United States Patent

Spears, Jr.

[15] 3,656,865

[45] Apr. 18, 1972

[54] ROTOR BLADE RETAINER

[72] Inventor: Esten W. Spears, Jr.

[73] Assignee: General Motors Corporation, Detroit, Mich.

[22] Filed: July 21, 1970

[21] Appl. No.: 56,763

[52] U.S. Cl. 416/221, 416/220

[51] Int. Cl. F01d 5/32

[58] Field of Search 416/221, 220

[56] References Cited

UNITED STATES PATENTS

3,397,865	8/1968	Catlow et al.	416/221
3,501,249	3/1970	Scalzo et al.	416/220
3,043,562	7/1962	Van Nest et al.	416/221
2,755,063	6/1956	Wilkinson	416/221
3,096,074	7/1963	Pratt et al.	416/221
3,137,478	6/1964	Farrell	416/220

Primary Examiner—Martin P. Schwadron

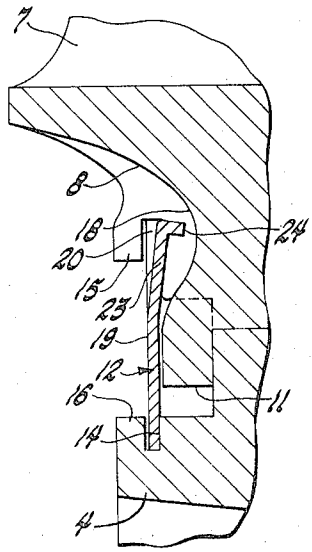
Assistant Examiner—Clemens Schimikowski

Attorney—Paul Fitzpatrick and Jean L. Carpenter

[57] ABSTRACT

A compressor rotor wheel has blade slots extending across the rim. The blades are retained in the slots by a ring of retaining plates disposed in an undercut groove in the face of the rim and having tabs which locate the retainers against circumferential movement and tabs which are deformable to abut the next adjacent plate or deformable to remove the plate for blade removal.

