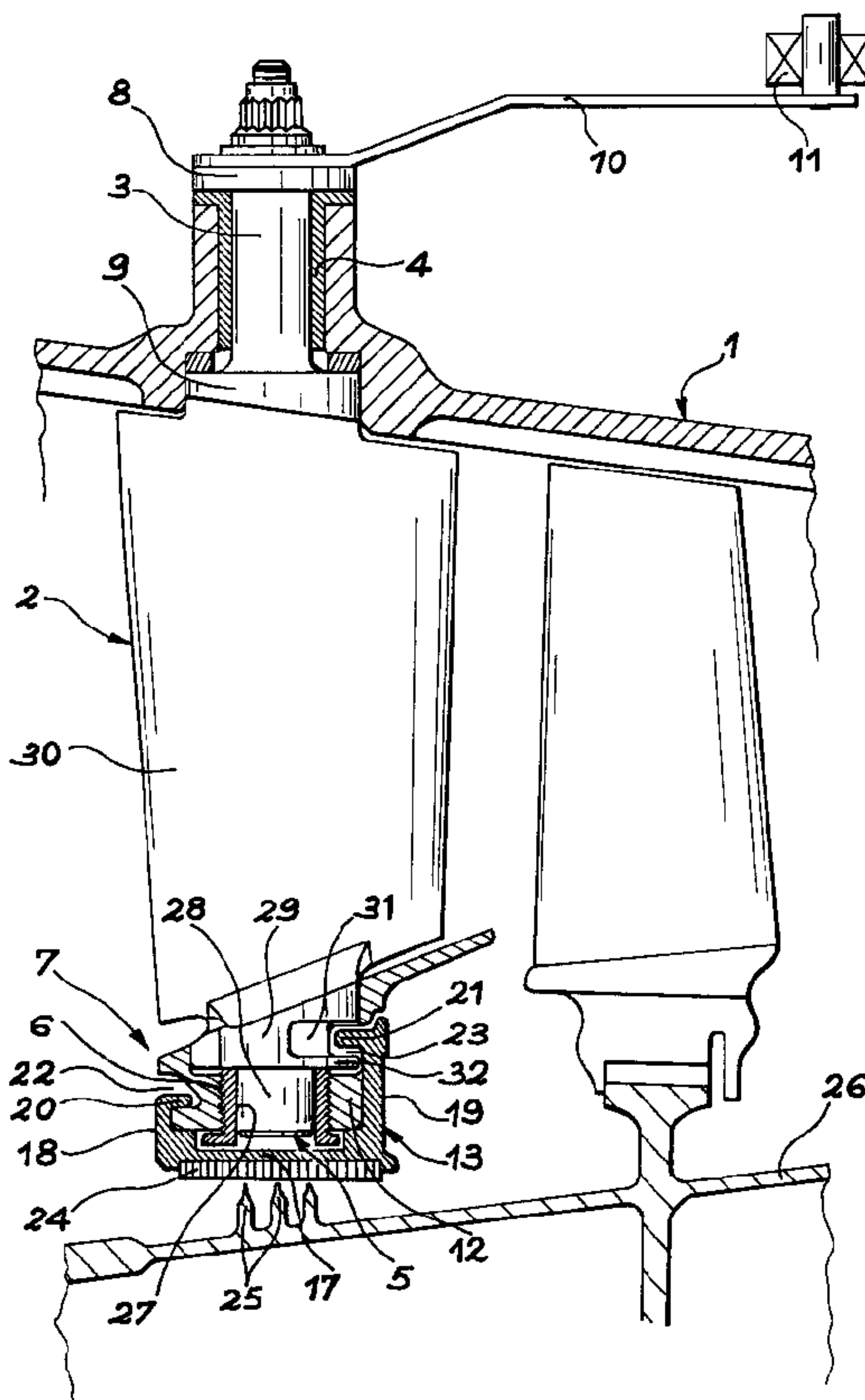




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(54) Titre : PLATEAU CIRCULAIRE D'AUBES PLACE AUX EXTREMITES INTERNES ET RATTACHE AU STATOR PAR UNE BAGUE DE RACCORD  
 (54) Title: CIRCULAR STAGE OF VANES AT INTERNAL ENDS CONNECTED BY A CONNECTING RING



(57) **Abrégé/Abstract:**

The present invention relates to a rectifier vane stage connected to a stator that is supported at the internal ends by a connecting ring which comprises a support ring and a stiffening ring, one retaining lip of which is inserted deeply into the support ring and similarly into the recesses of ends of the vanes. The possibility of vanes accidentally coming loose following a breakage of said vanes is therefore eliminated.

