channel only on two opposed axial sides. However, the "closed" wheels are susceptible to lint and dust, the efficiency decreasing as peripheral speed grows. Moreover, in many cases, closed designs require pre-filters for dust and lint which lead to additional pressure loss and, consequently, to additional deterioration in efficiency. In particular in lateral channel compressors with controlled peripheral speed, inferior efficiency at high speed rates has been accepted for the time being.

[0004] It is an object of the invention to embody a lateral channel compressor of controlled speed which exhibits as uniformly high as possible a degree of efficiency even with varying peripheral speeds.

[0005] According to the invention, this object is attained in a lateral channel compressor comprising the features of claim 1. The lateral channel compressor possesses an impeller which is arranged in a casing for rotation about an axial axis, in the radial direction on the side of its end having a supporting ring with a plurality of blades which are disposed in the peripheral direction and are located in a lateral channel. The lateral channel has an elliptical cross-sectional geometry, tapering from an aspiration side to a pressure side. The elliptical cross-sectional geometry is configured by an inside wall area of the casing as well as a sectional area of the supporting ring.

[0006] The special advantage of this configuration resides in the combination of the elliptical cross-sectional geometry and the tapering cross-sectional surface of the lateral channel. The tapering cross-sectional surface of the lateral channel aids in the compression of the gas, which improves the degree of efficiency. Special significance resides in that the elliptical cross-sectional geometry is formed by the casing as well as the supporting ring. As a result, the lateral channel is enclosed almost fully, having a defined elliptical geometry. The clearance between two impeller blades that succeed one another in the peripheral direction therefore has a closed elliptical cross-sectional geometry. This works in support of a configuration, as free from losses as possible, of the helical flow (circulating flow) of the gas inside the lateral channel, largely precluding any turbulences that might affect the efficiency.

[0007] In keeping with an appropriate further development, the inside wall area of the casing, opposite the supporting ring as seen in the radial direction, comprises a sectional area which retracts inwards into the lateral channel. As a result, most of the wall areas that determine the elliptical cross-sectional geometry are formed by the casing. The inside wall area of the casing comprises in particular approximately three quarters of the wall area of the elliptical cross-sectional geometry. Therefore, the lateral channel, for its major part, is defined by the stationary casing. Only a comparatively small area is defined by the rotating impeller and the supporting ring, which is advantageous, not least with a view to the mechanical stability of the rotating impeller.

[0008] For as closed an elliptical cross-sectional geometry as possible that is de-fined all over by a wall area, an appropriate development makes provision for the supporting ring to comprise a rib that extends in the radial direction as far as to the opposite inside wall area of the casing.

[0009] Suitably the supporting ring, by the rib, separates from one another two lateral channels which are disposed side by side in the axial direction. Consequently, the lateral channel compressor is a double-entry compressor in this initial embodiment. The two lateral channels will be called entries in the following.

[0010] For the elliptical cross-sectional geometry to form, an appropriate further development provides that the ribs first tapers in the radial direction and then widens again. Therefore, the rib, as seen cross-sectionally, has a constriction or necking i.e., it is concavely curved towards the lateral channel. In this case, the rib is preferably symmetrical of the two side by side entries.

[0011] With a view to circulatory flow, as free from turbulence as possible, the wall area that is defined by the rib passes as homogeneously as possible into the wall area, defined by the casing, of the lateral channel. To this end, provision is made for the two curved wall areas of the casing and the supporting ring to be aligned without any graduations at the two places where they pass into one another.

[0012] For as defined as possible a circulatory flow to be generated, it is preferably provided that the rib face on the side of the end as seen in the radial direction and the frontal flanks of the impeller blades substantially are in alignment i.e., they are substantially located on a joint rotational surface. Therefore, there are no irregularities where the blade flanks pass into, or are connected with, the rib.

[0013] In keeping with another development that serves the purpose, provision is made for a gap between the rib and the inside wall area opposite thereto. This gap is comparatively wide with no lint or dust accumulating between the rotating impeller and the casing. The width of the gap is preferably in the range of 1 mm to 3 mm or, respectively, 0.3 % and 1.5% of the outside diameter of the rib.

