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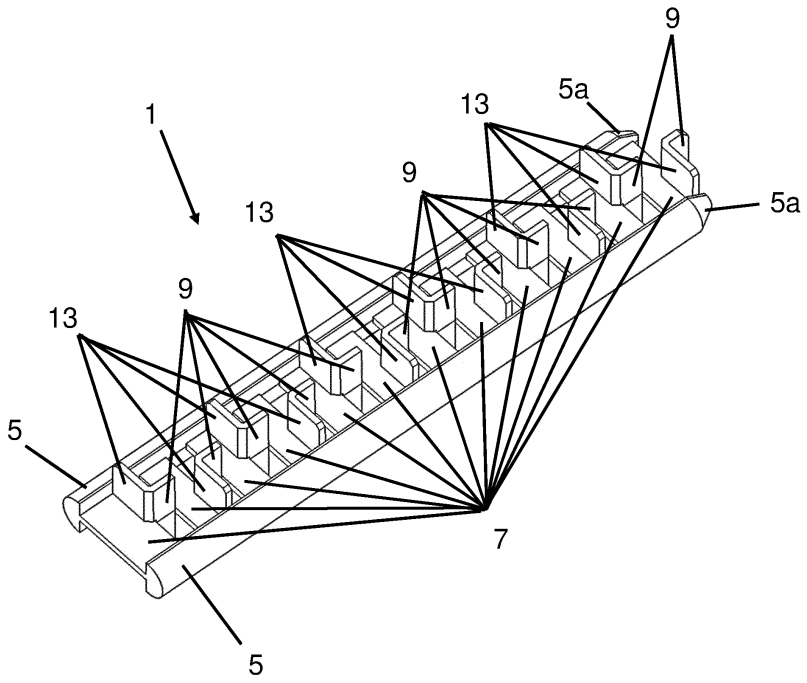
(54) **STATIC MIXER INSERT AND STATIC MIXER**

(57) The present invention relates to a static mixer insert (1) for mixing two viscous components within a mixing tube (50) of a static mixer (100). The static mixer insert (1) comprises a mixing structure (3) defining a mixing area with a plurality of consecutive mixing chambers arranged along a longitudinal axis (LA) of the mixing structure (3) when disposed within said mixing tube (50), and two longitudinally extending support bars (5) laterally connected outside to the mixing structure (3). Moreover, the present invention relates to a static mixer (100) with a mixing tube (50) and the above static mixer insert (1) provided within said mixing tube (50).

FIG. 2A



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Description

[0001] The present invention relates to a static mixer insert and a static mixer with such a static mixer insert.

[0002] To date, static mixer inserts having a mixing structure with a therein integrated support structure are provided to form compact and robust static mixer inserts and corresponding static mixers. Such configurations enable quite compact static mixers with good mixing characteristics. However, the compactness and mixing characteristics of such prior art configurations are limited due to negative interaction effects between the structural integrity of such static mixer inserts and their mixing characteristics. In particular, the smaller static mixer inserts are the larger the support structures generally have to be in a relative sense. This results in less free mixing space within the mixing structure and, thus, in deteriorated mixing characteristics.

[0003] Thus, there exists a demand for new configurations allowing the formation of static mixers with even smaller dimensions and better mixing characteristics.

[0004] Therefore, it is an object of the present invention to provide static mixer inserts and static mixers allowing the implementation of smaller dimensions and/or better mixing characteristics as known from prior art static mixers. This object is solved by the subject matter of the independent claims. Preferable modifications can be taken from the dependent claims.

[0005] According to a first aspect of the present invention, a static mixer insert for mixing two viscous components within a mixing tube of a static mixer comprises a mixing structure defining a mixing area with a plurality of consecutive mixing chambers arranged along a longitudinal axis of the mixing structure when disposed within said mixing tube, and two longitudinally extending support bars laterally connected outside to the mixing structure.

[0006] Said two support bars outside the mixing structure allow an improved structural integrity and robustness for the static mixer insert without limiting the free cross-section of the mixing structure. Thus, static mixer inserts with smaller overall dimensions and/or an improved mixing structure can be formed.

[0007] Preferably, the mixing structure is formed of various parts connected to each other in such a way that they form a single interconnected part.

[0008] Thus, the parts of the mixing structure form an integrated part having already a certain basic stability, which is then supplemented by the two support bars. The support bars are not formed by the parts of the mixing structure but by separate elements connected to the parts of the mixing structure.

[0009] Preferably, the mixing structure and the support bars are formed integrally, in particular via an injection-moulding process. This means that they are formed as one piece.

[0010] Such an integral configuration is very robust, while injecting-moulding was found to depict a simple but reliable method for forming such static mixer inserts.

[0011] Preferably, the mixing structure has a substantially rectangular cross-section, in particular with a ratio of its width to its depth of 0.7 to 1.3, preferably of 1.0.

[0012] Such an aspect ratio result in an improved robust configuration with good mixing characteristics.

[0013] Preferably, the mixing structure has a width of 1.0mm to 4.0mm, in particular of 1.0mm to 2.5mm and preferably of 1.7mm to 1.9mm, especially of 1.8mm.

[0014] Such a configuration is very compact and is suitable for very accurate dispensing processes of small amounts of component-mixtures. These very small dimensions for the mixing structure are only achievable with the support bars as defined above.

[0015] Preferably, the mixing structure comprises a first set of separation walls provided in a first plane along the longitudinal axis of the mixing structure and connecting the two support bars with each other.

[0016] Such a configuration is very robust and allows very good mixing characteristics.

[0017] Preferably, the mixing structure comprises a second set of separation walls provided in a second plane along the longitudinal axis and oriented perpendicular with respect to the first plane. Each separation wall of said second set of separation walls connects two separations walls of the first set of separations walls successive along the longitudinal axis of the mixing structure, to each other.

[0018] Such a configuration is even more robust and allows even better mixing characteristics.

[0019] Preferably, said separation walls define passage windows within said first plane or said second plane. A ratio of the height to the width of each of said passage windows is in particular in the range of 0.5 to 1.0.

[0020] Such passage windows allow beneficial mixing characteristics.

[0021] Preferably, the mixing structure comprises a deflection plate at the upstream or downstream end of each of said passage windows. Each of said deflection plates is tilted with respect to the longitudinal axis of the mixing structure, in particular by an angle in the range of 60° to 120°, for example by an angle of 90°.

[0022] Such deflection plates result in beneficial flow characteristics of the components along the mixing structure and, thus, in good mixing characteristics.

[0023] Preferably, each of the two support bars has an at least partially, in particular fully polygonal cross-section, for example a preferably equilateral triangular, quadrangular, pentagonal, hexagonal or octagonal cross-section, an at least partially, in particular fully, oval cross-section and/or an at least partially, in particular fully, circular cross-section. Preferably, each support bar comprises a tapered portion at one of its longitudinal ends, in particular at its downstream end.

[0024] Said cross-sections allow very robust but quite compact configurations for the support bars. Said tapered portions simplify an introduction of the static mixer insert in a corresponding mixing tube.

[0025] Preferably, the ratio of the thickness to the width

of each support bar is in the range of 0.4 to 0.7.

[0026] This configuration allows a very compact but still robust overall static mixer insert.

[0027] Preferably, the ratio of the width of each of the support bars to the width of the mixing structure is in the range of 0.2 to 0.5.

[0028] This configuration allows a very compact but still robust overall static mixer insert.

[0029] Preferably, the mixing structure comprises at least one, in particular multiple, of the following special elements for optimizing the component flows and/or the mixing of the viscous components when traveling along the mixing structure: guiding bars tilted with respect to the longitudinal axis of the mixing structure, in particular by an angle in the range of 45° to 90°, for example by an angle of 60°; exchange elements formed of a first a deflection plate at a downstream end of a passage window, a second deflection plate at an upstream end of said passage window and the separation wall connecting said two deflection plates to each other; tilted separation aid plates connected to a downstream end or to an upstream end of one of the separation walls. In particular, said guiding bars have a width of no more than 25% of the width of the mixing structure and/or guiding bars are provided along a separation wall of the above described first set of separation walls or connected at one end to a separation wall of the above described second set of separation walls and at its other end to one of the support bars. In particular, the separation wall connecting the two deflection plates of one exchange element to each other has a width corresponding to the width of the mixing structure at the location of said separation wall, or a width, in particular substantially, smaller than the width of the mixing structure at the location of said separation wall.

[0030] Such elements have been proven to result in improved flow and mixing characteristics.

[0031] Preferably, parts, in particular all parts, of the mixing structure have a thickness in the range of 0.10mm to 0.30mm, in particular of 0.15mm.

[0032] Such a configuration allows the formation of a very compact but robust static mixer with very good mixing characteristics.

[0033] According to another aspect of the present invention, a static mixer for mixing two viscous components comprises a longitudinal mixing tube and one of the above described static mixer inserts provided within said mixing tube.

[0034] Said mixing tube allows the final usage of the above described static mixer inserts for a mixing and dispensing process.

[0035] Preferably, the static mixer insert is fixed via press-fit and/or ultrasonic welding to the mixing tube.

[0036] The press-fit configuration is very simple, while the ultrasonic welding configuration is very robust.

[0037] Preferably, the mixing tube comprises a longitudinally extending central opening receiving the mixing structure of the static mixer insert, and two longitudinally extending recesses formed along the central opening, each receiving one of the two support bars.

