Nov. 19, 1929. A. LYSHOLM 1,736,612

STEAM TURBINE

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Fig. 1

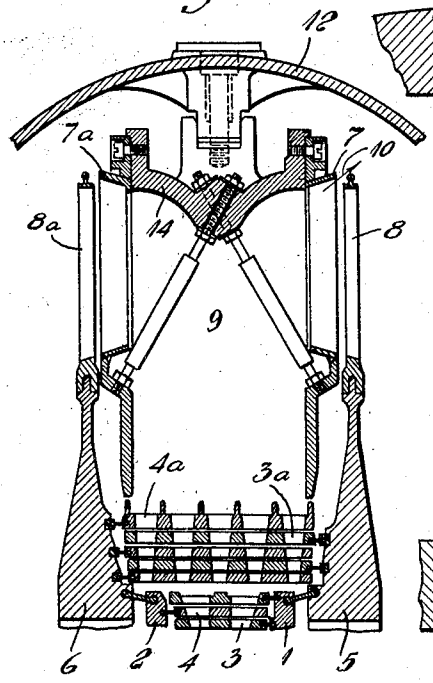


Fig. 2

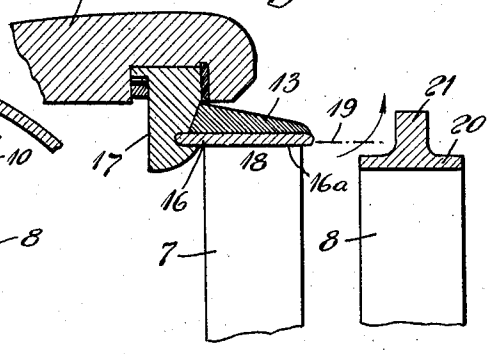


Fig. 3

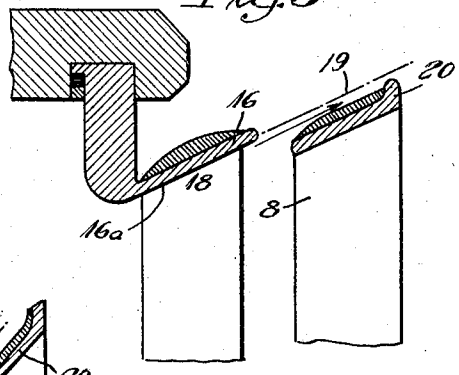
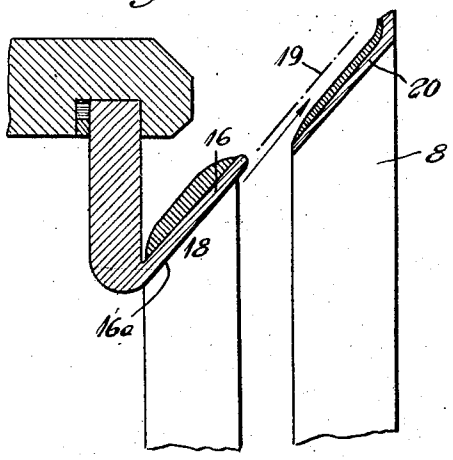


Fig. 4



Inventor
Alf Lysholm
By
Cameron, Kirkam & Sutton
Attorneys

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Fig. 5

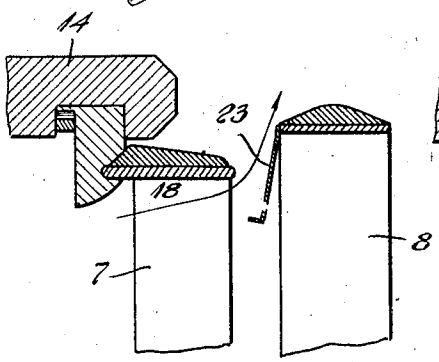


Fig. 6

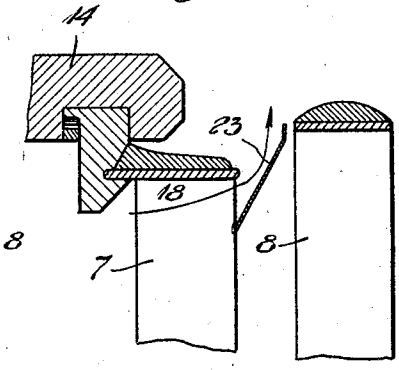


Fig. 7

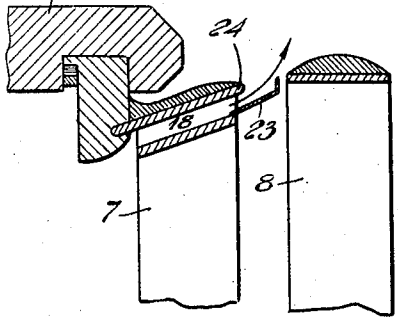
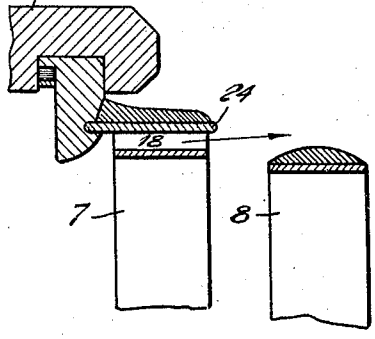


