March 13, 1956 R. G. A. EDWARDS 2,738,126

CONSTRUCTION OF COMPRESSOR ROTORS

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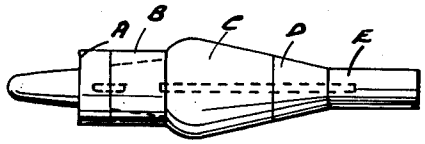

FIG. 1.

FIG. 2

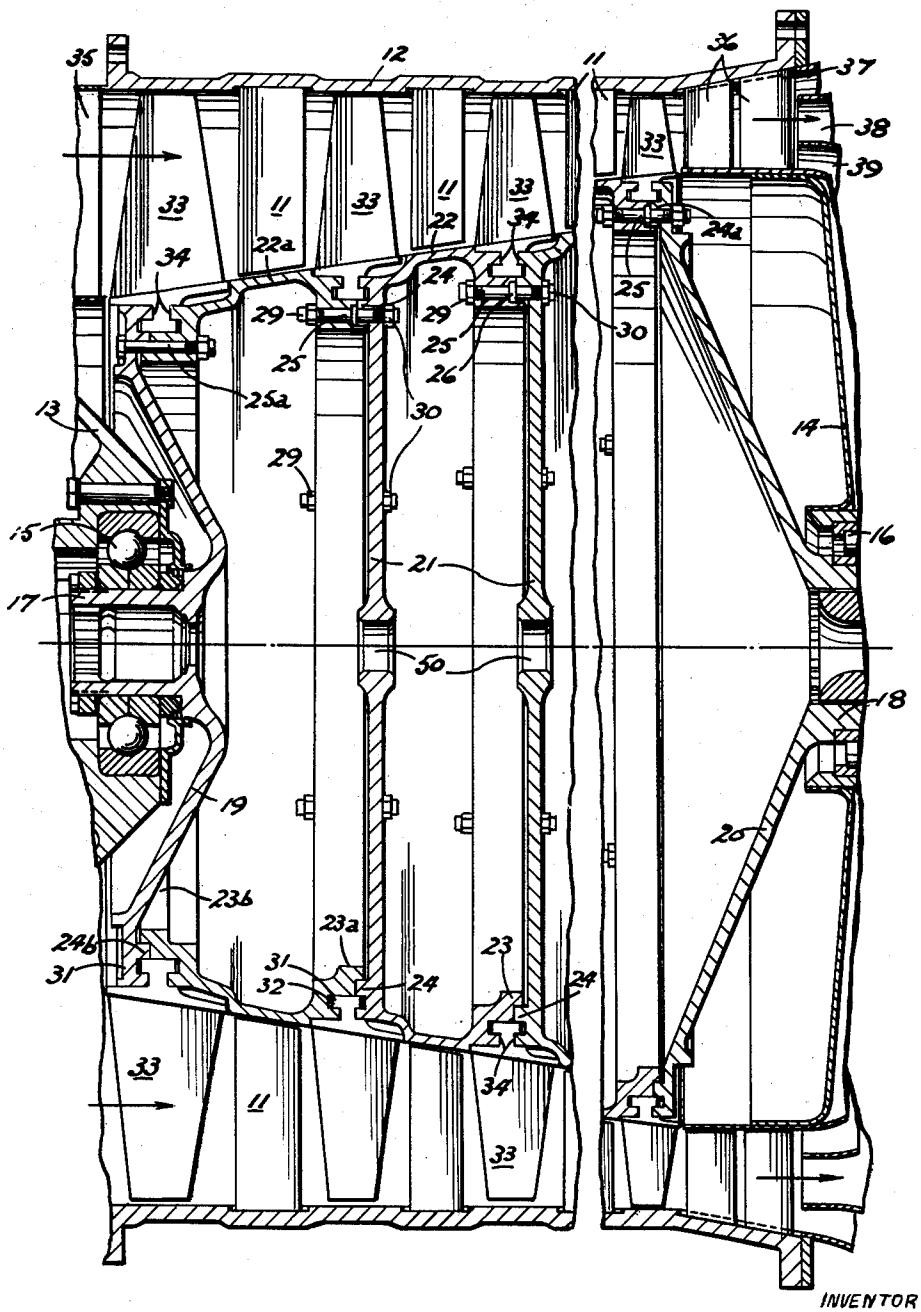

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FIG. 3

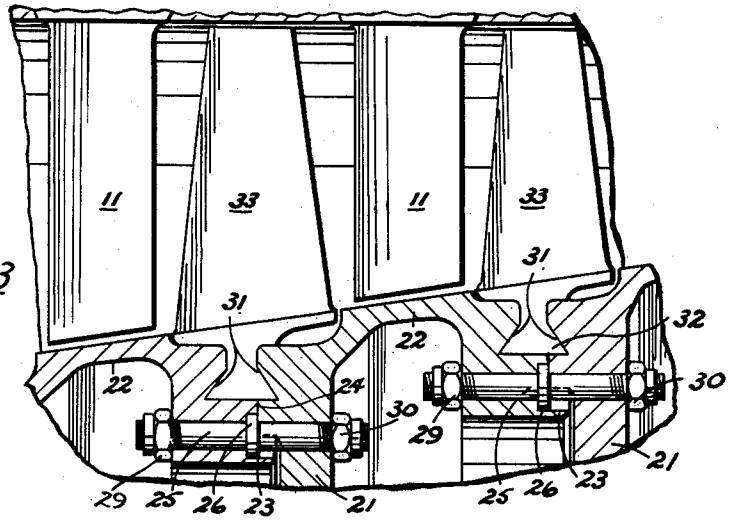


FIG. 8

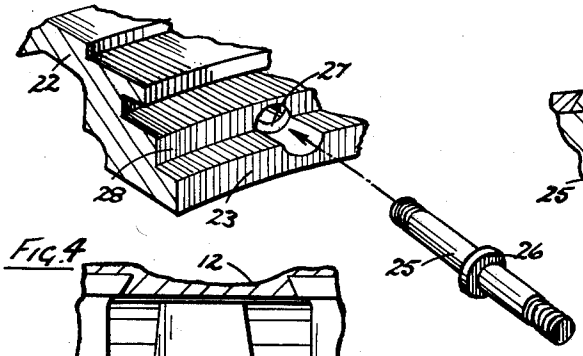


FIG. 6

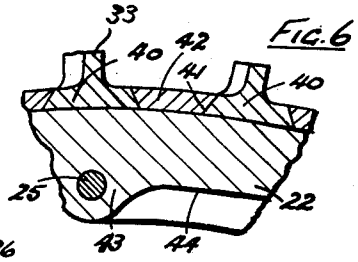


FIG. 4

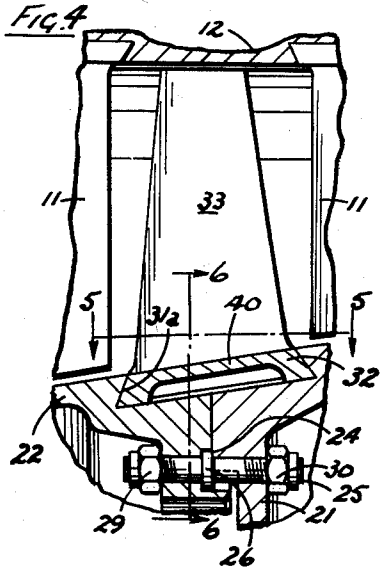


FIG. 5

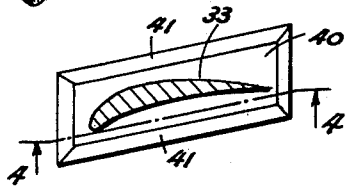
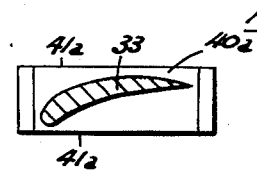


FIG. 7



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United States Patent Office 2,738,126 Patented Mar. 13, 1956

2,738,126

CONSTRUCTION OF COMPRESSOR ROTORS

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Application November 15, 1951, Serial No. 256,475

Claims priority, application Great Britain December 8, 1950

2 Claims. (Cl. 230—134)

This invention relates to an axial-flow compressor, particularly for a gas turbine engine.

The main object is to provide a robust form of bladed compressor rotor which will be relatively inexpensive to produce and will be well adapted to withstand the stresses to which it will be subjected when rotating at high speeds.

