US 20200283880A1

(19) United States

(12) Patent Application Publication

MICHLA et al.

(10) Pub. No.: US 2020/0283880 A1

(43) Pub. Date: Sep. 10, 2020

(54) **METHOD FOR MASKING A COMPONENT THAT IS INTENDED TO BE COATED WITH A THERMAL SPRAY LAYER**

(71) Applicant: **OERLIKON METCO AG, WOHLEN**, Wohlen (CH)

(72) Inventors: **Alexander MICHLA**, Hohentengen (DE); **Philipp GASTEL**, Laufenburg (DE); **Alexander SOLLBERGER**, Zofingen (CH); **Martin STOECKLI**, Boswil (CH); **Dario RUSSO**, Kilchberg (CH)

(73) Assignee: **OERLIKON METCO AG, WOHLEN**, Wohlen (CH)

(21) Appl. No.: **16/882,060**

(22) Filed: **May 22, 2020**

Related U.S. Application Data

(63) Continuation of application No. 15/775,241, filed on May 10, 2018, now abandoned, filed as application No. PCT/EP2016/077167 on Nov. 9, 2016.

(30) **Foreign Application Priority Data**

Nov. 12, 2015 (EP) 15194293.5

Publication Classification

(51) **Int. Cl.**

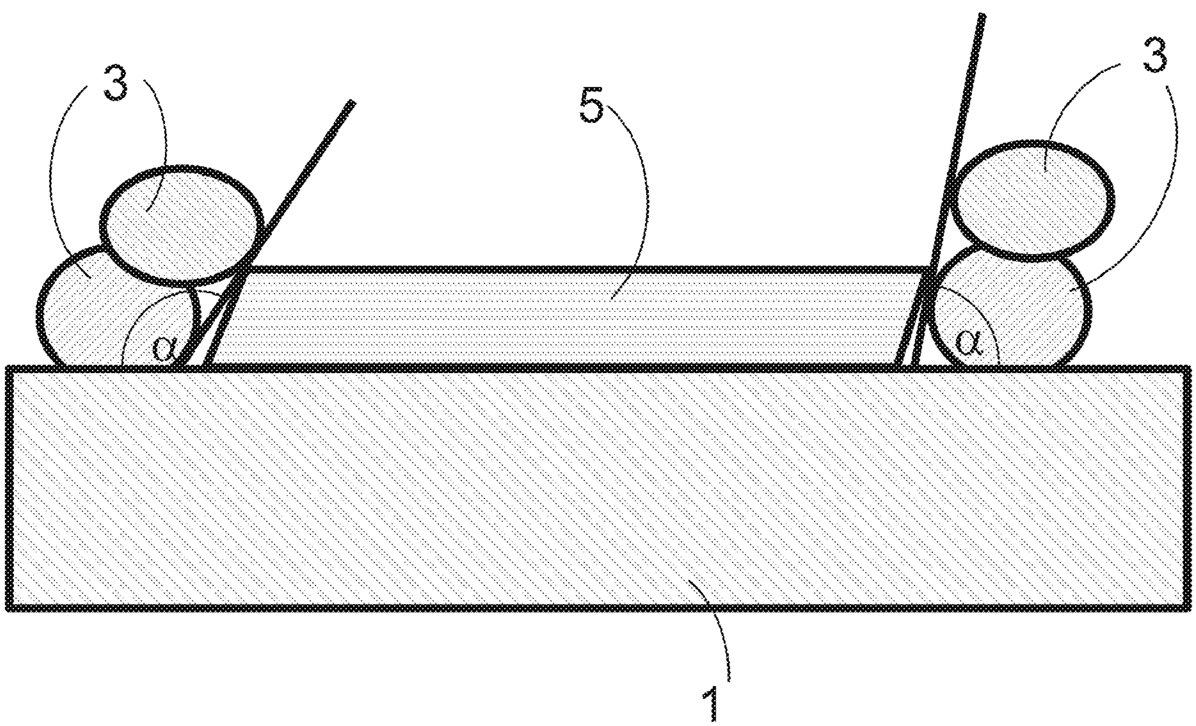
C23C 4/01 (2006.01)
C23C 4/02 (2006.01)
C23C 4/12 (2006.01)

(52) **U.S. Cl.**

CPC ***C23C 4/01*** (2016.01); ***C23C 4/12*** (2013.01); ***C23C 4/02*** (2013.01)

(57) **ABSTRACT**

Method for coating components by thermal spraying, wherein not the entire surface of the component is to be coated and wherein those parts of the surface that are not to be coated are covered by masking before coating and wherein the covering is made by a paste processes at least in the areas of critical mask boundaries, i.e. by way of a paste dispensed from at least one nozzle, wherein the paste is a curable paste and curing is photo induced and preferably made by way of UV radiation, characterized in that the masking utilizes a partial masking step and a complementary masking step, the complementary masking step being performed at least in the area of critical mask boundaries and the partial masking step being performed in an area spaced from the area of critical mask boundary and the method of partial masking is not a paste process.



