United States Patent

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[54] TURBINE STATOR STRUCTURE

2 Claims, 5 Drawing Figs.

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[51] Int. Cl. F01d 9/04, F01d 11/00
[50] Field of Search .... 253/78, 78B, 78D, 77.3, 39A, 39C; 103/111(c4); 231/132(S); 415/136, 139

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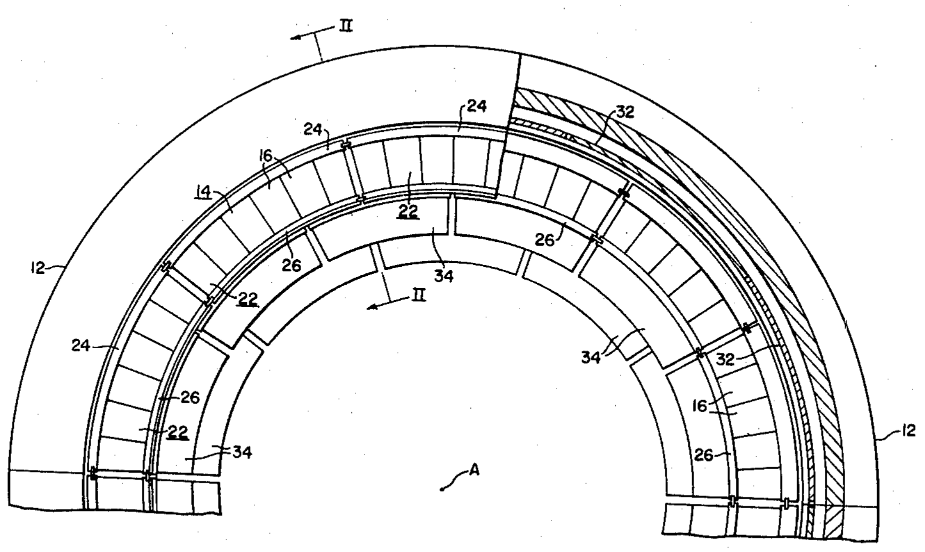
ABSTRACT: In a turbine stator structure a blade ring supports diaphragm assemblies including a plurality of vane segments disposed between rows of rotor blades, and a plurality of rows of ring segments which encircle the rotor blades. The blade ring is divided into two semicircular halves with each half supporting a plurality of rows of vane segments as well as the rows of ring segments. Axial and radial seal members at the joints between segments are so constructed that the radial members retain the axial members in position and the radial members are retained by the axial members and the blade ring.



