

July 30, 1957

W. H. BROWN

2,801,074

BLADE RETAINING MEANS

Filed Oct. 1, 1952

FIG. 3

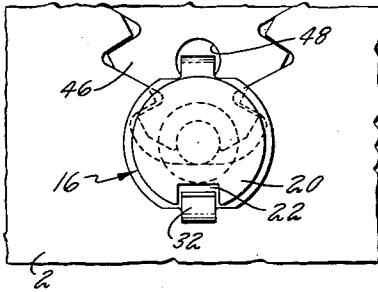


FIG. 4

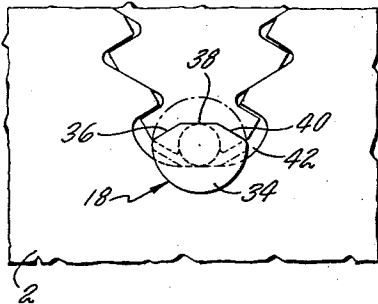


FIG. 1

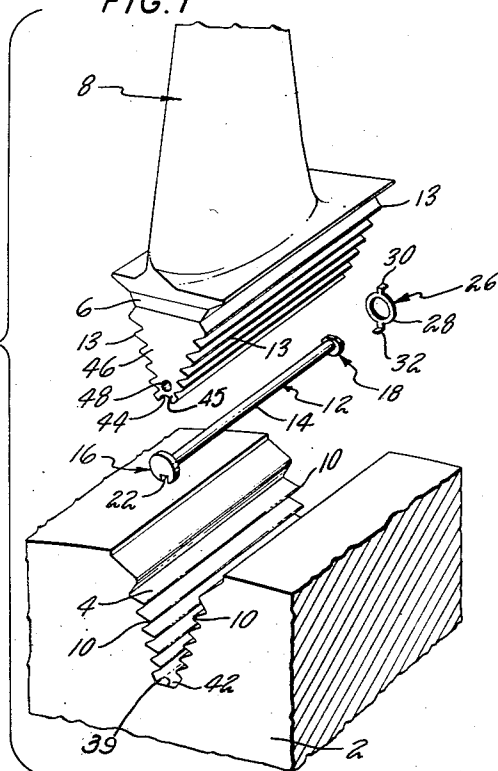
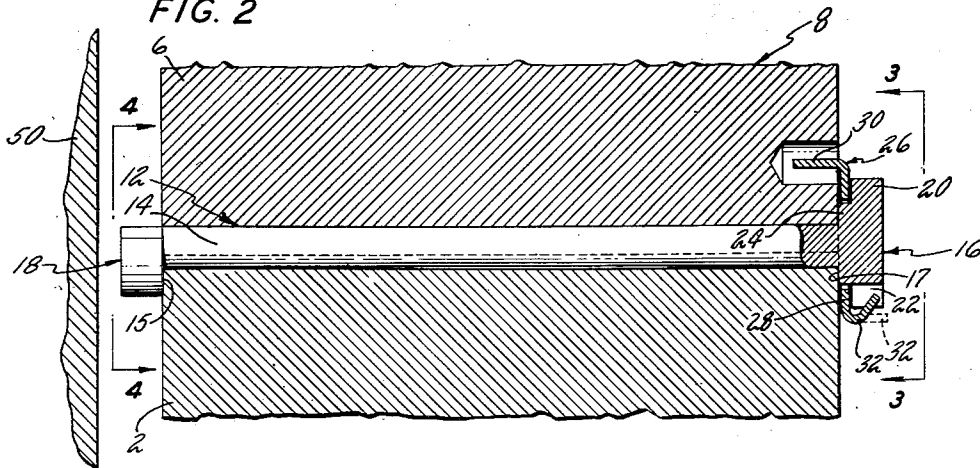


FIG. 2



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1

2,801,074

BLADE RETAINING MEANS

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Application October 1, 1952, Serial No. 312,540

4 Claims. (Cl. 253—77)

This invention relates to a device for locking blades in position in a supporting disc and is especially adapted for use with axial flow compressors or turbines.

