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Pedersen et al.

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[54] **VANE WITH AN AXLE PIN FOR AXIAL IMPELLER WHEELS**

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[51] **Int. Cl.²** **F04D 29/36**

[58] **Field of Search** 416/163–168, 416/207

[56] **References Cited**

UNITED STATES PATENTS

1,497,723	6/1924	Huguenin	416/168 A X
2,054,810	9/1936	Gaba	416/165 X
2,844,303	7/1958	Kristiansen	416/164
3,085,631	4/1963	Dagrell	416/168 X

FOREIGN PATENTS OR APPLICATIONS

1,377,164	9/1964	France	416/168
1,403,498	7/1969	Germany	416/168
707,844	4/1954	United Kingdom	416/168
823,526	11/1959	United Kingdom	416/168

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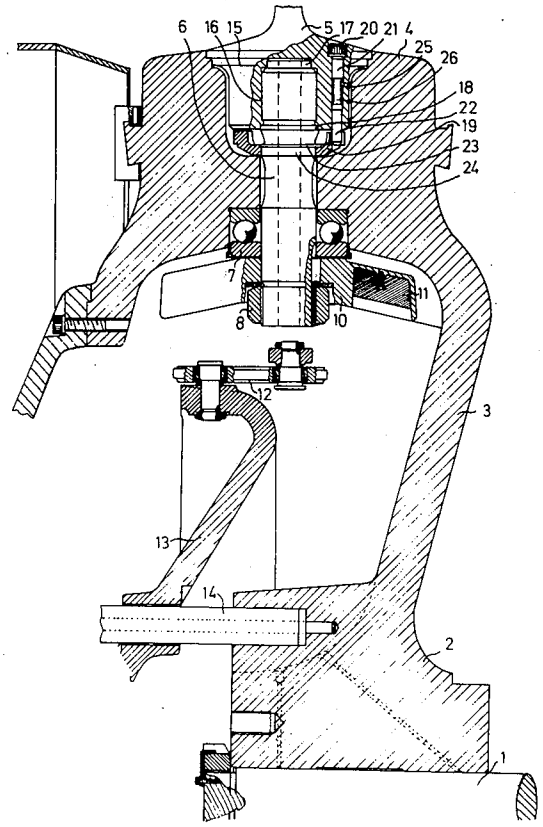
[57] **ABSTRACT**

A vane with an axle pin for axial flow fans comprising a number of vanes, each of which being with its axle pin, connected with a screw thread to the vane root, accommodated rotatably in the hub rim of the impeller wheel. Within the hub rim the pins are connected to means for turning the total number of vanes around their axes and the axes of the associated pins during the operation of the wheel. Outside its screw thread serving for being screwed into the associated vane each pin is provided with a portion having a smaller diameter than the bottom diameter of the screw thread and inside the screw thread it is provided with a portion having a larger diameter than the outer diameter of the screw thread, the bore of the vane being designed as corresponding reamed holes inside and outside a portion having a screw thread corresponding to the screw thread of the pin. Outside the underside of the vane root a fixation ring is provided on the pin and through the vane root a fixation screw is screwed in, the end of which engages a reamed aperture in the fixation ring.

