Sept. 17, 1963 W. E. D. VIVIAN 3,104,091

TURBINES

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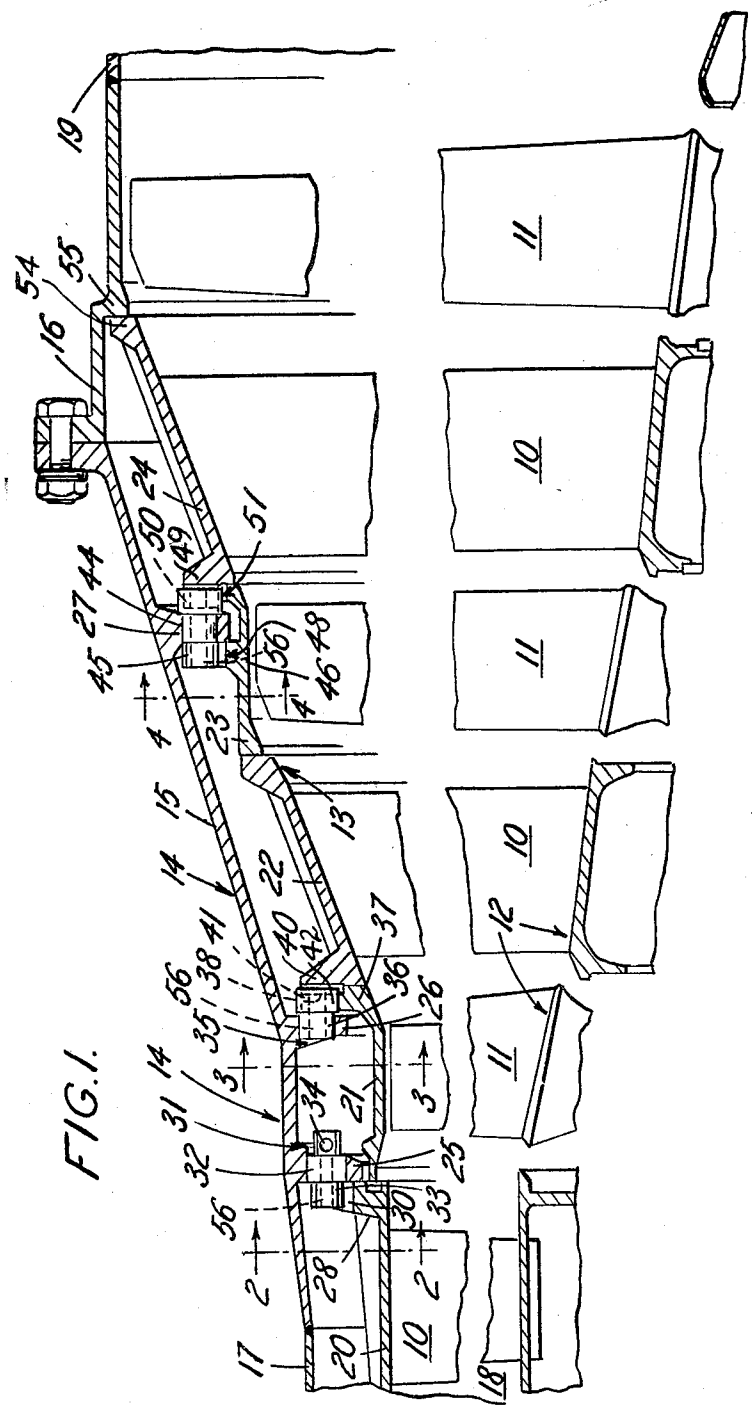


FIG. 1.

