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54 **Method for producing a metallic surface layer on a workpiece.**

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Description

The present invention relates to a method for producing a metallic surface layer on a workpiece and more particularly to a method for fusing a metallic surface layer applied by a conventional process.

When producing metallic surface layers on metallic workpieces, in particular layers from so-called self-fluxing alloys which are fused after their application onto the metallic substrate in order to fix or bind the layer strongly to said substrate, the thickness of the layer that can be produced is rather limited because of the fusing process and depends on the shape, the size and the kind of the workpiece. For layers of more than 0.5 mm thickness it occurs frequently that the material of the layer sinks or runs down during the fusing which leads to very troublesome defects mainly when the fusing is effected in a furnace. When the mass of a workpiece exceeds 50 kg and accordingly the application of heat requires the piece to remain in the furnace for a substantial time, the thickness of the layer is limited to less than 1 mm and relatively accurate furnace temperatures, for example within $\pm 5^\circ\text{C}$, as well as a controlled furnace working atmosphere are necessary. When workpieces have a rather irregular shape, the fusing process can often only take place under vacuum.

It is the main object of the invention to provide a method for producing relatively thick surface layers on workpieces allowing to prevent a sinking down or running off of the layer to be fused and in particular to provide such a method allowing to produce fused layers of more than 2 mm thickness and to fuse the same in the furnace independently of the position of the workpiece.

The method according to the invention comprises the steps of applying a supporting layer of a ceramic oxide material at least onto the portions of the workpiece covered by a previously applied metallic surface layer, subsequently fusing said metallic layer by supplying heat thereto and removing the supporting layer after the cooling down of the workpiece. The supporting layer has preferably a thickness from 0.01 to 5.0 mm. Depending on the particular case, the thickness of the supporting layer is preferably comprised between 0.2 and 3.0 or 0.2 and 0.8 mm.

The material of the supporting layer is preferably constituted by one or more of the following oxides ZrO_2 , TiO_2 , MgO , CaO , Al_2O_3 , Y_2O_3 , Cr_2O_3 . For example, the supporting layer is made from a mixture of ZrO_2 and 1 to 40% by weight of the total mixture, of at least one of the oxides CaO , MgO or Y_2O_3 or from a mixture of ZrO_2 and 3 to 50% by weight of the total mixture, of Al_2O_3 .

Alternately, the supporting layer is made from a mixture of Al_2O_3 and 1 to 40% by weight of the total mixture, of at least one of the oxides TiO_2 or MgO or from a mixture of Al_2O_3 and 1 to 30% by weight of the total mixture, of ZrO_2 .

In still another embodiment the supporting

layer is made from a mixture of Al_2O_3 and 0.5 to 10% by weight of the total mixture, of Cr_2O_3 .

The invention, its objects and advantages will be better understood from the following description of embodiments thereof given by way of example and illustrated in the attached drawing, in which

figure 1 shows the basic arrangement of a supporting layer on a workpiece provided with a surface layer prior to the fusing thereof in upright position in a furnace, and figure 2 shows the arrangement of a supporting layer as well as of an additional indicator layer on a workpiece for fusing with a gas torch.

As shown in figure 1, a cylindric workpiece 1 has been provided with a surface layer 2 made for example from a self-fluxing alloy, i.e. from an alloy with additions of boron and/or silicon or phosphorus. Layer 2 is applied in a conventional manner, for instance by thermal spraying using a well-known flame spraying torch supplied with a powdered alloy of the mentioned type. A supporting layer of a ceramic oxide material 3 is applied onto the surface layer 2 preferably also by thermal spraying and so as to cover the surface layer as shown in the form of a kind of crucible. This allows the workpiece to be placed in a vertical position in a furnace while the temperature thereof may raise above the melting point of the self-fluxing alloy of the surface layer. A very strict maintaining and checking of the temperature of the furnace as required in the usual processes is no longer necessary. The oxide ceramic material of the supporting layer is selected as a function of the basic material of the workpiece and the composition of the metallic surface layer preferably in such a way that the supporting layer breaks or can easily be removed during or after the cooling-down process due to the coefficient of expansion of the ceramic oxide material.

The present method allows even to conduct the fusing process in a furnace by using a protecting gas or under vacuum in cases where the surface layer is composed of an alloy with a low content of boron, silicon or phosphorus, while such alloys could not be fused in a furnace by the conventional method without supporting layer.

Figure 2 shows an embodiment in which a workpiece 21 of rather irregular shape is provided with a metallic surface layer 22 upon which a supporting layer 23 of ceramic oxide material is applied. In addition, an indicator layer 24 from the same material as the layer 22 has been sprayed over the supporting layer so as to allow to verify, during the fusing by means of a gas torch, that the fusing temperature of the surface layer has been reached. In that case, the supporting layer has a thickness of less than 0.5 mm so as to avoid a high damping up of heat.

