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

(11) Publication number: **0 456 596 A1**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **91610041.5**

(51) Int. Cl.[5]: **F04D 29/22**

(22) Date of filing: **06.05.91**

(30) Priority: **10.05.90 DK 1172/90**

(43) Date of publication of application:
13.11.91 Bulletin 91/46

(84) Designated Contracting States:
DE FR GB IT

(71) Applicant: **GRUNDFOS INTERNATIONAL A/S**
7-11, Poul Due Jensensvej
DK-8850 Bjerringbro (DK)

(72) Inventor: **Jensen, Niels Due**
Pilevej 1
DK-8850 Bjerringbro (DK)
Inventor: **Langgaard, Gunnar**
Ogardshojen 1A
DK-8800 Viborg (DK)

(74) *Representative*: **Noergaard, Tage et al**
Chas. Hude H.C. Andersens Boulevard 33
DK-1553 Copenhagen V (DK)

(54) **A centrifugal pump.**

(57) A centrifugal pump comprises a casing and a rotary impeller (1) provided with a cover plate (8) and a plurality of spacing blade means (2) fastened thereto. Radially seen, each spacing blade means comprises an outer, solid section ($2b'$, $2b_o$) and an inner section having at least one cavity (16, 17). The outer section forms an integral part with the inner section or is joined therewith. As a result the impeller is easily adapted to the desired operating conditions (capacity, pressure) without affecting the flow conditions at the outer periphery of the impeller, because a slight adaptation of the spacing blade means diameter by turning only results in removing material from the outer, solid section but not from the hollow section. The latter remains undamaged, and the flow conditions are consequently excellent.

