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(54) DATUM TRANSFER APPARATUS AND METHOD FOR INSPECTING COATED COMPONENTS

FESTPUNKTÜBERTRAGUNGSVORRICHTUNG UND VERFAHREN ZUR INSPEKTION VON BESCHICHTETEN KOMPONENTEN

APPAREIL DE TRANSFERT DE PLAN DE RÉFÉRENCE ET PROCÉDÉ D'INSPECTION DE COMPOSANTS REVÊTUS

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Description

TECHNICAL FIELD

[0001] The subject matter of the present disclosure generally relates to gas turbine engines, and more particularly, to methods of inspecting components of gas turbine engines.

BACKGROUND

[0002] In the manufacture of gas turbine engines, and other complicated pieces of machinery, many components of the engine need to be inspected prior to assembly to ensure compliance with dimensional requirements. For example, after a component is produced, it is common practice to inspect the component using a coordinate measuring machine (CMM). An accurate and precise measurement of a finished component is desired to ensure uniformity and quality. It is well known in the industry that a dimension of a desired portion on a component can be measured by using datum points as references, which locate the part in the six degrees of freedom needed to fully constrain the part.

[0003] Generally speaking, during the manufacturing process, simple planar datum points are located directly on the component for primary machining purposes. In most instances, these same planar datum points are used during the inspection processes. However, the location choice of these planar datum points are typically chosen in a manner that is best suited for particular manufacturing processes without regard to usage of the planar datum points during the later inspection processes.

[0004] Not all inspections are as simple as using the planar datum points to take measurements of a finished component. In certain instances during the manufacturing processes, a component may be coated, in its entirety or in part, with a protective or ornamental material. Some of these coatings have a significant thickness to them, which needs to be accounted for when inspecting and correlating the dimensions of the component. For example, in the manufacture of airfoils for gas turbine engines, particularly aluminum airfoils, relatively thick coatings are applied to protect the airfoil from corrosion and erosion. While such coatings are effective, they present a challenge in terms of inspection.

[0005] As mentioned before, the planar datum points are typically chosen based on what is best for the manufacturing processes without regard to the inspection processes. This is true even when the component needs to be coated. Moreover, when choosing the location of the planar datum points on the component little effort is made in marking the datum points in a location that avoids coating over the datum points. Particularly, such prior art techniques present a problem in that the coating over the planar datum points prevents the datum points from being used when correlating pre-coated dimensions to post-coated dimensions during inspection.

[0006] Thus, there is a need for a method of transferring datum points from a pre-coated state of a component to a post-coated state of the component to expedite the inspection process.

5 **[0007]** JP 0785995 B2 discloses a method of marking components of a car body with laser scans to create a different metal texture which can be distinguished after a painting process using a magnetic sensor. US
10 2007-0019213 A1 discloses an automated system for determining the location of holes with openings on surfaces that are at least partially obstructed with a thermal barrier coating.

SUMMARY

15 **[0008]** In accordance with an aspect of the disclosure, a method of inspecting components of a gas turbine engine between a pre-coated state and a post-coated state is provided. The method entails providing at least first
20 and second datum points onto the component in the pre-coated state, where each of the at least first and second datum points have a substantially hemi-spherical shape and a center point. The center points of each of the at least first and second datum points are utilized for measurement of a selected portion on the component in the
25 pre-coated state. Then, the component is coated without filling in the first and second datum points. Next, the center points of each of the at least first and second datum points are utilized for measurement of the selected portion on the component in the post-coated state. The pre-coated state measurements and the post-coated state
30 measurements are then correlated for inspection purposes.

35 **[0009]** In accordance with another aspect of the disclosure, the method of inspecting components between a pre-coated state and a post-coated state further entails providing a third datum point, having a substantially hemi-spherical shape and a center point, onto the component.

40 **[0010]** In accordance with yet another aspect of the disclosure, the method of inspecting components between a pre-coated state and a post-coated state entails each of the at least first through third datum points having diameters measuring approximately 0.953 cm (0.375 inches).

45 **[0011]** In further accordance with still another aspect of the disclosure, the method of inspecting components between a pre-coated state and a post-coated state further entails providing a third datum point, having a substantially cylindrical shape and a center point, onto the
50 component.

[0012] In accordance with another aspect of the disclosure, the method of inspecting components between a pre-coated state and a post-coated state entails the component having a flat planar surface.

55 **[0013]** In accordance with another aspect of the disclosure, the method of inspecting components between a pre-coated state and a post-coated state entails each of the at least first and second datum points being located

on the flat planar surface of the component.

[0014] In further accordance with yet another aspect of the disclosure, the method of inspecting components between a pre-coated state and a post-coated state further entails providing a fourth datum point, which is used in conjunction with the center point of the at least first datum point and the at least third datum point, for measurement of the selected portion on the component in the pre-coated state and the post-coated state.

[0015] In accordance with an aspect of the disclosure, an airfoil is provided. The airfoil has an attachment with a flat surface and a blade that extends longitudinally from the attachment. Disposed on the flat surface are at least first and second datum points, each of the at least first and second datum points having a substantially hemi-spherical shape and a center point, the center points and the flat surface being used for transferring measurements of a selected portion on the airfoil from a pre-coated state to a post-coated state. The first and second datum points are not filled in during a coating of the airfoil in order to provide the post-coated state of the airfoil.

[0016] In accordance with another aspect of the disclosure, the airfoil also includes a third datum point.

[0017] In accordance with yet another aspect of the disclosure, the airfoil includes the third datum point having a substantially hemi-spherical shape and a center point in which the center point is being used for transferring measurements of the selected portion on the airfoil from the pre-coated state to the post-coated state.

[0018] In further accordance with another aspect of the disclosure, the airfoil includes each of the first through third datum points having diameters of approximately 0.953 cm (0.375 inches).

[0019] In further accordance with yet another aspect of the disclosure, the airfoil includes a third datum point having a substantially cylindrical shape and a center point used for transferring measurements of the selected portion of the airfoil from the pre-coated state to the post-coated state.

[0020] In further accordance with another aspect of the disclosure, the flat surface of the airfoil serves as the third datum point for use in transferring measurements of the selected portion on the airfoil from the pre-coated state to the post-coated state.