Generally speaking, the thickness of the ceramic oxide layer is chosen depending mainly upon the thickness of the surface layer to be fused and upon the shape of the workpiece onto

which it is applied. The greater the thickness of the metallic surface layer and its tendency to run down due to the shape of the workpiece, the thicker the supporting layer must be made. The thickness of the supporting layer can be made different on different portions of the workpiece depending on these criteria. Furthermore, the composition of the supporting layer which mainly depends on the composition and thus on the fusing temperature of the metallic surface layer, determines the required porosity of the supporting layer. In most cases, the density of the supporting layer should be about from 80 to 95% of the theoretical density, i.e. the density of the massive material, a lesser density than the theoretical density being obtained in a known way by increasing the usual spraying distance.

The following example illustrates in a particular case the use of the method of the invention.

Example

Onto a shaft having a diameter of 60 mm and a length of 1000 mm, a layer from a self-fluxing NiCrBSi-alloy has been applied by flame spraying in a thickness of 2.5 mm. Subsequently a ceramic supporting layer composed of Al_2O_3 with 13% by weight TiO_2 with respect to the total weight of the mixture of Al_2O_3 and TiO_2 , has been applied by flame spraying to obtain a supporting layer having a thickness of 0.5 mm. The spraying distance was from 130 to 150 mm and was chosen to obtain a density of the supporting layer of about 80 to 95% of the theoretical density i.e. the density of the massive material.

The shaft coated as described above was then brought into a furnace in vertical position, the temperature of the furnace having been set at least 20°C above the fusing temperature of the Alloy of the surface layer. The shaft was kept at this temperature for a period of 10 minutes. After that period the shaft was removed from the furnace and cooled down. The relatively quick cooling led to a breaking of the ceramic supporting layer and falling down thereof.

The final metallic surface layer showed no faults such as forming of drops or running off as could be expected due to the increased temperature and the relatively long period of maintaining the same.

Claims

1. A method for producing a metallic surface layer on a workpiece comprising the steps of applying the layer on the desired portions of the workpiece, of applying a supporting layer of a ceramic oxide material at least onto the portions of the workpiece covered by said metallic layer by a process of thermal spraying in a thickness from 0.01 to 5.0 mm, of subsequently fusing the metallic layer by supplying heat thereto, and of removing the supporting layer after the cooling down of the workpiece.

2. A method according to claim 1, wherein the thickness of the supporting layer is comprised between 0.2 and 3.0 mm.

3. A method according to claim 2, wherein the thickness of the supporting layer is comprised between 0.2 and 0.8 mm.

4. A method according to claim 1, wherein the supporting layer comprises one of the oxides ZrO_2 , TiO_2 , MgO , CaO , Al_2O_3 , Y_2O_3 , Cr_2O_3 or a mixture of two or more of the same.

5. A method according to claim 4, wherein the supporting layer is made from a mixture of ZrO_2 and 1 to 40% by weight of the total mixture, of at least one of the oxides CaO , MgO or Y_2O_3 .

6. A method according to claim 4, wherein the supporting layer is made from a mixture of ZrO_2 and 3 to 50% by weight of the total mixture, of Al_2O_3 .

7. A method according to claim 4, wherein the supporting layer is made from a mixture of Al_2O_3 and 1 to 40% by weight of the total mixture, of at least one of the oxides TiO_2 or MgO .

8. A method according to claim 4, wherein the supporting layer is made from a mixture of Al_2O_3 and 1 to 30% by weight of the total mixture, of ZrO_2 .

9. A method according to claim 4, wherein the supporting layer is made from a mixture of Al_2O_3 and 0.5 to 10% by weight of the total mixture, of Cr_2O_3 .

10. A method according to claim 1, wherein the supporting layer has a thickness of not more than 0.5 mm and wherein a metallic indicator layer of between 0.01 and 1 mm thickness is applied onto the supporting layer prior to the fusing process.

11. A method according to claim 10, wherein the thickness of the indicator layer is comprised between 0.2 and 0.5 mm.

Patentansprüche

1. Verfahren zum Herstellen einer metallischen Oberflächenschicht auf einem werkstück, das die Arbeitsgänge des Aufbringens der Schicht auf die gewünschten Teile des Werkstückes, des Aufbringens einer Stützschrift aus einem oxydkeramischen Werkstoff in einer Dicke von 0.01 bis 5,0 mm durch thermisches Spritzen zumindest auf die mit der metallischen Schicht versehenen Teile des Werkstückes, des nachfolgenden Einschmelzens der metallischen Schicht durch Wärmeeinbringung in dieselbe und des Entfernens der Stützschrift nach dem Abkühlen des Werkstückes umfasst.

2. Verfahren nach Anspruch 1, bei dem die Schichtdicke der Stützschrift zwischen 0,2 und 0,8 mm liegt.

3. Verfahren nach Anspruch 2, bei dem die Schichtdicke der Stützschrift zwischen 0,2 und 0,8 mm liegt.

4. Verfahren nach Anspruch 1, bei dem die Stützschrift aus einem der Oxyde ZrO_2 , TiO_2 , MgO , CaO , Al_2O_3 , Y_2O_3 , Cr_2O_3 oder aus einer Mischung von zwei oder mehreren derselben besteht.

5. Verfahren nach Anspruch 4, bei dem die Stützschrift aus einem Gemisch von ZrO_2 und 1 bis 40 Gewichtsprozent, bezogen auf das Gesamt-

gewicht des Gemisches, mindestens eines der Oxyde CaO, MgO oder Y_2O_3 besteht.

