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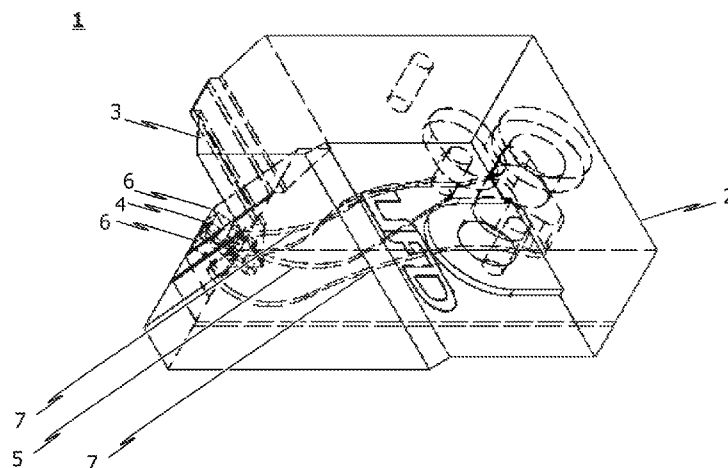


FIG. 3

(57) Abstract: The invention relates to a nozzle arrangement (1) for applying fluids, in particular thermoplastic adhesives, to a substrate, wherein the nozzle arrangement (1) has a main body (2) which is able to be connected, preferably exchangeably, to a mounting region of a distributor and which has an end-side side surface (3), wherein, in or on the end-side side surface (3) of the main body (2), there is provided at least one first outlet nozzle (4) for the fluid to be applied to the substrate, wherein, in the main body (2), there is formed a first fluid channel system (5), via which the at least one first outlet nozzle (4) is connected in terms of flow to a first fluid connector, which is provided in the main body (2) of the nozzle arrangement (1), wherein the nozzle arrangement (1) is a monolithic component produced by an additive production method.

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NOZZLE ARRANGEMENT FOR APPLYING FLUIDS, AND
METHOD FOR PRODUCING A MAIN BODY OF SUCH A NOZZLE
ARRANGEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Patent Application No. 16/814,650, filed 10-March-2020, which claims priority to DE patent application 10 2019 106 163.6 pursuant to 35 U.S.C. § 119 and 37 C.F.R. § 1.55, which was filed on 11-March-2019, and the entire disclosure of which is incorporated herein by reference.

BACKGROUND

Technical Field.

[0002] The invention relates in general to the applying of fluids, including thermoplastic or fibrous adhesives, to a substrate through at least one nozzle arrangement which is preferably releasably secured to a mounting surface of a distributor or a distributor head.

[0003] The distributor or distributor head generally serves for supplying the fluid being applied to the at least one nozzle arrangement. The purpose of such a system is to apply fluids to substrates which are moving for example relative to the at least one nozzle arrangement, in particular to apply adhesives in partial spraying patterns for the partial covering of a substrate.

Discussion of Art.

[0004] Document EP 0 872 580 A discloses for example a plurality of melt blowing nozzle arrangements or nozzles which can be secured, side by side, to one or both ends of a conventional distributor or distributor head, which ensures a metered supplying of adhesive to each nozzle arrangement. The nozzle arrangements each comprise a plurality of substantially parallel plate elements, forming a row of adhesive dispensing openings on

an exit surface. The row of fluid outlet openings of each nozzle arrangement forms a section of a longer row, formed by the plurality of adjacent nozzle arrangements, which are situated along a common end of the distributor head. One or both sides of the distributor can be secured next to the side of a similarly constructed distributor head in order to form even longer rows of fluid outlet openings, thereby providing a modular melt blowing adhesive dispensing system to accommodate substrates of any dimensional width.

[0005] The nozzle arrangements considered here have a very compact design. In particular, it is desirable to accommodate in the main body of the nozzle arrangement the highest possible number of outlet nozzles for the fluid being applied to the substrate and/or for other fluids, such as shaping air. In this way, an extremely flat and uniform application of fluids to the substrate surface is possible.

[0006] However, the number of outlet nozzles per main body of a nozzle arrangement cannot be increased arbitrarily, since a fluid channel system needs to be formed for each outlet nozzle inside the main body, in order to connect the outlet nozzle fluidically to a fluid port, likewise provided on the main body of the nozzle arrangement. This fluid port on the main body of the nozzle arrangement can be connected to a complementary port of a distributor or distributor head when the nozzle arrangement is mounted in the mounting region of the distributor/distributor head.

[0007] FIG. 1 shows part of a conventional nozzle arrangement known from the prior art, revealing the laminated construction.

[0008] FIG. 2 shows the nozzle assembly of FIG. 1 in an exploded view.

[0009] Specifically, it will be noticed in FIG. 1 and 2 that the conventional nozzle arrangement 100 is formed from a number of individual plates 101.1 to 101.6, which are joined flush with each other in the assembled state (see FIG. 1). For this, a pin element may be used, for example, which is inserted through a corresponding hole 102 or through a corresponding opening in the individual plates 101.1 to 101.6 and holds the individual plates 101.1 to 101.6 together.

[0010] Recesses or holes 103 to 107 are provided in the individual plates 101.1 to 101.6, which in the assembled state form a fluid channel system in the main body 101 of the nozzle arrangement 100, in order to connect the individual outlet nozzles 108 at one end face of the nozzle assembly fluidically to the fluid port on the main body 101 of the nozzle assembly.

[0011] With the aid of the drawings in FIG. 1 and 2 it can be seen that the laminated construction of the nozzle arrangement 100 does not allow the forming of arbitrarily designed fluid channel systems inside the main body 101. Furthermore, the number of individual fluid channel systems in the main body 101 of the nozzle arrangement 100 is limited, as is the number of individual outlet nozzles 108, 109 on the end-side lateral surface of the main body 101, serving to dispense an adhesive or to dispense shaping air and being arranged alternating with each other in a row.

