(12) STANDARD PATENT (11) Application No. AU 2006303660 B2
(19) AUSTRALIAN PATENT OFFICE

(54) Title
Rotor for a rotary machine and a rotary machine

(51) International Patent Classification(s)
F04D 29/22 (2006.01)

(21) Application No: **2006303660** (22) Date of Filing: **2006.07.07**

(87) WIPO No: **WO07/045288**

(30) Priority Data

(31) Number	(32) Date	(33) Country
10 2005 049 938.4	**2005.10.19**	**DE**

(43) Publication Date: **2007.04.26**
(44) Accepted Journal Date: **2012.02.02**

(71) Applicant(s)
Zeki Akbayir

(72) Inventor(s)
Akbayir, Zeki

(74) Agent / Attorney
Freehills Patent & Trade Mark Attorneys, Level 38 MLC Centre Martin Place, Sydney, NSW, 2000

(56) Related Art
DE 4223965
US 1959710

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

(43) Internationales Veröffentlichungsdatum
26. April 2007 (26.04.2007)

PCT

(10) Internationale Veröffentlichungsnummer
WO 2007/045288 A1

(51) Internationale Patentklassifikation:
F04D 29/22 (2006.01)

(21) Internationales Aktenzeichen: PCT/EP2006/006686

(22) Internationales Anmeldedatum:
7. Juli 2006 (07.07.2006)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
10 2005 049 938.4 19. Oktober 2005 (19.10.2005) DE

(71) Anmelder und
(72) Erfinder: AKBAYIR, Zeki [TR/DE]; Erbacher Str. 25, 64743 Beerfelden (DE).

(74) Anwalt: BEHRENS, Helmut; Rechtsanwalt, Gross-Gerauer Weg 55, 64295 Darmstadt (DE).

(81) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

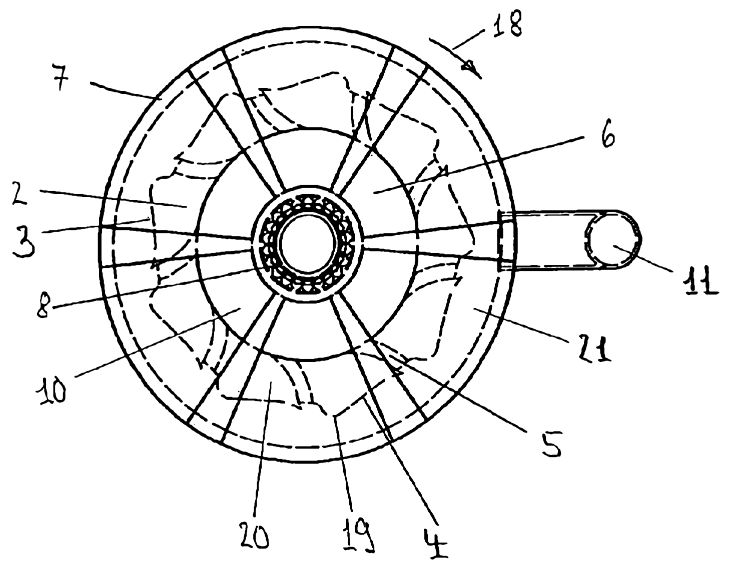
(84) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare regionale Schutzrechtsart)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:
— *mit internationalem Recherchenbericht*

[Fortsetzung auf der nächsten Seite]

(54) Title: ROTOR FOR A ROTARY MACHINE AND A ROTARY MACHINE

(54) Bezeichnung: ROTOR FÜR EINE STRÖMUNGSMASCHINE UND EINE STRÖMUNGSMASCHINE



(57) Abstract: The invention relates to a rotor (2) for a rotary machine and to a rotary machine equipped with said rotor, wherein the rotor (2) revolves in a gaseous or liquid medium and has, at least on one of its lateral surfaces (4), a profile (3) with at least one convex elevation (19) for producing a pressure difference. This rotor (2) is characterized by the fact that the convex elevation (19) is formed as an airfoil profile (3) of an aircraft, and the rotor (2) has an axial cavity (6) on the inside. In this case, the rotor (2) is connected to at least one chamber (12, 21) for guiding the medium provided in or away, wherein at least one passage opening (5) is provided between the cavity (6) and the outer lateral surface (4) in the region of the airfoil profile (3). Such a rotor (2) within different housing formations (7) forms a rotary machine, which can be used as a pump, a compressor, a condenser, a blower, a turbomachine, a turbine or as a pressure neutralizer.

[Fortsetzung auf der nächsten Seite]

WO 2007/045288 A1

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(57) Zusammenfassung: Die Erfindung betrifft einen Rotor (2) für eine Strömungsmaschine sowie eine damit ausgestattete Strömungsmaschine, wobei der Rotor (2) in einem gasförmigen oder flüssigen Medium umläuft und mindestens auf einer seiner Mantelflächen (4) ein Profil (3) mit mindestens einer konvexen Erhebung (19) zur Erzeugung eines Druckunterschieds aufweist. Dieser Rotor (2) ist dadurch gekennzeichnet, dass die konvexe Erhebung (19) wie ein Tragflächenprofil (3) eines Flugzeugs ausgebildet ist und der Rotor (2) innen einen axialen Hohlraum (6) aufweist. Dabei ist der Rotor (2) mit mindestens einer Kammer (12,21) zur Zu- oder Abführung des vorgesehenen Mediums verbunden, wobei zwischen dem Hohlraum (6) und der äußeren Mantelfläche (4) im Bereich des Tragflächenprofils (3) mindestens eine Durchtrittsöffnung (5) vorgesehen ist. Ein derartiger Rotor (2) innerhalb unterschiedlicher Gehäuseausbildungen (7) bildet eine Strömungsmaschine, die als Pumpe, Kompressor, Verdichter, Gebläse, Turbomaschine, Turbine oder als Druckneutralisator verwendbar ist.

