July 3, 1956 A. KURTI 2,753,149

BLADE LOCK

Filed March 30, 1951

Fig. 1.

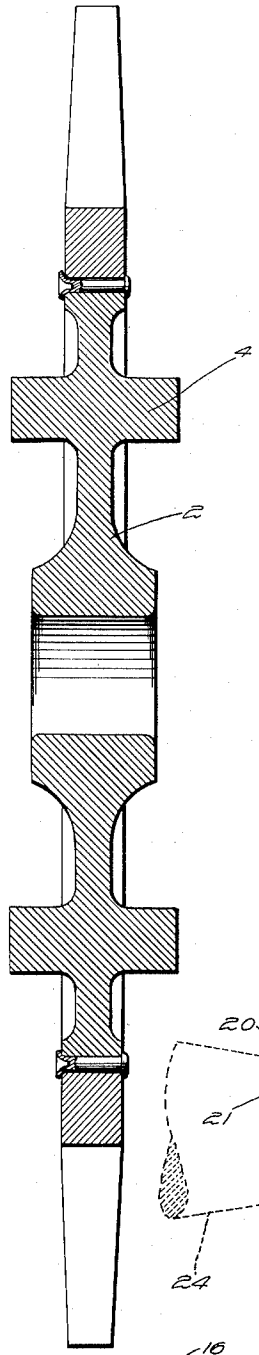


Fig. 2.

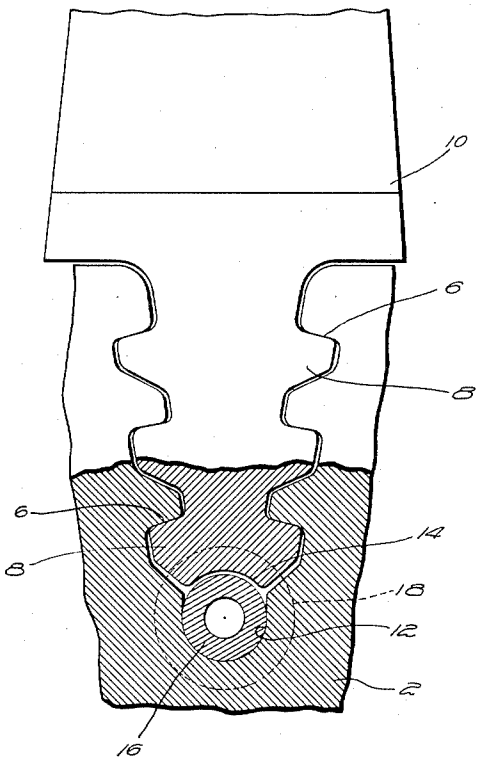


Fig. 3.

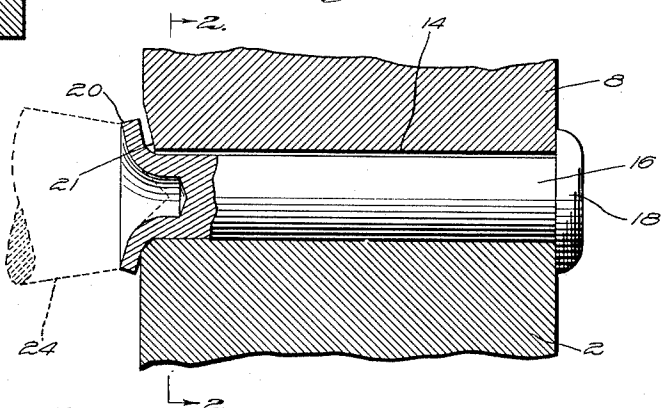
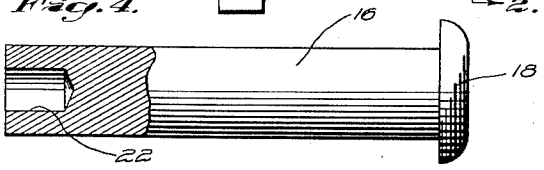


Fig. 4.



