



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.04.2010 Bulletin 2010/16

(51) Int Cl.:
B05D 7/00 (2006.01) **B05D 5/00** (2006.01)
B05D 3/02 (2006.01) **F26B 3/30** (2006.01)
F26B 23/02 (2006.01)

(21) Application number: **08425668.4**

(22) Date of filing: **15.10.2008**

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

(72) Inventor: **Bergaglio, Osvaldo**
40044 Sasso Marconi (IT)

(74) Representative: **Bergadano, Mirko et al**
Studio Torta S.r.l.
Via Viotti, 9
10121 Torino (IT)

(71) Applicant: **Symach S.r.l.**
40056 Crespellano BO (IT)

(54) **Method for painting a vehicle bodywork**

(57) A method for painting a vehicle bodywork (2), wherein at least one coat of primer is applied (106, 108, 110, 113) on at least one portion of bodywork (2) and is dried (107, 109, 111, 114), at least one coat of waterborne base paint is applied (116, 117, 120) on the primer coat and is dried (118, 121), and at least one coat of clear top paint is applied (123, 124) on the waterborne base paint

and is dried (125), each drying (107, 109, 111, 114, 118, 121, 125) being carried out by means of infrared radiations generated by a catalytic panel (8), which operates due to a catalytic radiation between a hydrocarbon gas and the oxygen present in the air and on which compressed air is blown for influencing the catalytic reaction so as to generate an infrared radiation emission spectrum distributed in the entire short-wavelength infrared band.

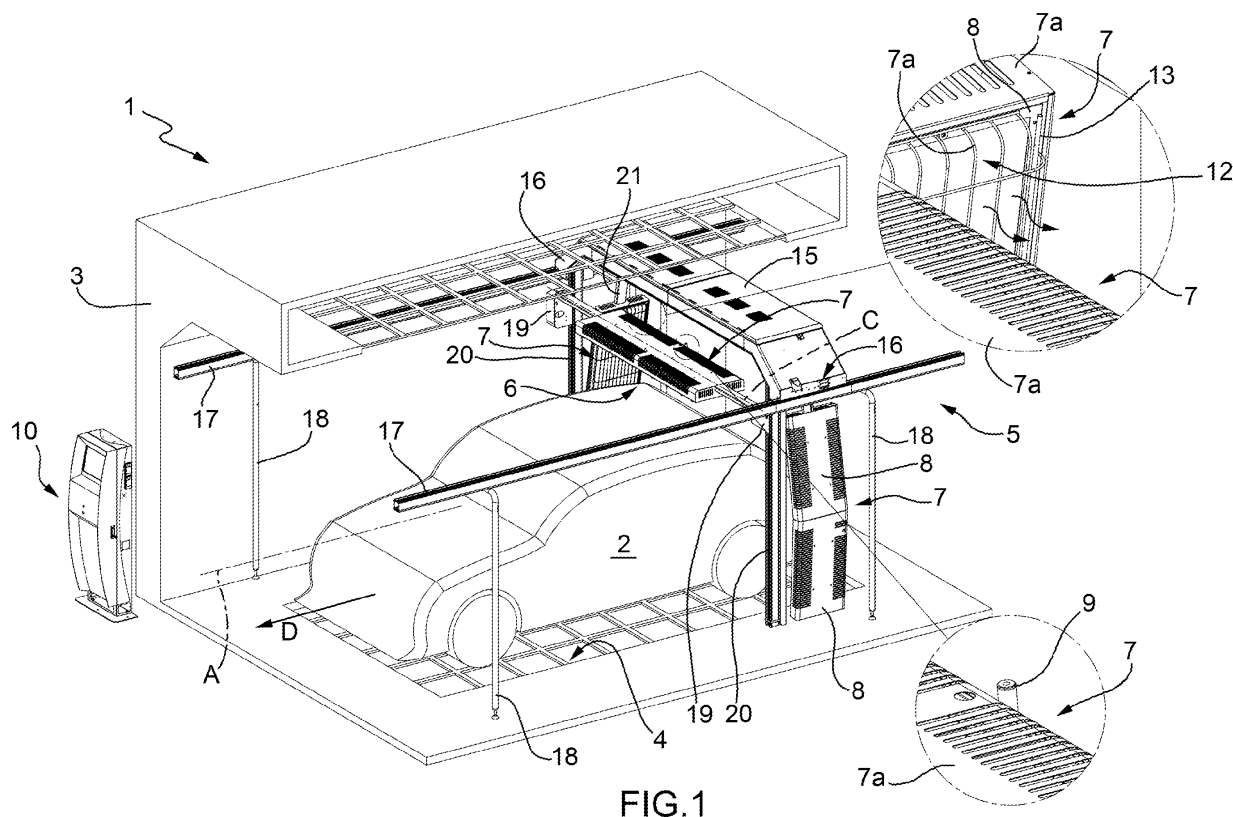


FIG. 1

Description

[0001] The present invention relates to a method for painting a vehicle bodywork.

[0002] Specifically, the present invention is advantageously, but not exclusively, applied in touching-up the paintwork of at least one part of a motor vehicle bodywork damaged in a road accident, or in painting a new bodywork part for replacing a damaged part, to which explicit reference will be made in the following description without therefore losing in generality.

[0003] For the purpose of touching up either a portion or the entire paintwork of a motor vehicle bodywork, body shops adopt a painting cycle which normally comprises applying a plurality of painting products in sequence on the surface of the damaged bodywork portion, such as body filler, primer, waterborne base paint and clear top paint.

[0004] The application of the body filler comprises the steps of:

- applying a first layer of body filler on the surface with one or more consecutive coats so as to obtain a first irregular thickness, however higher than the thickness the bodywork portion should have at the end of the body filler application;
- drying the first layer of body filler at room temperature or by means of electric drying devices, e.g. an infrared (IR) radiation lamp or a hot air blower;
- sanding the first layer of dried body filler;
- applying a second layer of body filler on the first layer of sanded body filler in a single coat having a second thickness lower than the first thickness;
- drying the second layer of body filler in the above-described manner; and
- sanding the second layer of dried body filler to achieve an optimal finish of the surface.

[0005] The application of each layer of body filler requires from 1 to 6 minutes according to the size of the bodywork portion, and each step of drying requires, in the fastest case comprising the use of drying devices, from 10 to 15 minutes.

[0006] The application of the primer comprises the following sequence of steps:

- applying half a coat of primer on the sanded body filler by spraying or by means of a roller;
- naturally hardening the half coat of primer;
- applying a second coat by spraying or by means of a roller;
- naturally hardening the second coat of primer;
- applying a third coat by spraying or by means of a roller;
- drying the applied coats of primer at room temperature for a certain number of hours, or by using a hot air oven, or by using an IR lamp; and
- sanding the dried primer in several steps using an

equal number of sandpapers of different grit.

[0007] The application of each coat of primer requires from 1 to 4 minutes according to the size of the bodywork portion, and the intermediate steps of hardening and the final drying step require at least 15 minutes.

