(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 669 398 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.12.2013 Bulletin 2013/49

(51) Int Cl.:
C23C 4/00 *(2006.01)*

(21) Application number: **13169796.3**

(22) Date of filing: **29.05.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **31.05.2012 US 201213485237**

(71) Applicant: **General Electric Company**
Schenectady, New York 12345 (US)

(72) Inventor: **Taxacher, Glenn Curtis**
Greenville, SC South Carolina 29615 (US)

(74) Representative: **Cleary, Fidelma**
GPO Europe
GE International Inc.
The Ark
201 Talgarth Road
Hammersmith
London W6 8BJ (GB)

(54) Method of coating corner interface of turbine system

(57) A method of coating a corner interface 14 of a turbine system includes placing a mesh assembly 18 proximate the corner interface 14. The method also includes depositing a coating 16 onto and through the mesh assembly 18 and into the corner interface 14, wherein the mesh assembly 18 dampens a kinetic energy of the coating 16 and secures the coating 16 proximate the corner interface 24.

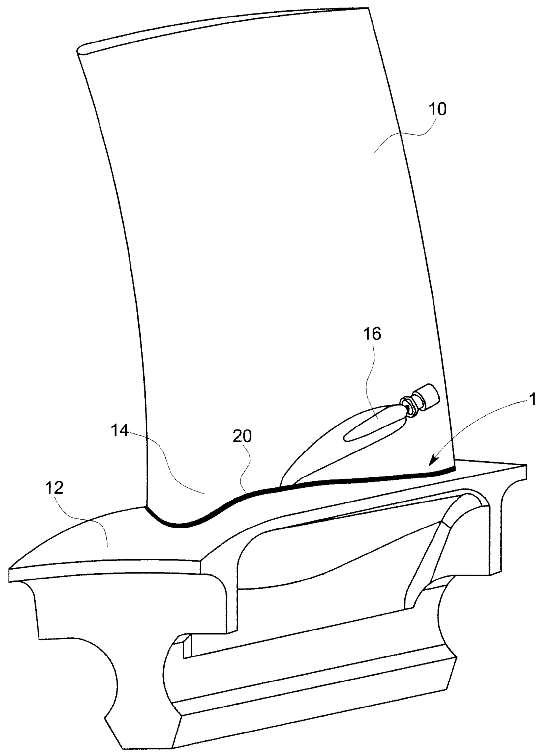

FIG. 1

EP 2 669 398 A1

Description

[0001] The subject matter disclosed herein relates generally to gas turbine systems, and more particularly to a method of coating components within gas turbine systems.

[0002] Typically, in turbine systems, components associated with rotating machinery such as compressors and turbines, for example, are subjected to a sustained high temperature, high load environment. Many of the components are coated for thermal or oxidative protection, with the coating process being a particulate aerosol or plasma spray comprising particles. During the coating process, the particles of the coating approach a surface of the component to be coated and the specific type of interaction of the particles with the surface depends on several factors, such as particle size, particle velocity, particle hardness, particle temperature, surface impingement angle, and the presence of sharp corners at the intersections of adjacent surfaces.

[0003] Often, when particles are applied into a corner joint, the particles will not adhere to the surface in a satisfactory manner, based on high particle energy and a ricocheting and/or reflecting of the particles. This prevents a proper buildup of the coating.

[0004] According to one aspect of the invention, a method of coating a corner interface of a turbine system includes placing a mesh assembly proximate the corner interface. The method also includes depositing a coating onto and through the mesh assembly and into the corner interface, wherein the mesh assembly dampens a kinetic energy of the coating and secures the coating proximate the corner interface.

[0005] According to another aspect of the invention, a method of coating a corner interface of a turbine component includes placing a mesh assembly proximate the corner interface, wherein the mesh assembly is removable. Also included is depositing a coating onto and through the mesh assembly and into the corner interface, wherein the mesh assembly dampens a kinetic energy of the coating and secures the coating proximate the corner interface. Further included is removing the mesh assembly from proximate the corner interface.

[0006] According to yet another aspect of the invention, a method of coating a corner interface of a turbine component includes placing a mesh assembly proximate the corner interface. Also included is depositing a coating onto and through the mesh assembly and into the corner interface, wherein the mesh assembly dampens a kinetic energy of the coating and secures the coating proximate the corner interface, wherein the mesh assembly comprises a material that is consumable within the coating.

[0007] Various advantages and features will become more apparent from the following description taken in conjunction with the drawings.

