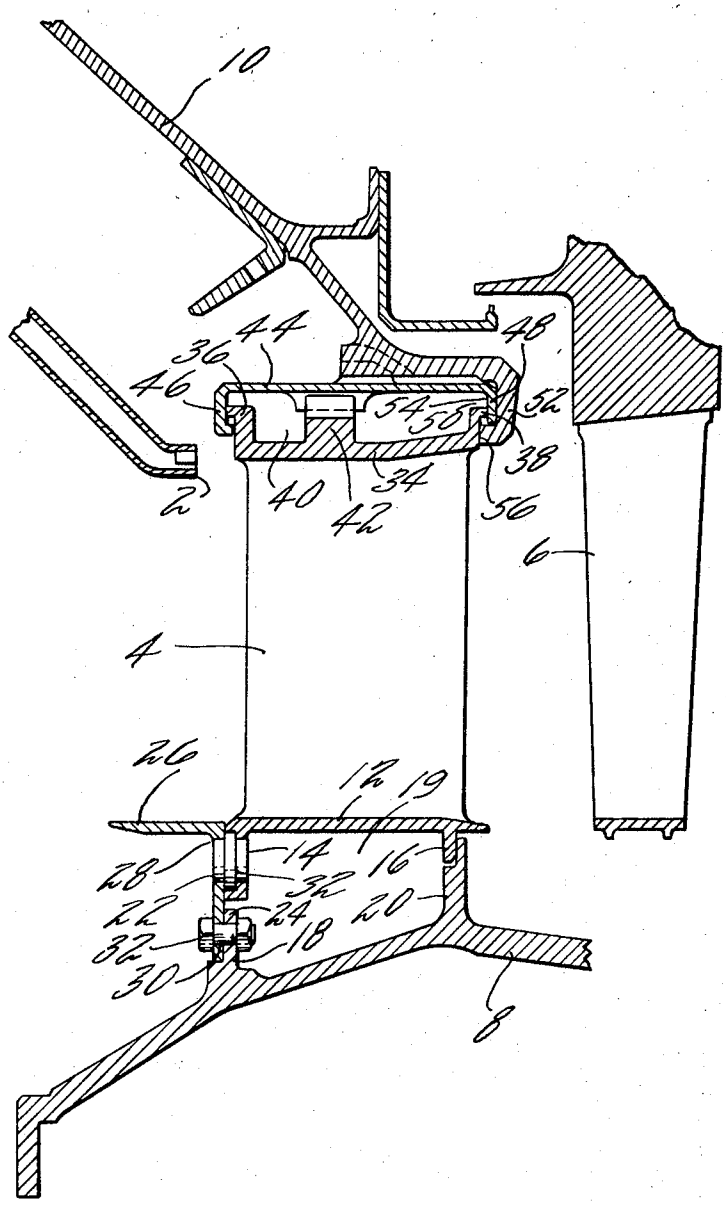
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TURBINE VANE RETENTION

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TURBINE VANE RETENTION

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ABSTRACT OF THE DISCLOSURE

A nozzle vane retention construction adapted principally for use downstream of an annular type combustion chamber in a gas turbine engine. The construction provides both vane retention capability and vane removal and replacement capability.

Background of invention

This invention relates to a gas turbine nozzle vane end retaining construction.

In a typical gas turbine engine, the compressor compresses a gas, normally air, and feeds it to a combustion chamber where it is mixed with fuel and burned increasing the pressure of the gas. The high pressure gas leaves the combustion chamber and passes first through a transition duct and then a first-stage nozzle. From here the gas is passed rearwardly through the turbine sections of the engine and exhausted.

The vanes of the first-stage nozzle ring are the first portions of the turbine section to come in contact with the hot gases produced in the combustion chamber. Consequently, these vanes are generally the parts most likely to become burned, eroded or otherwise damaged and are oftentimes found to require frequent replacement. The problem of replacing vanes which have become burnt and of preventing any portions of the damaged vanes from moving through the turbine section and causing damage thereto is aggravated when the combustion chamber is an annular combustion chamber. This is so because with this type of combustion chamber, access to the inner retaining section of the vanes is not possible. Therefore, vane retention at the inner section and vane replacement capability is not compatible.