2006303660 08 Jul 2011

ROTOR FOR A ROTARY MACHINE AND A ROTARY MACHINE

Field of Invention

The invention relates to a rotor for a rotary machine according to the preamble of claim 1 and to a rotary machine according to the preamble of claim 11.

Background of the Invention

Rotary machines are distinguished in that they produce a pressure difference in a gaseous or liquid medium or are driven by a pressure difference in a medium of this type. For this purpose, rotary machines of this type generally have a rotor which is rotatably mounted in the gaseous or liquid medium relative to a stator and produces, by way of its shape or arrangement, a pressure difference or converts the pressure difference in the medium into a rotational movement. Examples of rotary machines of this type include, in the first place, most types of pumps, compressors, turbomachines, turbines or wind energy converters which have a broad range of designs of rotors and are usually rotatably mounted in a housing as a stator.

DD 293 181 A5 discloses a rotary machine in the form of a pump having a cylindrical or conical rotor which is eccentrically mounted in a pump housing. This rotor is connected to a drive and produces on rotation a crescent-shaped revolving pump chamber which conveys preferably oil as a liquid from an inlet opening into an outlet opening. This pump, which is based on the hydrodynamic principle, produces during rotation in the crescent-shaped revolving housing an oil wedge which leads to a rise in pressure in the pump chamber and

2006303660 08 Jul 2011

outlet opening. In this case, the rotor has a relatively smooth round outer lateral surface which produces the rise in pressure in the liquid exclusively owing to its eccentric path of revolution. Nevertheless, an eccentrically revolving rotor of this type in a cylindrical housing is hardly suitable, owing to its unstructured lateral surface, in a gaseous medium in the pump chamber.

DE 103 19 003 A1 discloses a rotor of a wind energy converter by means of which wind energy is converted into electrical energy. In this case, the rotors consist of a shaft which is mounted in a stator and on which outwardly projecting rotor blades are arranged at constant-angle intervals. The rotor blades are in this case formed as a symmetrical wing of an airfoil of an aircraft that possesses in the flow direction a cylindrical lateral surface and accordingly has a convex protrusion which tapers to the rear at an acute angle. The rotor blades are in this case oriented in the wind direction in such a way that the wind which sweeps past brings about, as a gaseous medium and in accordance with Bernoulli's equation, a pressure difference which causes rotational movement of the mounted rotor in the stator. As a wing of this type causes on its edge which tapers at an acute angle a disruptive eddy formation, indentations are provided on the wing profile transversely to the wind direction. This gives rise to a lower pressure on the upper side than on the underside, leading to additional lift, as a result of which the eddy formation is reduced and more efficient energy conversion should be possible. However, a rotor of this type is provided exclusively for use in aeriform or gaseous media and, owing to its long rotor blades and the housing diameter necessitated thereby, can hardly be used with liquid media.

DE 42 23 965 A1 discloses a turbomachine rotor in which at least one support disk is mounted on a mounted shaft

2006303660 08 Jul 2011

and on the outer cylindrical lateral surface of which are arranged projecting short blades which revolve in a gaseous medium. This rotor is arranged in a stator housing and is driven via the shaft at a high rotational speed. In this case, the gaseous medium is pressed from an inlet opening into an outlet opening with a high condensing effect. Nevertheless, a turbomachine rotor of this type is generally not suitable for liquid media, as such media are non-compressible, so the thin blades could easily become damaged.

DE 197 19 692 A1 discloses a rotor pump which comprises an internally toothed rotor and has a very robust design of an internally toothed rotor. In this case, the pump consists of a housing containing a rotatable eccentric ring in which an outer impeller and an inner impeller are rotatably mounted. In this case, the inner impeller is an inner rotor which has a plurality of teeth arranged on its outer lateral surface and is rotatably arranged in an outer rotor. The outer rotor encloses the inner rotor with its inner lateral surface on which inwardly directed teeth are likewise arranged. In this case, both the inner and the outer teeth extend over the entire length of the lateral surface and consist substantially of a convex symmetrical elevation, six convex elevations being arranged on the outer lateral surface of the inner rotor and seven convex elevations being arranged on the inner lateral surface of the outer rotor. The inner cavity of the outer rotor is in this case respectively connected to an inlet opening and an outlet opening which oppose each other. The rotational movement of the inner rotor also gives rise to a rotational movement of the outer rotor in the eccentric ring, thus forming a series of chambers having variable volumes between the teeth of the inner and outer rotor. As a result, a fluid located in the chambers is drawn into the expanding chambers and out of the contracting chambers. The fluid provided

2006303660 08 Jul 2011

is in this case a hydraulic liquid which is pressed from the inlet opening into the outlet opening as a result of the pressure differences thus produced. As a rotor of this type consists of at least two toothed parts which are arranged coaxially with one another and must also have a differing number of teeth and mesh with one another with a precise fit only when designed with maximum precision, a rotor arrangement of this type is highly complex to manufacture and equipped with a number of parts which are subject to friction and dependent on wear.

Reference to any prior art in the specification is not, and should not be taken as, an acknowledgment or any form of suggestion that this prior art forms part of the common general knowledge in Australia or any other jurisdiction or that this prior art could reasonably be expected to be ascertained, understood and regarded as relevant by a person skilled in the art.