Inventor
Alexander Kurti
by Charles Allen
Attorney

United States Patent Office 2,753,149 Patented July 3, 1956

2,753,149

BLADE LOCK

Alexander Kurti, North Woodbury, Conn., assignor to United Aircraft Corporation, East Hartford, Conn., a corporation of Delaware

Application March 30, 1951, Serial No. 218,473

3 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 in the rotors of axial flow compressors or turbines.

When the supporting disc has a number of axially extending recesses in its periphery to receive the roots of blades which project radially outward from the disc, it becomes necessary to prevent axial movement of the blade relative to the disc because of the axial thrust exerted on the blade during the operation of the compressor turbine. The blades have been locked on the disc by integral tabs formed on opposite ends of the blade root with one of the tabs manufactured in such a position that the blade root may be inserted in the appropriate slot in the disc and the tab subsequently bent down against the side of the disc. The projecting tabs make more difficult the machining of the blade root surfaces and in use breakage of the tab during bending frequently occurs. This is especially true in the event of removal and reinsertion of a blade. A feature of this invention is an arrangement for locking the blade by the use of a separate replaceable member which can be inserted with the blade or separately therefrom and which requires no machining operation on either the disc or the blade for making the locking device usable.

In view of the large number of blades on each disc and the large number of stages in the compressors and turbines in many power plants, it becomes advantageous to have a quickly and easily inserted or removed lock. A feature of the invention is a lock which can be very readily produced in quantity and which can be inserted and locked with a minimum of effort.

More specifically, a feature of the invention is a rivet which is inserted in the slot at the base of the blade root and which has a pre-formed head at one end and can be riveted over at the opposite end for locking the blade root in position.

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 sectional view through a disc showing the blade lock.

Fig. 2 is a fragmentary side elevation of the disc with parts in section substantially along the line 2—2 of Fig. 3.

Fig. 3 is an enlarged sectional view showing the lock in greater detail.

Fig. 4 is a side elevation of the rivet before its insertion in the disc.

The invention is shown in conjunction with a compressor disc for use in a multistage axial flow compressor construction, but it will be apparent that the invention is equally applicable to the fastening of blades in the disc of axial flow turbines or other similar apparatus. In the arrangement shown the compressor disc 2, which may have axially projecting bosses 4 thereon for spacing the disc 2 from an adjacent similar disc for another stage of the compressor, has a plurality of slots 6 in its periphery to receive the similarly formed root 8 of the blade 10.

The particular shape of the blade root 8 or of the similarly shaped slot 6 is not critical and for the purpose of the present invention a somewhat conventional fir-tree type of blade attachment is shown. In any event the slot and cooperating blade roots have interfitting elements whch function to limit radial outward movement of the blade thereby retaining the blade radially in position when the disc is rotating. The blade attachment is such that the blade root is somewhat free in the slot, to provide for a slight freedom of movement for the blade in a circumferential direction as is well known in the art.

It will be noted, however, that for the purpose of the present invention the base of the slot 6 has a cylindrical recess 12 located beneath the blade root and the blade root has a curved surface 14 at the lowermost end to form, with the recess 12, a substantially cylindrical passage extending axially through the disc to receive the locking means which is in the form of a headed pin or rivet 16. It will be noted that the recess 12 is preferably substantially the same diameter as the rivet and that the surface 14 is so located with respect to the recess 12 that there will be a small amount of clearance provided between the shank of the rivet and the surface 14 such that the rivet will not function to wedge the blade root radially of the disc.

The rivet 16 has a pre-formed head 18 at one end which is of a large enough dimension to overlie the side of the disc 2 adjacent the slot 6 and also to overlie a part of the end wall of the blade root 8. After the blade root has been placed in position in the slot and after the rivet has been inserted, the end of the rivet remote from the head 18 is bent over as shown at 20 so that this end of the rivet will overlie both the side wall of the disc and the blade root to prevent the latter from moving axially with respect to the disc. The overlapping head 16 closes the end of the clearance space beside the rivet to prevent leakage of fluid.

The axial dimensions of the blade root and disc are selected to provide, when the rivet has been secured in position, a small clearance for the root between the ends of the rivet as shown at 21. This clearance also leaves the blade free to move slightly in a circumferential direction, as permitted by the blade attachment, in a manner well known in the art so that the blade is free to assume its proper position with respect to the disc when the latter is rotated.

