

Flow Device, Which Is Externally or Passively Powered, for a Liquid or Gaseous Medium, Comprising an Impeller Which Is Mounted in a Housing and Through Which the Medium Can Flow in the Axial Direction, and Use of Such a Flow Device

The invention relates to a flow device, which is externally or passively powered, for a liquid or gaseous medium according to the preamble of Claim 1 and to the use of such a flow device according to Claims 11-14.

An externally powered flow device can be present, for example, in the form of a fan that conveys a gaseous medium. The fan comprises an impeller, through which the medium can flow in the axial or radial direction and which rotates in the housing. In fluid mechanics one speaks of axial fans or centrifugal fans. The present invention relates to flow devices with an impeller through which the medium can flow in the axial direction and which is mounted in a housing. The impeller consists of an annular body with impeller vanes.

Fans are known in DE 10 2007 032 423 A1 as flow devices, which can be considered to be the closest prior art. As already described in DE 10 2007 032 423 A1, known axial fans have the disadvantage that the impeller vanes, which are connected to each other radially outwards by the annular body of the impeller or of the rotor, are connected radially inwards to a wheel hub, which is mounted in fixed bearings by means of a bearing shaft. In axial fans, the central mounting of the impeller is unfavorable, since the wheel hub shadows a large-area, central cross-sectional region of the wheel. As a result, entrained air that strikes the wheel hub in the axial direction is first deflected radially toward the outside before it is accelerated

again by the rotating impeller vanes and forwarded in the desired conveying direction.

According to DE 10 2007 032 423 A1, the problem is solved by contactlessly mounting the impeller on positionally fixed housing elements of the fan. The impeller is suspended by magnetic forces and the repulsive forces between like poles of permanent magnets are used to axially and radially center the impeller.

According to DE 10 2007 032 423, it is provided that a central opening is present, through which an injection air stream flows during the fan operation and which is axisymmetric with respect to the central axis of rotation. The air flow that is generated by a fan designed according to DE 10 2007 032 423 consists of a bypass flow, which is generated by the rotating wheel vanes, and a central injection flow, which arises in response to a pressure differential between the outflow side and the inflow side of the axial fan. The flow within the central injection flow corresponds more to a laminar flow than in the turbulent bypass region. As the distance from the impeller or an outlet nozzle of the fan increases, the initially laminar core flow begins to swirl in the central region of the overall air flow due to the interaction of the partial air flows in the transitional region. Due to the suitable selection of the ratio of the unobstructed cross-sectional portions of the central wheel opening and of the annular disk-shaped, unobstructed region, within which the wheel vanes rotate, fans having different outflow characteristics can be realized.

The problem addressed by the invention is that of improving a flow device of the aforementioned type such that a comparatively higher volumetric flow of the flowing medium is achievable.

This problem is solved in a flow device that is externally or passively powered according to the preamble of Claim 1 by the features of this claim.

Developments and advantageous embodiments can be gathered from the dependent claims.

The invention relates to a turbomachine, which is externally or passively powered, for a liquid or gaseous medium. When a medium is externally driven, an impeller with vanes draws the medium in, accelerates it, and pushes it into the outflow region. The external drive, for example, an electric motor or a turbine, sets the impeller into rotation. The vanes of the impeller generate a circulating force onto the medium due to their rotation, as a result of which a swirl arises. The swirl is a rotational motion of the medium about the axis of the impeller, which increases the kinetic energy of the medium.

In addition, the medium is pushed, due to the shape of the vanes of the impeller, from its outer circumference in the direction of its center, as a result of which a pressure gradient arises. This pressure gradient is a difference in the static pressure of the medium between the outer circumference and the axial central passage of the impeller, which increases the potential energy of the medium.

The medium flows through the impeller, both through the annular region, which is occupied by the vanes of the impeller, and

through the axial central passage. Due to the impeller, the medium assumes a higher speed and a higher pressure than prior to entering the impeller, which makes a high volumetric flow possible.