EP 0 456 596 A1

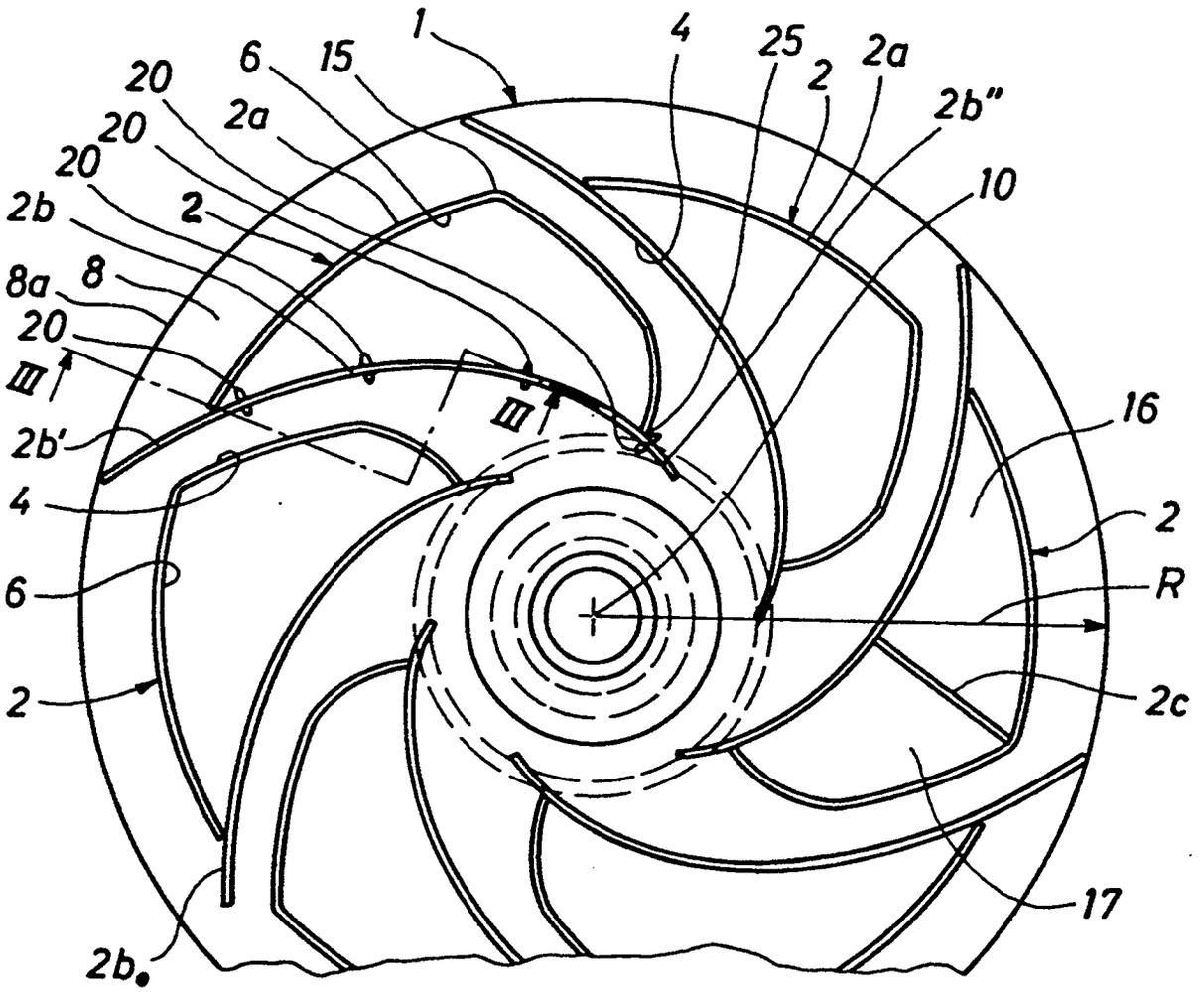

Fig.1

The invention relates to a centrifugal pump comprising a casing and a rotary impeller provided with a cover plate and a plurality of spacing blade means fastened thereto.

DE-PS No. 2.800.723 discloses a fan impeller, where two successive blades are joined by means of a common base plate adjacent one of the two cover plates. Another known fan impeller comprises blades of bent sheet material. It is, however, not mentioned that the blades are made of simple web segments. Known impellers are expensive to manufacture, as they require a large number of working operations, especially a large number of foldings of the sheet material. Moreover, the impellers are difficult to adapt to a predetermined capacity or pressure. Further, large known pump impellers are known, which are provided with spacing blade means in the form of hollow cavities. When the operating conditions (capacity, pressure) of a pump with such an impeller change, the diameter of the impeller may be altered by turning, thus possibly puncturing a spacing blade means. The pump medium can then flow into the cavity of the spacing blade means, thus having a considerable, negative effect on the flow conditions at the outer periphery of the spacing blade means.

The object of the invention is to provide a centrifugal pump of the above-mentioned type, where the impeller is easily adapted to a variety of different operating conditions (capacity, pressure).

The centrifugal pump according to the invention is characterized in that each spacing blade means, radially seen, comprises an outer, solid section and an inner section having at least one cavity, the outer section forming an integral part with the inner section or being joined therewith. As a result the impeller is easily adapted to the desired operating conditions (capacity, pressure) without affecting the flow conditions at the outer periphery of the impeller, because a slight adaptation of the blade diameter by turning only results in removing material from the outer, solid section but not from the hollow section. The latter remains undamaged, and the flow conditions in the pump are consequently excellent.

According to the invention, the outer section is without connection to the cover plate. Thus, it is particularly easy to remove material from the outer section during adaptation.

Furthermore, according to the invention, the outer and inner sections form an integral part and comprise at least one first curved web segment, preferably two such segments, to define ducts between the spacing blade means, one portion of the first web segment or of one of the web segments, respectively, of each spacing blade means radially projecting further than the remaining portion of the first web segment or of the other web segments, respectively, of the spacing blade means, the projecting part of the above-mentioned portion of the first web segment or of one of the web segments, respectively, being without any connection to the cover plate. As a result, it is particularly easy to adapt an impeller to the desired operating conditions (capacity, pressure) after manufacture, as a technician can easily shorten the web segment(s) a little at the outer periphery by means of a simple cutting tool so that the impeller is adapted without affecting the flow conditions at the outer periphery of the impeller.

Moreover, according to the invention, the web segment with the longest radial projection advantageously extends not quite as far as the cover plate.

In one embodiment of the invention each spacing blade means comprises at least three relatively small web segments defining at least one closed cavity, resulting in a relatively light impeller. Moreover, it is thus easier to shape a spacing blade means in such a way that the pump medium flows into the duct between two successive spacing blade means at an easily adjustable angle.

In another embodiment of the invention, one or more of the web segments of the inner section form an internal bracing therein, thus increasing the strength of the impeller.

In a further embodiment of the invention, the web segments are manufactured with a small cross-section by means of extrusion, resulting in a particularly inexpensive manufacture of the impeller.

