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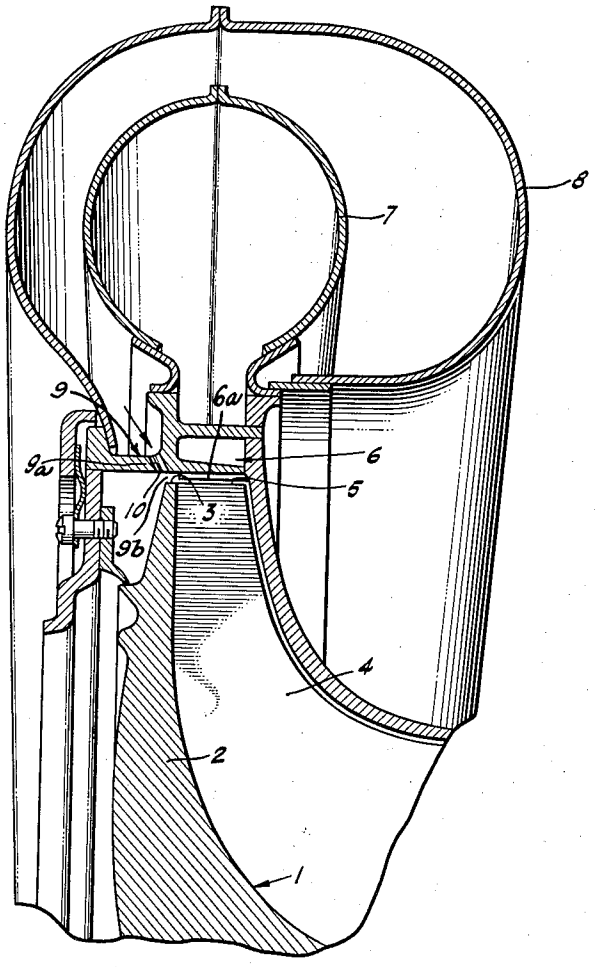

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MEANS FOR COOLING THE PERIPHERAL RIM OF A CENTRIPETAL TURBINE WHEEL

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3 Claims. (Cl. 253—39.15)

This invention relates to means for cooling the peripheral rim of a centripetal turbine wheel, and more particularly to such means for cooling the rim of a gas turbine wheel operating at elevated temperature.

Limitations in efficiency of gas turbines are imposed by the effects of elevated temperature and the centrifugal stresses in the material of the wheel during rotation. In the operation of centripetal hot turbine wheels, the relatively thin rim at the periphery of the wheel becomes very hot and is thereby subjected to extreme circumferential compression due to its thermal expansion. When the hot gas is shut off, the thin wheel rim cools more rapidly than the thicker hub portion causing relatively rapid contraction of the rim. Operation at elevated temperature and subsequent contraction due to rapid cooling creates cracks in the structure of the rim and ultimately causes its failure.

It is an object of the present invention to provide means for continuously cooling the peripheral rim of a centripetal turbine wheel to reduce the range of thermal variation in the rim of the wheel during successive cycles of high temperature operation and shutdown, whereby, the successive compression and contraction stresses do not approach the ultimate strength of the material in the rim of the wheel.

Another object of the invention is to provide a very simple means of ducting cooling air to the peripheral rim of a centripetal turbine wheel, whereby the operating temperature of the rim is maintained at a much lower degree which effectively reduces the range of temperature variation during operation and subsequent shutdown.

Another object of the invention is to provide means for cooling the peripheral rim of a centripetal turbine wheel wherein the rim of the wheel is disposed outside the flow path of hot gases entering the blades of the wheel, permitting a blast of cooling air to impinge upon the rim of the wheel without flow interference with the hot gases.

Another object of the invention is to provide a novel combination of turbine inlet hot gas and air conductors wherein cooling air in one of the conductors is directly released at the peripheral rim of the turbine wheel in a direction toward the axis thereof for optimum cooling of the rim compatible with good efficiency in the wheel.

Another object of the invention is to provide a very simple and compact arrangement of cooling air passages adjacent the turbine nozzle box whereby direct and uniform play of cooling air onto the rim of the turbine wheel may be maintained.

A further object of the invention is to provide a means for cooling the peripheral rim of a centripetal turbine wheel which comprises cooling air passages directed toward the rim of the wheel in close proximity thereto whereby the temperature of the rim may be accurately controlled.

Further objects and advantages will be apparent from the following specification and appended claims.

Reference is directed to the accompanying drawing in which the single figure shows an axial fragmentary sectional view of a centripetal gas turbine wheel contained in a substantially conventional casing on which is supported a nozzle box, a hot gas conductor and a surrounding air conductor.

