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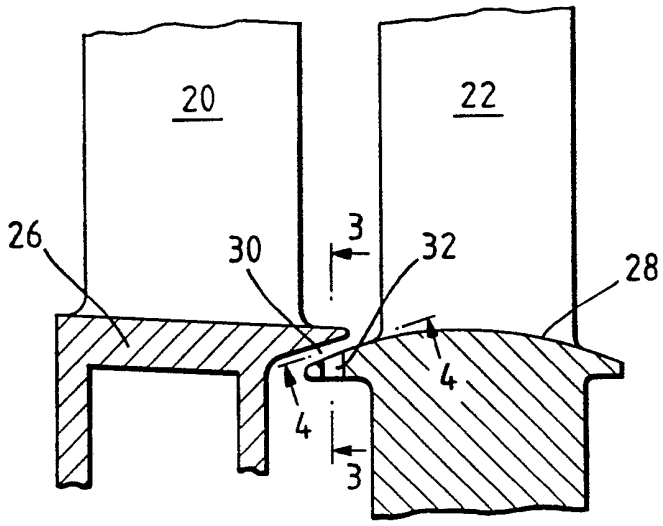
(54) Improvements in or relating to gas turbine engines

(57) Air which has been pumped radially outwardly along the face of the turbine disc (24, Fig. 1) in a gas turbine engine is ejected into the gas stream in the turbine annulus *via* shaped passages 32 in the turbine blade platforms 28, which are overlapped by the guide vane platforms 26 upstream thereof. The shaping of the passages 32 in combination with the overlap, ensures that the cooling air enters the gas stream at the roots of the blades in a direction generally parallel with that of the gas flow.

Fig. 2.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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Fig. 1.

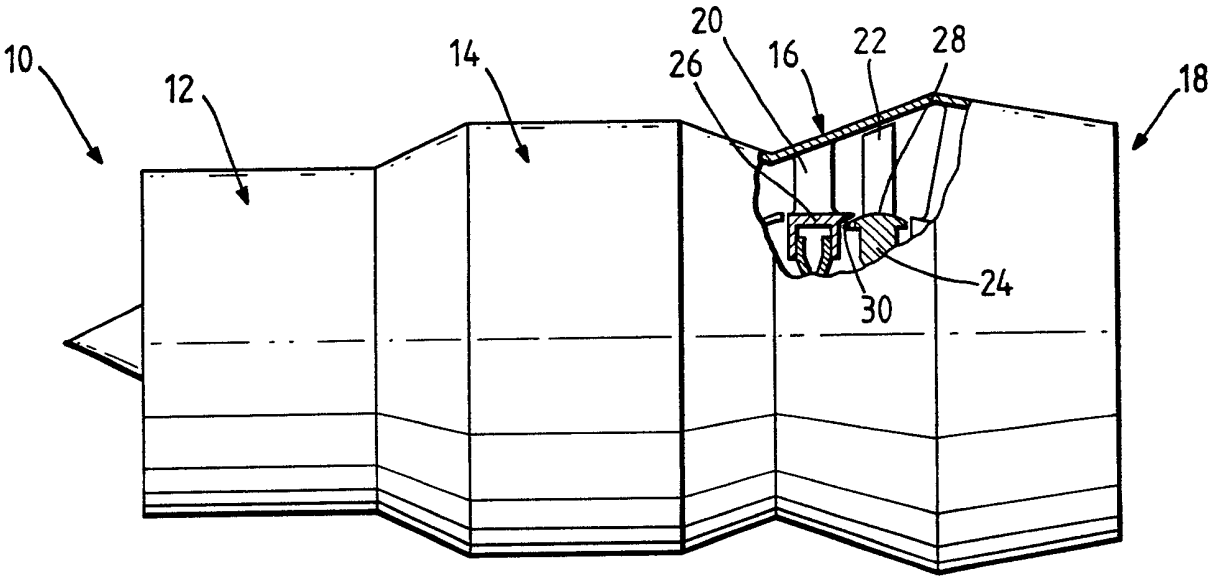


Fig. 2.