[0008] The application of the waterborne base paint normally comprises the steps of:

- applying half a coat of waterborne base paint on the dried primer;
- drying the half coat of waterborne base paint allowing it to evaporate for an interval of time in the range of 5 - 8 minutes;
- applying a full coat of waterborne base paint on the previous dried half coat;
- drying the full coat of waterborne base paint allowing it to evaporate for an interval of time in the range of 6 - 10 minutes;
- applying a drop coat of waterborne base paint on the previous dried full coat; and
- drying the drop coat of waterborne base paint allowing it to evaporate for an interval of time in the range of 3 - 5 minutes.

[0009] The waterborne base paint is to be applied one coat at a time so as to give the product the time required to stabilize, because otherwise, i.e. if applied in a single coat, a phenomenon known as deflocculation would occur, which consists in the rapid separation of the elements forming the product, such as for example the pigment, the aluminium foils for metallic colors, the resin and water.

[0010] The total evaporation time for drying the waterborne base paint is therefore in the range of approximately 15 - 25 minutes. The total evaporation time may be reduced by approximately one third with the aid of a fan or a Venturi type air gun for manual use. For some types of waterborne base paint, the drop coat is applied immediately after the full coat, and the following step of drying lasts for from 8 to 12 minutes, thus saving up to 15% on the total evaporation time. The time required for applying the three coats of waterborne base paint is instead approximately 4 and a half minutes for a 1 square meter surface.

[0011] The application of the clear top paint normally comprises the steps of:

- applying half a coat of clear top paint on the dried base paint by spraying;
- hardening the half coat of clear top paint for an interval of time in the range of 3 - 5 minutes;
- applying a full coat of clear top paint on the previous half coat by spraying; and
- drying the full coat of clear top paint by staying in an oven booth at a temperature in the range of 60 - 80°C, for an interval of time in the range of approximately 40 - 60 minutes.

[0012] The time required for applying the two coats of clear top paint is totally about 6 minutes. Instead, as may be inferred from the times mentioned above, the total hardening and drying time required for the clear top paint is considerably longer, i.e. in the range of approximately 45 - 65 minutes.

[0013] If the damaged bodywork part is replaced with a new part to be painted, applying the body filler is not necessary and a wet-on-wet primer is applied instead of the normal primer. The application of the wet-on-wet primer substantially comprises the steps of:

- applying a coat of wet-on-wet primer on the new bodywork part by spraying;
- completely drying the wet-on-wet primer at room temperature or at a slightly higher temperature in the painting booth.

[0014] The time required for applying the wet-on-wet primer coat is approximately 2 minutes, and the complete drying requires an interval of time of approximately 20 minutes.

[0015] It is easy to understand that the main drawback of the above-described painting cycle is the considerable time required for completing the paintwork, mainly due to the duration of the various steps of hardening and/or drying. This considerably limits the number of bodyworks which may be touched up over a day, with consequent income loss for body shops and long waiting times for the customer who owns the motor vehicle.

[0016] Furthermore, the above-described painting cycle may be carried out, with regards to the steps of drying, by means of a complex, costly drying apparatus comprising a plurality of devices for drying the various painting products, i.e. an IR lamp, a blower or a compressed air gun and an oven booth.

[0017] With regards to IR lamps, IR lamps structured for emitting infrared radiations in the so-called "short-wavelength infrared" band, and specifically infrared radiations having wavelength in the range of approximately 2 - 3 μm , are known. Such IR lamps are able to transfer a percentage of radiated energy in the range of approximately 8 - 12% to the painting product molecules, while the remaining percentage of energy is dispersed through the body of the object on which the painting product is applied. The drying time varies according to the material type of the body and to the thickness of the applied layer of painting product. Therefore, in addition to being variable, the total paint drying times are also rather long due to the inevitable dispersion of heat in the body.

[0018] IR lamps structured for emitting infrared radiations in the so-called "medium-wavelength infrared" band, and specifically infrared radiations having a wavelength in the range of approximately 4 - 6 μm , are also known. Such IR lamps are also rather inefficient, because approximately 40% of the radiated energy is dispersed in the external environment and partially given back to the body by means of a rather slow convective process,

while the radiated energy which reaches the layer of painting product is withheld by the external surface of the body which, by conduction, transfers it therein. In this case, the type of material of the body does not effect the total drying time of the painting product, which however is very long.

[0019] It is the object of the present invention to provide a method for painting motor vehicle bodywork parts, which method allows to reduce the total time for performing the painting cycle, and which may be implemented by means of a simpler drying apparatus.

[0020] According to the present invention, a method for painting the bodywork of a vehicle is provided as claimed in the appended claims.

[0021] The present invention will now be described with reference to the accompanying drawings, which show a non-limitative embodiment thereof, in which:

- figure 1 shows a diagrammatic, perspective view, with parts in section, parts on enlarged scale and parts removed for clarity, of a painting product drying apparatus, which apparatus allows to implement the method for painting the bodywork of a vehicle of the present invention;
- figures 2 and 3 show a perspective and a frontal views, respectively, of a part of the radiating device of the apparatus shown in figure 1, with parts of some components removed for clarity; and
- figures 4 and 5 shows a flow chart which describes the steps of the method for painting the bodywork of a vehicle of the present invention.

[0022] The method for painting the bodywork of a vehicle according to the present invention comprises, in general, applying a plurality of painting products, such as a body filler, a primer, a waterborne base paint and a clear top paint, on the surface of at least one portion of the bodywork to be repaired, according to new application sequence of layers of such painting products, and following up the application of each painting product with a corresponding step of drying of the painting product. The new application sequence of painting product layers, which will be described in greater detail below, is possible because each step of drying comprises generating and emitting, towards the bodywork portion surface, infrared radiations by means of at least one catalytic panel fed with a hydrocarbon gas which operates due to a catalytic reaction between the hydrocarbon gas and the oxygen present in the air, and blowing a mixture of air and oxygen on the catalytic panel to influence the catalytic reaction so as to generate an infrared radiation emission spectrum distributed over the entire short-wavelength infrared band.

[0023] More specifically, each step of drying the painting product of the method according to the present invention is implemented by a drying apparatus illustrated in figure 1. In such a figure, numeral 1 generically indicates, as a whole, the drying apparatus and numeral 2

indicates the bodywork of a motor vehicle, on the surface of which there is the painting product to be dried. In the following description, a painting product is a body filler, or a primer, or a waterborne base paint, or a clear or non-clear top paint, or any other type of similar paint. Furthermore, for simplicity, the painting product will be hereinafter referred to as "paint".

[0024] The apparatus 1 comprises a drying booth 3, which extends along a longitudinal axis A according to a preferably, but not necessarily, parallelepiped shape and is provided with a horizontal base 4 having a preferably, but not necessarily, rectangular shape. The motor vehicle, the bodywork 2 of which is concerned by the applied paint drying treatment, is placed over the base 4.

[0025] The apparatus 1 further comprises a gantry structure 5, which is arranged inside the drying booth 3 resting on the base 4 and is adapted to translate along a direction D substantially parallel to the longitudinal axis A, straddling the bodywork 2, and a radiating assembly 6, which is supported by the gantry structure 5 so as to superiorly and laterally surround the bodywork 2, and is adapted to generate heat in the form of electromagnetic radiations in the infrared band and to emit such radiations towards the surface of the bodywork 2 so as to cause the drying of the paint applied on the surface.

