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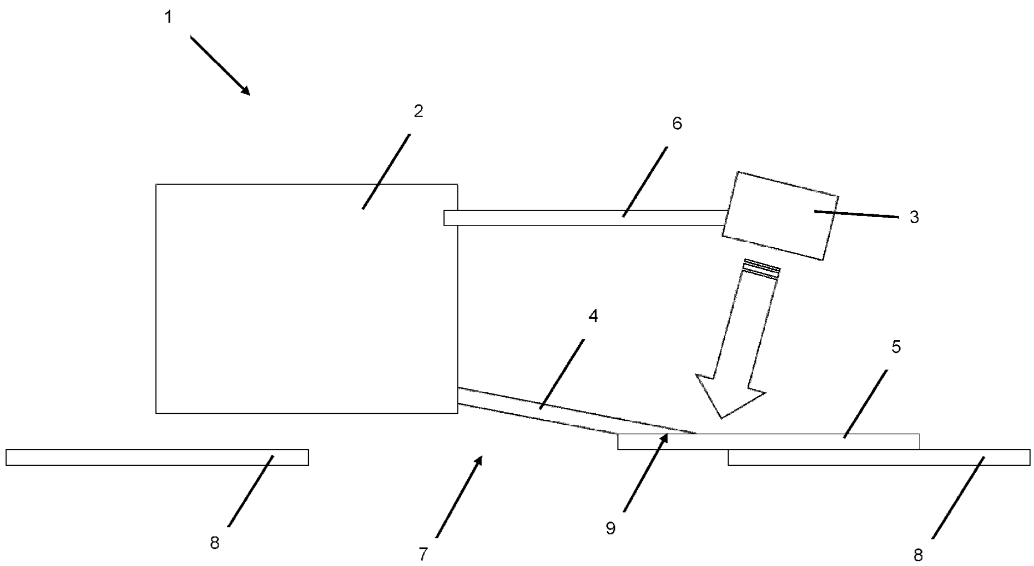
(54) **METHOD AND DEVICE FOR AUTOMATED FLUID TIGHT SEALING OF A HOLE IN A BODY ELEMENT OF A VEHICLE**

(57) Method for an at least partially automated fluid-tight sealing of a hole in a body element of a vehicle in which
a sealant is continuously applied to the hole and an edge area of the body element bordering the hole, preferably in the form of a liquid, a pasty mass or a self-supporting film, by means of a robot-assisted applicator;
the sealant is continuously pre-cured during its application, by means of the robot-assisted applicator, so that the sealant is provided with mechanical self-supporting capacity;
the pre-cured sealant is being completely cured with the supply of heat to form a liquid-tight sealing.

Fig.1



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Description

[0001] The invention relates to a method for automated fluid tight sealing of a hole in a body element of a vehicle. Furthermore, the invention relates to a device for automated fluid tight sealing of a hole in a body element of a vehicle.

[0002] Typically, during the painting process of a metallic vehicle body, said body is usually first pretreated, in which the body is sprayed or dipped with various phosphate salt solutions. This forms a crystalline metal-phosphate layer.

[0003] The body is then primed, whereby a corrosion protection primer is applied to the, preferably phosphated, sheet metal, which leads to very good adhesion with the sheet metal and thus prevents or slows down corrosion. Coating by electrolytic deposition has proven to be particularly advantageous, as even cavities that are difficult to access can be reliably primed. The body is then placed in a first oven for thermal curing of the anticorrosion paint, which is usually based on epoxy resins.

[0004] After pre-curing in the first oven, the coloring layer, the so-called base paint, is applied to the primed body.

[0005] A clear paint coat is then applied as the final layer and protects the entire paint layer structure against mechanical, chemical and environmental stresses. Finally, a complete thermal final curing of all paint layers takes place in a second oven, the so-called paint oven.

[0006] In particular, the invention relates to the solution of a specific technical problem that arises in the above outlined standard painting process of a metallic vehicle body during vehicle construction.

[0007] With regard to applying a corrosion protection primer/paint to the vehicle body by electrolytic deposition, a preferred method is the electrophoretic deposition (EPD), which is a widely used industrial process in which colloidal particles are deposited on an electrode under the influence of an electric field. More specific embodiments of the electrophoretic deposition process are cathodic dip painting (CDP) and anodic dip painting (ADP). Cathodic dip painting, also called "cataphoresis" or "Kathodische Tauchlackierung" (KTL) in German, is an electrochemical process in which the workpiece is coated in an immersion bath comprising a suspension of said colloidal particles. It is well suited for painting complicated structures and large quantities. Cataphoresis is a standard process for ensuring corrosion protection on vehicle body elements.

