Sept. 29, 1942. U. MEININGHAUS 2,296,862

BLADED DISK FOR RADIAL FLOW ROTARY MACHINES

Filed Jan. 28, 1941 4 Sheets-Sheet 1

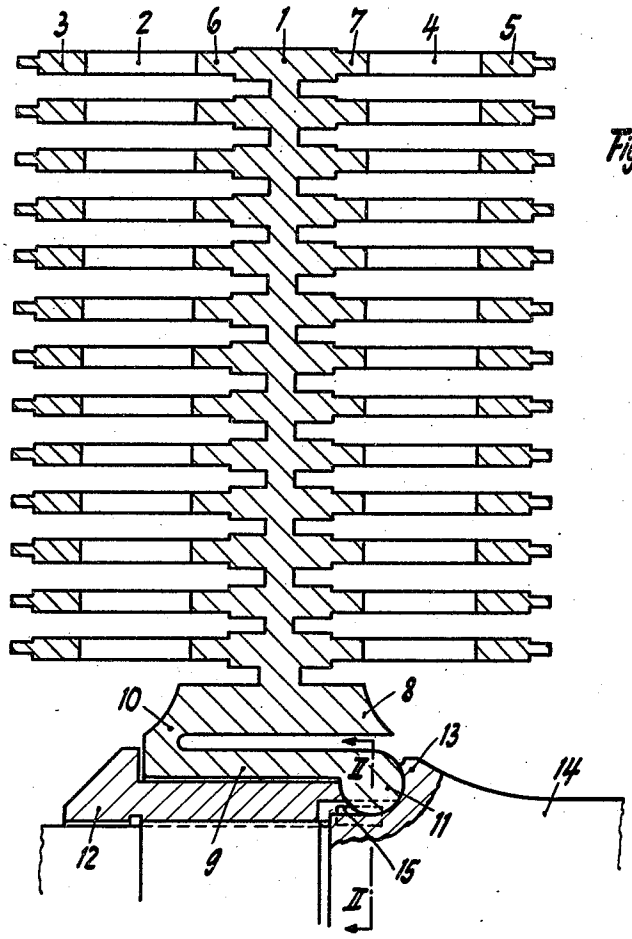


Fig.1

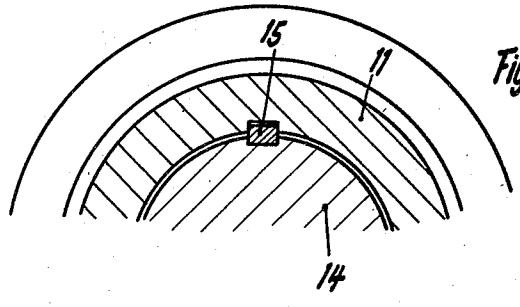


Fig.2

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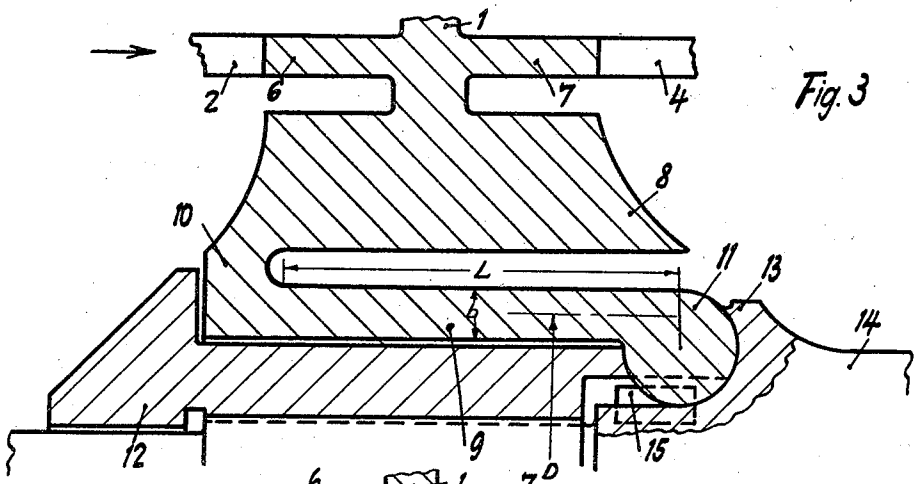