BRIEF DESCRIPTION

[0012] Based on this statement of the problem, the problem which the present invention proposes to solve is to modify a nozzle arrangement of the kind mentioned above so that a larger number of outlet nozzles and/or a more complex fluid channel system can be provided in the main body of the nozzle arrangement.

[0013] In particular, a solution should be provided with which the fluid channel systems formed in the main body of the nozzle arrangement can be adapted to the particular application as optimally as possible. Optimal means in this context that the fluid channel systems being formed inside the main body have a configuration such that the flow resistance in particular can be reduced.

[0014] This problem is solved according to the invention by the subject matter of the independent patent claim 1, which concerns a nozzle arrangement for the applying of fluids, especially thermoplastic adhesives, to a substrate.

[0015] The nozzle arrangement according to the invention comprises – like the nozzle arrangements of this kind that are known in the prior art – a main body which is able to be connected, preferably exchangeably, to a mounting region of a distributor or distributor head and having an end-side lateral surface. In or on the end-side lateral surface of the main body there is provided at least one and preferably a plurality of first outlet nozzles for the fluid to be applied to the substrate.

[0016] Furthermore, it is provided according to the invention that there is formed in the main body a first fluid channel system, via which the at least one first outlet nozzle is connected fluidically to a first fluid port, which is provided in the main body of the nozzle arrangement.

[0017] Unlike the nozzle arrangements known in the prior art, it is provided according to the invention that the nozzle arrangement is a monolithic component produced by an additive manufacturing method.

[0018] Accordingly, a traditional laminated construction of the nozzle arrangement is deliberately avoided in the present case. Instead, it is proposed to form at least the main body of the nozzle arrangement together with the fluid channel system provided in the main body and together with the at least one outlet nozzle provided on or in the end face of the main body with the aid of an additive manufacturing method.

[0019] This allows for significantly more complex geometries and configurations, especially for the at least one first fluid channel system inside the main body. Moreover, significantly more complex structures can be realized and a significantly larger number of outlet nozzles at or in the end face of the main body, given the same geometrical dimensions of the main body.

[0020] As a further advantage, it should be mentioned in particular that even complex fluid channel systems can be realized inside the main body with the aid of the additive manufacturing method. Such complex fluid channel systems may have at least partially three-dimensional curved fluid channel sections.

[0021] In other words, with the present invention the fluid channel systems inside the main body of the nozzle arrangement can be optimally adapted to the particular application. Thanks to the possibility of forming three-dimensional curved fluid channel sections inside the main body of the nozzle arrangement, the flow behavior of the fluid being supplied through the main body can also be adapted or optimized, especially in regard to the least possible flow resistance.

[0022] According to embodiments of the present invention, in or on the end-side lateral surface of the main body there is provided at least one second outlet nozzle and preferably a plurality of second outlet nozzles for the purpose of dispensing shaping air in a targeted manner in order to influence, for example, the direction of a fluid jet discharged from the at least one first outlet nozzle. The at least one second outlet nozzle is connected fluidically to a second fluid port, which is provided on the main body of the nozzle arrangement, via a second fluid channel system formed in the main body.

[0023] Thanks to the additive manufacturing method it is possible for the second fluid channel system to also have at least one fluid channel section formed in a partially three-dimensionally curved manner and thus to optimize the supply of fluid to the second outlet nozzle especially in terms of the expected flow resistance.

[0024] The additive manufacturing method by which the nozzle arrangement is created, according to realizations of the solution according to the invention, has the step of determining three-dimensional information about the main body, wherein the main body contains the at least one first and/or at least one second outlet nozzle, and the first and/or second fluid channel system is formed integrally in the main body.

[0025] The additive manufacturing method has the further step of converting the three-dimensional information into a plurality of layers, these layers defining the cross-sectional layers of the main body. At least one empty space within at least one of the layers is defined, which defines the first and/or second fluid channel system.

[0026] Finally, each layer of the main body is formed in succession, in particular by melting a metallic powder using laser energy and/or electrode beam energy.

[0027] Of course, however, it is also conceivable that the individual layers of the main body are formed from another material, such as ceramic material or plastic material.

[0028] Preferably, a laser sintering method or a direct metal laser sintering (DMLS) method is used during the additive manufacturing method.

[0029] The successive forming of each layer of the main body by melting a metallic powder using laser energy moreover involves, according to modifications of the solution according to the invention, a melting of a metallic powder comprising at least one of cobalt-chromium, HS188 and INCO625.

[0030] Alternatively or additionally, the successive forming of each layer of the main body by melting a metallic powder using laser energy can moreover involve a melting of a metallic powder having a particle size between approximately 10 μm and approximately 75 μm , preferably between approximately 15 μm and approximately 30 μm .

[0031] According to one preferred realization of the nozzle arrangement according to the invention, an extension region is formed by the additive manufacturing method on the end-side lateral surface of the main body, in which the at least one first outlet nozzle is formed, wherein the extension region and the at least one first outlet nozzle are formed such that the outlet opening of the at least one first outlet nozzle is at a distance from the end-side lateral surface of the main body, and wherein a main flow axis which is predefined by the at least one first outlet opening, along which the fluid is discharged from the at least one first outlet nozzle, makes an acute angle with the end-side lateral surface of the main body.

[0032] This modification of the nozzle arrangement according to the invention is in particular an optimized nozzle arrangement for the applying of fluids, especially thermo-

plastic adhesives, to substrates having a correspondingly complex geometry and therefore requiring a corresponding application method.