According to the invention, a bladed compressor rotor comprises a plurality of discs most of which have an axially-extending peripheral portion which forms a shroud between two adjacent blade rows of the rotor and the axial extremity of which has a spigotal engagement with the next disc, the two discs jointly providing a radial-locating peripheral groove, for the roots of a blade row, when bolted together, radially inwardly of the roots of that row, through their spigotally-engaging portions.

The term "bolt" is used herein in a generic sense to include the use of screws, nuts and bolts, nuts and studs or the like.

In practice all the discs may be as aforesaid, except for the end ones. Preferably the two end discs are of steel and fast with shaft portions journalled in a diaphragm or other portion of the stator, and all the other discs, which may be of aluminium or other light alloy, are peripherally supported from the end ones. In particular, the said other discs may be relatively-thin, plain discs with slightly enlarged hollow hubs providing a passage for cooling air. Near its periphery each of the light alloy discs is provided, at one side, with a short axial flange within which spigots the axial extremity of the aforesaid axially-extending portion of the adjacent disc, and radially outwardly of this flange is the radial-locating peripheral groove for the roots of a blade row. As will be well understood, such groove may be of T-section, "fir-tree" section, or preferably of dovetail section. The spigotal engagement between each light alloy disc and the axial extremity of the axially-extending peripheral portion of an adjacent disc ensures concentricity.

