This invention is directed to applying thermal barrier coating systems to hardware having passageways in the walls connecting apertures in the surface to a gas supply for film cooling. An inert gas, such as argon, is discharged through the apertures during the application of the thermal barrier coating system by plasma spraying. This flow of inert gas reduces both blocking of the holes and base metal oxidation during the coating operation.

13 Claims, 1 Drawing Figure
COVERING SOLID, FILM COOLED SURFACES WITH A DUPLEX THERMAL BARRIER COATING

TECHNICAL FIELD

This invention is concerned with providing corrosion resistance and thermal protection to solid film cooled hardware. The invention is particularly directed to applying thermal barrier coating system to solid, film cooled hardware.

Film cooling is used in gas turbine combustors, after-burners, transition ducts, shrouds, vanes, or blades. A plurality of passageways in the metal wall to apertures applying thermal barrier coating system to solid, film hardware. The invention is particularly directed to gas flows from the interior of the hardware through a cooled hardware.

When the film cooled hardware is coated with a thermal barrier coating system, the apertures usually become blocked. Also, various thermal barrier coating systems are used to provide corrosion resistance and thermal protection to these base metal surfaces.

When the film cooled hardware is coated with a thermal barrier coating system, the apertures usually become blocked with coating material. Also, the passageways leading from the interior of the hardware to the apertures may become blocked.

BACKGROUND ART

U.S. Pat. No. 4,050,133 to Cretella is directed to a method for refurbishing turbine vanes including a plasma spray coating process performed in an argon atmosphere. The vanes include cooling passages in the interior portion.

U.S. Pat. No. 4,251,599 to McCormick teaches a process for plasma spray coating a metal body while cooling the surface with an external blast of inert gas. Weatherly et al U.S. Pat. No. 4,095,003 is directed to a duplex coating method comprising plasma spraying followed by heat treatment in an inert atmosphere.

DISCLOSURE OF INVENTION

In accordance with the present invention an inert gas, such as argon, is discharged through the apertures in the film cooled surfaces of the hardware during the application of the thermal barrier coating system by plasma spraying. This flow of inert gas reduces both blocking of the holes and base metal oxidation during the coating operation.

BRIEF DESCRIPTION OF THE DRAWING

The details of the invention will be more fully described when taken with the accompanying drawing which is an elevation view, partially in schematic, showing hardware being coated in accordance with the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to the drawing, there is shown typical hardware having a curved configuration that is of the type found in gas turbine engines. More particularly, the hardware may be a part of a combustor, an after-burner, a transition duct, a shroud, or a vane or blade. The hardware is intended to be used in a high temperature environment where it is exposed to hot combustion gases. The hardware comprises an airfoil portion mounted between end walls or platforms and.

Provision is made for film cooling the surface of the airfoil portion. A plurality of apertures and passages extend from the surface to a suitable plenum chamber or supply passage, not shown, in the interior of the airfoil portion.

When the turbine is operating, a cooling gas flows through the passages to form a cooling film over the surface in a manner well known in the art. Apertures and passages having diameters between 0.010 inch and 0.020 inch have been adequate to supply the required amount of cooling gas for this film.

A thermal barrier coating system is relied on additionally to provide corrosion resistance and thermal protection to the hardware. Such a system may be of a two-layered duplex type disclosed in U.S. Pat. No. 4,055,705 to and of the graded type disclosed in U.S. Pat. No. 4,248,940 to .

According to the present invention the hardware to be coated is clamped in a fixture which properly positions it for the coating operation. The fixture includes a pair of spaced plates and which engage and seal both ends of the hardware at the end walls and respectively.

A pair of plasma spray guns and are provided for supplying the materials for the thermal barrier coating system. The gun has a nozzle from which there emanates a fine spray of particles of bonding metal. The spray is preferably NiCrAlY or CoCrAlY.

The gun has a nozzle from which there emanates a fine spray of barrier coating material. Stabilized zirconia has given satisfactory results as a thermal barrier material.