In yet another embodiment of the invention, the cover plate and the web segments are made of sheet metal, preferably having a thickness of 0.5-3.0 mm, especially 0.8-2.0 mm, thus facilitating manufacture.

In yet a further embodiment of the invention the end portion of the inner section comprised by the web segment or segments and closest to the centre of the impeller is provided with an inwardly facing nose, optionally only a single projection of the web segment, to ensure a locally defined extension of the cross-section of the duct immediately behind the duct inlet with respect to the flow direction of the pump medium through the duct, thus allowing for the most advantageous design of a duct inlet.

In a particularly advantageous embodiment of the invention, the web segments are substantially of C-, S- or wing-shape.

An especially reliable fasting of the blades is, according to the invention, obtained by the web segment or segments of a spacing blade means being fastened to the cover plate by welding or soldering spots at a radius smaller than or equal to 0.85 R, R being the radius of the cover plate.

In another advantageous embodiment of the invention each web segment is fastened with two, preferably four, welding or soldering spots.

Finally, the web segments according to the invention are cast with the cover plate.

The invention is described in greater detail below and with reference to the accompanying drawings in

which:

Figure 1 is a frontal view of a first embodiment of an impeller of a centrifugal pump according to the invention, where the impeller is provided with one cover plate,

Figure 2 shows a second embodiment of the impeller corresponding to Figure 1, where spacing blade means of different shapes are schematically shown; an impeller according to the invention is, however, always provided with spacing blade means of the same shape; and

Figure 3 is a sectional view of the impeller of Figure 1 along the line III-III.

The impeller of Figure 1 rotates inside a casing of a centrifugal pump (not shown). The impeller is provided with one cover plate 8 but may, in principle, be provided with two. The impeller is further provided with a plurality of spacing blade means 2, a pair of spacing blade means defining a duct 4. Each spacing blade means 2 comprises an outer, solid section 2b' and an inner, hollow section, i.e. the section of the spacing blade means 2 situated radially inwardly with respect to the outer section 2b'. The outer, solid section 2b' (cf. also $2b_o$) may form an integral part with the inner section or may be joined with the latter. The outer section 2b' (optionally $2b_o$) is thus not directly connected to the cover plate 8. If the outer and inner sections form an integral part, they may comprise two web segments 2a, 2b. The web segments may be fastened to the cover plate by means of welding, preferably spot welding, or soldering. As is apparent, each inner section comprises at least one inner closed cavity 6.

As is furthermore apparent, the web segment 2b extends as far as the outer peripheral edge 8a of the cover plate 8. A technician assembling the impeller parts can easily shorten the outer section 2b' of the web segment 2b to a greater or lesser extent by means of a simple cutting tool, thus adapting the impeller to a variety of operating conditions. Moreover it is apparent that the inner section may be provided with inwardly facing noses, in the present case the radially innermost end 2b" of the web segment 2b. As a result the portion of the duct 4 forming the duct inlet is locally extended 25, thus creating particularly advantageous flow conditions through the duct 4 in some pump types.

Prior to the above-mentioned cutting with a tool, a web segment may optionally extend over a considerable distance, as denoted by $2b_o$ at the bottom left corner of Figure 1, without, however, reaching the peripheral edge 8a of the cover plate.

Instead of two web segments a spacing blade means may comprise three web segments, as shown at the bottom right corner of Figure 1, where a web segment 2c forms a bracing. The web segment 2a at the top of Figure 1 may optionally be two web segments adjoining at a bend 15.

A spacing blade means 12 may comprise two web segments, cf. Figure 2, one of which 12f is substantially of C-shape, the other 12g substantially of S-shape. Optionally a spacing blade means may have the shape of an airplane wing made from one web segment, cf. 12h. Furthermore a spacing blade means may be made from a single web segment provided with an inwardly facing nose 12m", cf. 12m.

A web segment may be manufactured with a small cross-section by means of extrusion. It is also possible to make the segments and the cover plate of sheet metal having a thickness of preferably 0.5-3.0 mm, especially 0.8-2.0 mm.

As is shown by means of the web segment 2b of Figure 1, the web segment of a spacing blade means may be fastened to the cover plate by means of welding or soldering spots 20 and within a radius of less than or equal to 0.85 R (R being the radius of the cover plate). A web segment may be fastened with at least two, preferably four, welding or soldering spots 20.

The invention may be varied in many ways without thereby deviating from the scope of the invention. The web segments may, for instance, be cast with the cover plate.