[0021] In further accordance with still another aspect of the disclosure, the airfoil further includes a fourth datum point being used for transferring measurements of the selected portion on the airfoil from the pre-coated state to the post-coated state.

[0022] In accordance with an aspect of the disclosure, a system for inspecting components of a gas turbine engine is provided. The system includes a measuring probe, a processor and a platform. The platform is designed to receive the component, which includes at least first and second datum points that have a substantially hemi-spherical shape and a center point so that the measuring probe and processor can measure the first and second datum points in a pre-coated state and a

post-coated state. The first and second datum points are not filled in during a coating of the component in order to provide the post-coated state of the component.

[0023] In accordance with another aspect of the disclosure, the system includes the measuring probe which employs a white light measurement method.

[0024] In accordance with yet another aspect of the disclosure, the system includes the measuring probe, the processor and the platform which are all part of a coordinate measuring machine.

[0025] In further accordance with another aspect of the disclosure, the system includes the component having a third datum point, which has a substantially hemi-spherical shape and a center point.

[0026] In further accordance with still another aspect of the disclosure, the system includes the component having a flat surface serving as a third datum point.

[0027] In further accordance with yet another aspect of the disclosure, the system includes the component, which is an airfoil.

[0028] Other features and advantages of the disclosed systems and methods will be appreciated from reading the attached detailed description in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] For further understanding of the disclosed concepts and embodiments, reference may be made to the following detailed description, read in connection with the drawings, wherein like elements are numbered alike, and in which:

FIG. 1 is a perspective view of a fragmentary section of an airfoil constructed in accordance with the teachings of this disclosure;

FIG. 2 is a cross-sectional view of the airfoil of FIG. 1 taken along line 2-2 of FIG. 1; and

FIG. 3 is a top plan view of the airfoil of FIG. 1;

FIG. 4 is a cross-sectional view of an airfoil similar to FIG. 1, including a substantially cylindrical datum point;

FIG. 5 is a schematic view of a coordinate measuring machine; and

FIG. 6 is a flowchart illustrating the steps of the present disclosure.

[0030] As noted above, the disclosure pertains primarily to a method of transferring datum points from a pre-coated state of a component to a post-coated state of the component to expedite the inspection process. It is to be noted, however, that the appended drawings illustrate only typical embodiments and are therefore not to be considered limiting with respect to the scope of the disclosure or claims. Rather, the concepts of the present disclosure may apply within other equally effective embodiments. Moreover, the drawings are not necessarily to scale, emphasis generally being placed upon illustrat-

ing the principles of certain embodiments.

DETAILED DESCRIPTION

[0031] Referring now to the drawings, and with specific reference to FIG. 1, a component manufactured in accordance with the present disclosure is generally referred to by reference numeral 10. Throughout the following disclosure reference will be made to the component as being an airfoil, such as a blade or vane of a gas turbine engine, but it is to be understood that the teachings of this disclosure can be employed with equal effect to any component needing precise measurement. Moreover, it is noted that the use of "component" and "airfoil" are interchangeable. "Airfoil" is used to denote a particular type of component and is used in order to more clearly describe the method of the present disclosure. Therefore, it is understood that the present disclosure is not limited to airfoils, but applies to all components, which generally have a pre-coated and post-coated state as will now be described.

[0032] Furthermore, throughout the disclosure reference is made to datum "points". It is to be understood that the use of "points" is to denote any general datum feature. Thus, the use of "points" is not limited to the strict definition as is generally known and is interchangeable with words such as "feature" and "line" where appropriate.

[0033] As an example of the present invention, discussion is directed toward the manufacturing and inspecting processes of airfoils as generally used in the jet engine industry. Such airfoils are commonly manufactured from titanium metal. The strong, low-density and highly corrosion-resistant properties of titanium are ideal for use in aerospace applications. However, in an effort to improve upon the current technology and make the airfoil even lighter, the industry is moving in the direction of fabricating such airfoils from aluminum alloy.

[0034] Unlike a titanium airfoil, an aluminum alloy airfoil requires coatings on all surfaces to protect the metal from corrosion and erosion caused by the elements. In particular, the aluminum alloy airfoil is masked and then coated with polyurethane for protection. The masking and polyurethane coating add a significant thickness to the airfoil. Moreover, coating the entire surface of the aluminum alloy airfoil covers over the planar datum points that may be originally marked on the surface of the pre-coated airfoil. This covering over of the planar datum points presents a problem when inspecting the airfoil because the planar datum points can no longer be used when inspecting the airfoil in the post-coated state. It is in this regard that the present disclosure greatly improves upon the prior art.

[0035] Referring again to FIG. 1, the airfoil 10 is shown to include a blade 12, which extends longitudinally from an attachment 14, such as a dovetail attachment. The attachment 14 has a flat surface 16 on which are provided a first datum point 18 and a second datum point 20. Both

datum points 18,20 may be hemi-spherical in shape as shown and have center points 22,24, respectively. Flat surface 16 may be used as a third datum point, specifically when the exact thickness of the coating is known or can be measured by other means, as described later herein.

[0036] As shown best in FIG. 2, in the pre-coated state, both the first datum point 18 and the second datum point 20 are designed to be substantially hemi-spherical in shape and have diameters that measure approximately 0.953 cm (0.375 inches). However, other shapes and dimensions are certainly possible. Regardless of the dimension used, what is of import is that, the first and second datum points 18,20 have a pre-determined depth dimension with respect to the flat surface 16. This inclusion of the first and second data points 18,20 onto the flat surface 16, in its pre-coated state, facilitates inspecting and correlating pre-coated dimensions to post-coated dimensions as described in more detail further below.

[0037] It is important to note that after the coating process, the first and second datum points 18,20 are not entirely filled in with coating material and thus maintain their pre-coated shape albeit with a slightly decreased diameter measurement. Because the center point of a hemi-spherical shape is independent of its diameter, the first and second datum points 18,20 have the same center points 22,24 before and after the coating process. In other words, the center points 22,24 in the pre-coated state have the same dimension as in the post-coated state even though the diameters of the first and second datum points 18,20 are changed due to the thickness of the coating. Thus, it can be seen that the design of the first and second datum points 18,20 overcome the problem of the prior art planar datum points of being coated over and unusable in the post-coated state. Furthermore, the design of these datum points 18,20 allow these datum points to be used as primary machining datum points, as well as, transfer datum points, increasing flexibility in machining and fabricating components.