**ABSTRACT OF THE DISCLOSURE****CIRCULAR STAGE OF VANES AT INTERNAL ENDS CONNECTED BY A  
CONNECTING RING**

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CIRCULAR STAGE OF VANES AT INTERNAL ENDS CONNECTED BY A  
CONNECTING RING

DESCRIPTION

Field of the invention

The present invention relates to a circular stage of vanes whose internal ends are connected by a connecting ring.

A construction of this kind is used in turbo-  
5 machines for rectifier vane stages that are linked to the stator. The outer ends of the vanes are supported by the stator and the inner ends are supported by a connecting ring that is common to all the vanes of the stage and that therefore stiffens the assembly by  
10 connecting the vanes together. As the rectifier vanes are generally mounted to pivot in order to improve the performance of the machine at different speeds by adjusting the rectifying angle of the gas flow, the inner and outer ends of the vanes consist of pivots  
15 that are supported in respective bearings of the stator and the connecting ring.

The present patent concerns the internal section of the vanes and particularly the way in which the internal pivots are fitted inside the bearings of the  
20 connecting ring. If a vane breaks into two at the middle, the outer piece remains in place because the outer pivot is usually provided with shoulders that bear on the edges of the stator bearing, whereas the internal pivot is not provided with shoulders of this  
25 kind in order to allow the connecting ring to position

itself in the most suitable place by sliding on the internal pivots of the stage vanes. This causes the inner piece of the broken vane to be freed due to the pivot coming loose from the bearing. The flow of air in the machine propels the broken vane downstream which could destroy the vanes in a number of the stages that lie further on. The event of this happening is even more likely given that the rectifier pivoting vanes are usually located near the entrance to the low pressure compressor such that both the high and low pressure compressors of standard turbo-machines are thus exposed to the accidents described above.

Precautions against the internal pivot coming loose in the event of a vane breaking have already been taken in numerous patents of the prior art. French patent 2 723 614 filed by the present applicant may be mentioned in which an additional ring (referred to as 33 in the patent) is added to the connecting ring to constitute a stop under the internal pivoting stages. In particular, the additional ring is punched, the ends of the internal pivots are waisted with a throat and the edges of the apertures in the additional ring are inserted into the throats of the internal pivots. A movement towards the outside of the internal pivots pulls against the additional ring and causes it to stop against the connecting ring.

Despite this apparatus being effective, it also presents the following drawback: an additional ring must be provided thus increasing the weight and the production cost of the machine. Therefore, the present invention concerns an apparatus that achieves the same results but which avoids the drawback of adding a part that only serves a single purpose. The present

invention therefore enables the internal pivots to be retained using a structural part that is already present in the connecting ring and that requires only slight modification.

5           In its most general form, the invention may be defined as a circular stage of vanes with outer pivots that are housed in the pivoting bearings of a stator and internal pivots that are housed in a connecting ring. The connecting ring consists of a support ring  
10 and a stiffening ring that are interconnected. The support ring bears the internal pivoting bearings and the stiffening ring ends in two lips that are directed towards one another and that lie in the respective grooves in the support ring, the internal pivots being  
15 provided with a recess. In accordance with the invention, one of the lips passes through the support ring and lies in the recesses.

          According to one improvement, the recesses only lie in one section of the circumference, thereby  
20 providing a stop for the angular displacements of the vane. The recesses are also useful in the event of the vane breaking.

          One particular embodiment consists of a construction in which the vane pivots are in two  
25 sections in order to facilitate assembly. The lips of the stiffening ring lie in circles of two different diameters. The pivots consist of two sections: one section is a trunnion that is inserted into a sleeve of the bearing and the other is a widened section located  
30 between the trunnion and a vane blade. The recesses are cut into the widened sections and the lip opposite that which penetrates the recesses lies opposite the trunnions.

The invention will now be described in greater detail using the following figures that are attached in order to illustrate a specific embodiment:

. figure 1 is a longitudinal cross-section of a  
5 rectifier vane stage showing one of the vanes;

. figure 2 is a front view of the vane stage;

. and figure 3 shows an internal pivot of a vane inserted into the support ring.