[0014] In a preferred embodiment, it is further provided that the rib, on its radial face, possesses at least one groove and preferably two grooves that are displaced one in relation to the other by 180°. They extend in the axial direction. As the case may be, these grooves may also be askew of the axial direction by up to 45°.

[0015] For efficient circulatory flow, it is provided that the impeller blades lap over at least half the depth of the lateral channel. In this context, the depth of the lateral channel is understood to be the maximal clear inner width of the lateral channel as seen in the axial direction. To this end, the flanks of the impeller blades coincide with one of the two semiaxes of the elliptical cross-sectional surface. As the case may be, this semiaxis, which runs in the radial direction, also extends within the impeller blades.

[0016] According to an appropriate further development, the impeller blades are curved in the direction of their radial extension. This curvature aids in the forming of the circulatory flow, by a favourable component acting in the radial direction on the flow that forms. The gas flows in the radial direction from the impeller clearance into the lateral channel.

[0017] For the two lateral channels to be uniformly filled with the aspirated gas and for as early as possibly a pressure build-up to be produced, a preferred embodiment provides that approximately half the cross-sectional surface of an aspirating hole that opens out into the lateral channel laps over the impeller blades. This means that the impeller blades run past approximately half the aspirating hole, with the remaining half of the aspirating hole opening into a sectional area of the lateral channel the impeller blades do not pass. Suitably, provision is made for the aspirating hole to have a radius that corresponds approximately to the height of the impeller blades.

[0018] Details of the invention will become apparent from the ensuing description of an exemplary embodiment, taken in conjunction with the diagrammatic illustrations of the figures, in which

Fig. 1 is a diagrammatic illustration of details of a double-entry lateral channel compressor in the vicinity of the double-entry lateral channel as seen in the peripheral direction of the impeller;

Fig. 2 is a side view of an impeller blade as seen in the axial direction;

Fig. 3 is a plan view of an impeller as seen in the axial direction;

Fig. 4 is a plan view of an opened casing of the lateral channel compressor as seen in the axial direction;

Fig. 5 is a diagrammatic illustration of several cross-sectional views, one plotted on top of the other, of the lateral channel in various angular positions seen in the peripheral direction; and

Fig. 6 is a diagrammatic illustration of details of an impeller, with an aspirating hole roughly outlined, as seen in the axial direction.

[0019] In the figures components of identical action have the same reference numerals.

[0020] The lateral channel compressor, details of which are seen in Fig. 1, comprises a two-entry lateral channel 2 with two entries 2A, 2B that adjoin in the axial direction 4. The lateral channel compressor possesses a two-piece casing which includes a casing member 6 and a cover 8. The casing 6, 8 houses an impeller 12 rotatably about an axis of rotation that extends in the axial direction 4. The impeller 12 is operated by way of a drive shaft (not shown) and a driving motor. The impeller 12 extends in the radial direction 14, comprising a hub 16 that is followed by a supporting ring 18 which a plurality of blades 20 are disposed on in the peripheral direction or direction of rotation of the impeller 12. By its bottom side, the supporting ring 18 stands out from the hub 16 bilaterally in the axial direction 4. It has a rib 22 that runs in the radial direction 14, separating the entries 2A, 2B from each other and defining them one in relation to the other. Between the casing 6, 8 and the impeller 12, provision is made for a gap which is sealed by a sealing arrangement 24 which is fixed by screws 26 in the axial direction 4.

[0021] The elliptical cross-sectional surface of the two entries 2A, 2B is defined by an inside wall area 28 of the casing members 2, 6 as well as by a corresponding wall area of the rib 22. The inside wall area 28 as well as the rib 22 constitute curved surfaces, producing the elliptical cross-sectional contour. The curvatures of the inside wall area 28 and of the rib 22 are selected and mutually fitted in such a way that the wall areas pass into one another in as homogeneous and jointless a manner as possible. The individual wall areas therefore are substantially in alignment with one another.