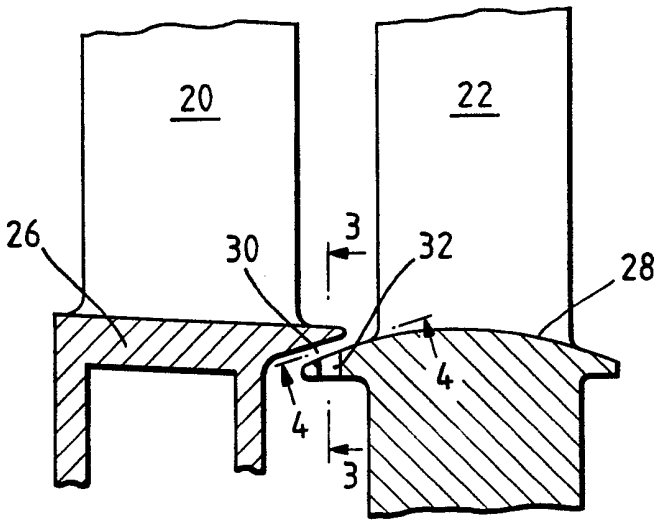


Fig. 3.

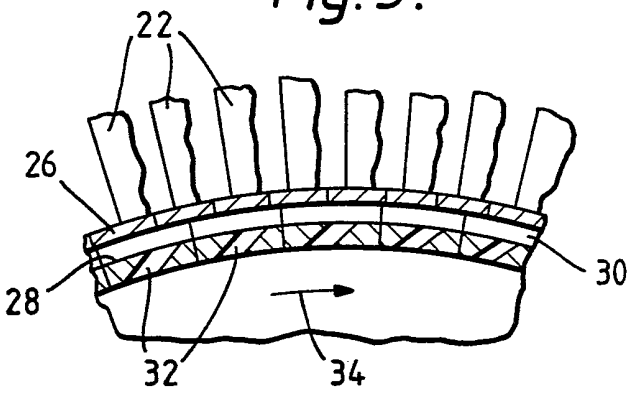


Fig. 4.

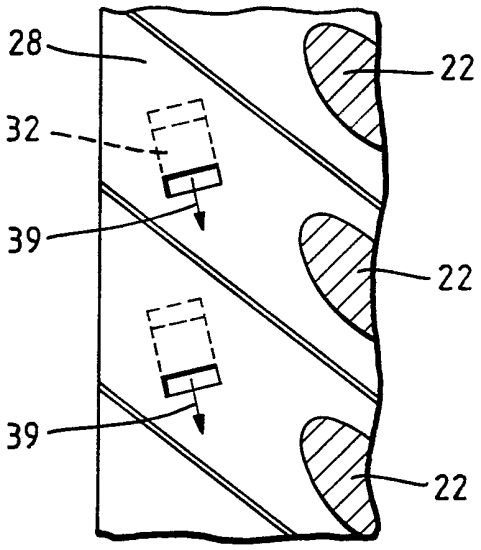
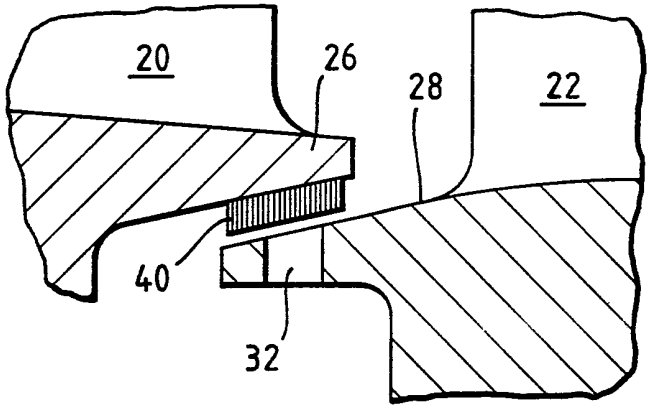


Fig. 5.



IMPROVEMENTS IN OR RELATING TO GAS TURBINE ENGINES

This invention relates to the control of a cooling fluid flow over a turbine stage of a gas turbine engine.

During operation of a gas turbine engine, the disc or discs of the turbine experience a flow of air thereover in a direction radially outwardly of the engine axis. The air exits between the downstream edges of the platforms of fixed guide vanes and the upstream edges of the platforms of an adjacent stage of rotating blades.

As the air passes across the face of the turbine disc, the rotary movement of the disc does work on it by way of increasing its velocity. The result is that on entering the turbine annulus via the spaced platform edges, the radially flowing air disturbs the gas flow in a direction which has a component axially of the engine in the vicinity of the roots of the turbine blades, which in turn causes a high secondary kinetic energy loss in the turbine stage that it enters.

The present invention seeks to provide an improved gas turbine engine.

Accordingly the present invention comprises a gas turbine engine in which the upstream portions of the platforms of an associated stage of turbine blades include guide means for guiding air which has traversed the face of the turbine disc which supports said blades, from said face into the space between each adjacent pair of turbine blades in a direction generally parallel with the flow of gases from a preceding stage of guide vanes.

The invention will now be described, by way of example and with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic view of a gas turbine engine which incorporates an embodiment of the present invention.