1 Claim, 2 Drawing Figures



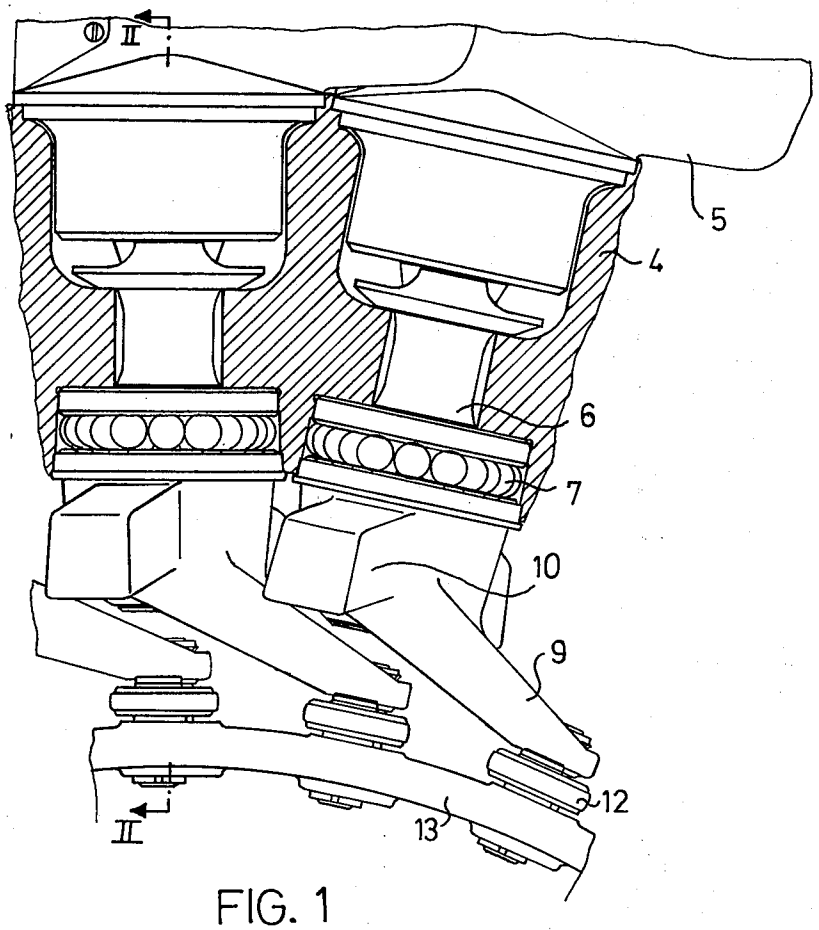


FIG. 1

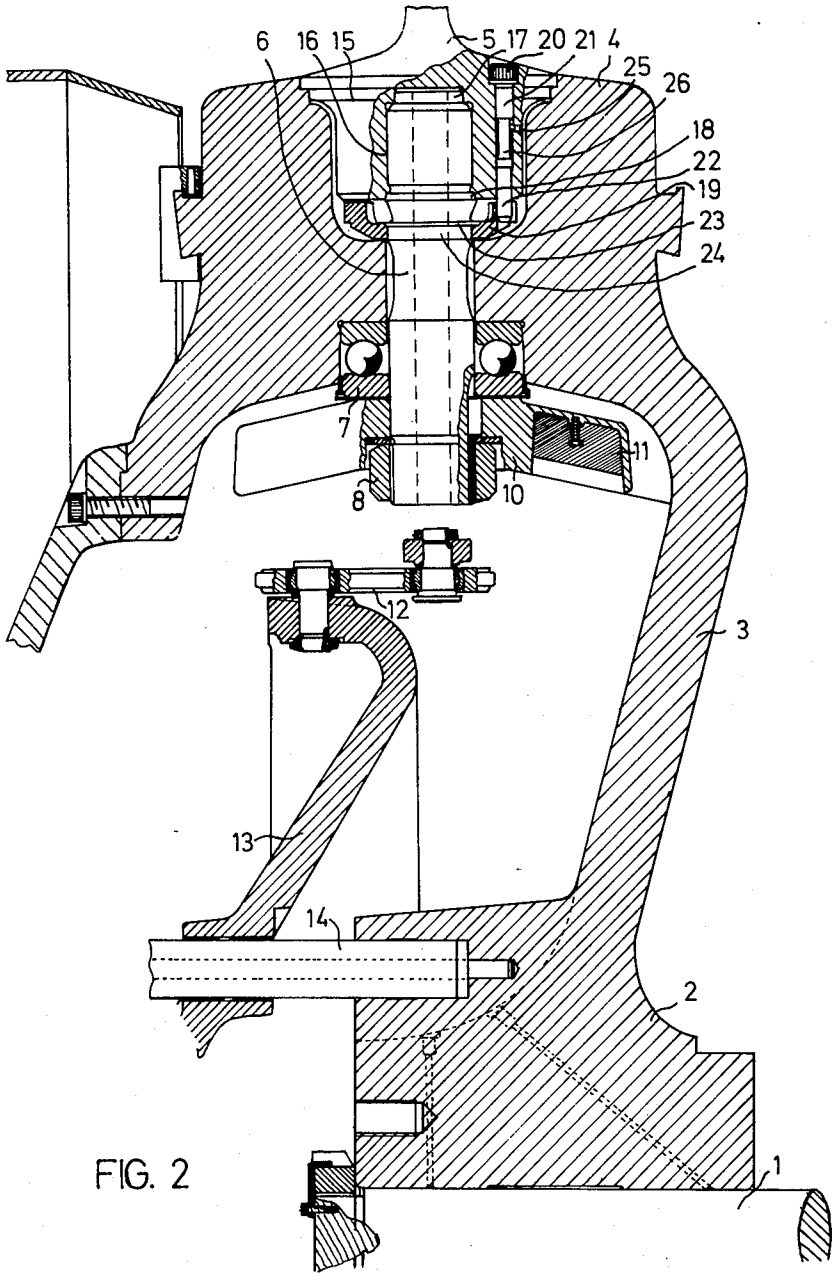


FIG. 2

VANE WITH AN AXLE PIN FOR AXIAL IMPELLER WHEELS

The invention relates to a vane with an axle pin for axial flow fans comprising a number of vanes, each of which with its pin, connected with a screw thread to the vane root, is accommodated rotatably in the hub rim of the impeller wheel and where within the hub rim the pins are connected to means for turning the total number of vanes around their axes and the axes of the associated pins during the operation of the wheel.