[0038] These recesses ensure that the static mixer insert is oriented within the mixer tube correctly.

[0039] Preferably, the static mixer insert comprises a head connected to the mixing structure and to the support bars. Said head comprises a flat disc portion extending perpendicular with respect to the longitudinal axis of the mixing structure and two inlets, one for each viscous component, oriented in parallel but shifted with respect to the longitudinal axis of the mixing structure. The mixing structure is connected to said head such that a first separation wall of the mixing structure is connected to said head and lies within a common extension plane defined by the two inlets, or is oriented perpendicular with respect to said common extension plane.

[0040] The described parallel orientation of the first separation wall results in a direct mixing of the two components when entering the mixing structure and, thus in improved mixing characteristics. The described perpendicular orientation of the first separation wall results in a reliable prevention of components flowing from one of the inlets via the other inlet into the other component chamber of the dispensing device connected to the static mixer.

[0041] Exemplary embodiments and functions of the present invention are described herein in conjunction with the following drawings, wherein:

- FIG. 1 shows a perspective cross-sectional view of a static mixer according to an exemplary embodiment of the present invention;
- FIG. 2A shows a perspective view of a static mixer insert according to a first embodiment of the present invention;
- FIG. 2B shows a top view of the static mixer insert of FIG. 2A;
- FIG. 2C shows an enlarged view of a left end of FIG. 2B;
- FIG. 2D shows a longitudinal view of the static mixer insert of FIG. 2A from a first end of the static mixer insert;
- FIG. 2E shows a side view of the static mixer insert of FIG. 2A;
- FIG. 2F shows a longitudinal view of the static mixer insert of FIG. 2A from the second end of the static mixer insert;
- FIG. 3 shows a perspective view of a first end of a static mixer insert according to a second embodiment of the present invention;
- FIG. 4A shows a perspective view of a central portion of a static mixer insert according to a third embodiment of the present invention;
- FIG. 4B shows a top view of the portion of the static mixer insert shown in FIG. 4A;
- FIG. 5A shows a perspective view of a central portion of a static mixer insert according to a fourth embodiment of the present invention;

FIG. 5B shows a top view of the portion of the static mixer insert shown in FIG. 5A;

FIG. 6A shows a perspective view of a central portion of a static mixer insert according to a fifth embodiment of the present invention;

FIG. 6B shows a top view of the portion of the static mixer insert shown in FIG. 6A;

FIG. 7A shows a perspective view of a central portion of a static mixer insert according to a sixth embodiment of the present invention;

FIG. 7B shows a top view of the portion of the static mixer insert shown in FIG. 7A;

FIG. 8A shows a perspective view of a central portion of a static mixer insert according to a seventh embodiment of the present invention;

FIG. 8B shows a top view of the portion of the static mixer insert shown in FIG. 8A;

FIG. 9A shows a perspective view of a central portion of a static mixer insert according to an eighth embodiment of the present invention;

FIG. 9B shows a top view of the portion of the static mixer insert shown in FIG. 9A;

FIG. 10A shows a perspective of a central portion of a static mixer insert according to a ninth embodiment of the present invention; and

FIG. 10B shows a top view of the portion of the static mixer insert shown in FIG. 10A.

[0042] Throughout the drawings, identical reference signs denote corresponding or at least similar elements. The static mixer inserts 1 described in the following are provided for a flow of the components to be mixed along the longitudinal axis LA of the corresponding mixing structure 3 as indicated by the arrow at the end of said longitudinal axis LA.

[0043] As can be seen in FIG. 1, an exemplary static mixer 100 in accordance with the present invention comprises a static mixer insert 1 and a mixing tube 50. Said static mixer insert 1 comprises a mixing structure 3 extending longitudinally along a longitudinal axis LA of the mixing structure 3. The mixing structure 3 is received by a longitudinal central passageway 52 formed by the mixing tube 50. Furthermore, the static mixer insert 1 comprises two longitudinally extending support bars 5 (see in particular the following figures), each received by a longitudinal recess 54 along the central passageway 52 of the mixing tube 50. The present static mixer insert 1 is provided with a head 21 comprising a flat disc portion 23 and two inserts 25 oriented in parallel with the longitudinal axis LA of the mixing structure 3. Said head 21 is provided for a fluidical coupling of the mixing structure 3 with outlets of a dispensing device (not illustrated) comprising two chambers, each filled with one of the two viscous components, which are to be mixed with each other prior to application thereof at a desired area. The term component as used herein includes both of pure materials and composite material.

[0044] In the illustrated embodiment, the disc portion 23 of the head 21 is ultrasonic-welded to a coupling ring 60 provided around a cover portion 58 of the mixing tube 50 to provide a further fixation of the static mixer insert 1 to the mixing housing 50 in addition to a press-fit fixation formed between the longitudinal support bars 5 of the static mixer insert 1 and the recesses 54 of the mixing tube 50. Furthermore, the mixing tube 50 is provided with a coupling portion 56 for connecting a dispensing tip (not illustrated) thereto. However, such a dispensing tip could also be integrated directly into the mixing tube 50.

[0045] In the illustrated embodiment, the mixing structure 3 is connected to said head 21 in an orientation resulting in that a first separation wall (described further below; 7) of the mixing structure 3 is oriented perpendicular with respect to a common extension plane of the two inlets 25 (substantially corresponding to the sectional plane of FIG. 1). Thus, the two inlets 25 are separated from each other, vie said first separation wall, preventing any leakage of the component from one inlet 25 through the other into the chamber for the other component within the dispensing device. Alternatively, said first separation wall 7 can lie within said common extension plane resulting in a direct mixing of the components from the two inlets 25.

[0046] In the following, further details are described with respect to exemplary embodiments for static mixer inserts 1 according to the present invention. Although not illustrated here, each of said static mixer inserts 1 can be supplemented by the head 21 described above or similar configurations.

[0047] As can be seen in Figures 2A to 2F, a static mixer insert 1 according to a first embodiment of the present invention comprises a mixing structure 3 formed of various flat elements 7, 9 and 13, and therewith integrally formed, for example via an injection-moulding process, two support bars 5 with semi-circular cross-sections.

[0048] In this embodiment, the mixing structure 3 comprises a first set of separation walls 7 connecting the two support bars 5 to each other, a second set of separation walls 9 connecting successive separation walls 7 of the first set of separation wall 7 to each other, and deflection plates 13 coupled to the separation walls 7 and 8. The separation walls 7 of the first set of separation walls 7 lie within a first plane along the longitudinal axis LA of the mixing structure 3 (parallel to the image plane of FIGS. 2B and 2C). The separation walls 9 of the second set of separation walls 9 lie within a second plane along the longitudinal axis LA of the mixing structure 3 but in perpendicular with respect to the first plane of the separation walls 7 of the first set of separation walls 7 (parallel to the image plane of FIG. 2E). The deflection plates 13 are oriented substantially perpendicular with respect to both of the first plane of the separation walls 7 of the first set of separation walls 7 and the second plane of the separation walls 9 of the second set of separation walls 9 (i.e. parallel

to the image plane one FIGS. 2D and 2F).

[0049] As can be seen best in FIG. 2A in view of FIG. 2B, the separation walls 7 and 9 of the two sets of separation walls 7 and 9 from passage windows 11 along said first plane. Said passage windows 11 are formed with an aspect ratio of 0.5 to 1.0. In the illustrated embodiment, the deflection plates 13 are provided on an upstream side of each of said passage windows 11 and oriented perpendicular to the longitudinal axis LA of the mixing structure 3. However, said deflection plates 13 can be position also on a downstream side and/or can be tilted with respect to the longitudinal axis LA by an angle α (see FIG. 2C) in the range of 60° to 120°.

[0050] The parts 7, 9 and 13 of the mixing structure are dimensioned such that the mixing structure 3 has a substantially rectangular cross-section with an aspect ratio, i.e. with a ratio of its width S to its depth T of 0.7 to 1.3, in particular of 1.0 (see FIG. 2D). The provided support bars 5 allow mixing structures 3 with a width S of 1.0mm to 4.0mm and in particular of 1.8mm.

[0051] With respect to the support bars 5, it is pointed to the fact these can also be formed with other cross-sectional shapes, like with partially or fully polygonal cross-sections, for example with a preferably equilateral triangular, quadrangular, pentagonal, hexagonal or octagonal cross-sections, at least partially or fullly oval cross-sections and/or other partially or even fully circular cross-sections. Additionally or alternatively, each support bar 5 can be provided with a tapered portion 5a for facilitating an insertion operation into a corresponding mixing tube 50 for forming a static mixer 100 in accordance with the present invention (see for example FIG. 2B).

[0052] Preferably, the ratio of the thickness D to the width C of each of the support bars 5 is in the range of 0.4 to 0.7 while the ratio of the width C of each of the support bars 5 to the width S of the mixing structure is in the range of 0.2 to 0.5, to ensure a preferable structural stability.

[0053] As illustrated in FIG. 3, in contrast to the above configuration, in which a separation wall 7 of the first set of separation walls 7 forms the first separation wall of the mixing structure 3, also a separation wall 9 from the second set of separation walls 9 can form the first separation wall of the mixing structure 3.