The invention is based on the finding that water runs more slowly out of a completely filled bottle when the bottle is turned with the opening upside down than from a bottle that is additionally set into a rotating motion and, as a result, a vortex forms in the water. This vortex results in a dynamic and sustained faster movement of the water flow out of the bottle. When a vortex is generated, the bottle therefore empties much faster. The flow device according to the invention, for example, a fan, accelerates the medium due to the rotation of the impeller so intensely that a vortex forms.

An important precondition for an optimal vortex is that the rotating medium can flow unobstructed through the flow path. In the present invention, this is achieved by omitting a central hub, which is present in conventional flow devices. In order to use the suction that is generated by the vortex, it is necessary to form a stable and powerful vortex. The flow dynamics in a vortex are the most stable structure and the least susceptible to disturbances by the surrounding medium. In flow devices that include obstacles to the free flow, the flow of the medium is provided with disturbances and turbulence from the beginning. An ordered rotation of the flow does not even take place. Obstacles or disturbances can prevent the formation of a vortex. A stable vortex breaks down only later. The breakdown does not take place within the flow, but rather the vortex expands from the edge toward the inside.

In so doing, the surrounding medium necessarily mixes with the accelerated medium in the vortex due to the laws of physics, in particular the Coanda effect and Bernoulli's principle. The surrounding medium is gradually decelerated by complex turbulence, as a result of which it becomes broader and calmer. A flow that originates from a stable vortex has a longer life and makes a greater rate of delivery possible with the same energy consumption. A stable and strongly pronounced vortex generates a suction that extends forward into the flowing medium, i.e., counter to the flow direction, and through or ahead of the rotating impeller vanes of the impeller, or of the rotor, of the flow device.

This effect arises when the water is drained out of a bathtub. A suction arises that not only pulls the water out of the lower layers through the outlet, but also suctions water from the surface. The rotation of the water is already set into motion by the developing vortex before it reaches the outlet. This also applies for the flow device that is described in this invention. The medium is already set into rotation and accelerated before it comes into contact with the impeller vanes. As a result, a lower power demand is achieved, since the suction effect occurs only when the vortex is stably expressed.

The comments presented with respect to the externally powered flow device apply similarly to a passively powered flow device, i.e., a flow device that is driven by the medium.

The impeller vanes preferably have a curvature and/or inclination that deviates from the axis of rotation of the impeller.

These features influence the power and the efficiency of the flow device. The mode of operation of these features can be explained as follows:

The curvature of the impeller vanes describes the deviation of the vanes from a straight line. The curvature can be either convex or concave, depending on whether the vanes are curved toward the outside or toward the inside. The curvature of the vanes influences the shape and the size of the flow channel between the vanes, through which the medium flows. A greater curvature constricts the flow channel and increases the flow speed. A smaller curvature widens the flow channel and reduces the flow speed. The optimal curvature of the vanes depends on the type and the purpose of the flow device. A greater curvature can be advantageous for a pump that is intended to generate high pressure. A smaller curvature, in contrast, can be advantageous for a turbine that is intended to generate high power.

The inclination of the impeller vanes describes the angle between the vanes and the axis of rotation of the impeller. Depending on whether the vanes are slanted in or counter to the direction of rotation of the impeller, the inclination can be either positive or negative. The inclination influences the direction and strength of the force that is exerted onto the medium. A positive inclination increases the force component in the direction of rotation and the swirl of the medium, while a negative inclination reduces both. The optimal inclination of the vanes depends on the type and the purpose of the flow device. A positive inclination can be advantageous for a pump that is intended to generate high pressure. A negative inclination, in contrast, can be advantageous for a turbine that is intended to generate high power.

The impeller vanes can have the shape of a crescent or a blade.

The impeller vanes are designed in the shape of a crescent or a blade in order to more efficiently and quietly convey the medium through the impeller. Flow losses are minimized and the flow quality is optimized. The aerodynamic properties of the vanes are improved due to the fact that the aerodynamic drag is reduced and the flow control is increased. The crescent or blade shape can increase the power and the efficiency of the flow device due to the fact that it adapts the rotational speed and the pressure of the medium.