While the prior art discloses many schemes for vane retention, the prior art constructions apparently did not consider the problem presented by using an annular combustion chamber. In fact, the prior art construction generally defines a construction wherein the inner vane end is bolted to a supporting casing. When an annular combustion burner is used, if the inner ends of the vanes are bolted to a casing, individual vanes cannot be removed because the annular combustion casing prevents access to the bolts. It should therefore be clear that the use of an annular combustion chamber with the prior art constructions would force a choice between either vane retention or vane removal capability.

Summary of the invention

It is the primary object of this invention to provide a nozzle vane retaining construction which will facilitate removal and replacement of vanes while being compatible with any type combustion chamber.

The present invention solves a problem existing with prior art vane retention constructions used in conjunction with annular combustion chambers. The construction disclosed herein permits retention of the first-stage nozzle vanes so that if one vane is burned out it will not pass through the turbine, while permitting individual removal and replacement of vanes in an engine that employs an annular type combustion chamber.

The present invention accomplishes the foregoing by using a retaining ring positioned and cooperating with the inner end of the stator vanes. No bolts or other locking means are used at the inner end of the vane; however, the retaining ring and cooperating vane projections on the vane ring are slidably positioned in a channel flange on an inner casing. The nozzle vanes are secured by locking means simultaneously to a removable ring and an outer casing. Therefore, once the removable ring has been detached, the entire vane assemblage is moved axially until the retaining ring and cooperating inner vane projections are free of the channel flange. Once clear, individual vanes can be removed and replaced.

Brief description of the drawing

The figure is a fragmentary longitudinal sectional view taken through a gas turbine showing the device of the invention.

Description of the preferred embodiment

As shown in the figure, hot combustion gases have annular combustion chamber **2** and impinge upon nozzle vane **4**, nozzle vane **4** directing the gases into turbine blade **6**. Nozzle vane **4**, only one of a ring being illustrated, extends between outer casing **8** and inner casing **10**.

Outer end **12** of vane **4** includes radially outwardly extending axially spaced flanges **14** and **16**. Outer casing **8** includes radially inwardly extending axially spaced flanges **18** and **20**, flanges **14** and **16** cooperating within and extending across the circumferential groove **19** between flanges **18** and **20**. Flange **14**, which is the upstream flange, has a plurality of apertures **22** and spaced outwardly from and in flange **18** is a plurality of apertures **24**. In abutting relationship to flange **14** and flange **18** is removable ring **26**, ring **26** having a plurality of openings **28** in axial alignment with aperture **22** and a second plurality of openings **30** in axial alignment with apertures **24**. Locking means **32** passing through both sets of openings and apertures connects ring **26** to the outer vane flange **14** and outer casing flange **18**.

Inner end **34** of vane **4** includes axially extending projections **36** and **38**, projection **36** extending upstream and projection **38** extending downstream. Positioned in the axial space **40** between projections **36** and **38** and connected to inner end **34** is radially inwardly extending lug **42**. Positioned around inner end **34** is retaining ring **44** which includes an L-shaped tab **46** and a radially outward extending tab **48**. Tab **46** is the upstream tab on retaining ring **44** and cooperates with axial projection **36** to position and locate the upstream inner end of vane **4**. Tab **48** and axial projection **38** are in substantially abutting relationship and together are positioned within channel opening **50** of flange **52** on inner casing **10**. Tab **48** and axial projection **38** are slidably movable in and out of flange **52**.

In order to remove vane **4** after an engine has been assembled, it is necessary to first remove ring **26**. The entire nozzle vane ring including retainer ring **44** is then free to move axially upstream. Once surface **54** on tab **48** clears surface **56** on channel flange **52**, any individual vane **4** will swing forward or upstream at the outer end **12** and then disengage from the nozzle ring as axial projection **36** passes surface **56**.