[0054] With respect to the above described two sets of separation walls 7 and 9, and the deflection plates 13 it is pointed to the fact that sets of two connected separation walls 7 and 9 with a thereto connected deflection plate 13 can be considered as one mixing element, wherein several, like for example twelve as in the illustrated embodiment or even more like for example twenty-four, of these mixing elements can form the mixing structure 3.

[0055] These mixing elements can be supplemented by one or multiple of special elements 15, 17 and/or 19 for optimizing flow-guiding and mixing characteristics of the mixing structure 3. Three examples of such special elements 15, 17 and 19 are described in the following with respect to Figures 4A to 10B. Said special elements 15, 17 and 19 can be combined with the mixing elements and/or each other in any desired manner.

[0056] A first example of such special elements are guiding bars 15 (see FIGS. 4A to 6B) which are provided with respect to the longitudinal axis LA of the mixing structure in a tilted manner, in particular by an angle β in the range of 45° to 90°, like for example by an angle of 60°. Said guiding bars are provided in particular with a width W of no more than 25% of the width S of the mixing structure 3.

[0057] Such guiding bars 15 can be provided along one separation wall 7 of the first set of separation walls 7, as illustrated in FIGS. 4A and 4B. Alternatively, the guiding bars 15 can connect a separation wall 9 of the second set of separation walls 9 with one of the two support bars 5, as illustrated in FIGS. 5A and 5B. This second kind of guiding bars 15 is preferably positioned such that in an assembled state of the static mixer insert 1 with a corresponding mixing tube 50, these guiding bars 50 run along the inner surface of the mixing tube 50.

[0058] Such guiding bars 15 allow to separate component flows from the separation walls 7 and 9 and/or from the inner surface of the mixing tube 50 for improved flow-guiding and mixing characteristics of the finally formed static mixer 100.

[0059] Of course, guiding bars 15 of both above described implementations can be combined with each other, as illustrated for example in FIGS. 6A and 6B.
be.

[0060] A second example of such special elements are exchange elements 17 formed of a first a deflection plate 13a at a downstream end of a passage window 11, a second deflection plate 13b at an upstream end of said passage window 11 and a separation wall 9 connecting said two deflection plates 13a and 13b to each other. As illustrated in FIGS. 7A and 7B, the corresponding separation wall 9 can have a width E, preferably substantially, smaller than the width S of the mixing structure 3 at the location of said separation wall 9. Thus, the two flows of the components can split within said exchange element 17 while being circulated. Alternatively, the corresponding separation wall 9 can have a width E corresponding to the width S of the mixing structure 3 at the location of said separation wall 9, such that only a circulation but no splitting/mixing of the component flows occurs within the exchange element 17 (see FIGS. 8A and 8B). As can be taken from a comparison of the embodiment of FIGS. 8A and 8B with the embodiment of FIGS. 9A and 9B, the exchange elements 17 can be configured to generate both of a clockwise circulation (see FIGS. 8A and 8B) and a counter-clockwise circulation (see FIGS. 9A and 9B).

[0061] A third example of such special elements are tilted separation aid plates 19 connected to downstream and/or upstream ends of the separation walls 7 and/or 9, as can be seen in particular in FIGS. 10A and 10B. These separation aid plates 19 serve to optimize the separation and combination of the component flows for an improved mixing characteristic.

[0062] The described special elements 15, 17 and 19 can be combined with each other and with the above described standard mixing elements in any desired number or combination. As can be seen for example in FIGS. 5A to 6B, FIGS. 8A to 9B and FIGS. 10A and 10B, the separation aid plates 19 can be combined with the above described guiding plates 15, with the above described exchange elements 17 and/or with further separation aid plates 19 freely. The same holds for other combinations.

[0063] Preferably, various parts, in particular all parts, of the mixing structure 3 are provided with a thickness in the range of 0.10mm to 0.30mm, in particular of 0.15mm

[0064] Finally, it is pointed to the fact that the above described embodiments are provided merely for clarification of the subject matter of the present invention but not for delimiting the scope of protection as defined by the accompanying claims. A skilled artisan will be able to think of various combinations and modifications of the described configurations falling under the scope of protection defined by the accompanying claims without being described explicitly herein.

Reference numeral list

[0065]

1	static mixer insert
3	mixing structure
5	support bar
5a	tapered portion
7	separation wall of first set of separation walls
9	separation wall of second set of separation walls
11	passage window
13	deflection plate
13a	first deflection plate of an exchange element 17
13b	second deflection plate of an exchange element 17
15	guiding bar
17	exchange element
19	separation aid plate
21	head
23	disc portion
25	inlet
50	mixing tube
52	central passageway
54	recess
56	coupling portion
58	cover portion
60	coupling ring
100	static mixer

A	width of the passage window(s) 11
B	height of the passage window(s) 11
C	width of the support bar(s) 5
D	thickness of the support bar(s) 5
E	width of the separation wall(s) 7 and/or 9
S	width of the mixing structure 3
LA	longitudinal axis of mixing structure 3

Claims

1. A static mixer insert (1) for mixing two viscous components within a mixing tube (50) of a static mixer (100), the static mixer insert (1) comprising:

   a mixing structure (3) defining a mixing area with a plurality of consecutive mixing chambers arranged along a longitudinal axis (LA) of the mixing structure (3) when disposed within said mixing tube (50); and
   two longitudinally extending support bars (5) laterally connected outside to the mixing structure (3).

2. The static mixer insert (1) according to claim 1, wherein the mixing structure (3) is formed of various parts (7, 9, 11, 13, 15, 17, 19) connected to each other in such a way that they form a single interconnected part.

3. The static mixer insert (1) according to claim 1 or 2, wherein the mixing structure (3) and the support bars (5) are formed integrally, in particular via an injection-moulding process.

4. The static mixer insert (1) according to any one of the preceding claims,
   wherein the mixing structure (3) has a substantially rectangular cross-section, in particular with an aspect ratio of 0.7 to 1.3, preferably of 1.0.

5. The static mixer insert (1) according to any one of the preceding claims,
   wherein the mixing structure (3) has a width (S) of 1.0mm to 4.0mm, in particular of 1.0mm to 2.5mm and preferably of 1.7mm to 1.9mm, especially of 1.8mm.

6. The static mixer insert (1) according to any one of the preceding claims, wherein the mixing structure (3) comprises a first set of separation walls (7) provided in a first plane along the longitudinal axis (LA) of the mixing structure (3) and connecting the two support bars (5) with each other.

7. The static mixer insert (1) according to claim 6,

   wherein the mixing structure (3) comprises a second set of separation walls (9) provided in a second plane along the longitudinal axis (LA) oriented perpendicular with respect to the first plane,
   wherein each separation wall of said second set of separation walls (9) connects two separations walls of the first set of separations walls (7) successive along the longitudinal axis (LA) of the mixing structure (3), to each other.

8. The static mixer insert (1) according to claim 7,

wherein said separation walls (7, 9) define passage windows (11) within said first plane or said second plane,
wherein a ratio of the height (B) to the width (A) of each of said passage windows (11) is in particular in the range of 0.5 to 1.0.

9. The static mixer insert (1) according to claim 8,

wherein the mixing structure (3) comprises a deflection plate (13) at the upstream or downstream end of each passage window (11),
wherein each deflection plate (13) is tilted with respect to the longitudinal axis (LA) of the mixing structure (3), in particular by an angle (α) in the range of 60° to 120°, for example by an angle of 90°.

10. The static mixer insert (1) according to any one of the preceding claims, wherein each of the two support bars (5) has an at least partially, in particular fully polygonal cross-section, for example a preferably equilateral triangular, quadrangular, pentagonal, hexagonal or octagonal cross-section, an at least partially, in particular fully, oval cross-section and/or an at least partially, in particular fully, circular cross-section, and/or wherein each support bar (5) comprises a tapered portion at one of its longitudinal ends, in particular at its downstream end.

11. The static mixer insert (1) according to any one of the preceding claims, wherein the ratio of the thickness (D) to the width (C) of each support bar (5) is in the range of 0.4 to 0.7.

12. The static mixer insert (1) according to any one of the preceding claims, wherein the ratio of the width (C) of each of the support bars (5) to the width (S) of the mixing structure (3) is in the range of 0.2 to 0.5.

13. The static mixer insert (1) according to any one of the preceding claims, wherein the mixing structure (3) comprises at least one, in particular multiple, of the following special elements (15, 17, 19) for optimizing the component flows and/or the mixing of the viscous components when traveling along the mixing structure (3):

guiding bars (15) tilted with respect to the longitudinal axis (LA) of the mixing structure (3), in particular by an angle (β) in the range of 45° to 90°, for example by an angle of 60°, and having in particular a width (W) of no more than 25% of the width (S) of the mixing structure (3),
wherein said guiding bars (15) are in particular provided along separation walls (7) of the first set of separation walls (7) of claim 5, or connected at one end to separation walls (9) of the second set of separation walls (9) according to claim 6, and at its other end to one of the support bars (5);
exchange elements (17) formed of a first a deflection plate (13a) at an downstream end of a passage window (11) according to claim 7, a second deflection plate (13b) at an upstream end of said passage window (11) and the separation wall (9, 7) connecting said two deflection plates (13a, 13b) to each other,
wherein said separation wall (7, 9) has in particular a width (E) corresponding to the width (S) of the mixing structure (3) at the location of said separation wall (7, 9), or a width (E), preferably substantially, smaller than the width (S) of the mixing structure (3) at the location of said separation wall (7, 9);
tilted separation aid plates (19) connected to a downstream end or to an upstream end of one of the separation walls (7, 9) according to one of claims 5 to 8.