[0008] Said body elements coated by cathodic dip painting often have cavities whose inner walls must also be coated for the purpose of corrosion protection. Body elements comprising cavities constitute a "complicated structure" for the purpose of this application.

[0009] Of course, in order to allow the suspension to access said cavities whose inner walls are to be coated, holes to said cavities have to be provided. After coating, however, the holes no longer serve any purpose, but must be sealed fluid-tight to prevent the subsequent entry of moisture, engine oil or similar.

[0010] According to methods known from the state of the art, the holes have so far been sealed in manual processes with adhesive tape or plugs after the painted body elements have left the first oven (CDP oven), but before the coloring layer is applied.

[0011] However, these manual processes are disadvantageous because they are time-consuming and imprecise. Furthermore, they are undesirable because they can lead to health problems for the personnel carrying out the work due to the monotonous physical strain.

[0012] Consequently, there is a vital industrial interest in automating the process of hole sealing.

[0013] The technical **problem** to be solved by the invention is therefore to provide a method and a device by means of which the hole sealing process can be at least partially automated in an advantageous manner.

[0014] As a **solution** to the technical problem a method is proposed for an at least partially automated fluid-tight sealing of a hole in a body element of a vehicle in which

- a sealant is continuously applied to the hole and an edge area of the body element bordering the hole, preferably in the form of a liquid, a pasty mass or a film, by means of a robot-assisted applicator;

- the sealant is continuously pre-cured during its application, by means of the robot-assisted applicator, so that the sealant is provided with mechanical self-supporting capacity;

- the pre-cured sealant is being completely cured with the supply of heat to form a liquid-tight sealing.

[0015] By means of the process according to the invention, it is now possible for the first time to automatically seal holes in car body elements in a fluid-tight manner. The basic idea of the invention, namely to replace the human part of the process, in particular the manual closing of the holes by means of adhesive tape or plugs, by an automated process step, is achieved by the method according to the invention. The use of a robot-assisted applicator according to the invention in combination with a sealant according to the invention, which can be cured in two stages, namely the pre-curing step and the curing step, leads to an advantageous synergetic effect. The effect is that the hole is continuously covered with a self-supporting sealant film during application, which is continuously self-adhered to the edge area of the hole and can then be final cured. As a result, a manual operation is no longer required. Furthermore, the process according to the invention can be seamlessly integrated into a painting process of a vehicle body, in particular comprising electrophoretic deposition, preferably cathodic dip painting, whereby the higher-level process is made more effective by the automation achieved according to the invention.

[0016] According to a preferred embodiment of the invention, the body element comprises a plurality of holes to be sealed. In this case, it is possible to apply and pre-cure the sealant to at least two or more holes in parallel, provided that the robot-assisted applicator provides a plurality of outlets and/or the robot comprises a plurality of applicators.

[0017] According to the invention, a sealant is applied to the hole to be sealed. The sealant is preferably applied in the form of a liquid or in the form of a pasty mass. The composition of the sealant is selected so that it can be cured in two stages. Pre-curing preferably takes place immediately before, during or immediately after application of the sealant. In practice, this means that pre-curing takes place in the applicator, preferably in the die, or immediately after the sealant has left the applicator. Preferably, the sealant is an adhesive composition comprising a first curable component and a second curable component.

[0018] The terms "application" and "applying" are used in the sense of the invention with the meaning that the hole in its final state is completely covered with the sealant. This preferably includes that the applicator in sum passes over the hole in its entire length and width including an edge area surrounding the hole. The applicator continuously delivers sealant, which is also continuously pre-cured during delivery. The pre-curing of the sealant takes place immediately before, during or immediately after the sealant leaves or has left the applicator. According to a preferred embodiment, the applicator passes over the entire length and width of the hole once in one go at a constant speed. The section of both the hole and the edge area that is passed over is continuously coated with sealant. This is particularly advantageous for comparatively small holes, as these holes can be completely covered with sealant in a single traverse of the applicator. According to another embodiment of the invention, the applicator passes over the hole according to a predefinable grid, in particular in the form of a plurality of webs. In this case, the hole is not completely covered with sealant during the first traverse. Instead, the sealant is applied and pre-cured over a hole section, in particular a web-shaped hole section, and an edge region adjacent thereto. The applicator then passes over the hole again. In the process, another section of the hole and the adjacent edge area are coated with sealant. If the additional section is one that is immediately adjacent to a hole section that has already been coated with sealant, the sealant is also applied in an overlap area between the two sections. In this way, the sealant of the further section is applied to the adjacent edge area, but also to the first already pre-cured sealant section, in particular sealant web, in the corresponding overlap area. Depending on the size or geometry of the hole, one additional sealant section, in particular sealant web, may be enough to cover the entire hole. In other cases, this process is repeated until the hole is completely covered by several sealant sections, in particular sealant webs. This is particularly advantageous with regard to comparatively large holes and/or complex hole geometries, as in this way it is not necessary to adapt the applicator to different hole sizes and/or geometries. Preferably, sealants are used that have different components that form their own three-dimensional networks by means of separate reaction mechanisms and/or separate reaction triggers, which three-dimensional networks in turn form an interpenetrating network after complete curing.