Summary of the Invention

The invention is therefore based on the object of providing a universally usable rotor for a large number of designs of rotary machines that is robust and almost maintenance-free while at the same time being simple to manufacture or provide the public with a useful alternative.

This object is achieved by the invention disclosed in claims 1 and 11. Developments and advantageous exemplary embodiments of the invention are disclosed in the sub-claims.

In one aspect of the invention there is provided a rotor for a rotary machine that revolves in a gaseous or liquid medium and has, at least on one of its lateral surfaces, a profile with at least one convex elevation for producing a pressure difference, wherein

2006303660 08 Jul 2011

the convex elevation is formed as an airfoil profile and the rotor has on the inside an axial cavity and the rotor is connected to at least one chamber for supplying or removing the medium, at least one passage opening being provided between the cavity of the outer lateral surface in the region of the airfoil profile.

The invention has the advantage that, as a result of the airfoil profile on one of the lateral surfaces of the rotor, owing to the Bernoulli effect resulting from the movement of the rotor or the flow of a gaseous or liquid medium, a reduced pressure effect is produced above the airfoil profile, thus allowing a rotor of this type to be used in rotary machines both for liquid and for gaseous media. As the pressure or suction effect is not produced by the formation of revolving sealing chambers, a medium laced with solids can thus advantageously also be conveyed, so rotors of this type are also highly suitable for continuous conveyance of bulk materials or dispersions.

At the same time, the invention has the advantage that the flow-beneficial airfoil profile gives rise to only slight eddy formation in the medium used and, apart from the bearings, there is no contact with a stator or other rotor parts, so rotary machines which are equipped with a rotor of this type operate particularly quietly and display almost no flow or frictional losses. As the rotor according to the invention is internally hollow and produces the pressure difference merely by way of a flat airfoil profile on one of the lateral surfaces, the rotor can be manufactured so as to be particularly light, so only low masses have to be accelerated, thus as a whole advantageously allowing a highly efficient rotary machine to be achieved, the low friction and the low flow turbulences notwithstanding.

In addition, the low rotor mass and the substantially symmetrical formation and centric rotation give rise to

2006303660 08 Jul 2011

only low centrifugal force effects, so a rotor of this type can advantageously be operated at high rotational speeds. This allows even high pressure differences at high flow speeds to be produced, as a result of which high outputs of the gaseous or liquid medium provided or of the solids contained therein can at the same time advantageously be achieved.

As the producible pressure difference rises, in a rotor sleeve profiled in accordance with the invention in this way, almost proportionally to the rotational speed, almost no pressure or volume fluctuations can advantageously occur at a constant rotor speed. The airfoil profile on the lateral sleeve produces, when the motor is being driven, at all times a pressure difference which is independent of the ambient pressure of the medium, thus advantageously allowing even high-density gaseous media to be conveyed or liquids from a very low depth to be pumped to the surface on application of static pressure.

The rotor according to the invention and a rotary machine equipped therewith can not only be utilized in the driven state for conveyance or producing pressure but can also be used, on flow-correct introduction of a pressurized medium, to produce rotational speed in order to produce energy, such as for example electricity, advantageously from water power or wind power.

In a multistage formation of the rotor according to the invention and a rotary machine equipped therewith, higher pressures can, in the case of axial stages and at a constant flow rate, advantageously be produced or, in the case of coaxial stages, the raising of the profile surface, while the pressure difference remains constant, advantageously allows still higher flow rates to be conveyed.

2006303660 08 Jul 2011

Brief Description of the Drawings

The invention will be described hereinafter in greater detail with reference to an exemplary embodiment illustrated in the drawings, in which:

Fig. 1 is a perspective view of a pump comprising a single-stage pump rotor;

Fig. 2 is a front view of the pump comprising the pump rotor;

Fig. 3 is a plan view of the pump comprising the pump rotor;

Fig. 4 shows a lamella ring of an impeller for the pump rotor;

Fig. 5 shows an arrangement of lamella elements of an impeller for the pump rotor;

Fig. 6 is a sectional view of a pump comprising a multistage pump rotor; and

Fig. 7 is a sectional view of a drive turbine.

Detailed Description of the Invention

Fig. 1 of the drawings is a perspective view of, as the rotary machine, a pump 1 having a single-stage hollow rotor 2, as a pump rotor, which has on an outer lateral surface 4 nine airfoil profile elements 3 between which passage openings 5 to the inner cavity 6 are arranged.

The pump 2 shown is a design which is operated preferably with water as a liquid medium. The pump 2 consists substantially of a stationary housing 7 as the stator, in which the pump rotor 2 is arranged. The rotor is, in the housing 7, rotatably mounted in two bearings 8 and has in its center a shaft 9 which is connected to a drive motor 9 (not shown). The housing 7 is substantially cylindrical in its formation and contains on its outer lateral surface an outlet opening 11 for removing the water to be pumped. An inlet opening 10, which is connectable to a feed line (not shown), is provided on the left-hand end face or lateral surface of the housing 7 to allow the water to be pumped to enter the cavity 6. The inlet opening 10 is connected to the cavity 6 of the rotor 2 and forms therewith an inlet chamber 12. A pump 1 of this type can in principle be used to convey all liquid media, such as for example water, oil and the like, and also all liquids which are mixed with solids, such as for example dispersions.

