June 13, 1961 M. J. SUTTERS 2,988,324

ROTORS FOR MULTI-STAGE AXIAL FLOW COMPRESSORS OR TURBINES

Filed Aug. 5, 1958

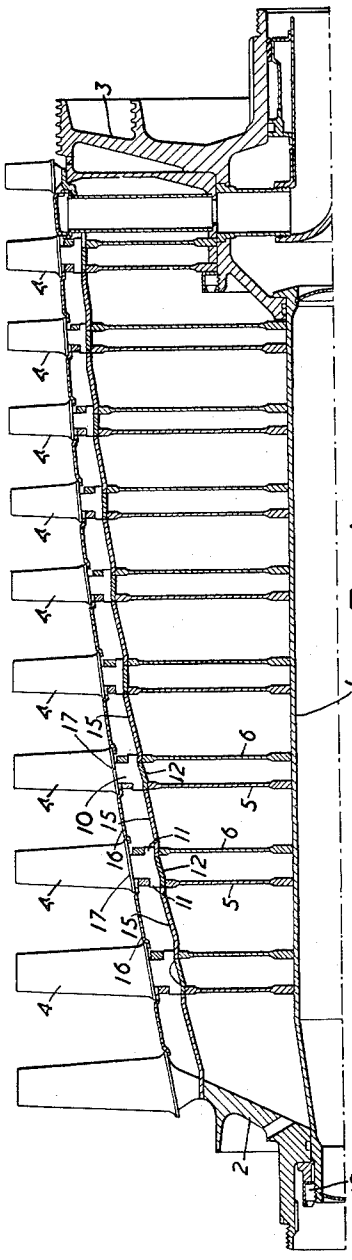


FIG. 1.

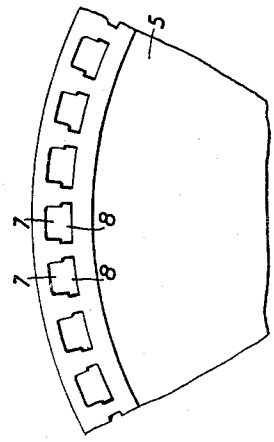


FIG. 3.

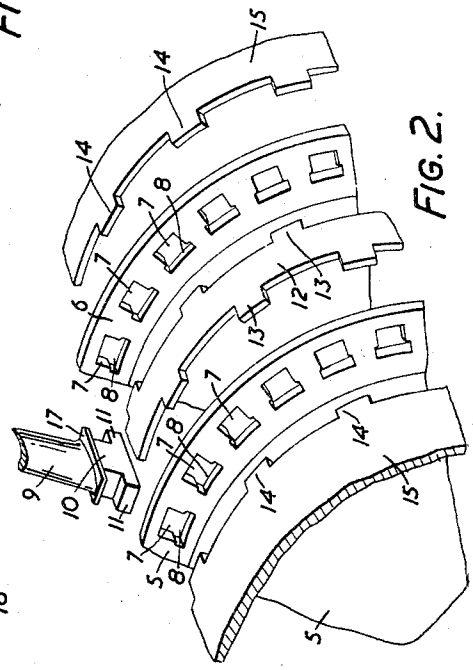


FIG. 2.

INVENTOR
Michael John Sutters
BY
Watson, Cole, Grindle & Watson
ATTORNEY

United States Patent Office 2,988,324 Patented June 13, 1961

2,988,324

ROTORS FOR MULTI-STAGE AXIAL FLOW COMPRESSORS OR TURBINES

Michael J. Sutters, London, England, assignor to D. Napier & Son Limited, London, England, a company of Great Britain

Filed Aug. 5, 1958, Ser. No. 753,332
5 Claims. (Cl. 253—39)

This invention relates to rotors for multi-stage axial flow compressors or turbines, and it is an object of the present invention to provide such a rotor of particularly light construction. For reasons of lightness and to facilitate manufacture it is a common practice to build up such rotors from several sections which are fitted together end to end. In such rotors two main requirements have to be considered, namely resisting the large centrifugal forces produced at high rotational speeds by the masses of the rotor blades and other rotating parts, and transmitting the drive from one section of the rotor to the next.

According to the present invention the blades in each of at least two adjacent rows of rotor blades have root portions provided with forward and rearward projections which enter holes adjacent the peripheries of two parallel thin supporting discs which resist the centrifugal forces acting on the blade row, and annular driving members concentric with the rotor extend between the said adjacent blade rows and are provided with forward and rearward projections which enter holes in the adjacent supporting discs.

Since the supporting discs have to resist mainly the centrifugal forces and only have to transmit the driving forces in the vicinity of the blade roots, and since the driving members which transmit the driving forces have only to resist centrifugal forces arising from their own masses, which are relatively small, the supporting discs and the driving members can all be of light construction.

Conveniently, the projections on the driving members and the projections on the blade roots occupy different parts of the same holes in the supporting discs.

In one form of the invention there are both the said interblade row driving members for transmitting the drive from one blade row to the next, and an additional inter-disc driving ring for each blade row which transmits the drive between the two supporting discs associated with this blade row, and one construction of this kind according to the invention is illustrated somewhat diagrammatically by way of example in the accompany drawings, in which:

FIGURE 1 is a sectional side elevation of a complete rotor assembly embodying the invention, in a plane containing the axis of the rotor.

FIGURE 2 is a perspective exploded view showing the construction and arrangement of a blade row with its inter-disc driving ring and two inter-blade-row driving members as used in the rotor shown in FIGURE 1; and

FIGURE 3 is an end elevation of a circumferential part of one of the two supporting discs associated with each blade row.

