blending of added material with base material on the blade.

[0004] A finishing tool used for the blending process comprises an abrasive device (e.g. a sand belt) with an abrasive surface, for removing added material in excess from the manufactured component. The finishing tool may be operated by a human, or may be automatically controlled. However, in both cases, the precision of the blending process may not be sufficient to comply with nominal specifications of the finished manufactured component (e.g. the final profile of the component after performing the blending operation is not compliant with the nominal specifications). For example, too much material may have been removed by the abrasive device from a portion of the manufactured component (base material has been removed during the blending process), and / or not enough material may have been removed by the abrasive device from another portion of the manufactured component (added material in excess has not been removed during the blending process). Thus, the lack of precision in the blending process is generally due to a lack of precision in the control of the abrasive device.

[0005] Therefore, there is a need for an apparatus and a method for blending added material with base material on a manufactured component, which overcomes the aforementioned limitations.

SUMMARY

[0006] According to a first aspect, the present disclosure provides an apparatus for blending added material with base material on a manufactured component. The apparatus comprises an abrasive device having an abrasive surface, for removing exceeding added material and for blending the added material with the base material. The abrasive surface performs in operation an abrasive motion. The apparatus further comprises a guide fixed to the abrasive device. The guide provides a plurality of contact points exceeding at least a portion of the abrasive surface. The apparatus also comprises a positioning mechanism for controlling position and angle of the abrasive surface and the

profile, some missing base material 35 is lacking with respect to a nominal profile 50 of the manufactured component 20. Thus, some material is added to the first profile, to make it compliant with the nominal profile 50. Depending on the type of manufactured component, damage to be repaired, etc., the base material 30 may further be modified before adding material, so as to ensure that the added material has enough thickness and/or adherence to the base material to result in a refurbished manufactured component 20 within tolerances set by corresponding specifications.

[0036] Figure 2B represents a second exemplary profile of the manufactured component 20, after addition of some material 42 to the manufactured component. The second profile comprises the base material 30, added material 40 corresponding to a nominal profile 50 of the manufactured component, and added material in excess 42. In order to make the profile compliant with the nominal profile 50, the added material in excess 42 must be removed.

[0037] Figure 2C represents a third exemplary profile of the manufactured component 20. As illustrated, the profile is not compliant with the nominal profile 50, because some added material in excess 42 which has not been removed. This is generally due to a lack of precision in the control of the abrasive device used for removing the added material in excess 42. For instance, the lack of precision consists in a lack of precision in the position of the abrasive device with respect to the manufactured component, and/or a lack of precision in the pressure applied to the abrasive device for removing material. Either not enough material is removed, or too much material is removed by the abrasive device.

[0038] The apparatus and method described in the present disclosure allow a blending of added material with the base material 30 of the manufactured component 20, by precisely controlling the process of removing the added material in excess 42, so as to as closely as possible reach the nominal profile of the manufactured component after its refurbishing.

with the manufactured component. Thus, depending on the size of the abrasive surface 110, the size and shape of the nominal profile of the manufactured component, and the position and shape of the guides 121 and 122, it is possible to identify at least one point of contact to be used on one of the guides 122 and 122, so as to procure high precision blending of the added material without affecting the base material, but rather using the material of the manufactured component which corresponds to the nominal profile with a contact point on one of the guides as a reference point.

[0044] Referring to Figures 5A-D concurrently, the control of the position and angle of the abrasive surface and the guide with respect to the manufactured component is illustrated.

[0045] Figure 5A represents a cross-section view of a manufactured component 300, comprising base material 301, added material 303, and exceeding added material 302. The exceeding added material 302 must removed be as it exceeds from the nominal profile of the manufactured component 300, and the added material 303 blended with the base material 301 to ensure a smooth and seamless finish.