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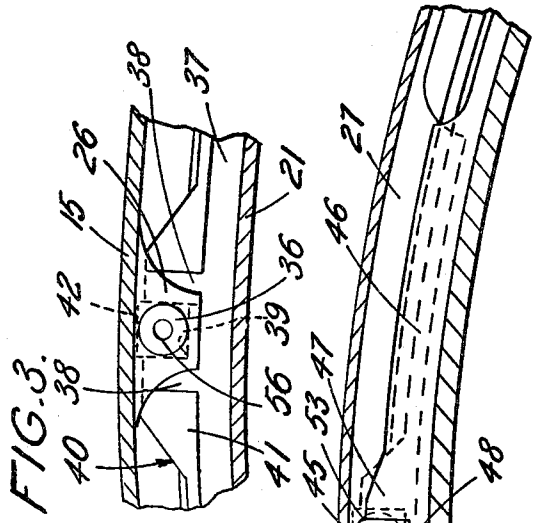


FIG. 3.

FIG. 4.

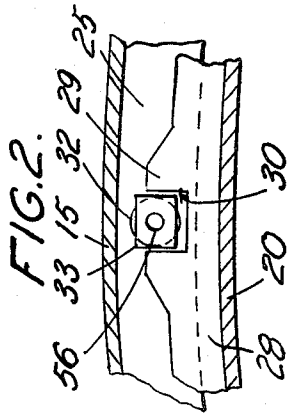


FIG. 2.

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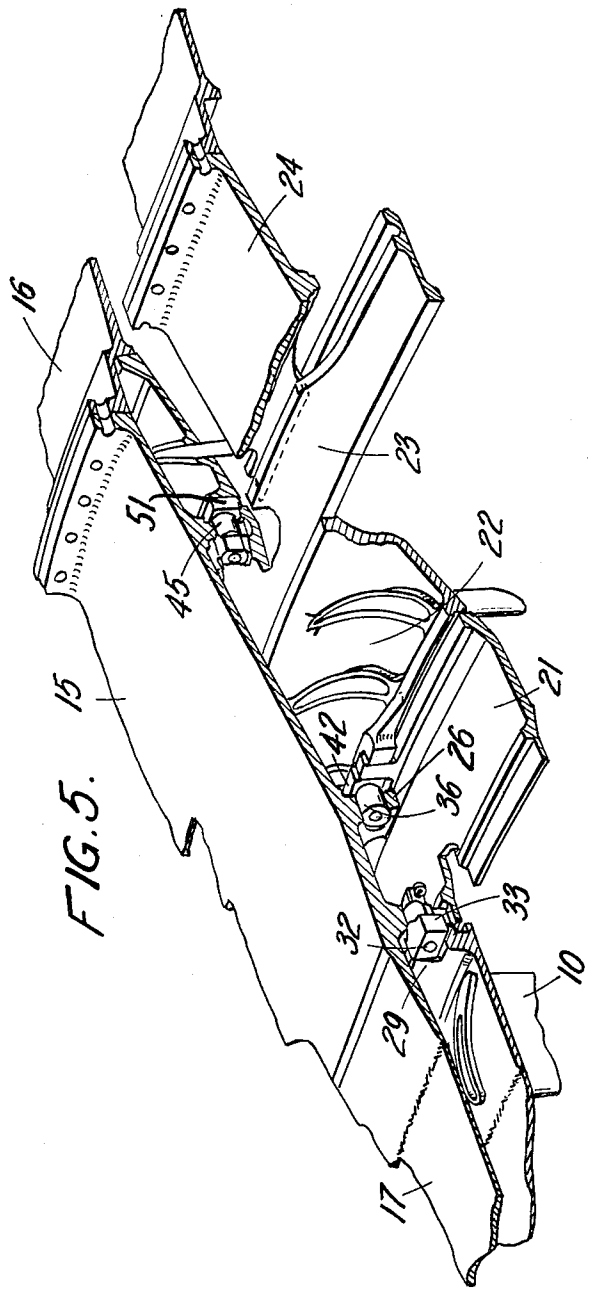