Fig. 2 of the drawings is a front view, showing in detail also the arrangement and formation of the rotor 2, of the pump 1 described hereinbefore. In this case, the rotor 2 consists substantially of a cylindrical impeller 20 which has on the inside a cylindrical cavity 6 which, in the case of the pump 1 shown, forms an inlet chamber 12. Nine convex elevations 3, which form an axially extending airfoil profile on the outer tangential lateral surface 4 of the rotor 2, are arranged on the outer lateral surface 4 of the rotor 2, distributed in identical angular portions. As the rotor 2 has on its outer tangential lateral surface 4 a plurality of airfoil profile elements 3 which, on rotation, form, as a result of the Bernoulli effect, a reduced pressure region even in gaseous media such as for example air, all gaseous media, such as gaseous media permeated with bulk materials, can thus also be conveyed, condensed or drawn in.

Passage openings 5 to the inner cavity 6 or to the inlet chamber 12 of the pump 1, which contains the medium to be pumped such as for example water, are provided in the end region of the airfoil profile 3. Fig. 3 of the drawings is a detailed plan view of the axial formation of the pump 1. Fig. 3 of the drawings reveals that the rotor 2 is lamellar in its construction in the axial direction. These lamellae are, owing to the airfoil profile 3 made of flat metal sheets, preferably cut out or punched out with the aid of a laser. In this case, the rotor 2 consists mainly of lamella rings 13 and an arrangement of lamella elements 14 which form the impeller 20.

Fig. 4 of the drawings is a more detailed view of the lamella rings 13 and Fig. 5 of the drawings is a more detailed view of the lamella elements 14 which, as an axial pack of lamellae, form the impeller 20 with the tangential lateral surfaces 4. The rotor 1 shown in Fig. 3 of the drawings consists of three arrangements of lamella elements 14 and a respective lamella ring 13 is fastened to its outer lateral surfaces. In this case, the lamella ring 13 preferably consists of a flat steel sheet which is protected against corrosion caused by aqueous liquids or consists of a stainless high-grade steel. Both the lamella rings 13 and the lamella elements 14 are usually made of the same material which, depending on the medium used, can also consist of other metals, hard plastics materials, synthetic fiber composite materials or ceramics. Each lamella ring 13 has on the inside a circular hole 23 having a diameter of, for example, 250 mm and a smallest outer diameter of approx. 360 mm. In this case, the lamella ring 13 contains preferably nine similar angular regions, each of 40°, and has arranged on its outer tangential lateral surface 4 in each case a convex elevation 19 which, counter to the direction of rotation 18, merges flat at a descending inclination with a run-out region 24 and forms an airfoil profile 3. The convex elevation 19 has relative to the running-out end preferably an elevation 19 of approx. 45 mm and possesses a radius of approx. 20 mm. The descending profile region 24, which runs out counter to the direction of rotation 18, has a concave curvature with a radius of 167 mm and extends over a length of approx. 70 mm. The convex elevation 19 with the descending concave running-out region 24 thus imitates on the lateral surface 4 a profile of an airfoil wing of aircraft. The airfoil profile 3 ends in this case in a slightly rising tip 25 which acts as a spoiler and substantially prevents turbulences on the tear-off edge.

The turbulence-preventing tip 25 is followed, counter to the direction of rotation 18, by a tangential straight surface which is at the shortest distance from the axis of rotation 26 and extends tangentially thereto over a length of approx. 5 mm. This straight surface delimits the passage openings 5 in the axial direction and terminates each individual airfoil profile 3 on the tangential outer lateral surface 4 of the rotor 2. In this case, each lamella ring 13 is formed by preferably similar airfoil profiles 3 which are arranged in identical angular regions and at the same distance from the axis of rotation 26.

Arranged between two outer lamella rings 13 are, to embody the pump rotor 2 shown, three lamella layers of in each case nine lamella elements 14 which on their outer radial edges also have the same airfoil profile 3 as the lamella rings 13. To form an impeller 20 of a rotor 2, the individual lamella elements 14 are connected, in congruent alignment with the airfoil profile 3, to a lamella ring 13 or to other lamella arrangements and accordingly constitute an axial impeller or an impeller part which forms on its outer tangential lateral surface 4 a uniform, axially oriented airfoil profile 3. In this case, the lamella elements 14 are however arranged tangentially set apart from one another and connected as a whole to the lamella rings 13, the distance between the lamella elements forming a passage opening 5 through which the medium provided is drawn outward by suction from the inner cylindrical cavity 6, as a result of the reduced pressure, along the descending airfoil profile 3, owing to the Bernoulli effect.

For the flow-beneficial formation of these passage openings 5, the individual lamella elements 14 are provided in their rear region with a convex curvature 15 and in their front region with a concave curvature 16 which allow a substantially eddy-free flow during the rotation. In this case, the concave curvature 15 on the inner edge also merges with a concave curvature which corresponds to the radius of the hole 23 in the lamella ring 13 of, for example, 125 mm. As a result, the rotor 2 forms on the inside an axially continuous cylindrical cavity 6 as the inlet chamber 12.

Star-shaped connecting elements, which are connected to the drive shaft 9 in a torsionally rigid manner and preferably to at least one of the lamella rings 13, are provided for fastening the impeller 20 to the drive shaft 9. In another embodiment of the invention, the airfoil profile 3 can also be arranged on the inner tangential lateral surface, the rotor 2 then having on the outside a circular lateral surface 4, as a result of which the direction of flow is reversed and the outlet chamber 21 is formed in the cavity 6 of the impeller 20 or of the rotor 2.

For operating the pump 1, the rotor 2 is driven at a predetermined rotational speed and in a predetermined direction of rotation 18, so a reduced pressure or difference in pressure from the surrounding gaseous or liquid medium forms on the outer lateral surface 4 in the direction of rotation 18 after the convex elevation 19 in accordance with the Bernoulli effect, so the medium is drawn outward out of the inner chamber 6 in which the pressure is higher. In this case, the pressure difference depends substantially on the rotational speed or the circumferential speed of the impeller 20. The pressure difference rises approximately linearly until the eddy formation on the tear-off edge or other turbulence elements becomes so great as to yield a significant counterpressure. This can however be reduced by an advantageous formation, in particular, of the torn-off edge and by the formation of a circular inlet 12 and outlet chambers 21, so at rotational speeds of at least 10,000 rpm the pressure rises linearly.

