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(54) **Impeller for centrifugal pump**

(57) A pump rotor is characterized by the fact that the rear shield diameter (1) is from 0.99 to 0.70 of the frontal shield diameter (2), whereas outlet blade(2) edges (2) are parallel on its all length to the axis of rotor rotation. Outlet blade edges have got skips to be al wide, being from 0.01 to 0.9 of rotor discharge channel width; however its height a2 is from 0.01 to 0.5 of its width.

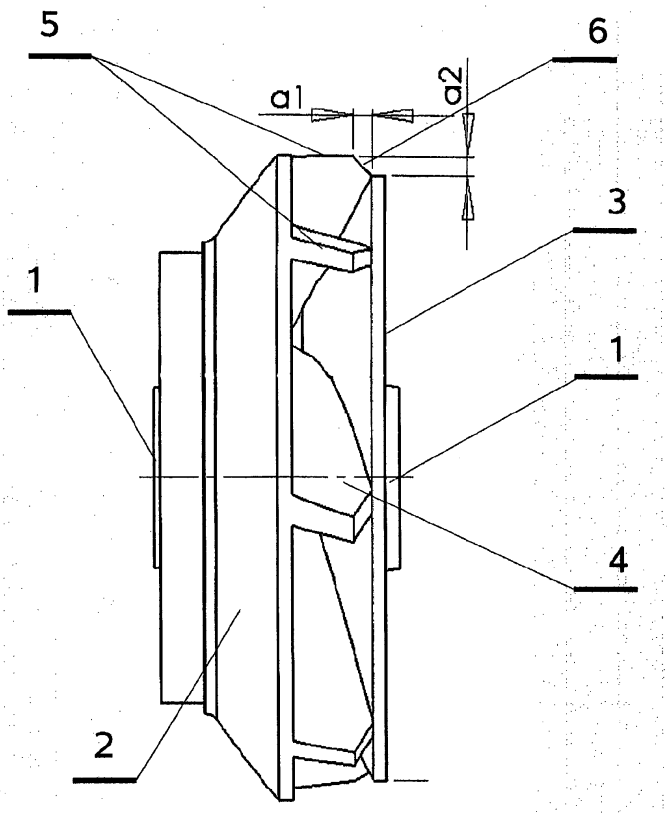

Fig. 3

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Description

[0001] The subject of invention is a rotor of impeller pump, especially centrifugal or screw pump with blades of spatial curvature.

[0002] A typical rotor of centrifugal pump generally consists of a hub and frontal as well as rear shield mounted on it, joined with blades forming internal discharge channels. The number of blades in rotors is from two to mostly eight or ten pieces, depending on demanded capacity and delivery head. In single-stage pumps there are used centrifugal rotors with blades of two-dimensional curvature, whereas frontal and rear shields have an equal diameter. In multi-stage submersible and deep-well pumps there are used centrifugal rotors with blades of spatial curvature and the rear shield diameter is equal or smaller than the frontal shield diameter, whereas outlet blade edges are a straight parallel line or a line diagonal to an axis of rotation, joining shield edges in order to get a diagonal direction of liquid flow to a stator inserting liquid to the next stage of pumping.

[0003] A rotor type and diameter as well as in less degree a body diameter determines two nominal pump parameters - its capacity (m3/s) and delivery head (m).

[0004] A smaller rotor diameter of impeller pump means less power consumption from a drive shaft as a result of less liquid friction losses on frontal and rear rotor shields as well as smaller surface of blades transferring the momentum moment to the flowing liquid and it causes a smaller delivery head.

[0005] The solution point of rotor, in which out let blade edges are parallel on its all length to the axis of rotor rotation, is that the rear shield diameter is from 0.99 to 0.70 of the frontal shield diameter.