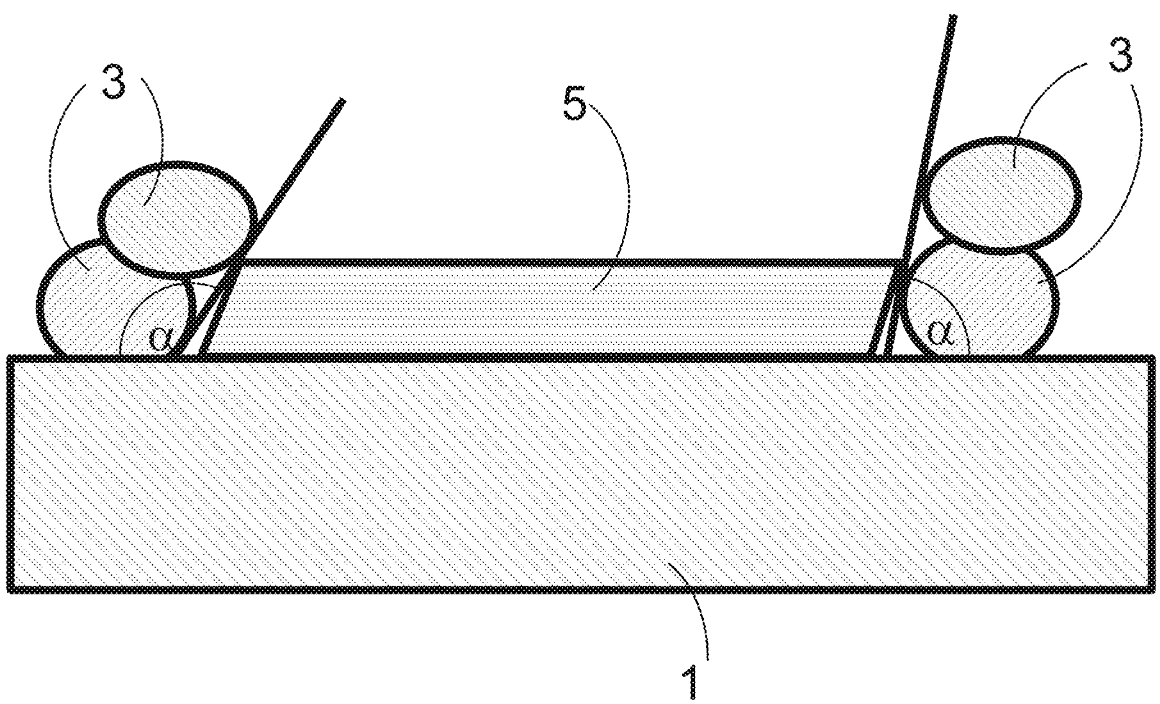


Fig. 1

METHOD FOR MASKING A COMPONENT THAT IS INTENDED TO BE COATED WITH A THERMAL SPRAY LAYER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The instant application is a continuation of U.S. application Ser. No. 15/775,241 filed on Nov. 9, 2016 which is a US National stage of PCT International Application No. PCT/EP2016/077167 filed Nov. 9, 2016 and which claims the priority benefit of European application No. 15194293.5 filed on Nov. 12, 2015. The entire disclosure of U.S. application Ser. No. 15/775,241 filed on Nov. 9, 2016 and PCT International Application No. PCT/EP2016/077167 filed Nov. 9, 2016 is expressly incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a method for masking a part of the surface of a component, which is to be coated by thermal spraying.

2. Discussion of Background Information

[0003] Thermal spraying is a coating process, in which a material, for example in powder form, is continuously melted. The resulting droplets are thrown onto the surface to be coated, whereby flattened droplets accumulate on the surface. The layers built up in this way lead to a coating, which may be, for example, harder, more brittle but also more porous than the uncoated component.