[0038] For example, and with particular reference to Figure 3, the center points 22,24 of the datum points 18,20, respectively, and flat surface 16, acting as a third datum point, are used to measure the airfoil 10 in the post-coated state. Having already used the first and second datum points 18,20 and the flat surface 16 to measure the airfoil 10 in the pre-coated state, the present disclosure can now correlate the measurements of airfoil 10 in the pre-coated and post-coated states for inspection purposes. The technique of using these datum points 18,20 and flat surface 16 are particularly useful during CMM or white light inspection because the inspection data can be taken over the entire surface of the airfoil 10, including the surfaces of the datum points 18,20, which makes it simple to find the center points 22,24.

[0039] In another aspect of the embodiment, three datum points are used in place of two datum points 18,20 and a flat surface 16. Because it is well known in the industry that a dimension of a desired portion on a com-

ponent can be measured by using datum points as references, which locate the part in the six degrees of freedom needed to fully constrain the part, it is appreciated that the location of the three datum points may be located anywhere on the component in order to measure any desired portion on the component. Similarly, the number of datum points used may be in excess of three such as four or more. Further, the diameter of the datum points may vary in size to fit the need of the particular component being inspected.

[0040] In yet another aspect of the embodiment, as shown in FIG. 4, one hemi-spherical datum point, one flat surface and one substantially cylindrical datum point 26 may be used in place of two hemi-spherical datum points and a flat surface. The cylindrical datum point 26 includes a substantially circular shape having a center point 28. Since the cylindrical datum point 26 maintains its shape from a pre-coated state to a post-coated state, its center point 28 is also the same in both states. Thus, it is appreciated that the cylindrical datum point 26 is utilized in the same manner as described above for the hemi-spherical datum points. Expounding upon this, in a further aspect of the embodiment, at least three datum points of any shape that has a center point dimension, which is the same in the pre-coated state and the post-coated state, may be used in place of two hemi-spherical datum points 18,20 and a flat surface 16.

[0041] In operation, the present disclosure may be used to assist the inspection system of FIG. 5 and practice of the method of FIG. 6. FIG. 5 illustrates a system, generally referred to by reference numeral 100, for inspecting components of a gas turbine engine. The system 100 includes a measuring probe 102 and a processor 104, which is operationally associated with the measuring probe 102. The system 100 also includes a platform 106, which is operationally associated with the measuring probe 102. The platform 106 is designed to receive the component 10 in a manner so that the measuring probe 102 and processor 104 measure the center points 22,24 of the first and second datum points 18,20 in a pre-coated state and a post-coated state. In one embodiment of the system 100, the measuring probe 102 employs a white light measurement method. In another embodiment of the system 100, the measuring probe 102, the processor 104 and the platform 106 are part of a coordinate measuring machine (CMM). Another embodiment of the system 100, includes a third datum point having a substantially hemi-spherical shape and a center point. In yet another embodiment, the component further includes a flat surface serving as a third datum point. And in a further embodiment, the component is an airfoil.

[0042] FIG. 6 illustrates a flowchart 200 of a method of inspecting components between a pre-coated state and a post-coated state. Box 202 shows the first step of providing at least first and second datum points onto the component in a pre-coated state. Each of the at least first and second datum points have a substantially hemi-spherical shape and a center point. Next, the center

points of each of the at least first and second datum points are utilized for measurement of a selected portion on the component. This step is shown in box 204. Box 206 is the step of coating the component. In the next step of the method, the center points of each of the at least first and second datum points are utilized for measurement of the selected portion on the component in the post-coated state, as shown in box 208. Box 210 shows the final step of correlating the pre-coated state measurements and the post-coated state measurements for inspection purposes.

[0043] While the present disclosure has shown and described details of exemplary embodiments, it will be understood by one skilled in the art that various changes in detail may be effected therein without departing from the scope of the disclosure as defined by claims supported by the written description and drawings.

Claims

1. A method of inspecting components (10) of a gas turbine engine between a pre-coated state and a post-coated state, comprising:
 - providing at least first and second datum points (18,20;18,26) onto the component in the pre-coated state, each of the at least first and second datum points having a substantially hemi-spherical shape and a center point (22,24;22,28);
 - utilizing the center points (22,24;22,28) of each of the at least first and second datum points (18,20;18,26) for measurement of a selected portion on the component (10);
 - coating the component without entirely filling in the first and second datum points (18;20;18;26);
 - utilizing the center points (22,24;22,28) of each of the at least first and second datum points (18,20;18,26) for measurement of the selected portion on the component (10) in the post-coated state; and
 - correlating the pre-coated state measurements and the post-coated state measurements for inspection purposes.
2. The method of claim 1, wherein a third datum point having a substantially hemi-spherical shape and a center point is provided on the component.
3. The method of claim 2, wherein each of the at least first through third datum points have a diameter of approximately 0.953 cm (0.375 inches).
4. The method of claim 1, wherein a third datum point having a substantially cylindrical shape and a center point is provided on the component.
5. The method of claim 1, wherein the component fur-

ther includes a flat planar surface (16).

6. The method of claim 5, wherein each of the at least first and second datum points (18,20;18,26) are located on the flat planar surface (16) of the component (10).
7. The method of claim 1, further including a fourth datum point, which is used in conjunction with the center point of the at least first datum point and the at least third datum point, for measurement of the selected portion on the component in the pre-coated state and post-coated state.
8. An airfoil (10) comprising:
 - an attachment (14) having a flat surface (16);
 - a blade (12) extending longitudinally from the attachment (14); and
 - at least first and second datum points (18,20) being disposed on the flat surface (16) of the attachment (14), each of the at least first and second datum points (18,20) having a substantially hemi-spherical shape and a center point (22,24), the center points and the flat surface being configured for transferring measurements of a selected portion on the airfoil from a pre-coated state to a post-coated state, wherein the first and second datum points (18,20) are not entirely filled in during a coating of the airfoil in order to provide the post-coated state of the airfoil.
9. An airfoil (10) of claim 8, further including a third datum point (16).
10. An airfoil of claim 9, wherein the third datum point has a substantially hemi-spherical shape and a center point, the center point of the third datum point, in conjunction with the center points of each of the at least first and second datum points, being used for transferring measurements of the selected portion on the airfoil from the pre-coated state to the post-coated state.
11. An airfoil of claim 10, wherein each of the first through third datum points have a diameter of approximately 0.953 cm (0.375 inches).
12. An airfoil of claim 9, wherein the third datum point has a substantially cylindrical shape and a center point used for transferring measurements of the selected portion on the airfoil from the pre-coated state to the post-coated state.
13. An airfoil (10) of claim 8, wherein the flat surface (16) is a third datum point used for transferring measurements of the selected portion on the airfoil from the

pre-coated state to the post-coated state.