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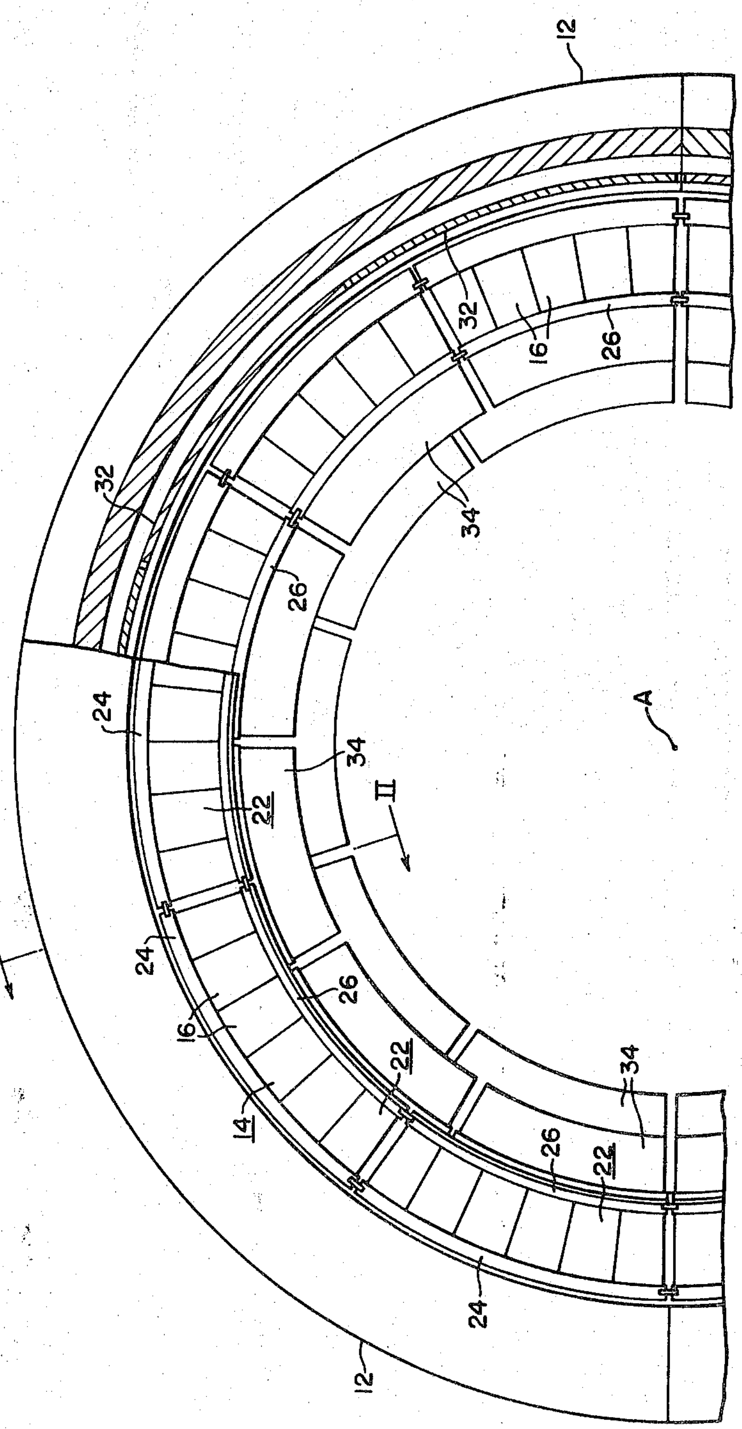

FIG. 1.

WITNESSES

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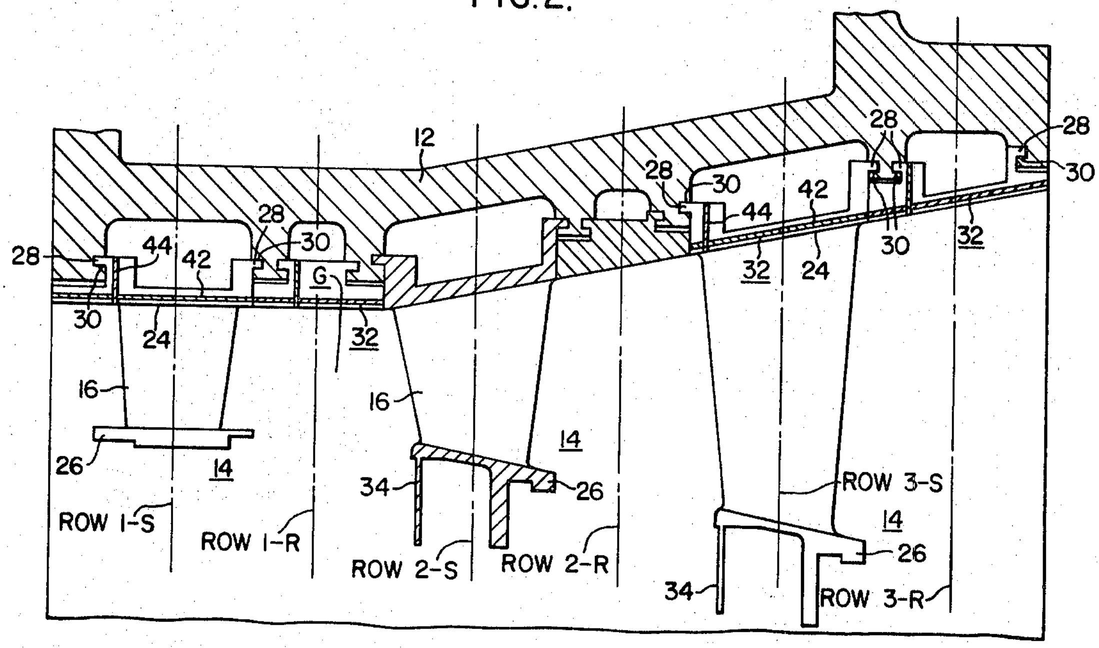
FIG. 2.



