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AEROFOIL SHAPED BLADE FOR A FLUID FLOW MACHINE SUCH AS A GAS TURBINE ENGINE

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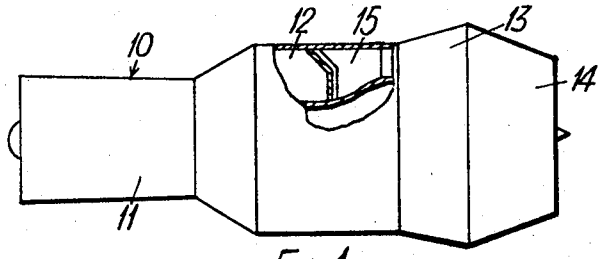


Fig. 1

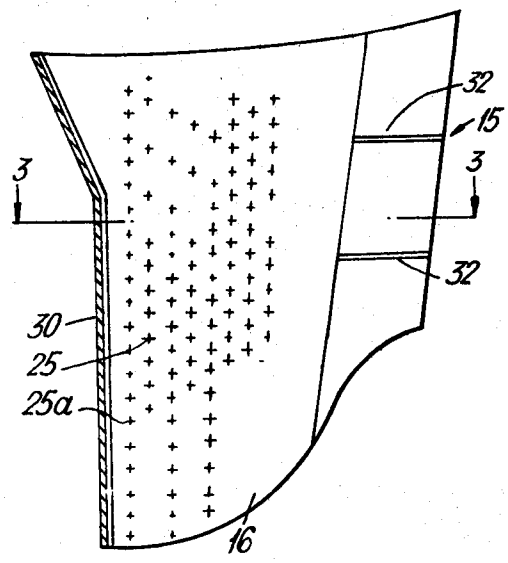


Fig. 2.

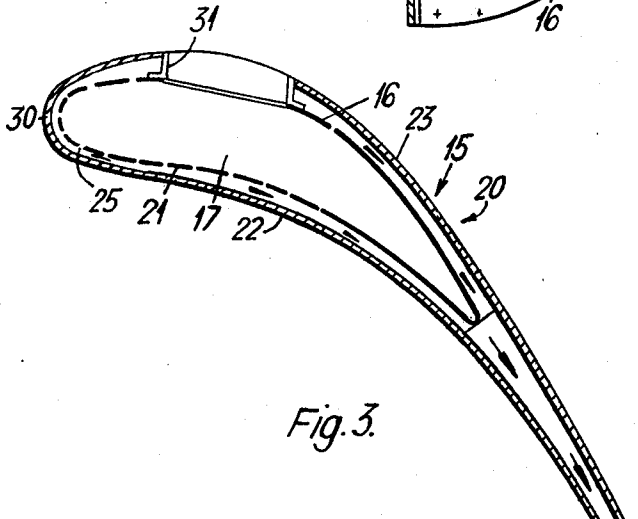


Fig. 3.

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AEROFOIL SHAPED BLADE FOR A FLUID FLOW MACHINE SUCH AS A GAS TURBINE ENGINE

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8 Claims. (Cl. 253—39.1)

ABSTRACT OF THE DISCLOSURE

An aerofoil-shaped blade having internal and external walls separated from each other by a space. The interior of the internal wall is adapted to receive cooling fluid and part of this cooling fluid passes through a multiplicity of holes in the internal wall and impinges on the interior of the external wall. The remainder of the cooling fluid passes across the space between the two walls of the blade directly to the exterior of the blade without mixing with the cooling fluid in the space.

This invention concerns an aerofoil-shaped blade adapted for use in a fluid flow machine such as a gas turbine engine.

The term "blade" is used in this specification in a broad sense as including for example nozzle guide vanes.

According to the present invention, there is provided an aerofoil-shaped blade adapted for use in a fluid flow machine such as a gas turbine engine and having an internal wall which is surrounded by an external wall and is separated therefrom by a space which extends adjacent both the opposite sides of the blade, the internal wall defining a chamber which is adapted to receive a cooling fluid, at least a major portion of the internal wall being provided with a multiplicity of holes through which the cooling fluid may pass from said chamber to said space so as to flow over and cool the interior of the external wall, the external wall having at least one aperture enabling the cooling fluid to escape from the space, said blade being provided with at least one passage through which a portion of the cooling fluid entering the chamber may pass across said space directly to the exterior of the blade without mixing with the cooling fluid in the space.

It will be appreciated that the present invention permits substantially the whole of the interior of the external wall of the blade to be cooled by jets of cooling fluid from the said chamber and thus to be more effectively cooled than hitherto. Moreover, the said multiplicity of holes may be so arranged as to ensure adequate cooling of the said interior of the external wall notwithstanding mal-distribution of the air flow in the said space. Thus by providing the holes in the right places, it is not necessary to use baffles in the said space to ensure that cooling fluid is directed to all parts thereof. Moreover, the disposition of the holes may be such as to compensate for local hot spots, while the provision of these holes over at least a major portion of the internal wall makes the disposition of the latter with respect to the external wall less critical than would otherwise be the case.

The said holes preferably extend throughout at least a major portion of both the radial length and the axial length of the internal wall.

The said holes may include holes extending throughout the whole radial length of the portion of the internal wall adjacent the leading edge of the blade.

Preferably few or no holes are provided adjacent the radially inner and outer ends of the internal wall.

