Jan. 6, 1959 P. KOLB ET AL 2,867,408

AXIAL LOCKING OF ROTOR BLADES FOR TURBINES AND THE LIKE

Filed March 17, 1954 2 Sheets-Sheet 1

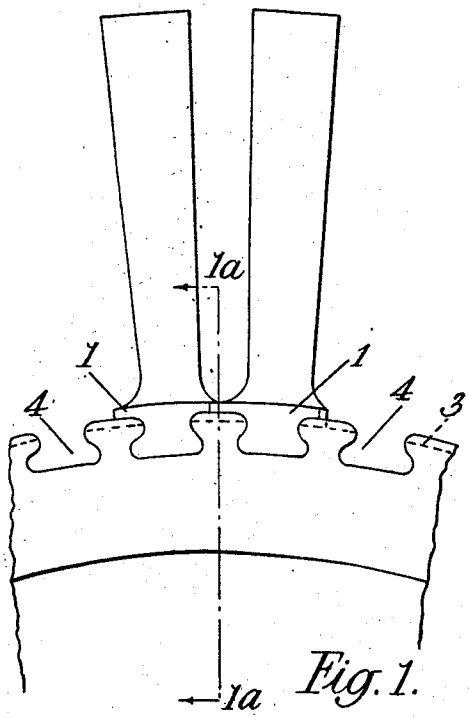


Fig. 1.

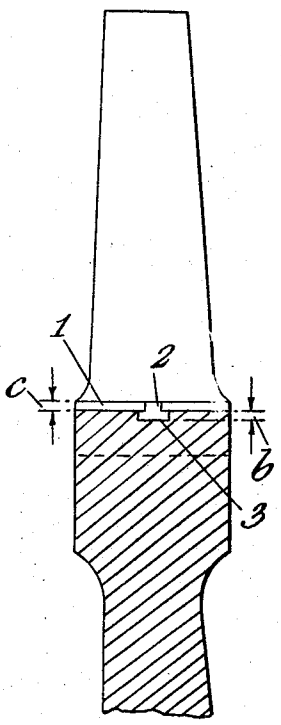


Fig. 1a.

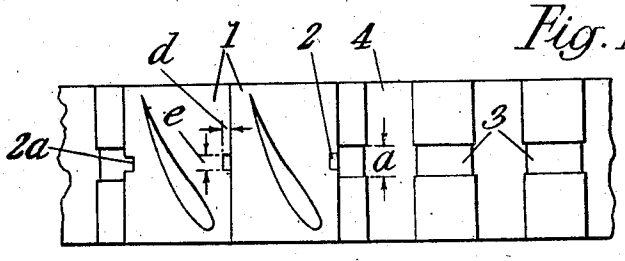


Fig. 2.

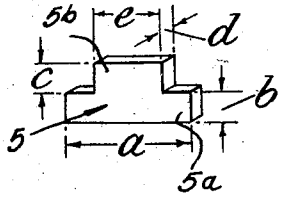


Fig. 3.

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AXIAL LOCKING OF ROTOR BLADES FOR TURBINES AND THE LIKE

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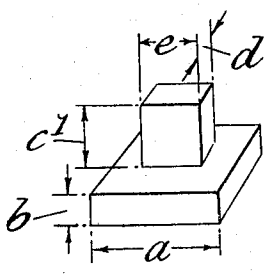


Fig. 4.

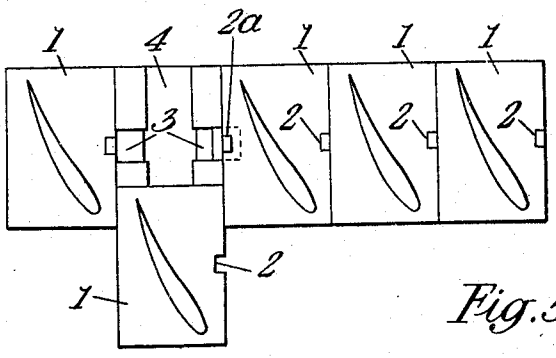


Fig. 5.

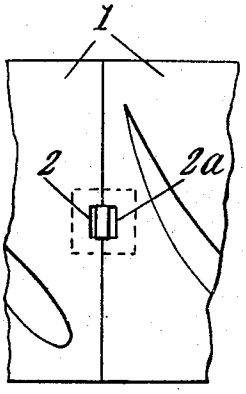


Fig. 6.