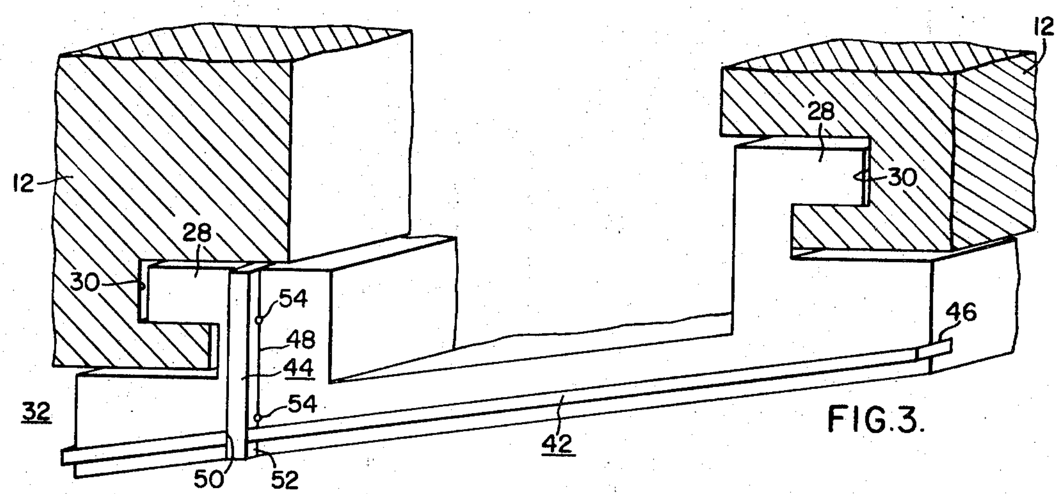


FIG. 3.

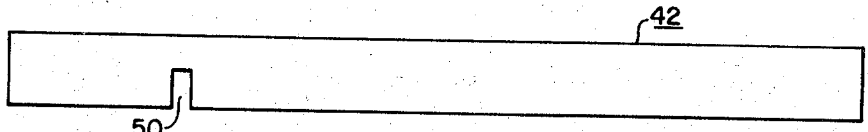


FIG. 4.

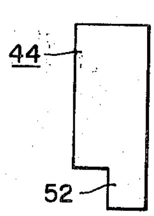


FIG. 5.

TURBINE STATOR STRUCTURE

BACKGROUND OF THE INVENTION

This invention relates, generally, to elastic fluid machines and, more particularly, to seals for joints between arcuate segments of stationary members of a turbine stator.

In elastic fluid machines, such as axial flow gas turbines, which are subjected to a relatively high rise in temperature during operation, it is desirable to provide a plurality of ring segments which encircle each row of rotor blades and to divide each diaphragm structure disposed between the rows of rotor blades into vane segments to accommodate the thermal expansion effects. Each diaphragm vane segment has an inner arcuate shroud segment and an outer arcuate shroud segment between which the stationary vanes or blades are secured. The outer arcuate shroud segments and the ring segments are assembled in a blade ring divided into two semicircular halves. It is desirable to provide seals at the joints between the segments to minimize leakage of the elastic fluid through the joints.

In a copending application Ser. No. 731,151 filed May 22, 1968, now U.S. Pat. No. 3,519,366 by R. F. Campbell and assigned to the same assignee as this invention there is described a seal arrangement particularly suitable for use at the joints between the inner shroud segments of the diaphragm structure.

An object of this invention is to provide axial and radial seal members suitable for use at the joints between arcuate segments which are assembled in the blade ring of the stator structure.

Another object of the invention is to so interlock the axial and the radial seal members that the radial members retain the axial members in position and the radial members are retained by the axial members and the blade ring when the segments are assembled in the blade ring.