[0004] It is remarkable that any fusible material can be sprayed and that almost any component material and almost any component geometry can be coated. The degree of automation that can be achieved with the method is very high as well as the reproducibility and the quality of the layers that can be achieved.

[0005] In many cases, however, not the entire surface of the component should be coated. Those parts of the surface which are not to be coated must therefore be covered, i.e. they must be masked. Unfortunately, the degree of automation achieved in masking is so far very low. In many cases, the components are still masked manually.

[0006] On the one hand, overlay masks are used, as described, for example, in JP 3158451 or U.S. Pat. No. 6,645,299. On the other hand, adhesive masks made of adhesive tapes are used, which are affixed directly to the parts of the surface which are not to be coated.

[0007] WO2010/031370 A1 shows a short overview of the common masking methods in connection with thermal spraying. There is also referred to the possibility of applying a masking of a paint or of a binder-containing mixture to the area to be protected, as described for example in U.S. Pat. No. 4,464,430. There, however, masking is done by way of dip coating by immersing the parts of the surface not to be coated by thermal spraying in an immersion bath. Of course, this method is limited to very few geometries.

[0008] In WO2010/031370 A1 itself a masking is described, which is made of an elastic material being slightly undersized. Among the materials described there are also elastomers, for example. When applying the masking to the component, the masking is very close to the component due to its undersize. This type of masking works especially well when the component has to be masked all around.

[0009] All methods described above have at least two disadvantages: on the one hand, they cannot be automated, or if at all only with a great technical effort. On the other hand, in many cases they do not allow the desired precision in the application. Thus, in many applications, those lines that define transitions from parts of the surface to be coated to parts not to be coated must be kept very precisely and, above all, reproducibly. Such lines are referred to below as critical mask boundaries. It is clear that there can also be transitions defining lines, which require less precision. These are referred to below as uncritical mask boundaries.

SUMMARY OF THE INVENTION

[0010] Thus, the present invention is based on the object of specifying a largely automated masking method, which allows the critical mask boundaries to be positioned with the required high accuracy.

[0011] According to the invention, the mask is realized at least along the critical mask boundaries by way of a paste which is dispensed by a nozzle. The term "paste" used in the present description means a liquid material having such a viscosity height that it can be applied to the surface of the component in the form of a sealing bead with any contour profile, without dissolving on the surface. According to the invention, the paste is curable.

[0012] Viscosity has a great influence on the precision with which a sealing bead with its geometric characteristics (generation of shading) can be produced. For this reason, according to a preferred embodiment of the present invention, the paste and/or the component to be masked is processed and applied under a predetermined tempered environment (cooled).

[0013] For example, curing can be made by evaporation of solvent contained in the paste. However, according to a preferred embodiment, curing is at least partially realized by crosslinking, particularly preferably by photo-induced crosslinking.

[0014] According to a particularly preferred embodiment, a UV curing paste is used. This is an advantage, among other things, because the paste just needs to be cured shortly after it has been applied to the component. In the course of thermal spraying, particularly if it is a plasma process, the component is exposed to intense UV radiation due to the plasma process, resulting in further curing and, ideally, complete curing. Due to the fact that the paste only has to be cured shortly, less expensive UV sources can be used and/or the UV irradiation time can be shortened.

[0015] According to another embodiment of the present invention, masking is performed in two steps. Areas to be masked are accordingly masked using one of the methods, as they are already known from the state of the art, wherein, however, no masking with the correspondingly known way is provided in the area of the critical mask boundaries. So, this is a partial masking, wherein the areas around the critical mask boundaries are left blank. The areas around the critical mask boundaries are then masked according to this embodiment by way of the method mentioned above, i.e. masking paste is applied to these areas by way of at least one nozzle, thus completing the masking. In doing so, it is advantageous to consider that there is an overlap with the partial masking when the masking is completed, in order to ensure that no unmasked areas are formed between partial masking and completion masking.

[0016] In this method, it is particularly advantageous that the masking of relatively large areas, which would take a lot of time with the paste process, can be applied quickly by way of a relative to the position relatively inaccurate method and the critical edge areas of the critical mask boundaries can be applied very precisely using the paste process. The inaccurate method can be automated relatively easily. The automation of the paste process is also possible. In the paste process, it is necessary that the place of the nozzle exit is moved relative to the areas close to the mask boundaries to be masked in the course of paste dispensing. In this case, either nozzle or component can be mounted on a robot.

