March 15, 1960 N. L. TURNBULL 2,928,651

BLADE LOCKING MEANS

Filed Jan. 21, 1955

FIG. 3

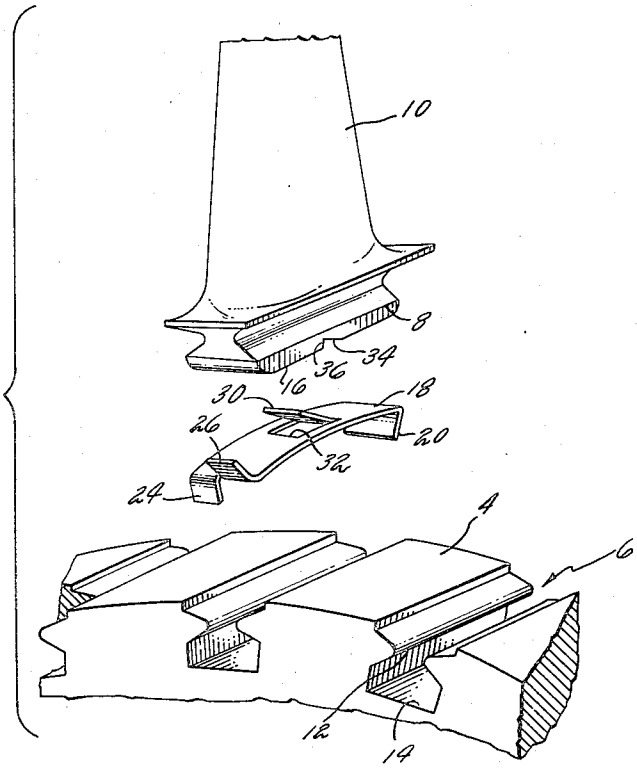


FIG. 2

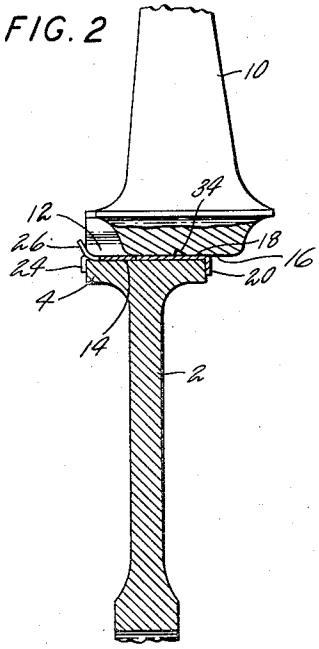


FIG. 1

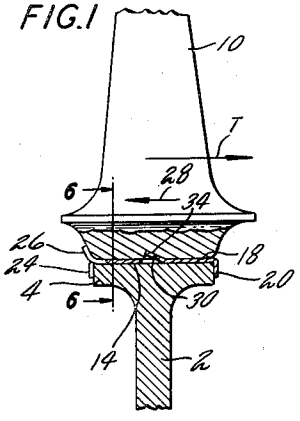


FIG. 4

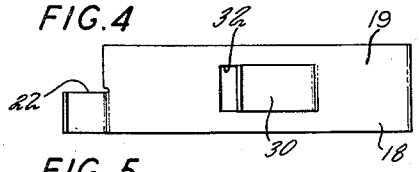


FIG. 5

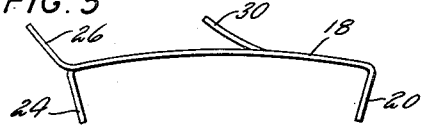
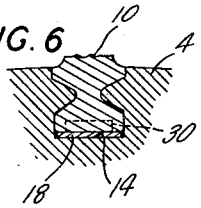


FIG. 6



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BLADE LOCKING MEANS

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Application January 21, 1955, Serial No. 483,257

9 Claims. (Cl. 253—77)

This invention relates to blade locking means for retaining compressor or turbine blades within the axially extending slots in the supporting rotor.

Locking devices having bendable parts are well known as shown in Kroon 2,434,935 or Comery 2,641,443. In each of these patents the lock is of necessity made of a material that is readily bendable into the locking configuration after the blade and lock are assembled on the rotor but which will stay in the locking configuration after being bent. The principal feature of this invention is a blade lock that requires no bending or other forming after assembly between the blade and the supporting rotor.

