June 20, 1961 E. P. WARNKEN 2,989,285

ROTOR CONSTRUCTION

Filed Sept. 18, 1958

FIG. 1.

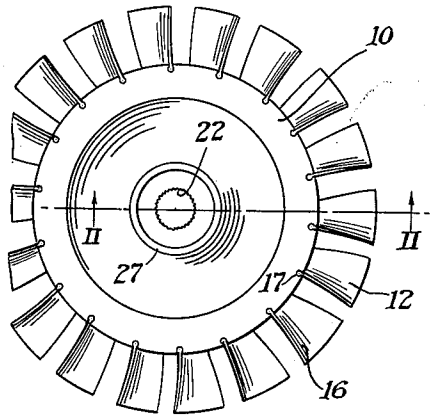
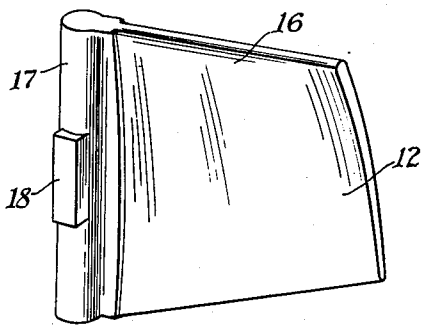


FIG. 3.



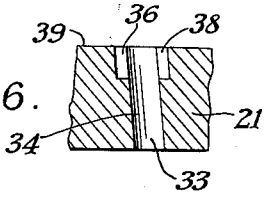


FIG. 6.

FIG. 2.

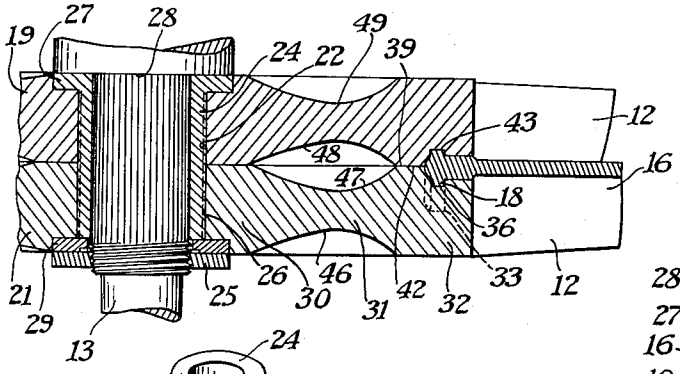
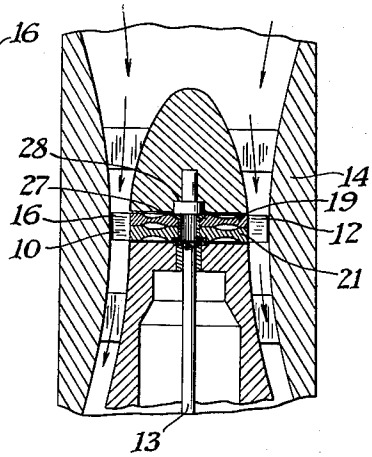


FIG. 5.



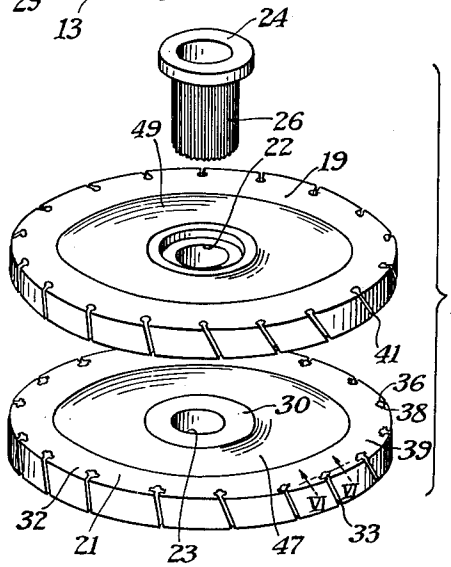


FIG. 4.

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United States Patent Office 2,989,285 Patented June 20, 1961

2,989,285

ROTOR CONSTRUCTION

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Filed Sept. 18, 1958, Ser. No. 761,764
5 Claims. (Cl. 253—77)

This invention relates to rotor construction and more particularly to construction of blade-carrying rotor wheels for air compressors and the like.