6. Verfahren nach Anspruch 4, bei dem die Stützschiicht aus einem Gemisch von ZrO_2 und 3 bis 50 Gewichtsprozent Al_2O_3 , bezogen auf das Gesamtgewicht des Gemisches, besteht.

7. Verfahren nach Anspruch 4, bei dem die Stützschiicht aus einem Gemisch von Al_2O_3 und 1 bis 40 Gewichtsprozent, bezogen auf das Gesamtgewicht des Gemisches, mindestens eines der Oxyde TiO_2 oder MgO besteht.

8. Verfahren nach Anspruch 4, bei dem die Stützschiicht aus einem Gemisch von Al_2O_3 und 1 bis 30 Gewichtsprozent ZrO_2 , bezogen auf das Gesamtgewicht des Gemisches, besteht.

9. Verfahren nach Anspruch 4, wobei die Stützschiicht aus einem Gemisch von Al_2O_3 und 0,5 bis 10 Gewichtsprozent Cr_2O_3 , bezogen auf das Gesamtgewicht des Gemisches, besteht.

10. Verfahren nach Anspruch 1, bei dem die Stützschiicht eine Dicke von nicht mehr als 0,5 mm aufweist und vor dem Einschmelzvorgang eine metallische Indikatorschiicht einer Dicke zwischen 0,01 und 1 mm auf die Stützschiicht aufgebracht wird.

11. Verfahren nach Anspruch 10, bei dem die Dicke der Indikatorschiicht zwischen 0,2 und 0,5 liegt.

Revendications

1. Procédé pour la fabrication d'une couche superficielle métallique sur une pièce, comprenant les opérations d'application de la couche sur les parties désirées de la pièce, d'application d'une couche support d'un matériau en oxyde céramique au moins sur les parties de la pièce recouvertes par ladite couche métallique, par un procédé de pulvérisation thermique, avec une épaisseur de 0,01 à 5,0 mm, de fusion subséquente de la couche métallique, par apport de

chaleur, et d'enlèvement de la couche support après le refroidissement de la pièce.

2. Procédé selon la revendication 1, dans lequel l'épaisseur de la couche support est comprise entre 0,2 et 3,0 mm.

3. Procédé selon la revendication 2, dans lequel l'épaisseur de la couche support est comprise entre 0,2 et 0,8 mm.

4. Procédé selon la revendication 1, dans lequel la couche support comprend l'un des oxydes ZrO_2 , TiO_2 , MgO, CaO, Al_2O_3 , Y_2O_3 , Cr_2O_3 ou un mélange de deux, ou davantage, d'entre eux.

5. Procédé selon la revendication 4, dans lequel la couche support est en un mélange de ZrO_2 et 1 à 40% en poids, par rapport au total du mélange, d'au moins un des oxydes CaO, MgO ou Y_2O_3 .

6. Procédé selon la revendication 4, dans lequel la couche support est en un mélange de ZrO_2 et 3 à 50% en poids, par rapport au total du mélange, de Al_2O_3 .

7. Procédé selon la revendication 4, dans lequel la couche support est en un mélange de Al_2O_3 et 1 à 40% en poids, par rapport au total du mélange, d'au moins un des oxydes TiO_2 ou MgO.

8. Procédé selon la revendication 4, dans lequel la couche support est en un mélange de Al_2O_3 et 1 à 30% en poids, par rapport au total du mélange, de ZrO_2 .

9. Procédé selon la revendication 4, dans lequel la couche support est en un mélange de Al_2O_3 et 0,5 à 10% en poids, par rapport au total du mélange, de Cr_2O_3 .

10. Procédé selon la revendication 1, dans lequel la couche support a une épaisseur n'excédant pas 0,5 mm et dans lequel une couche indicatrice métallique d'une épaisseur comprise entre 0,01 et 1 mm est appliquée sur la couche support préalablement à l'opération de fusion.

11. Procédé selon la revendication 10, dans lequel l'épaisseur de la couche indicatrice est comprise entre 0,2 et 0,5 mm.

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FIG. 1

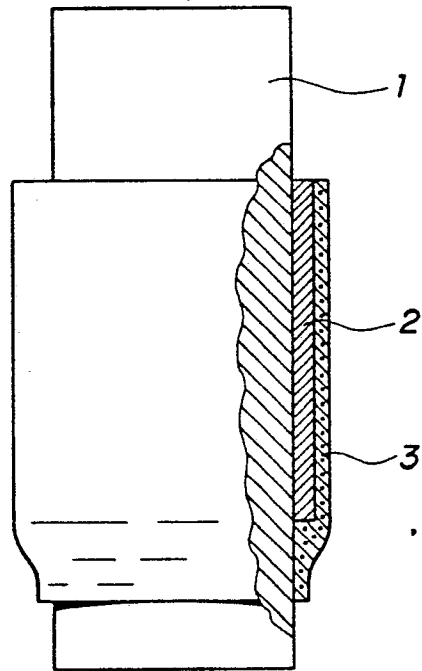


FIG. 2