[0026] The radiating assembly 6 comprises a plurality of radiating devices 7 mounted on the gantry structure 5 so as to be arranged substantially facing the external upper and side surfaces of the bodywork 2. Each radiating device 7 comprises a box-like containing frame 7a (shown in a detail of figure 1) made, for example, of stainless steel, and at least one catalytic panel 8 having an substantially rectangular shape and accommodated inside the box-like frame 7a. In the particular embodiment shown in figure 1, each radiating device 7 comprises two catalytic panels 8 accommodated in the box-like structure 7a so as to form a larger radiating surface than that offered by a single catalytic panel 8, so as to adapt to the size and shape of the bodywork 2.

[0027] Each catalytic panel 8 is fed by a hydrocarbon gas, such as, for example ethane, propane, butane, or methane, and is adapted to generate energy in the form of electromagnetic waves in the infrared band by means of a catalytic reaction, and specifically a "flameless" catalytic combustion reaction between the hydrocarbon gas and the oxygen present in the air. Furthermore, each radiating device 7 comprises a respective temperature sensor 9 (illustrated in a detail of figure 1) of pyrometric type and arranged so as to detect the temperature of the paint applied on a portion of the bodywork 2 facing the radiating device 7 itself and not to be influenced by the heat emanated by the radiating panels 8.

[0028] The apparatus 1 further comprises a control unit 10 adapted to adjust the generation of the electromagnetic waves in the infrared band by the radiating devices 7 according to the temperatures detected by the temperature sensors 9.

[0029] Figures 2 and 3 show a particular embodiment

of the catalytic panel 8, which has an substantially rectangular shape and comprises: a catalyzing support or bed 11 of known type preferably made of ceramic material doped with a catalyzing material, e.g. a noble metal consisting of platinum; a preheating resistor (not shown) adapted to take the catalyzing support 11 to a specific temperature so as to activate it before the hydrocarbon gas is fed to the catalytic panel 8; and a porous support of known type, and thus not shown, facing the catalyzing support 11 to receive the hydrocarbon gas and uniformly distribute it on an external, substantially flat surface 12 of the catalyzing support 11 itself. The catalyzing support 11 is structured to be crossed by the hydrocarbon gas in order to be able to break down the molecules of hydrocarbon into atoms of hydrogen and carbon, thus causing a flameless exothermic reaction between the hydrogen, the carbon and the oxygen present in the air on the surface 12, which reaction generates carbon dioxide, aqueous vapor and energy in form of electromagnetic waves in the infrared band. Specifically, the infrared radiations generated by such a catalytic panel 8 are emitted according to a first emission spectrum distributed over a relatively narrow range of wavelengths in the short-wavelength infrared band.

[0030] According to the present invention, each radiating device 7 comprises an air supplying device adapted to blow a mixture of air and oxygen onto the radiating panels 8 and to adjust the supplying of such a mixture of air and oxygen upon the control by the control unit 10. Mixture of air and oxygen hereinafter means a mixture of compressed air and pure oxygen, in which the percentage of compressed air may vary from 0% to 100% and, vice versa, the percentage of pure oxygen may vary from 100% to 0%. In other words, the mixture of air and oxygen may also be formed either by compressed air only, or by pure oxygen only. For simplicity, reference will be made hereinafter to the case of a mixture containing compressed air only, because the use of oxygen does not imply any substantial variation to the apparatus 1, and is however more dangerous than the use of compressed air. Indeed, compressed air provides a high amount of oxygen in any case, but it is not as flammable as pure oxygen.

[0031] With reference to figures 2 and 3, the air supplying device comprises two supplying pipes 13, each mounted on a respective catalytic panel 8, and each having a respective plurality of openings or holes 14, through which compressed air is blown. The holes 14 are reciprocally aligned in positions substantially facing the surface 12 to blow compressed air onto the surface 12 in directions substantially parallel to the surface 12 itself, so as to influence the mentioned catalytic reaction, and specifically to locally boost such a catalytic reaction and cause a variation in the infrared radiation emission spectrum.

[0032] Specifically, each supplying pipe 13 extends along an axis B parallel to the larger side edge of the catalytic support 11. The holes 14 are distributed on the

supplying pipe 13 with the respective axes being orthogonal to the axis B and laying on a plane substantially parallel to the surface 12 of the catalyzing support 11. The box-like frame 7a has an open side which is protected by a grid 7b and which is adapted to face the painted bodywork 2. The catalytic panel 8 is arranged with the surface 12 of the catalytic support 11 facing said open side. The supplying pipe 13 and the holes 14 are dimensioned so that the compressed air blown onto the catalytic panel 8 generates, in use, turbulences on the surface 12 such as to distribute the oxygen contained in the blown air in a non-uniform manner on the surface 12 itself. Specifically, the diameter of the holes 14 is in the range of one fifth - one third of the diameter of said supplying pipe 13.

[0033] The non-uniform distribution of oxygen, combined with the uniform distribution of the hydrocarbon gas, locally boosts the catalytic reaction, in several points of the surface 12, thus creating a non-uniform distribution of the temperature of the surface 12 which causes a variation, and specifically a broadening, of the emission spectrum of the electromagnetic waves generated by the catalytic panel 8. In other words, by blowing the compressed air, a second electromagnetic wave emission spectrum is generated, substantially distributed on the entire short-wavelength infrared band and considerably broader, in terms of wavelength range, than the first emission spectrum, which there would be if no air was blown. More precisely, the second electromagnetic wave emission spectrum is distributed in a wavelength range of 0.7 - 3.5 μm . Indeed, a high temperature corresponds to a high concentration of oxygen, and thus to an infrared radiation generation having a wavelength close to 0.7 μm , while a relatively low temperature corresponds to a reduced concentration of oxygen, and thus to a generation of infrared radiations having a wavelength close to 3.5 μm .

[0034] The second emission spectrum generated in the above-described manner allows to transfer a percentage of radiated energy up to 80% to the paint, regardless of the type of paint or painting product applied onto the bodywork 2, because the emission spectrum distributed in the mentioned wavelength range is compatible with a multiplicity of paint or painting product molecules.

[0035] With reference again to figure 1, the gantry structure 5 comprises a horizontal beam 15 adapted to support the radiating assembly 6. The horizontal beam 15 is arranged to be substantially orthogonal to a vertical middle plane (not shown) of the gantry structure 5, on which middle plane the longitudinal axis A lays, and has a pair of slides 16 at the opposite ends thereof, which slides are slidingly mounted on respective side guides 17, parallel to the longitudinal axis A, and are placed on opposite parts with respect to the middle plane, so as to allow the horizontal beam 15 to translate along the direction D. The two side guides 17 are supported by a series of vertical uprights 18 resting on the base 4 so as to keep the horizontal beam 15 over the bodywork 2.

[0036] The radiating assembly 6 comprises at least one pair of side radiating devices 7, which are arranged on opposite sides with respect to the middle plane so as to face the side surfaces of the bodywork 2 in use, and at least one upper radiating device 7, which is arranged in a substantially horizontal position between the side radiating devices 7 so as to face the upper surface of the bodywork 2 in use. In each side radiating device 7, a first of two catalytic panels 8 is in a substantially vertical position, while the second catalytic panel 8 is firmly fixed to the upper end of the first radiating panel 8 and is inclined with respect to the latter towards the middle plane of the gantry structure 5. In the upper radiating device 7, instead, the two catalytic panels 8 are reciprocally aligned.