Fig. 3

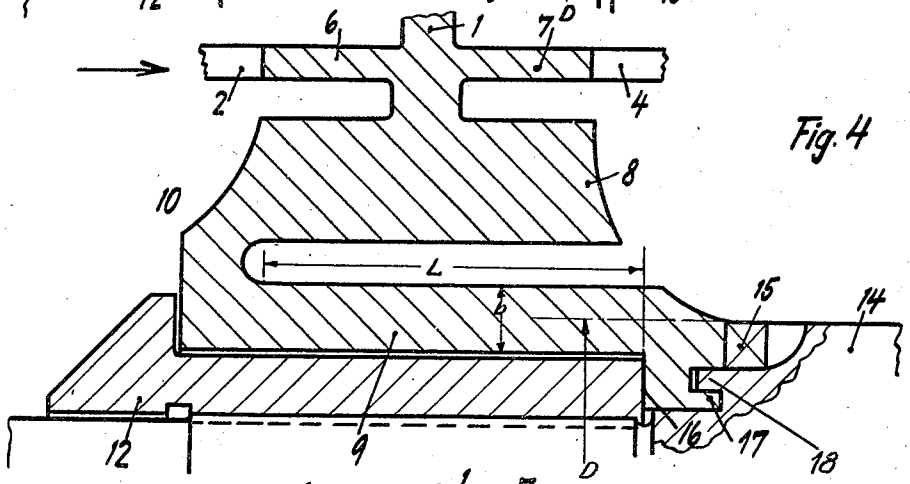


Fig. 4

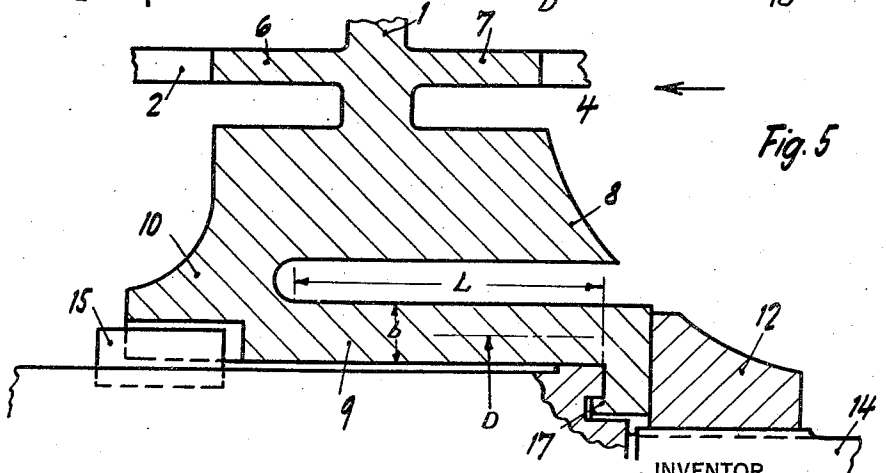


Fig. 5

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BLADED DISK FOR RADIAL FLOW ROTARY MACHINES