[0022] Centrally between the two entries 2A, 2B, provision is made for a sectional area 30 of the casing member 6 - either as a integral component of the casing member 6 or as a separate insert - which simultaneously constitutes a part of the inside wall area 28 for both entries 2A, 2B. The sectional area 30 is disposed opposite the rib 22 in the radial direction 14. On the whole, the elliptical cross-sectional geometry is largely determined by the casing 6,8. In particular, the sectional area 30 helps attain that the lateral channel 2 is continued above the frontal definition of the impeller blades 20 so that gas, which is to be compressed, may also flow into the lateral channel 2 substantially in the radial direction, producing a circulation 32 as roughly outlined by the arrow.

[0023] The long semiaxis 34A of the elliptical cross-sectional surface extends in the radial direction 14 and aligns with a respective flank 36 of the impeller blades 20. The exemplary embodiment shows the short semiaxis 34B to be perpendicular to the long semiaxis 34A, consequently running in the axial direction 4. In this case, the maximal extension along the long semiaxis 34A defines the height h of the lateral channel and the maximal extension in the direction of the short semiaxis 34B defines the depth t of the lateral channel i.e., the depth of the respective entry 2A, 2B.

[0024] In the radial direction 14, the rib 22 extends for approximately three quarters of the height h of the lateral channel. The face 38, on the side of the end in the radial direction 14, of the rib 10 is spaced from the sectional area 30 by a gap 40. The gap 40 is comparatively wide, preventing dust or lint from accumulating in this area. The face 38 is in at least near alignment with the frontal flank 39 of the impeller blades 20, the frontal flanks 39 and the face 38 being substantially peripherally level.

[0025] As seen in Fig. 2, the impeller blades 20 are curved, having a curved blade pan 42 which is mounted on a blade footing 44. By way of a radius r, the pan 42 passes without any edges into the blade footing 44. At the blade footing 44, the blade pan 42 is oriented in relation thereto and, consequently in relation to the horizontal by an angle β_1. At the top end, the blade pan 42 is oriented in relation to the horizontal by another angle β_2 which is in approximately the same range as the angle β_1, being approximately in an order of magnitude of 60°. The blade pan 42 itself has a radius of curvature R.

[0026] The curved design of the impeller blades 20 as well as the alignment thereof with the rib 10 will become excellently apparent once again from the plan view of Fig. 3. As can also be seen in this illustration, two grooves 46 are worked into the face 38 of the rib 22; they are displaced one in relation to the other by 180°. These grooves 46 help prevent any accumulation of dust or lint in the gap 40 between the rib 22 and the sectional area 30. In operation, the impeller 12 rotates about the axis of rotation 48 in the direction of rotation 50.

[0027] According to Fig. 4, which offers a view into the interior of the casing member 6 without the cover 8, an intake 52 and a pressure joint 54 are connected to the casing member 6. Upon operation, the impeller 12 (not shown in this case) rotates in the direction of rotation 50, compressing the gas, which has been sucked by the intake 52, continuously towards the pressure joint 54 and ejecting the compressed gas via the pressure joint 54. An interrupter 56 is disposed between both, the intake 52 and the pressure joint 54. They are spaced apart by approximately 60° in the exemplary embodiment.

[0028] With regard to a high degree of efficiency and an effective sealing, the lateral channel 2 is tapered in the direction of rotation 50 from the intake 52 to the pressure joint 54. Here, the taper is in particular steady and continuous, for example, linear. The reduction of the lateral channel cross-section is selected accordingly, depending on the application and the area of usage. The lateral channel cross-section is reduced, for example, by solely reducing the lateral channel depth t, as shown in particular in Fig. 5. According to said Figure, a total of 3 cuts are set in opposite positions by the lateral channel 2, with one cut in the area of the intake 52 (curve a), one cut approximately in the centre of the lateral channel at 180° (curve b) and one cut at the end of the lateral channel in the area of the pressure joint 54 (curve c). In the exemplary embodiment in Fig. 5, the depth of the lateral channel t is reduced by approximately ¼. As an alternative to tapering solely the lateral channel depth t, the lateral channel height h can also, or alternatively, be reduced. The reduction of the lateral channel depth t and / or the lateral channel height h is here in particular linear. Depending on the required pressure build-up, the current cooling ratio and the required characteristic curve, the depth t or height h is selected appropriately, for example, according to a parabolic or exponential gradient.