A high pressure difference can at the same time also allow an increase in the flow rate per unit of time, although this is limited by the cross-sectional surface areas of the passage openings 5. Nevertheless, the flow rate or the flow volume can easily be increased also by enlarging the surface area of the airfoil profile 3. In principle, a pressure difference can be produced with just one airfoil profile 3 on the circumference of the rotor 2 or of the impeller 20. Nevertheless, to increase the flow rate and to improve the flow ratio, nine airfoil profiles 3 were preferably arranged circularly around the tangential outer rotor sleeve 4, although both a smaller and a larger number of profile surfaces can also be embodied. A rotor 2 of this type comprising at least one airfoil profile 3 does not have to be cylindrical but can rather also have a spherical or conical outer lateral surface 4 by means of which a pressure difference can also be produced. In this case, a rotor of this type does not require any closed-off inlet 12 or outlet chambers 21 either, as simply rotation within a gaseous or liquid medium without a housing part reduces a pressure difference which can be utilized merely by means of a discharge or feed line which must be connected merely to one of the inlet 12 or outlet chambers 21. In this case, the possibility of utilizing the pressure compensation determines substantially the design of the rotary machine. Thus, a rotary machine having a closed-off inlet chamber connected to a line as a suction machine can also be formed for gaseous media or as a vacuum cleaner. Conversely, a rotor 2 having a closed-off outlet chamber 21 can advantageously be used as a compressor or blower for a gaseous medium or as a pump for the conveyance or for the pressure compensation of liquid media. A rotor 2 of this type can however also be used to produce rotational speed if there is a difference in pressure from a surrounding medium and to produce energy if there are differences in the water or air pressure.

In the particular embodiment of the invention shown in Fig. 6 of the drawings, a plurality of impellers 20 are arranged axially next to one another and separated from one another by separate outlet chambers 21. In this case, the four impellers 20 shown are arranged on a common drive shaft 9 which is mounted in two bearings 8 on a stator and the housing part. All of the impellers 20 are surrounded by a multipart housing 7 which has three intermediate walls 22 and accordingly forms four outlet chambers 21 in each of which a similar impeller 20 is rotatably arranged.

Each impeller is in this case formed like the impeller 20 described with reference to Fig. 1 to 5 of the drawings and consists basically of nine airfoil profiles 3 which are arranged on the outer lateral surface 4 and between which passage openings 5 to the inner cavity 6 are provided. In the first impeller 20, a first inlet opening 10 to the outer region of the housing 7 is provided as a circular recess which establishes a connection to the cavity 6 of the first impeller 20 as an inlet chamber 12. The gaseous or liquid medium provided is supplied to this first inlet opening 10, so the gaseous or liquid medium enters the first inlet chamber 12, which is formed as the cavity 6, of the first impeller 20. If the rotor 2 is driven at a predetermined rotational speed, a pressure difference is produced on the airfoil profile 3 in the region of the passage opening 5, as a result of which the medium is drawn outward into the first outlet chamber 21 surrounding the impeller 20. This gives rise in this outlet chamber 21 to an increase in pressure which acts through the second inlet opening 27 in the cavity or the inlet chamber of the second impeller 28. This rotating second impeller 28 produces, again, a pressure difference, so the medium enters a second outlet chamber 29 with an increase in pressure. As an inlet opening to the third impeller is provided also in the second outlet chamber 29, the pressure further increases by the same amount in each of the subsequent two outlet chambers, so a four-stage pump of this type leads to a four times greater rise in pressure than in a single-stage pump 1 comprising only one impeller 20. A multistage pump of this type as a rotary machine can be equipped with a large number of pressure increase stages, thus allowing almost any desired increases in pressure to be established, depending on the rotational speed provided.

A multistage pump of this type as a rotary machine can also be formed with radial stages. For this purpose, a plurality of impellers 20 having outer diameters of different sizes are arranged coaxially in one another and made to rotate by a common drive shaft 9. A rotary machine of such coaxial construction allows not only very high pressures to be produced but rather also, as a result of the high effective surface area of the airfoil profiles, high flow volumes per unit of time to be conveyed.

Fig. 9 of the drawings shows a further particular type of embodiment of the invention showing a drive turbine preferably for a liquid medium. Provided for this purpose is a single-stage cylindrical rotor 2 which has airfoil profiles 3 arranged on its outer lateral surface and passage openings 5 to its cavity which is arranged in a cylindrical housing 7. The housing 7 contains at its one axial end an inlet opening 10 and at its other axial end an outlet opening 11 which is formed in the manner of a bottleneck. The rotor 2 arranged in the housing 7 is driven by means of its inlet opening 10 via a shaft 9 by means of which the preferably liquid medium, such as for example water, is also supplied. Rotation causes the water to be drawn into the surrounding housing as an outlet chamber 21, thus producing therein excess pressure which issues from the flow-beneficial narrow bottleneck-type outlet opening 11 into the surrounding medium. Depending on the drive rotational speed and cross-sectional surface area of the outlet opening 11, the water flows at a specific outflow speed into the surrounding stagnant water, thus producing a turbine-like recoil effect. This allows preferably water vehicles to be driven or liquids to issue at high pressure as a function of direction into similar or different media.