In such axial flow impeller wheels, particularly those having large diameters, the vanes are subjected to extremely great centrifugal forces. It may sometimes be a question of forces of up to 50 tons per vane or more. Due to correspondingly great axial bearing pressures and the very high torque exerted on the vane during the operation, very great demands are put to the attachment of the pin in the vane. As a rule it will be out of the question to manufacture vane and pin in one piece, particularly when the vane is manufactured of cast material. Moreover it will, in particular when the fan is intended for operating in dust-containing gases which may cause a considerable wear of the vanes, be of importance that it is possible to exchange the vanes from the outside, that is to say without it being necessary to perform any operations in the interior of the hub. It is an additional requirement that the means for securing the attachment do not take up too much space, since there is only a relatively small space at disposal. Furthermore, they must not give rise to any essential weakening of the material of the vane root.

From British patent specification No. 627 258 an impeller wheel is known in which each vane is secured to a wheel rim by the vane root, which extends through a bore with a bearing in the wheel rim, being provided with a bore having a screw thread extending to the bottom of the bore, into which screw thread a shaft pin has been screwed, the said shaft pin being at its opposite end via an end piece with a bearing connected to the hub. In the case of such a construction, the screw thread in the bore of the vane foot will, besides being subjected to the centrifugal forces acting in the axial direction, also be subjected to considerable radial forces, and this makes it necessary, in particular in the case of fast-running axial flow impeller wheels having large diameters, to have the screw thread designed as a very tight-fitting thread. Such a tight-fitting screw thread will, however, besides increased costs of manufacture, also, as is mentioned in the following, cause that the screwing in of the pin is made difficult and that the risk of damage to the screw thread during this screwing-in operation is increased.

The problems mentioned above are solved in a particularly satisfactory way according to the invention by each pin outside its screw thread intended for being screwed into the associated vane being provided with a portion having a smaller diameter than the bottom diameter of the screw thread, and inside the screw thread being provided with a portion having a larger diameter than the outer diameter of the screw thread, and by the bore of the vane being designed as corresponding reamed or fitting holes inside and outside a portion with a screw thread corresponding to the screw thread of the pin and by a fixation ring being provided on the pin outside the underside of the vane root and by a fixation screw being screwed in through the root of the vane, the end of which fixation screw engages a reamed or fitting opening in the fixation ring.

The construction of the pin as fitting pins inside and outside the screw thread in connection with the corresponding reamed or fitting bores in the vane serves for absorbing radial forces, so that the screw thread is intended for absorbing only the centrifugal force directed in the axial direction. Since consequently the screw thread is not intended for absorbing the radial forces it is unnecessary to design this thread as a tight-fitting thread, and this is advantageous, since the screwing in of the pin would be made considerably more difficult and there would be a great risk of the thread seizing during the screwing-in operation so that the thread was damaged in particular the screw thread in the vane when the latter is manufactured of light-weight metal, and if the screw thread is damaged the vane has to be discarded, there being no practical possibility of boring out the thread and cutting a new thread having a larger diameter, since in this case it would be necessary to perform a corresponding boring out of all vanes and substitute all pins by pins having a heavier thread. The torsional forces occurring are during periods of standstill absorbed by the fixation screw through the fixation ring, and as this screw passes through the vane root in the axial direction, the hole in the vane root can be bored in a place where it does not cause any perceptible weakening of the material and, moreover, at such a distance from the axis that the reaction exerted by the screw against the torsion will act on a fairly large diameter so that a comparatively thin screw may be used. During the operation of the wheel, the very great centrifugal force acting on the vane in the axial direction of the pin causes that the thread is self-blocking and thereby absorbs the torsional forces.

The fixation ring may be constructed in one piece with the pin, but since it has a considerably larger diameter than the remaining part of the pin this causes a large waste of material, so that a shrinking-on of the fixation ring will be preferable.

In an embodiment of the invention the fixation ring has been shrunk onto the pin, while its aperture viewed in the direction at right angles to its plane is divided into two circular eccentrical sections, and the pin is provided with an eccentrical part corresponding to one of these sections.