[0033] Because of the fact that the nozzle arrangement in this embodiment is provided with a corresponding extension region in which the at least one first outlet nozzle is formed, the nozzle arrangement, especially when it is arranged [in] a distributor head carried on a robot arm, can also be used in flexible manner in areas of complex geometry without the danger of the nozzle arrangement or the distributor head coming into contact with areas of the substrate being coated.

[0034] Moreover, it is ensured that the nozzle outlet opening of the at least one first outlet nozzle always maintains the given distance from the surface of the area of the substrate being coated. In particular, the special geometry of the nozzle arrangement with the extension region allows the nozzle arrangement to also be swiveled and turned relative to the substrate being coated or the area of the substrate being coated, which is necessary for a uniform wetting of the area with the fluid, especially the thermoplastic adhesive.

[0035] According to preferred realizations of the last mentioned embodiment of the nozzle arrangement according to the invention, it is provided in particular that – looking in plan view – the main body of the nozzle arrangement is at least substantially rectangular. Moreover, it is provided that – likewise looking in plan view – the extension region of the nozzle arrangement is at least substantially trapezoidal or triangular, especially trapezoidal, and is connected by its longer base side to the end face of the main body.

[0036] Because of the fact that the main body in this embodiment – as in the prior art – has an at least substantially rectangular configuration (again in plan view), the nozzle arrangement can again be connected to the mounting region of the distributor head without requiring design changes to the mounting region or to the distributor head. The same also holds for the fluid distribution system which is provided by the distributor head and which is provided by a corresponding intersection region with the fluid channel system integrated in the main body of the nozzle arrangement.

[0037] In modification of the last mentioned embodiment it is provided in particular that one leg of the especially trapezoidal extension region in plan view is flush with a lateral surface of the main body. Alternatively or additionally, it can be provided that the at least one outlet opening is formed in one leg of the especially trapezoidal extension region in plan view, situated opposite the leg which is flush with the lateral surface of the main body of the nozzle arrangement.

[0038] These modifications are especially easy to realize, yet still effective solutions for designing the nozzle arrangement according to the invention so that even particularly complex geometrical regions of the substrate being coated can effectively arrive in the area of the at least one first outlet nozzle of the nozzle arrangement without any contact occurring between the nozzle arrangement or the distributor or distributor head and the substrate.

[0039] According to the invention, it is provided that the entire nozzle arrangement is a monolithic component created by an additive manufacturing method. In other words, all structural features of the nozzle arrangement are formed integrally in the main body of the nozzle arrangement. The integral design has the advantage that the entire nozzle arrangement and especially the orientation of the at least one first outlet nozzle or the outlet opening of the at least one first outlet nozzle and the corresponding fluid channel system in the interior of the main body of the nozzle arrangement can be produced with high precision and only extremely small tolerances.

[0040] All in all, the configuration of the nozzle arrangement according to the invention as a monolithic nozzle subassembly makes possible a compact nozzle arrangement in which all necessary functionalities are integrated.

[0041] According to realizations of the solution according to the invention, it is provided that the nozzle arrangement is produced by means of 3D printing. In particular, the laser sintering method or microlaser sintering, also known as selective laser melting (SLM), can be used here. Thanks to this manufacturing method, the at least one first fluid

channel system inside the main body of the nozzle arrangement can have a curved configuration in multiple planes, in order to achieve perfect flows. Further-more, no mounting of the first outlet nozzle on the main body of the nozzle arrangement is necessary, since the latter is also integrated with the main body of the nozzle arrangement. In this way, every possible assembly error and every tolerance discrepancy due to the assembly process can be prevented.

[0042] In the former laminar designed nozzle (prior art), a metallic sealing is accomplished only by screwing together the individual nozzle plates by the outer clamping plates. It is a constant challenge in this case to put enough screws in place to achieve an adequate surface pressure. This also means a design limitation, since no glue and/or air channels can be placed in the position of the screws (and additional positioning pins). Minimum distances from the screw boreholes also have to be maintained in order to achieve the sealing. Leakage also occurs constantly in the case of newly designed nozzles.

[0043] According to one aspect of the present invention, it is provided that the fluid, especially the thermoplastic adhesive, can be dispensed with the at least one first outlet nozzle in a predetermined event sequence. In particular, the nozzle arrangement according to the invention is suitable for dispensing the fluid (that is, the thermoplastic adhesive) with a pattern, especially an oscillating pattern.

[0044] For this, it is provided according to embodiments of the nozzle arrangement according to the invention that the outlet opening of the at least one first outlet nozzle of the nozzle arrangement is preferably coordinated with a plurality of fluid openings of second outlet nozzles, where these fluid openings dispense forming or deflecting air, in order to specifically deflect the fluid dispensed from the outlet opening of the at least one first outlet nozzle from the main flow axis. The plurality of the (additional) fluid openings, which are provided by the second outlet nozzles and which serve for dispensing corresponding forming or deflecting air, may be slanted to converge on the main flow axis of the outlet opening of the first outlet nozzle.

[0045] The invention is not confined to nozzle arrangements having a corresponding extension region for example at the end-side lateral surface of the main body. Instead, the invention is especially suitable for all nozzle arrangements having a relatively complex construction, and/or requiring an elevated number of outlet nozzles (first and/or second outlet nozzles).

[0046] The invention moreover relates to a corresponding method for producing a main body of a nozzle arrangement for applying fluids, in particular thermoplastic adhesives, to a substrate, wherein the main body has at least one first outlet nozzle and preferably at least one second outlet nozzle, and wherein, in the main body, there are/is formed at least one first fluid channel system and/or at least one second fluid channel system, via which the at least one first and/or at least one second outlet nozzle are/is connected fluidically to a first and/or second port on the main body of the nozzle arrangement.