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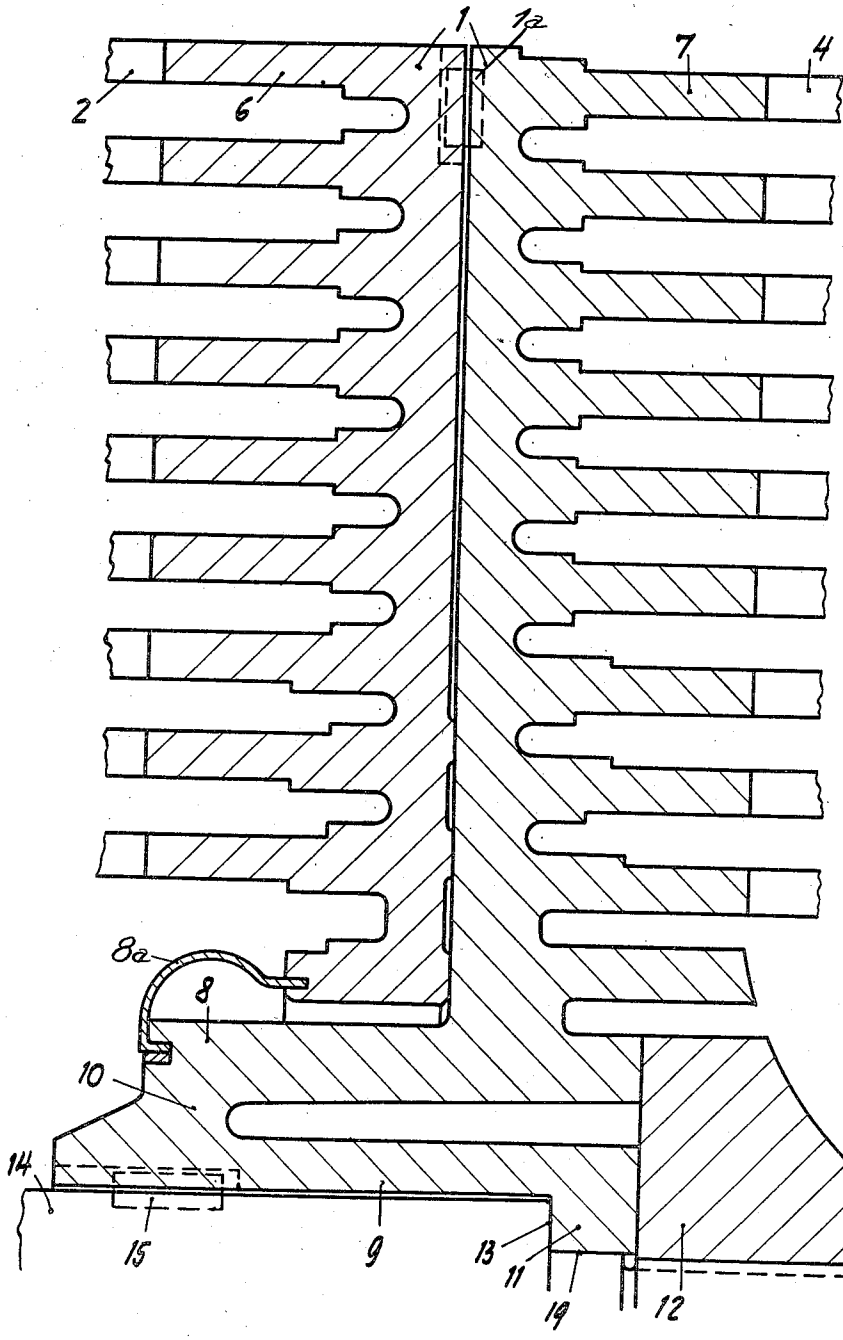


Fig. 6

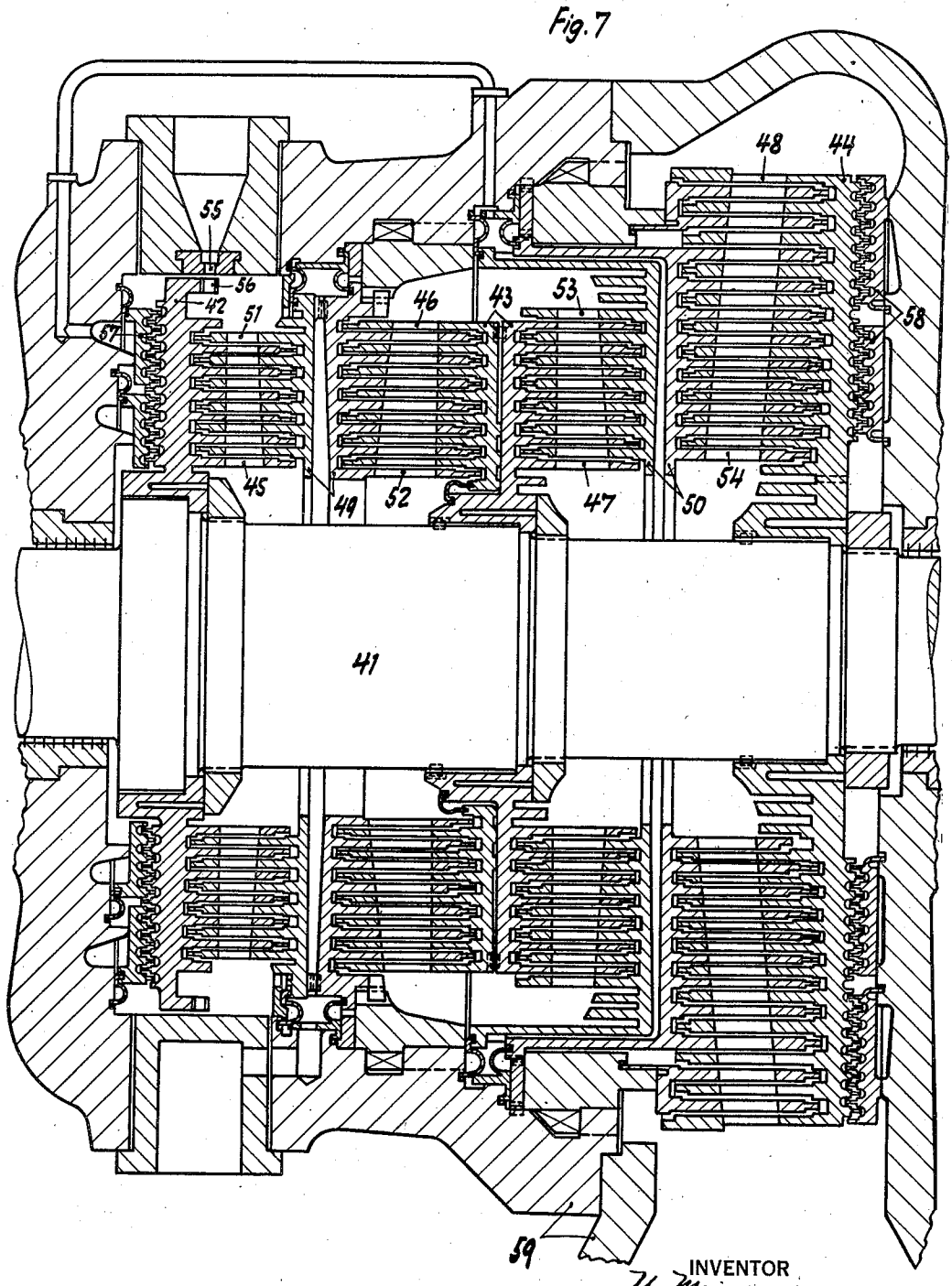
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Fig. 7