[0008] The subject matter, which is regarded as the invention, is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a front perspective view of a turbine airfoil being coated at a corner interface through a mesh assembly;

FIG. 2 is a side elevational view of an inner corner having a plurality of mesh assemblies therein;

FIG. 3 is a side elevational view of the inner corner having a split mesh assembly;

FIG. 4 is a side elevational view of the inner corner having a removable mesh assembly placed therein;

FIG. 5 is a side elevational view of the inner corner having a first coating layer disposed between the inner corner and the removable mesh assembly;

FIG. 6 is a side elevational view of the inner corner having the removable mesh assembly spaced outwardly from the first coating layer;

FIG. 7 is a side elevational view of the inner corner having a second coating layer disposed between the first coating layer and the removable mesh assembly;

FIG. 8 is a side elevational view of the inner corner having the first coating layer and the second coating layer disposed therein after the removable mesh assembly has been removed;

FIG. 9 is a front perspective view of an outer corner having the mesh assembly placed thereon;

FIG. 10 is a side elevational view of the outer corner having a continuous mesh; and

FIG. 11 is a side elevational view of the outer corner having a split mesh.

[0009] The detailed description explains embodiments of the invention, together with advantages and features, by way of example with reference to the drawings.

[0010] Referring to FIG. 1, an airfoil, or a first surface 10 of a turbine bucket is illustrated and intersects with a second surface 12 that is substantially perpendicular to the first surface 10. The intersection is generally referred to as a corner interface 14. A coating 16 is deposited proximate the corner interface 14 and may be applied in the form of a spray, for example. The coating 16 comprises a plurality of particles, including but not limited to plasma. Embodiments of the present invention are not limited to any particular type of spray device. Some nonlimiting examples of thermal spray methods include direct current (DC) plasma spray, vacuum plasma spray, suspension plasma spray (SPS), wire-arc spray, combustion/flame spray or high-velocity oxygen fuel thermal spray process (HVOF). To efficiently coat the corner interface 14 with the coating 16, a mesh assembly 18 is disposed proximate the corner interface 14 prior to depositing the coating 16. The mesh assembly 18 functions as a dampening element, with respect to a kinetic energy possessed by particles of the coating 16. Dampening of the kinetic energy reduces the tendency of the particles from ricocheting or deflecting away from the corner interface 14, thereby resulting in stabilization of the particles as they are deposited and retention of the particles proximate the corner interface 14, as a result of a more uniform energy distribution.

[0011] The mesh assembly 18 may be formed of various materials and includes a plurality of apertures 20. The density of the apertures 20 is dependent upon the particular application, and factors such as composition of the coating 16 and material of the corner interface 14 will influence how fine the mesh assembly 18 should be. The mesh assembly 18 may be removable or consumable, as will be described in detail below. Whether the mesh assembly 18 is removable or consumable will influence what material is employed for the mesh assembly 18. Such materials include, but are not limited to, woven or braided materials formed from ceramics such as Silicon Carbide (SiC) ceramic oxides including, but not limited to, those oxides of Aluminum, Silicon, and Boron, various carbon based materials, polymers and metallic alloys. As with the density of the mesh assembly 18, the suitable material of the mesh assembly 18 will depend upon composition of the coating 16 and material of the corner interface 14, but also upon whether the mesh assembly 18 is to be removable from the coating 16 or consumable within the coating 16. The mesh assembly 18 may be attached to the corner interface 14 in a variety of ways, including bonding or tacking the edges of the mesh assembly 18 to the corner interface 14, for example.

[0012] Referring now to FIGS. 2 and 3, the corner interface 14 is shown as an inner corner 22 arrangement, where the first surface 10 and the second surface 12 define an angle therebetween. The angle between the first surface 10 and the second surface 12 is approximately 90 degrees, but it should be appreciated that numerous other angles are appropriate for use with the embodiments disclosed herein. The corner interface 14 may include more than one mesh assembly 18 (FIG. 2). A plurality of mesh assemblies may be advantageous for a number or reasons, such as a desire to form a multi-layered coating 16, for example. In the illustrated example, a first mesh 24 and a second mesh 26 are shown. A first coating layer may be deposited into the corner interface 14 and disposed between the corner interface 14 and the first mesh 24. A second coating layer is then deposited through the second mesh 26 and is therefore disposed between the first coating layer and the second mesh 26. A first mesh 24 and a second mesh 26 have been shown as an example and it is contemplated that any number of meshes may be employed to provide an ability to produce multiple coating layers. The coating layers may be of the same or a distinct composition and may include gaps between them, depending on the mesh assembly 18. Additional coating 16 features and advantages may be achieved by employing a split mesh assembly 28 (FIG. 3), where a portion of the split mesh assembly 28 comprises a gap that allows the coating 16 to more freely enter the corner interface 14, but still retains the coating 16 by positioning of the split mesh assembly 28.