[0047] Exemplary embodiments of the solution according to the invention will be described more closely below, making reference to the enclosed drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0048] FIG. 1 schematically, a conventional nozzle arrangement with a laminated construction, known in the prior art;

[0049] FIG. 2 schematically, the nozzle arrangement known in the prior art per FIG. 1 in an exploded view;

[0050] FIG. 3 schematically and in a partially see-through isometric view, an exemplary embodiment of the nozzle arrangement according to the invention;

[0051] FIG. 4 schematically and in a plan view, the exemplary embodiment of the nozzle arrangement according to the invention per FIG. 3; and

[0052] FIG. 5 schematically and in a partially see-through isometric view, another exemplary embodiment of the nozzle arrangement according to the invention.

DETAILED DESCRIPTION

[0053] FIG. 1 shows part of a conventional nozzle arrangement 100 known in the prior art, revealing the laminated construction.

[0054] FIG. 2 shows the nozzle arrangement 100 of FIG. 1 in an exploded view.

[0055] Specifically, it can be seen in FIG. 1 and 2 that the conventional nozzle arrangement 100 is composed of a plurality of individual plates 101.1 to 101.6, which are joined flush with each other in the assembled state (see FIG. 1). For this, a pin element can be used, for example, which is inserted through a corresponding hole 102 or through a corresponding opening in the individual plates 101.1 to 101.6 and holds the individual plates 101.1 to 101.6 together.

[0056] Various recesses or holes 103 to 107 are provided in the individual plates 101.1 to 101.6, which in the assembled state form a fluid channel system in the main body 101 of the nozzle arrangement 100, in order to connect the individual outlet nozzles 108 at one end face of the nozzle assembly fluidically to a fluid port on the main body 101 of the nozzle assembly.

[0057] It can be seen from the representations in FIG. 1 and 2 that the laminated construction of the nozzle arrangement does not allow the forming of arbitrarily designed fluid channel systems inside the main body 101. Furthermore, the number of individual fluid channel systems in the main body 101 of the nozzle arrangement 100 is limited, as is the number of individual outlet nozzles 108 on the end-side lateral surface of the main body 101.

[0058] In order to accomplish a larger number of outlet nozzles 108 and/or a more complex fluid channel system in the main body 101 of the nozzle arrangement 100 – as

com-pared to the nozzle arrangements 100 known in the prior art – it is proposed according to the invention that the nozzle arrangement is a monolithic component generated by an additive manufacturing method.

[0059] An exemplary embodiment of the nozzle arrangement 1 according to the invention is shown in FIG. 3 (in a partly see-through isometric view) and in FIG. 4 (in a plan view).

[0060] Briefly summarized, the exemplary embodiment of the nozzle arrangement 1 according to the invention shown schematically in FIG. 3 and FIG. 4 is a monolithic component generated by an additive manufacturing method.

[0061] The nozzle arrangement 1 comprises a main body 2 having an end-side lateral sur-face, which is able to be connected, preferably exchangeably, to a mounting region of a distributor or distributor head and having in or on the end-side lateral surface 3 of the main body 2 at least one first outlet nozzle 4 for a fluid to be applied to a substrate with the aid of the nozzle arrangement 1.

[0062] Furthermore – as can be seen in particular from the representation in FIG. 3 – there is formed in the main body 2 of the nozzle arrangement 1 a first fluid channel system 5, via which the at least one first outlet nozzle 4 is connected fluidically to a first fluid port, which is provided in the main body 2 or on the main body 2 of the nozzle arrangement 1.

[0063] Moreover, it can be seen from the representation of FIG. 3 that in or on the end-side lateral surface 3 of the main body 2 there is provided at least one further second outlet nozzle 6 for the purpose of dispensing shaping air in a targeted manner via this at least one second outlet nozzle 6 in order to influence, as needed, the direction of a fluid jet discharged from the at least one first outlet nozzle 5.

[0064] It is likewise seen from the partly see-through representation of FIG. 3 that the at least one second outlet nozzle 6 for shaping air is connected fluidically by a second

fluid channel system 7 formed in the main body 2 to a second fluid port provided on the main body 2 of the nozzle arrangement 1.

[0065] Thanks to the additive manufacturing method with which at least the main body 2 of the nozzle arrangement 1 is produced, it is possible for the first fluid channel system 5 and the at least one further, second fluid channel system 7 to have at least fluid channel sections formed in a partially three-dimensionally curved manner, as can likewise be seen from the representation of FIG. 3.

[0066] The exemplary embodiment of the nozzle arrangement 1 according to the invention that is shown in FIG. 3 and 4 is a nozzle arrangement 1 designed in particular to apply fluids, such as thermoplastic adhesives, to substrates with a correspondingly complex geometry.

[0067] For this purpose, an extension region 10 is formed on the end-side lateral surface 3 of the main body 2 of the nozzle arrangement 1, in which the at least one first outlet nozzle 4 for the fluid being applied to the substrate is formed. The extension region 10 and the first outlet nozzle 4 are formed such that the outlet opening of the first outlet nozzle 5 is at a distance from the end-side lateral surface 3 of the main body 2 of the nozzle arrangement 1.

[0068] Moreover, it may be provided that a main flow axis which is predefined by the outlet opening of the first outlet nozzle 5, along which the thermoplastic adhesive material is discharged from the first outlet nozzle 5, makes an acute angle with the end-side lateral surface 3 of the main body 2.

[0069] In the exemplary embodiment of the nozzle arrangement 1 according to the invention shown in FIG. 3 and FIG. 4 it is provided in particular that – looking in plan view – the main body 2 of the nozzle arrangement 1 is at least substantially rectangular, and that – likewise looking in plan view – the extension region 10 is at least substantially trapezoidal, and is connected by its longer base side to the end face of the main body 2.

Specifically, one leg of the trapezoidal extension region 10 in plan view is flush with a lateral surface 3 of the main body 2.