The steel disc at one end may have a spigotal engagement with an independent, axially-extending ring (preferably of light alloy) providing the adjacent shroud and bolted to the steel disc jointly to provide therewith the radial-locating peripheral groove for the roots of the blade row at that end.

All the blades may be inexpensively formed of a plastic moulded to shape and incorporating a filler of asbestos or other heat-resisting material.

Preferably the light-alloy discs are die cast, to obviate the necessity for machining; but when the discs are not die cast the machining operations are easy turning ones, which allows of their production at low cost.

Preferably the axes of each set of retaining bolts lie on a pitch circle which is coincident with the cylindrical surface of the spigotal engagement, being as near the blade roots as is conveniently possible.

In the drawings:

Figure 1 is a diagrammatic view of a gas turbine engine

including an air intake A, an axial-flow compressor B, an annular combustion chamber C (although this latter could be a ring of separate combustion chamber units), an axial-flow turbine D, and a jet pipe E;

Figure 2 is an axial section of an axial-flow compressor constructed in accordance with the invention, parts being omitted for the sake of clearness;

Figure 3 is a fragmentary section similar to Figure 2 but to a larger scale and showing rotor blade roots of a different form;

Figure 4 is a view similar to Figure 3 but showing a modified construction;

Figures 5 and 6 are sections, respectively, on the lines 5—5 and 6—6 of Figure 4;

Figure 7 shows a modified (as compared with Figure 5) form of blade for mounting in the compressor; and

Figure 8 is an exploded, fragmentary perspective view showing the relationship between one of the fixing bolts and one of the spigoting parts.

In Figures 2 and 3 the compressor, of which an intermediate length has been omitted, has rows of radial stator blades **11**, **11** fast at their radially-outer ends with a stator casing **12**, and, at the upstream and downstream ends, respectively, the stator has diaphragms **13**, **14** which support bearing **15**, **16** for aligned shaft portions **17**, **18** fast with the opposite ends of the rotor.

The latter comprises steel end discs **19**, **20**, of which central hubs provide the shaft portions **17** and **18**, and intermediate discs **21**, **21** (two only of which are shown). Each of the discs **21**, which are of light alloy, is formed with an axially-extending peripheral portion **22** having a flange **23** spigotally engaged within an oppositely, axially-directed annular flange **24** of the disc adjacent its right-hand side in Figure 2, the portion **22** of the extreme right-hand disc **21** (not shown) having a similar engagement with a similar flange **24***a* of the right-hand end disc **20**. An independent axially-extending ring **22***a* has flanges **23***a* and **23***b* similarly spigotally engaging within the flange **24** of the left-hand disc **21**, and a flange **24***b* of the left-hand end disc **19**, respectively.

These spigotal engagements can best be seen at the bottom of Figure 2, while at the top of the latter, and in Figures 3 and 8, can best be seen the way the discs are bolted together. The bolts **25** (some only of which are shown) are inserted in bores which have their axes aligned with the axially-directed surfaces of the spigotally engaging flanges, and the bolts have shoulders **26** intermediate their ends (although the bolts **25***a* securing the ring **22***a* to the end disc **19** may be unshouldered).

These shoulders seat on steps **27** at the bottom of counterbores in the portions **22** (or ring **22***a*, as appropriate) for their outer radial surfaces to lie flush with the radial surfaces **28** at the roots of the flanges **23**, **23***a*, and they are located by lock-nuts **29**. This anchors the bolts, and the disc at the right-hand side, during assembly, can be slid onto the extending ends of the bolts and be secured by nuts **30**.

Each disc **21** has a central hole **50**, for cooling air.

Radially-outwardly of the spigotally-engaging flanges the discs **19**, **20** and **21**, and the portions **22** and ring **22***a* have grooves **31** to receive the roots **32** of associated rows of rotor blades **33**, and the portions **22** and ring **22***a* act as shrouds between the rows. It can be arranged, according to the profile of the rotor blade roots, for there to be axial clearance between the bottoms of the grooves and the roots (as shown in Figure 2) and for flanges **34** to grip necks of the roots when the nuts **30** are tightened, or for the grooves and roots to have a wedging engagement as shown in Figure 3 or 4.

As shown in Figure 2 the compressor can have air-inlet guide vanes **35**, and air-outlet guide vanes **36**, these vanes being fast with the stator and the vanes **36** directing the

compressed air into passages 37, 38, 39 leading to a combustion chamber.