Usually, a shrinking on of the fixation ring would be supposed to offer the sufficient security, but the fact that the ring is provided with two eccentrical sections and the pin with a corresponding eccentrical part offers a very considerable increase in the security against the fixation ring and the pin being turned ever so slightly relative to each other.

Below, the invention will be explained in greater detail with reference to the drawing in which

FIG. 1 diagrammatically shows part of an axial flow impeller wheel with a few vanes with the associated pins in an embodiment of the invention and

FIG. 2 shows a section on line II—II in FIG. 1, a larger part of the wheel being, however, shown in this illustration.

The hub 2 of the wheel is secured on the wheel shaft 1. The hub is in this embodiment constructed in one piece with a hub disc 3 and a hub rim 4. In the hub rim a number of vanes 5 have been accommodated, each of which comprises an axle pin 6 in an axial bearing 7 secured with a nut 8 which at the same time secures an

intermediate portion on the pin **6** with an adjustment arm **9** and with two balancing wings **10** which in their extreme ends are filled with lead **11** to achieve the necessary balancing. Each adjustment arm **9** is by means of a link rod **12** connected to an adjustment disc **13** which is axially displaceable relative to the wheel, but rotates together with the latter by means of drivers, of which FIG. **2** shows a single driver **14**.

The pin **6** is secured to the vane **5** at the root **15** of the vane by means of a screw thread **16.** Outside the screw thread **16** the pin **6** has a fitting portion **17** having a smaller diameter than the bottom diameter of the screw thread, and inside the screw thread it has a fitting portion **18** with a diameter larger than the outer diameter of the screw thread. These fitting portions **17** and **18** fit into corresponding parts of the bore in the vane root **15** inside and outside the screw thread **16.**

These fitting portions serve for absorbing the radial forces, and for absorbing the torsional forces there has on the pin **6** been shrunk on a fixation ring **19** which cooperates with a fixation screw **20** which is screwed down through the vane root **15** with a threaded part **21** and at its end is provided with a fitting portion **22** for corresponding reamed holes in the vane root **15** and in the fixation ring **19.**

As an additional safeguard against a turning of the pin **6** relative to the vane root **15** the aperture of the fixation ring **19** is, viewed in the axial direction, designed with two sections which are mutually eccentrical, while the pin **6** is provided with two corresponding portions **23** and **24** fitting these sections, the portion **23** being eccentrical relative to the axis of the pin with the same degree of eccentricity as the two sections in the aperture of the fixation ring **19.**

In order to ensure that the fixation screw **20** cannot in the case of vibrations occurring work loose and thereby be flung out between the vanes, which might destroy the latter completely, the fixation screw **20** is secured in the vane root **15** by means of a locking screw **25** which engages a turned-down groove **26** in the fixation screw **20** between the threaded part **21** and the fitting portion **22.** Out of regard to the mounting this groove **26** has a length which is sufficient for in part letting the fixation screw **20** go quite clear of the fixation ring **19,** in part enabling the fixation screw to be screwed down to the full depth without it being necessary to remove the locking screw **25.**

In the drawing, the fitting portions **17** and **18** are shown cylindrical, but at any rate one of these portions may be designed so as to be conical.

What is claimed is:

1. In a vane mounting assembly for an axial flow fan having a plurality of vanes (**5**) rotatably mounted in a hub rim (**4**) of an impeller wheel, each vane being mounted in the hub rim by an axle pin (**6**) having a threaded portion (**16**) engaging a correspondingly threaded portion in a bore in a root portion (**15**) of each vane, and including means (**9, 12, 13**) connected to each axle pin for simultaneously rotating all of the vanes about the axes of the axle pins, the improvements characterized by:

a. a first portion (**17**) of the axle pin between the threaded portion and the nearest end of the axle pin having a diameter less than the inside diameter of the threaded portion,

b. a second portion (**18**) of the axle pin between the threaded portion and the farthest end of the axle pin having a diameter greater than the outside diameter of the threaded portion,

c. the bore in the root portion of each vane including an inner portion having a diameter generally corresponding to and for receiving said first portion of the axle pin and an outer portion having a diameter generally corresponding to and for receiving said second portion of the axle pin,

d. a fixing ring (**19**) rigidly mounted on the axle pin beneath the bottom of the root portion of the vane when the axle pin is threaded thereinto, said ring extending outwardly from the axle pin and having an aperture therethrough, and

e. a locking screw (**20**) threaded into and extending through a bore in the root portion of the vane, an end (**22**) of said screw extending into the aperture in the fixing ring, whereby the first and second portions of the axle pin absorb radial forces during the operation of the fan, the threaded portion absorbs centrifugal forces, and the locking screw absorbs torsional forces.

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