It is a deviation from a straight line, which can be either convex or concave and influences the shape and size of the flow channel between the vanes, through which the medium flows. A larger crescent or blade shape constricts the flow channel and increases the flow speed. A smaller crescent or blade shape widens the flow channel and reduces the flow speed.

The optimal crescent or blade shape depends on the type and the purpose of the flow device. For example, a larger crescent or blade shape can be advantageous for a pump that is intended to generate a high pressure, while a smaller crescent or blade shape can be advantageous for a turbine that is intended to generate a high power.

The slope of the impeller vanes preferably decreases from outside to inside. The slope of the impeller vanes is defined as the theoretical distance that the impeller vane would cover in an axial medium during one revolution if it would rotate in a solid material such as a threaded block. If the slope were

linear, all regions of the impeller vanes, viewed from outside to inside, would contribute uniformly to the propulsion. In contrast, in a depressed slope, the outer regions would contribute more to the propulsion than the inner regions.

The slope thus influences the direction and magnitude of the force that the impeller vanes exert onto the medium.

A decreasing slope means that the impeller vanes become flatter in the direction of the central axial passage of the impeller. As a result, the vanes exert a smaller force component in the direction of rotation and a larger force component in the axial direction onto the medium. Thus, the medium is accelerated to a greater extent in the center.

The function of the decreasing slope is to minimize the flow losses and to optimize the flow quality. Flow losses are energy losses due to friction, turbulence, or shock waves. The flow quality is the uniformity and stability of the flow. A decreasing gradient can reduce the flow losses due to the fact that it reduces the friction between the medium and the vanes and avoids turbulence and shock waves, which can occur at high speeds. A decreasing slope can improve the flow quality due to the fact that it adapts the flow to the shape of the impeller and prevents flow separations, which can result in instabilities.

In addition to the shape and orientation of the impeller vanes, an adaptation and optimization of the number, distribution, and dimensioning of the impeller vanes can be feasible and advantageous.

As a result of this adaptation and optimization, the impeller vanes optimally convey the medium through the impeller, minimize the flow losses, and maximize the efficiency. The number, the distribution, and the dimensioning of the impeller vanes are important factors that determine the properties of the impeller, such as flow resistance, flow guidance, noise development, and power transmission.

The number of impeller vanes is the number of vanes that are fastened to the impeller ring. The number of the impeller vanes influences the size and the shape of the flow channel between the vanes, through which the medium flows. A larger number of impeller vanes reduces the size of the flow channel and increases the flow speed, while a smaller number of impeller vanes increases the size of the flow channel and decreases the flow speed. The optimal number of impeller vanes depends on the type and the purpose of the flow limiter. For example, a larger number of impeller vanes can be advantageous for a pump that is intended to generate a high pressure, while a smaller number of impeller vanes can be advantageous for a turbine that is intended to generate a high power.

The distribution of the impeller vanes is the arrangement of the vanes on the impeller ring. The distribution of the impeller vanes influences the uniformity and stability of the flow through the impeller. A uniform distribution of the impeller vanes yields a symmetric and stable flow, while a non-uniform distribution of the impeller vanes can result in an asymmetric and unstable flow. The optimal distribution of the impeller vanes depends on the type and the purpose of the flow device. For example, a uniform distribution of the impeller vanes can be advantageous for a pump or a turbine that requires high

reliability and safety, while a non-uniform distribution of the impeller vanes can be advantageous for a turbomachine that is intended to generate a certain flow form.

The dimensioning of the impeller vanes is the size and shape of the vanes, which can be described by different parameters, such as length, width, thickness, curvature, inclination, and slope. The dimensioning of the impeller vanes influences the aerodynamic properties of the vanes, such as air resistance, flow control, noise development, and force transmission. A greater dimensioning of the impeller vanes increases the size of the surface and the volume of the vanes, while a smaller dimensioning of the impeller vanes reduces the size of the surface and the volume of the vanes. The optimal dimensioning of the impeller vanes depends on the type and the purpose of the flow device. For example, a larger dimensioning of the impeller can be advantageous for a pump that is intended to generate a high pressure, while a smaller dimensioning of the impeller can be advantageous for a turbine that is intended to generate a high power.