[0046] Figure 5B represents a cross-section view of the manufactured component 300 and an abrasive surface 210. An abrasive device comprising the abrasive surface 210 is not represented for simplification purposes. A guide is not fixed to the abrasive device. The manufactured component 300 comprises the exceeding added material 302 and base material 305. The base material 305 of Figure 5B comprises the base material 301 and the added material 303 blended with the base material 301 represented in Figure 5A. The abrasive surface 210 removes the exceeding added material 302, without removing the base material 305. For this purpose, the abrasive surface 210 performs an abrasive motion 360 for removing the exceeding material 302. And the position of the abrasive surface 210 with respect to the manufactured component 300 follows an abrasion direction 350 for removing the totality of the exceeding added material 302. To provide a high precision blending and

WHAT IS CLAIMED IS:

1. An apparatus for blending added material with base material on a manufactured component, the apparatus comprising:

an abrasive device having an abrasive surface for removing exceeding added material and blending the added material with the base material, the abrasive surface performing in operation an abrasive motion;

a guide fixed to the abrasive device and providing a plurality of contact points exceeding at least a portion of the abrasive surface; and

a positioning mechanism for controlling position and angle of the abrasive surface and a point of contact of the guide with respect to the manufactured component, the positioning mechanism guiding in operation the abrasive surface along an abrasion direction while maintaining at least one of the plurality of contact points of the guide in contact with the manufactured component.

2. The apparatus of claim 1, wherein a section of a perimeter of the guide exceeding the abrasive surface has one of the following shapes: elliptical, parabolic or any curvilinear shape.

3. The apparatus of claim 1, wherein the added material consists in welded material.

4. The apparatus of claim 1, wherein the abrasive motion is opposite to the abrasion direction.

5. The apparatus of claim 1, wherein the manufactured component is moved with respect to the abrasive device in the abrasion direction.

6. The apparatus of claim 1 further comprising a force control mechanism for:

applying a force to the abrasive device when the abrasive surface is in contact with the manufactured component, to allow the abrasive surface to remove the exceeding added material; and

transferring the force from the abrasive device to the point of contact of the guide when the abrasive surface is in contact with the base material, to prevent the abrasive surface from removing the base material.

7. The apparatus of claim 6 further comprising a force sensor for:

measuring the force applied to the abrasive device;

comparing the measured force to a predetermined value corresponding to a force applied to the abrasive device when the abrasive surface and the guide are in contact with the base material; and

triggering a transfer of the force from the abrasive device and the guide when the measured force is equal to the predetermined value.

8. The apparatus of claim 1, wherein the positioning mechanism takes into consideration operational parameters for controlling the position and angle of the abrasive surface, the operational parameters including a wear of the abrasive surface, and specific characteristics of the manufactured component.

9. The apparatus of claim 1, wherein a trajectory of the abrasive surface with respect to the manufactured component is calculated by a computer, calculation of the trajectory comprising: determining the position and angle of the abrasive surface, and determining which of the plurality of contact points are to be kept in contact with the

manufactured component.

10. The apparatus of claim 9, wherein the trajectory is calculated by processing a 3D model of the manufactured component, the 3D model comprising a representation of the added material and the base material.

11. The apparatus of claim 1, wherein the abrasive surface is a sand belt.

12. The apparatus of claim 1, wherein the manufactured component consists in a blade.

13. A method for blending added material with base material on a manufactured component, the method comprising:

determining a trajectory of an abrasive surface of an abrasive device with respect to the manufactured component;

determining which of a plurality of contact points of a guide is to be kept in contact with the manufactured component along the trajectory;

actuating the abrasive device; and

controlling position and angle of the abrasive surface on the manufactured component along the trajectory, while keeping the determined contact point in contact with the manufactured component.

14. The method of claim 13, wherein the guide has a section of its perimeter exceeding the abrasive surface having one of the following shapes: elliptical, parabolic or any curvilinear shape.

15. The method of claim 13, wherein the added material consists in welded material.

16. The method of claim 13, wherein the abrasive surface performs an abrasive motion opposite to the trajectory.

17. The method of claim 13, wherein the manufactured component is moved with respect to the abrasive surface according to the trajectory.

