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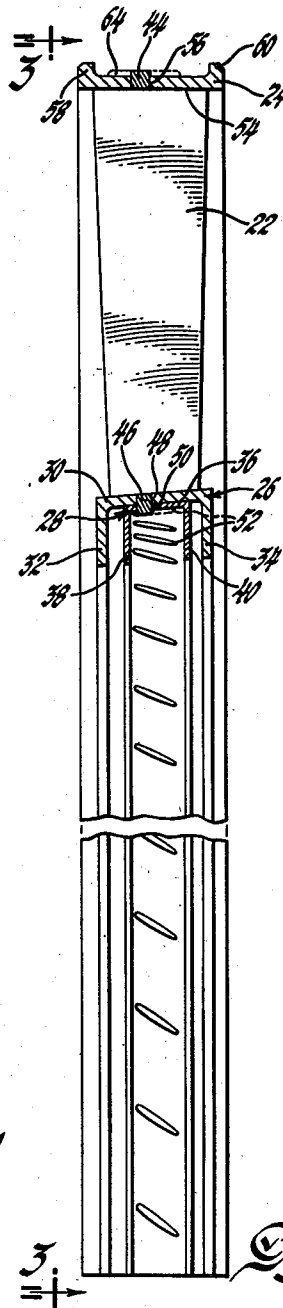
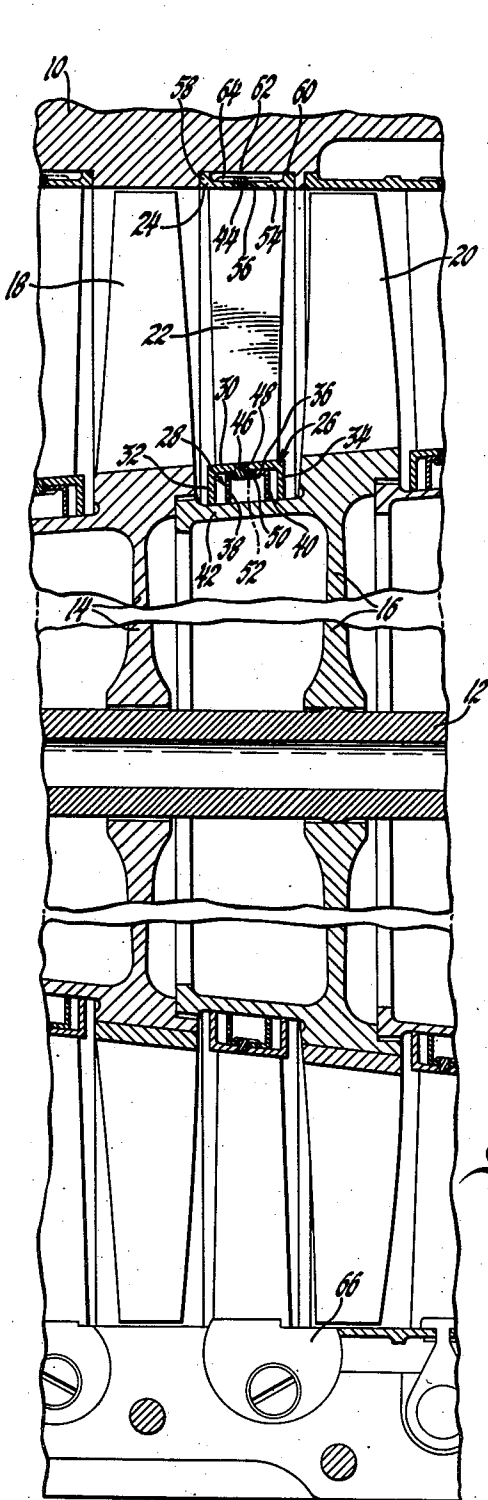
J. B. WHEATLEY ET AL

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TURBINE OR COMPRESSOR STATOR RING

Filed March 21, 1950

2 Sheets-Sheet 1



Inventors
John B. Wheatley
Arthur W. Gaubatz &
Charles C. Anderson
Willits, Helwig & Baillie
Attorneys

