(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 521 633 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.08.2019 Bulletin 2019/32

(51) Int Cl.:
F04D 29/28 *(2006.01)* ***F04D 29/30*** *(2006.01)*

(21) Application number: **18460086.4**

(22) Date of filing: **27.12.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **03.02.2018 PL 42450218**

(71) Applicant: **Szymanski, Piotr**
03-430 Warszawa (PL)

(72) Inventor: **Szymanski, Piotr**
03-430 Warszawa (PL)

(54) WINGLET OF THE FLOW COMPRESSOR WHEEL

(57) The invention relates to a winglet of the flow compressor wheel, designed for use in radial flow compressors and radial axial flow compressors, in particular in automotive turbochargers.

The subject invention relates to the curvature of the blade 2 and/or the supporting blade 3 at the outermost end in the section 6, which reduces the approach angle " β" of the blade and increases the angle "a". As a result, the leading edge 7 of the blade 2 and/or the supporting blade 3 is not a straight line, being curved at the external diameter of the compressor wheel. The section 6 is determined by the semi-axes H and L. This curvature reduces the pressure difference between the suction surface 4 and the compressing surface 5 of the blade 2 and/or the supporting blade 3 at the point where the pressure difference is greatest and turbulence occurs, i.e. in the section 6. Due to the fact that the pressure difference is reduced, turbulence at the end of the blade is also reduced, which increases the compressor's efficiency.

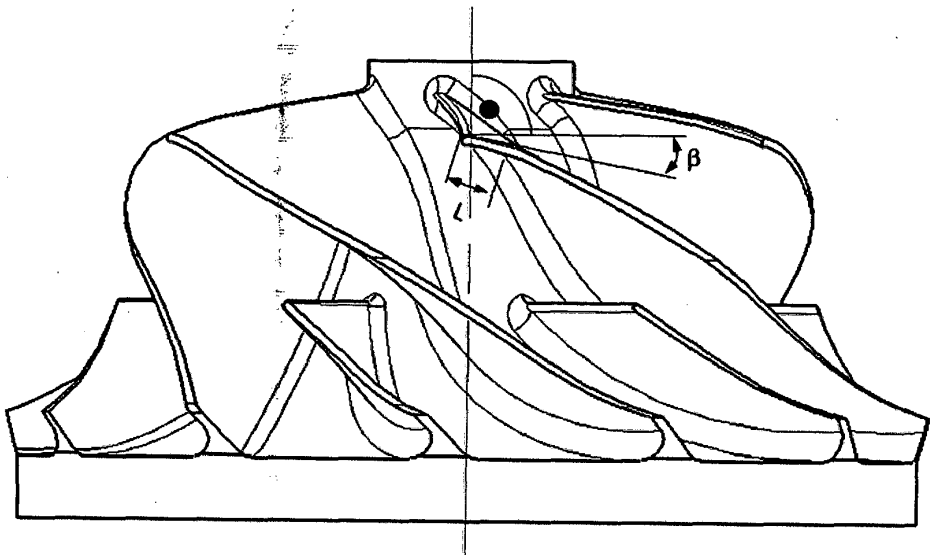

Fig. 4

EP 3 521 633 A1

Description

[0001] The invention relates to a winglet of the flow compressor wheel, designed for use in radial compressors and radial-axial compressors, in particular in automotive turbochargers.

[0002] There are known radial flow compressors and radial-axial flow compressors which are composed of an impeller and an impeller housing (stators). After applying rotational speed to the impeller, the compressing process is initiated and the medium begins to flow. Compressors of this type are used e.g. in aircraft turbine engines, gas turbines, power generators, turbochargers used in combustion engines, electric compressors, industrial fans and many more.

[0003] Such compressors, including in particular those used in turbochargers for increasing the efficiency of reciprocating engines, the compressor's efficiency should be as high as possible. The greater the efficiency of a compressor, the greater the efficiency of the engine on which have been used such an compressor. The shape of the blades 2 and the supporting blades 3 of compressor wheel 1 - have significant impact on compressor's efficiency. Of importance is here the distribution of pressure at the blades 2 and the supporting blades 3 associated with the compressor wheel 1. The patents US7261513 B2 and EP1972795 A2 propose a solution aimed at increasing the efficiency of a compressor.