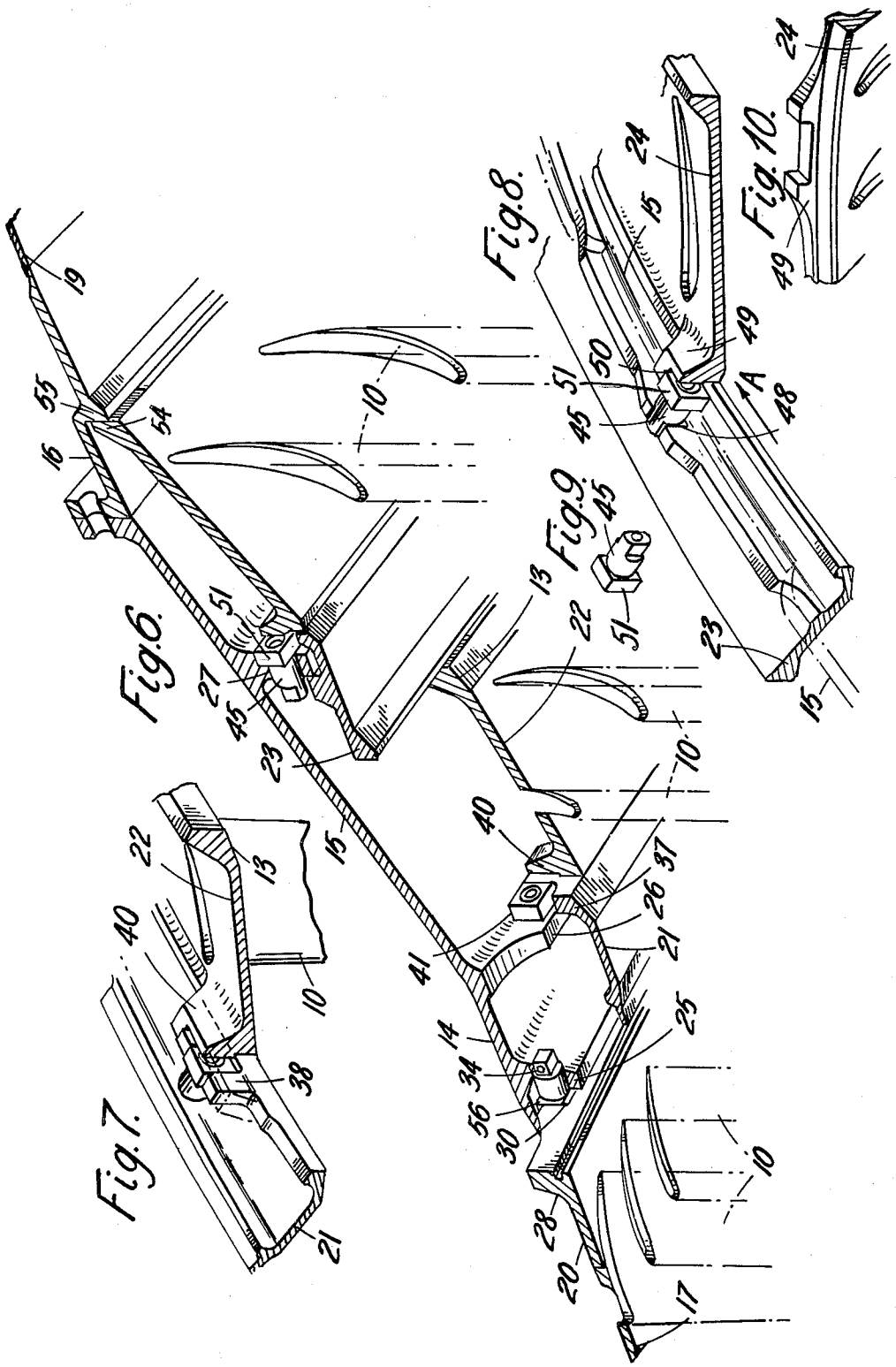
FIG. 5.

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Filed Jan. 15, 1960 4 Sheets-Sheet 4



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3,104,091

TURBINES

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3 Claims. (Cl. 253—39)

This invention relates to stator structures for rotary machines having annular fluid flow passages especially axial flow gas turbines.

According to this invention there is provided a stationary structure for an axial flow rotary machine, which structure comprises an annular supporting member and a liner ring member disposed coaxially with the supporting member, and a plurality of axially-extending pins mounted on one of the members, the other of the members being formed with radially-extending slots in which the pins engage so that the liner ring member is supported from the supporting member by the pins.