In the construction illustrated the rotor comprises a tubular "shaft" 1 to the ends of which are secured in a manner generally known in itself robust main supporting members 2 and 3 through which the rotor would be supported on appropriate bearings. The rotor includes eleven blade rows of which the invention is applied to the intermediate nine blade rows, indicated by the reference number 4 in FIGURE 1 and, since the essential elements associated with each of such blade rows are of the same general form, as shown in FIGURE 2, the arrangement will be described with particular reference to one of the blade rows only, it being understood that the corresponding parts associated with each of the nine intermediate blade rows will be similarly arranged.

As shown most clearly in FIGURE 2, the blade row assembly comprises two supporting discs 5 and 6 of annular form surrounding the tubular shaft, the rim of each supporting disc being formed as shown with a row of holes each comprising a narrower outer part 7 and a somewhat wider inner part 8.

Interposed between the two supporting discs is a blade row consisting of a row of blades 9, each of the blades in which has a root portion 10 of generally T section as shown in FIGURE 2, the projections 11 constituting the arms of the T being formed to fit closely within the outer parts 7 respectively of two aligned holes respectively in the discs 5 and 6 when the discs are assembled with the blades between them as shown in FIGURE 1.

Also interposed between the discs 5 and 6 is an inter-disc driving ring 12 having projections 13 on its two edges, the pitch of the projections on each edge being twice the pitch of the holes 7, 8 in the discs 5 and 6, while the dimensions of the driving ring 12 and of the projections 13 are such that the projections 13 fit into the wider parts 8 of the holes in the discs 5 and 6. When the two discs 5 and 6, the blades 9, 10, 11, the inter-disc driving ring 12 are assembled, therefore, the projections 11 on the blade roots lie in the outer parts 7 of all the holes and the projections 13 on the driving ring 12 lie in the inner parts 8 of alternate holes in each of the discs 5 and 6. The inner parts 8 of the other alternate holes in the discs 5 and 6 are, in the assembled rotor, occupied by projections 14 respectively on two annular inter-blade-row driving members 15. Thus, in the fully assembled rotor the outer parts of all the holes are occupied by blade root projections 11, while the inner parts of all the holes are occupied by the projections 13 or 14.

Around the rotor, outwardly spaced from the inter-blade ring driving members 15 are annular sealing members 16 extending at their ends beneath the platform portions 17 of the blades.

In practice the various discs 5, 6, blade rows 4, inter-disc driving rings 12, inter-blade-ring driving members 15 and sealing members 16 are assembled one after the other in appropriate sequence from the left-hand end of the tubular shaft, after which the member 2 is brought into position and the whole assembly is clamped up by means of the clamping nut indicated at 18.

In operation, centrifugal forces due to the mass of the rotating rows of blades are resisted almost entirely by the discs 5 and 6, the web portions of which can be made thin and light since no drive is transmitted through these portions, the drive being transmitted from one blade row to the next through the driving members 15 and between the two discs associated with each blade row by the driving rings 12.

What I claim as my invention and desire to secure by Letters Patent is:

1. A rotor for an axial flow multi-stage compressor or turbine including in combination at least two adjacent rows of rotor blades, each blade having a root portion provided with forward and rearward projections, two parallel supporting discs associated with each row of rotor blades forwardly and rearwardly thereof respectively and provided with holes extending completely therethrough adjacent to their peripheries into which the projections on the roots on the respective row of rotor blades extend, an annular driving member concentric with the rotor extending between the relatively adjacent supporting discs associated with the said adjacent rows of rotor blades and provided with forward and rearward projections extending into some of said holes in said relatively adjacent supporting discs, and driving rings concentric with the rotor

and each extending between the two supporting discs associated with the respective rows of rotor blades, each said driving ring having forward and rearward projections extending into others of said holes in the supporting discs between which it lies.

2. A rotor as claimed in claim 1 in which the forward, and rearward projections on the annular driving members extend into and occupy parts less than the entireties of said some holes in the supporting discs, into other parts of which holes the projections on some of the blade roots extend.

3. A rotor as claimed in claim 2 in which the projections on said driving rings extend into and occupy parts less than the entireties of said other holes in the supporting discs, into other parts of which holes projections on the remainder of the blade roots extend.

4. A rotor for an axial flow multi-stage compressor or turbine including in combination at least two adjacent rows of rotor blades, the blades in each row having root portions provided with forward and rearward projections, two parallel supporting discs associated with each row of rotor blades forwardly and rearwardly thereof respectively and having adjacent to each of their peripheries a row of holes extending completely through said discs and into parts of which extend the projections on the associated blade roots, a driving ring concentric with the rotor and lying between each pair of relatively adjacent supporting discs associated with adjacent rows of blades,

said driving ring having forward and rearward projections extending into other parts of alternate holes in each row of holes, and annular driving members concentric with the rotor lying between the said adjacent blade rows and having forward and rearward projections extending into other parts of the remaining alternate holes in the adjacent supporting discs.

5. A rotor for an axial flow multi-stage compressor or turbine as claimed in claim 4, including clamping parts situated adjacent to the ends of the rotor, and in which the roots of the rows of blades, the annular driving members, the supporting discs and the driving rings are clamped up together between said clamping parts.

References Cited in the file of this patent

UNITED STATES PATENTS

2,825,124	Nichols et al.	Mar. 4, 1958
2,861,823	Perry	Nov. 25, 1958

FOREIGN PATENTS

724,281	Great Britain	Feb. 16, 1955
757,980	Great Britain	Sept. 26, 1956
846,035	Germany	Aug. 7, 1952

OTHER REFERENCES

Germany, Application No. H13,425 (Kl. 46f 804), Dec. 29, 1955.