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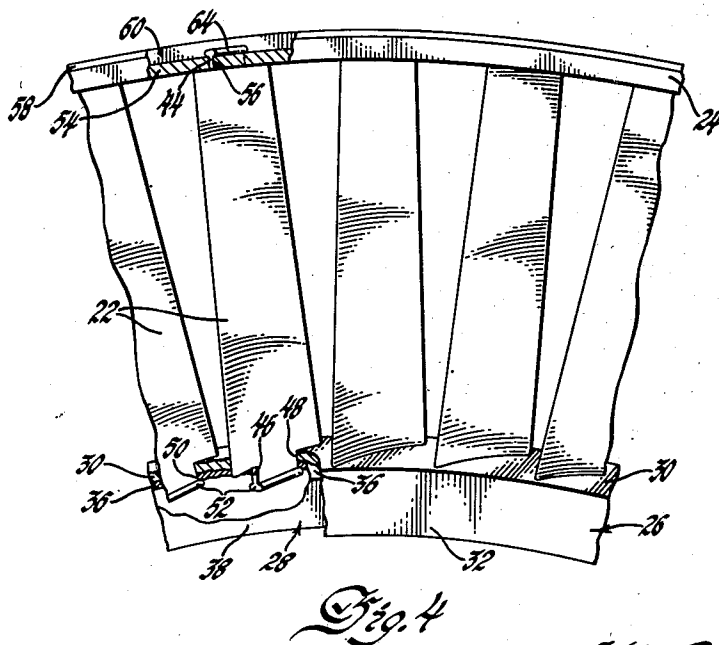
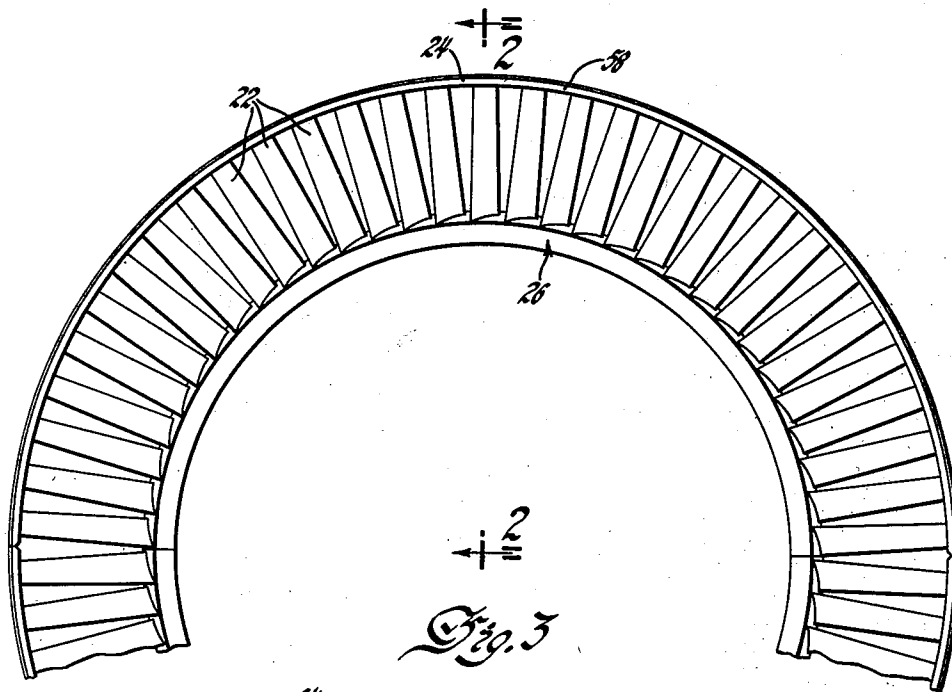
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Inventors
John B. Wheatley,
Arthur W. Gaudatz &
Charles C. Anderson
Willits, Helwig & Gaillico
Attorneys

UNITED STATES PATENT OFFICE

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TURBINE OR COMPRESSOR STATOR RING

John B. Wheatley, Arthur W. Gaubatz, and
Charles C. Anderson, Indianapolis, Ind., assign-
ors to General Motors Corporation, Detroit,
Mich., a corporation of Delaware

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4 Claims. (Cl. 253-78)

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This invention relates to multistage rotary machines and particularly to an improved stator ring and seal structure for axial flow elastic fluid compressors or turbines.

The present invention is shown as being embodied in the stator ring structure of the compressor of such a turbine and comprises an outer ring or band which radially spaces the stator blades, an inner sealing means of one or more annular channels, and stator blades positioned between and secured to the outer band and the inner sealing channels. The bases of the outer band and the sealing channels are apertured to receive projections or tenons formed on the ends of the stator blades, which blades are secured to the outer band and sealing channels by heading the blade tenons. This outer band is seated in an annular slot or groove formed in the inner surface of the compressor casing.