14. The static mixer insert (1) according to any one of the preceding claims, wherein parts (7, 9, 11, 13, 15, 17, 19), in particular all parts (7, 9, 11, 13, 15, 17, 19), of the mixing structure (3) have a thickness in the range of 0.10mm to 0.30mm, in particular of 0.15mm.

15. A static mixer (100) for mixing two viscous components, comprising:

a longitudinal mixing tube (50); and
a static mixer insert (1) according to any one of the preceding claims provided within said mixing tube (50).

16. The static mixer (100) according to claim 15, wherein the static mixer insert (1) is fixed via press-fit or ultrasonic welding to the mixing tube (50).

17. The static mixer (100) according to claim 15 or 16, wherein the mixing tube (50) comprises a longitudinally extending central passageway (52) receiving the mixing structure (3) of the static mixer insert (1), and two longitudinally extending recesses (54) formed along the central opening (52), each receiving one of the two support bars (5).

18. The static mixer (100) according to claim 17, wherein the static mixer insert (3) comprises a head (21) connected to the mixing structure (3) and to the support bars (5),

wherein said head (21) comprises a flat disc portion (23) extending perpendicular with respect to the longitudinal axis (LA) of the mixing

structure (3) and two inlets (25), one for each viscous component, oriented parallel with but shifted with respect to the longitudinal axis (LA) of the mixing structure (3),
wherein the mixing structure (3) is connected to said head (21) such that a first separation wall (7, 9) of the mixing structure (3) connected to said head (21) lies within a common extension plane defined by the two inlets (25), or is oriented perpendicular with respect to said common extension plane.