Claims

1. A centrifugal pump comprising a casing and a rotary impetter (1) provided with a cover plate (8) and a plurality of spacing blade means (2) fastened thereto, **characterized** in that each spacing blade means, radially seen, comprises an outer, solid section (2b', $2b_o$) and an inner section having at least one cavity (16, 17), the outer section forming an integrat part with the inner section or being joined therewith.

2. A centrifugal pump as claimed in claim 1, **characterized** by the outer section (2b', $2b_o$) being without connection to the cover plate (8).

3. A centrifugal pump as claimed in claim 1, **characterized** by the outer and inner sections forming an integral part and comprising at least one first curved web segment (12m, 12h), preferably two such segments (2a, 2b; 2c; 12f, 12g, 12j, 12k), to define ducts (4) between the spacing blade means, one portion (2b') of the first web segment or of one of the web segments (2b), respectively, of each spacing blade means radially projecting further than the remaining portion of the first web segment or of the other web segments, respectively, of the spacing blade means, the projecting part of the above-mentioned portion (2b') of the first web segment or of one of the web segments, respectively, being without any connection to the cover plate.

4. A centrifugal pump as claimed in claim 1 or 3, **characterized** by the web segment ($2b_o$) with the longest radial projection extending not quite as far as the cover plate (8).

5. A centrifugal pump as claimed in claim 2, 3 or 4, **characterized** by each spacing blade means (2) comprising at least three relatively small web segments (2a, 2b, 2c) defining at least one closed cavity (16, 17).

6. A centrifugal pump as claimed in one or more of the claims 1-5, **characterized** by one or more of the web segments of the inner section forming an internal bracing (2c) therein.

7. A centrifugal pump as claimed in one or more of the claims 1-6, **characterized** by the web segments being manufactured with a small cross-section by means of extrusion.

8. A centrifugal pump as claimed in one or more of the claims 1-7, **characterized** by the cover plate and the web segments being made of sheet metal, preferably having a thickness of 0.5-3.0 mm, especially 0.8-2.0 mm.

9. A centrifugal pump as claimed in one or more of the claims 1-8, **characterized** by the end portion (2) of the inner section comprised by the web segment (2m) or segments (2b, 2f, 2k) and closest to the centre (10) of the impeller being provided with an inwardly facing nose (12m″), optionally only a single projection (2b″) of the web segment, to ensure a locally defined extension (34, 25) of the cross-section of the duct immediately behind the duct inlet with respect to the flow direction of the pump medium through the duct.

10. A centrifugal pump as claimed in one or more of the claims 1-9, **characterized** by the web segments being substantially of C-, S- or wing-shape (12f, 12g, 12h, 12j, 12k, 12m).

11. A centrifugal pump as claimed in one or more of the claims 1-10, **characterized** by the web segment or segments of a spacing blade means being fastened to the cover plate by welding or soldering spots (20) at a radius smaller than or equal to 0.85 R, R being the radius of the cover plate.

12. A centrifugal pump as claimed in claim 10, **characterized** by two, preferably four, welding or soldering spots (20) for fastening a web segment.

13. A centrifugal pump as claimed in one or more of the claims 1-12, **characterized** by the web segments being cast with the cover plate.