The rotor for a compressor or turbine is generally made up of one or more supporting discs each having a row of radially extending blades with the roots of the blades fitting in axially extending slots provided in the disc. During operation of the compressor or turbine it becomes necessary to prevent axial movement of the blade relative to the disc because of the axial thrust exerted on the blade. The blade root is usually held in the slot by a blade lock which is preferably so constructed that removal of the blade from the disc will not necessitate damaging of either the blade or the disc.

The copending Ledwith application Serial No. 153,795, filed April 4, 1950, having the same assignee as this application, has a blade lock in the form of a strip extending from end to end of the slot that receives the blade root with tabs bent over at each end to engage the ends of the blade root and the sides of the disc. The copending Abild application Serial No. 153,985, filed April 4, 1950, now Patent No. 2,686,656, having the same assignee as this application, has a blade lock in the form of a strip extending from end to end of the slot that receives the blade root with notches therein which engage projecting ribs on the underside of the blade root and with tabs bent over at each end to engage the sides of the disc. These arrangements are generally satisfactory. The present invention presents an alternative arrangement which is equally effective and in many cases easier to assemble.

Blades have been locked in a disc by forming integral tabs on opposite ends of the blade root with one of the tabs in such a position that the blade root may be inserted in the properly formed slot in the disc and the tab subsequently bent down against the side of the disc. In this instance the blade root is made more difficult to machine and in many cases the material of the blade does not bend readily and very frequently the tab breaks off so that the blade must be scrapped. This is especially true in the event of removal and insertion of the blade since the tab frequently cannot be rebent successfully.

An object of this invention is to permit the removal or installation of a blade from one side of the supporting disc while said supporting disc is mounted.

Another object of this invention is to eliminate the necessity for a bent tab to project over either the blade root or the side of the supporting disc to hold said blade in place. In this invention the bent tab is merely used to prevent the locking member from rotating.

A further object of this invention is to provide a locking member which is held in position by a small washer having tabs and in which the centrifugal effect of the disc tends to move the tab cooperating with said locking member in a locking direction. This makes the part which needs to be replaced, if a tab breaks in assembling or disassembling a blade, a very small one.

Another object of this invention is to provide a locking

2

member which is locked from the side of the supporting disc from which the blade is inserted. As can be seen from the locking means of the blades enumerated above, it is necessary to lock said means from the side of the supporting disc opposite that from which the blade is inserted.

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 an exploded perspective view of a section of the supporting disc, a section of the blade including the blade root, the locking member, and the holding member. The locking member is shown in its locked position if mounted.

Fig. 2 is an axial sectional view on a radial plane through the bottom of a blade root and the bottom of a slot in a disc showing the locking member and its holding member in locked position.

Fig. 3 is a rear end view taken on the line 3—3 of Fig. 2.

Fig. 4 is a front end view taken along the line 4—4 of Fig. 2.

In the arrangement shown the supporting disc 2 has a plurality of slots 4 in its periphery to receive the similarly formed roots 6 of the blades 8. The particular shape of the blade root 6 or of the similarly shaped slot 4 for holding the blade from moving radially with respect to the slot is not critical, and for the purpose of the present invention a slot is shown having a series of ridges 10 extending along the sides of the slot. These ridges extend from the bottom of the slot to the outer periphery of the disc. The blade root is similar in shape having ridges 13, which when the blade root is assembled, slide between the ridges 10 of the disc.