Fig. 8



Inventor
Alf Lysholm
By
Cameron, Kirkham & Sutton
Attorneys

Patented Nov. 19, 1929 1,736,612

UNITED STATES PATENT OFFICE

ALF LYSHOLM, OF STOCKHOLM, SWEDEN, ASSIGNOR TO AKTIEBOLAGET LJUNGSTRÖMS ANGTURBIN, OF STOCKHOLM, SWEDEN, A JOINT-STOCK COMPANY OF SWEDEN

STEAM TURBINE

Application filed April 26, 1928, Serial No. 273,116, and in Sweden May 2, 1927.

The present invention refers to steam turbines provided with a radial blade system for high pressure, preferably of the double rotary type, and an axial blade system for low pressure adapted to receive steam from the first-mentioned system.

When such a turbine is in operation, steam is being supplied to the raidal blade system near the shaft of the turbine, said steam flowing in a radial direction outwardly through the radial blade system, the latter being thus caused to absorb energy. When the steam is transferred from the radial blade system to the axial blade system, its pressure and temperature are reduced to a considerable extent, by reason of which the steam will hold much moisture in the form of water or moisture particles which, if transferred to the axial blade system, are apt to cause considerable damage.

To explain this, it has been found in practice that the outer ends of the blades of the axial blade system show a certain kind of wear upon running for some time, said wear being caused by the moisture particles or water present in the moist steam passing through these parts of the blade system.

It has been previously proposed to lead off the steam from the space between the radial and the axial blade systems by providing the casing surrounding this space with holes through which the moist steam is hurled by the centrifugal force into the turbine exhaust. It has also been proposed to recover this moist steam, either by tapping or drawing it off in a similar manner, for the purpose of using said steam for preheating or the like. These arrangements, however, have not entirely eliminated the wearing-off of the blades at their outer ends, it having been found to be impossible to locate these holes in such a manner as to prevent the moist steam entirely from passing through the blade system.

The present invention relates to constructions in turbines of the type in question for the purpose of separating moisture particles from the steam that are detrimental to the blade system, and the invention consists in that the guide blade apparatus is formed at its outer part (counted from the center of the turbine), in such a manner, or is so located with relation to the outer parts of the axial blade system that moisture particles of the steam or moist steam flowing from the space between the radial and the axial blade systems past the outermost portions of the guide blade apparatus are caused to flow outside the radial blade system, while dry steam is being conducted to the latter.

The invention is illustrated in the accompanying drawings showing a few embodiments by way of example. Fig. 1 is a radial cross section through an outer portion of a turbine construction according to the invention, and Figs. 2–8 show various embodiments to an enlarged scale.

In most of these embodiments, an extension of the outer limitation of the passage for the moist steam through the guide blade apparatus will extend radially outside the moving blades of the axial blade system.

In Fig. 1, 1 and 2 designate turbine disks carrying blade rings 3 and 4 thrust into each other. The turbine disks 1 and 2 are connected with the turbine disks 5 and 6 by means of an articulated member, which latter disks also carry blade rings 3^a and 4^a thrust into each other. The disks 1, 5 and 2, 6 are adapted to rotate, together with the blade rings carried thereby, in opposite directions. The driving medium is admitted in the proximity of the turbine shaft (not shown in the drawing) and flows first through blades 3 and 4 and 3^a and 4^a respectively pertaining to the radial blade system, and then through an axial blade system comprising, first, a guide blade apparatus 7 or 7^a respectively and, second, a rim of moving blades 8 or 8^a respectively. The guide blade apparatus is connected with an arcuate part 14 which is connected to the turbine casing 12. The moving blades 8 and 8^a respectively are rigidly connected with the turbine disk 5 and 6 respectively, and rotate in the same direction as the latter.

The steam coming from the radial blade system may have a higher or lower percentage of moisture in the form of small moisture particles. When such steam is present in the

space 9, the said particles are hurled by the centrifugal force to the outer portions of this space. Therefore, such moist steam will be found in the guide blade apparatus substantially in its outer parts, and is supplied to the outer portions of the blades of the axial blade system, thus involving the drawbacks mentioned hereinbefore. In order to reduce the moisture of this steam, arrangements for tapping have been provided in the part 14 for the purpose of leading off the water from the steam. This measure, however, has not been found to be sufficiently effective, the steam having still been found to be moist when passing the outer parts of the guide blade apparatus.