Other objects of the invention will be explained fully hereinafter or will be apparent to those skilled in the art.

SUMMARY OF THE INVENTION

In accordance with one embodiment of the invention, a plurality of arcuate segments are assembled in a turbine stator blade ring which is divided into two semicircular halves. Axially and radially extending seal members are provided to seal the gaps between the ends of adjacent arcuate segments. The seal members are so constructed that the radial members retain the axial members in position and the radial members are retained by the axial members and the blade ring after the segments are assembled in the blade ring.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the nature and objects of the invention, reference may be had to the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an end view of the upper half of a turbine blade ring assembly embodying principal features of the invention, portions being cut away for clearness;

FIG. 2 is a sectional view of the blade ring assembly, taken along line II–II of FIG. 1;

FIG. 3 is an enlarged isometric fragmentary view, showing the end of one ring segment and the manner of retaining the seal members in grooves in the ring segment;

FIG. 4 is a view, in plan, of one of the axially extending seal members utilized in the seal ring assembly; and

FIG. 5 is a view, in side elevation, of one of the radially extending seal members utilized in the seal ring assembly.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the drawings, particularly to FIGS. 1 and 2, the structure shown therein comprises an inner tubular casing usually called a blade ring 12 which supports a plurality of diaphragm assemblies 14, each containing an annular array of vanes or blades 16 which encircle a turbine rotor (not shown) that rotates about the central axis A of the turbine. In a multistage axial flow turbine, a stationary diaphragm assembly containing stationary vanes or blades is provided between rows of rotor blades which rotate with the rotor. The stationary blades of the diaphragm direct the flow of motive fluid past the rotor blades (not shown) to motivate the rotor in a manner well known in the art. The blade ring 12 is divided into two semicircular halves, only the upper half being shown in the present drawing. The lower half is similar in structure to the upper half. The two halves are secured together in any suitable manner, as well known in the art. The blade ring 12 is mounted inside an outer turbine casing or cylinder (not shown).

As shown more clearly in FIG. 1, each diaphragm assembly 14 is divided into a plurality of arcuate segments 22 disposed in closely spaced relation with each other in an annular array. Each segment 22 has an outer arcuate shroud segment 24 and an inner arcuate shroud segment 26 between which the blades 16 are secured.

As shown more clearly in FIG. 2, the outer shroud segments 24 are generally channel-shaped in cross section, with axially extending tongues 28 provided in opposite sides of the channel which are received in circumferentially extending grooves 30 in the blade ring 12, thereby slidably attaching the outer shroud segments 24 to the blade ring. As also shown in FIG. 2, ring segments 32 are disposed between the shroud segments 24 to jointly define the outer periphery of the motive fluid passageway G. The ring segments 32 are attached to the blade ring 12 in a manner similar to the manner in which the shroud segments 24 are attached.

Each row of ring segments 32 encircles a row of rotor blades (not shown). In the present instance three annular rows 1–R, 2–R and 3–R of arcuate ring segments and three rows 1–S, 2–S and 3–S of arcuate vane segments are shown. The segments 24 of rows 2–S and 3–S and the segments 32 of rows 2–R and 3–R are so shaped that the circles formed by successive rows of segments increase in diameter. The inner shroud segments 26 of rows 2–S and 3–S are provided with inwardly extending flanges 34 which cooperate with seal members (not shown) and the rotor to minimize leakage of motive fluid.

In order to minimize leakage of the motive elastic fluid through the joints between neighboring arcuate segments, it is desirable to provide seals at the joints between the segments. In the aforesaid copending application there is described a seal arrangement particularly suitable for use at the joints between the inner shroud segments 26 of the diaphragm structure.

The present application is directed to a seal arrangement particularly suitable for use at the joints between the arcuate ring segments 32. However, the seal arrangement herein described also may be utilized at the joints between the outer shroud segments 24 of the diaphragm structure.

