June 9, 1953 P. D. COMERY ET AL 2,641,443

ROTOR BLADE LOCKING

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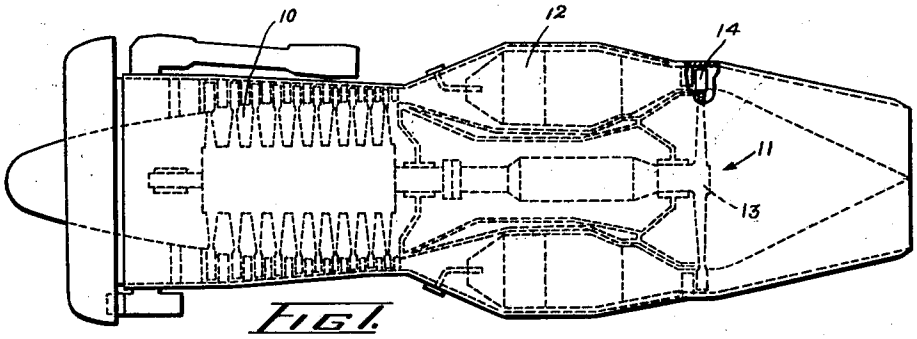


FIG 1.

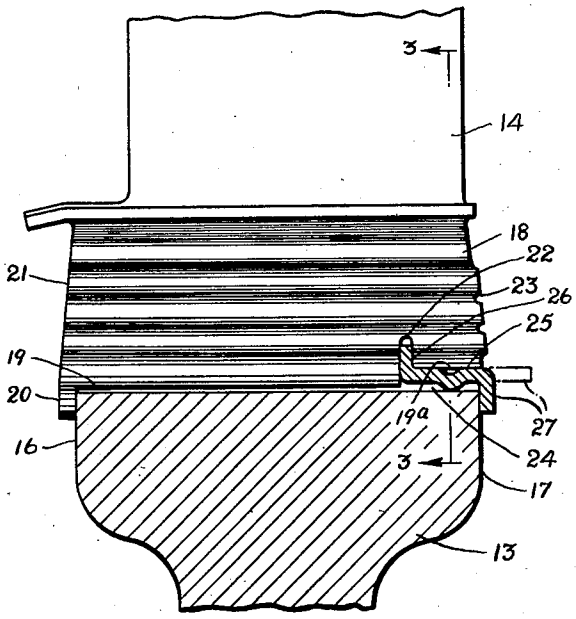


FIG 2.

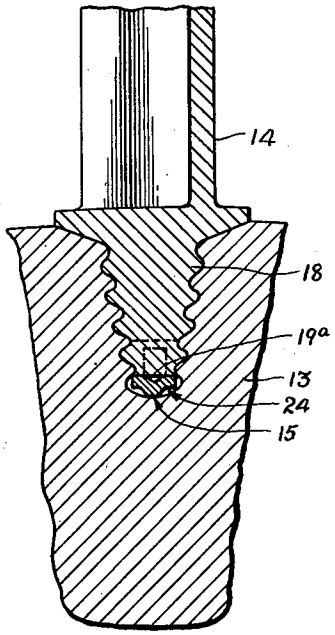


FIG 3.

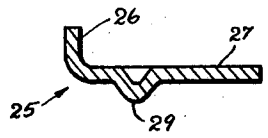


FIG 4.

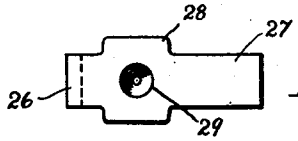


FIG 5.

INVENTORS
P.D. COMERY
J.T. PURVIS
PER
Gareth E. Mayhew
ATTORNEY

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ROTOR BLADE LOCKING

Peter Dennis Comery, Cooksville, Ontario, and Joseph Thompson Purvis, North York Township, York County, Ontario, Canada, assignors to A. V. Roe Canada Limited, Malton, Ontario, Canada, a corporation

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3 Claims. (Cl. 253—77)

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This invention relates to blading for rotary power conversion machines and the like and more particularly to an improved fastening device for such blading.

Blading of this type normally requires such accuracy of form and finish that the blades have to be manufactured individually. This practice, however, introduces fresh problems in connection with the mounting of the blades in the machine, problems which are particularly critical if the blade is to be mounted on a compressor or turbine rotor which will be rotating at high speed. Not only is centrifugal loading imposed upon the blade under these conditions but there is also axial loading due to the momentum of the working fluid and although this axial loading is usually small in comparison with the centrifugal loading some provision must nevertheless be made to absorb it.