18. The method of claim 13 further comprising:

applying a force to the abrasive device when the abrasive surface is in contact with the added material, to allow the abrasive surface to remove the added material; and

transferring the force from the abrasive device when the guide is in contact with the base material, to prevent the abrasive surface from removing the base material.

19. The method of claim 17 further comprising:

measuring the force applied to the abrasive device;

comparing the measured force with a predetermined value corresponding to a force applied to the abrasive device and the guide when the abrasive surface is in contact with the base material; and

transferring the force from the abrasive device when the measured force is equal to the pre-determined value.

20. The method of claim 13, wherein operational parameters are taken into consideration for controlling the position and angle of the abrasive surface, the operational parameters including a wear of the abrasive surface, and specific characteristics of the manufactured component.

21. The method of claim 13, wherein the trajectory is calculated by processing a 3D model of the manufactured component, the 3D model comprising a representation of the added material and the base material.

blending of added material with base material on the blade.

[0004] A finishing tool used for the blending process comprises an abrasive device (e.g. a sand belt) with an abrasive surface, for removing added material in excess from the manufactured component. The finishing tool may be operated by a human, or may be automatically controlled. However, in both cases, the precision of the blending process may not be sufficient to comply with nominal specifications of the finished manufactured component (e.g. the final profile of the component after performing the blending operation is not compliant with the nominal specifications). For example, too much material may have been removed by the abrasive device from a portion of the manufactured component (base material has been removed during the blending process), and / or not enough material may have been removed by the abrasive device from another portion of the manufactured component (added material in excess has not been removed during the blending process). Thus, the lack of precision in the blending process is generally due to a lack of precision in the control of the abrasive device.

[0005] Therefore, there is a need for an apparatus and a method for blending added material with base material on a manufactured component, which overcomes the aforementioned limitations.

SUMMARY

[0005a] The invention is defined in the independent claims. Some optional features of the invention are defined in the dependent claims.

[0006] According to a first aspect, the present disclosure provides an apparatus for blending added material with base material on a manufactured component. The apparatus comprises an abrasive device having an abrasive surface, for removing exceeding added material and for blending the added material with the base material. The abrasive surface performs in operation an abrasive motion. The apparatus further comprises a guide fixed to the abrasive device. The guide provides a plurality of contact points exceeding at least a portion of the abrasive surface. The apparatus also comprises a positioning mechanism for controlling position and angle of the abrasive surface and the

profile, some missing base material 35 is lacking with respect to a nominal profile 50 of the manufactured component 20. Thus, some material is added to the first profile, to make it compliant with the nominal profile 50. Depending on the type of manufactured component, damage to be repaired, etc., the base material 30 may further be modified before adding material, so as to ensure that the added material has enough thickness and/or adherence to the base material to result in a refurbished manufactured component 20 within tolerances set by corresponding specifications.

[0036] Figure 2B represents a second exemplary profile of the manufactured component 20, after addition of some material 42 to the manufactured component. The second profile comprises the base material 30, added material 40 corresponding to a nominal profile 50 of the manufactured component, and added material in excess 42. In order to make the profile compliant with the nominal profile 50, the added material in excess 42 may be removed.

[0037] Figure 2C represents a third exemplary profile of the manufactured component 20. As illustrated, the profile is not compliant with the nominal profile 50, because some added material in excess 42 which has not been removed. This is generally due to a lack of precision in the control of the abrasive device used for removing the added material in excess 42. For instance, the lack of precision consists in a lack of precision in the position of the abrasive device with respect to the manufactured component, and/or a lack of precision in the pressure applied to the abrasive device for removing material. Either not enough material is removed, or too much material is removed by the abrasive device.

[0038] The apparatus and method described in the present disclosure allow a blending of added material with the base material 30 of the manufactured component 20, by precisely controlling the process of removing the added material in excess 42, so as to as closely as possible reach the nominal profile of the manufactured component after its refurbishing.

with the manufactured component. Thus, depending on the size of the abrasive surface 110, the size and shape of the nominal profile of the manufactured component, and the position and shape of the guides 121 and 122, it is possible to identify at least one point of contact to be used on one of the guides 122 and 122, so as to procure high precision blending of the added material without affecting the base material, but rather using the material of the manufactured component which corresponds to the nominal profile with a contact point on one of the guides as a reference point.