[0029] The lateral channel compressor described here is characterized in particular by the special geometry of the lateral channel 2 with its elliptical cross-sectional geometry and the cross-sectional area which tapers in the direction of rotation 50. These two features create a double-entry lateral channel compressor, which combines the "closed" and the "open" designs for a lateral channel compressor. Here, a closed design is regarded as being a design in which the impeller blades 20 are open solely in the axial direction 4 to the lateral channel 2. By contrast, in an open design, three sides of the impeller blades 20 are open to the lateral channel 2. The lateral channel compressor described here combines the two design insofar as the impeller blades 20 are open on their frontal flanks 39 to the lateral channel 2, while at the same time being closed via the rib 22 in their central section to the sectional area 30 (see Fig. 1). This special arrangement, in particular in connection with the elliptical definition of the lateral channel 2 on almost all sides, achieves a high and consistent degree of efficiency. A lateral channel compressor of this type is therefore particularly useful in cases when speed regulation is required, since the degree of efficiency remains generally constant, regardless of the currently selected speed. The high degree of efficiency is achieved due to the systematic and largely turbulencefree guidance of the flow in order to produce the circulation 32, which is in particular produced by the special geometry of the lateral channel 2 in connection with the geometry of the impeller blades 20. The homogeneous transfer between the rib 22 and the inside wall area 28 is also a contributory factor. Due to the comparatively broad gap 40 (Fig. 1) and the two grooves 46 (Fig. 3), the lateral channel compressor is in addition unaffected by dust and lint.

[0030] In order to fill the two entries 2A and 2B, and to achieve the required early pressure build-up, approximately half of an aspiration opening 58, with which the intake 52 opens into the lateral channel 2, is covered over by the impeller 12 in the area of the impeller blades, as shown as a diagrammatical sketch in Fig. 6. The radius of the aspiration hole 58 approximately corresponds here to the radial height of the impeller blades 20.

List of reference numerals

[0031]

2	Lateral channel
2A, 2B	Entries
4	Axial direction
6	Casing member
8	Cover
12	Impeller
14	Radial direction
16	Hub
18	Supporting ring
20	Impeller blade
22	Rib
24	Sealing arrangement
26	Screw
28	Inside wall area
30	Sectional area
32	Circulation
34A	Long semiaxis
34B	Short semiaxis
36	Flank
38	Face
39	Frontal flank
40	Gap
42	Blade pan
44	Blade footing
46	Groove
50	Direction of rotation
52	Intake
54	Pressure joint
56	Interrupter
58	Aspiration hole

h	Lateral channel height
t	Lateral channel depth
r	Radius
R	Radius of curvature
β_1, β_2	Blade angle

Claims

1. A lateral channel compressor possessing an impeller (12) which is arranged in a casing (6, 8) for rotation about an axial axis of rotation (48), in the radial direction (14) on the side of its end having a supporting ring (18) with a plurality of blades (20) which are located in a lateral channel (2, 2A, 2B) with an elliptical cross-sectional geometry, the lateral channel (2, 2A, 2B) being defined by an inside wall area (28) of the casing (6, 8) and by a sectional area of the supporting ring (18), the cross-sectional surface of the lateral channel (2, 2A, 2B) tapering from an aspiration side to a pressure side.

2. A lateral channel compressor according to claim 1, wherein the inside wall area (28) opposite the supporting ring (18) as seen in the radial direction (14) comprises a sectional area (30) which retracts inwards into the lateral channel to form the elliptical cross-sectional geometry.

3. A lateral channel compressor according to one of claims 1 or 2, wherein the supporting ring (18) comprises a rib (22) that extends in the radial direction (14) as far as to the opposite inside wall area (28) of the casing (6, 8).

4. A lateral channel compressor according to claim 3, wherein two entries (2A, 2B) of the lateral channel (2, 2A, 2B) which are disposed side by side in the axial direction (4), are defined and separated from each other by the rib (22).

5. A lateral channel compressor according to claim 3 or 4, wherein the curved rib (22) aligns with the curved inside wall area (28).

6. A lateral channel compressor according to any one of claims 3 to 5, wherein the rib (22) which forms the elliptical cross-sectional geometry in the radial direction (14) is first tapered and then widened again.

