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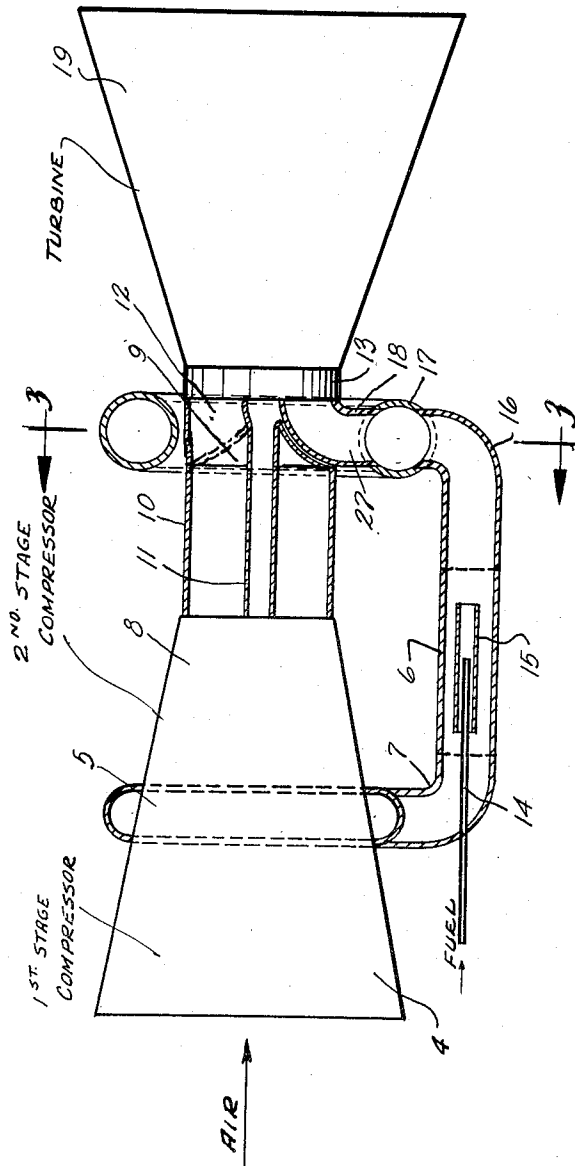
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AIR-COOLING GAS TURBINE BLADE

Filed May 3, 1948

2 Sheets-Sheet 1



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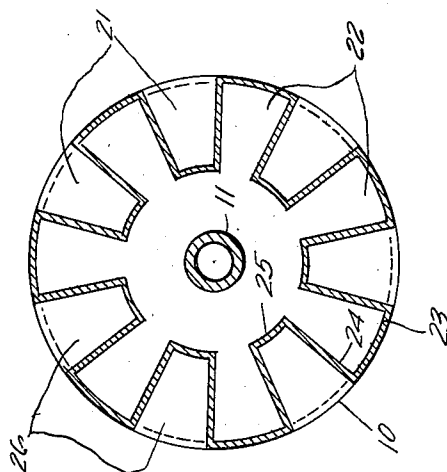


Fig. 3

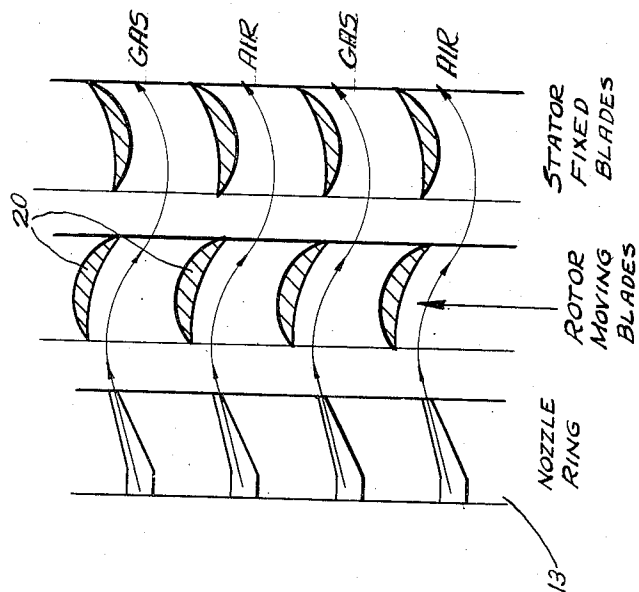


Fig. 2

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AIR-COOLING GAS TURBINE BLADE

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6 Claims. (Cl. 60—39.19)

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This invention is directed to improvement in the operation of power plants and is particularly adapted to use in the gas turbine or jet propulsion engine.