One feature of the invention is a blade lock having a resilient retaining means which becomes operative merely by the assembly of the blade lock with the blade and the rotor. Another feature is a lock which provides for disassembly of the blade from the rotor without deformation of the lock. Another feature is a blade lock which is positioned on the rotor before insertion of the blade and which has a resilient engagement with the blade root for holding the blade in its axial position on the rotor.

Other objects and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate an embodiment of the invention.

Fig. 1 is a fragmentary sectional view showing the blade lock in operative position.

Fig. 2 is a view similar to Fig. 1 showing the blade partly assembled on the rotor.

Fig. 3 is a view of the elements of Fig. 1 in perspective and spaced radially apart to show the construction.

Fig. 4 is a plan view of the lock.

Fig. 5 is a side elevation of the lock.

Fig. 6 is a sectional view along the line 6—6 of Fig. 1.

The lock is shown in connection with the attachment of a compressor blade to a supporting disc. As best shown in Figs. 1 and 3, the blade supporting rotor 2 is in the form of a disc having a wide peripheral flange 4 in which are formed a plurality of axially extending slots 6 each of which receives the root 8 of one of the blades 10. In the arrangement shown, the slot 6 is substantially dovetail in shape and the blade root is similar in shape. The slot 6 has a narrow portion 12 radially outward of the base thereof so that the blades are retained radially in position within the slot. The particular configuration of the blade root and slot is not critical except that the slot and root have cooperating abutment means for locking the blades in position against centrifugal forces. The base surface 14 of the slot is preferably flat from end to end and the base surface 16 of the blade root when positioned within the slot is spaced from the surface 14 a sufficient distance to form a substantially flat clearance space and to receive the blade lock 18 therebetween.

As shown in Figs. 4 and 5, the lock or locking piece 18 is in the form of a flat strip of material having a main

portion 19 of substantial width, being preferably substantially the width of the base surface 14 of the slot. At one end the lock has a downwardly bent tab 20 at a substantial angle to the main portion. The tab 20 is preferably the full width of the strip of material and this tab 20 overlies one end surface of the peripheral flange on the rotor as shown in Fig. 1. At the other end the strip is split longitudinally as at 22 to define a downwardly extending tab 24 which overlies the adjacent end of the peripheral flange on the rotor disc when the lock is in position. The tabs 20 and 24 are spaced apart a distance slightly greater than the axial dimension of the rotor adjacent the slot for engagement with the end walls of the rotor when the strip is in locking position. Also at this end of the strip is an upwardly extending tab 26 which is adapted, when the lock is in position, to engage with the end of the blade root as best shown in Fig. 1. It will be understood that this tab 26 preferably extends at an oblique angle to the main portion 19 of the strip and the end of the blade root is preferably at the same angle so that the tab will be forced down into the plane of the strip by axial pressure on the blade in the direction of the arrow 28 in Fig. 1 when removal of the blade is attempted. As shown, the strip before assembly may be bowed but is substantially flat or planar when in use, as in Fig. 2.

Centrally of the main portion 19 of the strip is an upwardly extending projection or tab 30 formed by a substantially U-shaped slot 32 in the strip. The tab 30 is resilient and is integral with the strip, being resiliently connected thereto at its right-hand end, that is to say, its right-hand transverse edge as shown in Fig. 4. This tab projects upwardly from the plane of the strip for engagement in a notch 34 formed in the base surface 16 of the blade root and is resiliently held in this position. The tab 30 and the tab 26 extend at approximately the same oblique angle to the plane of the strip such that when the blade is assembled as in Fig. 1, the tab 26 will prevent free movement of the blade to the left and the tab 30 engaging with the wall 36 of the notch 34 will prevent movement of the blade to the right, Fig. 1. In assembly, the lock is preferably so arranged that the tab 26 or 24 depending on whether the blade is for a compressor or turbine prevents movement of the blade in the direction that the blade is normally urged by the thrust acting on the blade, this thrust being in the direction of the arrow T of Fig. 1 for a turbine blade or the opposite for a compressor blade.