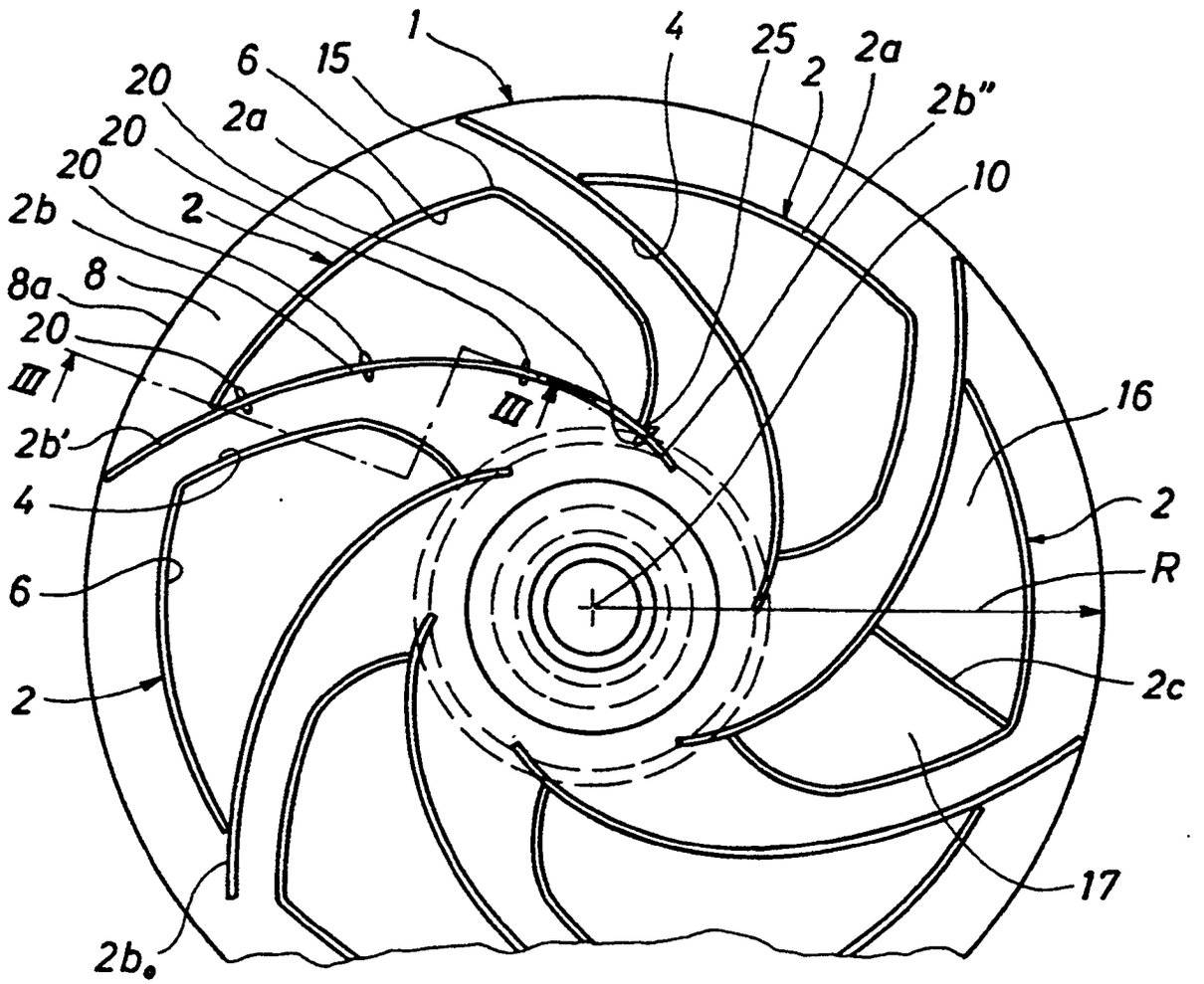
1
4
25
2
2a
2b"
10
6
15
20
2a
20
20
2b
2
8a
8
20
III
III
2b'
4
6
2
16
2
R
2c
17
2b