[0013] Referring to FIGS. 4-8, a method of depositing the coating 16 is illustrated. As described above, the first mesh 24 may be removable. By removable, it should be appreciated that the first mesh 24 is positioned and attached proximate the corner interface 14 (FIG. 4) prior to depositing of the coating 16. The coating 16 is then deposited toward and through the first mesh 24 until a first coating layer 30 has been formed (FIG. 5). The first mesh 24 is then removed and the second mesh 26, which is larger than the first mesh 24 in the illustrated example, is positioned and attached proximate the corner interface 14 (FIG. 6) prior to depositing a second coating layer 32. The second coating layer 32 is then deposited toward and through the second mesh 26 (FIG. 7). Subsequently, the second mesh 26 is removed and the multi-layer coating 16 remains within the corner interface 14 (FIG. 8).

[0014] The mesh assembly 18 may alternatively or conjunctively comprise one or more consumable meshes. By consumable, it should be appreciated that one or more meshes are positioned and attached proximate the corner interface 14 prior to depositing of the coating 16, however, in contrast to the removable mesh, the consumable mesh is integrated with the coating 16 upon deposition of the coating onto and through the mesh assembly 18. The consumable mesh is consumed by, or integrated with, the coating 16 in a variety of ways. First, this may be accomplished by employing a mesh that is formed of a material that is of a compatible material makeup with the coating composition, such as a Silicon Carbide (SiC) mesh used in conjunction with a ceramic coating. Alternatively, a process such as fusion of the mesh due to heat of a fusion active at the time of coating may be employed. Such an example is the use of a carbon or polymer mesh with a hot vapor deposition or plasma coating particles. These are merely exemplary methods in which the mesh assembly 18 may be consumed by, or integrated with, the coating 16. It should also be understood that multiple coating layers may be formed by using one or more consumable meshes.

[0015] Referring to FIG. 9, the corner interface 14 is shown as an outer corner 34 arrangement, where the first surface 10 and the second surface 12 define an angle therebetween. The angle between the first surface 10 and the second surface 12 is approximately 270 degrees, but it should be appreciated that numerous other angles are appropriate for use with the embodiments disclosed herein. This configuration is in contrast to the inner corner 22 arrangement described above and merely illustrates the applicability of the method with various interfaces of differing alignments. As is the case with the inner corner 22 arrangement, the outer corner 34 arrangement may be comprised of a continuous configuration (FIG. 10) or a split configuration (FIG. 11).

[0016] While the invention has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Additionally, while various embodiments of the invention have been described, it is to be understood that aspects of the invention may include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

[0017] Various aspects and embodiments of the present invention are defined by the following numbered clauses:

1. A method of coating a corner interface of a turbine system comprising:

    placing a mesh assembly proximate the corner interface; and
    depositing a coating onto and through the mesh assembly and into the corner interface, wherein the mesh assembly dampens a kinetic energy of the coating and secures the coating proximate the corner interface.

2. The method of coating a corner interface of a turbine system of clause 1, wherein the corner interface comprises an intersection between a first surface and a second surface, the first surface and the second surface defining an angle of open area of approximately 90 degrees.

3. The method of coating a corner interface of a turbine system of any preceding clause, wherein the corner interface comprises an intersection between a first surface and a second surface, the first surface and the second surface defining an angle of open area of approximately 270 degrees.

4. The method of coating a corner interface of a turbine system of any preceding clause, wherein placing the mesh assembly proximate the corner interface comprises bonding the mesh assembly to a surface.

5. The method of coating a corner interface of a turbine system of any preceding clause, wherein placing the mesh assembly proximate the corner interface comprises tacking the mesh assembly to a surface.

6. The method of coating a corner interface of a turbine system of any preceding clause, wherein the mesh assembly comprises a ceramic material.

7. The method of coating a corner interface of a turbine system of any preceding clause, wherein the mesh assembly comprises a carbon based material.

8. The method of coating a corner interface of a turbine system of any preceding clause, wherein the mesh assembly comprises a polymer material.

9. The method of coating a corner interface of a turbine system of any preceding clause, wherein the mesh assembly comprises a metallic alloy.

10. The method of coating a corner interface of a turbine system of any preceding clause, further comprising placing a plurality of mesh assemblies proximate the corner interface.

11. The method of coating a corner interface of a turbine system of any preceding clause, wherein the coating comprises a plasma.

12. A method of coating a corner interface of a turbine component comprising:

    placing a mesh assembly proximate the corner interface, wherein the mesh assembly is removable;
    depositing a coating onto and through the mesh assembly and into the corner interface, wherein the mesh assembly dampens a kinetic energy of the coating and secures the coating proximate the corner interface; and
    removing the mesh assembly from proximate the corner interface.

13. The method of coating a corner interface of a turbine component of any preceding clause, wherein placing the mesh assembly proximate the corner interface comprises bonding the mesh assembly to the corner interface.

14. The method of coating a corner interface of a turbine component of any preceding clause, wherein placing the mesh assembly proximate the corner interface comprises tacking the mesh assembly to the corner interface.