The strip, or at least the portion of the strip adjacent to the tab 30, is made resilient so that during assembly of the blade with the rotor the tab 30 may be sprung down into the plane of the strip as shown in Fig 2 and will spring back into the notch 34 when the blade is in its completely assembled position of Fig. 1. It is obvious that the spacing of the notch 34 from the end of the blade root corresponds to the spacing of the tabs 26 and 30.

In assembly, the locking piece is placed in the base of the slot as shown in Fig. 2 and the blade root is then inserted at the right-hand end of the slot and is moved axially toward the left into the completely assembled position of Fig. 1. If it becomes necessary to remove a blade the holding action of the tab 26, which is also resilient, is not enough to prevent removal of the blade by a push on the blade toward the left. The force on the blade necessary to deflect the tab 26 is obviously greater than any of the normal forces that would act on the blade while it is in operative position within an axial flow compressor or turbine. Alternatively, the tab 26 might be deflected down by insertion of a thin flat tool between the base of the blade and the locking device.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. In elastic fluid apparatus, a rotor disc having root receiving slots extending transversely of the disc at its periphery, and blades having roots engaging in said slots, said slots and said roots having complemental abutment means for locking said blades to said disc against centrifugal forces, the base surface of the root having a notch therein between its ends, the base surface of the root being spaced from the base surface of the slot to provide a substantially flat clearance space, in combination with locking means for each blade including a flat strip of material positioned in said clearance space, said strip being several times wider than the thickness thereof and also wider than the radial depth of the clearance space, said strip having at least one tab projecting from each end and out of the plane of the strip and engaging the opposite sides of the disc, and a resilient projection on the strip engaging said notch, said resilient projection being integral with the strip at one end and having its other end free and normally projecting out of the plane of the strip, said projection by its resiliency being movable substantially into the plane of the strip for removal of the blade from the disc.

2. In elastic fluid apparatus, a rotor disc having root receiving slots extending transversely of the disc at its periphery, and blades having roots engaging in said slots, said slots and said roots having complemental abutment means for locking said blades to said disc against centrifugal forces, the base surface of the root having a notch therein between its ends, the base surface of the root being spaced from the base surface of the slot to provide a substantially flat clearance space, in combination with locking means for each blade including a flat strip of material positioned in said clearance space, said strip being several times wider than the thickness thereof, said strip having at least one tab projecting from each end and out of the plane of the strip and engaging the opposite sides of the disc and a resilient tab intermediate its ends connected along one transverse edge to the strip and extending longitudinally of and out of the plane of the strip from its connected edge into engagement with said notch, said tab by its resiliency being movable substantially into the plane of the strip during axial assembly of the blade on the disc.

3. In elastic fluid apparatus, a rotor disc having root receiving slots extending transversely of the disc at its periphery, and blades having roots engaging in said slots, said slots and said roots having complemental abutment means for locking said blades to said disc against centrifugal forces, the base surface of the root having a notch therein between its ends, the base surface of the root being spaced from the base surface of the slot to provide a substantially flat clearance space, in combination with locking means for each blade including a flat strip of material positioned in said clearance space, said strip being several times wider than the thickness thereof, said strip having at least one tab projecting from each end and out of the plane of the strip and engaging the opposite sides of the disc and an intermediate resilient tab connected along one transverse edge to the strip and extending out of the plane of the strip and longitudinally of the strip from its connected edge, said tab engaging in said notch, said strip at the end toward which the resilient tab extends having a second resilient tab extending out of the plane of the strip to overlie the end of the blade root.

4. In elastic fluid apparatus, a rotor disc having root receiving slots extending transversely of the disc at its periphery, and blades having roots engaging in said slots, said slots and said roots having complemental abutment means for locking said blades to said disc against centrifugal forces, the base surface of the root having a notch therein between its ends, the base surface of the root being spaced from the base surface of the slot to provide a substantially flat clearance space, in combination with locking means for each blade including a flat strip of material positioned in said clearance space, said strip being several times wider than the thickness thereof, said strip having at least one tab projecting from each end and out of the plane of the strip and engaging the opposite sides of the disc and a tab integrally attached to the strip at one end of the tab and supported by the strip between its ends, said strip being resilient at its attachment with the tab such that the tab is resiliently supported by the strip said tab being spaced from the ends of the strip and having its other end free and normally extending out of the plane of the strip and engaging said notch when the blade is in position in the disc.