Although there have been various locking devices developed for this purpose, for the most part these fail to provide positive location of the blade relative to its mounting. In addition, their use usually entails more or less complicated machining of the rotor or of the blade root itself, and particularly is this true when some form of locking wire is used.

It is the object of this invention to provide improved retaining means for withstanding this axial loading.

The invention will be more readily understood by reference to the accompanying drawings which form a part of this specification and in which like reference characters denote like parts throughout the same. In these drawings,

Figure 1 illustrates a gas turbine engine having a turbine rotor with blades such as those with which the invention is concerned attached thereto,

Figure 2 is a fragmentary view of a rotor blade held in the rotor against axial movement by a locking device in accordance with the invention,

Figure 3 is a section taken on the line 3—3 in Figure 2,

Figure 4 is an elevation of a locking strip for holding the blade in the rotor, and

Figure 5 is a plan view of the locking strip.

A typical gas turbine engine as illustrated in Figure 1 includes a compressor 10, a turbine assembly 11 and a combustion system 12 located between them. The turbine assembly comprises a rotor 13 supporting a series of radially-extending blades 14, the blades being mounted in a series of peripheral slots 15, which in the embodiment illustrated are of "fir tree" cross-section

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as best seen in Fig. 3; the slots extend from the front face 16 of the rotor to its rear face 17 in a substantially axial direction.

The blades themselves are formed with blade roots 18 of fir tree shape which conform to the shape of the slots 15, each root terminating at the base in the basal extremity or tip 19. An integrally formed lug or stop 20 projects perpendicularly from the tip 19 of the root at the forward face 21 of the root and the root is slotted transversely to provide a recess 22. The root tip 19 is machined flat to provide an indented portion 19a between the recess 22 and the rear face 23 of the root to leave a space 24 between the root 18 and the base of the slot 15 in the assembled position.

Figures 4 and 5 illustrate a preferred form of a locking strip 25 which may be formed from a flat metal blank; the strip has rectangular end tabs 26 and 27 of substantially equal width and an intermediate portion or plate 28 whose width is materially greater than that of the end portions. The plate 28 is centrally dished to provide a dimple 29 whose depth is very slightly greater than the depth of the space 24 provided between the root 18 and the base of the slot 15. One tab 26 of the strip 25 is bent through a right angle to provide a projection extending outwardly on the side which is opposite to the projection of the dimple 29; the tab 26 is slightly shorter in length than the depth of the recess 22. The proportions of the strip 25 are such that when it is disposed in the space 24 with the tab 26 projecting into the recess 22, the remote extremity of the plate 28 will be located just short of the rear face 17 of the rotor.

In attaching a blade to the turbine rotor 13, the locking strip 25 is first fitted into the space 24 on the bottom of the blade root 18 with the projecting tab 26 of the strip extending into the recess 22. The blade root is then slid rearwardly into one of the mating slots 15 in the rotor until the projecting lug 20 on the blade encounters the front face of the rotor, and the blade being thus positioned, the tab 27 on the strip 25 is bent through a right angle to engage the rear face 17 of the rotor. By making the intermediate portion or plate 28 wider than the extended tab 27 the bend in the strip tends to occur along the line between the plate and the tab, and by judicious choice of the length of the central portion the line of the bend is so positioned that the rear face 17 of the rotor will be tangential to the inner radius of the bend. Further, it is possible to achieve a larger bend radius at this point by

having the depth of the space 24 greater than the normal thickness of the undimpled portion of the strip and disposing the dimple on the rotor side of the strip, that is, on the same side as the center of curvature of the final bend so that the centre of curvature will be located ahead of the rear face of the rotor.

The projecting lug 20 therefore provides positive restraint against rearward movement of the blade in the slot while the bent tab 27 holds the blade against movement along the slot in the opposite sense. In addition, the dimple 29 exerts a compressive force against the respective faces of the blade root and the rotor on opposite sides of the space 24 and this force assists in maintaining the relative positions of the blade and the rotor.

The projecting element 20 may be replaced by similar elements on the front or rear faces of either the blade root or the rotor, the recess 22 and the space 24 being positioned correspondingly, and it is to be understood that the form of the invention herewith shown and described is to be taken as a preferred example of the same and that various changes may be made in the shape, size and arrangement of the parts without departing from the spirit of the invention or the scope of the subjoined claims.