FIG. 1

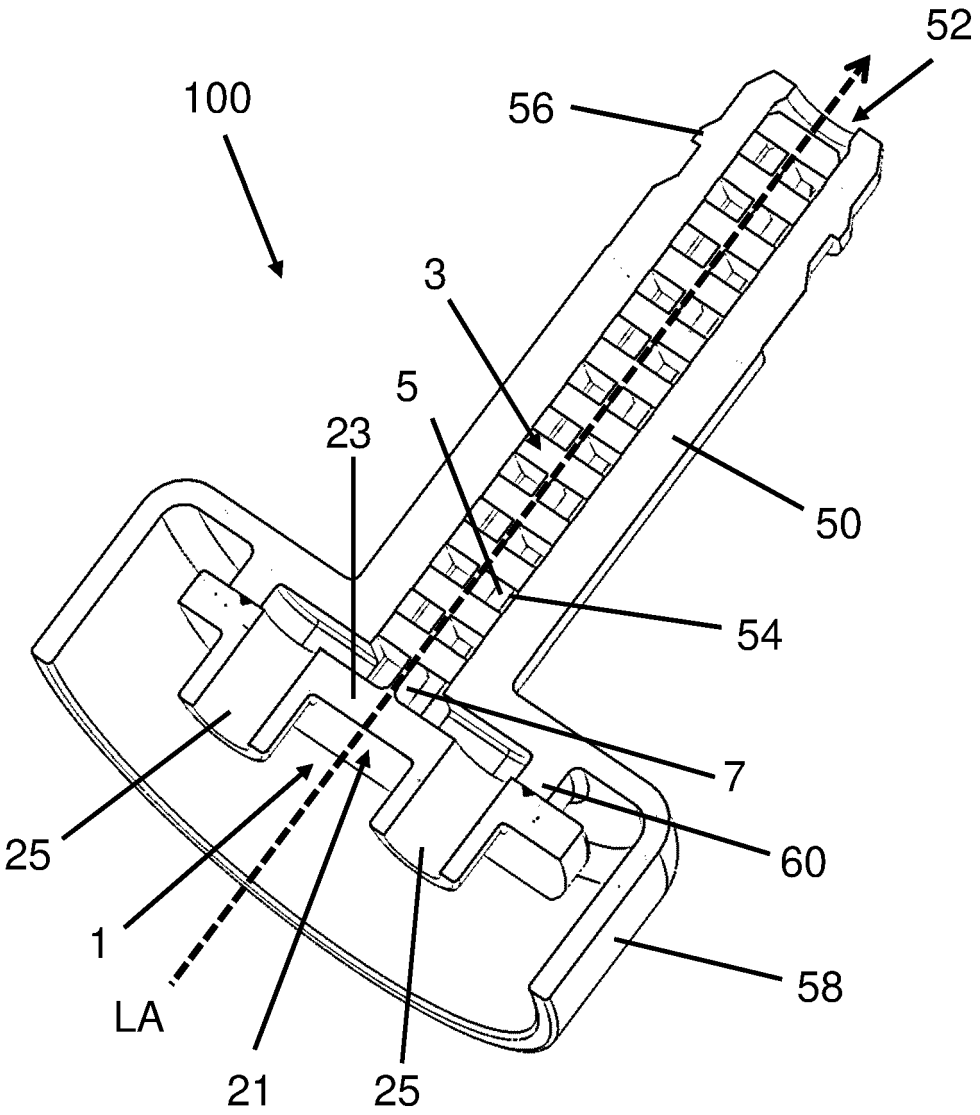


FIG. 2A

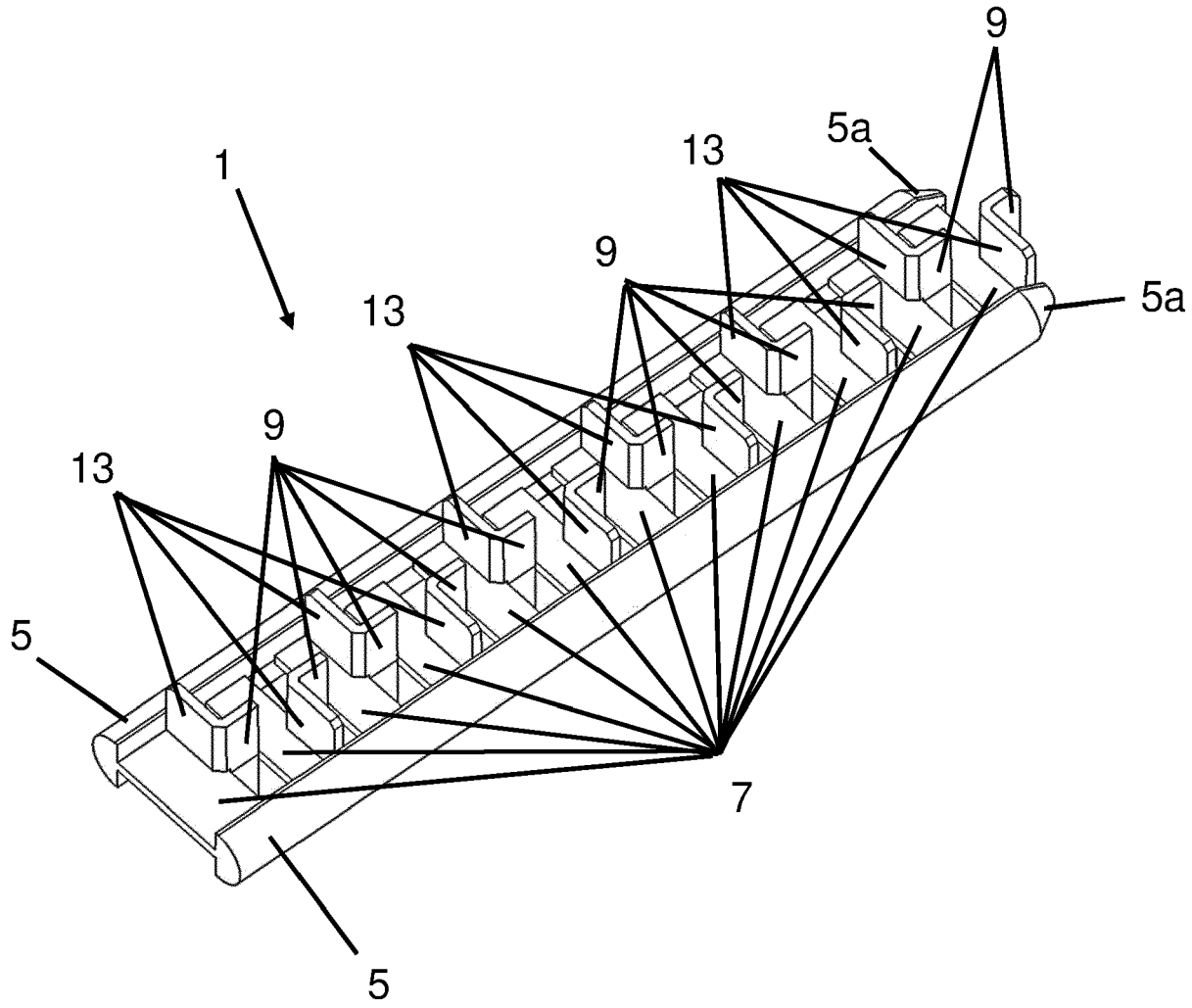


FIG. 2B

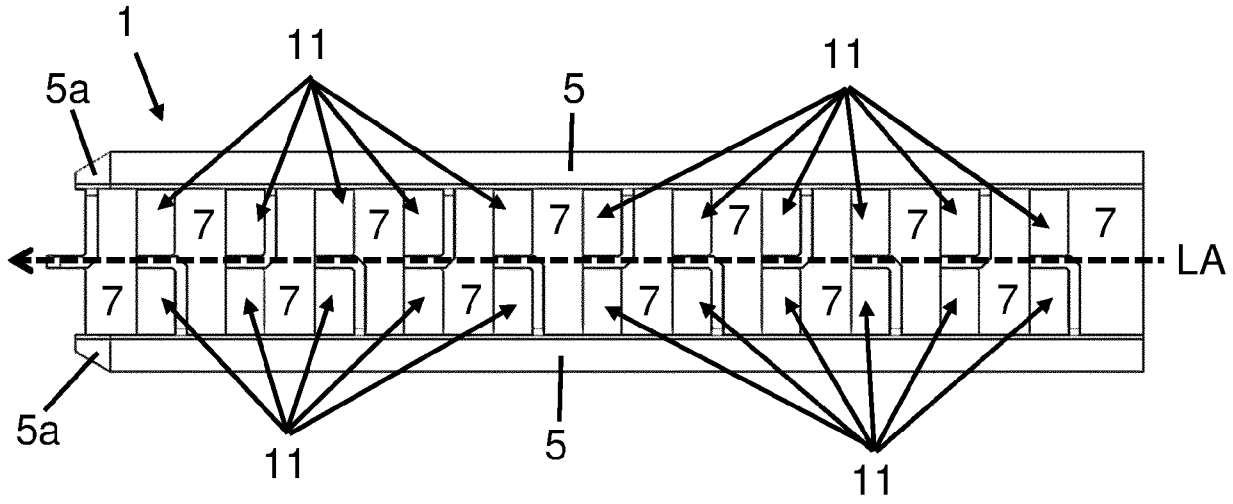


FIG. 2C

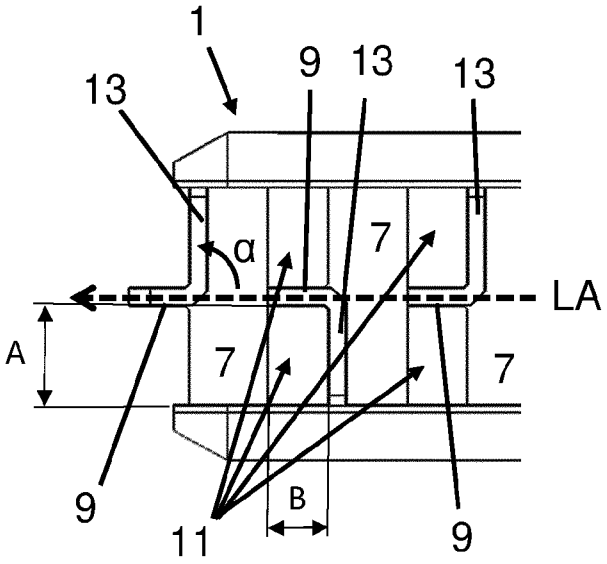


FIG. 2D

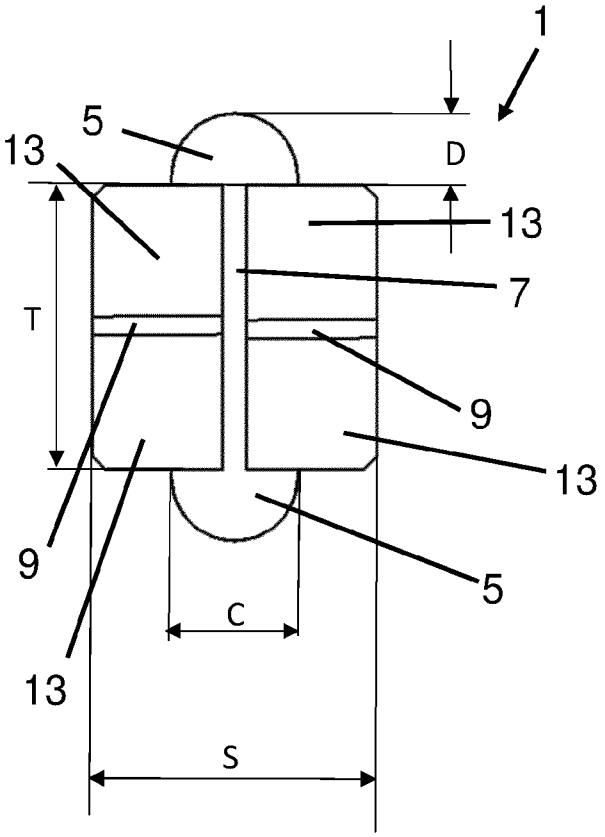


FIG. 2E

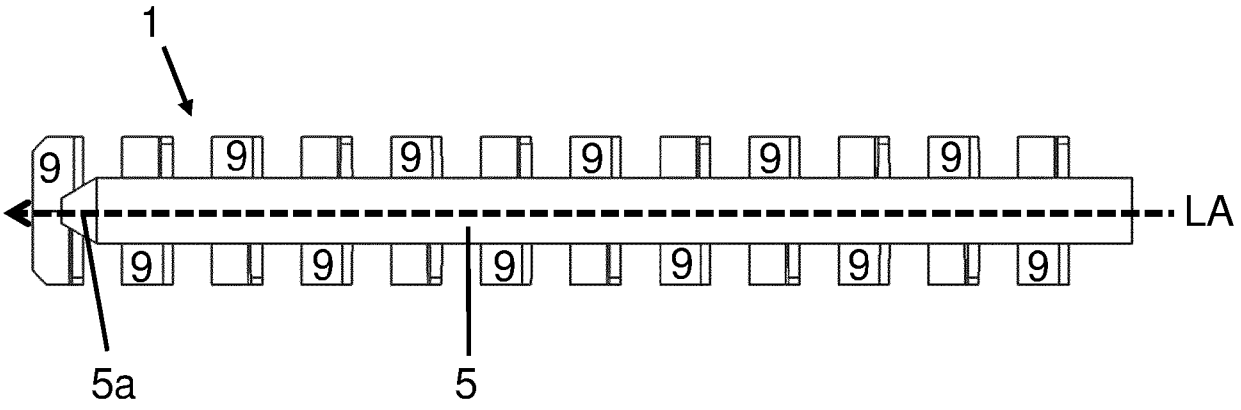


FIG. 2F

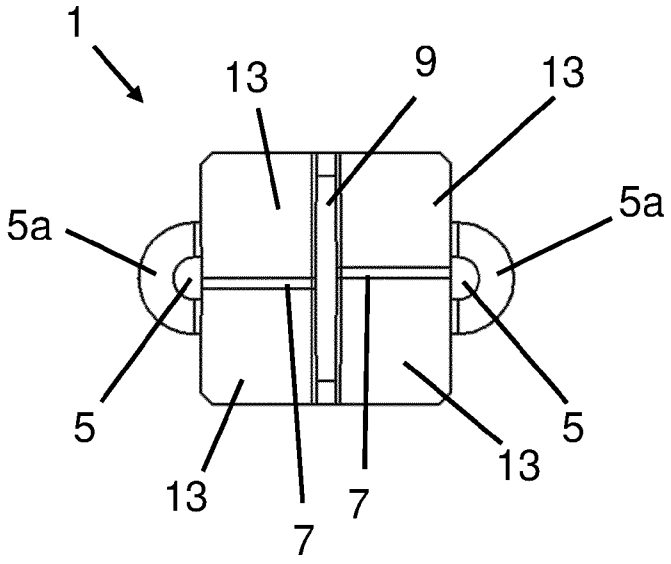


FIG. 3

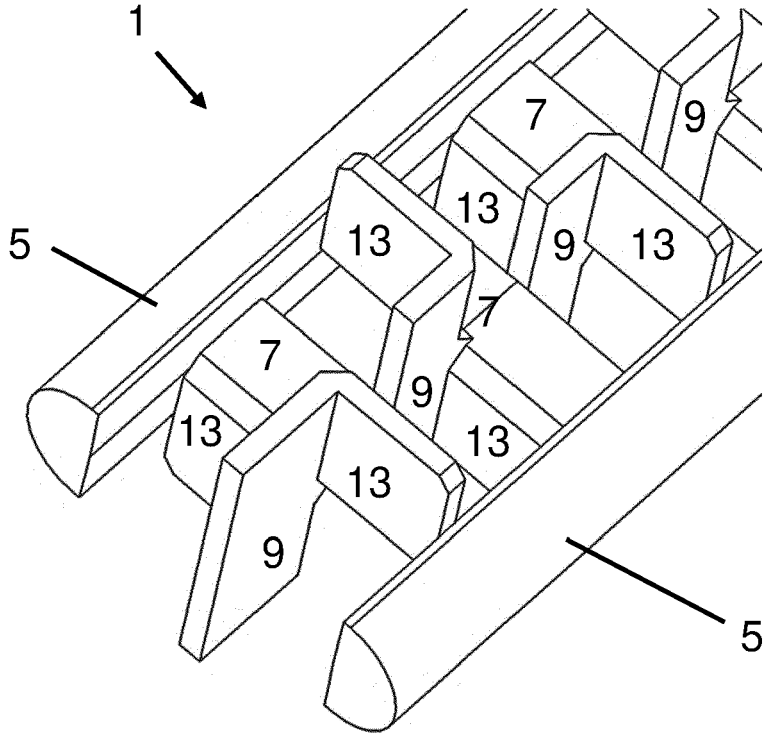


FIG. 4A

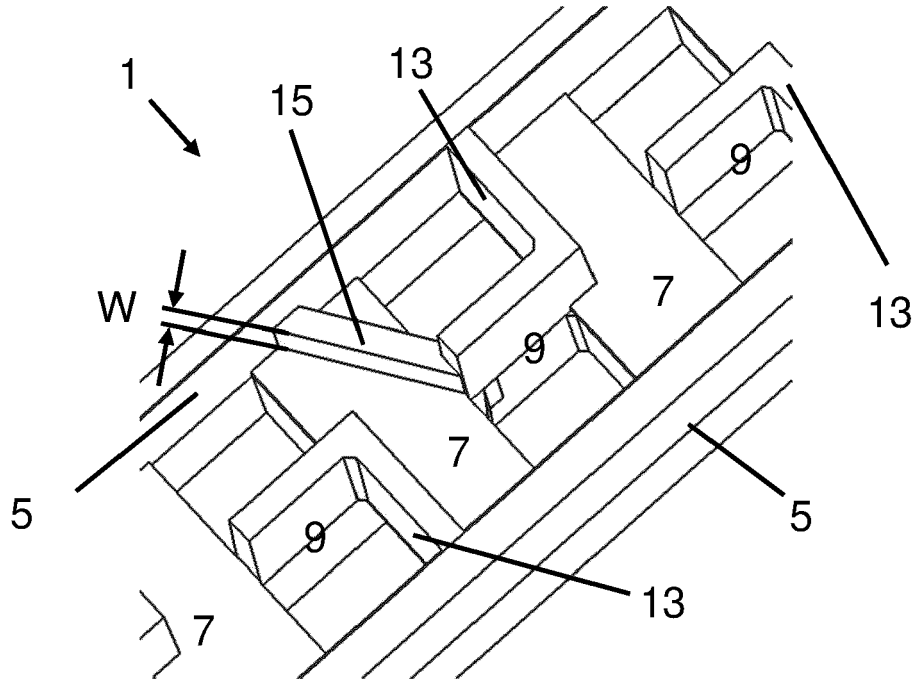


FIG. 4B

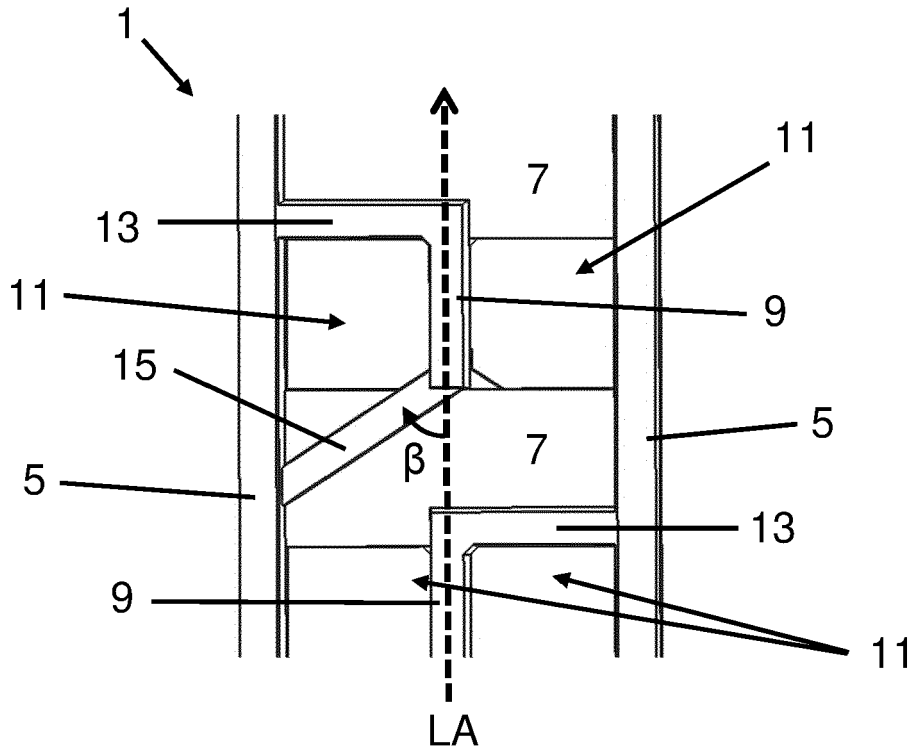


FIG. 5A

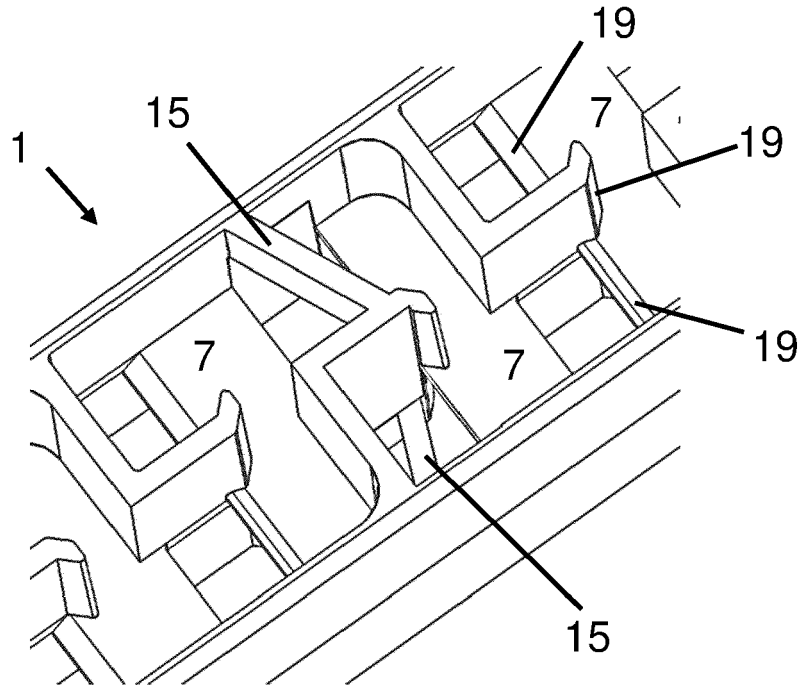


FIG. 5B

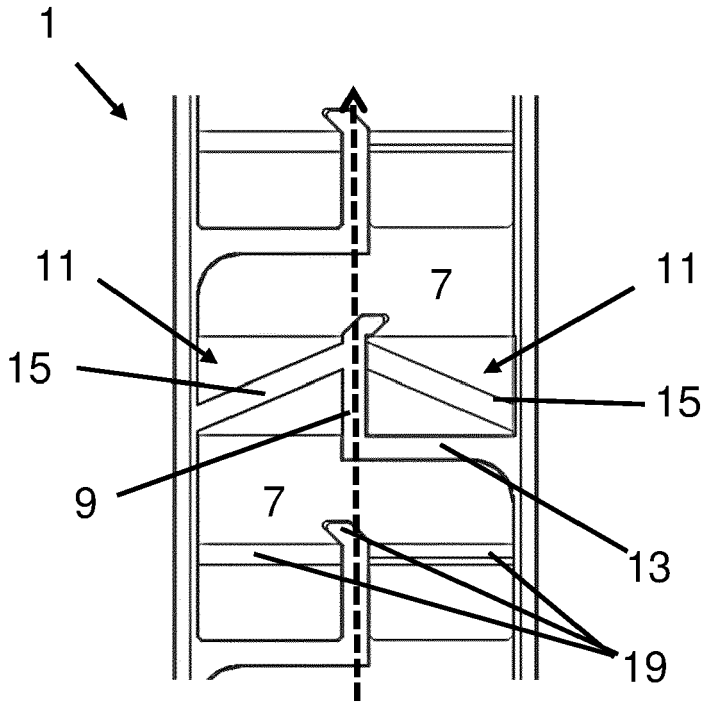


FIG. 6A

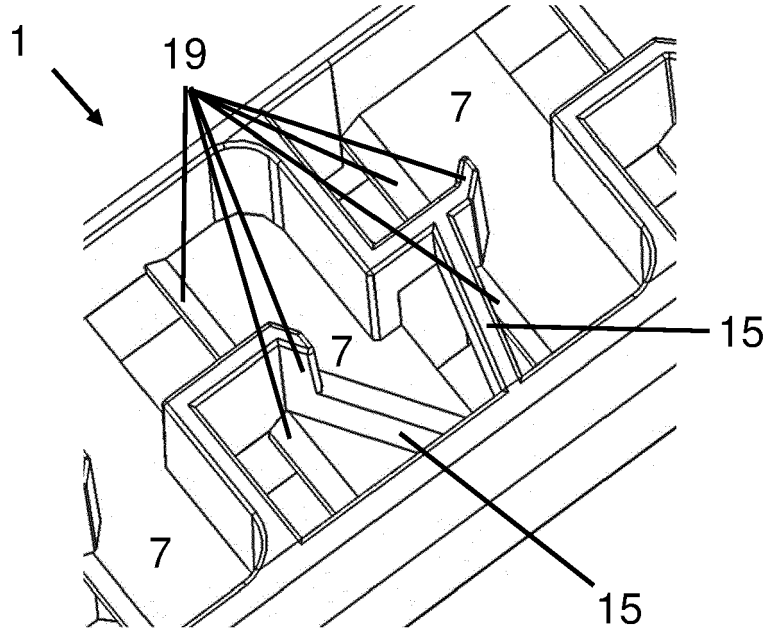


FIG. 6B

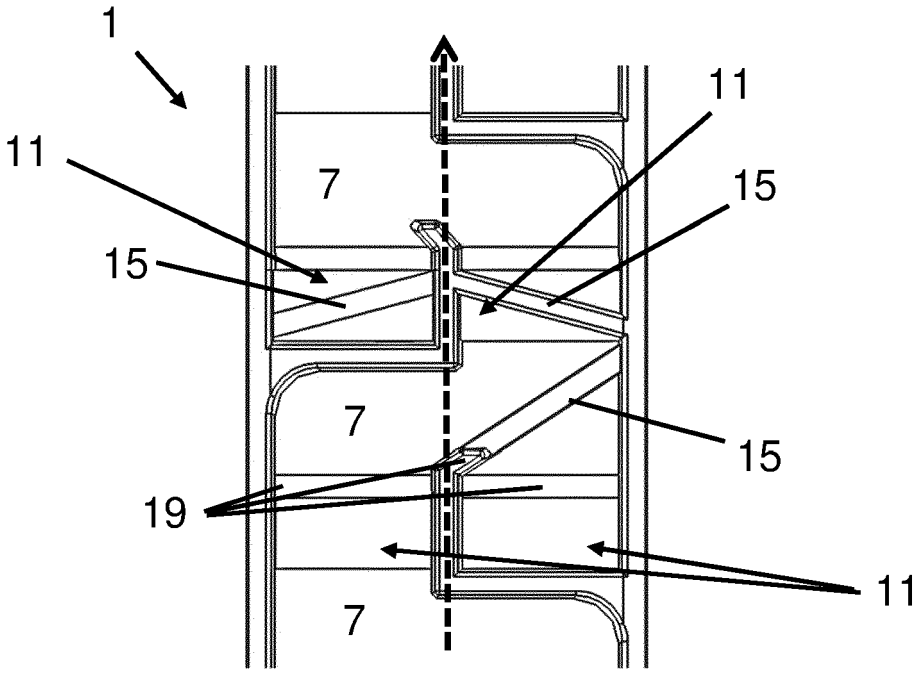


FIG. 7A

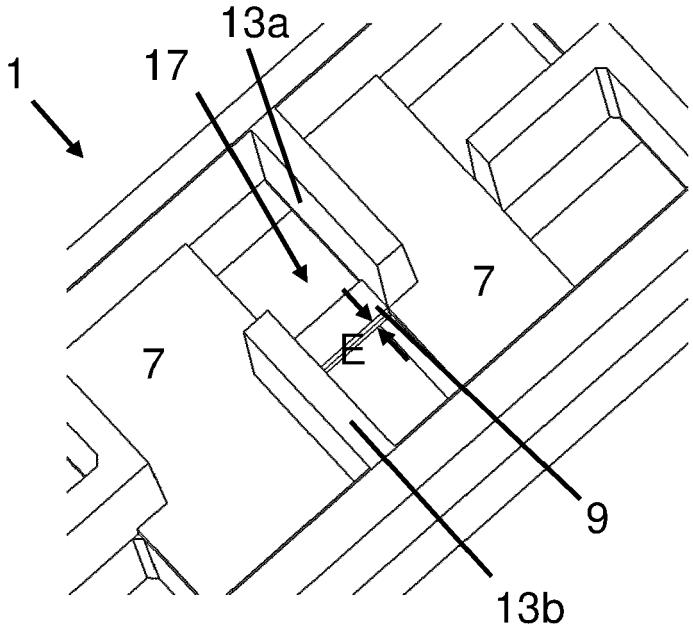


FIG. 7B

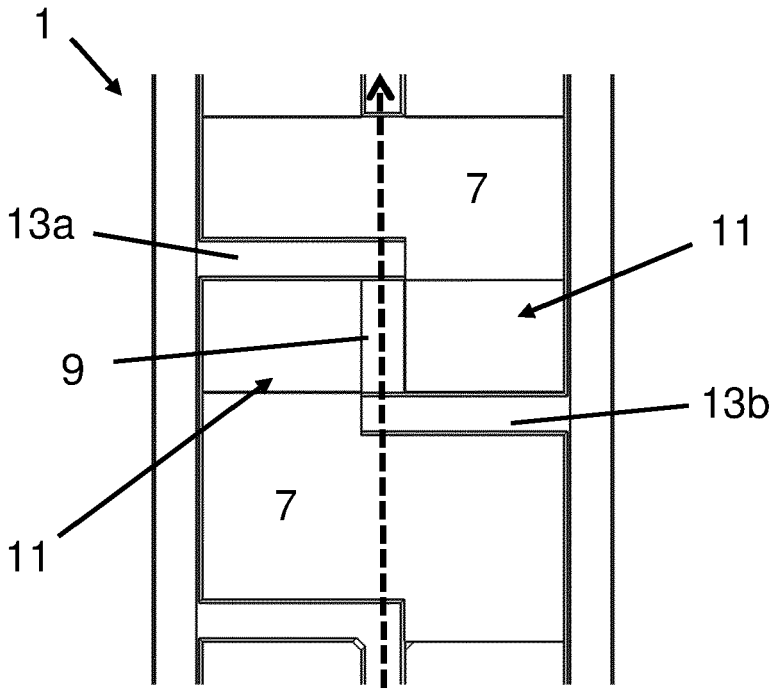


FIG. 8A