By way of example one embodiment of the invention will now be described with reference to the annexed drawing in which:

FIGURE 1 is a sectional side elevation of one half of a three-stage axial flow gas turbine having a stator structure in accordance with the invention,

FIGURES 2, 3 and 4 are cross-sectional fragmentary views taken respectively along lines 2—2, 3—3 and 4—4 in FIGURE 1,

FIGURE 5 is a perspective view of the arrangement with parts broken away to show the construction,

FIGURE 6 is another perspective view of the arrangement looking in the upstream direction, the blades and parts of the various members being omitted or cut away to show the construction,

FIGURES 7 and 8 are local perspective views with various elements omitted to show the construction,

FIGURE 9 shows one of the axially extending pins, and

FIGURE 10 shows the shape of the upstream end portion of one of the blade platforms viewed in the direction of arrow A in FIGURE 9, the blades being omitted.

Referring to FIGURES 1, 5 and 6 the three stages of the turbine each comprise a ring of stator blades **10** and a ring of rotor blades **11**. The stator and rotor blades extend across an annular gas passage defined by radially spaced inner and outer walls **12**, **13**. A casing **14** for the turbine, comprising an upstream major housing section **15** bolted to a downstream minor section **16**, is welded at its upstream end to the outer casing **17** of a combustion system which delivers hot gas to an entry duct **18** to the turbine. The downstream end of the turbine casing **15** is welded to the turbine exhaust duct **19**.

The outer wall **13** of the gas passage through the turbine comprises the outer wall **20** of the turbine entry duct **18**, a first-stage liner **21**, an annulus of second-stage stator blade platforms **22**, a second-stage liner **23**, and an annulus of third-stage stator blade platforms **24**.

The major section of the turbine casing **15**, which is substantially frusto-conical, is radially spaced from the outer wall **13** of the gas passage and is formed integrally with supporting means represented by a radial flange **25** and two series of circumferentially-spaced lugs **26**, **27** which series are axially spaced from each other. The

flange **25** and the lugs **26**, **27** extend radially inwardly towards the outer wall for the support and location of the entry duct wall **20**, the stator platforms **22**, **24** and the rotor liners **21**, **23**. The outer ends of the first-stage stator blades are welded to the adjacent wall **20** of the turbine entry duct which terminates downstream in an outwardly projecting radial flange **28**. This flange **28** is provided at intervals around its rim with pairs of circumferentially spaced radial shoulders **29** (see FIGURE 2) the rim between each pair of shoulders being cut away to form an open-ended slot **30**, and at its downstream face the flange **28** abuts against the flange **25**. The flange **25** is drilled axially to provide an annular series of holes **31** with which the slots **30** of the duct flange are caused to register, and locating pins **32** with flat-sided heads **33** pass through the registering slots **30** and holes **31** to locate the flange **28** of the turbine entry duct and to support the flange **28** from the flange **25**. The shanks of the locating pins terminate in flat-sided portions of reduced diameter which may be drilled to provide passages **34** for split pins, or other suitable means may be provided for retaining the locating pins **32** in position.

Referring to FIGURES 1, 3 and 7, the upstream series of radial supporting lugs **26** are drilled axially to form holes **35** for the reception of locating pins **36**. The liner **21** for the first-stage rotor is provided at its downstream end with an outwardly projecting radial flange **37** which has at intervals around its rim pairs of radial shoulders **38**, each pair of shoulders defining between them an open-ended slot **39**, and the liner flange **37** which is located adjacent the supporting lugs **26** is adapted to abut at its downstream face against the radial flanges **40** of the second-stage stator platforms **22**. The slots **39** of the flange register with the holes **35** in the lugs **26**.