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UNITED STATES PATENT OFFICE

2,296,862

BLADED DISK FOR RADIAL FLOW ROTARY MACHINES

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Application January 28, 1941, Serial No. 376,275
In Germany February 2, 1940

8 Claims. (Cl. 253—39)

The present invention relates to the bladed wheel construction of rotary machines, and especially of radial flow steam and gas turbines.

It is the general object of the invention to provide an elastic and tight joint between such wheel and the shaft which is capable of withstanding a high pressure difference prevailing between the two sides of the wheel, and in particular a joint which does not restrict the flow of the medium impinging the blades and avoids parts projecting excessively from the space occupied by the wheel body. Other, more specific objects of the invention will appear from the detailed description hereinafter.

The accompanying drawings illustrate by way of example steam turbine wheels according to the invention. Fig. 1 shows a vertical section through the upper half of such a wheel, Fig. 2 a transverse section through the hub along the lines II—II of Fig. 1. Fig. 3 illustrates the hub part of Fig. 1 to full scale, while Figs. 4 to 6 represent modified constructions of the hub. Fig. 7 shows a vertical section through the whole turbine.

In Fig. 1 the wheel 1 carries on one side the blades 2 with the head rings 3 and on the other side the blades 4 with the head rings 5. The blades 2 are inserted into the carrier rings 6 and the blades 4 into the carrier rings 7 which are formed in the wheel 1 by cutting grooves between them. At the inner circumference of the wheel a stiffening ring 8 is arranged to increase the strength of the wheel against side pressure. To support the disk on the shaft I arrange a ring 9 and dispose the web 10 joining the supporting ring 9 with the stiffening ring 8 at the left ends of these rings. The right end of the supporting ring 9 I provide with a ring 11 of circular cross section and press this ring by means of a circular nut 12 against a correspondingly shaped shoulder 13 of the shaft 14. A key 15 transfers the torque. Fig. 2 shows the arrangement of the key 15 on the circumference of the ring 11 and the shaft 14. By moving the web 10 to the one end face of the disk 1 I give the supporting ring 9 a comparatively great axial length. This length enables the ring 9 to be made comparatively thick, for example, of the order of the thickness of the carrier rings 6 and 7, without impairing its elasticity. Thus the ring 9 is easily made strong enough to withstand even high pressure differences prevailing between its inner and outer circumference. The axial length of the ring 9 required to keep its elasticity despite increased thickness I obtain without increasing the axial dimensions of the wheel to any appreciable extent and without adding any obstruction to the flow of the steam or weakening the shaft.