[0006] It is advantageously, when the rear shield diameter is from 0.99 to 0.70 of the frontal shield diameter, whereas outlet blade edges are parallel on its all length to the axis of rotor rotation and out let blade edges have got skips to be al wide, being from 0.01 to 0.9 of rotor discharge channel width, however its height a2 is from 0.01 to 0.5 of its width.

[0007] It is advantageously, when the rear shield diameter makes up from 0.98 to 0.85 of the frontal shield diameter.

[0008] It is advantageously, when the rear shield diameter of pump rotor according to the invention makes up from 0.96 to 0.90 of the frontal shield diameter.

[0009] It is very advantageously, when the rear shield diameter of pump rotor according to the invention makes up 0.95 of the frontal shield diameter.

[0010] The solution point of rotor, in which outlet blade edges are on its all length directed askew to the axis of rotor rotation, is that the rear shield diameter is from 0.99 to 0.70 of the frontal shield diameter and outlet blade edges have got skips to be a1 wide, being from 0.01 to 0.9 of rotor discharge channel width, however its height a2 is from 0.01 to 0.5 of its width.

[0011] It is advantageously, when the rear shield diameter of pump rotor is from 0.9 to 0.70 of the frontal shield diameter and outlet blade edges have got skips to be a1 wide, being from 0.1 to 0.6 of b2 rotor discharge channel width, however its height a2 is from 0.2 to 0.5 of its a1 width.

[0012] It is very advantageously, when the rear shield diameter of pump 5 rotors is from 0.80 to 0.70 of the frontal shield diameter and outlet blade edges have got skips to be a1 wide, being from 0.4 to 0.5 of rotor discharge channel width; however its height a2 is from 0.4 to 0.5 of its a1 width.

[0013] The invention was presented in work examples in the figure, not limiting them in any way, on which fig. 1 shows a rotor in an end view in the form of work, in which outlet blade edges are parallel on its all length to the axis of rotor rotation, fig. 2 shows a rotor in a perspective view, in which outlet blade edges are parallel on its all length to the axis of rotor rotation, fig. 3 shows a rotor in an end view, in which outlet blade edges are on its all length directed askew to the axis of rotor rotation, fig. 4 shows a perspective view of rotor, in which outlet blade edges are on its all length directed askew to the axis of rotor rotation. Fig. 5 shows a graph of rotor work parameters according to the invention, in which outlet blade edges are parallel on its all length to the axis of rotor rotation and in which the rear shield diameter is 0.96 of the frontal shield diameter, in comparison with the work of standard rotor. However, fig. 6 shows a graph of rotor work parameters according to the invention, in which the rear shield diameter is 0.86 of the frontal shield diameter and a1 skip width is 0.4 of discharge channel width, and its height makes up 0.2 of its width.

[0014] A rotor of impeller pump has got a hub (1), a front a1 shield (2), a rear shield (3) joined with blades (4) of outlet edges (5) parallel to the axis of rotor rotation and having got a skip (6).

[0015] Broken lines presented in fig. 5 illustrate the rise of rotor efficiency, which the rear shield diameter is 0.96 of the frontal shield diameter. It is caused by the decrease of whirling shield friction loss without decreasing the surface of rotor blades. As a result, power consumption is decreasing without a significant decrease of delivery head, what causes, as a last resort, the efficiency rise of the whole impeller pump. The second observed result of such rotor construction is loosening the outlet rotor blade grid, causing lowering a speed value and decreasing the outlet loss from the rotor as well as the inlet loss to the element of liquid draining, having also an impact on the efficiency rise. In case of multi-stage pumps there is being observed a mating improvement of rotor and stator as a result of faster change of liquid flow direction in the direction of rotor axis and decreasing flow losses in the flow system.

[0016] In fig. 6 there is shown a rotor profile with a skip from the side of rear shield by means of broken line. There has been observed a significant decrease of power consumed by a rotor with insignificant lowering the delivery head, what finally gives the rise of pump efficiency. It is

caused by decreasing liquid friction losses of whirling shields as well as partial power decrease, transferred by blades to pumped liquid. Apart from the efficiency increase, there has been observed a profile e form improvement of pump flow. In case of unstable profiles, in which a delivery head for

[0017] Q=0 is smaller than for a pump efficiency Q>0 the applied rotor according to the invention causes the rise of delivery head for small pump capacity.