2006303660 08 Jul 2011

Patent claims

1. A rotor for a rotary machine that revolves in a gaseous or liquid medium and has, at least on one of its lateral surfaces, a profile with at least one convex elevation for producing a pressure difference, wherein the convex elevation is formed as an airfoil profile and the rotor has on the inside an axial cavity and the rotor is connected to at least one chamber for supplying or removing the medium, at least one passage opening being provided between the cavity of the outer lateral surface in the region of the airfoil profile.

2. The rotor as claimed in claim 1, wherein the rotor contains the at least one impeller and a shaft which is connected thereto in a torsionally rigid manner and is rotatably mounted in a stator.

3. The rotor as claimed in claim 1 or 2, wherein the impeller is substantially cylindrical in its formation and has on the inside a cylindrical cavity, the airfoil profile being arranged either on the outer lateral surface or on the inner lateral surface.

4. The rotor as claimed in one of the preceding claims, wherein at least one airfoil profile is arranged axially and tangentially on one of the lateral surfaces of the impeller, the airfoil profile having at least one radial convex elevation which, counter to the direction of rotation, merges with an elongated, descending run-out region, the distance of which from the axis of rotation decreases in an outer lateral surface and increases in an inner lateral surface and at or in the end region of which at least one passage opening to the inner cavity is arranged.

2006303660 08 Jul 2011

5. The rotor as claimed in one of the preceding claims, wherein the impeller is made of a metal, a plastic, a glass fiber composite or a ceramic material.

6. The rotor as claimed in one of the preceding claims, wherein the impeller is lamellar in its construction and consists of at least one lamella ring with at least one airfoil profile and an arrangement of at least one lamella element with an airfoil profile which are joined together in axial alignment, the lamella elements being sufficiently set apart from one another tangentially to form at least one passage opening.

7. The rotor as claimed in one of the preceding claims, wherein the convex elevation describes a reference circle surface which has a defined radius and merges, counter to the direction of rotation, with the descending run-out region which extends rectilinearly, slightly convexly or slightly concavely and in the region of which or at the end of which the passage opening is arranged.

8. The rotor as claimed in one of the preceding claims, wherein the descending run-out region is slightly concave in its formation and, at its end, a radially outwardly directed tip is arranged in the manner of a spoiler as a tear-off edge.

9. The rotor as claimed in one of the preceding claims, wherein the impeller is axially multistaged in its formation, a plurality of spaced-apart impeller parts which each act as a separate impeller being arranged in axial succession in the direction of the axis of rotation, although the impeller parts are connected to one another or to the shaft in a torsionally rigid manner.

2006303660 08 Jul 2011

10. The rotor as claimed in one of claims 1 to 8, wherein the impeller is radially multistaged in its formation, a plurality of impellers having different diameters being arranged coaxially in one another and symmetrically to the axis of rotation and connected to one another and/or to the shaft in a torsionally rigid manner.

11. A rotary machine comprising a rotor as claimed in one of claims 1 to 10, wherein the rotary machine has, as the stator, a housing in which the rotor is mounted and which forms, with either an outer lateral surface and/or an inner lateral surface of the rotor, at least one chamber which, on rotation, displays a difference in pressure from the surrounding gaseous or liquid medium.

12. The rotary machine as claimed in claim 11, wherein the housing forms, as the chamber in which the medium is supplied, an inlet chamber and, as the chamber in which the medium is removed, an outlet chamber.

13. The rotary machine as claimed in claim 11 or 12, wherein the rotary machine contains at least one rotor, the outer lateral surface of which is surrounded by a housing part and forms therewith on the rotor an inlet chamber or outlet chamber and has at least one inlet opening and/or outlet opening.

14. The rotary machine as claimed in claim 11 or 12, wherein the rotary machine contains at least one rotor, the inner cavity of which is covered by at least one housing part and forms with the cavity an inlet chamber or outlet chamber and has at least one inlet opening and/or outlet opening.

15. The rotary machine as claimed in one of claims 11 to 14, wherein the rotary machine contains at least

2006303660 08 Jul 2011

one inlet chamber and an outlet chamber, each chamber having an inlet opening or outlet opening.

16. The rotary machine as claimed in one of claims 11 to 15, wherein the rotary machine contains at least one rotor with an axially multistage impeller and its outer lateral surfaces are surrounded by a separate housing part which has a respective inlet opening for the subsequent stage with a further impeller part or an inlet opening or outlet opening.

17. The rotary machine as claimed in one of claims 11 to 15, wherein the rotary machine contains at least one rotor with a radially multistage impeller which is surrounded by a common housing part and/or the cavities of which are covered by at least one housing part, at least one housing part being provided with an inlet opening or outlet opening.

18. The rotary machine as claimed in one of claims 11 to 17, wherein the rotary machine is formed as a drive turbine and contains at least one rotor which has an impeller and is surrounded by a cylindrical housing part and encloses the rotor and contains an axial inlet opening for supplying a gaseous or liquid medium and for introducing a shaft and has, at its opposing axial end, a bottleneck-shaped outlet opening.

19. The rotary machine as claimed in one of claims 11 to 17, wherein the rotary machine is formed as a pump, compressor, condenser, turbine, turbomachine or pressure neutralizer.

20. The rotary machine as claimed in one of claims 11 to 17, wherein the rotary machine is formed to produce rotational speed by means of a gaseous or liquid medium and contains at least one inlet chamber for the directional supply of the pressurized gaseous or liquid medium, which inlet chamber is formed in such

2006303660 08 Jul 2011

a way that the direction of flow is directed toward the convex elevation of the rotatably mounted rotor.