Fig. 3 shows the same arrangement at the hub on full scale. The references of Fig. 1 apply also to Figs. 3 to 6. In the arrangement of Fig. 4 the end of the ring 9 is clamped between the two radial surfaces 16 and 17. Any radial movement of the end is prevented by the shoulder 18. The key 15 transfers again the torque. The clamping of the ring end between the radial surfaces 16 and 17 prevents any tilting of this end. If the axial length of the ring 9 is correspondingly chosen the elasticity of the ring will make good for the stiffness of the clamping. Fig. 5 shows a construction wherein the nut 12 is arranged outside the hub. In Fig. 6 the end of the ring 9 is shrunk or pressed on the shaft at 19. This shrink widens the end and relieves the stresses in the ring 9 when the disc is widened by heat or centrifugal force. In addition the shrink tightens the joint.

I secure a sufficient elasticity of the ring 9 by choosing the axial length L of the ring between the support and the joint with the web 10 in the limits from 0.8 to 1.7 times the square root of the product of the radial ring thickness b and the mean diameter D of the ring according to the formula:

$$L=0.8 \text{ to } 1.7\times\sqrt{b\times D}$$

whereby the dimensions are taken in one and the same unit.

As can be seen from the drawings, whether the disk 1 is formed of one piece, as in Figs. 1 to 5, or of two sections united by an elastic, relatively thin ring 8a and locked together in the circumferential direction by a key 1a, as in Fig. 6, the carrier rings are formed by cutting grooves in the disk down to a certain residual thickness or depth; while the supporting ring 9 is formed by cutting a groove into the body of the disk for a greater depth than the other grooves, so that such ring 9 is of greater axial length than the carrier rings, and in the case of a disk bladed on both sides, extends approximately from the outer edge of one group of carrier rings to the outer edge of the opposite group of such rings.

The steam turbine which Fig. 7 shows in section makes use of the present invention for all wheels. The shaft of the turbine appears at 41 and carries the wheels 42, 43 and 44 with the blades 45, 46, 47 and 48. The fastening of the wheels 42, 43 and 44 corresponds with Fig. 6. The disks 49 and 50 hold the stationary blades

51, 52, 53 and 54. The steam enters through the nozzles 55, passes the impulse blade row 56 and then the reaction blading 51, 52, 53 and 54. The axial thrust of the reaction blading is balanced by the labyrinth discs 57 and 58. 59 represents the housing of the turbine.

Obviously, my invention is not restricted to rotary machines of the specific form illustrated, but for example may be used with wheels along which the working medium flows in the same direction on both sides. Or only one side of the wheel may carry blades, the other side for instance labyrinth packing.

I claim:

1. A blade or labyrinth carrying disk for radial flow rotary machines, in particular steam or gas turbines, having axially extending carrier rings formed by grooves cut into the body of the disk down to a certain residual depth and carrying blades or labyrinth packing at their outer ends, a shaft, and an additional, supporting ring running parallel to the carrier rings and formed by a groove cut into the body of the disk with greater depth than the other grooves, the supporting ring being of substantially the radial thickness of the carrier rings, but of greater axial length and having only the free end thereof connected to the shaft.

2. A blade or labyrinth carrying disk for radial flow rotary machines, in particular steam or gas turbines, having on both sides axially extending carrier rings formed by grooves cut into the body of the disk down to a certain residual depth and carrying blades or labyrinth packing at their outer ends, a shaft, and an additional, supporting ring running parallel to the carrier rings and formed by a groove cut into the body of the disk from one side of the disc down to almost the other side, the supporting ring extending substantially over the whole width of the disk and having only the free end thereof connected to the shaft.

3. A disk according to claim 1, wherein an abutment on the free end of the supporting ring is pressed against a shoulder of the shaft by an annular nut arranged inside of the supporting ring.

4. A disk according to claim 2, wherein an abutment on the free end of the supporting ring is pressed against a shoulder of the shaft by an annular nut arranged inside of the supporting ring.

5. A disk according to claim 1, wherein the free end of the supporting ring is shrunk on the shaft.

6. A disk according to claim 2, wherein the free end of the supporting ring is shrunk on the shaft.

7. A disk according to claim 1, wherein the axial length of the supporting ring between the point of connection with the shaft and the joint with the disk lies in the limits from 0.8 to 1.7 times the square root of the product of the radial ring thickness and the mean diameter of the supporting ring.

8. A disk according to claim 2, wherein the axial length of the supporting ring between the point of connection with the shaft and the joint with the disk lies in the limits from 0.8 to 1.7 times the square root of the product of the radial ring thickness and the mean diameter of the supporting ring.

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