Claims

1. A rotor of impeller pump including a hub, a frontal shield, a rear shield joined with blades, **characterized in that** the rear shield diameter (1) is from 0.99 to 0.70 of the frontal shield diameter (9), whereas outlet edges (5) of blades (4) are parallel on its all length to the axis of rotor rotation.

2. A pump rotor according to the claim 1 **characterized in that** the rear shield diameter (3) is from 0.99 to 0.70 of the frontal shield diameter (2), whereas outlet edges (5) of blades (4) are parallel on its all length to the axis of rotor rotation and outlet blade edges have got skips (6) to be a1 wide, being from 0.01 to 0.9 of rotor discharge channel width, however its height a2 is from 0.01 to 0.5 of its width.

3. A pump rotor according to the claim 1 or 2 **characterized in that** the rear shield diameter (3) makes up from 0.98 to 0.85 of the frontal shield diameter (2).

4. A pump rotors according to the claim 3 **characterized in that** the rear shield diameter (3) makes up from 0.96 to 0.90 of the frontal shield diameter (2).

5. A pump rotor according to the claim 4 **characterized in that** the rear shield diameter (3) makes up 0.92 of the frontal shield diameter (2).

6. A rotor of impeller pump including a hub, a frontal shield, a rear shield joined with blades, **characterized in that** the rear shield diameter (3) is from 0.99 to 0.70 of the frontal shield diameter (2), whereas outlet blade edges are on its all length directed askew to the axis of rotor rotation and outlet edges (5) of blades (4) have got skips (6) to be a1 wide, being from 0.01 to 0.9 of rotor discharge channel width, however its height a2 is from 0.01 to 0.5 of its width.

7. A pump rotor according to the claim 6 **characterized in that** the rear shield diameter (3) is from 0.9 to 0.70 of the frontal shield diameter (2) and outlet edges (5) of blades (4) have got skips to be al wide, being from 0.1 to 0.6 of rotor discharge channel width, however its height a2 is from 0.2 to 0.5 of its width.

8. A pump rotor according to the claim 7 **characterized in that** the rear shield diameter (3) is from 0.80 to 0.70 of the frontal shield diameter (2) and outlet edges (5) of blades (4) have got skips to be a1 wide, being from 0.4 to 0.5 of its width.