4 Claims, 6 Drawing Figures



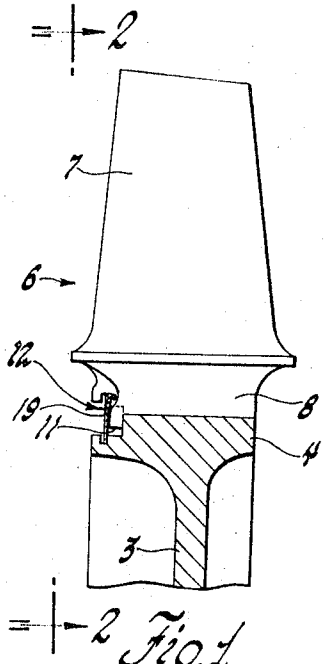


Fig. 1

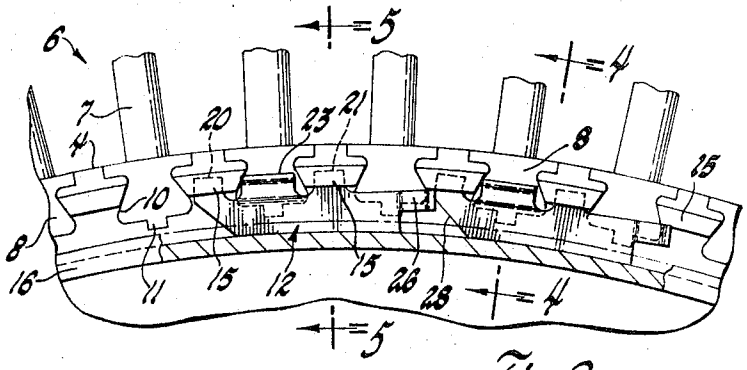


Fig. 2

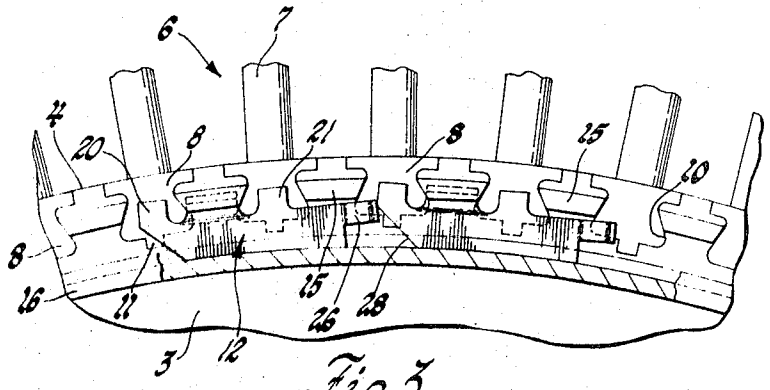


Fig. 3

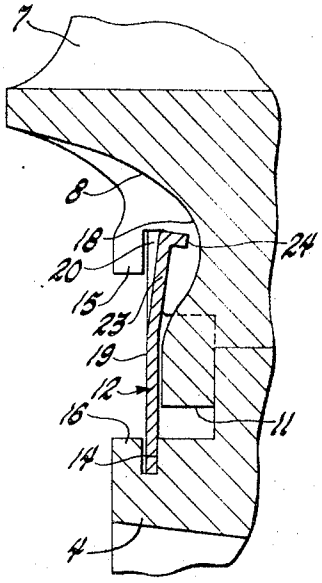


Fig. 4

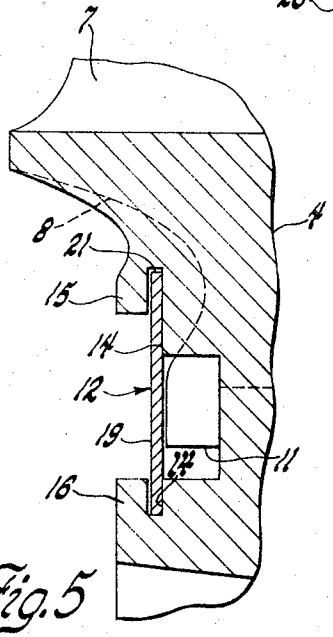


Fig. 5

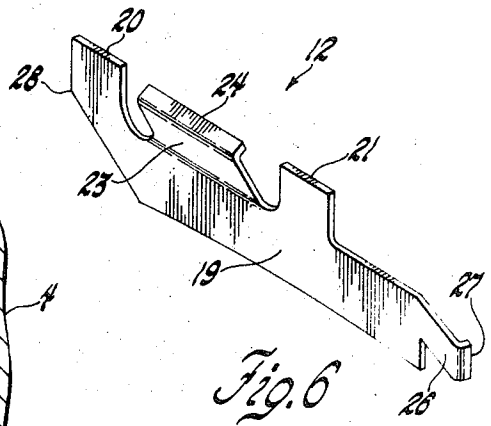


Fig. 6

INVENTOR.
Esten W. Spears, Jr.
BY
Paul Fitzpatrick
ATTORNEY

ROTOR BLADE RETAINER

The invention herein described was made in the course of work under a contract or subcontract thereunder with the Department of Defense.

DESCRIPTION

My invention relates to bladed rotor structures and particularly to a blade retaining arrangement providing for secure retention of blades in a compressor rotor or the like and for easy removal of a blade in case of damage.

The principal objects of my invention are to improve the retention of blades in turbomachinery, to provide an improved bladed rotor structure, to facilitate mounting and removal of blades in compressor rotors and analogous devices, and to provide a simple, inexpensive, secure, readily applied and removed blade retaining arrangement for a turbomachine rotor wheel.

The nature of my invention and its advantages will be clear to those skilled in the art from the succeeding detailed description of the preferred embodiment of the invention and the accompanying drawings thereof.

FIG. 1 is a partial sectional view of a compressor rotor wheel taken in a plane containing the axis of rotation of the wheel.

FIG. 2 is a partial elevation view of the wheel taken in the plane indicated by the line 2—2 in FIG. 1.

FIG. 3 is a view similar to FIG. 2 illustrating the insertion of the blade retainers.