Figure 2 is an enlarged part view of the engine of Figure 1.

Figure 3 is a view on line 3-3 of Figure 2.

Figure 4 is a view on line 4-4 of Figure 2.

Figure 5 depicts a further embodiment of the present invention.

Referring to Figure 1. A gas turbine engine 10 comprises a compressor 12, combustion equipment 14, a turbine section 16 and an exhaust gas nozzle 18, all in flow series.

In the example, the turbine section 16 comprises a stage of fixed guide vanes 20 and a stage of turbine blades 22 which are mounted on a turbine disc 24 for rotation therewith.

Both the stage of vanes 20 and the stage of turbine blades 22 are provided with platforms 26 and 28 respectively and the former overlap the latter and a peripheral space 30 is defined thereby, which is more clearly seen in Figure 2, reference to which is now made.

As is depicted in Figure 2, the leading edge of the blade platform 28 is overlapped by the trailing edge of the vane platform 26. The overlapped portion of the blade platform 28 has a plurality of equi-angularly spaced passages 32 passing therethrough, through which air passes, having first flowed radially outwardly via the front face 34 of the disc 24 during operation of the engine. The air exits into the peripheral space 30 defined by the overlapping platform portions of the vanes 20 and the blades 22 and thence flows in a direction which has a downstream component, into the stage of turbine blades 22.

Referring now to Figure 3. It is seen that the passages 32 are inclined to planes which are radially of the disc 24 and contain the axis of rotation of the disc. The inclination being in the direction of rotation of the disc 24 during operation of the engine and as indicated by the arrow 34.

During operation of the engine 10, air is pumped radially outwardly towards the rim of the disc 24 by the rotary action of the disc thereon. There results a

pressure bias across the space in which the disc lies, and the turbine annulus. The bias is such as to ensure that the air will pass into the turbine annulus via the passages 32 and the peripheral space 30, rather than the hot gases in the turbine annulus being allowed to flow in the opposite direction.

The inclination of the passages 32 combined with the shelter afforded the airflow by the overlapping guide vane platforms ensures that the air will enter the turbine annulus in the region of the roots of the blades 22, at an angle which is closer to being parallel with the flow of gases from the guide vanes 20 into the stage of turbine blades 22, before forming the gases from the stage of guide vanes. Turbulence at the blade roots with its consequent reduction in turbine efficiency, is thus at least substantially reduced.

Referring to Figure 4. In this further embodiment, the passages 32 are also inclined in a downstream direction, at a small angle to planes normal to the axis of rotation of the turbine stage 16. This also reduces the differences in direction of the flow of cooling air therefrom, relative to the flow of hot gases from guide vanes to turbine blades, as is indicated by the arrows 39 and moreover, obviates the need for overlapping platforms.

In Figure 5, a further embodiment provides small fences 40 on the underside of each vane platform and which are arranged and spaced so as to guide the cooling air in the desired direction when it has exited the passages 32.

In operation of the engine 10, the turbine stage 16 will grow radially outwardly. In order to avoid damaging the fences 40 by collision with the underlapping lip of the blade platforms 28, the fences 40 could comprise brush seals i.e. metallic filaments which would bend instead of break and which are well known per se.

Claims:-

1. A gas turbine engine in which the upstream portions of the platforms of an associated stage of turbine blades include guide means for guiding air which has traversed the face of the turbine disc which supports said blades, from said face into the space between each adjacent pair of turbine blades in a direction generally parallel with the flow of gases from a preceding stage of guide vanes.

2. A gas turbine engine as claimed in claim 1 wherein said guide means comprises passageways through said upstream portion of the blade platform which passages are inclined both in the direction of rotation of said turbine blades and in a downstream direction so as to ensure that said air exits therefrom in a direction which is generally parallel with the flow of gases from said preceding stage of guide vanes.

3. A gas turbine engine as claimed in claim 1 wherein said guide means comprises passages through said upstream portions of the blade platforms, which passages are inclined in the direction of rotation of said turbine blades and wherein the downstream portions of platforms on said preceding stage of guide vanes overlap said upstream portions of said blade platforms and their passage exits in spaced relationship therewith.

4. A gas turbine engine as claimed in claim 3 including fences affixed to the underside of each downstream portion of the platforms of said preceding stage of guide vanes and positioned so as to straddle the exits of respective passages so as to assist in the direction of air which exits therefrom, into the spaces between adjacent turbine blades, said direction being generally parallel with the gas flows from said preceding stage of guide vanes.

5. A gas turbine engine as claimed in claim 4 wherein the fences are brush seals as defined in this specification.

6. A gas turbine engine substantially as described in this specification and with reference to the drawings.

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