As best shown in Fig. 2, the blade locking member 12 is in the form of a rotatable or angularly turnable pin, or rod, 14 having a head at each end. A rear head 16 is constructed and arranged to engage an area of both the side of the blade root and the side of the supporting disc with which it cooperates in all rotative positions. A front head 18 is constructed and arranged to engage a maximum area of both the other side of the blade root and the other side of the supporting disc in one rotative or angular position, referred to as the "locked" position and not to engage any portion of the supporting disc in another rotative or angular position 180 degrees from the last mentioned position, referred to as the "unlocked" position. The length of pin 14 between the inside face 15 of the front head 18 and the inside face 17 of the rear head 16 is equal to the width of the disc 2 and blade 8 at this point.

The rear head 16 is formed at one end of pin 14 of two integral circular members having different size diameters. The outside circular member 20 of said rear head 16 is formed of a large diameter having a notch 22 there-through on the outer periphery thereof for a purpose to be hereinafter described. The inside circular member 24 of said rear head 16 is formed of a reduced diameter to receive a holding member or locking means 26. The diameter of the inner circular member 24 is of such a size that when mounted it covers portions of both the blade root and the cooperating slot in the supporting disc. Holding member 26 consists of a washer member 28 having two tabs 30 and 32, extending from the outer periphery thereof 180 degrees apart. While these tabs are placed apart at an angle of 180 degrees it is to be understood that they may be placed at other degrees of angularity.

The front head 18 is formed at the other end of pin 14. This head comprises a member having one half thereof semicircular in shape as at 34 and the other half

3

shaped so as to slide through the opening formed at the bottom of a slot 4 of supporting disc 2. In the embodiment shown this other half is formed of three sides 36, 38 and 40, the middle side of the three sides, side 38, being located tangent to the outer periphery of the pin 14 and of a length approximately equal to the diameter of pin 14. This side 38 in the "unlocked" position of locking member 12 lies in a plane with the bottom 39 of slot 4 and the sides 36 and 40 fall within the opening 42, while the part 34 engages only the side of the blade root.

To accommodate pin 14 of locking member 12 a groove or passageway 44 extends along the bottom 45 of each blade root 6 along its entire length. In the rearward face 46 of each blade root 6 there is located a hole 48 for a purpose to be hereinafter described. The axially extending groove or passageway is formed by having cooperating portions of the root and slot adjacent the bottom of the slot spaced apart in a direction at right angles to the axis of the disc far enough to receive the pin portion of the locking member and to permit it to turn in the groove.

Before the mounting of a blade having a locking means such as disclosed herein a holding member 26 has one tab bent so that it extends at an angle of approximately 90 degrees from the plane of the washer portion 28 and the other tab bent so that it extends at an angle of approximately 90 degrees from the plane of the washer member 28 in a direction opposite to that of the other tab (see dotted tab 32 in Fig. 2). In assembling, the holding member 26 is then placed over front head 18 of a blade locking member 12, moved along pin 14, and fitted over the reduced diameter of the inside circular member 24 of rear head 16. Pin 14 of this blade locking member is now placed in a groove 44 of a blade root 6 of a blade with the tab 30 extending inwardly from holding member 20 being positioned in hole 48. The blade lock is rotated to its "unlocked" position and the assembled blade root, locking member and holding member are inserted into a slot in the disc. When the assembly is fully inserted, with face 17 of rear head 16 against the rear side of the blade root and disc, the locking member is rotated through 180 degrees to the "locked" position. The locking member is in its fully "locked" position when the notch 22 is facing directly downward in this arrangement. This provides a means of visual inspection from the one side of the locking member to determine if the opposite side is correctly positioned. The tab 32 is then bent over into the notch 22. The locking member 12 now holds the blade in place and the holding member 26 now prevents the locking member from rotating.

As referred to hereinbefore, the tabs 30 and 32 may be placed in varying degrees of angularity from each other. It is also noted here that locking members may be formed having heads of various other shapes which will either permit the blade and locking member to be inserted in the supporting disc together or permit the locking member to be inserted in the supporting disc with the blade being thereafter inserted. These heads may also be shaped so that they will be moved from an "unlocked" to a "locked" position in a varying number of degrees.