[0070] Moreover, it is provided that the at least one outlet opening of the first outlet nozzle 5 is formed in one leg of the trapezoidal extension region 10 as seen in plan view, situated opposite the leg which is flush with the lateral surface 3 of the main body 2.

[0071] In the nozzle arrangement 1 according to the invention, the extension region 10 together with the at least one first outlet nozzle 4 in the extension region 10 and together with the rest of the main body 2 of the nozzle arrangement 1 is formed as a monolithic component with the aid of an additive manufacturing method.

[0072] Thus, corresponding fluid channel systems 5, 7 can be formed in especially simple manner in the main body 2 and in the extension region 10 of the nozzle arrangement 1, which are fluidically connected to the first outlet nozzle 5 and/or to the second outlet nozzles 6 of the nozzle arrangement 1.

[0073] As already indicated and as can be seen schematically in FIG. 3, the outlet opening of the first outlet nozzle 4 is associated with one and preferably with a plurality of further fluid openings, whose main axis along which a fluid (especially pressurized air) is dispensed from the further fluid openings is slanted in the direction of the main flow axis of the outlet opening of the first outlet nozzle 4. Moreover, it is provided that the fluid openings of the second outlet nozzle 6 are offset in regard to the outlet opening of the first outlet nozzle 4 in the direction of the lateral surface 3 of the extension region 10 on or in which the outlet opening of the first outlet nozzle 4 is formed.

[0074] With the aid of these fluid openings of the second outlet nozzle 6, it is possible to steer compressed air in the direction of the jet of thermoplastic adhesive dispensed by the first outlet nozzle 5, and thereby deflect the jet of adhesive as needed. In particular, in this way it is possible to deflect the jet of adhesive dispensed through the first outlet nozzle 4 periodically from the main flow axis, for example in order to form an Omega-shaped pattern of the jet of adhesive applied to the substrate.

[0075] FIG. 5 shows schematically and in a partly see-through isometric view a further exemplary embodiment of the nozzle arrangement 1 according to the invention. This nozzle arrangement 1 corresponds substantially in structural and functional respects to the nozzle arrangement 1 of FIG. 3; however, the representation of FIG. 5 shows the fluid channel systems 5, 7 formed in the main body 2, especially their curved configuration in multiple axes.

[0076] The invention is not confined to the exemplary embodiments shown in the drawings, but rather emerges from a combined consideration of all the features disclosed herein.

WHAT IS CLAIMED IS:

1. Nozzle arrangement (1) for applying fluids, in particular thermoplastic adhesives, to a substrate, wherein the nozzle arrangement (1) has a main body (2) which is able to be connected, preferably exchangeably, to a mounting region of a distributor and which has an end-side side surface (3), wherein, in or on the end-side side surface (3) of the main body (2), there is provided at least one first outlet nozzle (4) for the fluid to be applied to the substrate, wherein, in the main body (2), there is formed a first fluid channel system (5), via which the at least one first outlet nozzle (4) is connected in terms of flow to a first fluid connector, which is provided in the main body (2) of the nozzle arrangement (1), wherein the nozzle arrangement (1) is a monolithic component produced by an additive production method.

2. Nozzle arrangement (1) according to Claim 1,

wherein, in the or on the end-side side surface (3) of the main body (2), there is provided at least one second outlet nozzle (6), and preferably a multiplicity of second outlet nozzles (6), for the purpose of dispensing shaping air in a targeted manner in order to influence, as required, the direction of a fluid jet dispensed from the at least one first outlet nozzle, wherein the at least one second outlet nozzle (6) is connected in terms of flow to a second fluid connector, which is provided on the main body (2) of the nozzle arrangement (1), via a second fluid channel system (7) formed in the main body (2).

3. Nozzle arrangement (1) according to Claim 1 or 2,

wherein the first fluid channel system (5) and/or the second fluid channel system (7) have/has at least one fluid channel section formed in a regionally three-dimensionally curved manner.

4. Nozzle arrangement (1) according to one of Claims 1 to 3,

wherein the additive production method by which the nozzle arrangement (1) is produced comprises the following:

- determining three-dimensional information about the main body (2) of the nozzle arrangement (1), which contains the at least one first and/or second outlet nozzle (4, 6) and in which the first and/or second fluid channel system (5, 7) are/is formed;
- converting the three-dimensional information into a multiplicity of layers which define cross-sectional layers of the main body (2), wherein at least one empty space within at least some of the layers is defined which defines the first and/or second fluid channel system (5, 7); and
- successively forming each layer of the main body (2), in particular by melting a metallic powder using laser energy and/or electron beam energy.

5. Nozzle arrangement (1) according to Claim 4,

wherein the additive production method is a laser sintering method or a direct metal laser sintering (DMLS) method.

6. Nozzle arrangement (1) according to one of Claims 1 to 5,

wherein an extension region (10), in which the at least one first and/or second outlet nozzle (4, 6) are/is formed, is formed on the end-side side surface (3) of the main body (2), wherein the extension region (10) and the at least one outlet nozzle are formed such that the outlet opening of the at least one first and/or second outlet nozzle (4, 6) is at a distance from the end-side side surface (3) of the main body (2) and a main flow axis which is predefined by the outlet opening of the at least one first outlet nozzle (4) and along which the fluid dispensed from the at least one first outlet nozzle (4) moves, encloses an acute angle with the end-side side surface (3) of the main body (2).

7. Nozzle arrangement (1) according to Claim 6,

wherein, as seen in plan view, the main body (2) is at least substantially of right-angled form, and wherein, likewise as seen in plan view, the extension region (10) is at least substantially of trapeziform or triangular form and is connected via its longer base side to the end side of the main body (2).