Fig 1

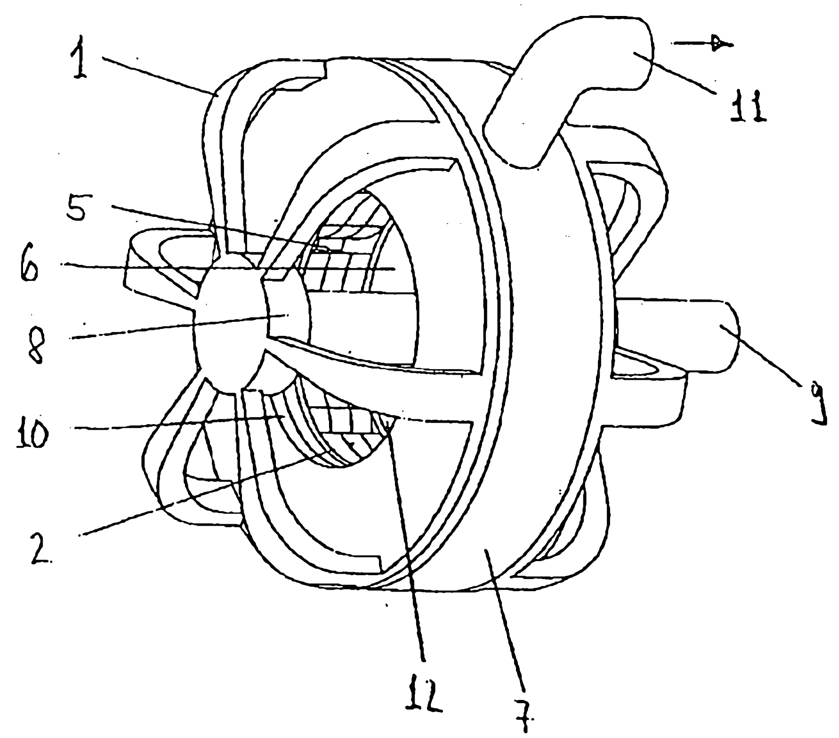


Fig 2

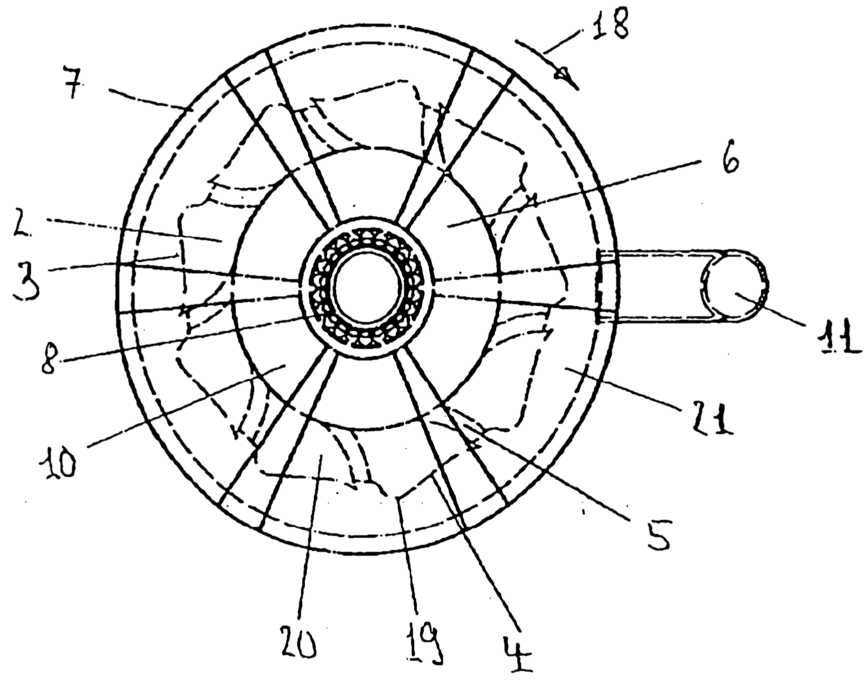


Fig 3

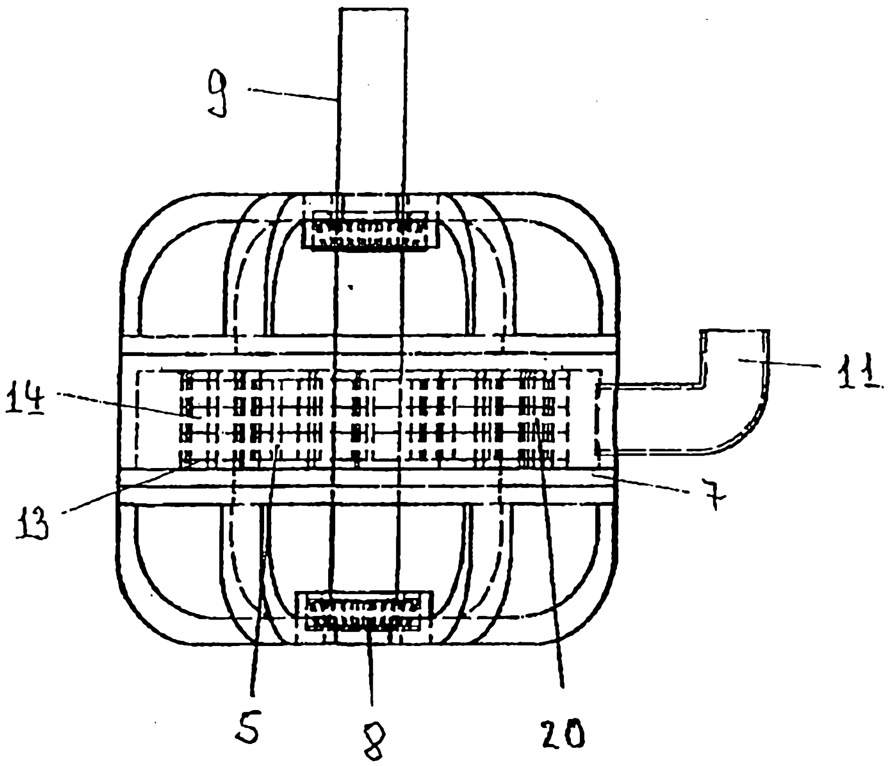