15. The method of coating a corner interface of a

turbine component of any preceding clause, further comprising placing a plurality of mesh assemblies proximate the corner interface.

16. The method of coating a corner interface of a turbine component of any preceding clause, wherein the coating comprises a plasma.

17. A method of coating a corner interface of a turbine component comprising:

placing a mesh assembly proximate the corner interface; and depositing a coating onto and through the mesh assembly and into the corner interface, wherein the mesh assembly dampens a kinetic energy of the coating and secures the coating proximate the corner interface, wherein the mesh assembly comprises a material that is consumable within the coating.

18. The method of coating a corner interface of a turbine component of any preceding clause, wherein placing the mesh assembly proximate the corner interface comprises bonding the mesh assembly to the corner interface.

19. The method of coating a corner interface of a turbine component of any preceding clause, wherein placing the mesh assembly proximate the corner interface comprises tacking the mesh assembly to the corner interface.

20. The method of coating a corner interface of a turbine component of any preceding clause, further comprising placing a plurality of mesh assemblies proximate the corner interface.

Claims

1. A method of coating a corner interface (14) of a turbine system comprising:

placing a mesh assembly (18) proximate the corner interface (14); and
depositing a coating (16) onto and through the mesh assembly (18) and into the corner interface (14), wherein the mesh assembly (18) dampens a kinetic energy of the coating (16) and secures the coating (16) proximate the corner interface (14).

2. The method of coating a corner interface (14) of a turbine system of claim 1, wherein the corner interface (14) comprises an intersection between a first surface (10) and a second surface (12), the first surface (10) and the second surface (12) defining an angle of open area of approximately 90 degrees.

3. The method of coating a corner interface (14) of a turbine system of any preceding claim, wherein the corner interface (14) comprises an intersection between a first surface (10) and a second surface (12), the first surface (10) and the second surface (12) defining an angle of open area of approximately 270 degrees.

4. The method of coating a corner interface (14) of a turbine system of any preceding claim, wherein placing the mesh assembly (18) proximate the corner interface (14) comprises bonding the mesh assembly (18) to a surface.

5. The method of coating a corner interface (14) of a turbine system of any preceding claim, wherein placing the mesh assembly (18) proximate the corner interface (14) comprises tacking the mesh assembly (18) to a surface.

6. The method of coating a corner interface (14) of a turbine system of any preceding claim, wherein the mesh assembly (18) comprises a ceramic material.

7. The method of coating a corner interface (14) of a turbine system of any preceding claim, wherein the mesh assembly (18) comprises a carbon based material.

8. The method of coating a corner interface (14) of a turbine system of any preceding claim, wherein the mesh assembly (18) comprises a polymer material.

9. The method of coating a corner interface (14) of a turbine system of any preceding claim, wherein the mesh assembly (18) comprises a metallic alloy.

10. The method of coating a corner interface (14) of a turbine system of any preceding claim, further comprising placing a plurality of mesh assemblies proximate the corner interface (14).

11. The method of coating a corner interface (14) of a turbine system of any preceding claim, wherein the coating (16) comprises a plasma.

12. A method of coating a corner interface (14) of a turbine component comprising:

placing a mesh assembly (18) proximate the corner interface (14), wherein the mesh assembly (18) is removable;
depositing a coating (16) onto and through the mesh assembly (18) and into the corner interface (14), wherein the mesh assembly (18) dampens a kinetic energy of the coating (16) and secures the coating (16) proximate the corner interface (14); and

removing the mesh assembly (18) from proximate the corner interface (14).

13. The method of coating a corner interface (14) of a turbine component of claim 12, wherein placing the mesh assembly (18) proximate the corner interface (14) comprises bonding the mesh assembly (18) to the corner interface (14).

14. The method of coating a corner interface (14) of a turbine component of claim 12 or claim 13, wherein placing the mesh assembly (18) proximate the corner interface (14) comprises tacking the mesh assembly (18) to the corner interface (14).

15. The method of coating a corner interface (14) of a turbine component of any of claims 12 to 14, further comprising placing a plurality of mesh assemblies proximate the corner interface (14).