The adaptation and optimization of the number, distribution, and dimensioning of the impeller vanes is a complex and multifaceted problem, which requires different mathematical models, numerical methods, and experimental methods. The adaptation and optimization can vary in accordance with the requirements and limiting conditions of the flow system.

In addition, the housing can have an inlet, the diameter of which in the region of the impeller vanes corresponds to the diameter of the impeller vanes themselves.

When the housing has an inlet, the diameter of which in the region of the impeller vanes corresponds to the diameter of the impeller vanes themselves, the medium is conveyed through the impeller at a lower speed and a higher pressure. Thus, the flow losses are minimized and the efficiency is maximized. The inlet is the opening through which the medium enters the housing. The diameter of the inlet influences the flow speed and the static pressure of the medium upstream prior to the entry into the impeller.

A same diameter means that the inlet has the same cross-section as the region of the impeller vanes. As a result, the medium has a constant speed and a constant pressure before it reaches the impeller. The medium is therefore accelerated to a lesser extent and compressed to a lesser extent.

The function of the same diameter consists in minimizing the flow losses and maximizing the efficiency. Flow losses arise due to friction, turbulence, or shock waves and result in the loss of energy. The efficiency describes the ratio of energy that is emitted to energy that is absorbed. A consistent diameter can reduce flow losses due to the fact that it reduces friction between the medium and the housing and avoids turbulence and the formation of shock waves at high speeds. In addition, a consistent diameter can increase the efficiency due to the fact that it improves the energy transmission between the medium and the impeller.

The inlet should taper in the shape of a funnel to the diameter of the impeller vanes.

A funnel-shaped taper means that the inlet has a larger cross-section than the region of the impeller vanes and reduces in size in the direction of the impeller. Thus, the medium has a lower speed and a higher pressure before it reaches the impeller.

The function of the funnel-shaped taper consists in minimizing the flow losses and maximizing the efficiency. The flow losses are the energy that is lost due to friction, turbulence, or shock waves. The efficiency is the ratio of the emitted energy to the absorbed energy. A funnel-shaped taper can reduce the flow losses due to the fact that it reduces the friction between the medium and the housing and avoids the turbulence and the formation of shock waves that can occur at high speeds. A funnel-shaped taper can increase the efficiency due to the fact that it improves the energy transmission between the medium and the impeller.

The function of the funnel-shaped taper depends on the type and the purpose of the flow device. A funnel-shaped taper can be advantageous, for example, for a pump that is intended to generate a high pressure, while a uniform or expanded diameter can be advantageous for a turbine that is intended to generate a high power.

In addition, the inlet can have a flow guide mechanism, which is designed as a spiral and/or as a diffuser.

A flow guide mechanism in the form of a spiral or a diffuser can contribute to influencing the flow direction of the medium and prompting the development of a vortex. Thus, a greater stability

of the vortex that is formed and a higher efficiency and power can be achieved.

The rotor of the motor is driven by the annular impeller, while the stator is enclosed by the housing.

The flow device can be operated using a directly driven electric motor. The electric motor is a specific type, which is connected directly to the impeller without a gearbox.

The directly rubbing electric motor converts electrical energy into mechanical energy due to the fact that it generates a rotating magnetic field that drives the rotor. There are different designs of the directly rubbing electric motor, such as the asynchronous motor, the stepper motor, or the permanently excited synchronous motor. The directly rubbing electric motor has the advantage of a high rotational speed, high efficiency, high precision, and low noise development.

The rotor is the rotatable part of the electric motor and consists of an annular impeller with vanes. The rotating magnetic field of the stator sets the rotor into motion.

The stator is the fixed part of the electric motor and consists of a housing, which encompasses the rotor. The stator generates the rotating magnetic field, which drives the rotor. It consists of multiple coils and soft iron cores, which are fastened to the housing.