[0004] The wheel of the flow compressor 1 is composed of the blades 2 and additionally it can be provided with the supporting-leading blades 3. The blades have suction surfaces 4 and compressing surfaces 5. As an results of rotation of compressor wheel 1 there is generated pressure difference on the blades 2 and supporting blades 3. Negative pressure is produced at the suction surfaces 4 while positive pressure is produced at the compressing surfaces 5. The greatest pressure difference occurs at the external diameter of the blades 2 near the leading edge. This section is identified by number 6 in fig. 1. A pressure too low at the suction surface may cause the separation of a stream of the working medium, which reduces the efficiency and/or causes unstable operation of the compressor. A pressure difference between the suction side 4 and the compressing side 5 also causes turbulence in the section 6 presented in fig. 1. This turbulence reduces the compressor's efficiency. This effect is similar to that observable at the ends of aircraft wings. Winglets are used in aircraft wings to reduce the resistance induced by the said turbulence. The solution based on the use of a winglet is covered by the patents US8366056 B2 and US5348253 A, among others.

[0005] The blades 2 and the supporting blades 3 associated with the compressor wheel 1 most often are done as ruled surface. Such blades are relatively simple to design and fabricate. Solutions based on blades featuring a much more complicated surface are less common. In both cases, a solution for increasing the efficiency of the compressor wheel is a winglet of the flow compressor wheel, which reduces the pressure difference between the suction surface 4 and the compressing surface 5 at the point where the pressure difference is greatest and turbulence occurs, i.e. in the section 6, in that the end of the blade 2 is curved in the direction identified by the arrow 9 in the embodiment presented in fig. 3.

[0006] The subject of the invention is presented in its embodiment on the drawing where fig. 3 shows a diagram of how the end of the blade 2 is curved, where the angle α is the greatest difference in angles at the leading edge 7 of the blade 2.

[0007] The subject of the invention is presented in its embodiment on the drawing where fig. 4 shows a diagram of how the end of the blade 2 is curved, where the angle β is the approach angle of the blade.

[0008] The subject of invention is the curvature of the blade 2 and/or the supporting blade 3 at the outermost end in the section 6. This reduces the approach angle β and increases the angle α. As a result, the leading edge 7 is not a straight line, being curved at the external diameter of the compressor wheel towards the surface in the direction identified by the arrow 9 in fig. 3. The section 6 is determined by the semi-axes H and L presented in the embodiment in fig. 5.

Claims

1. Winglet of the flow compressor wheel, **characterized in that** it is the curvature in the edge of the compressor blade (2) and/or the supporting blade (3) in the section (6) **in that** it reduces the approach angle "β" of the compressor blade (2) and/or the supporting blade (3) in the section (6), thus reducing the pressure difference at the edge of the blade 2 and/or the supporting blade (3) and reducing the pressure difference at the surfaces in the section (6).

1. Winglet of flow radial compressor wheel according to claim 1, **characterized in that** the angle "α" is from 3° to 25°.

3. Winglet of the flow compressor wheel according to claim (1), **characterized in that** the angle "β" is from 0° to 15°.

4. Winglet of the flow compressor wheel according to claim 1, **characterized in that** it reduces the turbulence at the corner of the blade (2) and/or the supporting blade (3) in the section 6.

5. Winglet of the flow compressor wheel according to claim 1, **characterized in that** the length "H" with reduced approach angle of the blade (2) and/or the supporting blade (3) is up to 30% of the length of the leading edge (7).

6. Winglet of the flow compressor wheel according to claim 1, **characterized in that** the length "L" with reduced approach angle of the blade is equal up to 10% of the lateral length of the edge (8) of the blade (2) and/or the supporting blade (3).