According to the invention, the object in view is attained in that the steam passing the outer portions of the guide blade apparatus is conducted radially outside the moving blades 8 and 8^a respectively. According to the embodiment shown in Fig. 1, this is obtained by the radial extension of the exhaust side of the guide blade apparatus being greater than the same extension of the inlet edge of the blades pertaining to the axial blade system. Moist steam is thus permitted to flow past the blade system in the direction of the arrow 10.

In the embodiment according to Fig. 2, the guide blade 7 is secured by welding to a blade head 16 as at 13, and is rigidly connected, by the member 17, to the part 14 carrying the guide blade apparatus as previously described. The moist steam flowing through the guide blade apparatus at 18 passes in the direction of the arrow over the blade head 20 and gets into the outlet of the turbine without passing through the axial blade system. A peripherally extending edge 21 on the heads of the moving blades imparts to the steam a radial direction on the same entering the outlet of the turbine.

In this embodiment, a line (as dotted line 19) extended outward from the part 16^a will pass outside of the outer end portions of the axial blade system.

In Fig. 3, the outer limitation of the guide blade apparatus as well as the head 20 of the moving blade are of a conical shape. Here, too, that portion of the steam which is moist passes through the guide blade apparatus at 18 and in the direction of the arrow outside the moving blades 8.

In the embodiments shown, the inlet side of the moving blades have a smaller radial extension than the outlet side of the guide blades.

In Fig. 4, an embodiment is shown where this condition does not exist, but where the moist steam passes nevertheless in the direction of the arrow outside the axial blade system and its blades 8. In this embodiment, as in the previously described embodiments, an extension 19 of the outer limiting surface 16^a in the passage 18 of the moist steam will pass outside of the blades 8 with the appertaining part 20 in the axial blade system, as in the embodiment shown in Fig. 2.

Figs. 5 and 6 show an embodiment of the invention, where the inlet edge of the moving blade 8 has a greater radial extension than the outlet side of the guide blade 7. In this embodiment, the overlapping portion of the moving blade is screened by means of a lip or screen 23 preventing the moist steam from getting into the outer part of the moving blade 8. Instead, the steam passes in the direction of the arrow past the outer portion of the moving blade 8, as illustrated.

In the embodiment according to Fig. 5, the lip 23 is secured to the moving blade 8, whereas it is attached to the guide blade 7 in the embodiment according to Fig. 6.

Figs. 7 and 8 illustrate embodiments where the outer part 24 of the guide blade apparatus has been provided with holes shaped as guide blades, through which a passage 18 for the moist steam is provided in such a manner that the steam is caused to flow outside the axial blade system. In Fig. 7, where the moving blade 8 is longer than the blade of the guide blade apparatus, the embodiment in question has been combined with a screen 23 compelling the steam to pass outside the blade 8.

In all of these embodiments, the guide blades as well as the moving blades are shown as being soldered fast to their heads and, therefore, in the case of screening being required, the corresponding screens may be welded in connection with the welding of the blades, either on the moving blades or on the guide blade apparatus.

What I claim is:—

1. In a steam turbine, the combination of a radial blade system and an axial blade system, with means for delivering moisture particles and moist steam from the radial blade system past and outside of the outer end portion of the axial blade system.

2. In a steam turbine, the combination of a radial blade system and an axial blade system, with guide blade mechanism, and means for delivering moisture particles and moist steam through said mechanism and past and outside of the outer end portion of the axial blade system.

3. In a steam turbine, the combination of a radial blade system and an axial blade system, with guide blades, and a support for said guide blades directing moisture particles and moist steam past and outside of the outer end portions of the axial blade system.

4. In a steam turbine, the combination of a radial blade system and an axial blade system, with guide blades extending radially beyond the outer end portions of the axial blade system, and means associated with said

guide blades for directing moisture particles and moist steam past and outside of the outer end portions of the axial blade system.

5. In a steam turbine, the combination of a radial blade system and an axial blade system, with a guide blade system directing steam from the radial blade system through the axial blade system, and means associated with said guide blade system for directing moisture particles and moist steam from the radial blade system past and outside of the outer end portions of the axial blade system.

6. In a steam turbine, the combination of a radial blade system and an axial blade system, with a guide blade system extending radially beyond the outer end portions of said axial blade system, a support for said guide blade system, and a passage in said support directing moisture particles and moist steam from the radial blade system past and outside of the outer end portions of the axial blade system.

In testimony whereof I affix my signature.

ALF LYSHOLM.