An object of this invention is to provide apparatus for increasing the power output from and efficiency of turbines by making it possible to use higher than normal driving-fluid temperatures.

A further object of this invention is to provide apparatus for using higher than normal driving-fluid temperatures in turbines by supplying cooling air at substantially lower temperatures than that of the driving fluid to the turbine.

A further object of this invention is to provide apparatus for preventing the overheating of the turbine blades of a turbine when using higher than normal driving-fluid temperatures by a novel means of admitting coolant fluid at a temperature substantially lower than the driving fluid to the turbine.

The invention will be described by reference to the attached drawings, in which:

Figure 1 is a diagrammatic section view of a jet propulsion engine incorporating the instant invention;

Figure 2 is a diagrammatic sketch of a portion of a turbine of a jet propulsion engine incorporating the instant invention; and

Figure 3 is a diagrammatic section view of a manifold, as seen through section 3—3 of Figure 1, adapted to apply the cooling gases to the turbine of a jet propulsion engine.

In Figure 1, a gas turbine set is shown diagrammatically which includes a two-stage air compressor, a turbine, and related operating parts. Air is inducted into the first stage compressor 4 by the motion of the rotor of the compressor. A portion of the air discharged from the first stage compressor is collected in collector ring 5 and supplied to burner 6 through conduit 7. The remainder of the air is conducted through the second stage compressor 8. The compressed air, discharged from the second stage compressor 8, is conducted to the coolant manifold 9 through the space defined by the concentric cylindrical walls 10 and 11. Conduits 12, welded to the coolant manifold 9, conduct the air to the selected nozzle on the nozzle ring 13.

Fuel from a source not shown, is introduced continuously through pipe 14 into the center of burner tube 15. A selected amount of air is directed continuously from the air passing through the burner 42 through the burner tube 15 and mixes therein with the fuel. The fuel-air mixture is burned continuously, and the hot exhaust gases,

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discharged from the burner tube 15, are mixed with the remainder of the air, which is passed around the outside of the burner tube 15. The mixture of air and exhaust gases is fed through conduit 16 to manifold 17, and thereafter fed through conduits 18, welded to the manifold 17 and connecting with the selected nozzles on the nozzle ring 13. The turbine 19 is adapted to receive through its turbine passages alternately, during rotation, the hot driving fluid, and the coolant air, at a substantially lower temperature than the driving fluid, from their respective nozzles on the nozzle ring 13.

The second stage compressor is designed such that the pressure of the air admitted to the nozzles on nozzle ring 13 will be sufficient to produce a gas velocity of the air as it leaves the nozzle substantially equal to the velocity of the driving fluid as it leaves its nozzle, thereby preventing shock loading of the turbine blades, assuming the same nozzle design.

Sufficient power may be taken from the turbine 19 to operate one or both stages of the compressor, or the compressor may be driven by a separate source of power.

Referring to Figure 2, showing a portion of the turbine 19 and the related nozzle ring 13, the relationship of the combustion gas flow to the coolant air flow through the turbine is shown. The coolant air is admitted to alternate nozzles in the nozzle ring 13, whereby the nozzle ring is cooled. The rotor blades 20 are contacted alternately with relatively cool air and with hot combustion gases, enabling the temperature of the blades to be maintained below the pre-existing maximum temperature limit, while using hotter combustion gases.

Figure 3 is a diagrammatic section through the coolant manifold 9, taken at a location approximately that designated by line 3—3 in Figure 1, showing concentric cylindrical walls 10 and 11, further showing how partial sectors of this annular flow space may be blanked off by end plates 21, leaving selected passages 22, defined by plate walls 23, 24, 25, whereby the coolant air may be directed to selected portions of the nozzle ring. These walls also define spaces 26, external to the air manifold, through which conduits 27 (see Figure 1), may lead combustion gases from gas manifold 17 (see Figure 1), to the remainder of the nozzle ring.