14. An airfoil of claim 13, further including a fourth datum point used, in conjunction with the center point of each of the at least first datum point and the flat surface, for transferring measurements of the selected portion on the airfoil from the pre-coated state to the post-coated state.
15. A system for inspecting components of a gas turbine engine (10), comprising:
 - a measuring probe (102);
 - a processor (104) operationally associated with the measuring probe (102); and
 - a platform (106) receiving the component (10), the component including at least first and second datum points (18,20) having a substantially hemi-spherical shape and a center point (22,24), the measuring probe (102) and processor (104) for measuring the center points (22,24) of each of the at least first and second datum points (18,20) in a pre-coated state and a post-coated state, wherein the first and second datum points (18,20) are not entirely filled in during a coating of the component in order to provide the post-coated state of the component.

Patentansprüche

1. Verfahren zur Inspektion von Komponenten (10) eines Gasturbinenmotors zwischen einem Zustand vor Beschichtung und einem Zustand nach Beschichtung, umfassend:
 - Bereitstellen von zumindest einem ersten und einem zweiten Festpunkt (18, 20; 18, 26) an der Komponente in dem Zustand vor Beschichtung, wobei jeder von dem zumindest ersten und zweiten Festpunkt eine im Wesentlichen hemisphärische Form und einen Mittelpunkt (22, 24; 22, 28) aufweist;
 - Verwenden der Mittelpunkte (22, 24; 22, 28) von jedem von dem zumindest ersten und zweiten Festpunkt (18, 20; 18, 26) zur Messung eines ausgewählten Abschnitts an der Komponente (10);
 - Beschichten der Komponente, ohne den ersten und den zweiten Festpunkt (18, 20; 18, 26) vollständig zu füllen;
 - Verwenden der Mittelpunkte (22, 24; 22, 28) von jedem von dem zumindest ersten und zweiten Festpunkt (18, 20; 18, 26) zur Messung des ausgewählten Abschnitts an der Komponente (10) in dem Zustand nach Beschichtung; und
 - Korrelieren der Messungen des Zustands vor Beschichtung und der Messungen des Zu-

- stands nach Beschichtung für Inspektionszwecke.
2. Verfahren nach Anspruch 1, wobei ein dritter Festpunkt, der eine im Wesentlichen hemisphärische Form und einen Mittelpunkt aufweist, an der Komponente bereitgestellt ist. 5
 3. Verfahren nach Anspruch 2, wobei jeder von den zumindest ersten bis dritten Festpunkt einen Durchmesser von annähernd 0,953 cm (0,375 Zoll) aufweist. 10
 4. Verfahren nach Anspruch 1, wobei ein dritter Festpunkt, der eine im Wesentlichen zylindrische Form und einen Mittelpunkt aufweist, an der Komponente bereitgestellt ist. 15
 5. Verfahren nach Anspruch 1, wobei die Komponente ferner eine flache planare Fläche (16) beinhaltet. 20
 6. Verfahren nach Anspruch 5, wobei sich jeder von dem zumindest ersten und zweiten Festpunkt (18, 20; 18, 26) an der flachen planaren Fläche (16) der Komponente (10) befindet. 25
 7. Verfahren nach Anspruch 1, ferner beinhaltend einen vierten Festpunkt, der in Verbindung mit dem Mittelpunkt des zumindest ersten Festpunktes und des zumindest dritten Festpunktes verwendet wird, zur Messung des ausgewählten Abschnitts an der Komponente in dem Zustand vor Beschichtung und dem Zustand nach Beschichtung. 30
 8. Schaufelprofil (10), umfassend: 35
 - eine Anbringung (14), die eine flache Fläche (16) aufweist;
 - eine Schaufel (12), die sich längs von der Anbringung (14) erstreckt; und 40
 - zumindest einen ersten und einen zweiten Festpunkt (18, 20), die an der flachen Fläche (16) der Anbringung (14) angeordnet sind, wobei jeder von dem zumindest ersten und zweiten Festpunkt (18, 20) eine im Wesentlichen hemisphärische Form und einen Mittelpunkt (22, 24) aufweist, wobei die Mittelpunkte und die flache Fläche konfiguriert sind, um Messungen eines ausgewählten Abschnitts des Schaufelprofils von einem Zustand vor Beschichtung zu einem Zustand nach Beschichtung zu übertragen, wobei der erste und der zweite Festpunkt (18, 20) während einer Beschichtung des Schaufelprofils, um den Zustand nach Beschichtung des Schaufelprofils bereitzustellen, nicht vollständig gefüllt werden. 50
 9. Schaufelprofil (10) nach Anspruch 8, ferner beinhaltend einen dritten Festpunkt (16). 55
 10. Schaufelprofil nach Anspruch 9, wobei der dritte Festpunkt eine im Wesentlichen hemisphärische Form und einen Mittelpunkt aufweist, wobei der Mittelpunkt des dritten Festpunktes in Verbindung mit den Mittelpunkten von jedem von dem zumindest ersten und zweiten Festpunkt verwendet wird, um Messungen des ausgewählten Abschnitts an dem Schaufelprofil von dem Zustand vor Beschichtung zu dem Zustand nach Beschichtung zu übertragen.
 11. Schaufelprofil nach Anspruch 10, wobei jeder von dem ersten bis dritten Festpunkt einen Durchmesser von annähernd 0,953 cm (0,375 Zoll) aufweist.
 12. Schaufelprofil nach Anspruch 9, wobei der dritte Festpunkt eine im Wesentlichen zylindrische Form und einen Mittelpunkt aufweist, der verwendet wird, um Messungen des ausgewählten Abschnitts an dem Schaufelprofil von dem Zustand vor Beschichtung zu dem Zustand nach Beschichtung zu übertragen.
 13. Schaufelprofil (10) nach Anspruch 8, wobei die flache Fläche (16) ein dritter Festpunkt ist, der verwendet wird, um Messungen des ausgewählten Abschnitts an dem Schaufelprofil von dem Zustand vor Beschichtung zu dem Zustand nach Beschichtung zu übertragen.
 14. Schaufelprofil nach Anspruch 13, ferner beinhaltend einen vierten Festpunkt, der in Verbindung mit dem Mittelpunkt von jedem von dem zumindest ersten Festpunkt und der flachen Fläche verwendet wird, um Messungen des ausgewählten Abschnitts an dem Schaufelprofil von dem Zustand vor Beschichtung zu dem Zustand nach Beschichtung zu übertragen.
 15. System zur Inspektion von Komponenten eines Gasturbinenmotors (10), umfassend:
 - eine Messsonde (102);
 - einen Prozessor (104), der mit der Messsonde (102) wirkverbunden ist; und
 - eine Plattform (106), die die Komponente (10) aufnimmt, wobei die Komponente zumindest einen ersten und einen zweiten Festpunkt (18, 20) beinhaltet, die eine im Wesentlichen hemisphärische Form und einen Mittelpunkt (22, 24) aufweisen, wobei die Messsonde (102) und der Prozessor (104) dazu dienen, die Mittelpunkte (22, 24) von jedem von dem zumindest ersten und zweiten Festpunkt (18, 20) in einem Zustand vor Beschichtung und einem Zustand nach Beschichtung zu messen, wobei der erste und der zweite Festpunkt (18, 20) während einer