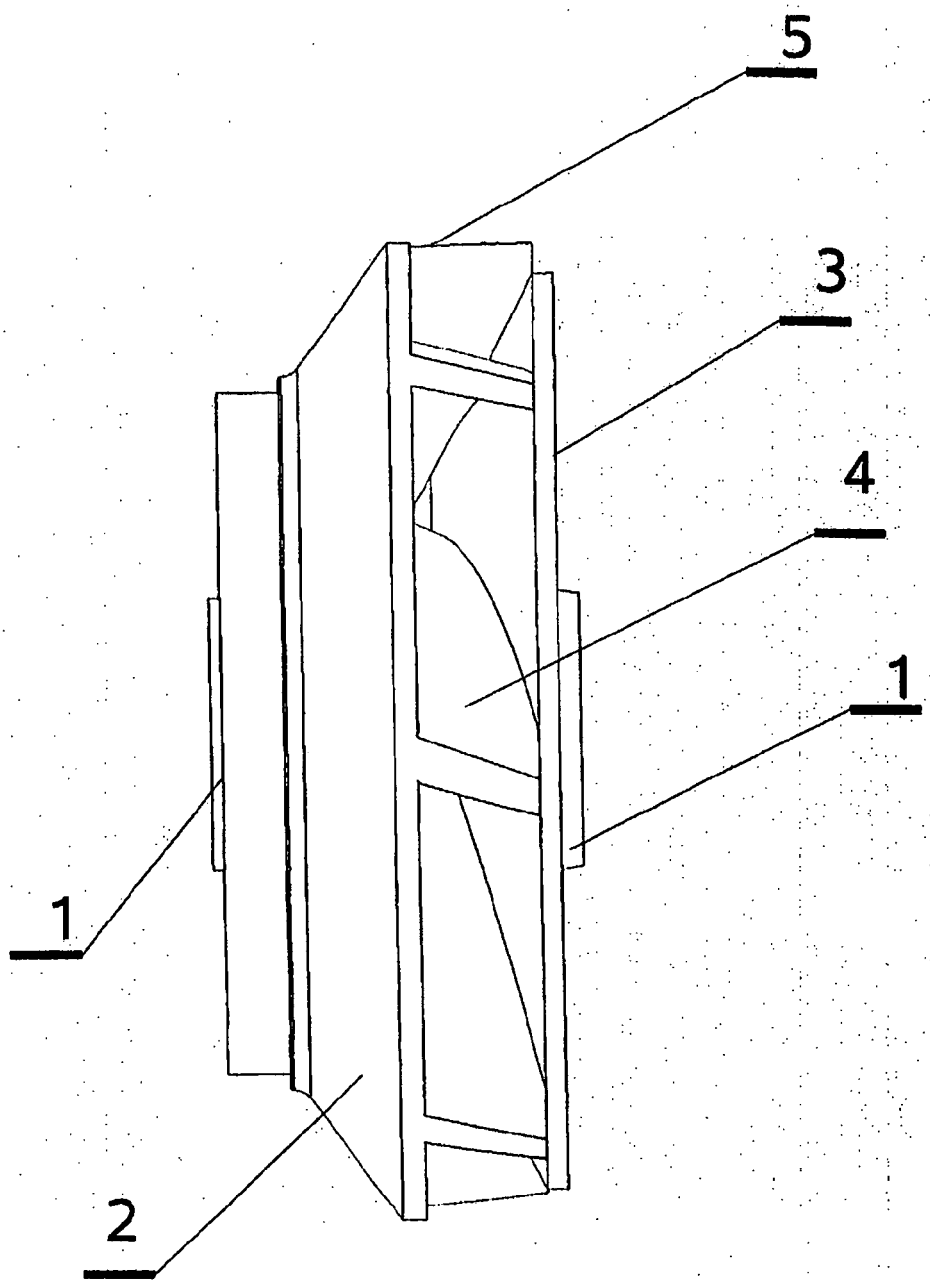

Fig. 1

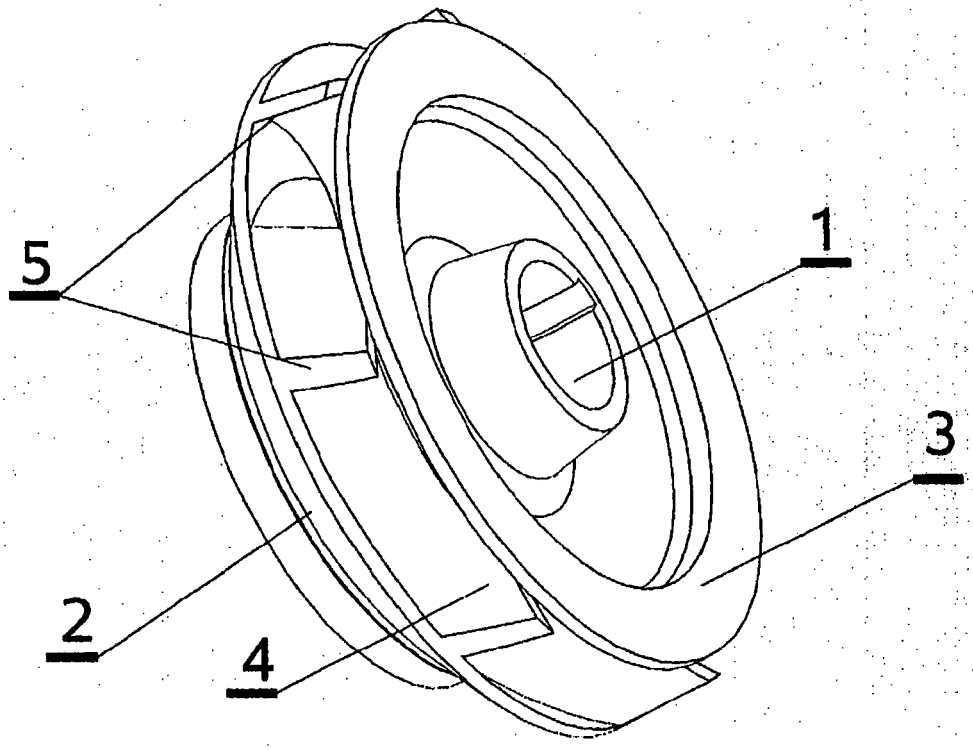

Fig. 2