It is considered advantageous in certain applications such as the compressor section of gas turbine engines to fabricate blade-carrying rotors from reinforced plastic material. Such rotor wheels are characterized by relatively large peripheral and hub portions and joined by a relatively thin intermediate section. The enlarged periphery is necessary to support the air foil blades, and the intermediate portion is required to be thin to reduce centrifugal stresses created during rotation of the unit. Prior to the present invention it has been difficult to fabricate rotor wheels of such configuration because of inherent limitations in the molding of reinforced plastic structures, it being difficult to mold the wide overhang of the hub and the periphery.

In view of the foregoing state of the art, it is an objective of the present invention to provide a rotor wheel formed of two matching discs in which the portion of each disc between the hub and the periphery is of reduced cross sectional thickness.

It is a further object of the present invention to provide a rotor construction fabricated from a plurality of discs, each of which can be readily molded from reinforced plastic materials.

It is a still further object of the present invention to provide an air foil blade having a root shape which is readily assembled to a twin disc rotor and in which means are provided for locking the blade between said discs.

These and further objects and features of the present invention will be apparent to those skilled in the art from the following description and the accompanying drawings in which:

FIGURE 1 is a plan view of a rotor construction in accordance with an embodiment of this invention;

FIGURE 2 is a sectional view in elevation taken along section line II—II of FIGURE 1;

FIGURE 3 is a perspective view showing one of the rotor blades;

FIGURE 4 is an exploded perspective view showing the discs of the rotor wheel and a hub member on which the discs are mounted;

FIGURE 5 is a longitudinal section showing the rotor operably mounted in an air compressor; and

FIGURE 6 is a sectional view taken along section line VI—VI of FIGURE 4.

In the following detailed description and the drawing like reference characters indicate like parts.

In FIGURES 1 and 5 is shown a rotor wheel **10** which carries a plurality of rotor blades **12**. The rotor **10** can be mounted on a shaft **13** (FIGS. 2 and 5) inside an appropriate housing **14** (FIG. 5).

As shown in FIGURE 3, each blade **12** includes a main or airfoil section **16** and a root section **17**. The root section is enlarged, as shown, and lugs **18** (only one of which is shown in FIGURE 3) are formed on opposite sides of the central portion of the root end section. Ends of lugs **18** terminate short of the ends of root sections.

As shown most clearly in FIGURES 2 and 4, the rotor wheel includes two discs **19** and **21**. The discs **19** and **21** have central openings **22** and **23** respectively, through which a thimble **24** extends. The thimble **24** has external knurling **26** which engages the discs **19** and **21** to cause them to turn together and with the thimble **24**. The thimble **24**, in turn, is mounted on the shaft **13**. A nut (FIG. 2) mounted on the shaft holds disc **19** in engagement with a flange **27** of the thimble and holds the flange **27** of the thimble against a shoulder **28** of the shaft **13**. A washer **29** mounted on the shaft **13** engages the disc **21**.

The discs are intended to be molded of appropriate plastic material such as fiber glass reinforced phenol-formaldehyde materials, or may be formed of metal or other suitable material.

The lower disc **21** has a hub section **30** which receives a portion of the thimble **24**, an intermediate section **31** of reduced thickness, and an outer section **32** of full thickness. The outer section is provided with a plurality of slots **33**, each of which receives the lower half of root end portion of one of the blades.

Details of construction of one of the slots **33** are shown in FIGURE 6. The slot **33** includes a lower portion **34** of a size to receive a main portion of the root end section **17** of one of the blades. The slot **33** also includes enlarged sections **36** and **38** which intersect a face **39** of the disc. Each of the enlarged sections **36** and **38** receives one-half of one of the lugs **18** of the root end section of one of the rotor blades. The upper disc is generally similar in construction to the lower disc **21**. The upper disc **19** is provided with slots **41**, each of which receives an upper half of the root end section of one of the blades. A face **42** of the upper disc **19** (FIG. 2) which engages the face **39** of the lower disc, has enlarged slot sections **43** which receive upper portions of the lugs **18**.

When the discs and blades are assembled, the root portions **18** of the blades are locked between the discs.