The machine comprises an outer stator 1 and at  
10 least one vane stage 2 that is equipped with the invention. Vanes 2 have a first end, that constitutes an outer pivot 3 that passes through stator 1 where an outer bearing 4 is located, and an opposite end that constitutes an internal pivot 5 which is inserted into  
15 a bearing 6 of a connecting ring 7, said connecting ring being connected to all vanes 2 of the stage. Outer pivot 3 is provided with shoulders 8 and 9 between which bearing 4 is retained, thereby limiting the radial displacement of vane 2 in the machine (axial  
20 displacement could also be mentioned when the direction of pivots 3 and 5 are considered). The outer pivot 3 leaves stator 1 and ends in a connection with a control lever 10, the other end of which is connected to a control ring 11 common to all vanes 2 of the stage.  
25 Control ring 11 lies around stator 1 and it is turned in order to control the rotation of levers 10 and vanes 2 around pivots 3 and 5.

Connecting ring 7 consists mainly of a support ring 12 in which bearings 6 are cut and a stiffening  
30 ring 13 that covers a section of support ring 12. The reason for this construction becomes clear on referring to figure 2. The figure shows that support ring 12 is not built in a single part but comprises abutting

sections 14 of which there are two, four or eight sections in standard embodiments. Figure 2 also shows stiffening ring 13 that constitutes the means for maintaining said sections in place. The stiffening ring  
5 comprises two semi-circular sections 15 that are connected together. Referring back to figure 1, stiffening ring 13 may be seen to have a cross-section similar to that of a rail with a bottom section 17 under support ring 12, flanks 18 that partially cover  
10 the plane surfaces of support ring 12 and lips 19 and 20 that are located at the end of flanks 18 and 19 that are inserted into grooves 22 and 23 of support ring 12. As lips 20 and 21 are directed towards one another they maintain stiffening ring 13 on support ring 12 and keep  
15 them interconnected. It may also be pointed out that an additional function of the stiffening ring 13 is to provide a material on the inner surface of bottom section 17 that is abradable, in other words easily worn out. Said material is used to come into contact  
20 with the circular peaks or projections 25 of a rotor 26 to create an almost leaktight seal during standard operation of the machine when the differential thermal dilations have brought projections 25 made of abradable material 24 into contact and starts to abrade it as a  
25 result of friction. It should also be mentioned that internal bearing 6 is constituted by a sleeve 27 that is inserted through a perforation in support ring 12, outer surface of said support ring being threaded. Given that the internal pivot 5 actually consists of a  
30 trunnion 28 that is inserted into sleeve 27 and of a widening 29 located between trunnion 28 and a blade 30 of vane 2, it may be seen that adjustment of connecting ring 7 is effected by screwing sleeves 27 into the

threaded perforations of support ring 12 until the  
outer ends 31 of sleeves 27 stop against widened  
sections 29. Any deflection or vibrations in the radial  
direction of connecting ring 7 are therefore  
5 eliminated.

Unlike other embodiments that are already known in  
the art, cylindrical lips 20 and 21 do not belong to  
circles of the same diameter but, as one of the flanks  
19 is much wider than the other flank 18, lip 21 that  
10 is borne by said flank 19 extends opposite widened  
section 29 whereas the other lip only lies opposite  
trunnion 28. Moreover, lip 21 is long enough to fit  
into a recess 31 cut into widened section 29, the  
groove 23 incorporated in the widened section passing  
15 completely through a surface of the support ring 12.  
The material of widened section 29 located between  
recess 31 and trunnion 28 constitutes an edge 32 that  
bears against lip 21 in the event of an outward  
movement of vane 2 caused, for example, by the vane  
20 breaking, and said edge resists the internal pivot 5  
coming loose. This construction, that conforms to the  
above-mentioned objective, is extremely simple but  
effective in retaining the vane.

Figure 3 completes the description of this  
25 invention by showing the main parts of the invention  
even more clearly. Sleeve 27 has, however, been omitted  
from the drawing to show the details more clearly. It  
may be noted that recess 31 advantageously lies only on  
a section of the circumference and finishes therefore  
30 in two lateral stopping surfaces 33 that limit the  
angular deflection of vane 2 by coming into contact  
with lip 21. This is particularly advantageous in the  
event of vane 2 breaking and the piece of blade 30 that

belongs to internal pivot 5 tailing away haphazardly,  
in other words freely following the direction of the  
gas flow.