[0037] The upper radiating device 7 is mounted to the horizontal beam 15 by means of a further pair of slides 19, which are slidingly mounted on respective vertical guides 20 integral with the horizontal beam 15 and placed on opposite sides with respect to the middle plane of the gantry structure 5 to allow the upper radiating device 7 to translate vertically either away from or towards the base 4 so as to move either to or away from the upper surface of the bodywork 2. Furthermore, the upper radiating device 7 is connected to the slides 19, so as to be able to rotate about an axis C substantially parallel to the base 4, and thus substantially orthogonal to the mentioned middle plane.

[0038] The side radiating devices 7 are mounted to the horizontal beam 15 by means of respective arms 21, only one of which is visible in figure 1, slidingly mounted along the horizontal beam 15 to allow each side radiating device 7 to translate along a direction transversal to the longitudinal axis A, from and to the middle plane so as to move either away from or towards a side surface of the bodywork 2.

[0039] The gantry structure 5 further comprises a plurality of electromechanical actuators (not shown) of known type adapted to drive, upon the control by the control unit 10, the slides 16 for translating the horizontal beam 15 along the direction D, the slides 19 for translating the upper radiating device 7 away from and towards the base 4, and the arms 21 for translating the side radiating devices 7 away from and towards the middle plane, and to rotate the upper radiating device 7 about the axis C.

[0040] The control unit 10 comprises a memory (not shown) for storing a series of drying recipes in form of data tables, each of which is univocally associated to a specific paint and comprises an optimal paint drying temperature and an optimal exposure time interval of the paint to the aforesaid second infrared radiation emission spectrum, and a control module, e.g. a keypad, for allowing a user to select the type of paint applied onto the bodywork 2. The control unit 10 is further configured to control and coordinate the different operating steps of the apparatus 1 operation, and specifically for actuating the various electromechanical actuators of the apparatus

1 and for adjusting the flow rate and/or pressure of the hydrocarbon gas and compressed air fed to the various radiating devices 7 according to the paint temperature in the various portions of the bodywork 2, acquired by means of temperature sensors 9 so as to meet the requirements of the selected drying recipe.

[0041] The adjustment of the flow rate and/or of the compressed air pressure consists in an open/closed (on/off) adjustment for switching the emission spectrum generated by the radiating devices 7 from the first emission spectrum to the second emission spectrum. More specifically, if the measured temperature is higher than the optimal temperature by a given margin, the feeding of the compressed air to the corresponding catalytic panels 8 is interrupted so as to restrict the infrared radiation emission spectrum, and i.e. for generating the mentioned first infrared radiation emission spectrum. Instead, if the measured temperature is lower than the optimal temperature by a given margin, the feeding of the compressed air to the corresponding catalytic panels 8 is allowed in order to broaden the infrared radiation emission spectrum, and i.e. for generating the mentioned second infrared radiation emission spectrum.

[0042] The method for painting the bodywork of a vehicle according to the present invention is shown in the flow chart in figures 4 and 5, and includes applying a plurality of painting products, such as a body filler, a primer, a waterborne base paint and a clear top paint, onto the surface of a bodywork portion to be repaired according to a particular sequence of applications of layers or coats of the various painting products intercalated between steps of drying carried out by means of the apparatus 1, i.e. by employing the above-described radiating devices 7. The application times of the painting products shown hereinafter are to be referred to a bodywork portion with a 1 square meter surface.

[0043] With reference to figure 4, the painting method is initially differentiated according to whether the bodywork portion to be repaired is a damaged portion to be touched up or a new portion for replacing the damaged one: in the first case (NO criterion in block 100), the body filler must be applied beforehand to restore the original shape of the bodywork portion; instead, no body filler is required in the second case (YES criterion in block 100).

[0044] Specifically, in the case of damaged bodywork portion (NO criterion in block 100), the method comprises applying a first layer of body filler having a thickness in the range of 400 - 600 μm on the surface of the portion of bodywork to be repaired, by operating a rather strong pressure on the surface (block 101). The time required for completing such an operation is approximately 30 s, assuming an extension of the body filler of approximately 0.25 square meters. The first layer of body filler is immediately dried by exposing it to the infrared radiations generated by the radiating device 7 for an exposure time ET1 in the range of 30 - 40 s taking the body filler to a temperature T1 in the range of 80 - 90°C, and preferably of 85°C (block 102). When the temperature of the body filler

is still at least of 70°C, a plurality of further layers of body filler having substantially the same thickness as the first layer of body filler are applied over each other starting from a first layer of body filler to reach the desired thickness (block 103). Waiting periods, each having a value in the range of 10 - 15 s, are intercalated between applications of the further layers of body filler so as to allow a certain hardening of the body filler. The time required to complete such an operation is in the range of 2 - 3 minutes. After their application, the further layers of body filler are immediately dried by means of the infrared radiations generated by the radiating device 7 for an exposure time ET2 in the range of - and 50 s, taking the body filler to a temperature T2 in the range of 90 - 100°C, and preferably of 100°C, so as to obtain a total reticulation of the body filler (block 104). The body filler is sanded (block 105) at the end of the exposure time ET2.

[0045] Once the body filler has been sanded, a first coat (half coat) of primer having a thickness in the range of 20 - 30 μm (block 106) is applied by spraying or by means of a roller thereon. The time required to apply the primer coat is approximately 1 minute. The first primer coat is immediately dried by exposing it to the infrared radiations generated by the radiating device 7 for an exposure time ET3 in the range of 20 - 30 s taking the primer to a temperature T3 in the range of 80 - 90°C, and preferably of 85°C (block 107). A second coat of primer having a thickness in the range of 30 - 40 μm (block 108) is applied on the first primer coat by spraying or by means of a roller when its temperature is still at least of 50°C. The second primer coat is immediately dried by exposing it to the infrared radiations generated by the radiating device 7 for an exposure time ET4 in the range of 30 - 40 s taking the primer to a temperature T4 in the range of 105 - 115°C, and preferably of 110°C (block 109). A third coat of primer having the same thickness as the second coat (block 110) is applied on the second primer coat by spraying or by means of a roller when its temperature is still at least of 50°C. The third primer coat is also immediately dried by exposing it to the infrared radiations generated by the radiating device 7 for the exposure time ET4 so as to take the primer to the temperature T4 (block 111). At this point, a step of sanding which comprises a single passing with a P400-grit sandpaper follows (block 112).

[0046] In the case of a new bodywork portion (YES criterion in block 100), the method comprises directly applying a coat of wet-on-wet primer having a thickness in the range of 20 - 30 μm (block 113) onto the new bodywork portion by spraying or by means of a roller. The time required for applying the coat of wet-on-wet primer is approximately 1 minute. The coat of wet-on-wet primer is immediately dried by exposing it to the infrared radiations generated by the radiating device 7 for an exposure time ET5 in the range of 40 - 30 s taking the wet-on-wet primer to a temperature T5 in the range of 80 - 90°C, and preferably of 85°C (block 114). At the end of drying, the wet-on-wet primer is cooled for a time sufficient to reach

a temperature of 35°C (block 115).