Beschichtung der Komponente, um den Zustand nach Beschichtung der Komponente bereitzustellen, nicht vollständig gefüllt werden.

Revendications

1. Procédé d'inspection de composants (10) d'un moteur à turbine à gaz entre un état pré-revêtu et un état post-revêtu, comprenant :

la fourniture d'au moins des premier et deuxième points de plan de référence (18, 20 ; 18, 26) sur le composant dans l'état pré-revêtu, chacun des au moins premier et deuxième points de plan de référence présentant une forme sensiblement hémisphérique et un point central (22, 24 ; 22, 28) ;

l'utilisation des points centraux (22, 24 ; 22, 28) de chacun des au moins premier et deuxième points de plan de référence (18, 20 ; 18, 26) pour la mesure d'une partie sélectionnée sur le composant (10) ;

le revêtement du composant sans remplir entièrement les premier et deuxième points de plan de référence (18, 20 ; 18, 26) ;

l'utilisation des points centraux (22, 24 ; 22, 28) de chacun des au moins premier et deuxième points de plan de référence (18, 20 ; 18, 26) pour la mesure de la partie sélectionnée sur le composant (10) dans l'état post-revêtu ; et la corrélation des mesures d'état pré-revêtu et des mesures d'état post-revêtu à des fins d'inspection.

2. Procédé selon la revendication 1, dans lequel un troisième point de plan de référence présentant une forme sensiblement hémisphérique et un point central est disposé sur le composant.

3. Procédé selon la revendication 2, dans lequel chacun des au moins premier à troisième points de plan de référence présente un diamètre d'environ 0,953 cm (0,375 pouces).

4. Procédé selon la revendication 1, dans lequel un troisième point de plan de référence présentant une forme sensiblement cylindrique et un point central est disposé sur le composant.

5. Procédé selon la revendication 1, dans lequel le composant inclut en outre une surface plane plate (16).

6. Procédé selon la revendication 5, dans lequel chacun des au moins premier et deuxième points de plan de référence (18, 20 ; 18, 26) est situé sur la surface plane plate (16) du composant (10) .

7. Procédé selon la revendication 1, incluant en outre un quatrième point de plan de référence, qui est utilisé en conjonction avec le point central de l'au moins premier point de plan de référence et l'au moins troisième point de plan de référence, pour la mesure de la partie sélectionnée sur le composant dans l'état pré-revêtu et l'état post-revêtu.

8. Plan de sustentation (10) comprenant :

une fixation (14) présentant une surface plate (16) ;

une pale (12) s'étendant longitudinalement à partir de la fixation (14) ; et

au moins des premier et deuxième points de plan de référence (18, 20) étant disposés sur la surface plate (16) de la fixation (14), chacun des au moins premier et deuxième points de plan de référence (18, 20) présentant une forme sensiblement hémisphérique et un point central (22, 24), les points centraux et la surface plate étant configurés pour transférer des mesures d'une partie sélectionnée sur le plan de sustentation d'un état pré-revêtu vers un état post-revêtu, dans lequel les premier et deuxième points de plan de référence (18, 20) ne sont pas entièrement remplis pendant un revêtement du plan de sustentation pour fournir l'état post-revêtu du plan de sustentation.

9. Plan de sustentation (10) selon la revendication 8, incluant en outre un troisième point de plan de référence (16).

10. Plan de sustentation selon la revendication 9, dans lequel le troisième point de plan de référence présente une forme sensiblement hémisphérique et un point central, le point central du troisième point de plan de référence, en conjonction avec les points centraux de chacun des au moins premier et deuxième points de plan de référence, étant utilisé pour transférer des mesures de la partie sélectionnée sur le plan de sustentation de l'état pré-revêtu vers l'état post-revêtu.

11. Plan de sustentation selon la revendication 10, dans lequel chacun des premier à troisième points de plan de référence présente un diamètre d'environ 0,953 cm (0,375 pouces).

12. Plan de sustentation selon la revendication 9, dans lequel le troisième point de plan de référence présente une forme sensiblement cylindrique et un point central utilisé pour transférer des mesures de la partie sélectionnée sur le plan de sustentation de l'état pré-revêtu vers l'état post-revêtu.