The directly rubbing electric motor enables force to be transmitted directly between the stator and the rotor. Due to the omission of the gearbox, frictional losses, play,

maintenance, and noise development are reduced. The results in higher efficiency, reliability, and safety for the flow device.

According to one development, the annular impeller can be mounted in the housing suspended by magnetic forces.

Due to the suspended mounting of the annular impeller in the housing by means of magnetic forces, mechanical losses are minimized and the service life is maximized. Magnetic forces are forces that act between magnets or between magnets and magnetizable materials. They can be either attractive or repulsive, depending on the orientation of the magnetic poles.

The suspended mounting means that the impeller is held in a stable position by means of a magnetic field, without having direct contact with the housing. It is set into rotation by an external drive, such as an electric motor or a turbine. Thus, the impeller generates a swirl and a pressure gradient onto the medium that flows through the impeller.

The suspended mounting has the function of eliminating the friction between the impeller and the housing. This friction would otherwise result in mechanical losses, wear, noise development, and heat development. Due to the suspended mounting, the efficiency, reliability, and safety of the flow device are increased.

The suspended mounting can be realized by means of different types of magnetic bearings, such as passive, active, or hybrid magnetic bearings. Passive magnetic bearings use the attractive or repulsive forces between permanent magnets or between permanent magnets and superconductors in order to stabilize the

impeller. Active magnetic bearings, in contrast, use controllable forces between electromagnets and magnetizable materials in order to stabilize the impeller. Hybrid magnetic bearings combine passive and active magnetic bearings in order to use the advantages of both systems.

Due to the mass distribution of the impeller more into the outer region in comparison to designs having a central hub, a higher rotational energy and a stronger gyroscopic effect are generated, which increases the directional stability of the impeller. This can also be used for the flight stabilization of drones. A gyroscopic effect is the inertia of a rotating body relative to directional changes of the axis of rotation.

The invention also relates to the use of an externally powered flow device. Possible uses are as a fan, as a screw or propeller of boats and ships, and as a jet engine.

The flow device, which can be used as a fan or as a replacement for typical screws and propellers of boats and ships can be designed to be very flat and, thus, lightweight and space-saving.

When used as a jet engine, its power could be increased by means of a vortex formed according to the invention if, according to the invention, an impeller vane that is not mounted by means of a hub were used, i.e., an impeller with impeller vanes, which permits, or ensures, a flow in the center with formation of a strong and stable vortex.

The invention is explained in the following with reference to an exemplary embodiment, which is shown in the drawing. Wherein:

Fig. 1 shows a perspective view of a conventional flow device consisting of an impeller with impeller vanes, which are fastened on a hub,

Fig. 2 shows an axial longitudinal section of the flow device according to Fig. 1 in the resting state,

Fig. 3 shows an axial longitudinal section of the flow device according to Fig. 1 with a simulation of a flowing medium,

Fig. 4 shows a perspective view of a flow device according to the invention consisting of an impeller with a central opening,

Fig. 5 shows an axial longitudinal section of the flow device according to Fig. 4 in the resting state,

Fig. 6 shows an axial longitudinal section of the flow device according to Fig. 4 with a simulation of a flowing medium,

Fig. 7 schematically shows an annular permanent magnet as part of the housing for mounting an impeller,

Fig. 8 schematically shows a cross-section of the aforementioned permanent magnet according to Fig. 7,

Fig. 9 shows a design with permanent magnets that are wider inside than outside,

Fig. 10 shows an impeller with permanent magnets, each of which is arranged at an angle of 120° with respect to one another, in a top view,

Fig. 11 shows the impeller according to Fig. 10 from a position rotated by 90° , in a side view,

Fig. 12 schematically shows a front view of the impeller with two impeller vanes,

Fig. 13 schematically shows the impeller according to Fig. 12 in cross-section, and

Fig. 14 schematically shows a fan with the impeller and coils of an electromagnet mounted thereon.

The drawing shows different embodiments of flow devices.