[0019] The term "curable" is to be understood so that the first and second component of the sealant each form a polymer network when exposed to a component-specific trigger. The term "pre-curing" is to be understood as the step in which the first component forms a first polymer network. The term "completely curing" or "final curing" is to be understood as the step in which the second component forms a second polymer network, when the first polymer network has already been formed during pre-curing.

[0020] Preferably pre-curing takes place immediately before, during and/or immediately after the sealant leaves the robot-assisted applicator, in particular a die, preferably a flat die, comprised by the applicator. Advantageously, the viscosity of the sealant for the application can be adjusted in this way. Furthermore, the consistency with which the sealant leaves the applicator can be adjusted. This has advantages with regard to applying the sealant to different hole geometries and sizes.

[0021] It is particularly preferred that the polymerization of the first component is initiated by means of electromagnetic radiation as a trigger specific to the first component, in particular UV radiation and/or IR radiation, preferably UV radiation. Preferably, the polymerization of the first component is based on a chain growth reaction, in particular a free-radical polymerization, as reaction mechanism. Preferably, the polymerization of the first component leads to a first three-dimensional polymer network during the pre-curing step. In particular, the first component comprises acrylate and/or methacrylate monomer system. Alternatively, the first component comprises a vinyl ether monomer system.

[0022] Preferably, an initiator is used which has an absorption maximum in the wavelength range from 365 nm to 405 nm. It has been shown that this allows UV curing to be carried out with lower radiation intensity and duration.

[0023] It is furthermore preferred that the polymerization of the second component is initiated by the supply of heat as a trigger specific to the second component. Preferably, the polymerization of the second component is based on a step growth reaction, in particular a polyaddition reaction, as reaction mechanism. Preferably, the polymerization of the second component leads to a second three-dimensional polymer network. In particular, the second component is based on an epoxy-amine monomer system, preferably forming an epoxy resin, when being cured. When the first and the second component are fully cured, the first polymer network and the second polymer network form a three-dimensional interpenetrating network.

[0024] For the purposes of the invention, the term "monomer system" includes pure monomers, oligomers, high viscosity pre-polymerized polymers and mixtures thereof. Preferably, the monomer system may also include additives such as hardeners and/or initiators.

[0025] According to a preferred embodiment of the invention, the sealant includes additives with which certain properties of the sealant can be influenced advantageously. The additives include cross-linking agents, tackifiers, mineral fillers, in particular chalk or tallow, impact modifiers, in particular core-shell particles, functionalized fillers, in particular salinized fillers, glass fibers, glass flakes, Kevlar fibers, carbon fibers or mixtures thereof.

[0026] According to the invention, the sealant is continuously applied to the hole and to an edge area of the body element bordering the hole by means of a robot-assisted applicator while the applicator passes over the hole and the bordering edge area of the body element, so that the sealant completely covers the hole and the bordering edge area. After pre-curing, the sealant forms a film, preferably a self-supporting film in the area of the hole. Advantageously, the hole is already covered by the end of the pre-curing process, so that no more impurities can penetrate into the cavity behind it. Furthermore, the sealant is already firmly bonded to the body element. The body element can therefore be subjected to further process steps without the risk of the sealant coming loose.

[0027] According to the invention, sealant is continuously applied to an edge area of the body element bordering the hole, so that as a result the sealant covers the bordering edge area. For the purposes of the invention, the term "edge area" includes the edge itself and a surface section of the body element adjoining the edge. The surface section is the section to which sealant is applied. The size of the surface section is selected so that it is sufficient for fluid-tight and mechanically stable attachment of the sealant. This also includes an embodiment in which the sealant, after application, is in contact only with the edge itself, but not with the surface section. Furthermore, the term includes only a single continuous edge if the hole is formed with a round contour in the body element or a plurality of interconnected edges if the hole is formed with an angular contour in the body element. According to this definition, a circular hole would have an edge area with a single edge, a triangular hole, an edge area with three edges, a square hole, an edge area with four edges, etc. Complex edge geometries that deviate from the aforementioned basic shapes are also conceivable. The invention is also suitable for such geometries as long as the hole can be sealed with the sealant via a bordering edge area.