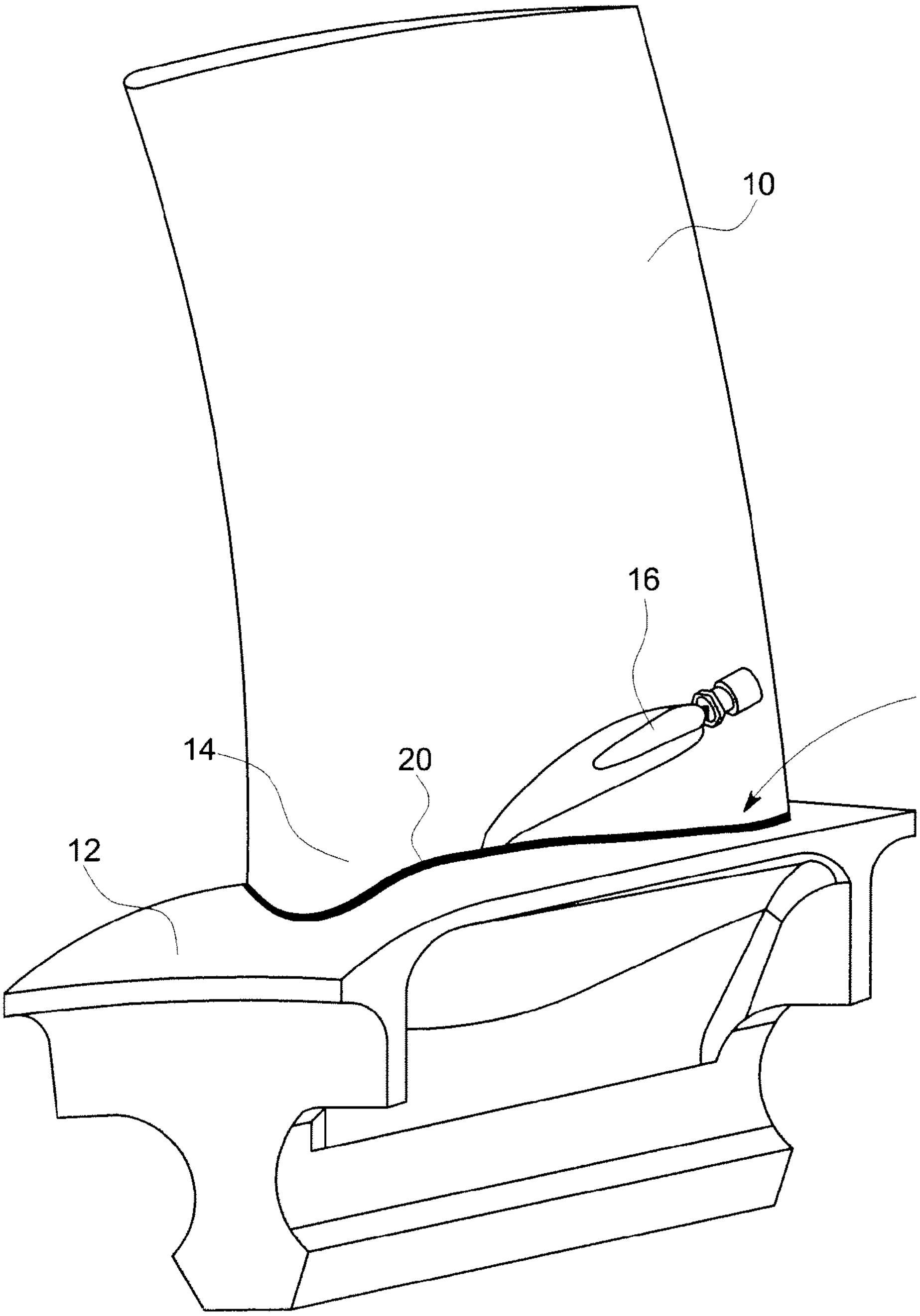

FIG. 1

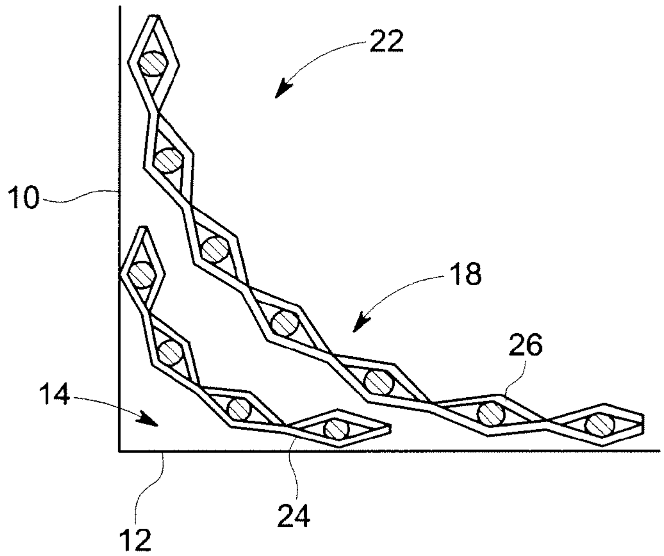

FIG. 2

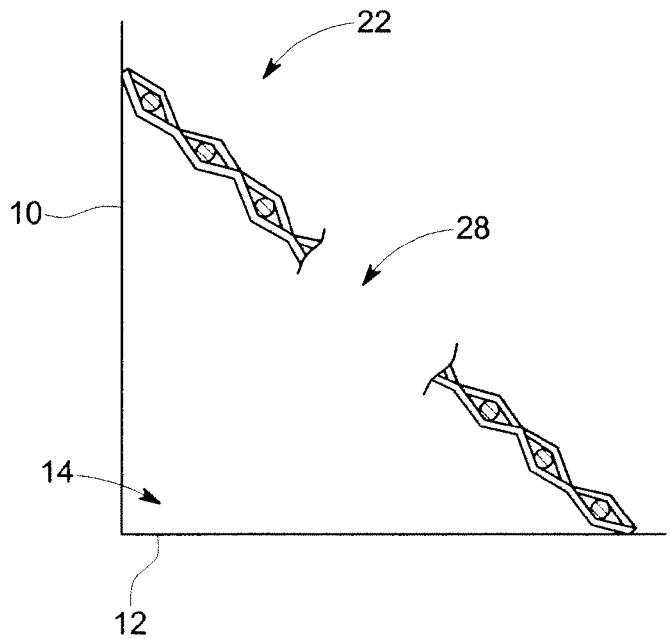

FIG. 3

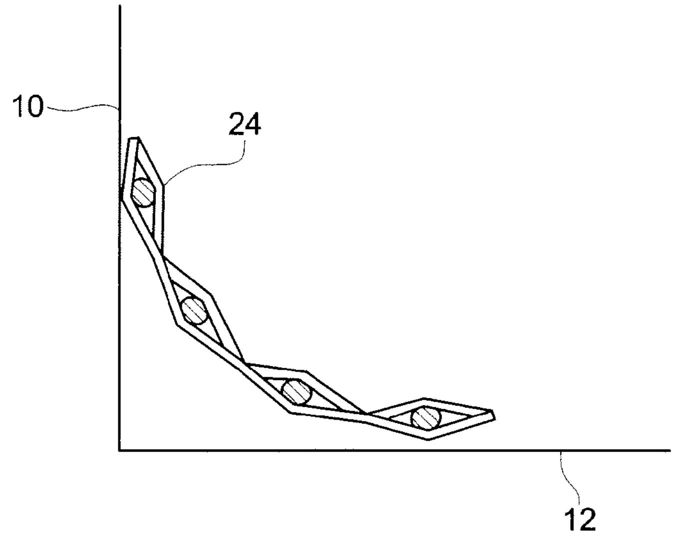

FIG. 4

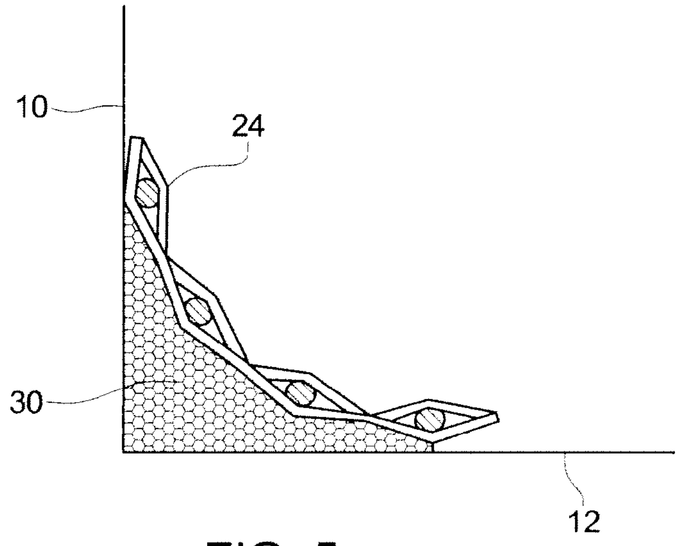

FIG. 5

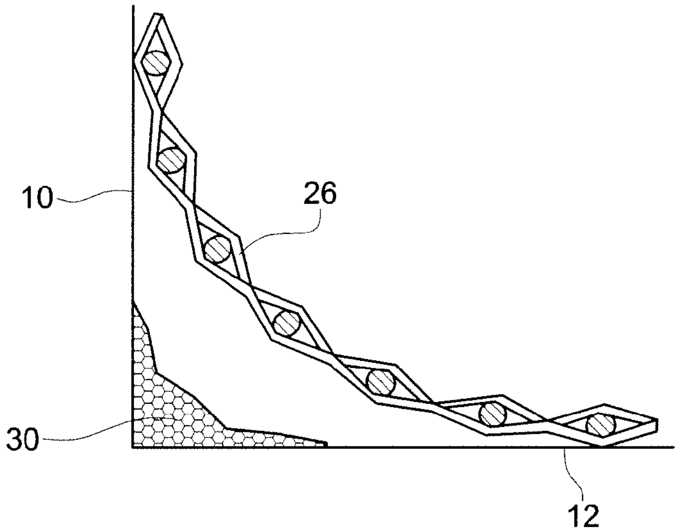

FIG. 6

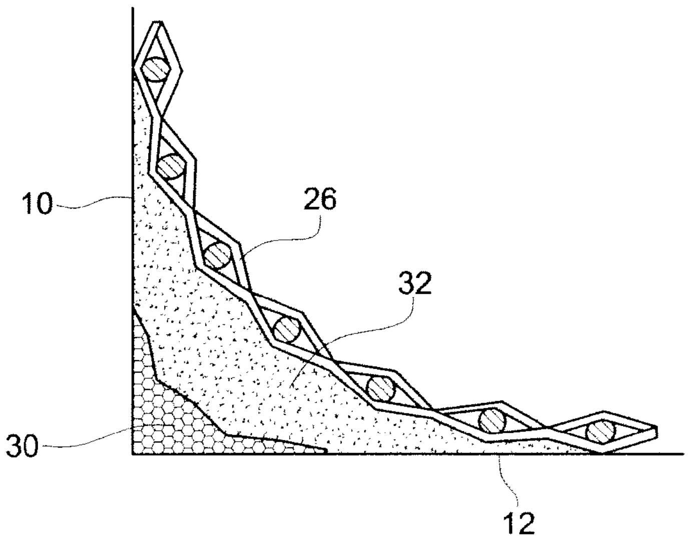

FIG. 7

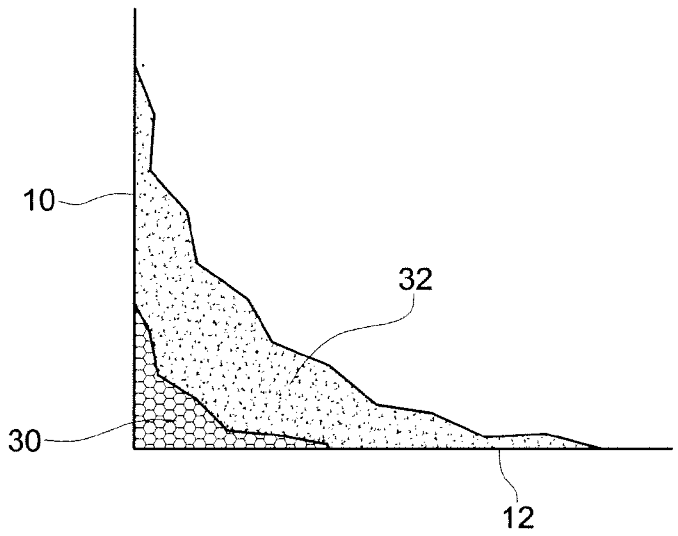

FIG. 8

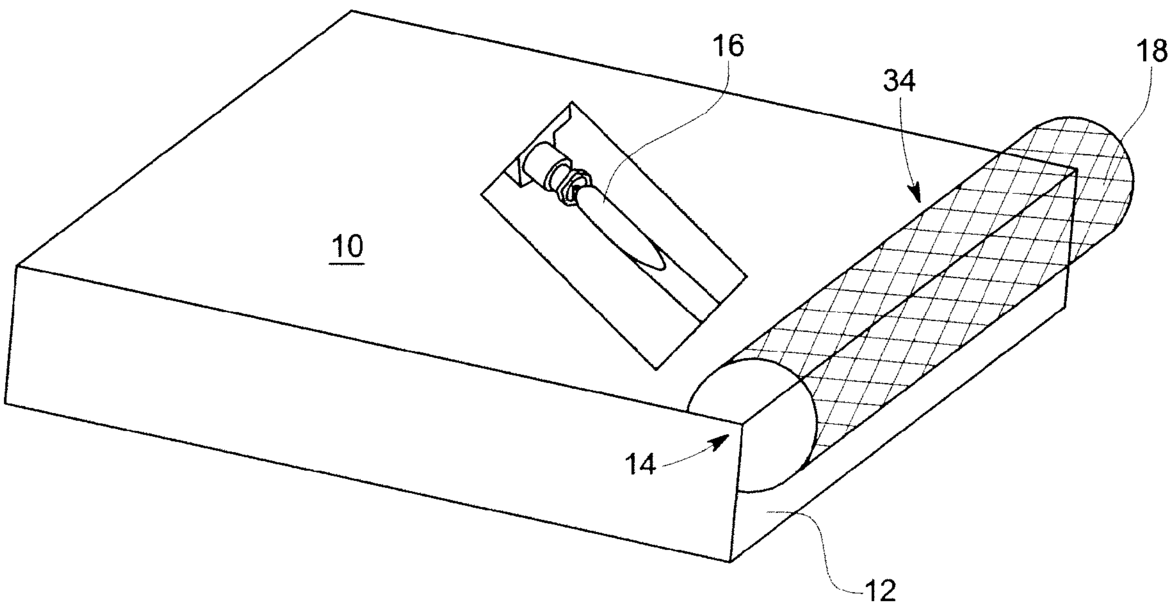