An important feature of the invention is the provision of a conduit which places the interior of the hardware in communication with a supply of inert gas, such as argon, which is under pressure. It has been found that argon under a pressure of 80 psia produces an adequate flow through the apertures to prevent their clogging.

In operation, the argon under the pressure flows through the conduit to the interior of the hardware. This argon then discharges from the film cooling holes in the surface at a mass flow rate of 0.005 to 0.015 lbs/second.

The surface is first degreased and then roughened by grit blasting. Excess grit is removed from the interior of the hardware with an oil free air blast.

A bond coating is supplied through the gun to the nozzle. The bond coating is deposited on the surface to a thickness between 0.002 inch and 0.004 inch while the argon gas is passing through the apertures thereby reducing the blockage.

After the bond coating has been applied, a ceramic coating is supplied from the spray gun and the nozzle to a thickness of between 0.004 to 0.010 inch. Here again, the flow of the argon from the holes inhibits blocking and reduces base metal oxidation during the coating application.

Silicon carbide paper having an A weight and 600 size is used to polish or smooth the exposed ceramic surface. A roughness of 1 to 3 micrometers (RMS) has been found to be satisfactory. Any grit remaining within the hardware is removed with an oil free air blast.

While the preferred embodiment of the invention has been disclosed and described, it will be appreciated if various modifications may be made to the invention without departing from the spirit of the invention and the scope of the subjoined claims.
I claim:
1. A method of applying a thermal barrier coating system to a member having a plurality of passages therein extending from a surface thereof to a plenum chamber to accommodate an outward flow of fluid to provide film cooling in a high temperature environment comprising the steps of supplying a fluid under pressure to said plenum chamber whereby said fluid flows outward through said passages, plasma spraying a metal bond coat onto said surface having the passages therein while said fluid flows through said passages, and depositing a thermal barrier coating material on said metal bond coat while said fluid flows through said passages whereby entry of said coating material into said passages is prevented thereby inhibiting blockage thereof and reducing base metal oxidation.
2. A method of applying a thermal barrier coating system as claimed in claim 1 including the step of roughening said surface of said member having the passages therein prior to plasma spraying the metal bond coating onto said surface.
3. A method of applying a thermal barrier coating system as claimed in claim 1 wherein the fluid under pressure in the plenum chamber is an inert gas.
4. A method of applying a thermal barrier coating system as claimed in claim 3 wherein the inert gas is argon.
5. A method of applying a thermal barrier coating system as claimed in claim 4 wherein the argon gas is supplied under a pressure of about 80 psia.
6. A method of applying a thermal barrier coating system as claimed in claim 5 wherein the mass flow rate of the argon through the passages is between about 0.005 and 0.015 lbm/second.
7. A method of applying a thermal barrier coating system as claimed in claim 1 wherein the metal bond coat is selected from the group consisting of NiCrAlY and CoCrAlY.
8. A method of applying a thermal barrier coating system as claimed in claim 7 wherein the surface having the passages therein is curved and the metal bond coat is deposited on said curved surface to a thickness between about 0.002 inch and 0.004 inch while the fluid is passing through the passages.
9. A method of applying a thermal barrier coating system as claimed in claim 1 wherein a ceramic material is deposited on the metal bond coat by plasma spraying.
10. A method of applying a thermal barrier coating system as claimed in claim 9 wherein the ceramic material is yttria stabilized zirconia.
11. A method of applying a thermal barrier coating system as claimed in claim 10 wherein the yttria stabilized zirconia is plasma sprayed to a thickness between about 0.004 inch and 0.010 inch.
12. A method of applying a thermal barrier coating system as claimed in claim 11 including the step of polishing the exposed ceramic surface.
13. A method of applying a thermal barrier coating system as claimed in claim 12 wherein the ceramic surface is polished to a roughness of 1 to 3 micrometers (RMS).