Fig 4

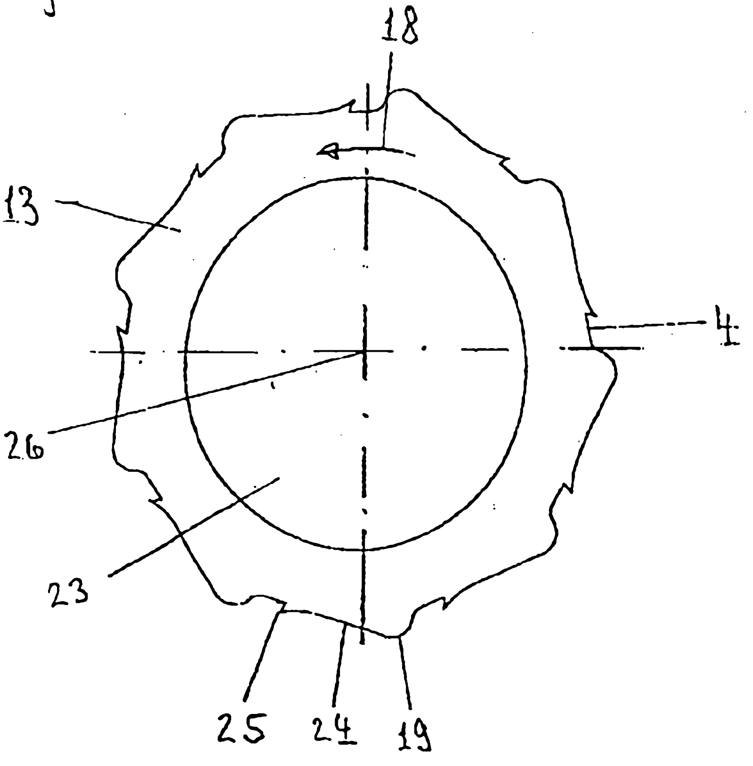


Fig 5

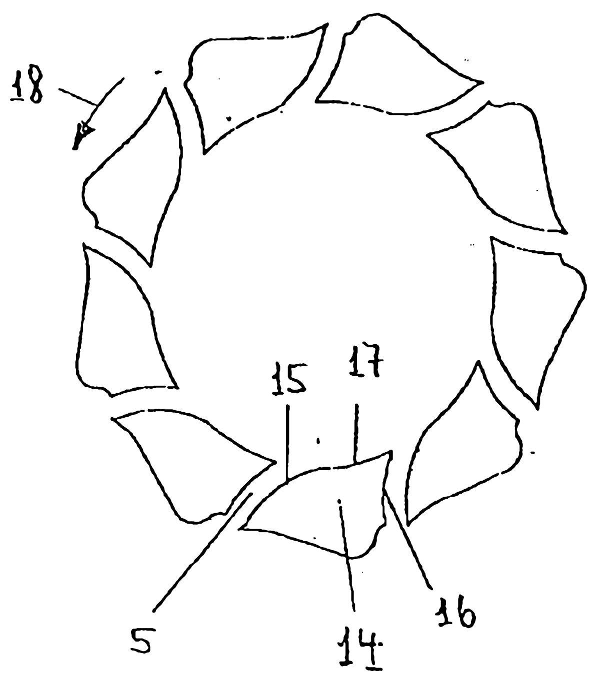


Fig 6

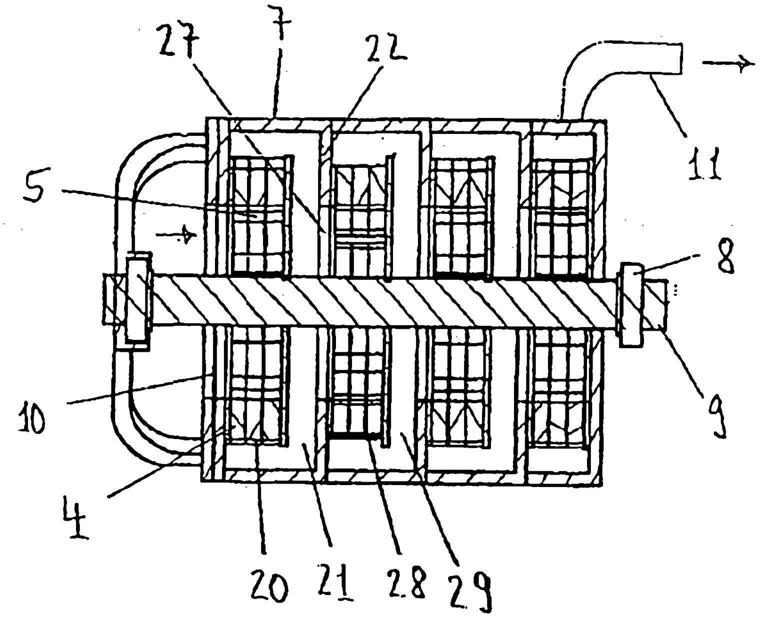


Fig 7