The turbine wheel **1** is a conventional centripetal turbine wheel having a disc-like body **2** provided with a thin peripheral rim **3**. Fixed to the body are the blades **4** having their outer extremities **5** substantially contiguous with the peripheral rim. These blades **4** extend from one side of the body at the peripheral rim and are generally co-extensive with the nozzle means **6**, which may be of any suitable type known in such turbines. The nozzle means provides discharge means **6***a* substantially co-extensive with the outer extremities **5** of the blades **4**, and the peripheral rim of the turbine wheel **1** is to one side of and clear of the flow path of hot gases which enter the blades at their extremities. Communicating with the nozzle means is the inner scroll **7** which is a hot gas conductor. The outer scroll **8** surrounds the inner scroll and serves as a cooling air conductor and may also provide air to support combustion for generating hot gases which pass from the inner scroll through the discharge means **6***a* of the nozzle means **6** to the blades of the turbine wheel. The nozzle means is provided with an annular trough **9** communicating with the interior of the outer scroll **8** adjacent to the peripheral rim of the turbine wheel. Trough **9** includes a wall **9***a* extending axially from the discharge means **6***a* and radially spaced from the periphery of rim **3** to provide a passage **9***b* between the rim and wall. Wall **9***a* is provided with passages **10** which are directed toward the peripheral rim of the turbine wheel. These passsages **10** are in close proximity to the peripheral rim of the turbine wheel and are directed toward the axis thereof whereby cooling air passing therethrough impinges directly on the peripheral rim **3**.

In operation of the turbine wheel hot gas flows from the inner scroll **7** through the discharge means **6***a* of nozzle means **6** and to the blades **4** at their outer extremities **5**. During flow of the hot gases, heat from the blades is conducted to the thin peripheral rim, raising it to a high temperature. The rim **3** is outside the flow path of gases issuing from the nozzle means **6**, and therefore the flow of hot gases does not seriously impair the flow of cooling air on the rim **3** through passage **9***b* from the passages **10**. The direction of the passages **10** is angular to the axis of the turbine wheel **1** and generally toward the direction of discharge of gas from the wheel blade side of the peripheral rim so that the cooling air impinging upon said peripheral rim is carried through passage **9***b* into the hot gas flow to the turbine wheel.

Continuous impingement of cooling air on the peripheral rim of the turbine wheel during operation thereof maintains its temperature at a considerably lower level so that initial expansion stresses therein are relatively small and successive shutdown contraction stresses are proportionately reduced. Continuous cooling of the peripheral rim of the wheel during high temperature operation thereof maintains the temperature variation in the rim within a safe range so that fatigue cracking of the material in the rim is reduced and the life expectancy of the wheel is greatly increased.

Although my invention has been disclosed as related more particularly to hot centripetal turbine wheels, it will be apparent to those skilled in the art that its principles may be applied to other types of turbomachinery.

I claim:

1. A high temperature centripetal turbine wheel hav-

ing a peripheral rim and axially extending blades, nozzle means adjacent said blades, a hot gas scroll communicating with the nozzle means, an air conducting scroll surrounding the hot gas scroll, and stationary passage means at the exterior of and adjacent the periphery of the wheel and communicating with the interior of the air conducting scroll, said passage means being disposed to direct cooling air inwardly onto the peripheral rim of the high temperature turbine wheel.

2. A high temperature centripetal turbine wheel having a peripheral rim and axially extending blades, nozzle means adjacent the blades, a hot gas scroll communicating with the nozzle means, and air conducting scroll surrounding the hot gas scroll, and stationary passage means at the exterior of and adjacent the periphery of the wheel and communicating with the interior of the air conducting scroll, said passage means being disposed to direct cooling air from said air conducting scroll onto the peripheral rim of the high temperature turbine wheel, said passages being directed inwardly and angularly toward the axis of the high temperature turbine wheel and the blades on said wheel.

3. In a gas turbine: a high temperature centripetal wheel having a disc-type body with a relatively thin peripheral rim, said body having blades projecting axially from and outwardly along one side of said body with the radially outer ends of said blades terminating at the peripheral rim of said body, means rotatably mounting said wheel, a hot gas scroll in peripheral registration with said wheel, nozzle means communicating with said hot gas scroll and disposed radially outwardly of said outer

ends of said blades, said nozzle means defining discharge means for hot gases having an axial length no greater than the axial length of said outer ends of said blades to direct hot gases inwardly against said blades, said rim of said body being disposed to one side of said discharge means, a cooling air scroll having a portion disposed at said one side of said discharge means with a wall thereof extending axially from said discharge means to overlie said rim and substantially radially spaced from the periphery of said rim to provide a passage for flow of cooling air over said rim toward said blades, said wall having cooling air passages extending through said wall from said cooling air scroll, said passages in said wall extending inwardly at an angle toward the peripheral rim of said body and toward said blades to direct streams of cooling air against said rim and through said passage toward said blades.

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