The type of locking means disclosed in this specification is adapted particularly to installations where one side of the blade and supporting disc is inaccessible when mounted due to an engine part such as indicated at 50. Such an arrangement is shown for example in Rubbra 2,594,808 (Fig. 2). As can be seen from Fig. 2, the blade 8 can be removed and replaced from the one side without having to remove the entire supporting disc assembly from the engine. This is advantageous in the field where a minimum of tools are available and the need has been found to replace a blade.

Although a specific blade locking means has been shown and described herein for purpose of illustration, it will be evident to those skilled in the art that the

4

invention is capable of various modifications and adaptations within the scope of the appended claims.

I claim:

1. In combination, a supporting disc having an axially extending slot in its periphery, said slot having a bottom, a blade having a root fitting in and engaging in said slot said root having a bottom, said slot and root having interengaging means retaining the blade against radial outward movement relative to the disc, said root and slot having cooperating portions adjacent the bottom spaced apart in a direction at right angles to the axis of the disc to define an axial groove between the root and slot, and means for retaining said blade root in axial position in the slot including a rotatable pin extending through the groove adjacent the bottom of the root, said pin having a head at each end, one head being transversely larger than the pin so that it engages an area of both the side of the blade root and the side of the supporting disc with which it cooperates in all rotative positions, the other head being eccentric to the pin and smaller than the portion of the slot adjacent the bottom so that in one position thereof it will pass through said slot when said pin is in said groove and in another position it will engage an area of both the end of the blade root and the side of the supporting disc with which it cooperates.

2. In combination, a supporting disc having axially extending slots in its periphery, a number of blades, each blade having a root fitting in and engaged in one of said slots of said disc, each root and the cooperating slot having adjacent portions spaced apart radially and forming therebetween an axially extending groove, and means for retaining each of said blade roots in axial position in its slot including a rotatable pin in said groove having a head at each end, one head being transversely larger than the pin and engaging an area of both the side of the blade root and the side of the supporting disc with which it cooperates in all rotative positions, the other head being eccentric to the pin and projecting beyond the pin surface except on one side thereof which is tangential to the surface of the pin and being smaller than the slot in the disc so that in one angular position it will permit said root to pass through said slot and in another angular position it will engage an area of both the end of the blade root and the side of the supporting disc with which it cooperates.

3. A rotor including a disc having axially extending slots in its periphery, a number of blades having roots, with each root fitting in and engaged in one of the slots, each slot and cooperating blade root having means retaining the blade against radial outward movement relative to the disc, each blade root and the cooperating slot having cooperating portions spaced apart in a direction at right angles to the axis of the disc thereby forming an axially extending passageway between the surfaces of said cooperating portions, a rotatable pin extending through said passageway, said pin having a head at each end, the head at one end being larger than the passageway in transverse section to overlap a part of the blade root and a part of the disc, the head at the other end being smaller in transverse section than the disc slot to overlap a part of the blade root only in one position of the pin, said second named head being eccentrically arranged on the pin to overlap both a part of the blade root and a part of the disc in another angular position of said pin, and pin locking means engaging said pin and for locking said pin against rotation in the passageway.

4. A rotor including a disc having an axially extending slot in its periphery, a blade having a root, with said root fitting in and engaged in said slot, the cooperating slot and blade root having means retaining the blade against radial outward movement relative to the disc and said slot and root having adjacent portions radially spaced apart thereby forming an axially extending passageway between the surfaces of said adjacent portions, a rotatable pin extending through said passageway, said pin having

a head at each end, the head at one end being smaller in transverse section than said slot and eccentric to the axis of the pin to overlap only a portion of the blade root in one angular position of the pin and to overlap a part of the blade root and also a part of the disc at another angular position of said pin, the head at the other end of the pin being larger in transverse section than the passageway to overlap both a part of the blade root and a part of the disc at least in said another angular position of said pin, and pin locking means engaging said pin for locking said pin against rotation in the passageway.

5

10

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