CLAIMS

1. Circular stage of blades with outer pivots that are housed in outer pivot bearings of a stator and first  
5 internal pivots that are housed in internal pivot bearings of a connecting ring that comprises a support ring and a stiffening ring that are interconnected, said support ring bearing internal pivot bearings and said stiffening ring ending in two lips that are directed towards one another  
10 and lie in respective grooves of said support ring, said internal pivots being cut with recesses, wherein one of said lips extends through said support ring and lies in said recesses.

15 2. The circular stage of blades of claim 1, wherein said recesses lie only on a section of a circumference of said circular stage.

20 3. The circular stage of blades of claim 1, wherein said lips of the stiffening ring lie over circles of two different diameters and said internal pivots comprise two sections, including a first section that is a trunnion inserted into a sleeve of the internal pivot bearings and a second section that is a widened section, said widened  
25 section being located between the trunnion and a blade of a vane, the recesses being cut in widened sections, a first of the lips opposite a second of the lips lying in the groove that extends opposite the trunnion.

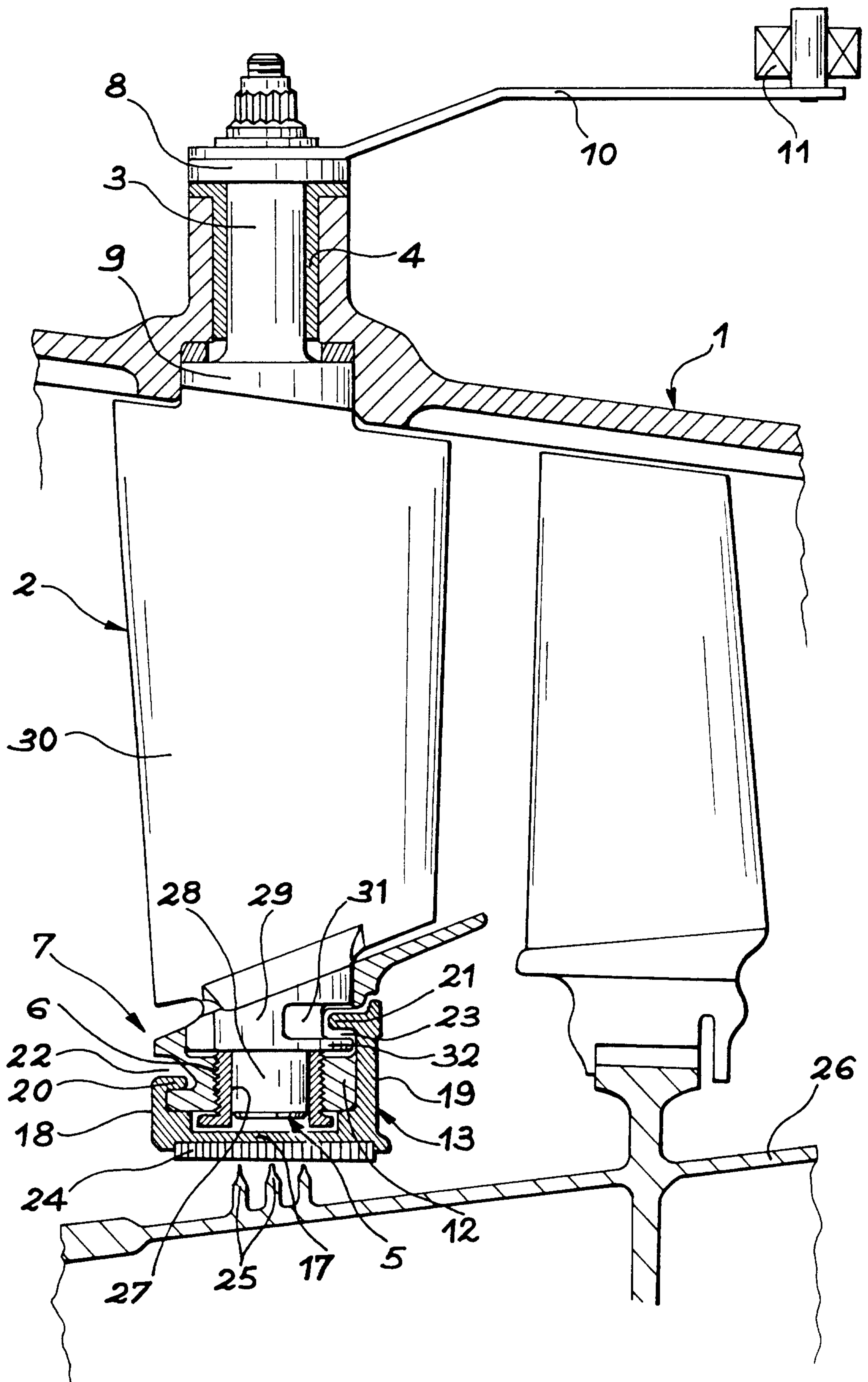


FIG. 1

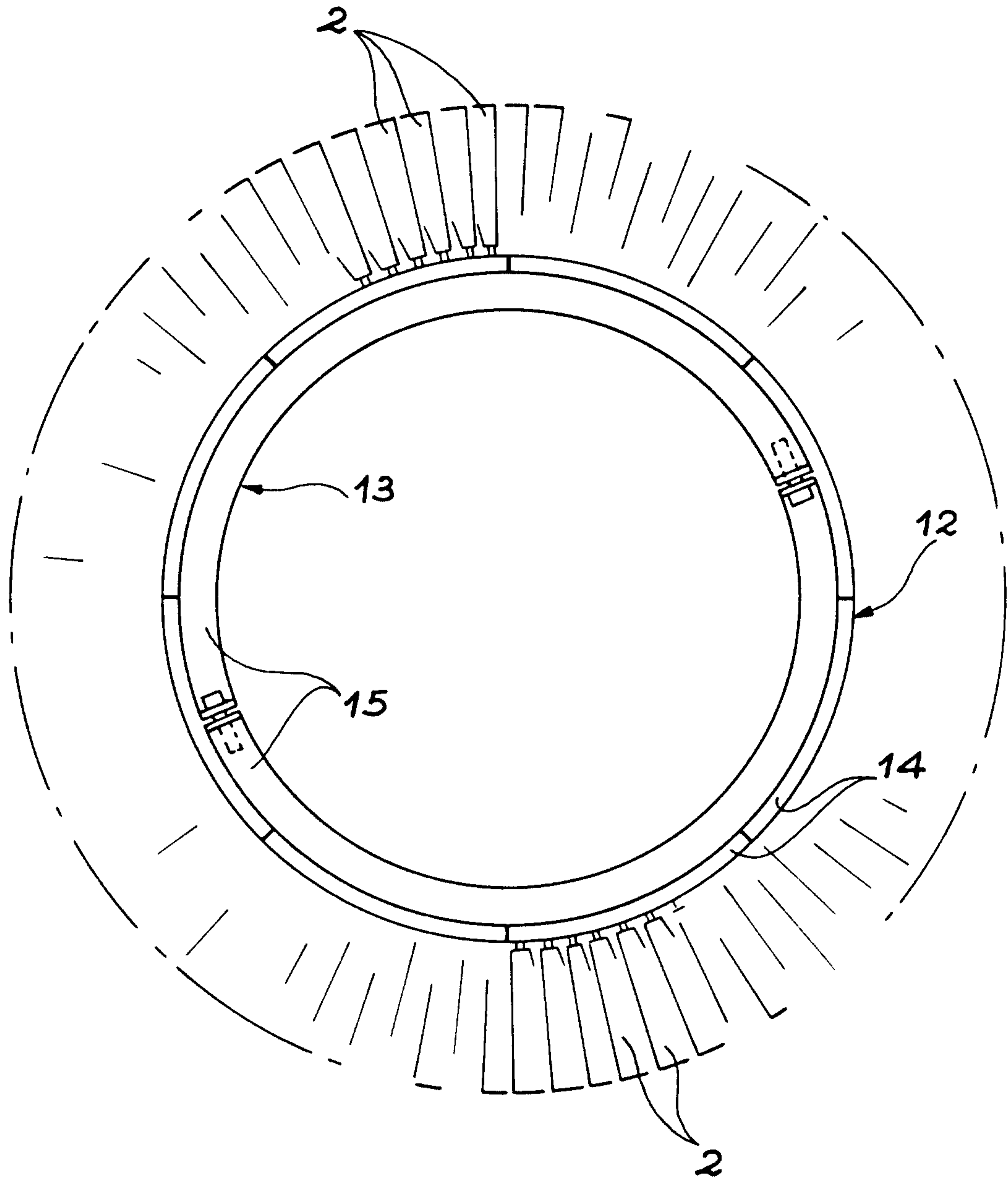


FIG. 2

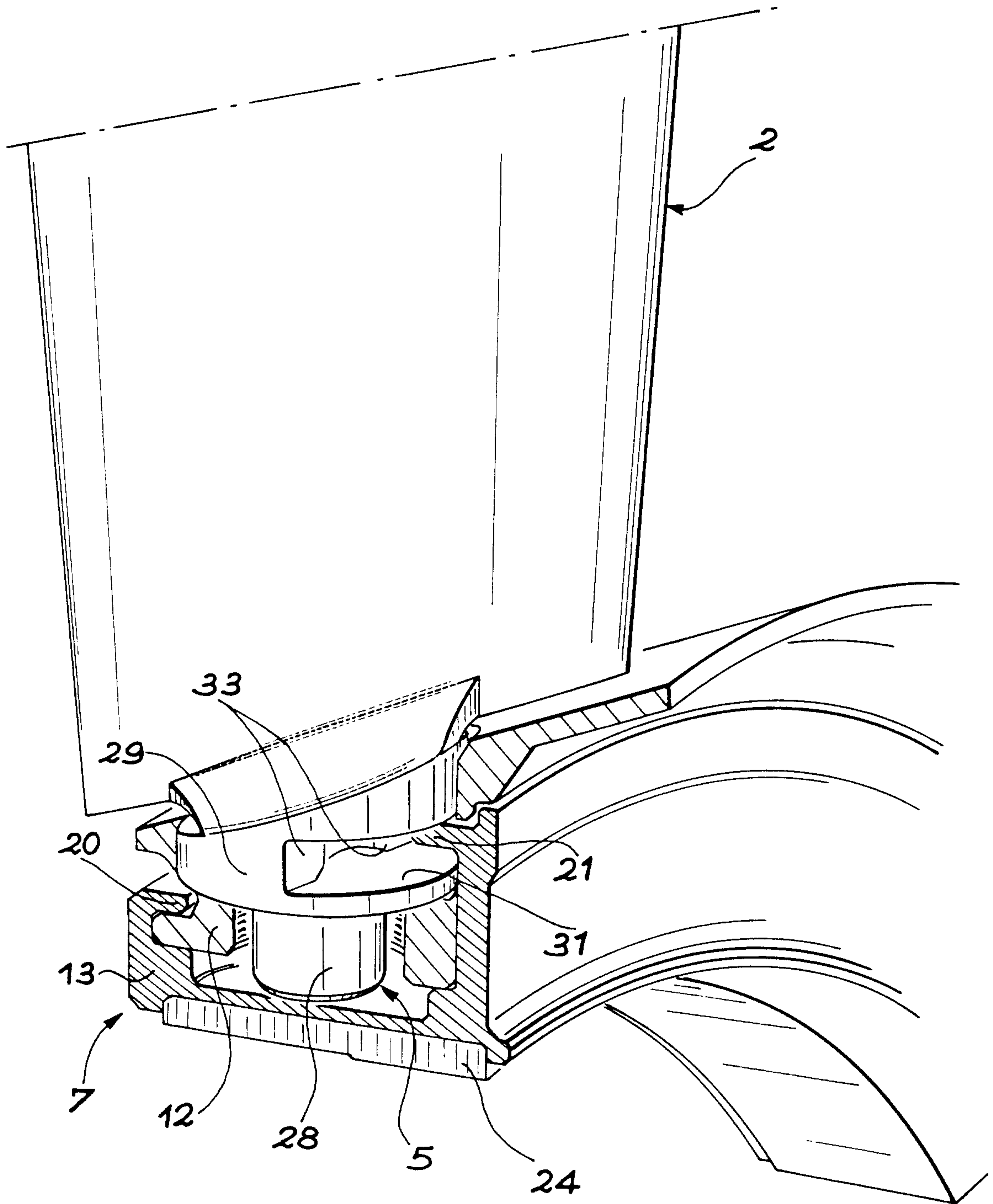


FIG. 3