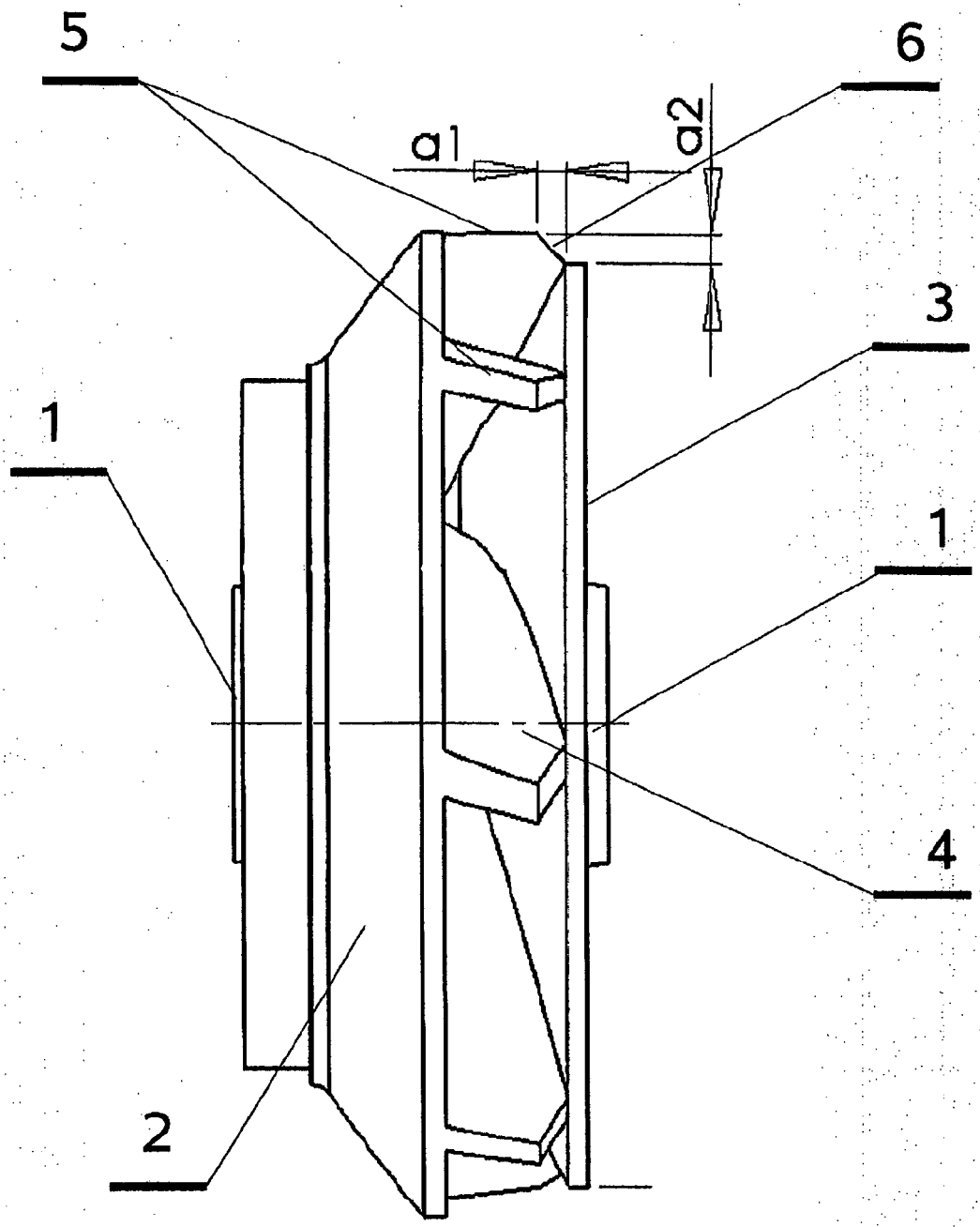

Fig. 3

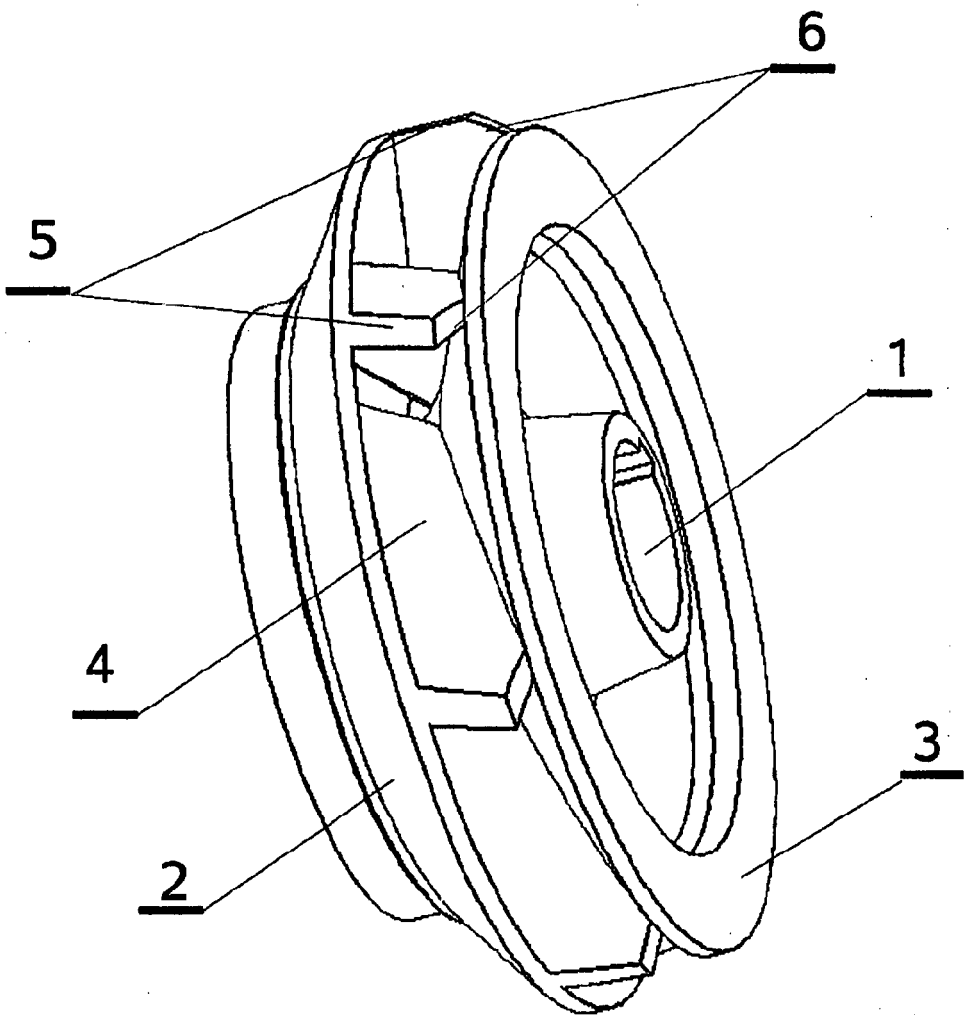

Fig. 4