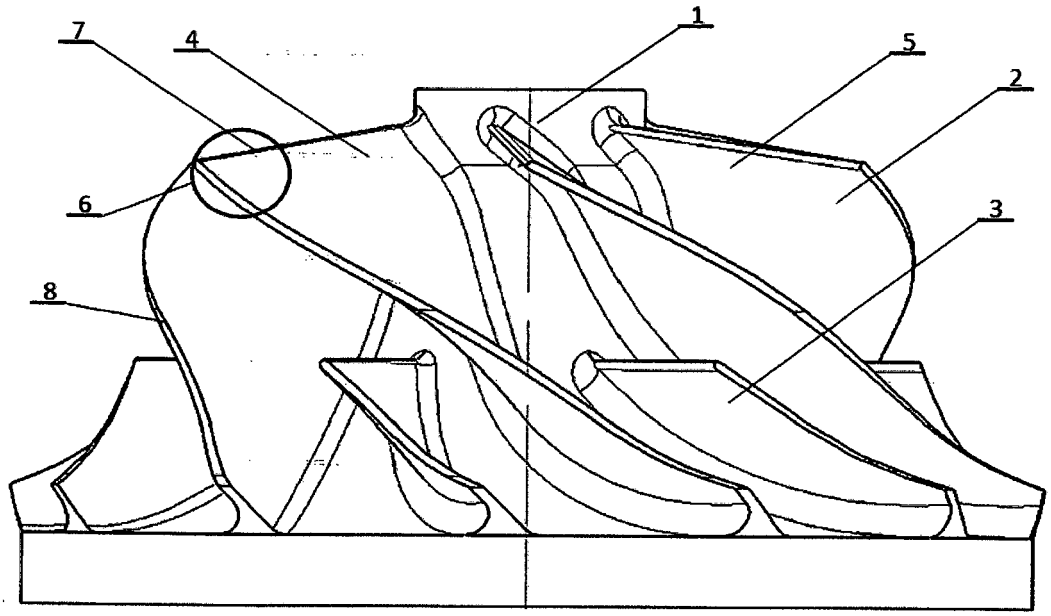

Fig. 1

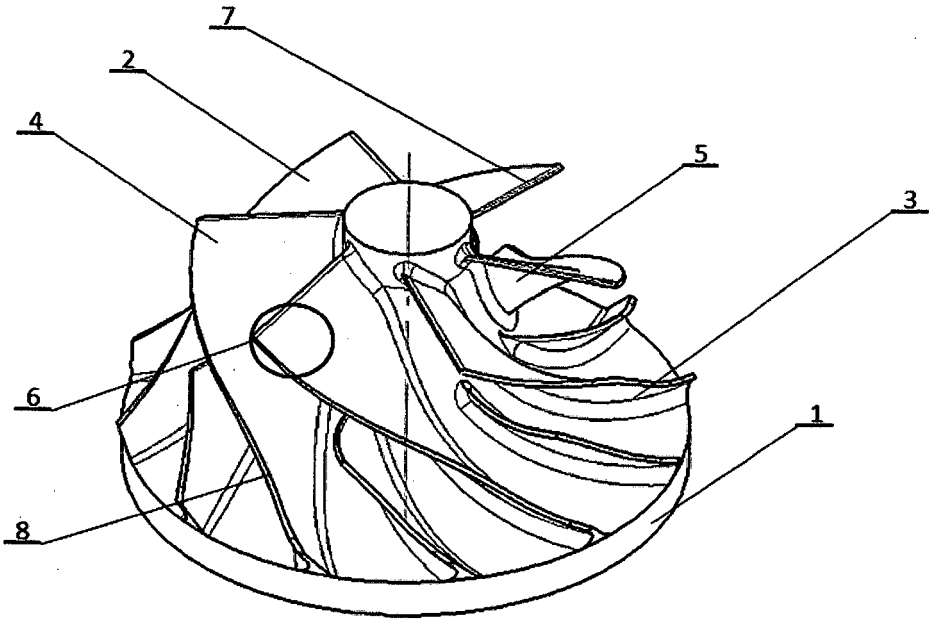

Fig. 2

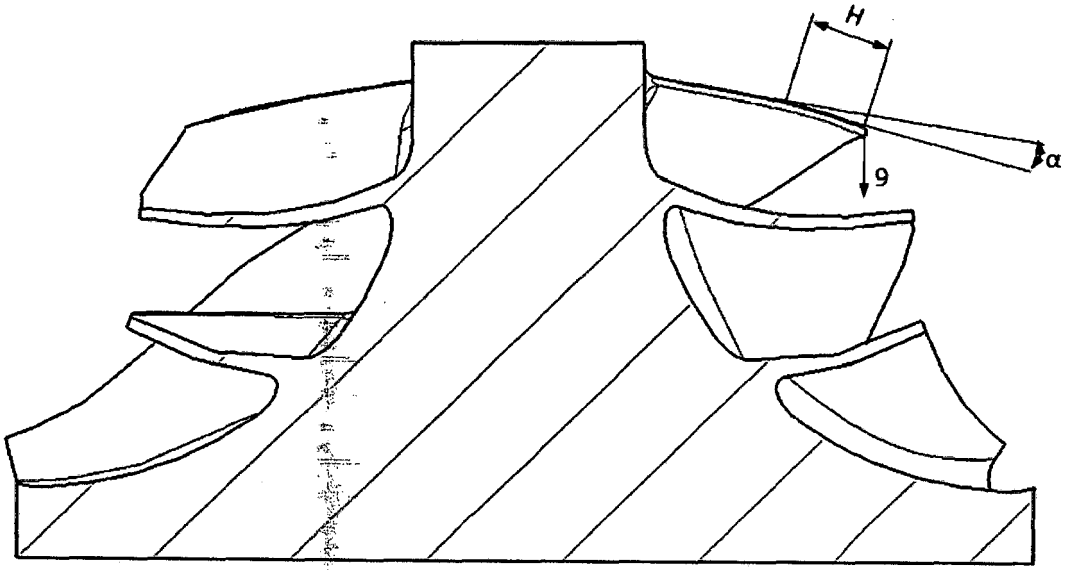

Fig. 3

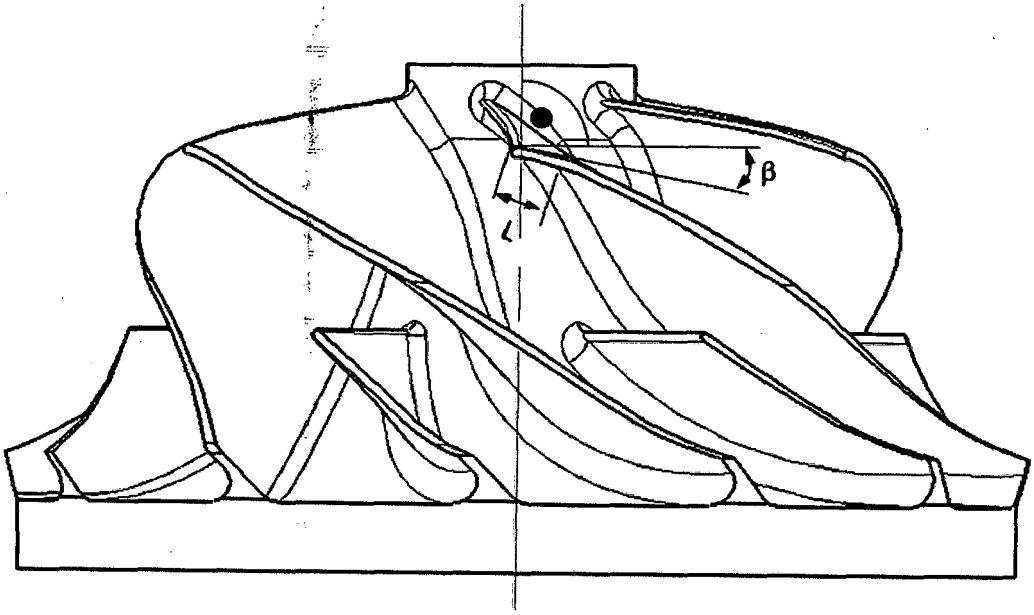

Fig. 4

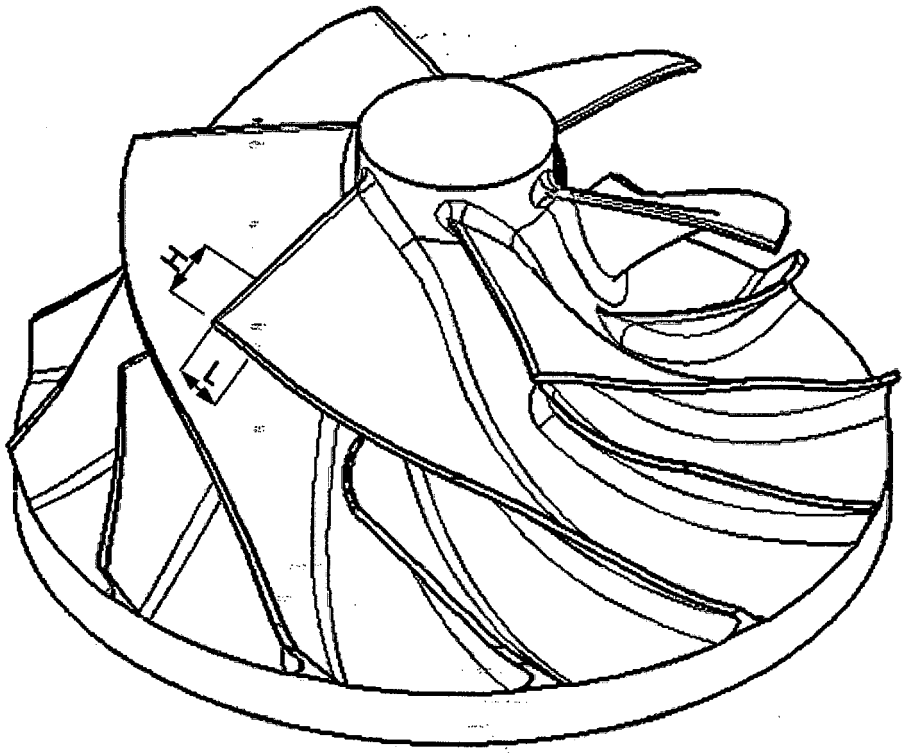

Fig. 5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 46 0086

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	EP 1 361 008 A1 (BORGWARNER INC [US]) 12 November 2003 (2003-11-12) * paragraph [0052]; figure 2 * * abstract *	1-6	INV. F04D29/28 F04D29/30