5. In elastic fluid apparatus, a rotor disc having root receiving slots extending transversely of the disc at its periphery, and blades having roots engaging in said slots, said slots and said roots having complemental abutment means for locking said blades to said disc against centrifugal forces, the base surface of the root having a notch therein between its ends and being radially spaced from the base surface of the slot to provide a clearance space, in combination with locking means for each blade including a strip of material positioned in said clearance space, said strip having at least one tab projecting from each end and out of the plane of the strip and engaging the opposite sides of the disc and a tab formed from and integral with said strip between its ends, said tab having its free end projecting at an oblique angle from the plane of the strip toward the base surface of the root a greater distance than the height of said clearance space and said strip being resilient to provide for deflection of the tab into the plane of the strip in the portion of the strip from which the tab was formed during insertion of the blade in the disc, said tab engaging in said notch when the blade is in locked position in the disc to prevent axial movement of said blade with respect to the disc.

6. In elastic fluid apparatus, a disc member having root receiving slots extending transversely of said member at its periphery, and blade members having roots engaging in said slots, said slots and said roots having complemental abutment means for locking said blades to said disc against centrifugal forces, the base surface of each root being spaced from the base surface of the associated slot to provide a clearance space, the base surface of one of said members having a notch therein, in combination with locking means in the form of a strip of material in said clearance space, said strip having a tab at each end out of the plane of the strip and engaging the end of the other of said members, and a projection between the ends of the strip engaging said notch, said projection being integrally secured to the strip at one end of the projection and having its other end free and normally projecting obliquely from and out of the plane of the strip, said strip and the projection at least at the integral attachment therebetween being resilient to provide for deflection of the projection substantially into the plane of the strip during assembly of the root in the disc.

7. In elastic fluid apparatus, a disc member having root receiving slots extending transversely of said member at its periphery, and blade members having roots engaged in said slots, said slots and said roots having complemental abutment means for locking said blades to said disc against centrifugal forces, the base of each root having a flat surface of substantial width and the confronting base of the slot having a corresponding flat surface, the base surface of each root being spaced from the base surface of the slot to provide a clearance space, the flat surface of one of said members having a notch therein, in combination with locking means in the form of a flat strip of resilient material in said clearance space,

said strip having a tab at each end permanently bent out of the plane of the strip and engaging opposite sides of the other of said members, and said strip also having a spring tab between its ends displaced from the plane of said strip, said tab having a base and a free end, said tab comprising a portion of said strip connected to said strip at its base and bent at its free end out of the plane of the strip a greater distance than the height of said clearance space to engage said notch when said blade is in locked position in said disc.

8. For use in turbine or compressor rotors having a row of rooted blades whose root parts are disposed in transversely extending slots in the periphery of the rotor part, which slots and roots have cooperating abutment means for locking said blades in said rotors against centrifugal forces, a locking piece for securing a blade part in its slot in the rotor part, comprising a flat strip of material having a main portion extending through said slot between the base of the blade root and the adjacent base of the slot and having its ends extending beyond said slot and at a substantial angle to said strip, said ends being spaced apart a distance slightly greater than the axial spacing of the end walls of one of said parts adjacent to the locking piece for engagement with the end walls of said one of said parts, said main portion having a projection extending obliquely from the strip between its ends and adapted to engage in a recess in the other of said parts, said projection having a resilient connection along one edge to the strip such that the projection is resiliently urged into its obliquely extending position.

9. For use in turbine or compressor rotors having a row of rooted blades whose root parts are disposed in transversely extending slots in the periphery of the rotor parts, which slots and roots have cooperating abutment means for locking said blades in said rotors against centrifugal forces, a locking piece for securing a blade part in its slot in the rotor part, comprising a flat strip of material having a main portion extending through said slot between the base of the blade root and the adjacent base of the slot and having its ends extending beyond said slot and at a substantial angle to said strip, said ends being spaced apart a distance slightly greater than the axial spacing of the end walls of one of said parts adjacent to the locking piece for engagement with the end walls of said one of said parts, said main portion having a projection extending obliquely from the strip between its ends and adapted to engage in a recess in the other of said parts, said strip being resilient, said projection being integral therewith and having a resilient connection along one edge to the strip such that the projection is resiliently urged into its obliquely extending position.

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