FIG. 4 is an enlarged sectional view taken on a broken plane indicated by the line 4—4 in FIG. 2.

FIG. 5 is an enlarged sectional view taken on the plane indicated by the line 5—5 in FIG. 2.

FIG. 6 is an axonometric view of a blade retainer plate.

Referring first to FIG. 1, a compressor rotor stage comprises a wheel 3 having a rim 4. The rim mounts a row of blades 6, each blade including an airfoil portion 7 and a root 8. The root, as will be apparent from FIG. 2, is of dovetail shape and is adapted to slide into a dovetail slot 10 extending across the rim, either parallel to or skewed to the axis of rotation of the wheel 3. The blade root includes a lug 11 extending radially inward from the root which abuts a face of the rim to limit movement of the blade into the rim. Normally, the lug is disposed so as to oppose the resultant of aerodynamic and centrifugal forces which tends to cause the blade to slide out of the blade slot.

The structure so far described may be considered to be conventional. There is needed some mode of retention to prevent the blades from sliding back and forth in the blade slot, and particularly from sliding forward in the structure illustrated, with the lug 11 moving away from the rim. Various expedients have been proposed and adopted for this purpose but, so far as I am aware, there has been none having the advantages of my improved blade retaining arrangement to be described.

The ring of blades 6 is retained by a ring of locking members or retaining plates 12. The retaining plates are mounted in an undercut groove 14 in the forward face of the rim as illustrated, the groove being overlaid by two flanges, an outer flange 15 and an inner flange 16. The inner flange is continuous around the circumference of the rim and, therefore, defines a continuous abutment at the front of the groove 14. The groove 14 is intersected by the blade slots 10 so that the outer flange 15 is discontinuous, the flange being present only between the blade slots. It will be noted that a portion of the forward face of the blade root, indicated at 18 in FIG. 4, is recessed behind the face of the rotor rim and that the lugs 11, as most clearly shown in FIGS. 4 and 5, abut the forward face of the rim to the rear of the groove 14.

Each retaining plate, as shown most clearly in FIG. 6 in its form before application, is a sheet metal plate of ductile material such as a suitable stainless steel or any metal appropriate to the particular environment. The body or major portion of the retaining plate is a strip 19 having a slightly curved edge which rides in the radially inner portion of groove 14. The plate includes two fingers 20 and 21, these being spaced apart a distance equal to the spacing between individual blade roots circumferentially of the wheel. Each plate 12 also includes a tab 23 having a bent-over end portion 24, the tab extending radially outward and slightly forward from the strip 19 halfway between the fingers 20 and 21. The end portion of the strip opposite the finger 20 is of reduced width and defines a bendable tab 26 the end of which is bent over at right angles to provide an abutment 27. The abutment 27 is adapted to engage the end 28 of the next adjacent retaining plate.

As indicated in FIG. 3, after the blades have all been slid into place on the rim, each plate 12 is put in place on the rotor with the edge engaged in the inner portion of groove 14 and with the fingers 20 and 21 abutting adjacent blade roots 8. In this position, the tab 23 is disposed against the face of the rim in front of the flange 15. Then, as indicated in FIG. 2, the plate 12 is slid to the left, as viewed in that figure, a distance equal to one-half the blade spacing so that the fingers 20 and 21 slide into the outer portion of groove 14 behind flange 15 and the tab 23 is disposed in front of the end of the blade root 8. In this condition, as shown particularly in FIG. 5, the retaining plates 12 closely approach the forward face of the lug 11 to prevent forward movement of the blade root in the slot.

Then, the tab 23 is bent inwardly to a position as indicated in FIG. 4 in which the tab, or at least the end portion 24 of the tab, lies within the blade slot 10 and thus the plate 12 is anchored against movement circumferentially of the groove 14. Successive retaining plates 12 are inserted, going around the rotor. To insert the final retaining plate, it is necessary to deform the tab 26 outwardly. This tab is then bent inward so as to abut against the first installed retaining plate. The tabs 27 thus provide a further safeguard against displacement of the retaining plates.