[0028] According to a particularly preferred feature of the invention, the process according to the invention is part of a higher-level painting process comprising a step of coating the body element with a corrosion protection paint, preferably based on electrophoretic deposition, in particular cathodic dip painting, prior to applying the sealant to the body element. In this case, the body element is first electrophoretically coated in an immersion bath. Optionally, prior to that, in particular in case of a metallic body element, said body element may be pretreated, in which the metallic body element is sprayed or dipped with at least a phosphate salt solution. This forms a crystalline metal-phosphate layer, which improves the adhesion between the metallic base material of the body element and the corrosion protection paint layer. The body element has a cavity and a hole through which the reactive suspension in the immersion bath can flow into the cavity in such a way that the inner walls of the cavity are coated. The body element is then removed from the immersion bath, preferably automatically, and placed into a first oven, in which the corrosion protection paint is being thermally cured, in particular completely cured. Preferably, the corrosion protection paint is based on or consist of an epoxy resin. Afterwards, the body element is then removed from the first oven, preferably automatically, and fed to the robot-assisted sealing process according to the invention. In this case, when applying the sealant to the edge area of the body element bordering the hole, the sealant is directly applied to the previously cured coating layer of corrosion protection paint covering the edge area of the body element. However, when being part of the higher-level painting process, prior to completely curing the pre-cured sealant covering the hole, the body element comprising the coating of the previously cured corrosion protection paint and the pre-cured sealant is first coated with a colored base paint. In the context of the invention, the term "colored" also includes the achromatic colors "white" and "black". Afterwards a clear paint coat may preferably be disposed directly onto the layer of the colored base paint, in order to provide further protection against physical, mechanical and chemical influences. Finally, the body element is then brought into a second oven, i.e. the paint oven and is being subjected to heat, so that the sealant as well as the painting layers are completely cured. The integration of the sealing method according to the invention into the painting method has several favorable synergetic effects. First of all, thanks to the automated hole sealing according to the invention, it is now possible for the first time to completely automate the entire painting process. Furthermore, there is a particular advantage when both the corrosion protection paint and the second component of the sealant are based on an epoxy resin. In this way, a particularly good adhesion of the sealant film to the body element is achieved.

[0029] The invention also relates to a robot-assisted applicator for applying a sealant, preferably in the form of a liquid, a pasty mass or a film, over a hole in a body element of a vehicle, comprising an application unit and a radiation unit, wherein the application unit comprises a flat die for spreading the sealant over the width of the hole and the adjacent edge sections opposite to each other in the width direction and wherein the radiation unit comprises a UV and/or IR radiation source, the radiation unit being arranged relative to the flat die such that the radiation unit is directed with respect to the direction of radiation towards the die and/or towards an area immediately adjacent to the die outlet.

[0030] The robot-assisted applicator according to the invention basically permits two advantageous process designs. On the one hand, the sealant can be applied in liquid form or as a pasty mass. In this case, the radiation unit is directed with respect to the direction of radiation to an area immediately adjacent to the die outlet, so that the sealant continuously conveyed from the die outlet is applied in such a way that it is deposited in suspension above the hole and precured to form a film immediately after exiting the die outlet. This embodiment has the advantage that the sealant can wet the edge area bordering the hole while it is still at least partially liquid before precuring is complete. It has been shown that with this embodiment, the bond between the sealant film and the edge area is stronger after pre-curing and complete curing of the sealant.

[0031] In addition, the robot-assisted applicator permits processing in which the sealant is already pre-cured inside the die. For this purpose, it is preferably provided that the radiation unit is directed towards the die with respect to the direction of the emitted radiation. Furthermore, it may be advantageous for the die to have, on the radiation side, a wall section with a material that is permeable to the emitted radiation. The pressing means can preferably be formed at the die outlet as a lip, profile or roll arranged transversely, in particular at right angles, to the conveying direction of the sealant. In particular, the pressing means is formed as a transverse strip made of plastic or metal, as a rubber lip, a roll and/or as an element formed in the manner of a doctor blade.

[0032] This embodiment has the advantage that, on the one hand, overhead application of the already precured sealant film is possible. On the other hand, it is also advantageous that the film cannot collapse into the hole during application, even at low traversing speeds of the applicator.