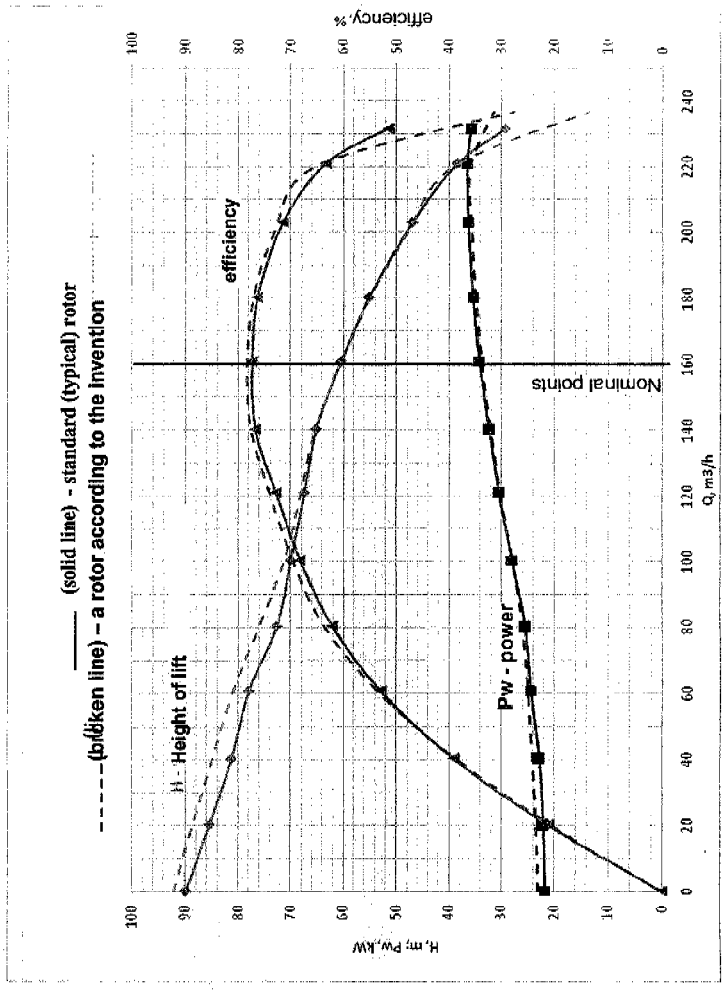
(solid line) - standard (typical) rotor
(broken line) – a rotor according to the invention
H - Height of lift
efficiency
Pw - power
Nominal points
H, m; Pw, kW
efficiency, %
Q, m3/h