It is of course understood that the arrangement may vary from one in which alternate nozzles are on coolant and hot gases to arrangements in which several nozzles handle one fluid, followed

by several nozzles handling the other. The exact mechanical details for either arrangement may be worked out by those skilled in the art.

It is essential, in order to prevent shock loading of the rotor blades, that the coolant air be admitted to the rotor blades at approximately the same velocity as the combustion gases. As is well known in the art, the proportioning of the nozzles, in relation to entry pressure thereto, determine exit velocity. In order that the nozzle design for coolant air be generally similar to that for gases, which is obviously desirable for mechanical reasons, it is preferable to raise the pressure of the coolant air to a level approximating that of the combustion gases. The utilization of the second stage compressor serves this purpose.

I claim:

1. In a gas turbine possessing a nozzle ring, conduit means for conducting hot gases to alternate nozzles on said nozzle ring; at least one fuel burner adapted to continuously receive fuel and air and to burn the mixture therein to produce said hot gases; a compressor adapted to induct air and to discharge it under pressure, and conduit means for conducting said compressed air to said burner; the improvement which comprises a second compressor adapted to compress a portion of the air taken from the discharge of said first compressor, means for conducting said portion of air from said first compressor to said second compressor, conduit means for conducting said air from said second compressor, a manifold connected to the end of said conduit means adapted to receive said twice compressed air and direct said air to alternate nozzles on said nozzle ring not used for the passage of driving fluid, a rotor mounted for rotation upon an axis with turbine passages adapted to continuously receive alternately said coolant air and said hot gases from said nozzles on said nozzle ring.

2. In a gas turbine set comprising a two stage air compressor, at least one fuel burner, and a turbine equipped with a nozzle ring; the improvement which comprises means for conducting a portion of the air from the first stage of the compressor to the fuel burner; said burner adapted to burn a fuel in said air to produce a hot working gas; means for conducting said hot working gas to alternate nozzles on the turbine nozzle ring; means for conducting the remaining air from the first stage of the compressor to the second stage; and means for conducting the compressed air from the second stage to alternate nozzles on the nozzle ring not used for the transfer of hot working gas; the second stage of the compressor being designed to impart to the compressed air sufficient energy to produce a discharge velocity from the nozzles substantially equal to the discharge velocity from the nozzles of the hot working gas.

3. In a gas turbine system, a gas turbine including a rotor having radial peripheral blades, and adjacent circumferential stationary nozzles; a combustor; a first compressor for supplying com-

pressed air to said combustor; a conduit connection between the combustor and a sector of said stationary nozzles for supplying to said sector compressed heated gases; and means including a second compressor for supplying a coolant, at a pressure in excess of said compressed air, to another sector of said stationary nozzles.

4. In a gas turbine system, a gas turbine including a rotor having radial peripheral blades, and adjacent circumferential stationary nozzles; a combustor; a first compressor for supplying compressed air to said combustor; a conduit connection between the combustor and a sector of said stationary nozzles for supplying to said sector compressed heated gases; and means including a second compressor for supplying a coolant, at a pressure in excess of said compressed air, to another sector of said stationary nozzles, said pressure and nozzle capacities being such as to secure equal velocities at the nozzles of both nozzle sectors.

5. In a gas turbine system, a gas turbine including a rotor, radial peripheral blades and adjacent circumferential stationary nozzles, a combustor for supplying heated gases to selected stationary nozzles; a first compressor for supplying compressed air to said combustor; and means including a second compressor for supplying coolant under pressure to other selected stationary nozzles; the pressure of the coolant being such and the coolant nozzle capacities being such as to secure equal gas velocities at exit from the nozzles of both groups.

6. In a gas turbine system, a gas turbine including a rotor, radial peripheral blades on said rotor and a plurality of circumferentially spaced stationary nozzles adjacent said blades on the upstream side thereof; a combustor for supplying heated gases to selected stationary nozzles; a first compressor for supplying compressed air to said combustor, and means including a second compressor for supplying coolant under pressure to other selected stationary nozzles.

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