Fig.1

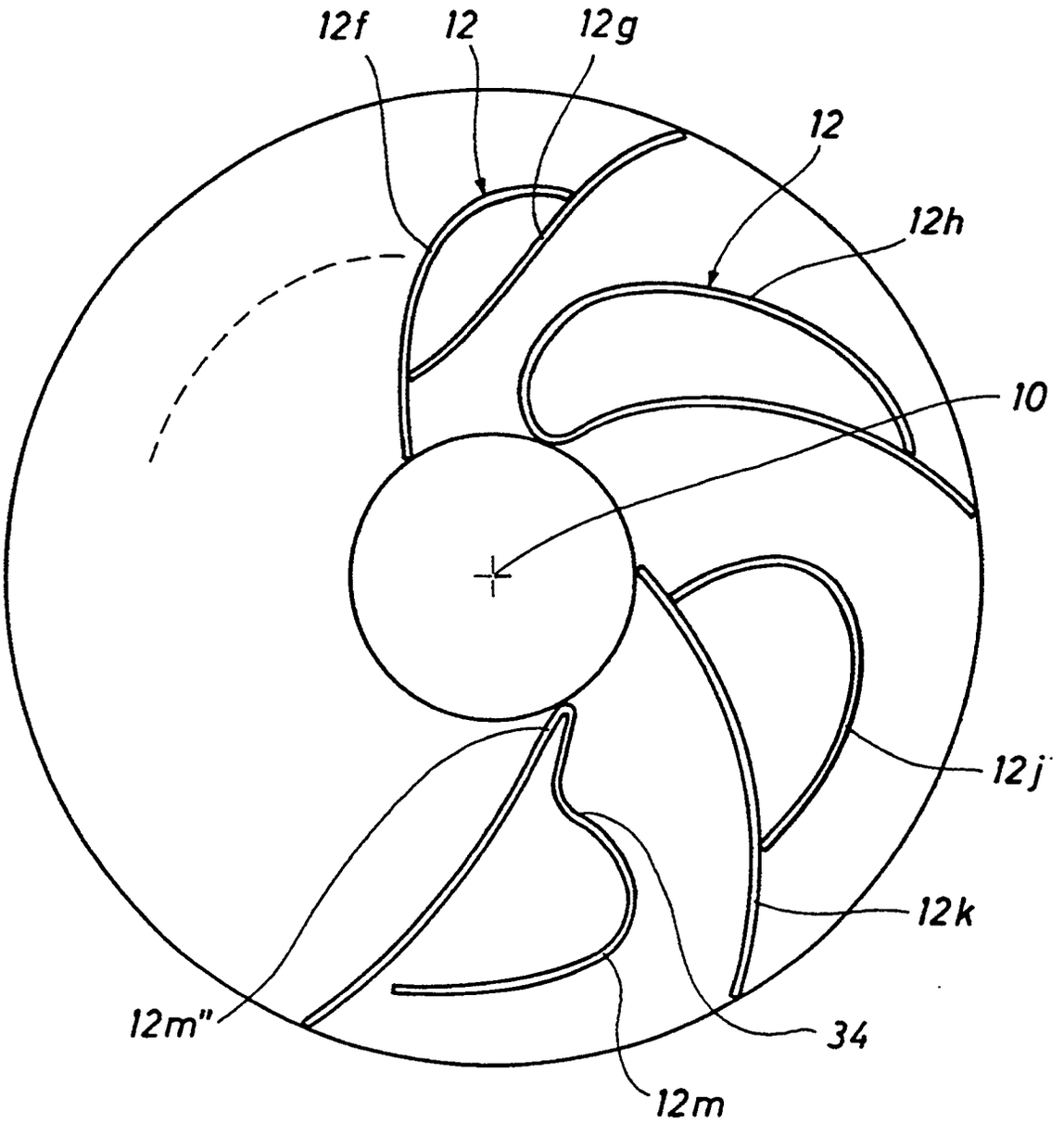

Fig.2

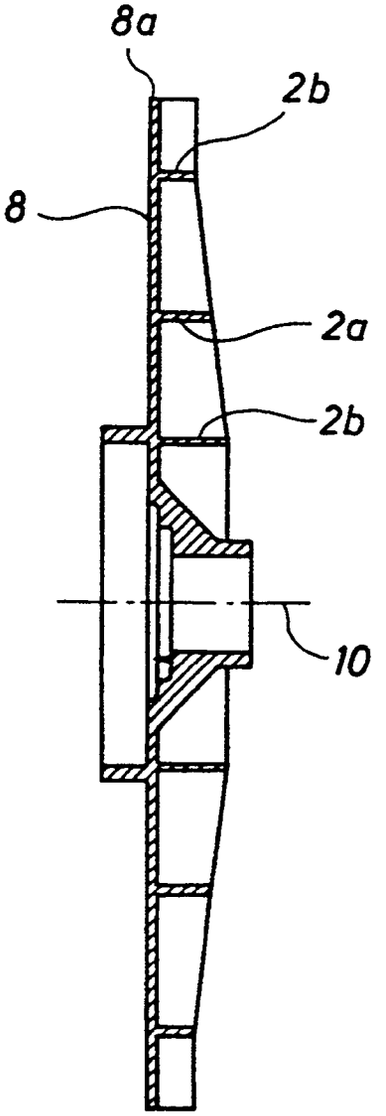

Fig.3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 91610041.5

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US - A - 1 030 561 (BLACKMER) * Totality *	1-3,5	F 04 D 29/22
A	--	4,6,8	
X	FR - A - 1 139 152 (BABCOCK & WILCOX) * Totality *	1,4,6, 9	
A	--		
	US - A - 4 874 293 (GUTZ WILLER) * Totality; esp. fig. 2,4 *	1-13	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F 04 D 1/00
F 04 D 17/00
F 04 D 29/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	22-08-1991	WERDECKER

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 (P0401)