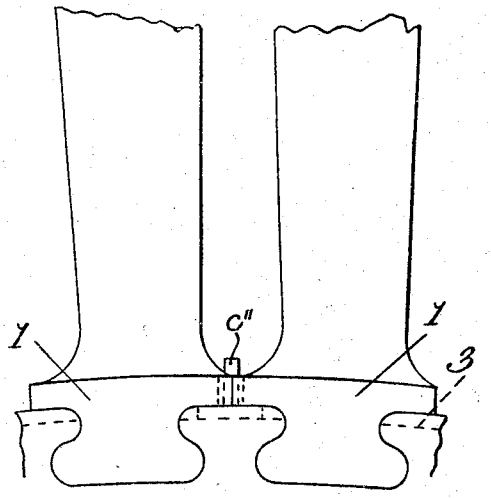


Fig. 7.

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United States Patent Office

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AXIAL LOCKING OF ROTOR BLADES FOR TURBINES AND THE LIKE

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Application March 17, 1954, Serial No. 420,418

Claims priority, application Great Britain April 10, 1953

3 Claims. (Cl. 253—77)

This invention relates to the axial locking of rotor blades for compressors, turbines or fans, hereinafter generally referred to as turbines, the blades being of the type which are inserted into dovetailed or serrated slots machined in a generally axial direction around the periphery of the said rotor.

A common method of accomplishing the axial locking (i. e., against movement in a direction substantially parallel to the rotor axis) of such blades is to hammer over lightly the serrations or sides of the dovetail at either end of the rotor root. While performing its function effectively this method suffers from the disadvantage that a certain amount of local damage is done to the rotor or disc and this limits the number of times for which the operation may be repeated during subsequent reblading of the rotor. Moreover removal of a blade so locked involves further damage to the rotor as the spread material must be chipped away or sheared off with or near the blade root itself.

The object of the invention is to provide an axial locking device for the rotor blades of turbines which is simple to make, effective, and free from the above disadvantages.

The invention consists in a method for the locking of rotor blades for compressors, turbines or fans herein referred to generally as turbines, the blades being of the type which are inserted into dovetailed or serrated slots, machined in a direction which is generally axial with respect to the rotor around the periphery of the said rotor, which method comprises providing a continuous groove in the circumferential face of the rotor, providing a slot in one of the sides of each blade platform which is disposed in a direction parallel to the rotor axis, said slot being narrower than the rotor groove and positioned so that when the blade is in position in the rotor the said slot coincides with the rotor groove, and inserting in the groove of the rotor a locking piece consisting of a base portion fitting the rotor groove and a protruding tongue which fits into the blade platform slot so as to prevent movement of the blade in a direction parallel to the rotor axis; and in the above method in which for the purpose of locking the final blade to be inserted in the row, the platform of the first blade to be inserted is provided with a further slot similar in size, shape and position to the other slot but disposed on the axially disposed side of the platform opposite the normal slot and a locking piece, having a base portion of similar shape to the normal locking piece referred to above and a tongue of similar cross section to the tongue of the normal locking piece but of greater length, is fitted into the groove of the rotor and arranged so that its tongue fits partly into the slot of the platform of the first blade to be inserted and partly into the adjacent slot in the platform of the last blade to be inserted, said tongue being subsequently spread to fill the combined slots in the said platform so as to prevent movement of the last blade in a direction parallel to the rotor axis.

Referring to the accompanying diagrammatic drawings:

Figure 1 shows a type of blade root and attachment to the rotor in one form to which the invention is applicable;

Figure 1*a* is a section on the line 1*a* of Figure 1 looking in the direction of the arrows;

Figure 2 is a partly developed plan view of the rotor of a turbine in accordance with the invention;

Figure 3 is a perspective view of a blade locking key for all blades except the last;

Figure 4 is a perspective view of the blade locking key for the last blade of the row;

Figure 5 shows again a partly developed plan of the rotor showing the last blade being inserted;

Figure 6 shows an enlarged part plan and

Figure 7 an end view of the last blade in position.

Referring now to Figure 1 a type of blade root and attachment to the rotor to which this invention is applicable is shown. Alternatively the blade root may be of the common "fir-tree" form or bulb root form so long as insertion of the blade into the rotor is made in a generally axial direction with respect to the rotor.

