Aug. 28, 1962 K. D. HILTON 3,051,439

BLADES FOR GAS TURBINE ENGINES

Filed June 8, 1959

FIG. 1.

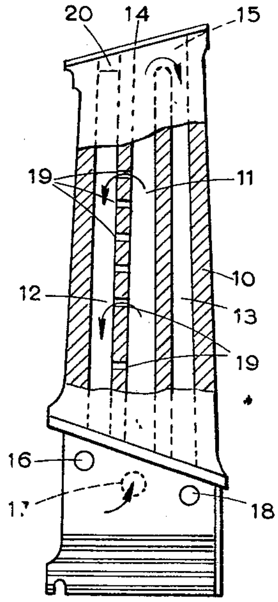


FIG. 2.

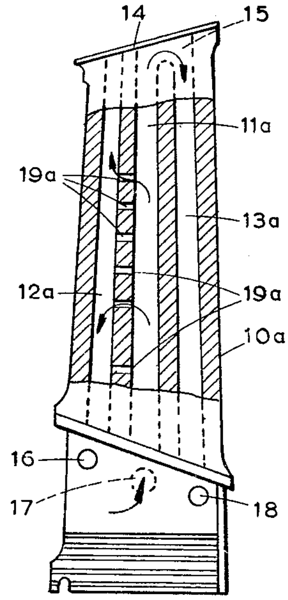


FIG. 3.

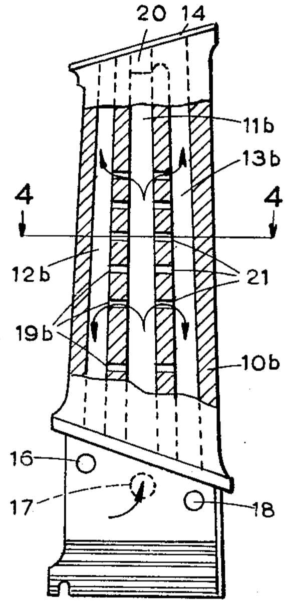


FIG. 4.

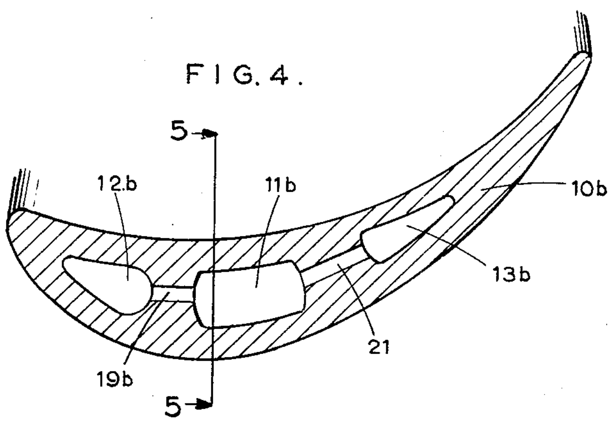
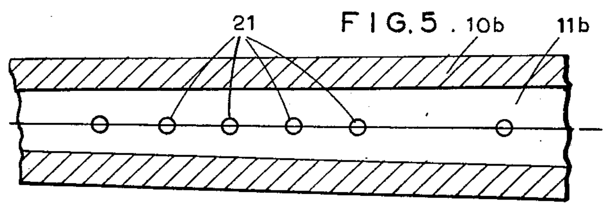


FIG. 5.



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3,051,439

BLADES FOR GAS TURBINE ENGINES

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5 Claims. (Cl. 253—39.15)

This invention relates to blades, particularly blades for gas turbine engines, and to arrangements of passages for the flow of fluid through said blades. The fluid may be air or a gas or a suitable liquid, the fluid being used primarily for cooling purposes in the case for example of a turbine blade or in the case of a compressor blade or inlet guide vane, for heating or anti-icing purposes.

According to this invention a blade has at least two internal passages extending longitudinally of the blade, one being nearer to an edge of the blade than the other, the fluid medium being introduced via the latter passage and drawn off via the former, said passages being interconnected by one or more transverse passages through which the fluid passes from one passage to the other as a jet or a series of jets directed toward the said edge of the blade.

The transverse pasages if more than one is provided are preferably of small diameter or cross-sectional area compared with the longitudinal passages and may be of any suitable cross-sectional shape, as for example circular, square or rectangular in cross-section. If only one transverse passage is provided it preferably takes the form of a comparatively narrow longitudinally positioned slot.

The transverse passage or transverse passages may be arranged or grouped adjacent the longitudinal central portion of the blade so as to provide cooling (or heating) where it is most needed.

The longitudinal passage adjacent the edge of the blade can be open at both ends or it can be closed at one end according to the distribution of fluid which is required.

If desired there can be one longitudinal passage adjacent each edge of the blade (leading and trailing edges) and they can both be fed from a common central longitudinal passage interconnected with the longitudinal passages adjacent the edges by two separate passages or sets of transverse passages.

Alternatively one edge can be cooled or heated by jets derived from transverse passages and the other edge can be cooled or heated by fluid flowing through the passageway axially of the blade.