[0047] With reference to figure 5, half a coat of waterborne base paint having a thickness in the range of 5 - 10 μm (block 116) is immediately applied by spraying on the dried, sanded primer or on the dried wet-on-wet primer. A full coat of waterborne base paint having a thickness in the range of 10 - 15 μm (block 117) is applied by spraying on the half coat of waterborne base paint immediately thereafter. The time required for applying the two coats of waterborne base paint is approximately 3 minutes. Immediately after applying the full coat, the base paint is dried by exposing it to the infrared radiations generated by the radiating device 7 for an exposure time ET6 in the range of 30 - 40 s taking the base paint to a temperature T6 in the range of 60 - 70°C, and preferably of 65°C (block 118). At the end of drying the full coat, the waterborne base paint is cooled down for a time sufficient to reach a temperature of 30°C (block 119). A shaded coat of waterborne base paint having a thickness in the range of 2 - 4 μm (block 120) is applied on the full coat of the waterborne base paint at the temperature of 30°C. The application time of the drop coat of the base paint is approximately 1 minute and a half. Immediately after applying the drop coat, the base paint is dried by exposing it to the infrared radiations generated by the radiating device 7 for an exposure time ET7 in the range of 15 - 20 s taking the base paint to a temperature T7 in the range of 45 - 55°C, and preferably of 50°C (block 121). At the end of drying the drop coat, the waterborne base paint is cooled down again for a time sufficient to reach a temperature of 35°C (block 122).

[0048] Immediately after drying and cooling the waterborne base paint, i.e. when its temperature is of 35°C, half a coat of clear top paint having a thickness in the range of 15 - 20 μm (block 123) is applied by spraying. A full coat of clear top paint having a thickness in the range of 40 - 50 μm (block 124) is applied by spraying on the half coat of clear top paint immediately thereafter. The time required for applying the two coats of clear top paint is approximately 4 and a half minutes. Immediately after applying the full coat, the clear top paint is dried by exposing it to the infrared radiations generated by the radiating device 7 for an exposure time ET8 in the range of 40 - 50 s taking the base paint to a temperature T8 in the range of 115 - 125°C, and preferably of 120°C (block 125). Once the exposure to infrared radiations has been finished, the paintwork is to be considered complete only after having left the clear top paint cool down for a time sufficient to reach a temperature in the range of 30 - 35°C (block 126).

[0049] According to a further embodiment (not shown) of the present invention, the painting method differs from the embodiment shown in figure 4 and described above in that the shaded coat of waterborne base paint is applied directly onto the wet surface, i.e. immediately after having applied the full coat, rather than onto the dry surface. This depends on the particular type of waterborne base paint used. Specifically, the steps of drying and

cooling the waterborne base paint indicated by blocks 118 and 119, respectively, in the flow chart in figure 5 are not included, and the subsequent step of drying the waterborne base paint, i.e. shown in block 121 in figure 5, is modified in its carrying out time, i.e. the base paint is dried by exposing it to the infrared radiations generated by the radiating device 7 for a different exposure time ET9 in the range of 30 - 40 s taking the base paint itself to a temperature T9 in the range of 65 - 75°C, and preferably of 70°C.

[0050] The main advantage of the method for painting the bodywork according to the present invention is the drastic reduction, of approximately 90%, of the drying times of each painting product without deteriorating the features of the same. Such a drastic reduction of the drying times is made possible by the particular infrared radiation emission spectrum (second emission spectrum) generated by the radiating devices 7 by blowing the compressed air on the corresponding catalytic panels 8 fed with hydrocarbon gas.

[0051] Furthermore, the second emission spectrum, being distributed in the entire short-wavelength infrared band, allows any painting product to be optimally dried, making the new application sequence of layers of the various painting products described above possible, which implies a drastic reduction, of approximately 80%, of the total application and finishing times of each painting product.

[0052] Indeed, the particular drying technique suppresses the need for hardening times either between one coat and the next of the same painting product (e.g. the primer), or between two different painting products (e.g. between the last waterborne base paint and the first clear top paint), and thus allows a continuous application of the various painting products on the hot support resulting in an enormously speeding up of the entire painting cycle. Additionally, the particular technique allows to facilitate the modeling of the surface to be reconstructed by means of the body filler and to reduce the porosity of the filled surface. As a consequence, the surface of the damaged bodywork portion may be reconstructed in a single cycle consisting in the body filler application and sanding, while by using the known techniques the application and sanding cycle must be repeated at least twice.

[0053] Finally, the method for painting the bodywork of the present invention is based on the use of a single type of device, i.e. the radiating device 7, for drying any painting product. It is indeed sufficient to vary some parameters, such as for example the exposure time to the infrared radiation and the desired temperature, to adapt the radiating device 7 to the various painting products used, such as the body filler, the primer, the waterborne base paint and the clear top paint. This contributes to simplify and speed up the whole painting cycle.

Claims

1. A method for painting a vehicle bodywork, which method comprises the steps of:

- applying (106, 108, 110, 113) at least one coat of primer on at least one portion of bodywork (2);
 - drying (107, 109, 111, 114) the primer applied on the portion of bodywork (2);
 - applying (116, 117, 120) at least one coat of waterborne base paint on the dried primer;
 - drying (118, 121) the waterborne base paint applied on the primer;
 - applying (123, 124) at least one coat of clear top paint on the dried waterborne base paint;
 and
 - drying (125) the clear top paint applied on the waterborne base paint;

and is **characterized in that** each step of drying (107, 109, 111, 114, 118, 121, 125) comprises:

- generating and emitting infrared radiations towards said surface by means of a catalytic panel (8) fed by hydrocarbon gas and operating due to a catalytic reaction between the hydrocarbon gas and the oxygen present in the air; and
 - blowing a mixture of air and oxygen onto the catalytic panel (8) for influencing said catalytic reaction so as to generate an infrared radiation emission spectrum distributed in the entire short-wavelength infrared band.

2. A method according to claim 1, wherein said portion of bodywork (2) is a damaged bodywork portion to be touched up; the method comprising the steps of:

- applying (101, 103, 113) at least one layer of body filler on the surface of the portion of bodywork (2); and
 - drying (102, 104) the body filler applied on the surface of the portion of bodywork (2);

said coat of primer being applied (106, 108, 110, 113) on the dried body filler, and the drying (102, 104) of the body filler comprising:

- generating and emitting infrared radiations towards said surface by means of a catalytic panel (8) fed by hydrocarbon gas and operating due to a catalytic reaction between the hydrocarbon gas and the oxygen present in the air; and
 - blowing a mixture of air and oxygen onto the catalytic panel (8) for influencing said catalytic reactions so as to generate an infrared radiation emission spectrum distributed in the entire short-wavelength infrared band.

3. A method according to claim 2, wherein said step of applying (101, 103) at least one layer of body filler on the surface of at least one portion of the bodywork (2) comprises the steps of:

- applying (101) a first layer of body filler having a first determined thickness on said surface; and
 - applying (103) a plurality of further layers of body filler over each other, starting from the first layer of body filler, which layers substantially have the same thickness, until a desired thickness of body filler is obtained;

said step of drying (102, 104) the body filler applied on the surface of the portion of bodywork (2) comprising the steps of:

- drying (102) the first layer of body filler immediately after the application by exposing the first layer of body filler to said infrared radiation emission spectrum for a first exposure time (ET1) taking the body filler to a first temperature (T1); and
 - drying (104) each further layer of body filler immediately after the application thereof by exposing the further layers of body filler to said infrared radiation emission spectrum for a second exposure time (ET2) taking the body filler to a second temperature (T2).