The principal object of the invention is to provide a stator ring structure which is simple and inexpensive to manufacture and assemble, light in weight, and which possesses adequate structural strength. These features, incorporated into the present invention, are particularly desirable in aircraft turbine construction, where weight is such a major consideration. The outer band and the sealing channels are preferably constructed wholly of rolled stock, resulting in a ring structure which possesses little weight and sufficient rigidity. Moreover, the entire ring structure may be constructed in two semi-circular segments which are secured, one at a time, to the turbine compressor casing, thereby facilitating assembly of the ring.

Another object of the invention is to provide an improved construction and arrangement whereby loss due to leakage of elastic fluid around the blade tips is reduced to a minimum. This is accomplished in accordance with the invention by the aforementioned sealing means comprising one or more annular channels having apertured bases to which the stator blade tenons are affixed. The channel flanges are adapted to project into proximity with portions of the rotor discs, thereby constituting a very effective labyrinthine seal as well as a structural support and spacing device for the stator blades.

Other objects and advantages of the invention will more fully appear from the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a fragmentary longitudinal section of a compressor of an axial flow elastic fluid tur-

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bine provided with blades and a stator ring structure embodying the invention.

Figure 2 is an enlarged sectional view, partly broken away, taken along the line 3-3 of Figure 2, showing one of the stator blades with the outer band and sealing channels attached thereto.

Figure 3 is an end view, taken along the line 3-3 of Figure 2, showing the semi-circular construction of the stator ring structure.

Figure 4 is an enlarged fragmentary view, partly in elevation and partly in section, of a portion of the stator ring structure, showing the method of attachment of the blades to the outer band and the sealing channels.

Referring to the drawings, the compressor of an axial flow elastic fluid turbine having a casing 10 is shown in Figure 1. Within the casing 10 is a rotor with a shaft 12 passing through rotor discs 14 and 16 containing rotor blades 18 and 20, respectively. A stator ring structure is located on either side of each row of rotor blades, each stator ring comprising a row of stator blades 22 secured between a circular outer band 24 and annular sealing channels 26 and 28. During operation the elastic fluid is directed by the nozzles formed by the stator blades to the passages defined between the adjacent rotor blades and discharged from the latter to the nozzles formed by the next annular series of stator blades.

Leakage of fluid around the stator blades is materially reduced by the provision of the aforementioned sealing means secured to the inner tips of the stator blades. This sealing means, in a preferred embodiment, as shown in the drawings, comprises the two concentrically arranged annular channel members 26 and 28. The larger outer channel 26 has a base or shroud portion 30 which may project beyond the edge of the stator blades 22, as shown in Figures 1 and 2, and two inwardly directed sealing flanges 32 and 34. The smaller inner channel also comprises a base portion 36 and two inwardly extending sealing flanges 38 and 40, the base 36 of this smaller channel having a width less than the base portion 30 of the larger outer channel 26 and seated thereupon. The edges of the resultant series of axially spaced flanges 32, 34, 38 and 40 are adapted to project into proximity with an axial extension 42 of rotor disc 16, thereby acting as a very effective labyrinthine seal. The embodiment of the invention shown in the drawings is one where the sealing channels are adapted to cooperate with a conical projection of the rotor disc. These flanges can be of various lengths or shapes adapt-

ed to fit irregularly contoured or rounded sealing members or surfaces on the rotor. The exact construction of the sealing flanges will be governed, of course, by the contour of such rotor members.

As shown in the drawings, the tip portions of the compressor stator blades 22 are shaped to provide outer and inner projections or tenons 44 and 46, respectively. The details of construction of these blade tenons and the method of attachment of the sealing channels 26 and 28 and the outer band 24, which will be subsequently described, are best shown in Figures 2 and 4. It can be seen that the larger annular sealing channel 26 is preferably of greater thickness than the smaller inner sealing channel 28, the former supplying most of the rigidity to the seal structure. The smaller channel is principally a sealing device, although it too contributes to the structural strength of the stator ring and aids in the alignment of the stator blades. The inner tenon 46 of the stator blade 22 has a length slightly greater than the combined thicknesses of the bases 30 and 36 of the sealing channels 26 and 28 to permit the heading of the tenons by electric upsetting or other suitable means, thereby securing the sealing channels to the blades. Similarly the length of the outer blade tenon 44 is sufficiently greater than the thickness of the outer band 24 to allow the ready attachment of the blades to the outer band by heading the blade tenons.