The second-stage stator platforms **22** are flanged at both ends, the upstream radial flange **40** of each platform being provided with a pair of circumferentially-spaced shoulders **41** which extend axially in the upstream sense to form between them a recess the back wall of which is constituted by the flange face between the shoulders **41**. In the position in which the parts are shown in FIGURE 1 there is an axial clearance between the downstream face of lugs **26** and the upstream faces of flange **37** and shoulders **41**. The stator platforms **22** abut the downstream face of the liner flange **37** and interlock with one another to form a ring which cannot collapse inwardly. The recess in each platform registers with and receives a pair of the slot-defining radial shoulders **38** of the liner flange **37**. Each platform recess also receives the flat-sided head **42** of a location pin **36** which is engaged between the radial shoulders **38** of the liner flange **37**. The shanks of the location pins **36** enter the holes **35** in the supporting lugs **26** and in this manner both the liner and the stator platforms are supported from and located with respect to the supporting lugs of the turbine casing. The flat-sided heads of the location pins **36** are held between the lugs **26** and the upstream flanges **40** of the stator platforms **22** and thereby the pins are retained in position.

Referring to FIGURES 1 and 4, the downstream series of circumferentially-spaced supporting lugs **27** are likewise drilled axially to provide holes **44** for locating pins **45**. The liner **23** for the second-stage rotor is thickened at its upstream end where it abuts the annulus of second-stage stator platforms **22** and, intermediately of its length,

the liner is formed with an outwardly projecting radial flange 46 which overlaps and abuts the supporting lugs 27 and is provided at intervals around its rim with pairs of circumferentially-spaced radial shoulders 47, the rim between each pair of shoulders being cut away to form open-ended slots 48. The liner slots 48 register with the holes 44 in the supporting lugs. The platforms 24 of the third-stage stator blades are flanged at both ends and the upstream radial flange 49 of each platform is provided with a pair of circumferentially-spaced shoulders 50 which extend axially in the upstream sense to form between them a recess the back wall of which is constituted by the flange face between the shoulders. In the position in which the parts are shown, there is an axial clearance between the upstream extremities of the shoulders 50 and the downstream face of lugs 27. Like the platforms 22, the platforms 24 also interlock with one another to form a ring which cannot collapse inwardly. Each recess in the ring of platforms registers with a hole 44 in one of the supporting lugs and receives the flat-sided head 51 of a locating pin 45, the shank of which passes through the registering hole 44 of the supporting lug and through the registering slot 48 in the liner flange 46. The end portions of the pin shanks which engage in the liner slots 48 are provided with opposing flats 53. Axial movement of the locating pins is limited in the upstream sense by the lugs 27 and in the opposite sense by the upstream flanges 49 of the stator platforms. In this manner, the liner 23 and the stator platforms 24 are supported from the supporting lugs 27 of the turbine casing. The downstream flanges 54 of the stator platforms abut a radial flange 55 on the downstream section 16 of the turbine casing.

The stator structure of the turbine may be assembled as follows.

The pins 32 are inserted into the holes 31 of the turbine casing flange 25 and secured in position by split pins which enter the holes 34 in the shanks of the pins 32. The pins 36 are inserted into the holes 35 in the upstream series of casing lugs 26. The major section 15 of the turbine casing is then welded as indicated to the outer casing 17 of the combustion system. The outer wall 20 of the turbine entry duct 18 is then arranged so that the slotted flange 28 of the duct abuts the supporting flange 25 of the turbine casing with the slots 30 in the duct flange 28 registering with the holes 31 in the casing flange 25 and receiving the heads 33 of the locating pins 32.

The first-stage liner 21 is brought to the upstream series of supporting lugs 26 with the liner slots 39 in register with the lug holes 35 and with the heads 42 of the pins 36 occupying the slots 39 in the liner. The second-stage stator blades with their outer platforms 22 are then brought by an axial movement against the liner 21 with the recesses in the flanges 40 of the stator platforms 22 in register with the slots 39 in the liner flange 37. Each recess in the flanges 40 receives the head 42 of a locating pin 36 together with parts of the pair of slot-defining radial shoulders 38 on the liner flange which flank the head 42. The external surfaces of the shoulders 38 fit snugly against the opposing internal surfaces of the side walls of the recess.