4. A method according to claim 3, wherein said first thickness is in the range of 400 - 600 μm , said first exposure time (ET1) is in the range of 30 - 40 s, said first temperature (T1) is in the range of 80 - 90°C, said second exposure time (ET2) is in the range of 40 - 50 s, and said second temperature (T2) is in the range of 90 - 110°C.

5. A method according to claim 3 or 4, wherein the step of applying (103) a plurality of further layers of body filler over each other starting from the first layer of body filler comprises intercalating waiting periods between the applications of the further layers of body filler.

6. A method according to claim 5, wherein each of said waiting periods is in the range of 10 - 15 s.

7. A method according to anyone of the claims from 2 to 6, wherein said step of applying (106, 108, 110) at least one coat of primer on at least one portion of bodywork (2) comprises applying three coats of primer over each other starting from the dried body filler; said step of drying (107, 109, 111) the primer comprises drying each primer coat immediately after the respective application by exposing a first coat of primer to said infrared radiation emission spectrum for a respective third exposure time (ET3) by taking

the first coat of primer to a third temperature (T3) and exposing each of the other two coats of primer to said infrared radiation emission spectrum for a fourth exposure time (ET4) by taking said other two coats of primer to a fourth temperature (T4).

8. A method according to claim 7, wherein said third exposure time (ET3) is in the range of 20 - 30 s, said third temperature (T3) is in the range of 80 - 90°C, said fourth exposure time (ET4) is in the range of 30 - 40 s, and said fourth temperature (T4) is in the range of 105 - 115°C.
9. A method according to claim 1, wherein said portion of bodywork (2) is a new bodywork portion; said step of applying (113) at least one coat of primer on at least one portion of bodywork (2) comprises applying a coat of wet-on-wet primer on the new bodywork surface; said step of drying (114) the wet-on-wet primer comprising drying (114) the wet-on-wet primer immediately after the application thereof by exposing the wet-on-wet primer to said infrared radiation emission spectrum for a fifth exposure time (ET5) by taking the wet-on-wet primer to a fifth temperature (T5).
10. A method according to claim 9, wherein said fifth exposure time (ET5) is in the range of 30 - 40 s, and said fifth temperature (T5) is in the range of 80 - 90°C.
11. A method according to anyone of the claims from 1 to 10, wherein said step of applying (116, 117, 120) at least one coat of waterborne base paint onto the dried primer comprises the steps of:
 - applying (116) half a coat of waterborne base paint on the dried primer;
 - applying (117) a full coat of waterborne base paint immediately after the half coat of waterborne base paint; and
 - applying (120) a drop coat of waterborne base paint on the full coat of waterborne base paint.
12. A method according to claim 11, wherein said step of drying (118, 121) the waterborne base paint applied onto the primer comprises the steps of:
 - drying (118) the waterborne base paint after the application of said full coat of waterborne base paint and before applying said drop coat of waterborne base paint by exposing the waterborne base paint to said infrared radiation emission spectrum for a sixth exposure time (ET6) by taking the waterborne base paint at a sixth temperature (T6); and
 - drying (121) the waterborne base paint after the application of the drop coat of waterborne base paint by exposing the waterborne base paint to said infrared radiation emission spec-

trum for a seventh exposure time (ET7) by taking the waterborne base paint to a seventh temperature (T7).

13. A method according to claim 12, wherein said sixth exposure time (ET6) is in the range of 30 - 40 s, said sixth temperature (T6) is in the range of 60 - 70°C, said seventh exposure time (ET7) is in the range of 15 - 20 s, and said seventh temperature (T7) is in the range of 45 - 55°C.
14. A method according to claim 11, wherein said drop coat of waterborne base paint is applied immediately after said full coat of waterborne base paint; said step of drying (121) the waterborne base paint applied on the primer comprising drying (121) the waterborne base paint after the application of the drop coat of waterborne base paint by exposing the waterborne base paint to said infrared radiation emission spectrum for a seventh exposure time (ET7) by taking the waterborne base paint to a seventh temperature (T7).
15. A method according to claim 14, wherein said seventh exposure time (ET7) is in the range of 30 - 40 s and said seventh temperature (T7) is in the range of 65 - 75°C.
16. A method according to anyone of the claims from 1 to 15, wherein applying (123, 124) at least one clear top paint on the dried waterborne base paint comprises:
 - applying (123) half a coat of clear top paint on the dried waterborne base paint; and
 - applying (123) one full coat of clear top paint immediately after the half coat of clear top paint;said step of drying (125) the clear top paint applied on the waterborne base paint comprising drying the clear top paint immediately after the application of the full coat of clear top paint by exposing the clear top paint to said infrared radiation emission spectrum for an eighth exposure time (ET8) taking the clear top paint to an eighth temperature (T8).
17. A method according to claim 16, wherein said eighth exposure time (ET8) is in the range of 40 - 50 s and said eighth temperature (T8) is in the range of 115 - 125°C.
18. A method according to anyone of the claims from 1 to 17, wherein said infrared radiation emission spectrum is distributed in a wavelength range of 0.7 - 3.5 μm .

19. A method according to anyone of the claims from 1 to 18, wherein said air and oxygen mixture comprises compressed air.