Fig. 1 shows a perspective view of a conventional flow device consisting of an impeller 10 with impeller vanes 12, which are fastened on a hub 14. The impeller vanes 12 of the flow device have a linear slope. The slope of an impeller vane 12 describes the distance that the impeller vane 12 covers in an axial direction parallel to the impeller axis 16 per revolution. In the case of a linear slope, the blade angle of the impeller vanes 12 increases continuously and proportionally from the root of the impeller vanes 12 in the center to the outer tip. The blade angle describes the angle that the impeller vane 12 forms at the respective radial position with respect to the axis of rotation 16 of the impeller 10.

Fig. 2 shows an axial longitudinal section of the flow device according to Fig. 1 in the resting state as the preliminary stage to a simulation. The impeller vanes 12 and the central hub 14, to which the impeller vanes 12 are fastened, are apparent.

Fig. 3 shows an axial longitudinal section of the flow device according to Fig. 1 with a simulation of a flowing medium. It is shown that both the hub 14 and the impeller vanes 12 spread the flowing medium 18 downstream from the impeller 10 toward the outside. A central vortex cannot arise in this embodiment.

Fig. 4 shows a perspective view of a flow device according to the invention consisting of an impeller 20 with impeller vanes 22, which are fastened on an outer annular body 24. A central hub is not present. Instead, the impeller 20 has an opening 26 in the center. The impeller vanes 22 of the flow device do not have a linear slope. Rather, the blade angle of the impeller vanes 22 increases disproportionately from the edge of the central opening 26 to the outer tip.

Fig. 5 shows an axial longitudinal section of the flow device according to Fig. 4 in the resting state as the preliminary stage to a simulation. The impeller vanes 22 and the central opening 26 are apparent.

Fig. 6 shows an axial longitudinal section of the flow device according to Fig. 4 with a simulation of a flowing medium 28. It is shown that the flowing medium 28 downstream from the impeller 20 is deflected in the direction of the center and compressed. At a distance from the impeller 20, the flow lines are also compressed to form a core 30. Here, a stable vortex arises, which contributes to increasing the throughput of the medium 28.

Figures 7 through 14 show a flow device in the form of a fan. This comprises an impeller, which is mounted by means of permanent magnets and has an annular body with a central

passage. The fan is a lightweight flow device, in the case of which a stable vortex can form. A further advantage is that the fan can be designed to be very flat. This is made possible due to the positioning of the drive as the stator around the impeller as the rotor. The stator is positioned quasi externally radially around the rotor. It is not necessary to arrange a drive axially upstream or downstream from the impeller with the impeller vanes.

An annular permanent magnet 32 for mounting the impeller is apparent in Fig. 7. Fig. 8 shows a cross-section of the permanent magnet 32 around the impeller. The permanent magnet reduces the frictional resistance of the impeller. The concave shape of the annular permanent magnet 32 on the inside is used to guide the impeller, which is suspended inside the annular permanent magnet 32. The permanent magnet can also be referred to as a retaining ring. Further annular permanent magnets can be provided. One annular permanent magnet 32 is already sufficient for a lighter-weight variant of the fan. Multiple annular permanent magnets strengthen or ensure the secure retention and the stability at higher rotational speeds of the impeller or of the impellers, in particular in heavier and higher-powered variants of the flow devices, for example, fans.

The flow device can have a one-piece, outer bearing ring for mounting the impeller or the rotor, which does not perform a function for the drive.

When the impeller 34 or the rotor is driven by means of a bipolar outer stator, this outer ring can be advantageously constructed of two separate half-rings 36, 38, as Fig. 9 shows.

Thus, it is made possible to use the different charge of the two poles separately from one another.

In the latter case, the rotor should ideally be constructed using at least three permanent magnets 40, 42, 44, as is shown in Fig. 10. These are each arranged by 120° with respect to one another and, thus, are brought into rotation due to the changing polarity of the stator.

Figs. 10 and 11 show a design with permanent magnets 40, 42, 44 that are wider inside than outside in order to prevent displacements of the mounted permanent magnets under centrifugal forces.