[0033] In order to provide any of said processing options, the radiation unit is configured to change the radiation angle of the radiation to be emitted. For this purpose, the radiation unit or a part of the radiation unit, in particular the radiation source, can be configured to be pivotable. Alternatively, the angle of the radiation is set. In this case, different applicators having radiation angles adapted to the specific processing can be provided.

[0034] According to a preferred embodiment of the invention, the radiation source comprises a plurality of UV-LEDs. Advantageously, LEDs provide the necessary intensity of UV-radiation at a comparably low energy consumption and a longer life span. It is further preferred that the plurality of UV-LEDs is provided in the form of a circular, semi-circular or linear LED bar. Preferably, the LED bar further comprises cooling means, in particular a cooling profile made of metal at the back of the bar. Preferably, the LED bar is pivotably supported by the radiation unit, so that the die itself and a region immediately adjacent to the die outlet can be targeted by the emitted radiation in order to promote applicating the sealant in different states, i.e. liquid, pasty or as a film.

[0035] Preferably, the UV-LEDs are adapted to emit UV-radiation in the wavelength range from 365 nm to 405 nm, in order to provide the necessary trigger radiation for the preferred initiators of the first component of the sealant.

[0036] According to a preferred feature of the invention, the radiation unit is attached to the application unit and arranged at a distance from the flat die. In particular, the distance is set so that the emitted radiation has to cover a path of 2 cm to 10 cm in order to interact with the sealant. Preferably, the radiation unit is attached to the application unit and arranged at a distance from the flat die by means of an elongated spacer. The elongated spacer may preferably be formed as a metal profile.

[0037] The robot-assisted applicator is preferably adapted to be mounted onto and be operated by a jointed-arm robot.

[0038] The invention further relates to a robot comprising a robot-assisted applicator according to the invention and two robot-arms, each of which is movably linked to the other at one end, wherein the applicator is movably attached to one of the arms at the other end of said arm.

[0039] Preferably, the robot is a jointed-arm robot, in particular a six-axis jointed-arm robot. In addition, the robot, in particular the six-axis jointed-arm robot, provides means, in particular conduits, for conducting the sealant in liquid or paste form from a sealant tank to the applicator according to the invention. For this purpose, the conduit system of the robot is fluidically connected to the sealant conduits of the applicator.

[0040] The invention is illustrated below by means of detailed embodiments.

Fig.1 shows a robot-assisted applicator according to a first embodiment of the invention;

Fig.2 shows a robot-assisted applicator according to a second embodiment of the invention.

[0041] Figure 1 shows a robot-assisted applicator 1, comprising an application unit 2 and a radiation unit 3, on its way passing over a hole 7 to be sealed.

[0042] The application unit 2 has a flat die 4 for applying sealant 5. The radiation unit 3 has a radiation source not shown in the form of a linear UV LED bar.

[0043] The radiation unit 3 is connected to the application unit 2 via an elongated spacer 6. The radiation unit 3 is arranged at a distance from the flat die via the spacer 6.

[0044] In the present example, the radiation unit 3 is arranged at a fixed angle to the flat die 4, so that the emitted radiation irradiates an area which directly adjoins the outlet of the flat die 4 in the conveying direction of the sealant 5.

[0045] The flat die 4 is used to continuously apply sealant 5 over the hole 7 formed in a body element of a vehicle as well as the edge area 8 laterally delimiting the hole 7.

[0046] For this purpose, the robot-assisted applicator 1, together with the application unit 2 and the radiation unit 3, travels over the entire hole 7 and the edge area 8 at a predefinable speed.

[0047] On its way over the hole 7 and the edge area 8, sealant 5 is continuously conveyed out of the outlet 9 of the flat die 4 as a liquid and immediately afterwards continuously pre-cured by means of UV radiation to a self-supporting film, adhesively attached to edge area 8.

[0048] During the pre-curing process, a first component of the sealant is polymerized in a radical polymerization process initiated by UV radiation to form a first three-dimensional network. The first component comprises an acrylate and/or methacrylate monomer system.

[0049] Figure 2 shows a robot-assisted applicator 1, comprising an application unit 2 and a radiation unit 3, on its way passing over a hole 7 to be sealed.

[0050] The application unit 2 has a flat die 4 for applying sealant 5. The radiation unit 3 has a radiation source not shown in the form of a linear UV LED bar.

[0051] The radiation unit 3 is connected to the application unit 2 via an elongated spacer 6. The radiation unit 3 is arranged at a distance from the flat die via the spacer 6.