8. Nozzle arrangement (1) according to Claim 6 or 7,

wherein the outlet opening of the at least one first outlet nozzle (4) is assigned at least one and preferably a multiplicity of fluid openings of second outlet nozzles (6), whose main flow axis, along which a fluid dispensed from the fluid opening of the at least one second outlet nozzle (6) moves, is inclined in the direction of the main flow axis of the outlet opening of the first outlet nozzle (4).

9. Method for producing a main body (2) of a nozzle arrangement (1) for applying fluids, in particular thermoplastic adhesives, to a substrate, wherein the main body (2) has at least one first outlet nozzle (4) and preferably at least one second outlet nozzle (6), and wherein, in the main body (2), there are/is formed at least one first fluid channel system (5) and/or at least one second fluid channel system (7), via which the at least one first and/or second outlet nozzle (4, 6) are/is connected in terms of flow to a first and/or second connector on the main body (2) of the nozzle arrangement (1), wherein the production method is an additive production method which comprises the following:

- determining three-dimensional information about the main body (2), which contains the at least one first and/or second outlet nozzle (4, 6) and in which the first and/or second fluid channel system (5, 7) are/is formed;
- converting the three-dimensional information into a multiplicity of layers which define cross-sectional layers of the main body (2), wherein at least one empty space within at least one of the layers is defined which defines the first and/or second fluid channel system (5, 7); and

- successively forming each layer of the main body (2), in particular by melting a metallic powder using laser energy and/or electron beam energy.

10. Method according to Claim 9,

wherein the successive formation of each layer of the main body (2) through melting of a metallic powder using laser energy also comprises melting a metallic powder which comprises at least one of cobalt-chromium, HS188 and INCO625.

11. Method according to Claim 9 or 10,

wherein the successive formation of each layer of the main body (2) through melting of a metallic powder using laser energy also comprises melting a metallic powder which has a particle size between approximately 10 μm and approximately 75 μm , preferably between approximately 15 μm and approximately 30 μm .

AMENDED CLAIMS
received by the International Bureau on 29 July 2020 (29.07.20)

1. Nozzle arrangement (1) for applying fluids, in particular thermoplastic adhesives, to a substrate, wherein the nozzle arrangement (1) has a main body (2) which is able to be connected, preferably exchangeably, to a mounting region of a distributor and which has an end-side side surface (3), wherein, in or on the end-side side surface (3) of the main body (2), there is provided at least one first outlet nozzle (4) for the fluid to be applied to the substrate, wherein, in the main body (2), there is formed a first fluid channel system (5), via which the at least one first outlet nozzle (4) is connected in terms of flow to a first fluid connector, which is provided in the main body (2) of the nozzle arrangement (1), wherein the nozzle arrangement (1) is a monolithic component produced by an additive production method,

wherein the first fluid channel system (5) and/or the second fluid channel system (7) have/has at least one fluid channel section formed in a regionally three-dimensionally curved manner.

2. Nozzle arrangement (1) according to Claim 1,

wherein, in the or on the end-side side surface (3) of the main body (2), there is provided at least one second outlet nozzle (6), and preferably a multiplicity of second outlet nozzles (6), for the purpose of dispensing shaping air in a targeted manner in order to influence, as required, the direction of a fluid jet dispensed from the at least one first outlet nozzle, wherein the at least one second outlet nozzle (6) is connected in terms of flow to a second fluid connector, which is provided on the main body (2) of the nozzle arrangement (1), via a second fluid channel system (7) formed in the main body (2).

4. Nozzle arrangement (1) according to one of Claims 1 to 2,

wherein the additive production method by which the nozzle arrangement (1) is produced comprises the following:

- determining three-dimensional information about the main body (2) of the nozzle arrangement (1), which contains the at least one first and/or second outlet nozzle (4, 6) and in which the first and/or second fluid channel system (5, 7) are/is formed;
- converting the three-dimensional information into a multiplicity of layers which define cross-sectional layers of the main body (2), wherein at least one empty space within at least some of the layers is defined which defines the first and/or second fluid channel system (5, 7); and
- successively forming each layer of the main body (2), in particular by melting a metallic powder using laser energy and/or electron beam energy.

5. Nozzle arrangement (1) according to Claim 4,

wherein the additive production method is a laser sintering method or a direct metal laser sintering (DMLS) method.

6. Nozzle arrangement (1) according to one of Claims 1, 2, 4, or 5,

wherein an extension region (10), in which the at least one first and/or second outlet nozzle (4, 6) are/is formed, is formed on the end-side side surface (3) of the main body (2), wherein the extension region (10) and the at least one outlet nozzle are formed such that the outlet opening of the at least one first and/or second outlet nozzle (4, 6) is at a distance from the end-side side surface (3) of the main body (2) and a main flow axis which is predefined by the outlet opening of the at least one first outlet nozzle (4) and along which the fluid dispensed from the at least one first outlet nozzle (4) moves, encloses an acute angle with the end-side side surface (3) of the main body (2).

7. Nozzle arrangement (1) according to Claim 6,

wherein, as seen in plan view, the main body (2) is at least substantially of right-angled form, and wherein, likewise as seen in plan view, the extension region (10) is at least substantially of trapeziform or triangular form and is connected via its longer base side to the end side of the main body (2).

8. Nozzle arrangement (1) according to Claim 6 or 7,

wherein the outlet opening of the at least one first outlet nozzle (4) is assigned at least one and preferably a multiplicity of fluid openings of second outlet nozzles (6), whose main flow axis, along which a fluid dispensed from the fluid opening of the at least one second outlet nozzle (6) moves, is inclined in the direction of the main flow axis of the outlet opening of the first outlet nozzle (4).