The rivet is preferably made of relatively soft material and in order to prevent upsetting of the shank portion of the rivet during the formation of the out-turned portion 20 of the rivet it may be desirable to countersink this end of the rivet as shown at 22, Fig. 4. With this arrangement, after the rivet has been inserted in the recess 12 the end may be upset readily as by a pre-formed tool 24, indicated diagrammatically in dotted lines in Fig. 3. The material of the rivet is soft enough so that it will retain the blade in position during normal operation of the compressor or turbine but will bend freely enough so that the blade may be removed intentionally, merely by driving the root axially out of the disc. It will be apparent that a rivet of this type may be produced in quantity at a low cost and can be inserted readily in the disc for locking the blade root with a minimum of effort. Furthermore, when the lock is inserted it does not in any way interfere with the proper functioning of the blade root in its slot in the disc.

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. A rotor including a disc having axially extending slots in its periphery, a number of blades having roots en-

gaging in said slots, there being one root in each slot, each of said slots and the cooperating blade root having cooperating means therein to limit the radial outward movement of the blade in the slot, each of said slots and the cooperating blade root being so dimensioned that there is a small freedom of movement for the blade in a circumferential direction, said disc having cylindrical recesses extending therethrough in an axial direction at the base of, and opening into, said slots, there being one recess for each slot, each of the blade roots having a curved surface at the lowermost end to form with the cooperating recess a substantially cylindrical passage, and a rivet positioned in said recess, said rivet being smaller in diameter than the dimension from the bottom of the recess to the curved surface on the root, said rivet having a head at each end to overlie a part of the end of the blade root and a part of the disc.

2. A rotor including a disc having axially extending slots in its periphery, a number of blades having roots engaging in said slots, there being one root in each slot, each of said slots and the cooperating blade root having cooperating means therein to limit the radial outward movement of the blade in the slot, each of said slots and the cooperating blade root being so dimensioned that there is a small freedom of movement for the blade in a circumferential direction, said disc having cylindrical recesses extending therethrough in an axial direction at the base of, and opening into, said slots, there being one recess for each slot, each of the blade roots having a curved surface at the lowermost end to form with the cooperating recess a substantially cylindrical passage, and a rivet positioned in said recess, said rivet being smaller in diameter than the dimension from the bottom of the recess to the curved surface on the root, said rivet having a head at each end to overlie a part of the end of the blade root and a part of the disc, said rivet being substantially the same diameter as the recess, the curved surface of the blade root being slightly spaced from the rivet when the latter is in the base of the recess to provide a small clearance therebetween such that the

freedom of movement of the blade is not interfered with.

3. A rotor including a disc having axially extending slots in its periphery, a number of blades having roots engaging in said slots, there being one root in each slot, each of said slots and the cooperating blade root having cooperating means therein to limit the radial outward movement of the blade in the slot, each of said slots and the cooperating blade root being so dimensioned that there is a small freedom of movement for the blade in a circumferential direction, said disc having cylindrical recesses extending therethrough in an axial direction at the base of, and opening into, said slots, there being one recess for each slot, each of the blade roots having a curved surface at the lowermost end to form with the cooperating recess a substantially cylindrical passage, and a rivet positioned in said recess, said rivet being smaller in diameter than the dimension from the bottom of the recess to the curved surface on the root, said rivet having a head at each end to overlie a part of the end of the blade root and a part of the disc, the blade root and the disc being so dimensioned axially as to provide, when the rivet is in position, a small clearance for the blade root between the ends of the rivet.

References Cited in the file of this patent

UNITED STATES PATENTS

1,347,031	Guy	July 20, 1920
1,619,133	Kasley	Mar. 1, 1927
1,719,415	Back	July 2, 1929
2,434,935	Kroon	Jan. 27, 1948

FOREIGN PATENTS

15,893	Great Britain	of 1908
618,011	Great Britain	Feb. 15, 1949

OTHER REFERENCES

SAE Journal, article entitled "Ten Ways to Attach Blades," February 1948; at pp. 32–35 (p. 32 only is relied on).