Fig. 5

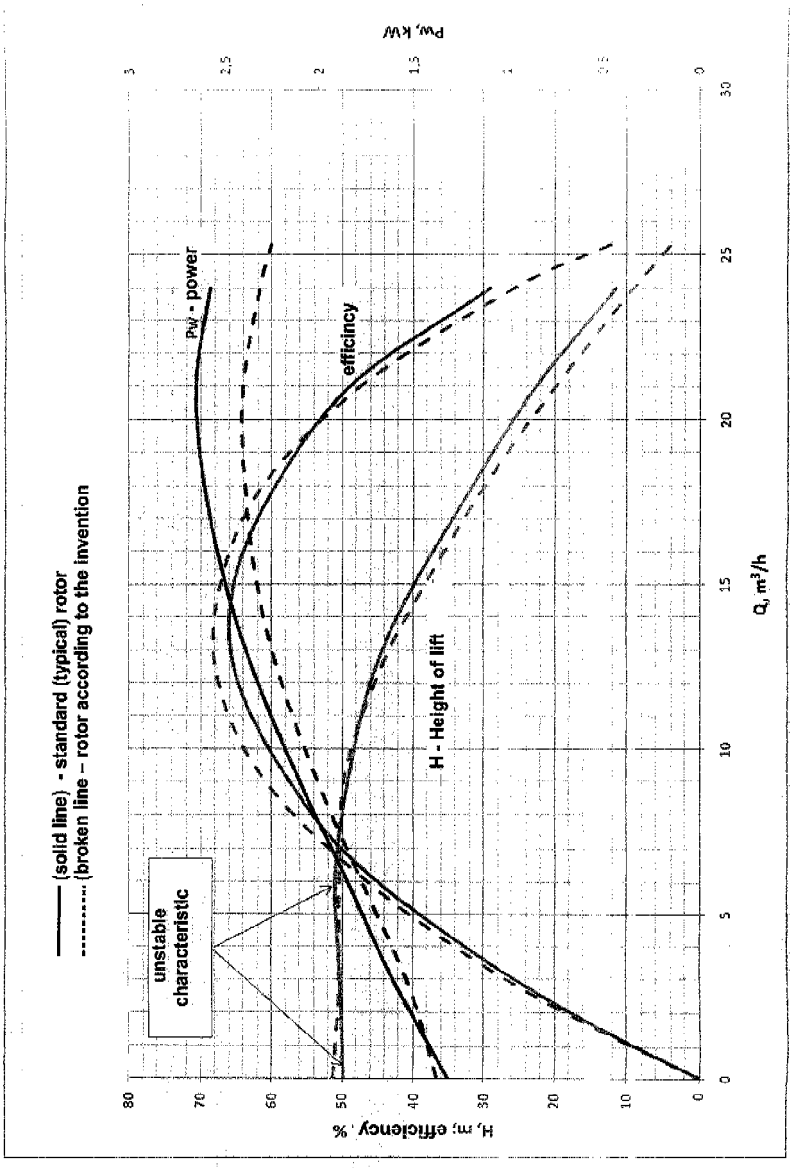
(solid line) - standard (typical) rotor
(broken line – rotor according to the invention
unstable characteristic
Pw - power
efficincy
H - Height of lift
H, m; efficiency, %
Pw, kW
Q, m³/h
0
5
10
15
20
25
30
10
20
30
40
50
60
70
80
0
0.5
1
1.5
2
2.5
3

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 11 00 2276

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 886 417 A (REMSTAD STEVEN C [US] ET AL) 12 December 1989 (1989-12-12) * column 2, lines 9-24,41-44; figures 1,2 *	1-8	INV. F04D29/22
E	WO 2011/089512 A2 (ITT MFG ENTERPRISES INC [US]; CIPELLI MATTEO [IT]; COSTA PAOLO [IT]; S) 28 July 2011 (2011-07-28) * page 9, line 16 - page 12, line 3; figures 2-4 *	1	
A	US 6 481 961 B1 (PAI CHENG-HUAI [TW]) 19 November 2002 (2002-11-19) * figures 1, 2 *	1-8	
A	JP 52 016009 A (SHINKO KIKAI SEISAKUSHO KK) 7 February 1977 (1977-02-07) * abstract; figures 5,6 *	1-8	
A	US 2009/280013 A1 (KUPFERBERG MINEL [CA]) 12 November 2009 (2009-11-12) * paragraphs [0010], [0014] - [0017]; figures 1-3 *	1-8	TECHNICAL FIELDS SEARCHED (IPC) F04D
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 January 2012	Homan, Peter

CATEGORY OF CITED DOCUMENTS

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20-01-2012

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