[0017] Preferably, the component would be mounted on the robot arm for smaller components to be masked, because in this case, the connection of the nozzle to the paste reservoir, which is usually ensured by hoses, is not exposed to any movement. However, for larger components that are more difficult to move, it may be advantageous to mount the nozzle on the robot arm. More generally, mechanisms for positioning and/or orientation of the component and/or mechanisms for positioning and/or orientation of the at least one nozzle may be provided.

[0018] Due to the robot-controlled movement in space, free-form paths can be traversed.

[0019] As already described above, a critical mask boundary is described by a precise sealing bead. The non-critical mask boundaries can be divided into at least two categories, namely applying of e.g. simple covers. However, in some cases covers cannot be attached to undercuts, or would possibly restrict the dispensing process. For this reason, according to a preferred embodiment, a low-viscosity pasty material is used in a second dispenser. Due to the low viscosity, it coalesces and can therefore be applied over a wide area. Initially, the precise sealing beads are placed.

[0020] As already explained, precise masking in the area of the critical mask boundaries is essential in many applications. However, the inventors have discovered that sometimes in these areas after removing the masking no layer applied by thermal spraying was left, although the masking was applied very precisely. From this observation, the idea was born to try, to realize the masking along the critical mask boundaries not slowly increasing but with high steepness. This is based on the assumption that if the thermally sprayed layer is realized as a continuous layer extending the critical mask boundary at the transition from the area to be coated to the area not to be coated, components of the sprayed layer are carried away beyond the mask boundary when removing the coating.

[0021] To avoid such a continuous layer, the paste is therefore preferably adapted to the material of the component to be masked in such a way that a contact angle of at least 90° is formed. Then, the mask thickness does not continuously increase at the critical mask boundary but forms an at least vertical, if not even overhanging wall. As a result, the thermally sprayed layer is substantially interrupted at the critical mask boundary. When the masking is removed, no parts of the layer are carried away beyond the critical mask boundary. If the contact angle exceeds 90°, there is an increased shading effect, which contributes to the separation of the spray layers left and right of the critical mask boundary. In order to further enhance this shading effect, in a particularly preferred embodiment of the present method, a second sealing bead is placed over the first sealing bead. This second sealing bead is applied in such a way that a reinforced overhang is realized resulting in a reinforcement of the shading effect.

[0022] Here, the contact angle is defined similar to the contact angle at a boundary between a liquid and a solid, as, when the paste is applied, a contact angle is formed, wherein the contact angle does not change substantially during the entire process, regardless of whether the paste cures or not. The angle is defined in the following as the angle of contact, which is enclosed by the surface of the component and a tangent at the surface of the sealing bead or a tangent at the surfaces of the double sealing beads at the boundary between the component and the sealing bead.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The sole FIGURE shows two overlying sealing beads applied to a component.

DETAILED DESCRIPTION OF THE INVENTION

[0024] The FIGURE illustrates the corresponding situation in which two overlying sealing beads **3** are applied to a component **1** in such a way that the contact angle is $\alpha>90°$ (visible at the left edge of the FIGURE). A contact angle $\alpha<90°$ would not be optimal, because this can lead to problems of layer separation of the layer **5** (visible at the right edge of the FIGURE).

What is claimed:

1. A method for coating components by thermal spraying, wherein not the entire surface of the component is to be coated and wherein those parts of the surface that are not to be coated are covered by masking before coating and wherein the covering is made by means of paste processes at least in the areas of critical mask boundaries, i.e. by means of a paste dispensed from at least one nozzle, wherein the paste is a curable paste and curing is photo induced and preferably made by means of UV radiation, characterized in that the masking comprises a partial masking step and a complementary masking step, the complementary masking step being performed at least in the area of critical mask boundaries and the partial masking step being performed in an area spaced from the area of critical mask boundary and the method of partial masking is not a paste process.

2. A method for coating components by thermal spraying, wherein not the entire surface of the component is to be coated and wherein those parts of the surface that are not to be coated are covered by masking before coating and wherein the covering is made by means of paste processes at least in the areas of critical mask boundaries, i.e. by means of a paste dispensed from at least one nozzle, wherein the paste is a curable paste and curing is photo induced and preferably made by means of UV radiation, characterized in that a first sealing bead is applied to the component in the area of at least one critical mask boundary in the course of the paste process and that a second sealing bead is at least partially applied to this first sealing bead.

3. A method according to claim **1**, characterized in that the paste is selected such, that the sealing bead formed when applied to the component has a contact angle of at least 90°.

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