[0052] In the present example, the radiation unit 3 is arranged at a fixed angle to the flat die 4, so that the emitted radiation irradiates a region of the flat die 4 which is located upstream of the outlet 9 of the flat die 4 in the conveying direction of the sealant 5.

[0053] As a result, the sealant 5 is already pre-cured in the flat die 4 and leaves the outlet 9 of the flat die 4 in the form of a self-supporting film.

[0054] To improve the interaction between radiation and sealant 5, the flat die 4 has a window on the radiation unit side, which is not shown and is formed from a material that is permeable to UV radiation.

[0055] In addition, the outlet 9 of the flat die 4 has a rubber lip which is not shown. The rubber lip is arranged at right angles to the direction of flow of the sealant 5 at the outlet 9. The rubber lip is used to press and bond the sealant 5 in the form of the self-supporting film to the edge area 8

[0056] The flat die 4 is used to continuously apply sealant 5 over the hole 7 formed in a body element of a vehicle as well as the edge area 8 laterally delimiting the hole 7.

[0057] For this purpose, the robot-assisted applicator 1, together with the application unit 2 and the radiation unit 3, travels over the entire hole 7 and the edge area 8 at a predefinable speed.

[0058] During the pre-curing process, a first component of the sealant is polymerized in a radical polymerization process initiated by UV radiation to form a first three-dimensional network. The first component comprises an acrylate and/or methacrylate monomer system.

[0059] Irrespective of the pre-curing options shown in the two embodiment examples, the body element, which comprises the hole 7 delimited by the edge area 8, is further treated in the same way after the sealant application and pre-curing have been completed. The further treatment serves to completely cure the pre-cured sealant film 5, whereby the hole 7 is sealed fluid-tight and the mechanical properties of the sealant film are improved.

[0060] For this purpose, the body element is placed in an oven and heated to a predeterminable temperature for a predeterminable period of time. The second component of the sealant 5 is then polymerized by heat to form a second three-dimensional network. The polymerization reaction of the second component is based on a heat-initiated polyaddition mechanism.

[0061] Due to the fact that at the time the second network is formed from the second component, the first network from the first component is already substantially completely formed, an interpenetrating three-dimensional network is formed from the first and the second network. This further improves the sealing and adhesive properties as well as the mechanical stability of the sealant film 5.

Reference Numbers

[0062]

1 Robot-assisted applicator
2 Application unit
3 Radiation unit
4 Flat die
5 Sealant (film)
6 Spacer
7 Hole
8 Edge area
9 Flat die outlet

Claims

1. Method for an at least partially automated fluid-tight sealing of a hole in a body element of a vehicle in which

a. a sealant is continuously applied to the hole and an edge area of the body element bordering the hole, preferably in the form of a liquid, a pasty mass or a self-supporting film, by means of a robot-assisted applicator;

b. the sealant is continuously pre-cured during its application, by means of the robot-assisted applicator, so that the sealant is provided with mechanical self-supporting capacity;

c. the pre-cured sealant is being completely cured with the supply of heat to form a liquid-tight sealing.

2. Method according to claim 1, **characterized in that** the pre-curing is conducted by electromagnetic radiation, in particular UV- and/or IR-radiation, by means of the robot-assisted applicator having a source of electromagnetic radiation.

3. Method according to claims 1 or 2, **characterized in that** the sealant is applied over the hole in such a way that the sealant forms a film, preferably a self-supporting film, at least in the area of the hole.

4. Method according to claims 1 to 3, **characterized in that** the sealant being an adhesive composition comprising a first curable component and a second curable component.

5. Method according to claim 4, **characterized in that** pre-curing comprises that only the first curable component is being at least partially cured, in particular by means of UV- and/or IR-radiation.

6. Method according to claim 5, **characterized in that** during the step of completely curing, the second curable component is being cured, wherein an interpenetrating network is formed with the already at least partially cured first curable component.

7. Method according to any of the claims 1 to 6, **characterized in that** the edge area of the body element bordering the hole comprises a coating of a previously cured corrosion protection paint, preferably based on an epoxy resin, wherein the sealant is applied onto said coating.

8. Method according to claim 7, **characterized in that** prior to completely curing the pre-cured sealant, the body element comprising the coating of the previously cured corrosion protection paint and the pre-cured sealant is first coated with a colored base paint and afterwards with a clear paint coat, wherein the body element is then brought into a paint oven and subjected to heat, so that the sealant as well as the painting layers are completely cured.