13. Plan de sustentation (10) selon la revendication 8,

dans lequel la surface plate (16) est un troisième point de plan de référence utilisé pour transférer des mesures de la partie sélectionnée sur le plan de sustentation de l'état pré-revêtu vers l'état post-revêtu.

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14. Plan de sustentation selon la revendication 13, incluant en outre un quatrième point de plan de référence utilisé, en conjonction avec le point central de chacun du au moins premier point de plan de référence et de la surface plate, pour transférer des mesures de la partie sélectionnée sur le plan de sustentation de l'état pré-revêtu vers l'état post-revêtu.

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15. Système d'inspection de composants d'un moteur à turbine à gaz (10), comprenant :

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une sonde de mesure (102) ;

un processeur (104) fonctionnellement associé à la sonde de mesure (102) ; et

une plateforme (106) recevant le composant (10), le composant incluant au moins des premier et deuxième points de plan de référence (18, 20) présentant une forme sensiblement hémisphérique et un point central (22, 24), la sonde de mesure (102) et le processeur (104) pour mesurer les points centraux (22, 24) de chacun des au moins premier et deuxième points de plan de référence (18, 20) dans un état pré-revêtu et un état post-revêtu, dans lequel lesdits premier et deuxième points de plan de référence (18, 20) ne sont pas entièrement remplis pendant un revêtement du composant afin de fournir l'état post-revêtu du composant.

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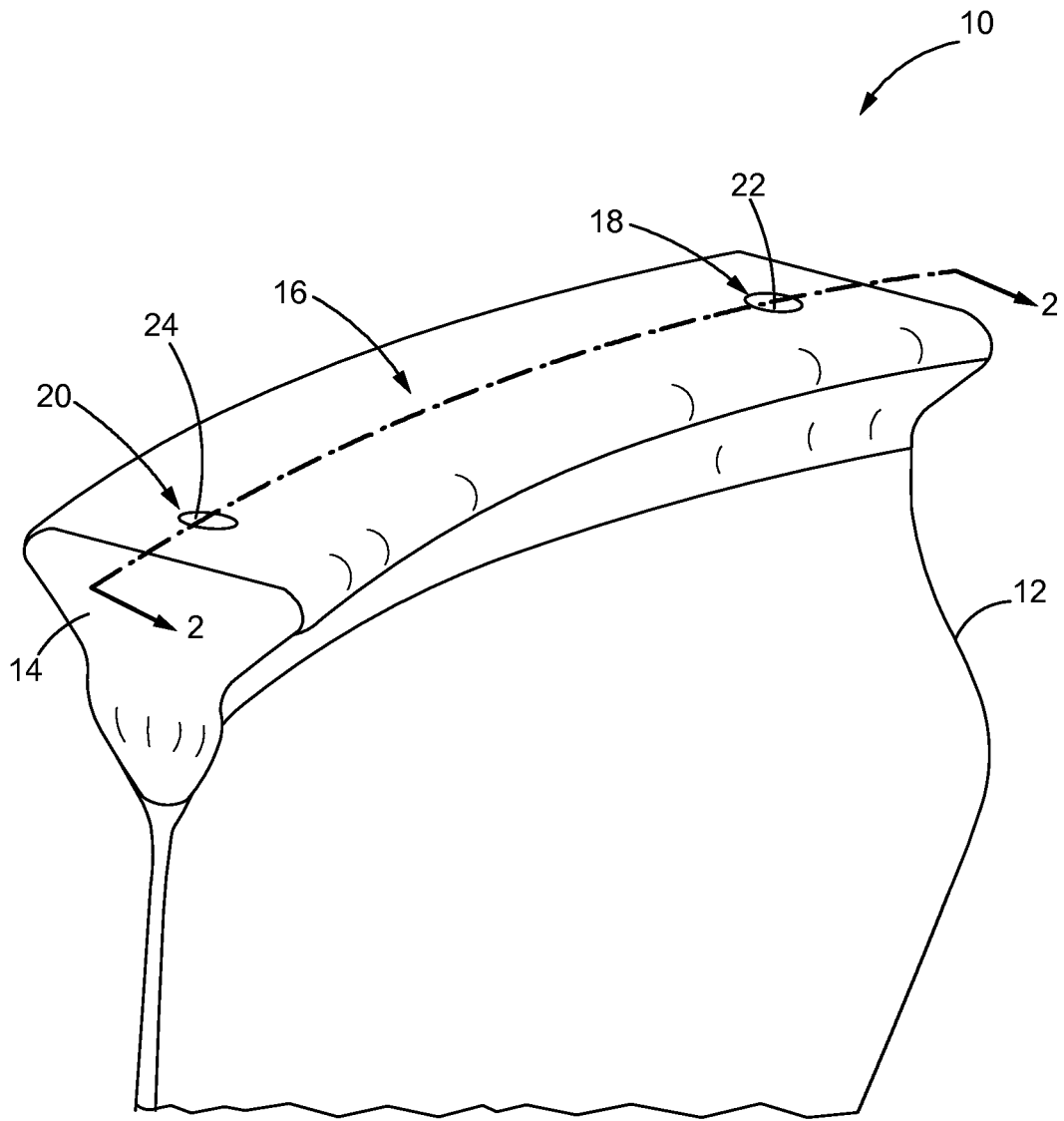