7. A lateral channel compressor according to any one of claims 3 to 6, wherein the face (38) of the rib (22) on the end side in the radial direction (14) is in at least near alignment with the frontal flanks (39) of the impeller blades (20).

8. A lateral channel compressor according to any one of claims 3 to 7, wherein a gap (40) is defined between the rib (22) and the opposite inside wall area (28), the width of which is approximately in the range of 0.3 to 1.5% of the outside diameter of the rib.

9. A lateral channel compressor according to any one of claims 3 to 8, wherein the rib (22), on its radial face (38), possesses at least one groove (46) and preferably two grooves (46) that are displaced one in relation to the other by 180°, extending in the axial direction (4), or being askew of the axial direction by an angle of up to 45°.

10. A lateral channel compressor according to any one

of the above claims, wherein one of the two semiaxes (34A) of the elliptical cross-sectional surface of the lateral channel (2, 2A, 2B) runs in the radial direction (14) and along from the flanks (36) of the impeller blades (20) or within the area of the impeller blades (20).

11. A lateral channel compressor according to any one of the above claims, wherein the impeller blades (20) are curved in the direction of their radial extension.

12. A lateral channel compressor according to any one of the above claims, wherein on the aspiration side, an aspiration hole (58) opens out into the lateral channel (2, 2A, 2B), which laps over with its semi cross-sectional surface the impeller (12) which extends into the lateral channel (2, 2A, 2B).

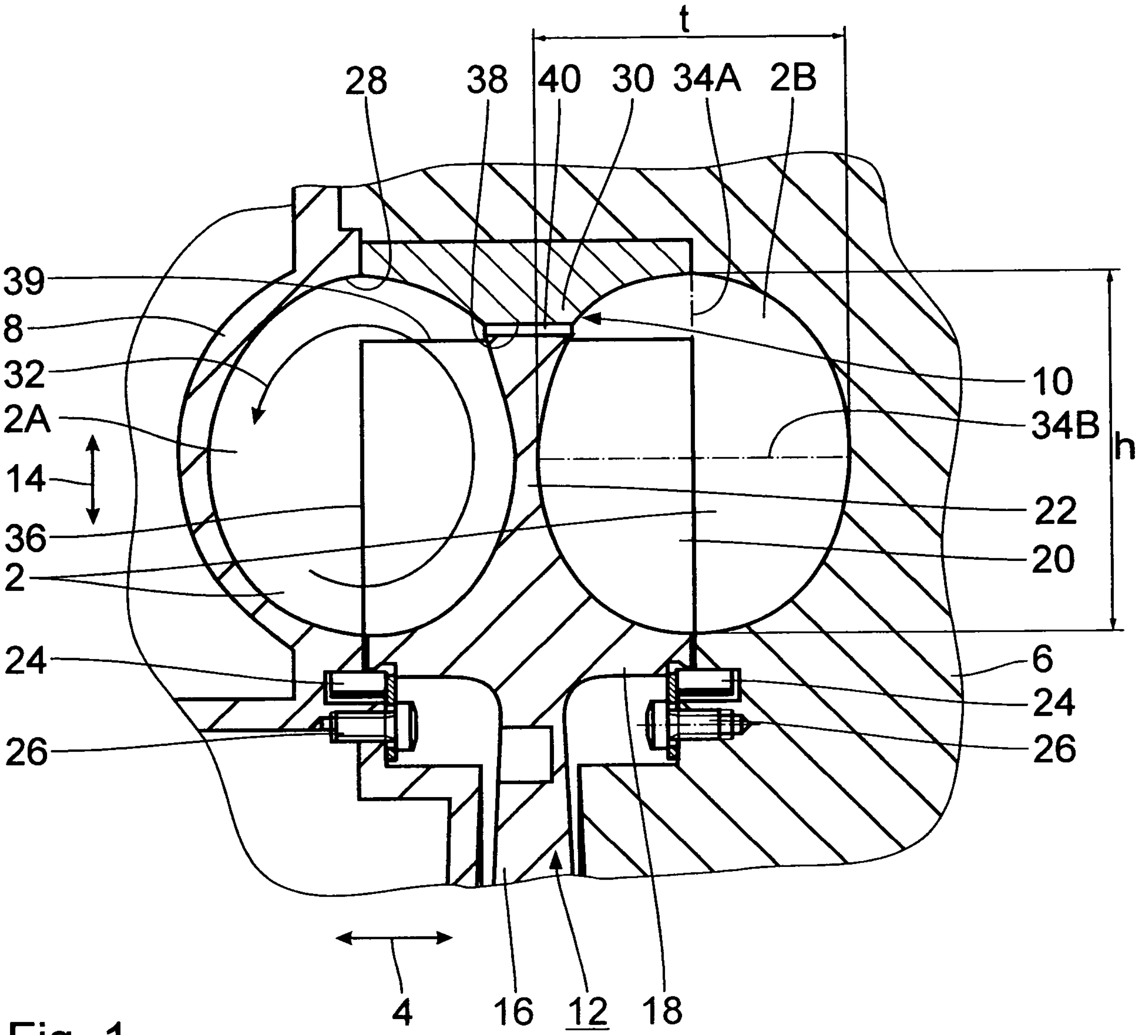
t
28
38
40
30
34A
2B
39
8
32
2A
14
36
2
10
34B
h
22
20
6
24
24
26
26
4
16
12
18