FIG. 9

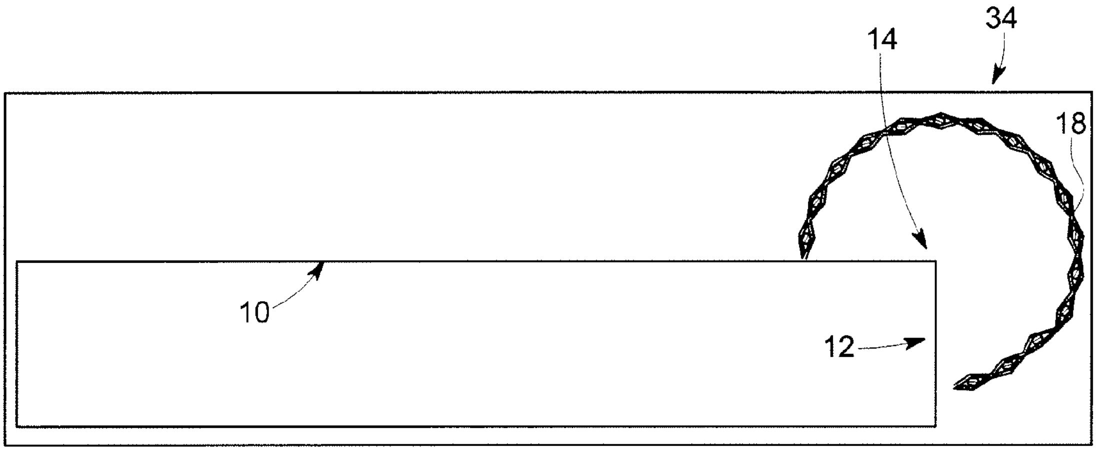

FIG. 10

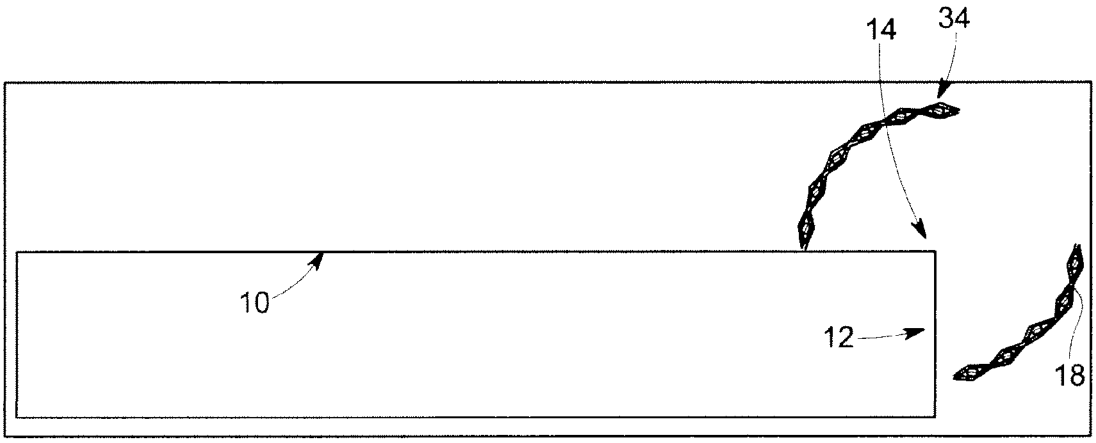

FIG. 11

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 16 9796

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 580 293 A2 (ROLLS ROYCE PLC [GB]) 28 September 2005 (2005-09-28) * paragraphs [0029] - [0031], [0038] - [0040]; claims 1-4, 15-17; figures 2, 4-9 *	1-15	INV. C23C4/00
A	EP 2 305 853 A1 (GEN ELECTRIC [US]) 6 April 2011 (2011-04-06) * claims 1, 14 *	1,12	
A	US 2003/134040 A1 (FUSARO ROBERT ANTHONY [US] ET AL FUSARO JR ROBERT ANTHONY [US] ET AL) 17 July 2003 (2003-07-17) * abstract; claim 1 *	1,12	

TECHNICAL FIELDS SEARCHED (IPC)

C23C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	31 October 2013	Ruiz Martinez, Maria

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 16 9796

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

31-10-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1580293 A2	28-09-2005	EP 1580293 A2	28-09-2005
		US 2005214505 A1	29-09-2005
		US 2008317602 A1	25-12-2008
EP 2305853 A1	06-04-2011	EP 2305853 A1	06-04-2011
		US 2011074113 A1	31-03-2011
US 2003134040 A1	17-07-2003	US 2003134040 A1	17-07-2003
		US 2004009297 A1	15-01-2004

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82