The embodiment shown in Figures 4 to 6 differs from that of Figure 2 mainly in the way the blades, which are preferably of molded plastic, are supported. In this case the blades 33 are fast with platforms 40 which are chamfered at the up-stream and down-stream edges to have a dovetail engagement with the grooves 31*a*. The intermediate edges 41 of the platforms are also chamfered and are located by reversely bevelled edges of fillets 42, the up-stream and down-stream edges of the fillets also being bevelled to have a dovetail engagement with the grooves 31*a*. As shown in Figure 5 the platforms (and, of course, the fillets) are parallelogram-like in plan.

The blade shown in Figure 7 has a rectangular platform 40*a* of which the up-stream and down-stream edges are bevelled, like those of the platform 40 of Figure 5, to have a dovetail engagement with the grooves 31*a*, the intermediate edges 41*a* in this case lying in planes which are radial of the rotor axis so as to pack closely together when the blades of a row are assembled.

For lightening the portions 22 and the ring 22*a* their radially inner edges can be relieved, as indicated at 44 in Figure 6, intermediate the bolting positions where bosses 43 are left to accommodate the bolts 25, 25*a*. Also for lightening purposes, the platforms 40, and 40*a* can be hollowed on the underside as shown in Figure 4.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. A demountable axial-flow bladed compressor rotor comprising opposite end discs fast with respective outwardly-extending coaxial shaft portions, a plurality of concentric intermediate thin discs with axially-extending peripheral portions at their corresponding one sides, each of said axially-extending portions having at its extremity a radially-inwardly directed flange which is formed on its outer axial side for spigotal engagement with the adjacent disc, an axially-extending ring between said end disc and the extreme intermediate disc whose axially-extending portion is remote from the adjacent end disc, said ring being provided at its ends with radially-inwardly directed flanges which are formed on their outer axial sides for spigotal engagement respectively with the adjacent end and intermediate discs, said ring and axially-extending peripheral portions constituting shrouds and supporting said intermediate discs from said end discs in mutually spaced relation whereby to form a light hollow structure which is internally reinforced against centrifugal loads by said discs and which is supported from said shaft portions, each said axially-extending portion and each end of said ring also forming with the disc to which it is spigoted a peripheral groove for locating a row of rotor blades, said adjacent end disc, the radially-inwardly directed flange of said ring remote from said adjacent end disc, and each said radially-inwardly directed flange of said axially-extending portions having fast therewith a circle of bolts which extend parallel to the axis of the compressor through a corresponding circle of coacting holes which is in the adjacent spigotally-engaged part and intersected by the cylindrical surface of the spigotal engagement, and detachable nuts on the extending ends of said bolts whereby said ring, said axially-extending portions and said adjacent discs are demountably held in assembled relation with the associated blade rows detachably clamped in said peripheral grooves.

2. A demountable axial-flow bladed compressor rotor comprising opposite end discs fast with respective outwardly-extending coaxial shaft portions, a plurality of concentric intermediate thin discs with axially-extending peripheral portions at their corresponding one sides, each of said axially-extending portions having at its extremity a radially-inwardly directed flange formed on its outer axial side with an annular step, each of said intermediate discs on the side opposite said axially-extending portion formed with an annular ridge, the adjacent steps and ridges forming a spigot for inter-engaging adjacent discs and axially-extending portions, said axially-extending portions forming shrouds, an axially-extending ring between the extreme intermediate disc whose axially-extending portion is remote from the adjacent end disc and said end disc, said ring having at each end a radially-inwardly directed flange, said ring flanges each having an annular step, the said end disc having an annular ridge for spigotal engagement with the adjacent annular step of said ring and the other annular step of said ring spigotally engaging the ridge of the adjacent intermediate disc, said ring forming a shroud, said ring and axially-extending portions supporting said intermediate discs from said end discs in mutually spaced relation whereby to form a light hollow structure which is internally reinforced against centrifugal loads by said discs and which is supported from said shaft portions, each said axially-extending portion and each end of said ring also forming with the disc to which it is spigoted a peripheral groove for locating a row of rotor blades, said adjacent end disc, the radially-inwardly directed flange of said ring remote from said adjacent end disc, and each said radially-inwardly directed flange of said axially-extending portions having fast therewith a circle of bolts which extend parallel to the axis of the compressor through a corresponding circle of coacting holes which is in the adjacent spigotally-engaged part and intersected by the cylindrical surface of the spigotal engagement, and detachable nuts on the extending ends of said bolts whereby said ring, said axially-extending portions and said adjacent discs are demountably held in assembled relation with the associated blade rows detachably clamped in said peripheral grooves.

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