Referring to the drawings:

FIGURE 1 is a side elevation of a blade, partly in section, showing the jet cooling of this invention applied to the leading edge of the blade;

FIGURE 2 is a similar arrangement except that the leading edge longitudinal passage has both ends open;

FIGURE 3 is a similar elevation, partly in section, showing the jet cooling applied to both leading and trailing edges of the blade;

FIGURE 4 is an enlarged section on line **4—4** of FIGURE 3; and

FIGURE 5 is an enlarged part section on line **5—5** of FIGURE 4.

In FIGURE 1 the blade **10** which is a turbine blade has a central longitudinal passage **11**, and two longitudinal passages **12** and **13** adjacent the leading and trailing edges of the blade respectively.

The tip of the blade is closed by a plate **14** but the passages **11** and **13** are interconnected by an internal passage **15**.

The inner ends of all three longitudinal passages are open via apertures **16**, **17** and **18** respectively, aperture **17** being on one side of the blade stem where there is a high pressure and the other openings on the side where there is a lower pressure, aperture **17** being used for the entry of the fluid and apertures **16** and **18** for the discharge of the fluid.

The central longitudinal passage **11** is connected to the leading edge passage **12** by internal transverse passages **19** which are of considerably less cross-sectional area than the longitudinal passages. Passage **12** is closed at its outer end by a plug **20**.

In use cooling air or other fluid is supplied via aperture **17** to the central longitudinal passage **11**. A proportion of this air or other fluid passes at high velocity in the form of jets through the transverse passages **19** and is directed onto that part of the internal wall of the passage **12** which is adjacent the leading edge of the blade. The high velocity cooling jets so formed are arranged to cool that part of the leading edge (the longitudinal central portion) which becomes hottest in operation. The cooling is much more effective than conventional single and double pass cooling arrangements.

In FIGURE 2 the blade **10*a*** has a central passage **11*a*** and two edge passages **12*a*** and **13*a***. The passage **11*a*** is connected to the passage **12*a*** via internal transverse passages **19*a***.

In this arrangement the passage **12*a*** is open at both ends, the remaining details and the operation of the cooling being the same as described with reference to FIGURE 1.

In FIGURE 3 the blade **10*b*** includes a central passage **11*b*** which is closed at its outer end by a plug **20**. The blade also includes two edge passages **12*b*** and **13*b*** and there are two distinct sets of transverse passages **19*b*** and **21**.

The form of the passages is shown more clearly in FIGURES 4 and 5.

In operation cooling air or other fluid supplied to the central passage **11*b*** passes through transverse passages **19*b*** and **21** respectively and is directed in the form of jets on to the walls of passages **12*b*** and **13*b*** respectively which are adjacent the leading and trailing edges.

Although in the constructions shown a series of small transverse passages are shown, a passage may be used having the form of a comparatively long and narrow slot.

I claim:

1. A blade for a gas turbine engine having at least two wholly internally positioned longitudinally arranged passages, one of which is situated further from a blade edge than the other and constitutes a cooling fluid entrance and intermediate blade portion cooling passage, the other constituting a fluid discharge passage, said passages being connected respectively with separate apertures in the blade root on the high and low pressure sides respectively of the blade for the entry and discharge of fluid respectively, said entrance passage and discharge passage being interconnected intermediate their lengths only by transverse passage means of smaller cross-sectional area than either longitudinal passage for the transfer of fluid in high velocity jet form directly across the discharge passage toward the blade edge, said blade and passages being so constructed that cooling fluid after use flows only longitudinally of the blade for discharge.

2. A blade for a gas turbine engine having at least two wholly internal passages extending longitudinally of the blade for substantially its full active length, one passage being nearer to the leading edge of the blade than the other, the passage farthest from the leading blade edge constituting a cooling fluid entrance passage and a conduit for cooling an internal portion of the blade and the passage nearest the leading blade edge constituting a fluid discharge passage, transverse passage means directly interconnecting adjacent passage wall areas of the two longitudinal passages intermediate their lengths and so

configured that fluid passes in the form of jets from the entrance passage and is directed in the discharge passage against the opposite wall thereof and towards the edge of the blade to cool the latter, discharge means from said last mentioned passage so located that the now heated fluid flows only longitudinally of the blade after cooling said edge, a second longitudinal discharge passage situated near the trailing edge of the blade, the fluid entrance passage being located between the two discharge passages, said transverse passage means being of lesser total cross-sectional area than the entrance passage and interconnecting only the entrance passage and the discharge passage near the leading edge of the blade for the transfer of fluid in jet form onto the wall of the passage nearest the leading edge.

3. A blade as claimed in claim 2, wherein the passage nearest the leading edge is closed at its outer end and the fluid entrance passage and passage nearest the trailing edge are connected by an internal passage at their outer ends.

4. A blade as claimed in claim 2, wherein the passage nearest the leading edge is open at both ends and the fluid entrance passage and passage nearest the trailing edge are connected by an internal passage at their outer ends.

5. A blade as claimed in claim 2, wherein the fluid entrance passage is connected with the discharge passage nearest the trailing edge by other transverse passage means of comparatively small cross-sectional area for the transfer of fluid in jet form which impinges on the internal walls of the discharge passage.

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