The second-stage liner 23 is brought into the major section 15 of the turbine casing and, if necessary, is partially rotated so that its radial shoulders 47 clear the downstream series of supporting lugs 27. As soon as the liner flange 46 has passed the lugs 27 it is partially rotated to cause the shoulders 47 to overlap the lugs 27 and to place the slots 48 in register with the holes 44 in the lugs 27. Locating pins 45 are then inserted from the downstream end so that their shanks pass through the holes 44 in the lugs 27 and into the slots 48 in the liner flange 46 and their heads 51 abut the downstream faces of the lugs 27. The third-stage stator blades with their outer platforms 24 are then brought by an axial movement against the protruding heads 51 of the pins 45 with the recesses in the platform flanges 49 in register with the holes 44 in the lugs 27 and the heads 51 of the pins 45 so that each recess snugly receives the head 51 of a pin 45. Finally the downstream section 16 of the turbine casing is bolted as shown to the major section 15 of the casing and this results in an end flange 55 abutting the downstream flanged ends 54 of the third or final stage stator platforms 24.

The outer wall 13 of the gas passage from the first-stage liner 21 to the third-stage stator annulus 24 is thus generally located in an axial direction by the supporting lugs 26 and the end flange 55 of the turbine casing 14 and is supported therefrom by means of the pins 36, 45, which engage in holes provided in the lugs 26, 27 which are integral with the turbine casing 15.

As shown the pins may be provided with axial passages 56 to facilitate their extraction.

I claim:

1. A stationary structure for an axial flow rotary machine, which structure comprises an annular liner, a platform ring member carrying stator blades and abutting one axial end of the annular liner to form an assembly which defines a wall of a passage for the working fluid, an annular supporting member disposed coaxially with said assembly and radially spaced from said assembly on the side thereof remote from the working fluid, said supporting member having a ring of projections extending radially towards said annular liner and said annular liner having adjacent one axial end only thereof a ring of projections which are in axial alignment with but offset from the projections on the supporting member and which have radially-extending slots therein, and axially-extending pins mounted in the projections on the supporting member and having flat-sided portions which extend into, and engage the sides of, the slots in the projections on the annular liner so that the annular liner is supported by one end only by the pins on the supporting member against forces perpendicular to the axis of said structure, the ring member having parts which project towards the supporting member, which prevent the pins from disengaging from the slots, and which have axially-extending tongue-and-slot engagement with the projections on the annular liner so that the annular liner carries the ring member, and said supporting member providing an axial abutment facing the end of the ring member remote from the annular liner for holding the ring member in engagement with the annular liner.

2. A stationary structure for an axial flow rotary machine which structure comprises first and second liner ring members which are coaxial with and axially spaced from each other, an intermediate liner ring member between the first and second ring members, which, first, second and intermediate ring members together define the outer wall of an annular passage for the working fluid, an annular supporting member disposed coaxially with, and radially spaced from, said ring members on the side of the latter remote from the working fluid passage, the first and second ring members having portions which project radially outwardly towards the supporting member, and the supporting member having axially-spaced portions which project inwardly towards the respective said first and second ring members but which are axially offset from the said portions of the first and second ring members, and a plurality of axially-extending pins mounted on each of said portions of the supporting member, the said portions of the first and second ring members being formed with radially-extending slots in which the pins engage so that the first and second ring members are supported against forces perpendicular to the axis of the structure from the supporting member, the first ring member having said radially outwardly projecting portion formed adjacent one axial end thereof so as to be supported against said perpendicular forces only by said one end, and the second ring member having said radially outwardly projecting portion formed adjacent the middle of its length so as to pro-

ject axially in each direction beyond said portion and the intermediate ring member being located against axial movement by abutment with the first and second ring members and having tongue-and-slot engagement with one of them, the slots extending radially and the tongues extending axially into engagement with the slots, so that the intermediate ring member is carried by this liner ring.

3. A structure as claimed in claim 2 wherein the intermediate liner ring between the first and second liner ring members carries radially-inwardly extending stator blades.

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