Higher-powered flow devices require a rotor with current-induced coils. This technology is already known with different electric motors, regardless of whether these are direct-current or alternating-current motors and/or synchronous or asynchronous motors.

The impeller 34, or the rotor, is ideally also mounted by means of permanent magnets 40, 42, 44 in order to enable stable and low-friction guidance. Fig. 12 shows a front view of the impeller 34, or the rotor, wherein only two impeller vanes 46, 48 are shown, for the sake of clarity. The shape of the impeller vanes is arbitrarily established here. The shape and orientation as well as the dimensions and distribution of the impeller vanes can deviate from the impeller vanes shown in order to generate a stable and strong vortex. It is not absolutely necessary to design the impeller vanes 46, 48, as shown in Fig. 13, to be profiled to a lesser extent in the front region where the air

flow enters and to increasingly enlarge these in the further course of the air flow.

Fig. 14 shows the fan with the impeller 34 and the coils 50, 52 as an integral part of the electromagnets. The coils 50, 52 are connected to the impeller 34 and form a rotating unit. According to the invention, the center 54 of the impeller 34 and, thus, of the flow device remains open in order to ensure space for the swirl or vortex, which forms that much more strongly and intensively, the higher is the rotational speed of the impeller.

The inlet of the fan is wider in order to convey a stable and strong air flow. A similar principle is known with respect to jet propulsion.

List of reference characters

10	impeller
12	impeller vane
14	hub
16	axis of rotation
18	medium
20	impeller
22	impeller vane
24	annular body
26	opening
28	medium
30	core
32	permanent magnet
34	impeller
36	half-ring
38	half-ring
40	permanent magnet
42	permanent magnet
44	permanent magnet
46	impeller vane
48	impeller vane
50	coil
52	coil
54	center

C l a i m s

1. An externally or passively powered flow device for a liquid or gaseous medium, consisting of a housing that is equipped with an impeller through which the medium can flow in the axial direction and which is settable into rotation by an external drive or by the medium, wherein the impeller comprises an annular body with impeller vanes, which annular body is mounted in the housing on the outer circumference of the annular body and has an axial central passage, characterized in that a swirl combined with a pressure gradient which increases from the outer circumference to the axial central passage of the impeller is impressible onto the medium.
2. The flow device of Claim 1, characterized in that the impeller vanes have a curvature and/or an inclination that deviates from the axis of rotation of the impeller.
3. The flow device of Claim 1 or 2, characterized in that the impeller vanes have a crescent or blade shape.
4. The flow device of one of Claims 1-3, characterized in that the slope of the impeller vanes decrease from outside to inside.
5. The flow device of one of Claims 1-4, characterized in that, in addition to the shape and orientation of the impeller vanes, an adaptation and optimization of the number, the distribution, and the dimensions of the impeller vanes is implementable.

6. The flow device of one of Claims 1-5, characterized in that the housing can have an inlet, the diameter of which in the region of the impeller vanes corresponds to the diameter of the impeller vanes themselves.

7. The flow device of one of Claims 1-6, characterized in that the inlet tapers in the shape of a funnel to the diameter of the impeller vanes.

8. The flow device of one of Claims 1-7, characterized in that the inlet has a flow guide mechanism, which is designed as a spiral and/or as a diffuser.

9. The flow device of one of Claims 1-8, characterized in that, in the case of an external drive, this consists of a directly driven electric motor, the rotor of which is formed by the annular impeller and the stator of which is formed by the housing enclosing the rotor.

10. The flow device of one of Claims 1-9, characterized in that the annular impeller is suspended in the housing by magnetic forces.

11. A use of an externally powered flow device of one of Claims 1-10 as a fan.

12. The use of an externally powered flow device of one of Claims 1-10 as a screw or propeller of boats and ships.

13. The use of an externally powered flow device of one of Claims 1-10 as a jet engine.

14. The use of an externally powered flow device of one of Claims 1-8 or 10 as an electric generator.