9. Method for producing a main body (2) of a nozzle arrangement (1) for applying fluids, in particular thermoplastic adhesives, to a substrate, wherein the main body (2) has at least one first outlet nozzle (4) and preferably at least one second outlet nozzle (6), and wherein, in the main body (2), there are/is formed at least one first fluid channel system (5) and/or at least one second fluid channel system (7), via which the at least one first and/or second outlet nozzle (4, 6) are/is connected in terms of flow to a first and/or second connector on the main body (2) of the nozzle arrangement (1), wherein the production method is an additive production method which comprises the following:

- determining three-dimensional information about the main body (2), which contains the at least one first and/or second outlet nozzle (4, 6) and in which the first and/or second fluid channel system (5, 7) are/is formed;
- converting the three-dimensional information into a multiplicity of layers which define cross-sectional layers of the main body (2), wherein at least one empty space within at least one of the layers is defined which defines the first and/or second fluid channel system (5, 7); and
- successively forming each layer of the main body (2), in particular by melting a metallic powder using laser energy and/or electron beam energy,

wherein the first fluid channel system (5) and/or the second fluid channel system (7) have/has at least one fluid channel section formed in a regionally three-dimensionally curved manner.

10. Method according to Claim 9,

wherein the successive formation of each layer of the main body (2) through melting of a metallic powder using laser energy also comprises melting a metallic powder which comprises at least one of cobalt-chromium, HS188 and INCO625.

11. Method according to Claim 9 or 10,

wherein the successive formation of each layer of the main body (2) through melting of a metallic powder using laser energy also comprises melting a metallic powder which has a particle size between approximately 10 μm and approximately 75 μm , preferably between approximately 15 μm and approximately 30 μm .

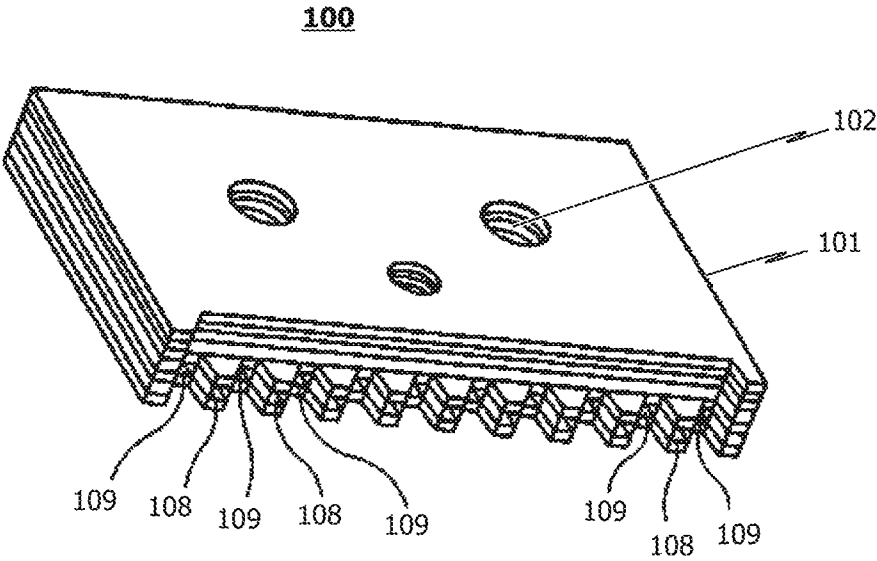


FIG. 1

(Stand der Technik)

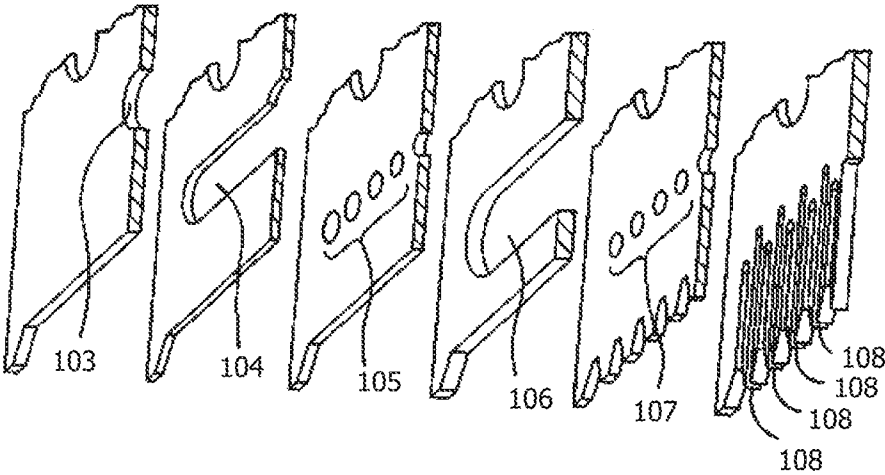


FIG. 2

(Stand der Technik)