What we claim as our invention is:

1. A locking device for a blade of a rotary power conversion machine having a blade supporting member and blades provided with blade root members whereby they are demountably secured to the supporting member, the said members each having exposed opposite end faces and being in slidable relationship in a direction extending between the end faces and in interlocking relationship in another direction, comprising a stop element projecting from one and engaging the other of the said members to provide positive relative location of the root member with respect to the supporting member and with respect to one sense of the direction of slidable relationship, one of the said members having a recess located intermediately of its opposite end faces, and means cooperating with the recess for preventing relative movement of the root member with respect to the supporting member in the other sense of the direction of slidable relationship, which means includes a plate disposed between the said members and having projecting tabs at opposite edges, the plate having a thickened portion at which the opposite faces of the plate bear upon the said members, one of the tabs extending into the recess in the recessed member and the other of the tabs engaging an exposed face of the member not so recessed, the said other tab being bendable at the margin of the plate after assembly to so engage the said face.

2. A locking device for a blade of a rotary power conversion machine having a blade supporting member and blades provided with blade root members whereby they are demountably secured to the supporting member, the said members each having exposed opposite end faces and being in slidable relationship in a direction extending between the end faces and in interlocking relationship in another direction, the said members having adjacent basal surfaces extending between the opposite end faces and facing each other, comprising a stop element projecting from one and engaging the other of the said members to provide positive relative location of the root member with respect to the supporting

member and with respect to one sense of the direction of slidable relationship, one of the said members having a recess extending from the basal surface of the recessed member into the body of the recessed member at a location spaced from its opposite end faces, the basal surface of the recessed member being cut away between the recess and one of the exposed end faces to provide a space between the basal surfaces, the depth of the said space being less than the depth of the recess, and means co-operating with the recess for preventing relative movement of the root member with respect to the supporting member in the other sense of the direction of slidable relationship, which means includes a locking strip disposed in the said space between the basal surfaces of the said members, the strip being formed from a relatively thin metal blank and being of materially greater width over a portion intermediate of the ends than the width of the end portions to provide an intermediate plate and projecting tabs at opposite ends of the plate, the plate being dished to increase the thickness of the strip beyond its normal thickness, the normal thickness of the strip being less than the depth of the said space between the basal surfaces and the dished portion of the strip being compressed between and tightly engaging the said basal surfaces, one of the tabs extending into the recess in the recessed member and the other of the tabs engaging an exposed face of the member not so recessed, the said other tab being bendable at the margin of the plate after assembly to so engage the said face.

3. A locking device for a blade of a rotary power conversion machine having a blade supporting member and blades each provided with a blade root member whereby they are demountably secured to the supporting member, the said members each having exposed opposite end faces and being in slidable relationship in a direction extending between the end faces and in interlocking relationship in another direction, the said members having adjacent basal surfaces extending between the opposite end faces and facing each other, comprising a stop element projecting from one and engaging the other of the said members to provide positive relative location of the root member with respect to the supporting member and with respect to one sense of the direction of slidable relationship, one of the said members having a recess extending from the basal surface of the recessed member into the body of the recessed member at a location spaced from its opposite end faces, the basal surface of the recessed member being cut away between the recess and one of the exposed end faces to provide a space between the basal surfaces, the depth of the said space being less than the depth of the recess, and means co-operating with the recess for preventing relative movement of the root member with respect to the supporting member in the other sense of the direction of slidable relationship, which means includes a strip disposed in the said space between the basal surfaces of the supporting member and the blade root, the strip being formed from a relatively thin metal blank and being of materially greater width over a portion intermediate of the ends than the width of the end portions to provide an intermediate plate and projecting tabs at opposite ends of the plate, the plate being dished to increase the thickness of the strip beyond its normal thickness, the normal thickness of the strip being

less than the depth of the said space between the basal surfaces and the dished portion of the strip being compressed between and tightly engaging the said basal surfaces, one of the tabs extending into the recess in the recessed member and the other of the tabs engaging an exposed face of the member not so recessed, the said other tab being bendable at the margin of the plate after assembly to so engage the said face, the convex face of the plate being on the same side of the strip as the center of curvature of the bend whereby the bend will be spaced from the basal surfaces of the last mentioned member and the blade root and the radius of the bend will be greater than if the bend were not so spaced.

PETER DENNIS COMERY.
JOSEPH THOMPSON PURVIS.

No references cited.