As shown most clearly in FIGURE 2, the intermediate section **31** of the disc **21** is cut away as indicated at **46** and **47** on its opposite faces to reduce the thickness and mass of the intermediate section. Similarly, an intermediate section of the upper disc **19** is cut away as indicated at **48** and **49** on its opposite faces. The cut away sections at the adjacent faces form an annular space between the discs inboard of the outer engaging sections and outboard of the inner or hub sections. As shown, the cutting away reduces the mass of the intermediate sections of the discs substantially without providing any excessive overhangs. The overhangs of the hub sections and outer sections of the rotor discs are of such moderate proportions that the dies can be formed from plastic materials.

It is apparent that the discs **19** and **21** are identical in configuration, they being assembled juxtaposed in a face-to-face relationship. Thus, a single molding and machining setup can be provided to produce the twin disc wheel **10**.

The rotor wheel illustrated in the drawing and described above is subject to structural modification without departing from the spirit and scope of the appended claims.

I claim:

1. A rotor, comprising; a pair of interchangeable discs each having a plurality of slots provided through and axially across the outer peripheral edge thereof, said slots of respective discs being axially alignable, a plurality of rotor blades each including a root section receivable in radially locked engagement within said slots and having a locking projection provided intermediate the ends thereof, and said root sections and slots being cooperatively formed for axial locking engagement of said locking projections between said discs as secured in face engaging relation.

2. A rotor, comprising; a pair of interchangeable discs

each having a plurality of slots provided through and axially across the outer peripheral edge thereof in equally spaced relation, said slots of respective discs being axially alignable and enlarged near one end thereof, a plurality of rotor blades each having a root section receivable in radially locked engagement within said slots and including a locking projection provided intermediate the ends thereof and receivable within the enlarged ends of said slots as adjacently disposed and aligned, and means for securing said discs together within the projections of said root sections axially locked therebetween.

3. A rotor, comprising; a pair of interchangeable discs each having a plurality of slots provided through and axially across the outer peripheral edge thereof in equally spaced relation, said slots of respective discs being axially alignable and enlarged near one end thereof, a plurality of rotor blades each having a root section receivable in radially locked engagement within said slots and including locking projections provided on opposite sides of said root sections and intermediate the ends thereof and receivable within the enlarged ends of said slots as adjacently disposed and aligned, said enlarged ends being formed for the close fitting reception of said locking projections, and means for securing said discs together with said projections securely held therebetween.

4. A rotor, comprising; a pair of interchangeable discs each having a plurality of slots provided within and axially across the outer peripheral edge thereof, a plurality of rotor blades each having a root section receivable in the slots of said discs as secured together and having said slots aligned, said slots and root sections being cooperatively formed for radial locking engagement of said rotor blades, locking projections provided on opposite sides of said root sections and intermediate the ends thereof, and said slots of at least one of said discs being formed adjacent one face thereof for axial locking reception of said locking projections therein.

5. A turbine rotor, comprising; a pair of interchangeable rotor discs adapted to be secured in face-to-face engaging relation, said discs including enlarged inner and outer peripheral portions providing a reduced annular midsection and a mass reductive space between said discs as secured together, a plurality of turbine blade root receptive slots provided within and extended axially and fully across the outer peripheral edges of said discs; said slots of respective discs being axially alignable as said discs are secured together, a plurality of turbine blade members each having a blade section and a root section of a size spanning said discs as secured together, said slots and the root sections of said blade members being cooperatively formed for radial locking engagement therebetween, locking projections provided on opposite sides of said root sections and centrally thereof, and said slots being formed adjacent only one face of said discs for close fitted reception of said projections and for axial locking engagement of said root sections thereby as said discs are secured together with the receptive ends of said slots next adjacently disposed.

References Cited in the file of this patent

UNITED STATES PATENTS

532,232	De Laval	Jan. 8, 1895
1,073,623	Owen et al.	Sept. 23, 1913
1,118,361	Lasche	Nov. 24, 1914
1,263,448	McFarland	Apr. 23, 1918
2,657,008	Atkinson	Oct. 27, 1953
2,685,405	Stalker	Aug. 3, 1954
2,819,869	Meyer	Jan. 14, 1958
2,844,354	Warnken	July 22, 1958
2,848,190	Barr	Aug. 19, 1958

FOREIGN PATENTS

134,184	Australia	Sept. 7, 1949