9. Robot-assisted applicator for applying a sealant, preferably in the form of a liquid, a pasty mass or a self-supporting film, over a hole in a body element of a vehicle, comprising an application unit and a radiation unit, wherein the application unit comprises a flat die for spreading the sealant over the width of the hole and the adjacent edge area and wherein the radiation unit comprises a UV and/or IR radiation source, the radiation unit being arranged relative to the flat die such that the radiation source is directed with respect to the direction of radiation towards the flat die and/or towards an area immediately adjacent to the die outlet.

10. Robot-assisted applicator according to claim 9, **characterized in that** the radiation source comprises a plurality of UV-LEDs.

11. Robot-assisted applicator according claim 10, wherein the plurality of UV-LEDs is provided as a semi-circular or a linear LED bar.

12. Robot-assisted applicator according to claims 9 or 10, wherein the radiation unit is attached to the application unit and arranged at a distance from the flat die by means of an elongated spacer.

13. Robot-assisted applicator according to claim 9 to 12, **characterized in that** the outlet of the flat die comprises a pressing means.

14. Robot-assisted applicator according to claim 11, **characterized in that** the pressing means is formed as a transverse strip made of plastic or metal, as a rubber lip, a roll and/or as an element formed in the manner of a doctor blade.

15. Robot comprising a robot-assisted applicator according to claims 9 to 14 and two robot-arms, each of which is movably linked to the other at one end, wherein the applicator is movably attached to one of the arms at the other end of said arm.