A platform 1 of each blade is provided with a small rectangular slot 2 (see Figures 1*a* and 2) preferably midway along one axially disposed side of the platform, this slot being on the same side of the platform for all blades. A small groove 3 which, as the drawings show, is broader than the slot 2 but also of rectangular section is turned round the periphery of the rotor intersecting with and interrupted by blade slots 4. The position of this peripheral groove is so chosen that its centre line, which lies on a radial plane, is directly underneath the slot in the blade platform when the blade is in position in the rotor.

Such a blade, then, is inserted into its slot in the rotor. The locking piece 5, Figure 3, which is made of any suitable metal and whose various dimensions correspond with the dimensions of the peripheral groove and platform slot as indicated in Figures 1, 2 and 3 is then placed in position so that its base 5*a* lies in the peripheral groove and its tongue 5*b* protrudes up through and engages with the slot in the blade platform, so locking the blade securely against motion in a direction parallel to the rotor axis. The next blade is then slid into position in the rotor into the blade slot adjacent to the locking piece just inserted, the unslotted axially disposed side of its platform coming up against the locking piece so completely restraining the key from movement. This process is repeated round the row until the last blade is reached, when a different method of locking must be used.

The preferred method of locking the last blade of a row is as follows:

The first blade inserted in a row has both of the axially disposed sides of its platform equipped with rectangular slots, the extra slot being indicated by 2*a* in Figure 2. A piece of copper, or similar ductile material shaped as shown in Figure 4 is used as the locking piece for the last blade.

In Figures 1*a*, 2, 3 and 4 the reference letters *a, b, c, d* and *e* apply to corresponding faces of locking pieces and the slots into which they are fitted and give an indication of equivalent dimensions. The tongue *c'* of the last blade locking piece of Figure 4 is made longer than that of the normal locking piece, that is, about twice the size because of the subsequent peening required.

With the second last blade of the row fitted in the manner previously described with its locking piece, the last blade locking piece (Figure 4) is placed in position so that its base lies in the peripheral groove and partly under the first blade's platform and its tongue protrudes up through and beyond the extra slot 2*a* provided in the first blade platform as in Figure 5. The last blade is then inserted into its slot as in Figure 5 and

pushed into its final position, the slot in its platform falling directly opposite the extra slot *2a* in the platform of the first blade. The last locking piece is then slid half out of its position in the first blade so that its tongue is then half in the extra slot of the first and half in the slot of the last blade, as shown clearly in Figures 6 and 7. Finally the protruding portion *c''* of the tongue is gently peened so that the whole volume of the combined slots of the first and last blades is filled.

We claim:

1. In a bladed rotor for a compressor, turbine or fan, comprising a rotor body having a plurality of axially extending circumferentially spaced dovetail slots and a corresponding plurality of blades having faces fitting in the said dovetail slots and held radially and circumferentially thereby, the said blades having also circumferentially extending platforms overlying the rotor periphery at each side of the groove, so that the platform of adjacent blades substantially touch each other, means for locking the blades to the rotor body against axial movement, comprising for each blade, a locking piece having a base portion shorter in the axial direction than the face of the blade and a protruding tongue of less width in the axial direction than the base portion and extending radially from the axially middle part thereof, the rotor body between each adjacent dovetail slot having a slot holding and fitting the base portion of said locking piece, the last said slot having a radially open portion accommodating a said tongue and the blade platforms having recesses receiving and fitting the said protruding tongues.

2. Rotor blade locking means according to claim 1, in which the said blade platform recesses extend in the same circumferential direction.

3. Rotor blade locking means according to claim 1, in which one of the blades has a slot in its platform in addition to the said recesses, the said slot facing in the opposite circumferential direction from the first said blade platform recess of the said blade and comprising a double locking piece having a protruding tongue fitting in the said slot and the recess of an adjacent blade, the said last named protruding tongue having a circumferential width less than the combined width of the said additional slot and recess in the platform of the said blade and sufficient circumferential width to permit expanding by peening so as to fill the said slot and adjacent recess.

References Cited in the file of this patent

UNITED STATES PATENTS

2,651,494 Persson ..... Sept. 8, 1953

FOREIGN PATENTS

307,832 Great Britain ..... Oct. 15, 1927
671,960 Great Britain ..... Aug. 14, 1952