FIG. 1

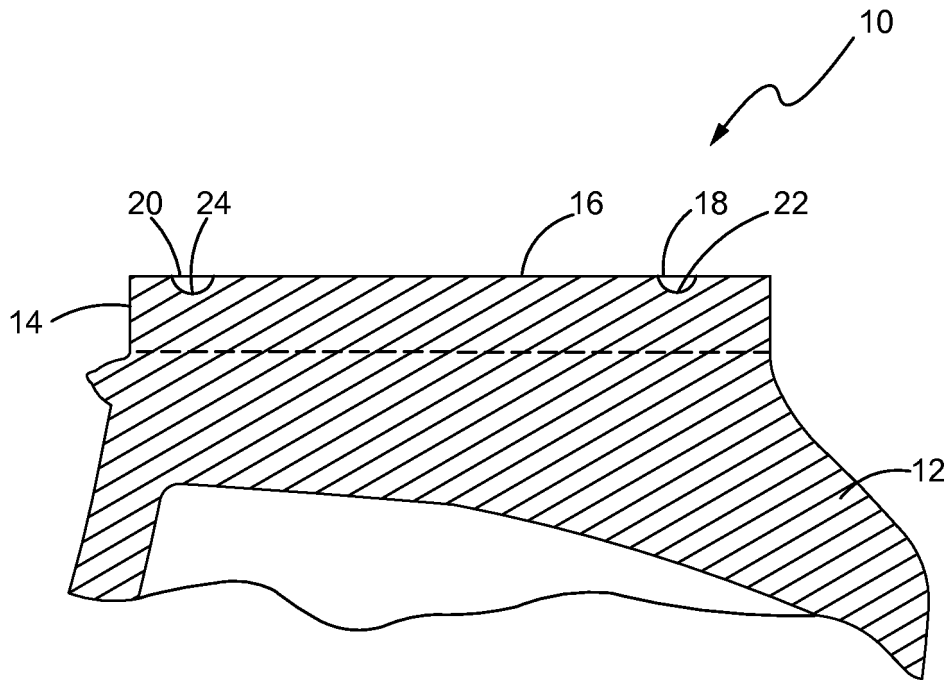


FIG. 2

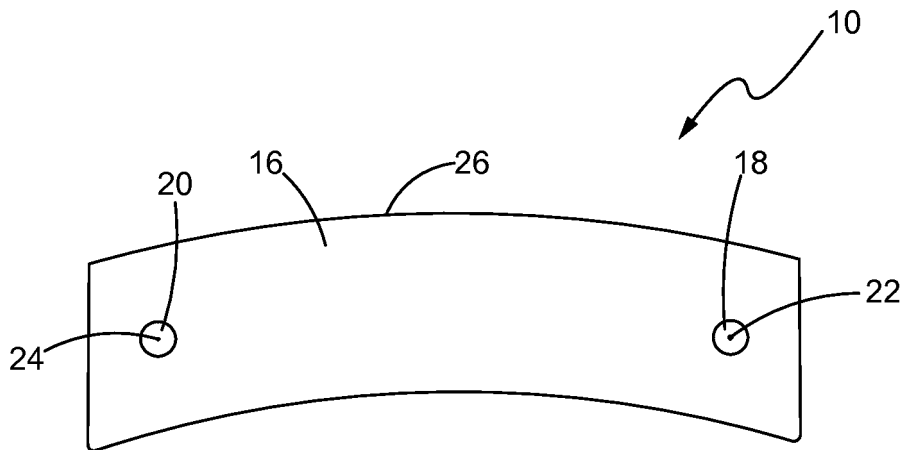


FIG. 3

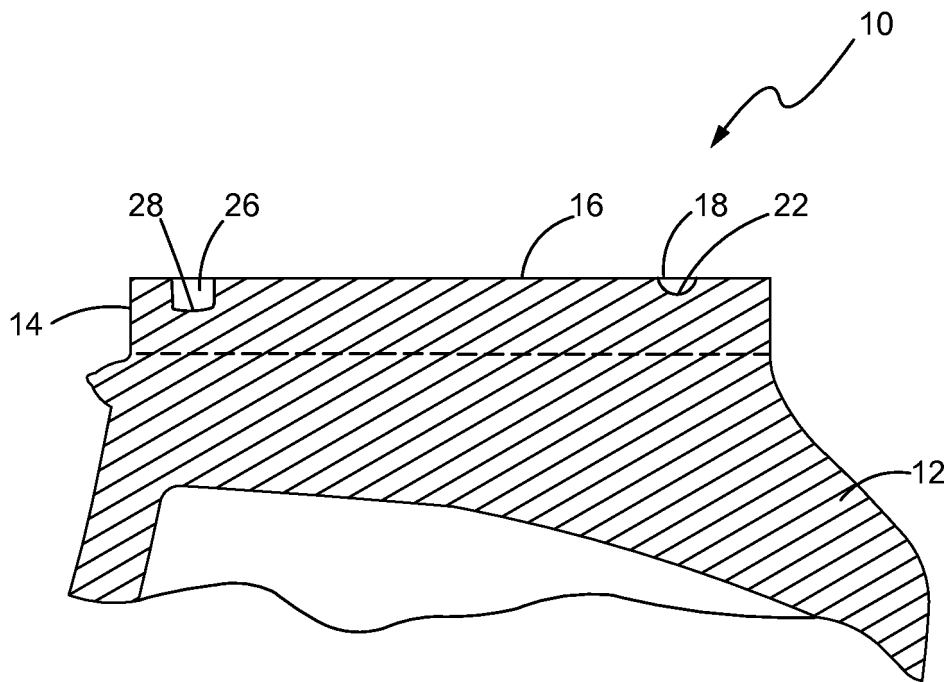


FIG. 4