Fig.1

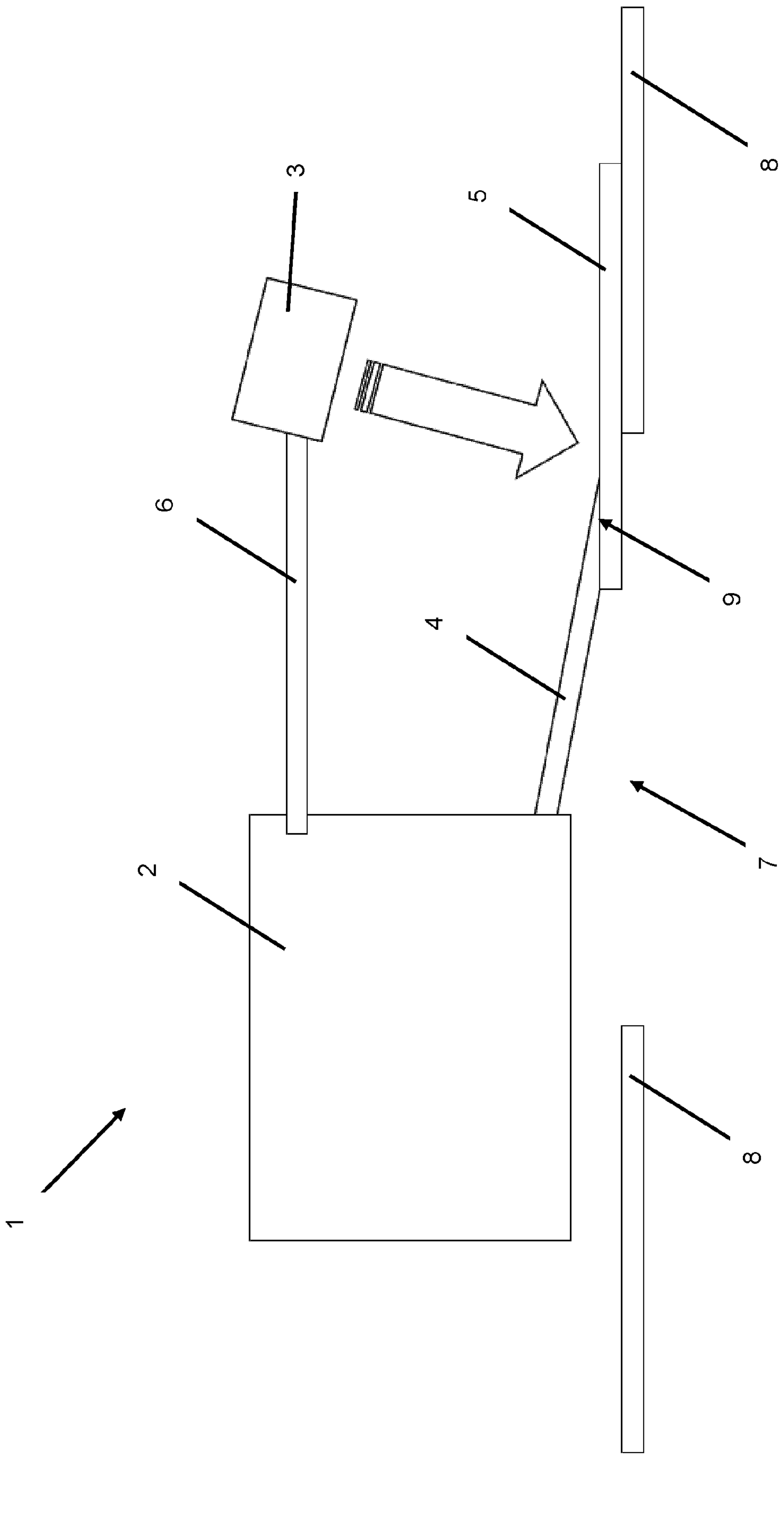
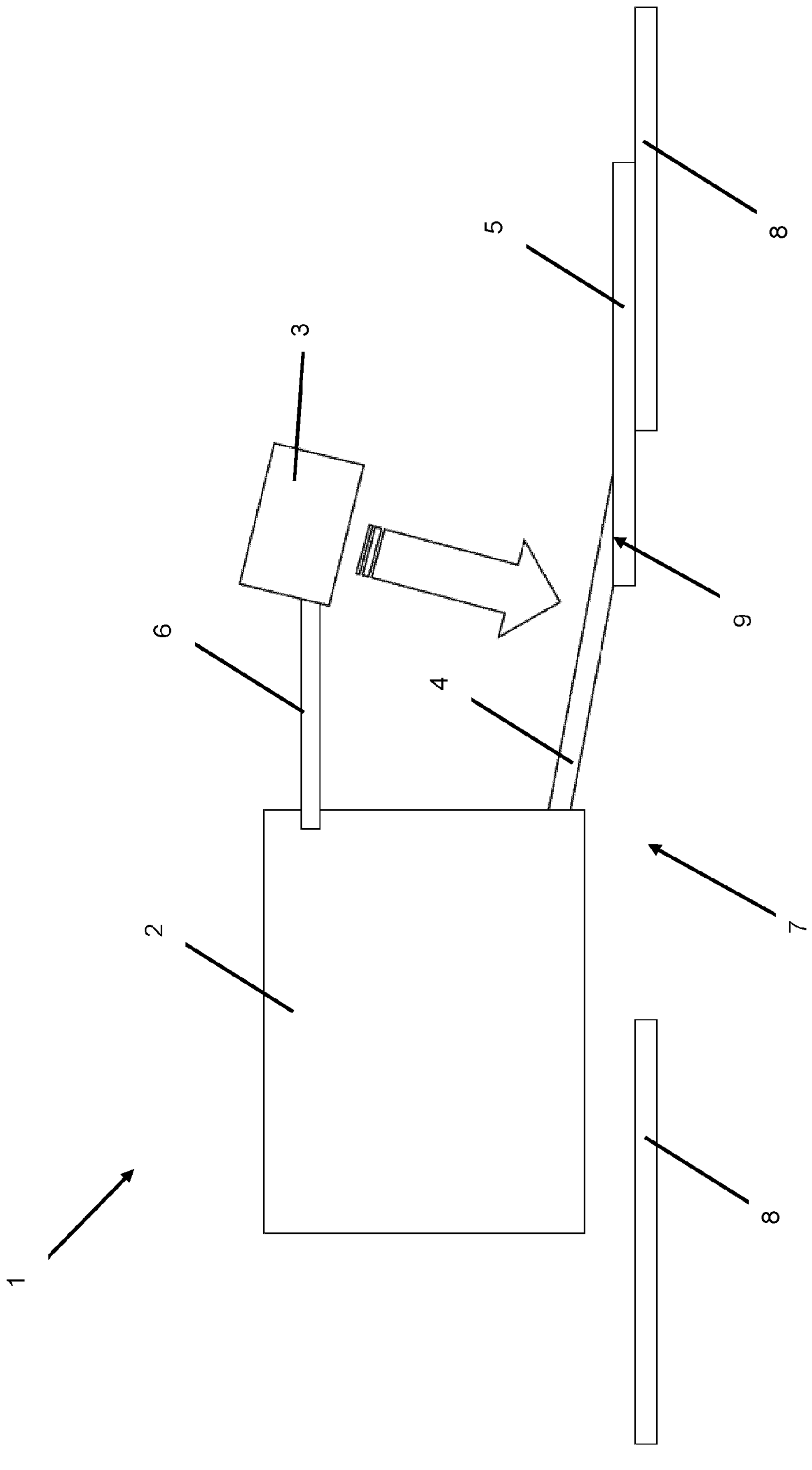


Fig. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 5013

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search	Date of completion of the search	Examiner
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X : particularly relevant if taken alone
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