5

10

15

20

25

30

35

40

45

50

55

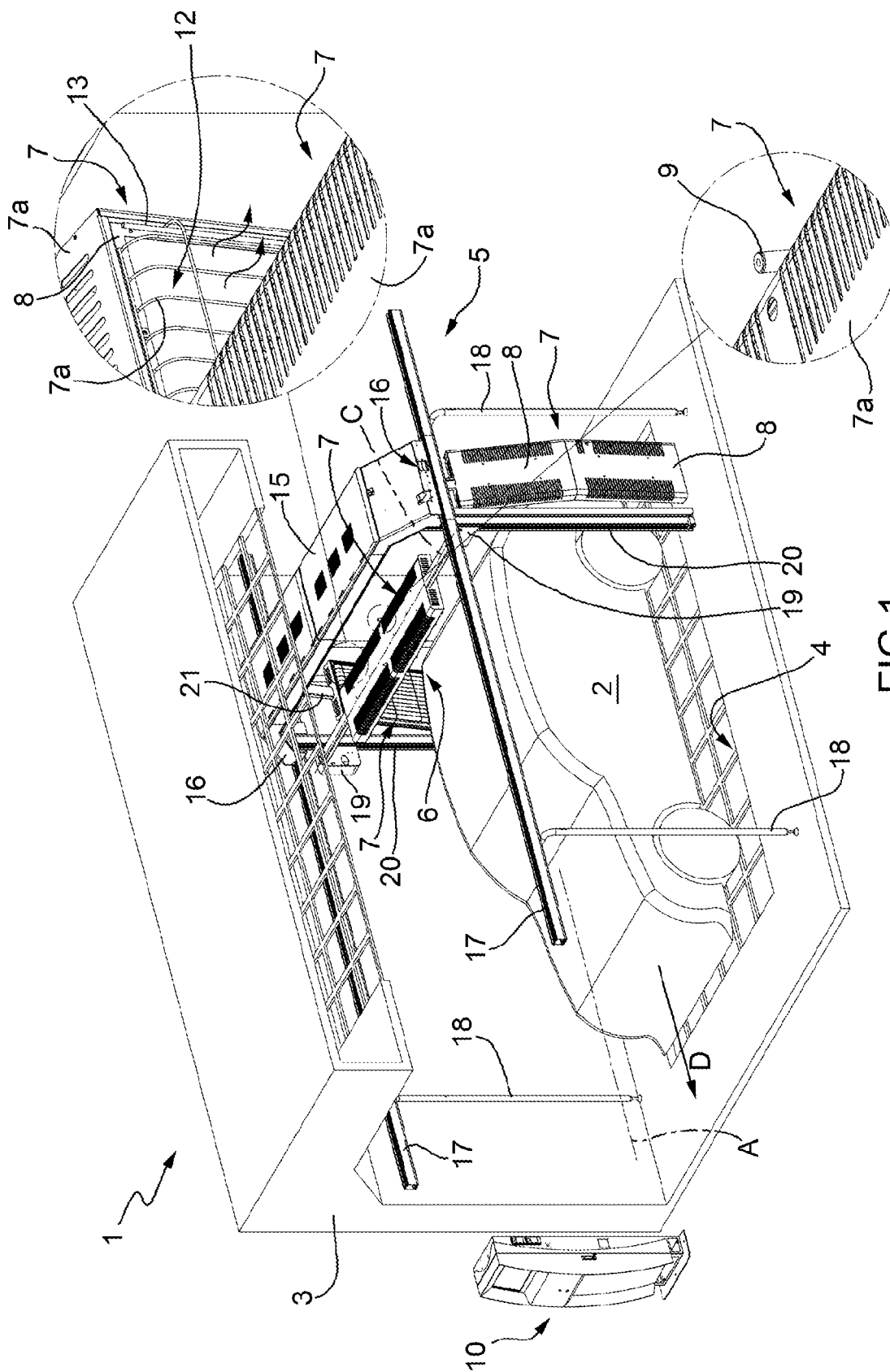
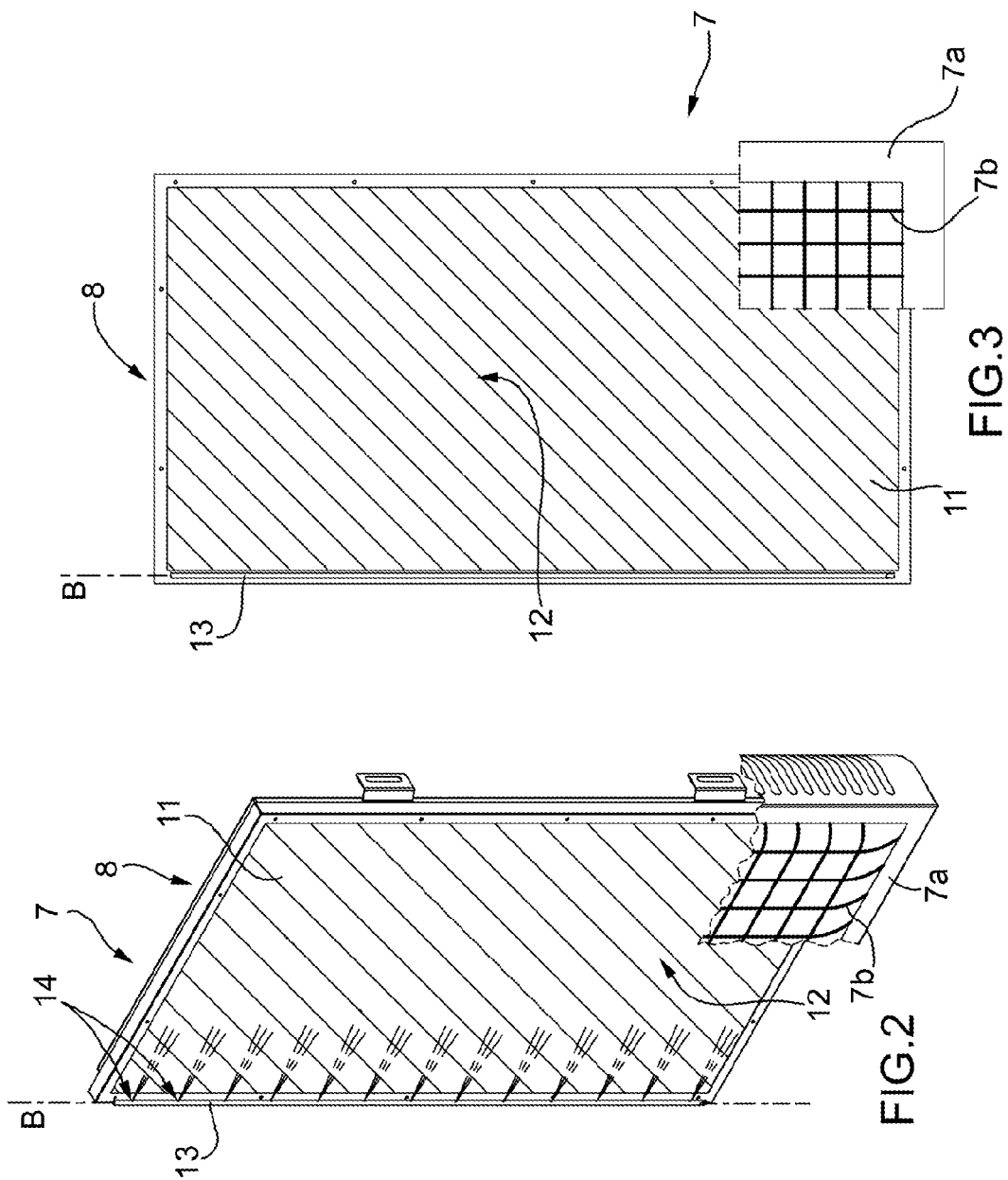