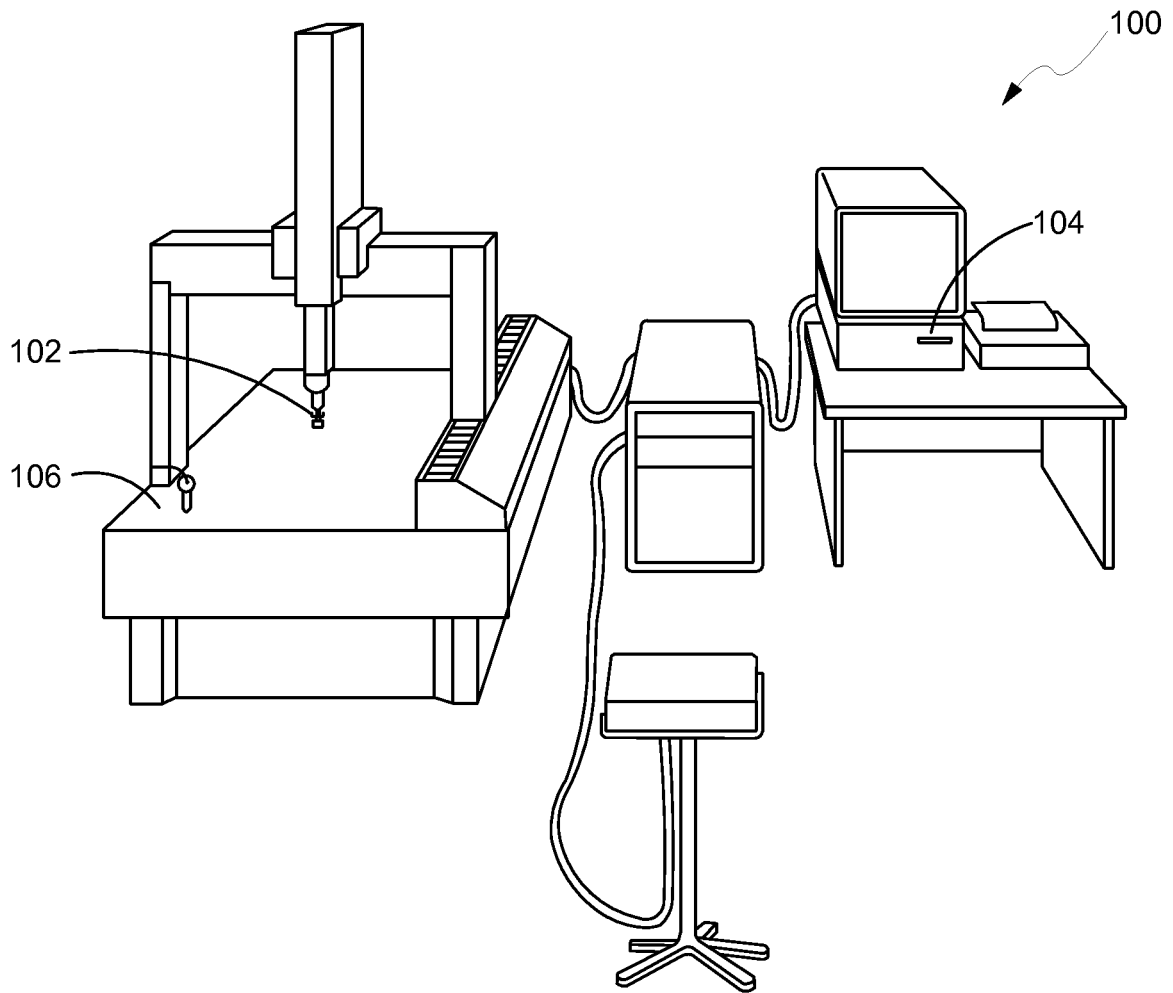


FIG. 5

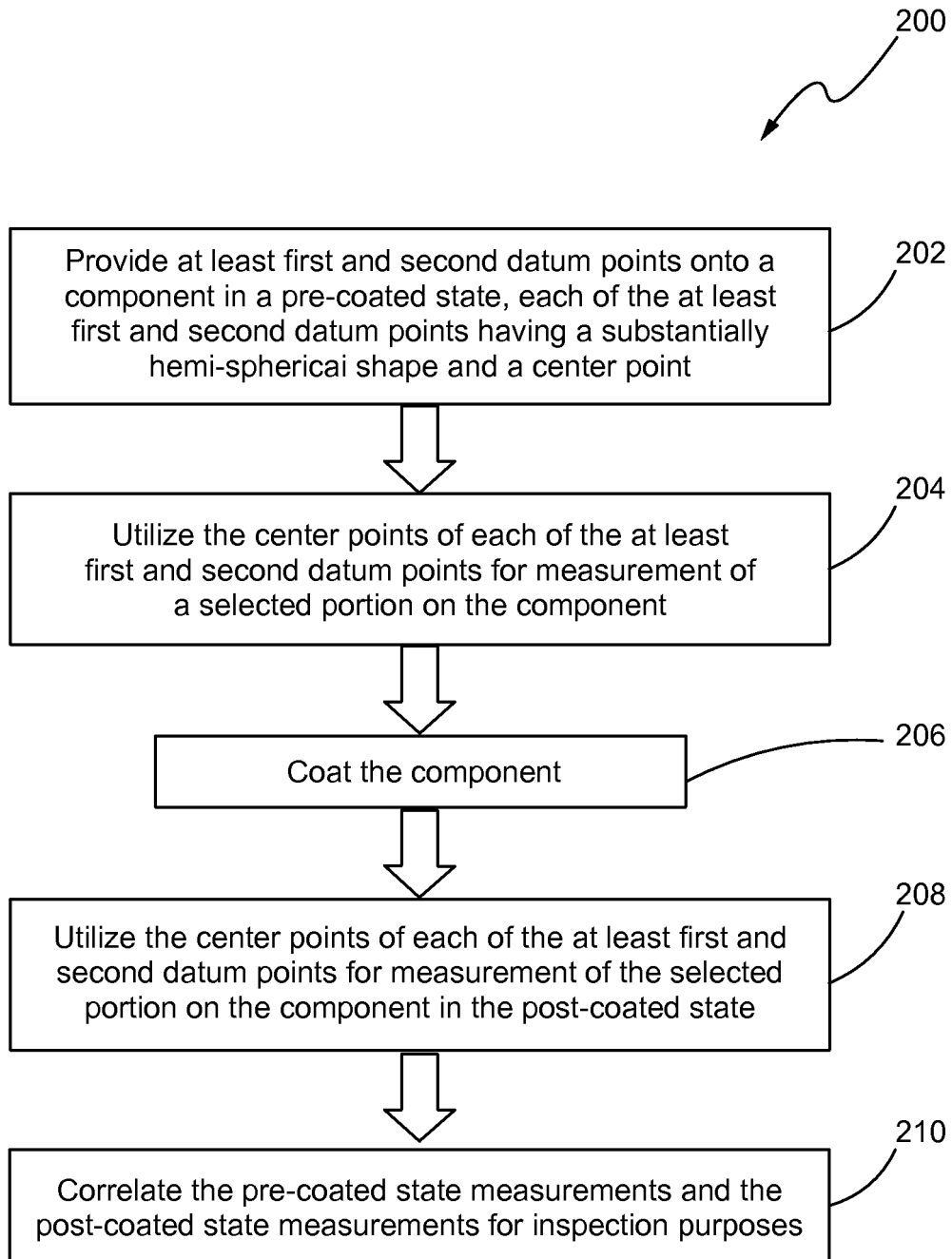


FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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