I claim:

1. A gas turbine including an annular combustion chamber, an outer casing, an inner casing, a plurality of vanes extending between the casings downstream of the combustion chamber, said vanes being arranged circumferentially about the engine axis, and a row of blades axially spaced downstream from said vanes, the improvement comprising:

the outer casing having a pair of axially spaced inwardly extending flanges;

a removable ring including a first locking means for attachment to one of said flanges, said ring and the other flange forming a circumferential groove in which the outer end of the vanes are positioned and said ring having a second locking means for positioning the outer ends of each of said vanes axially and circumferentially;

a pair of axially extending projections on the inner end of each of said vanes;

an outwardly extending flange on the inner casing, said flange defining a forwardly facing channel opening, and

a retaining ring positioned peripherally of the inner ends of the vanes, said ring having an outwardly extending L-shaped tab defining a rearwardly facing opening and an outwardly extending tab axially spaced therefrom and forming a circumferential groove therebetween in which the axial projections of each of said vanes are positioned, the axial projections axially abutting the tabs on said retaining ring, the outwardly extending tab and the abutting axial projections being slidably positioned in said forwardly facing channel opening, said retaining ring causing movement of the entire vane assembly and permitting individual vane removal after the removable ring is detached, the entire vane assemblage and retaining ring is moved axially and the tab and projection is disengaged from said channel opening.

2. A construction as in claim 1 wherein:

the upstream end of each of said outer vane ends has a plurality of apertures;

the upstream inwardly projecting flange has a plurality of apertures, spaced radially outwardly from the apertures in said outer vane ends;

the removable ring has a plurality of inner openings in axial alignment with said apertures in said outer vane end and a plurality of outer openings in axial alignment with said apertures in said radially inwardly projecting flange; and

locking means extending through both sets of axial aligned openings and apertures.

3. A construction as in claim 1 wherein:

each of said inner ends of said vanes has an inwardly projecting lug; and

said retaining ring has a plurality of slots within which said lugs cooperate.

4. A nozzle vane retaining apparatus for retaining the inner and outer ends of nozzle vanes in an inner and outer casing, respectively, comprising:

a plurality of vanes arranged in a circumferentially spaced annular series, the outer end of each of said vanes having a pair of axially spaced outwardly extending flanges, the inner end of each of said vanes having an upstream directed substantially L-shaped flange axially spaced from a downstream directed substantially L-shaped flange;

a removable ring having means for attaching said ring to the upstream outwardly extending flange on the outer end of each of said vanes and means for attaching said ring to said outer casing; and

a retaining ring positioned peripherally of the inner end of the vanes, said ring having a substantially L-shaped flange at its upstream end and defining a rearwardly facing opening and spaced axially therefrom on outwardly extending tab, said upstream directed L-shaped flange being positioned in said opening and said downstream directed L-shaped flange and outwardly extending tab being substantially adjacent, said tab and downstream flange being slidably positioned in a forwardly facing flange opening on said inner casing.

5. A construction as in claim 4 wherein:

each of said inner ends of said vanes has an inwardly projecting lug; and

said retaining ring has a plurality of slots within which said lugs cooperate.

6. A construction as in claim 5 wherein:

the upstream end of each of said outer vane ends has a plurality of apertures;

said removable ring has a plurality of openings in axial alignment with said apertures; and

said outer vane end is attached to said ring by locking means extending through said opening and said aperture.

References Cited

UNITED STATES PATENTS

2,605,997	8/1952	Lombard et al.	253—78
2,628,067	2/1953	Lombard	253—78
2,937,000	5/1960	Ledwith	253—78
2,984,454	5/1961	Fiori	253—78
3,062,499	11/1962	Peterson	253—78
3,075,744	1/1963	Peterson	253—78
3,363,416	1/1968	Heybyrne et al.	253—78
3,365,173	1/1968	Lynch et al.	253—78

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