The radial length of the blade at its upstream end may

be substantially greater than its radial length at its downstream end.

The said space may extend to the trailing edge of the blade, the external wall being provided with a said aperture or apertures at the said trailing edge.

The invention also comprises an annular combustion chamber for a gas turbine engine having a plurality of angularly spaced apart nozzle guide vanes therein constituted by blades as set forth above.

The radial length of the combustion chamber may be substantially greater centrally of its ends than at either of its ends.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:

FIGURE 1 is a diagrammatic view, partly in section, of a gas turbine engine having nozzle guide vanes in accordance with the present invention,

FIGURE 2 is an enlarged sectional view of such a nozzle guide vane, and

FIGURE 3 is a section taken on the line 3—3 of FIGURE 2.

In FIGURE 1 there is shown a gas turbine engine **10** having a compressor **11**, a combustion chamber **12**, and a turbine **13** which drives the compressor **11**, the turbine exhaust gases being directed to atmosphere through an exhaust pipe **14**.

The combustion chamber **12** is an annular combustion chamber in the downstream half of which there are mounted a plurality of angularly spaced apart nozzle guide vanes **15**.

Each of the nozzle guide vanes **15** has an internal wall **16** which defines a chamber **17**. The chamber **17** is supplied at its radially outer end with part of the air compressed by the compressor **11**, this air being employed as dilution air for the dilution of the products of combustion so that their temperature is acceptable to the turbine **13**. In order to simplify FIGURE 1, however, the manner in which the dilution air enters the chamber **17** is not shown.

The internal wall **16** of each nozzle guide vane **15** is surrounded by an external wall **20** thereof. The walls **16**, **20** are separated by a space **21** which extends adjacent both the opposite sides **22**, **23** of the nozzle guide vane and extends to the trailing edge **24** thereof.

A major portion of the internal wall **16** is provided with a multiplicity of holes **25** through which the dilution air may pass from the chamber **17** to the space **21** so as to flow over and cool the interior of the external wall **20**. The air passing through the holes **25** impinges on the external wall **20** in the form of jets. The external wall **20** is provided at the trailing edge **24** with one or more apertures **26** through which the dilution air may escape from the space **21**.

As will be seen, the holes **25** extend throughout a major portion of both the radial length and the axial length of the internal wall **16**. The holes **25** also include a row of holes **25***a* which extend throughout the whole radial length of the portion of the internal wall **16** adjacent the leading edge **30** of the nozzle guide vane. Thus, there is adequate cooling of the said leading edge. Very few of the holes **25** however are provided adjacent the radially inner and outer ends of the internal wall **16**.

Each nozzle guide vane **15** is provided with a plurality of radially spaced apart passages **31** through which a portion of the dilution air which has entered the chamber **17** may pass across the space **21** directly to the interior of the nozzle guide vane without mixing with the dilution air in the space **21**.

The downstream end of the internal wall **16** is spaced well away from the trailing edge **24**, flow through the portion of the space **21** downstream of the internal wall **16** being divided into three portions by internal baffles **32**.

The radial length of the combustion chamber **12** is substantially greater centrally of its ends than at either of its ends. As a result, the nozzle guide vanes **15** have to be formed as shown with a radial length at their upstream ends which is substantially greater than their radial length at their downstream ends. Thus, the radially innermost portion of the space **21** will, in operation, form a low pressure region which, but for the fact that the holes **25** are provided throughout a major portion of the internal wall **16**, would result in inadequate cooling of some parts of the interior of the external wall **20**.

We claim:

1. An aerofoil-shaped blade adapted for use in a fluid flow machine such as a gas turbine engine, comprising an internal wall and an external wall, the said internal wall being surrounded by said external wall and being separated entirely therefrom by a space which extends adjacent both the opposite sides of the blade, a chamber defined by said internal wall, said chamber being adapted to receive a cooling fluid, a multiplicity of holes being provided on at least a major portion of the internal wall through which the cooling fluid may pass from said chamber to said space so as to flow over and cool the entire interior of the external wall, at least one aperture being provided in the external wall enabling the cooling fluid to escape from the space, at least one passage in said blade extending directly from the chamber within said internal wall across said space to the exterior of said external wall through which a portion of the cooling fluid entering the chamber may pass across said space directly to the exterior of the blade without mixing with the cooling fluid in the space.

2. A blade as claimed in claim **1** in which the said holes extend throughout at least a major portion of both the radial length and the axial length of the internal wall.

3. A blade as claimed in claim **1** in which the said holes include holes extending throughout the whole radial length of the portion of the internal wall adjacent the leading edge of the blade.

4. A blade as claimed in claim **1** in which a limited number of holes are provided adjacent the radially inner and outer ends of the internal wall.

5. A blade as claimed in claim **1** in which the radial length of the blade at its upstream end is substantially greater than its radial length at its downstream end.

6. A blade as claimed in claim **1** in which the said space extends to the trailing edge of the blade, the external wall being provided with at least one said aperture at the said trailing edge.

7. An annular combustion chamber for a gas turbine engine having a plurality of angularly spaced apart nozzle guide vanes therein constituted by blades as claimed in claim **1**.

8. A combustion chamber as claimed in claim **7** in which the radial length of the combustion chamber is substantially greater centrally of its ends than at either of its ends.

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