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F. LJUNGSTRÖM.  
FASTENING THE BLADES OF AXIAL STEAM TURBINES.  
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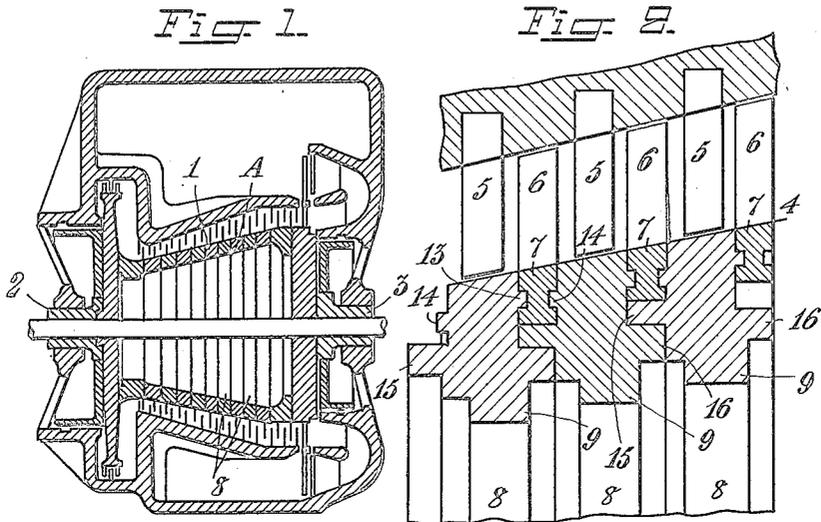


Fig. 4. Fig. 5. Fig. 6.

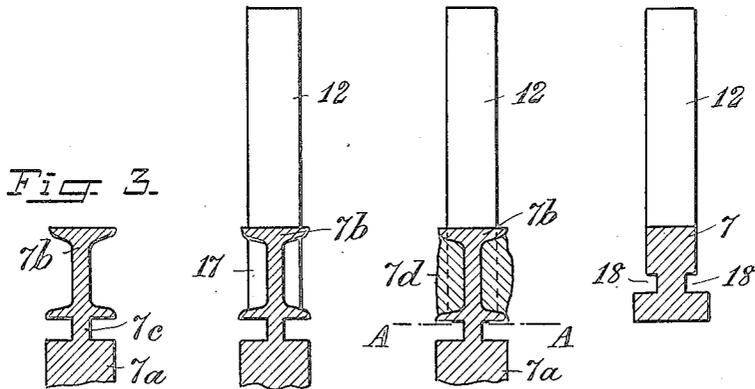
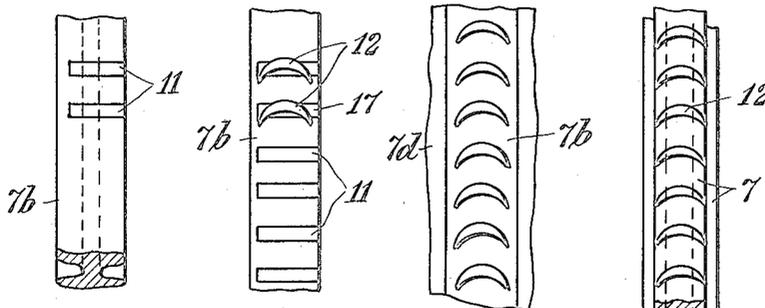


Fig. 7. Fig. 8. Fig. 9. Fig. 10.



Inventor  
F. Ljungström,  
By H. R. Kerlake  
Attorney

## UNITED STATES PATENT OFFICE.

FREDRIK LJUNGSTRÖM, OF BREVIK, LIDINGON, SWEDEN.

FASTENING THE BLADES OF AXIAL STEAM TURBINES.

Application filed January 7, 1920. Serial No. 350,011.

*To all whom it may concern:*

Be it known that I, FREDRIK LJUNGSTRÖM, a subject of the King of Sweden, residing at Brevik, Lidingon, Sweden, have invented certain new and useful Improvements in Fastening the Blades of Axial Steam Turbines, of which the following is a specification.

The present invention relates to an arrangement in axial steam turbines and has for its purpose to provide for an attachment of the blades which is of a nature to permit of an easy replacement of single blade-rings.

Heretofore, the blades have been fastened by jamming them or otherwise attaching them in slots provided in the turbine rotor, the blades thus forming a rigid unit together with the rotor, which latter has not permitted of single blades or rings being removed for replacement by others.