Fig. 1

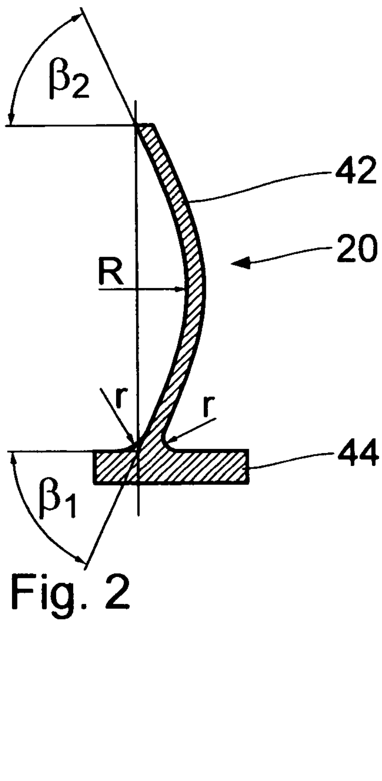
β2
42
20
R
r
r
44
β1

Fig. 2

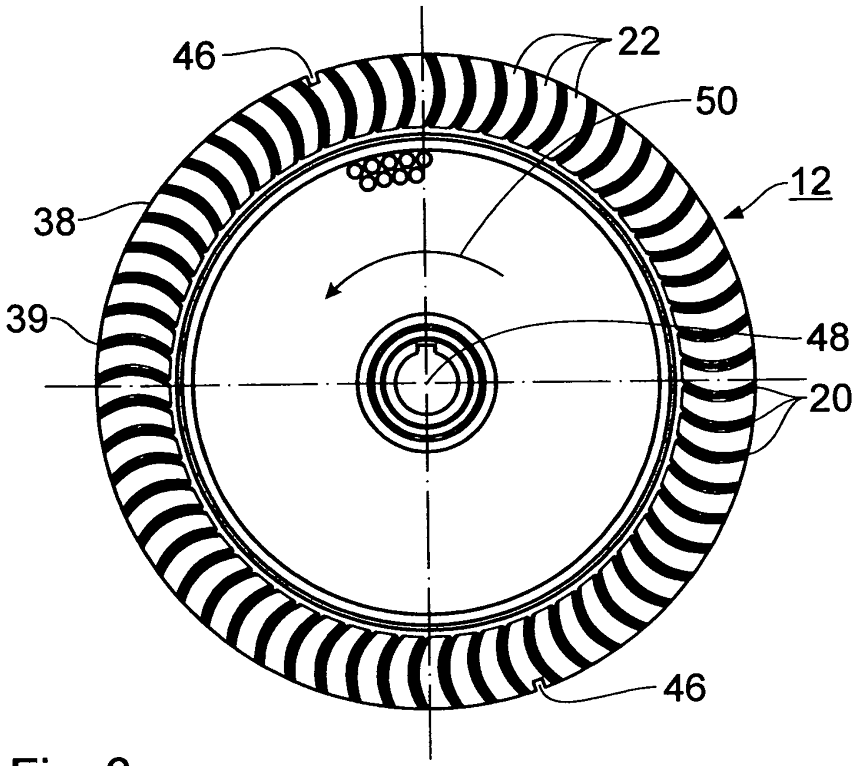

Fig. 3

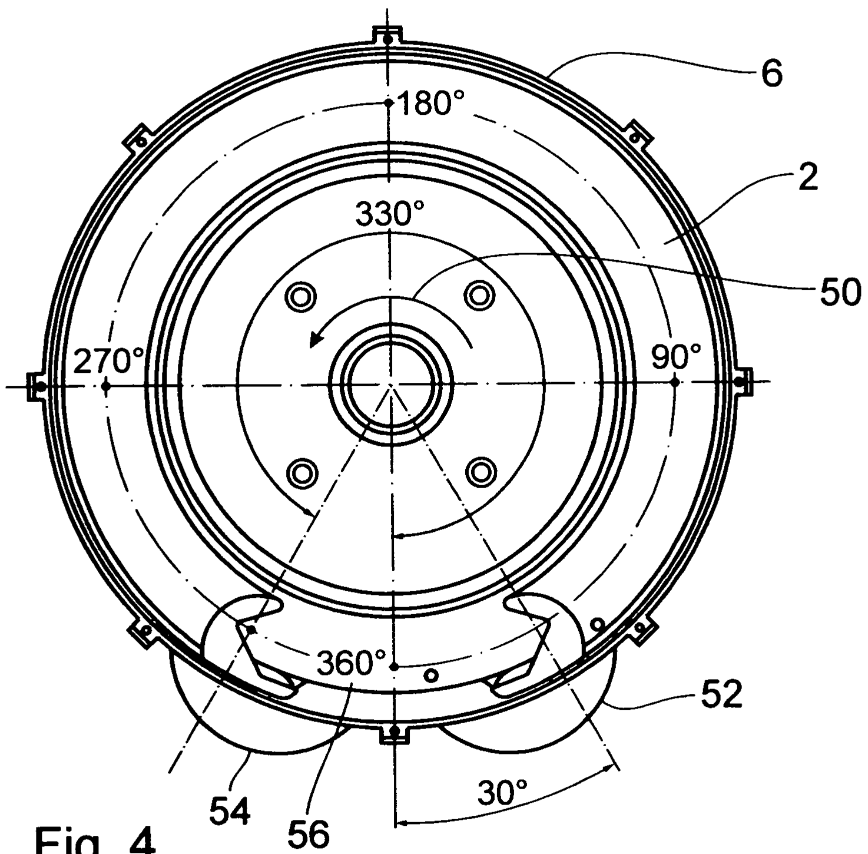

Fig. 4