As shown more clearly in FIG. 3, an axially extending seal member 42 and a radially extending seal member 44 are provided at each joint between neighboring ring segments 32. Each end of each segment 32 has a groove 46 therein for receiving the seal member 42 and a groove 48 therein for receiving the seal member 44. The grooves 46 and 48 intersect each other.

As shown more clearly in FIG. 4, the axial seal member 42 is an elongated substantially flat metal strip with a rectangular notch 50 in one edge of the strip. The thickness of the strip 42 is shown in FIG. 3.

As shown in FIG. 5, the radial seal member 44 is a substantially flat metal strip having a projecting tab 52 at one end of the strip. The thickness of the strip 44 is also shown in FIG. 3.

The axial seal member 42 extends in axial direction across the gap between a pair of neighboring ring segments 32 and is received in their associated grooves 46. The radial seal member 44 extends radially across the gap between neighboring ring segments 32 and is received in their associated grooves 48 in the neighboring ends of the segments. The axially extending seal members prevent radial outward leakage of elastic fluid and the radially extending seal members prevent axial leakage flow of the elastic fluid.

As shown more clearly in FIG. 3, the axial seal member **42** is retained in position in the groove **46** by the tab **52** on the radial seal member **44** which extends into the notch **50** in the axial seal member **42**. The radial seal member **44** is retained in the groove **48** by "prick punching" **54** on the edges of the groove **48**. A relatively small clearance is provided in the grooves **46** and **48** for the seal members **42** and **44**, respectively. The prick punching is required to hold the strips in place during assembly only. After the parts are assembled in the blade ring **12**, the seal strips are mutually retained. The tab **52** of the radial seal **44** extends into the notch **50** in the axial seal **42**, thereby retaining the axial seal in position. The radial seal **44** is then prevented from falling out by the axial seal in one direction and the blade ring **12** in the other direction as shown in FIG. 3.

As explained hereinbefore, the seal arrangement herein described is particularly suitable for use at the joints between ring segments of a stator structure which has a relatively small differential in radial expansion and requires no rotation of the seal strip for assembly or circumferential expansion. The present arrangement may also be utilized at the joints between the outer shroud segments of the diaphragm structure of a turbine stator.

From the foregoing description it is apparent that the invention provides an interlocked sealing arrangement for the gaps at the joints between arcuate segments of a turbine stator structure. The seal arrangement is particularly suitable for use with gas turbines and is effective to reduce leakage from the flow path and to obtain a reduction in the amount of hot gas leaking into cooled areas.

Since numerous changes may be made in the above described construction and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all subject matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In an elastic fluid machine, in combination:
a blade ring;
a plurality of arcuate segments assembled in said blade ring and disposed in closely spaced relation with each other in an annular array thereby forming gaps between neighboring segments;
separate axially and radially extending seal members disposed between neighboring segments and extending across said gaps;
the ends of neighboring segments being provided with at least one groove for receiving an axial seal member and at least another groove for receiving a radial seal member;
said grooves intersecting each other;
each seal member being an elongated substantially flat metal strip;
the axial seal member having a notch therein; and
the radial seal member having a projecting tab on one end which extends into the notch and is effective to form an interlock therewith, whereby the radial seal member retains the axial seal member in position and the radial seal member is retained by the axial seal member and the blade ring after the segments are assembled in the blade ring.

2. In an elastic fluid machine, in combination:
a blade ring;
a plurality of arcuate segments assembled in said blade ring and disposed in closely spaced relation with each other in an annular array thereby forming gaps between neighboring segments;
axially and radially extending seal members disposed between neighboring segments and extending across said gaps;
said seal members being so constructed that the radial members retain the axial members in position and the radial members are retained by the axial members and the blade ring after the segments are assembled in the blade ring;
the ends of neighboring segments being provided with at least one groove for receiving an axial seal member and at least another groove for receiving a radial seal member;
each seal member being an elongated substantially flat metal strip;
the axial seal member having a notch therein;
the radial seal member having a projecting tab on one end which extends into the notch and is effective to form an interlock therewith; and
prick punches on an edge of the groove containing the radial seal member for retaining the radial seal member in its groove in said segment during assembling of the segment in the blade ring.