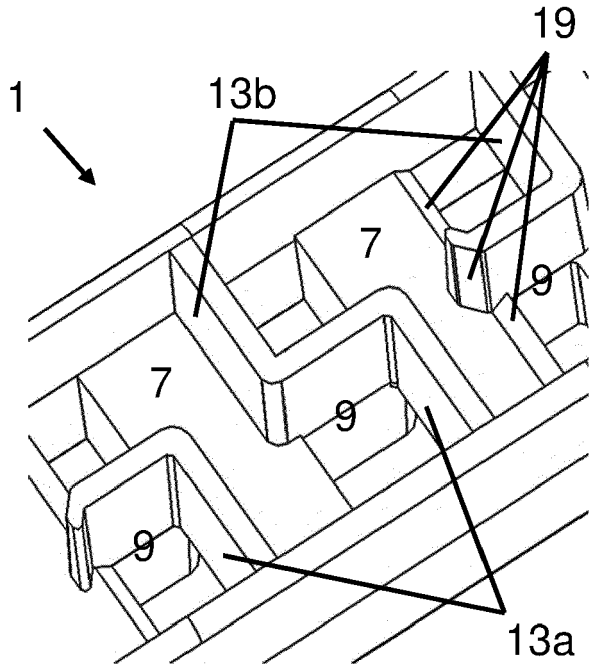


FIG. 8B

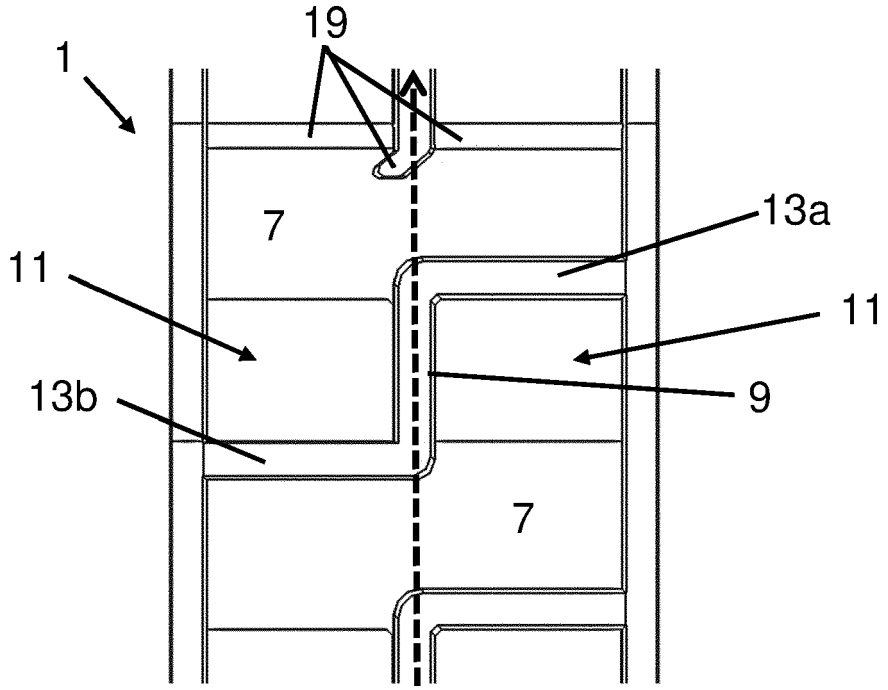


FIG. 9A

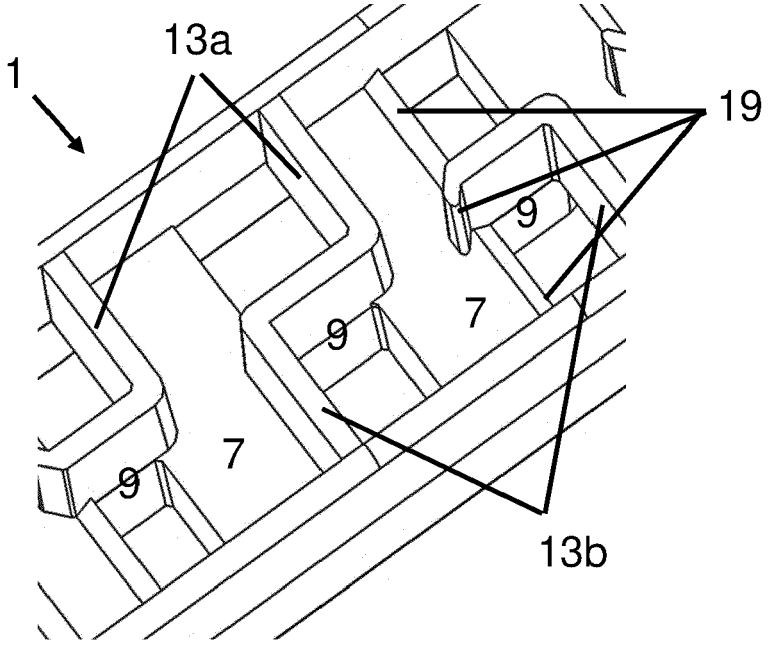


FIG. 9B

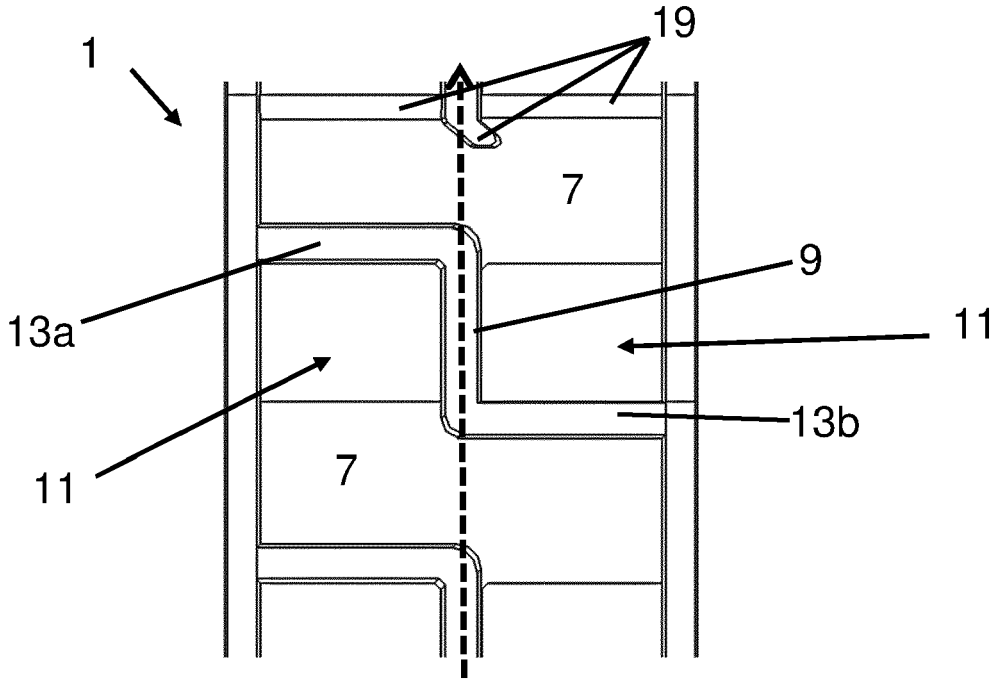


FIG. 10A

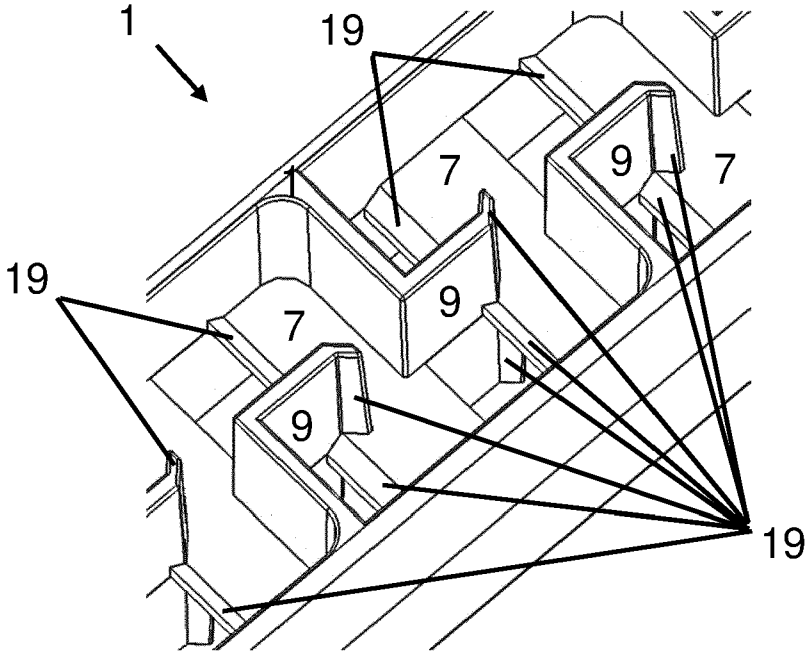
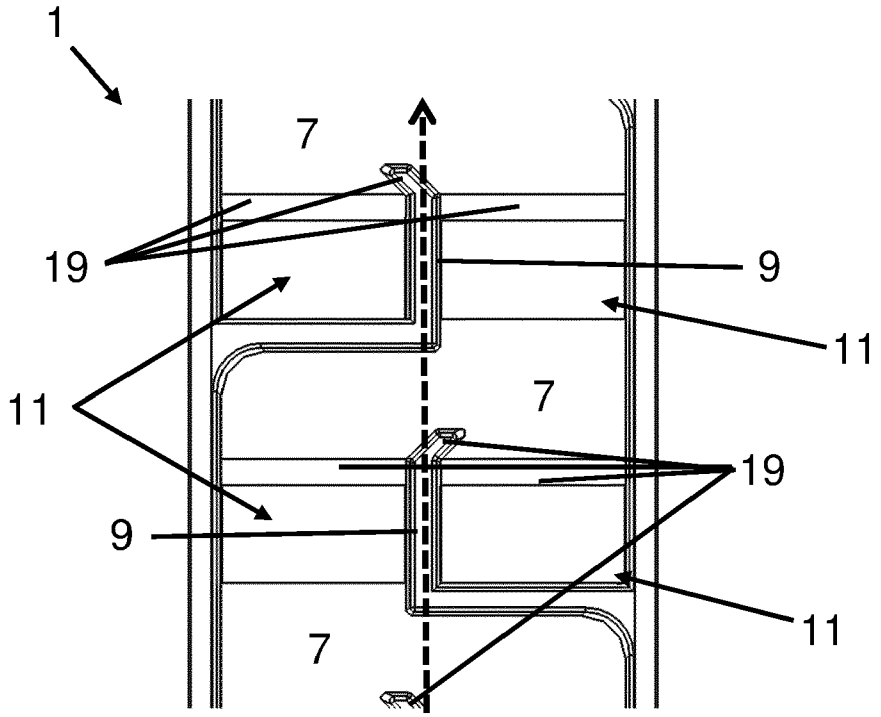


FIG. 10B



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EUROPEAN SEARCH REPORT

Application Number
EP 23 18 6652

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	EP 0 815 929 A1 (SULZER CHEMTECH AG [CH]) 7 January 1998 (1998-01-07) * abstract * * figures 1, 5, 6, 10,11, 12 *	1-12, 14-16	INV. B01F23/47 B01F25/431 B01F25/432
X	US 2020/171448 A1 (BUBLEWITZ ALEXANDER [DE] ET AL) 4 June 2020 (2020-06-04) * figures 8A-8C * * abstract * * paragraphs [0096], [0097] *	1-12, 14-16	
X	US 4 600 544 A (MIX THOMAS W [US]) 15 July 1986 (1986-07-15)	1-5, 10-12, 14,16	
A	* abstract * * figures 8, 12 *	6-9,15	
X	US 2009/073800 A1 (TARMANN PAUL G [US] ET AL) 19 March 2009 (2009-03-19)	1-3,5, 10-12, 14-16	
A	* figure 2 * * abstract *	4,6-9	TECHNICAL FIELDS SEARCHED (IPC) B01F

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	15 January 2024	Krasenbrink, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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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

EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 23 18 6652

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-12, 14-16

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 23 18 6652

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-12, 14-16

   static mixer insert comprising a tapered portion at the longitudinal end of each support bar

   ---

2. claim: 13(partially)

   static mixer insert comprising guiding bars tilted with respect to the longitudinal axis of the mixing structure

   ---

3. claim: 13(partially)

   static mixer insert comprising exchange elements formed of a first a deflection plate, a second deflection plate and a separation wall connecting said two deflection plates to each other

   ---

4. claim: 13(partially)

   static mixer insert comprising tilted separation aid plates connected to downstream and/or upstream ends of the separation walls

   ---

5. claims: 17, 18

   static mixer comprising a mixing tube with two longitudinally extending recesses for receiving the support bars

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 18 6652

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
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15-01-2024

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82