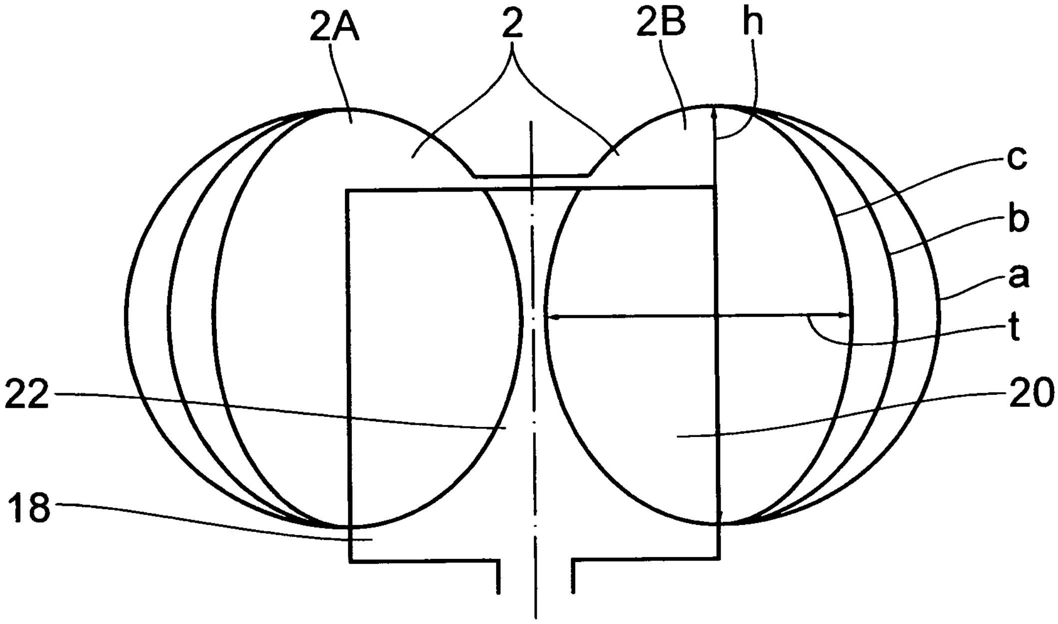

Fig. 5

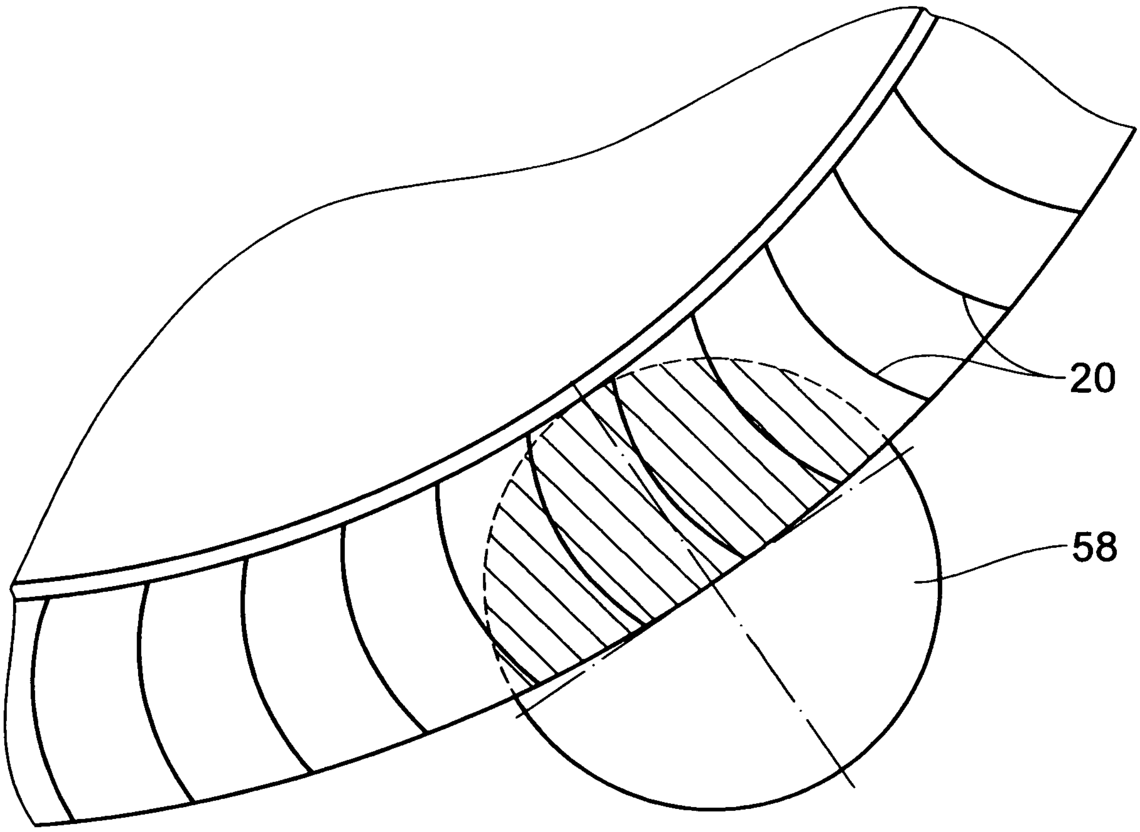

Fig. 6