[0044] Referring to Figures 5A-D concurrently, the control of the position and angle of the abrasive surface and the guide with respect to the manufactured component is illustrated.

[0045] Figure 5A represents a cross-section view of a manufactured component 300, comprising base material 301, added material 303, and exceeding added material 302. The exceeding added material 302 may removed be as it exceeds from the nominal profile of the manufactured component 300, and the added material 303 blended with the base material 301 to ensure a smooth and seamless finish.

[0046] Figure 5B represents a cross-section view of the manufactured component 300 and an abrasive surface 210. An abrasive device comprising the abrasive surface 210 is not represented for simplification purposes. A guide is not fixed to the abrasive device. The manufactured component 300 comprises the exceeding added material 302 and base material 305. The base material 305 of Figure 5B comprises the base material 301 and the added material 303 blended with the base material 301 represented in Figure 5A. The abrasive surface 210 removes the exceeding added material 302, without removing the base material 305. For this purpose, the abrasive surface 210 performs an abrasive motion 360 for removing the exceeding material 302. And the position of the abrasive surface 210 with respect to the manufactured component 300 follows an abrasion direction 350 for removing the totality of the exceeding added material 302. To provide a high precision blending and

WHAT IS CLAIMED IS:

1. An apparatus for blending added material with base material on a manufactured component, the apparatus comprising:

an abrasive device having an abrasive surface for removing exceeding added material and blending the added material with the base material, the abrasive surface performing in operation an abrasive motion, the abrasive surface defining a substantially circular shape along an extremity of the abrasive device;

a guide fixed to perpendicular to the abrasive surface and providing a plurality of contact points exceeding at least a portion of the abrasive surface, the guide having a substantially elliptical shape defining a center, the center of the guide being positioned at a center of the circular shape of the abrasive surface; and

a positioning mechanism for controlling position and angle of the abrasive surface and a point of contact of the guide with respect to the manufactured component, the positioning mechanism guiding in operation the abrasive surface along an abrasion direction while maintaining at least one of the plurality of contact points of the guide in contact with the manufactured component,

wherein the substantially circular shape defines a half circle.

2. The apparatus of claim 1, wherein the added material consists in welded material.

3. The apparatus of claim 1, wherein the abrasive motion is opposite to the abrasion direction.

4. The apparatus of claim 1, wherein the manufactured component is moved with respect to the abrasive device in the abrasion direction.

5. The apparatus of claim 1 further comprising a force control mechanism for:

applying a force to the abrasive device when the abrasive surface is in contact with the manufactured component, to allow the abrasive surface to remove the exceeding added material; and

transferring the force from the abrasive device to the point of contact of the guide when the abrasive surface is in contact with the base material, to prevent the abrasive surface from removing the base material.

6. The apparatus of claim 5 further comprising a force sensor for:

measuring the force applied to the abrasive device;

comparing the measured force to a predetermined value corresponding to a force applied to the abrasive device when the abrasive surface and the guide are in contact with the base material; and

triggering a transfer of the force from the abrasive device and the guide when the measured force is equal to the predetermined value.

7. The apparatus of claim 1, wherein the positioning mechanism takes into consideration operational parameters for controlling the position and angle of the abrasive surface, the operational parameters including a wear of the abrasive surface, and specific characteristics of the manufactured component.

8. The apparatus of claim 1, wherein a trajectory of the abrasive surface with respect to the manufactured component is calculated by a computer, calculation of the trajectory comprising: determining the position and angle of the abrasive surface, and determining which of the plurality of contact points are to be kept in contact with the

manufactured component.

9. The apparatus of claim 8, wherein the trajectory is calculated by processing a 3D model of the manufactured component, the 3D model comprising a representation of the added material and the base material.

10. The apparatus of claim 1, wherein the abrasive surface is a sand belt.

11. The apparatus of claim 1, wherein the manufactured component consists in a blade.