The base 30 of the larger outer sealing channel 26 and the base 36 of the smaller inner sealing channel 28 are provided throughout their circumferences with apertures 48 and 50, respectively, which are aligned to permit the inner tenons 46 of the stator blades 22 to be positioned in these apertures of both sealing channels, the same blade tensions being used to secure both these members to the blade tips. As previously stated, the blade tenons 46 are upset by appropriate means, the resultant tenon heads 52 being best shown in Figure 4. Thus both sealing channels 26 and 28 are securely fastened to the same blade tenons in a single operation without the necessity for any additional connecting means.

The outer band 24 extends around the inside of and engages the casing. This band, which functions principally to secure and radially space the stator blades, has a base 54 provided with apertures 56 throughout its circumference, with the outer tenons 44 of the stator blades positioned in these apertures and headed, as hereinbefore described, to secure the blades to the other band. As shown in the drawings, the outer band 24 may be formed with outwardly projecting peripheral flanges or rims 58 and 60, which are seated in an annular slot or groove 62 formed in the inner surface of the casing. These rims 58 and 60, engaging the casing groove 62, prevent axial movement of the ring structure and aid in the blade alignment, as well as increase the structural strength of the stator ring. Moreover, as can be seen in Figures 1 and 2, this arrangement provides an annular clearance space between the base 54 of the outer stator band 24 and the casing 10 for the formed blade tenon heads 54.

The outer band 24 and the sealing channels 26 and 28 are each preferably constructed of rolled stock and formed in two semi-circular segments, as shown in Figure 3, to facilitate assembly of the stator ring. These ring members

are sufficiently flexible so that after the inner blade tenons 46 are positioned within the apertures 48 and 50 in the sealing channels 26 and 28, and before any of the tenons are headed, these channels may be straightened out enough to permit the insertion of the outer blade tenons 44 into the apertures 56 of the outer band 24, which in turn may be sprung over the outer tenons. Adequate clearances may be provided between the apertures 48, 50 and 56 and the blade tenons 44 and 46 to expedite this procedure. Keepers 66, shown in Figure 1, may be employed to retain the ring structure within the casing during assembly.

It will be understood that the term "compressor," as used hereinbefore, is not intended as a limitation on the use of the invention and that the described stator ring structure is adapted generally for use in compressors, turbines and similar rotary machines where it is necessary to have a stationary blade assembly adjacent to rotor blades to direct the flow of elastic fluid.

We claim:

1. A blade assembly for a fluid machine of the dynamic type comprising, in combination, an arcuate outer strip, at least one arcuate inner strip of channel form with the flanges directed inwardly, and a plurality of blades extending from the outer strip to the inner strip, the depth of the said arcuate strips in a radial direction being small relative to the length of the blades from one strip to the other, the said strips when unassembled being light and flimsy and readily deflected in a radial direction relative to the arcs thereof, means on each end of each blade abutting on each of said strips throughout substantially the axial extent of said blades, the blades extending radially with respect to the arcs of the strips from a common center and being rigidly secured to the said strips so that the strips and blades cooperate to form a rigid lattice and stiffen the said strips.

2. A blade assembly as claimed in claim 1 in which the arcuate extent of the strips is substantially 180 degrees.

3. A blade assembly as claimed in claim 1 in which the blades have tenons at each end and the abutment means includes shoulders at the bases of the tenons, openings through the strips through which the tenons extend, the blade shoulders bearing against one face of the strips, and the tenons rigidly secured against the other face of the strips.

4. A stator assembly for a fluid machine of the dynamic type, comprising, in combination, a casing formed with a shallow circumferential groove in the inner surface thereof and an arcuate blade assembly mounted therein comprising an arcuate outer strip, at least one arcuate inner strip of channel form with the flanges directed inwardly, and a plurality of blades extending from the outer strip to the inner strip, the depth of the said arcuate strips in a radial direction being small relative to the length of the blades from one strip to the other, the said strips when unassembled being light and flimsy and readily deflected in a radial direction relative to the arcs thereof, means on each end of each blade abutting one each of said strips throughout substantially the axial extent of said blades, the blades extending radially with respect to the arcs of the strips from a common center and being rigidly secured to the said strips so that the strips and blades cooperate to form a rigid lattice and stiffen the said strips; the said outer arcuate

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strip being disposed in the said groove with the inner surface of the strip substantially corresponding to the inner surface of the casing.

JOHN B. WHEATLEY.
ARTHUR W. GAUBATZ.
CHARLES C. ANDERSON.

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