A	WO 2017/120031 A1 (CATERPILLAR INC [US]) 13 July 2017 (2017-07-13) * page 6, line 3 - page 7, line 34; figures 4,5 * * abstract *	1-6	
A	EP 2 461 041 A1 (MITSUBISHI HEAVY IND LTD [JP]) 6 June 2012 (2012-06-06) * the whole document *	1-6	

TECHNICAL FIELDS SEARCHED (IPC)

F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 June 2019	Hermens, Sjoerd

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 46 0086

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-06-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1361008 A1	12-11-2003	DE 60315374 T2	08-05-2008
		EP 1361008 A1	12-11-2003
		JP 4672970 B2	20-04-2011
		JP 2004052754 A	19-02-2004
		US 6588485 B1	08-07-2003
WO 2017120031 A1	13-07-2017	CN 108474256 A	31-08-2018
		DE 112016005560 T5	20-09-2018
		US 2017191492 A1	06-07-2017
		WO 2017120031 A1	13-07-2017
EP 2461041 A1	06-06-2012	CN 102472293 A	23-05-2012
		EP 2461041 A1	06-06-2012
		JP 5473457 B2	16-04-2014
		JP 2011027089 A	10-02-2011
		US 2012121432 A1	17-05-2012
		WO 2011013258 A1	03-02-2011

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 7261513 B2 **[0003]**
- EP 1972795 A2 **[0003]**
- US 8366056 B2 **[0004]**
- US 5348253 A **[0004]**