The invention consists therein that the blades are attached to blade-rings or disks, the latter being retained by a number of rings arranged beside each other and pressed together axially in any convenient manner. These rings may also constitute parts of the turbine rotor itself.

The invention also consists therein that adjacent surfaces of the retaining rings and the blade rings are machined so as to fit together when pressed against each other, the rings or the rotor parts being provided on their inner sides with projecting ledges or the like of such a nature that the rings may be taken apart without difficulty by hammer-blows or by means of a tool set against the said ledges.

Further, the invention consists in the blade-rings being formed by rings in which the moving blades are inserted and welded in radially extending slots.

The invention is illustrated in the accompanying drawing. Fig. 1 shows (partly diagrammatically) an axial-flow turbine drawn to a reduced scale, and Fig. 2 is a detail view drawn to a larger scale. Figs. 3, 4, 5 and 6 are sectional views of a blade-ring according to the invention during different steps of manufacture. Figs. 7, 8, 9 and 10 show the corresponding blade-rings in plan.

In the embodiment disclosed, the rotor 1 is divided into rings 8, which rings are retained by means of two sleeves 2 and 3 threaded on the turbine shaft.

The thread, of course, has to be directed oppositely to the direction of rotation of the turbine shaft.

4 denotes the steam passage (Fig. 2) with the guide blades 5 and the moving blades 6 located therein. The section of the attachment 7 of the moving blades is formed so that it fits between two adjacent rotor rings 8. Besides being shaped so as to conveniently mesh with the blade-ring 7 by means of projections 13 and 14, respectively, the section of each rotor-ring 8 is also formed for engagement with the adjacent rotor-rings by means of projections 15 and 16 respectively. On the inside, the rotor rings are provided with a projecting ledge, boss or the like 9 so as to facilitate the taking apart of the rings by means of a suitable tool set up against the said ledge.

The Figures 3-10 show four different steps in the manufacture of the blade-rings. The original ring 7<sup>a</sup> is provided at the top with an I-shaped ring 7<sup>b</sup> which is connected with the ring 7<sup>a</sup> by means of a narrow web 7<sup>c</sup>. In the ring 7<sup>b</sup> there are provided slots 11 (Fig. 7) milled or otherwise worked into the material, the bases 17 of the blades 12 being fitted into said slots. Figs. 4 and 8 illustrate the present state of the blade ring. By welding there is applied some material 7<sup>d</sup> around the blade bases, as will be seen from Figs. 5 and 9.

By cutting on the line A-A of Fig. 5 and turning in the lathe, the final form of the ring 7 is obtained as shown in Figs. 6 and 10. When assembling the rotor, the projections 13 and 14 respectively of the rings 8 enter the interstices 18.

Upon cutting the web 7<sup>c</sup>, the ring 7<sup>a</sup> may be used to produce other blade rings.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. An axial flow turbine rotor composed of rotor rings clamped together so as to lie close to one another and forming the turbine drum proper, blade carrying rings clamped between said drum forming rings, projections on one set of said rings, and the other set of rings being formed with corresponding recesses meshing with said projections.

2. An axial flow turbine rotor composed of rotor rings clamped together so as to lie close to one another and forming the turbine drum proper, other rings having blades welded thereto clamped between said drum

forming rings, projections on one set of said rings, and the other set of rings being formed with corresponding recesses meshing with said projections.

- 5 3. An axial-flow turbine rotor as claimed in claim 1 wherein flanges are provided on and extending at substantial right angles from the sides of the first mentioned rotor rings and are positioned to face each other, the flange on one side of each ring being  
10 designed to telescopic engagement with the flange on the adjacent side of the adjacent ring so that the whole body of rings will form a rigid unit when connected together.
- 15 4. An axial-flow turbine rotor as claimed in claim 1 wherein the blade carrying rings

are provided with circular grooves on opposite sides and corresponding flanges at substantially right angles from the adjacent sides of the rotor rings for engagement with  
20 the grooves so that the several rings and blades form a rigid unit when assembled.

5. An axial-flow turbine rotor as set forth in claim 1 wherein the rotor rings are provided on the inside with abutting surfaces,  
25 substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FREDRIK LJUNGSTRÖM.

Witnesses:

G. H. BERGROBE,  
F. E. HACE.