2 / 3

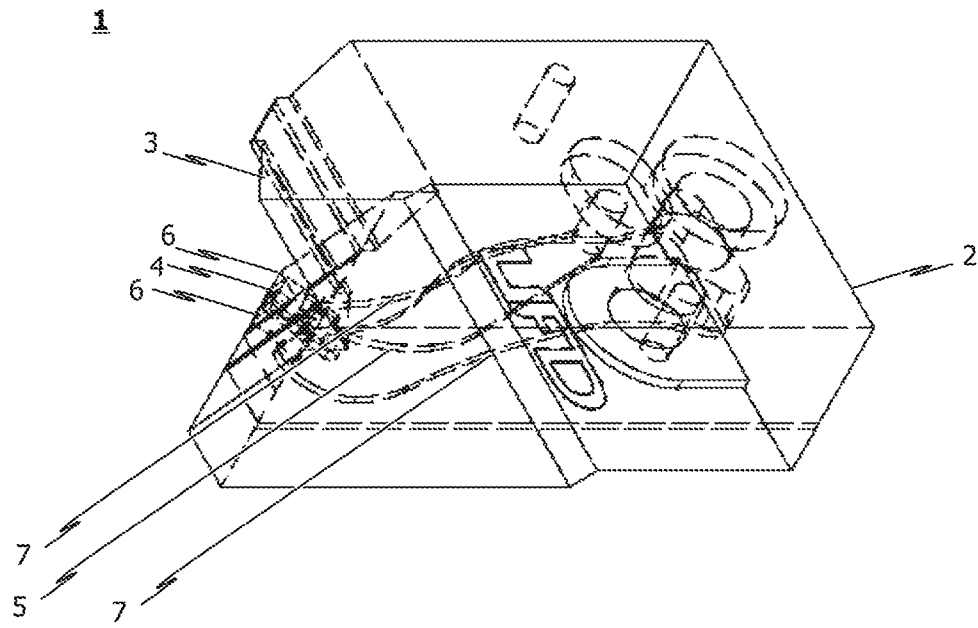


FIG. 3

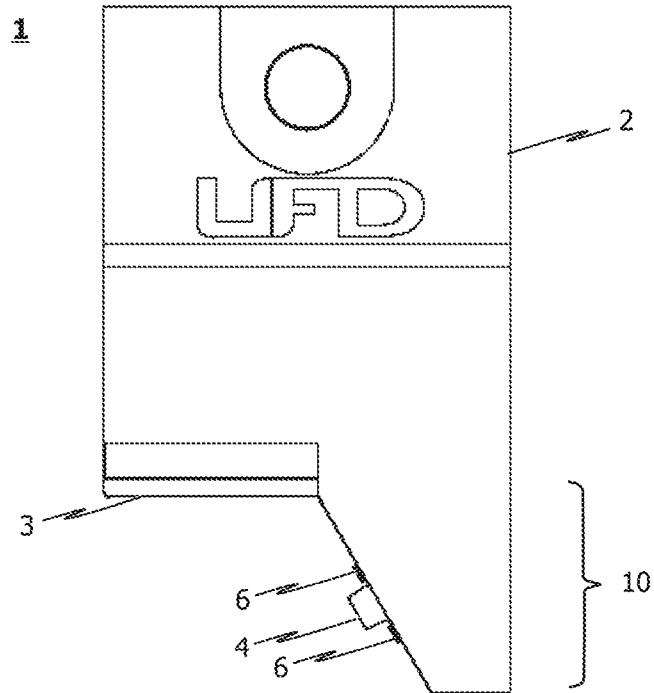


FIG. 4

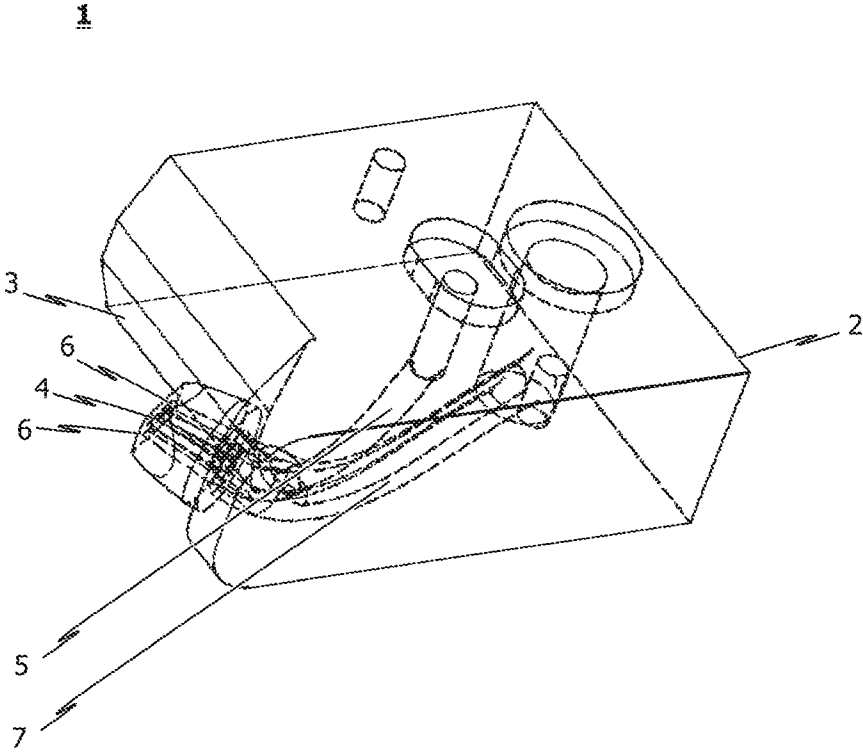


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2020/022012

A. CLASSIFICATION OF SUBJECT MATTER
INV. B05C5/00 B05B7/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B05C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 769 947 A (KRAPPWEIS ANDREAS [DE]) 23 June 1998 (1998-06-23)	1,2
Y	the whole document	9
X	EP 2 145 695 A1 (SIKA TECHNOLOGY AG [CH]) 20 January 2010 (2010-01-20)	1,2
Y	the whole document	9
X	WO 00/69571 A1 (FABER CASTELL A W [DE]; BECK UDO [DE] ET AL.) 23 November 2000 (2000-11-23)	1,2
Y	the whole document	9
X	DE 10 2017 207851 A1 (AUDI AG [DE]) 15 November 2018 (2018-11-15)	1,2
Y	the whole document	9



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 May 2020

Date of mailing of the international search report

03/06/2020

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2020/022012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5769947	A	23-06-1998	NONE

EP 2145695	A1	20-01-2010	CN 102089083 A 08-06-2011
			EP 2145695 A1 20-01-2010
			US 2011114266 A1 19-05-2011
			WO 2010007033 A1 21-01-2010

WO 0069571	A1	23-11-2000	NONE

DE 102017207851	A1	15-11-2018	NONE