FIG.1



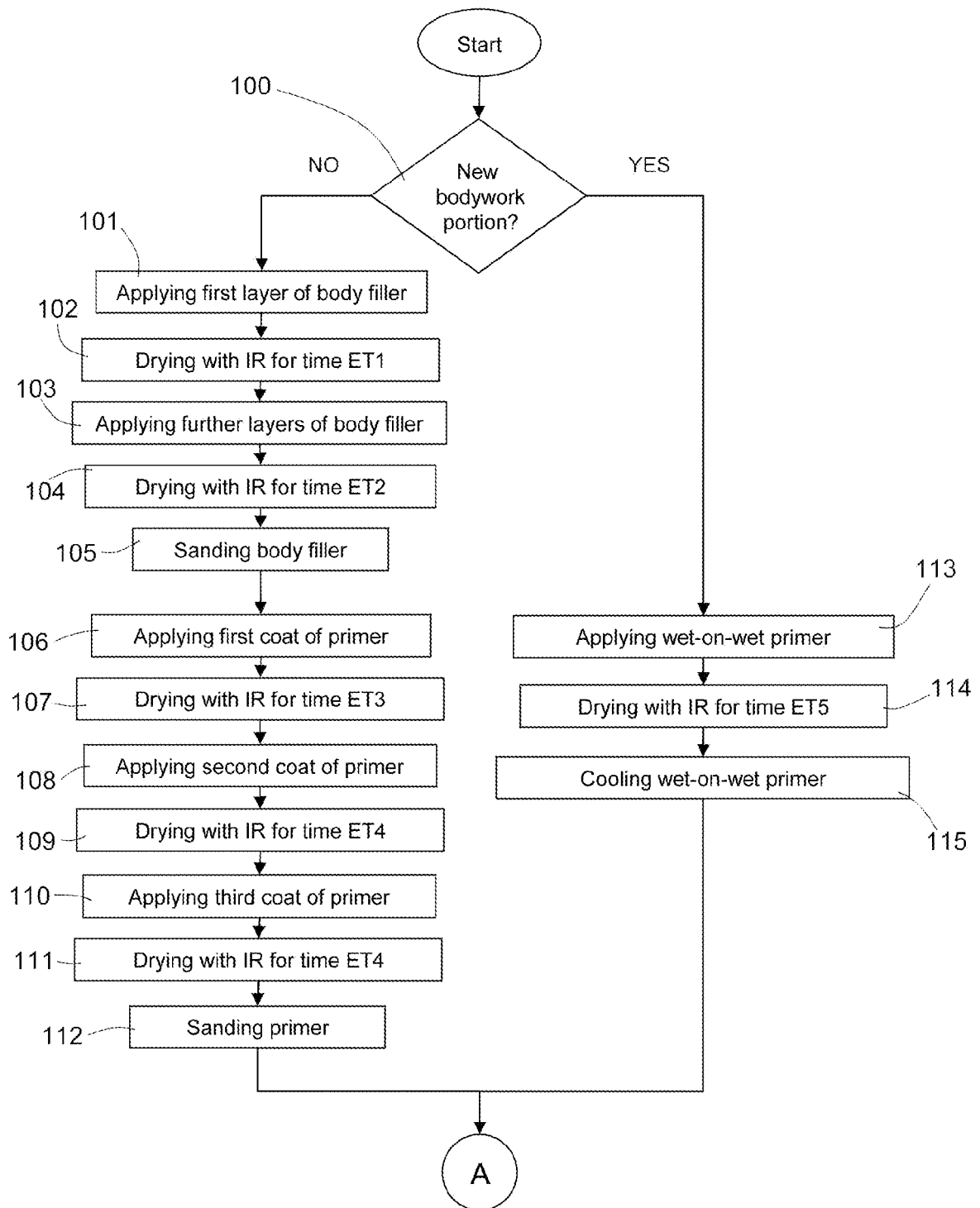


FIG.4

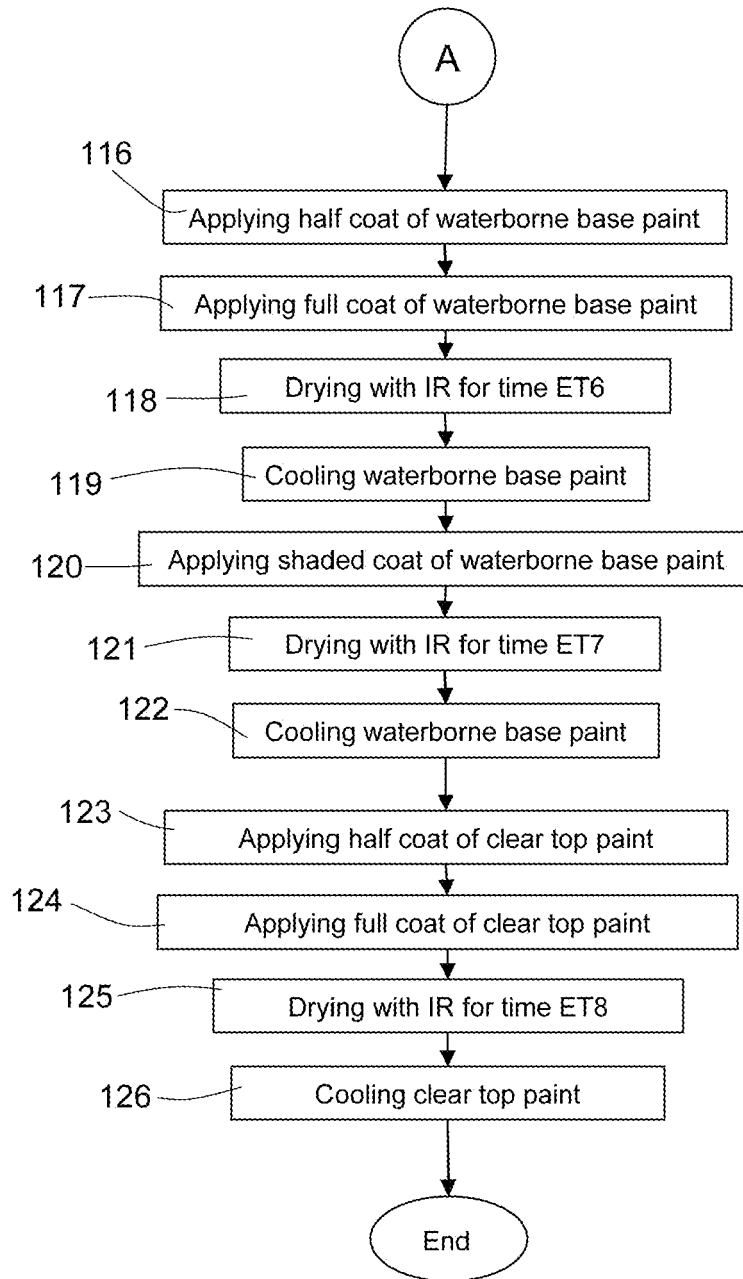


FIG.5



EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5668

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	ANONYMOUS: "Paint Application Process the Infrared Technology SYMACH Sirt" [Online] 2006, THE RESEARCH LABORATORY SYMACH (HANDBOOK OF SYMACH-PROCESS), XP002515114 Retrieved from the Internet: URL:http://www.symach.com/newsite/upload/mmagini/manualeEN.pdf.zip> [retrieved on 2008-02-12] * page 5 * * page 11 - page 22 * * page 28 - page 30 *	1-19	INV. B05D7/00 B05D5/00 B05D3/02 F26B3/30 F26B23/02
Y	US 2003/129300 A1 (OKADA TOSHIKAZU [JP] ET AL) 10 July 2003 (2003-07-10) * paragraph [0002] * * paragraphs [0077], [0079], [0080] * * paragraphs [0034], [0050], [0056] *	1,2,9, 11,16, 18,19	
Y	US 2004/123491 A1 (SCHNEIDER HEIKO [DE]) 1 July 2004 (2004-07-01) * paragraphs [0013], [0014], [0025], [0026], [0038] - [0041], [0046], [0047], [0051], [0052]; figures 2,3 *	1,2,9, 11,16, 18,19	TECHNICAL FIELDS SEARCHED (IPC) B05B F26B B05D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 13 February 2009	Examiner Endrizzi, Silvio
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

 2
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 42 5668

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

13-02-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003129300 A1	10-07-2003	CN 1415430 A	07-05-2003
		DE 60210718 T2	04-01-2007
		EP 1295649 A2	26-03-2003
		JP 2003093967 A	02-04-2003

US 2004123491 A1	01-07-2004	DE 10242944 A1	25-03-2004
		EP 1398587 A2	17-03-2004