To remove the retaining plates, it is only necessary to bend the end portions 26 and tabs 23 outward with a suitable prying tool. With the tabs 23 and 26 pried outwardly from the rotor face, it is a simple matter to slide the retainer a one-half blade slot distance and remove it from the groove 14. This done, wherever it is necessary to remove a blade, the blade may be slid out of the slot and replaced by a new blade. The retaining plate 12 which has been bent and rebent is then discarded, and a new one is inserted as in the original installation. End portions 26 may be originally angled forward as shown in FIG. 6, or may be bent forward only if necessary to clear a retaining plate already in place.

The convenience and simplicity as well as the light weight and inexpensive nature of the blade retaining arrangement according to my invention will be apparent to those skilled in the art.

Note that both tabs 23 and 26 must be bent out to release a retaining plate, and that the tabs need be bent through only a small angle for installation, thus minimizing the possibility of cracking the retainers. The installation does not require notching the continuous fibers of the wheel rim.

The detailed description of the preferred embodiment of the invention for the purpose of explaining the principles thereof is not to be considered as limiting or restricting the invention, since many modifications may be made by the exercise of skill in the art without departing from the scope of the invention.

I claim:

1. A bladed rotor structure comprising, in combination, an annular rim having an end face and blade slots extending generally axially of the rim from the end face; blades having roots slidably insertable into and mounted in the slots, the blades and rim having abutment means limiting movement of the roots into the rim and the roots having a portion within the slot inset from the rim face when the blades are in place; the rim face having two opposed overlying flanges defining between them a retainer mounting groove intersecting the blade slots; and a ring of blade retaining plates disposed in the said groove, the blade retaining plates overlying the blade

roots to prevent movement of the blade roots from the slots, each retaining plate including a tab deformable into a blade slot confronting a said root portion.

2. A bladed rotor structure comprising, in combination, an annular rim having an end face and blade slots extending generally axially of the rim from the end face; blades having roots slidably insertable into and mounted in the slots, the blades and rim having abutment means limiting movement of the roots into the rim and the roots having a portion within the slot inset from the rim face when the blades are in place; the rim face having two opposed overlying flanges defining between them a retainer mounting groove intersecting the blade slots; and a ring of blade retaining plates disposed in the said groove and engaging end-to-end, the blade retaining plates overlying the blade roots to prevent movement of the blade roots from the slots, each retaining plate including a tab deformable into a blade slot confronting a said root portion, each retaining plate including an end portion adapted to engage the next retaining plate deformable away from the rim to free the retaining plate for circumferential movement for removal of a plate.

3. A bladed rotor structure comprising, in combination, a rotor rim having an axis of revolution and having a radial face, the rotor having an undercut groove extending around the face bounded by inner and outer overlying flanges and having dovetail blade mounting slots extending across the face, the slots interrupting the outer flange; blades extending from the rim having roots mounted in the slots, each blade root including a lug abutting the face of the rim to limit blade movement into the slot; and a removable blade locking member restraining blade movement out of the slot, the member being a unitary plate including a strip extending along the groove across at least one slot and received behind the inner flange, at least two fingers received behind the outer flange, and a tab deformable into a blade mounting slot to lock the member against movement circumferentially of the rim.

4. A bladed rotor structure comprising, in combination, a rotor rim having an axis of revolution and having a radial face, the rotor having an undercut groove extending around the face bounded by inner and outer overlying flanges and having dovetail blade mounting slots extending across the face, the slots interrupting the outer flange; blades extending from the rim having roots mounted in the slots, each blade root including a lug abutting the face of the rim to limit blade movement into the slot; removable blade locking members restraining blade movement out of the slot, each member being a unitary plate including a strip extending along the groove across at least one slot and received behind the inner flange, at least two fingers received behind the outer flange, and a tab deformable into a blade mounting slot to lock the member against movement circumferentially of the rim, the locking members being in end-to-end abutment around the rim, and each locking member including a part deformable for release of the said locking member abutting the next adjacent locking member.

* * * * *