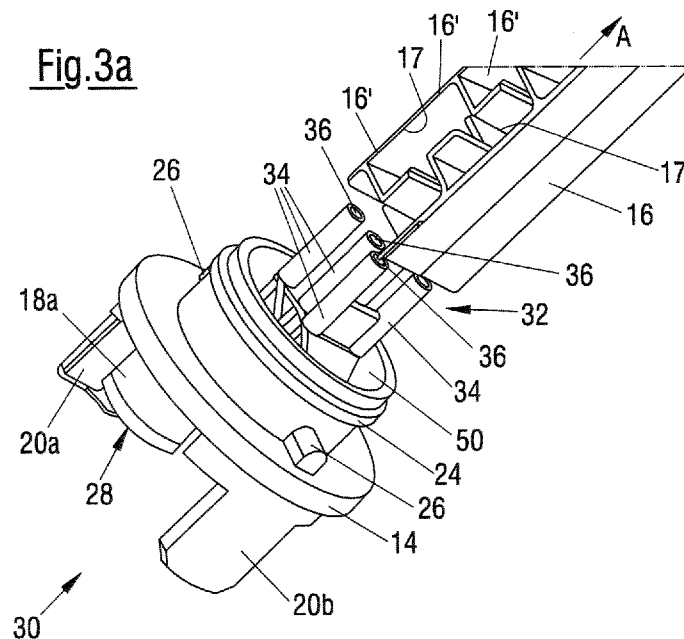




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(54) **Title:** MIXER, MULTI-COMPONENT DISPENSER, AND METHOD OF DISPENSING MULTI-COMPONENT MATERIAL FROM A MULTI-COMPONENT DISPENSER



(57) **Abstract:** The present application relates to a mixer for mixing multi-component materials, the mixer comprising a mixing element (16) arranged at a longitudinal axis of the mixer for mixing multi-component materials; and an inlet section (14) arranged at the longitudinal axis. The inlet section (14) comprises a first channel (28) for conducting a first component from an inlet side (30) to an outlet side (32), wherein said first channel (28) splits up into a set of sub-channels (34) within the inlet section (14), the set of sub-channels (34) opening into a set of first outlets (36) arranged at the outlet side (32) and the first outlets (36) being configured to direct a flow of a first component of the multi-component material to the mixing element (16) arranged at the outlet side (32). The application further relates to a multi-component dispenser and to a method of dispensing multi-component material from a multi-component dispenser.



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Mixer, multi-component dispenser, and method of dispensing multi-component material from a multi-component dispenser

The present invention relates to a mixer for mixing multi-component materials, the mixer comprising a mixing element arranged at a longitudinal axis of the mixer for mixing multi-component materials; and an inlet section arranged at the longitudinal axis. The invention further relates to a multi-component dispenser and to a method of dispensing multi-component material from a multi-component dispenser.

Mixers respectively mixing tips, as they are also known as, are used to mix multi-component material dispensed from a multi-component cartridge. Such mixers are used in a plethora of fields of application ranging from industrial applications, such as the use of adhesives to bond structural components one to another, or as protective coatings for buildings or vehicles, to medical and dental applications, for example, to make dental molds.

The multi-component material is, for example, a two-component adhesive comprising a filler material and a hardener. In order to obtain the best possible mixing result, e.g. an adhesive having the desired bond strength, the multi-component material has to be thoroughly mixed.

For this purpose the mixers comprise mixing elements arranged one after the other that repeatedly divide and re-combine part flows of the multi-component material to thoroughly mix the multi-component material.

On mixing the multi-component material, the material remaining in the mixer after the dispensing process is generally discarded as it remains in the mixer. Depending on the field of application the multi-component material can be comparatively expensive and may only be used for one application at a time. This is particularly true, for example in the dental field, where only part of the multi-component material stored in the cartridge is used for one application/patient at a time with the remaining multi-component material being stored in the multi-component cartridge for future applications. Thus, the excessive use of large volumes of multi-component material remaining in a mixer after a single use leads to unnecessary cost.

Moreover, if the difference in viscosities between the two fluids present in the multi-component cartridge is too large, then the resistance the fluid having the higher viscosity experiences as it traverses through the mixer is greater than that of the low viscosity fluid and hence can cause the low viscosity fluid to traverse through the mixer faster than the high viscosity fluid causing a sub-optimal mixing result.

For this reason it is an object of the present invention to provide a mixer that guides the multi-component material efficiently through the mixer for a thorough mixing of the multi-component material in the mixer, that enables a reduction in the amount of mixing material left behind in a mixer and that can be produced in an as facile manner as possible.

This object is satisfied in accordance with the subject matter having the features of claim 1.

Such a mixer comprises a mixing element arranged at a longitudinal axis of the mixer for mixing multi-component materials; and an inlet section arranged at the longitudinal axis; wherein said inlet section comprises a first channel for conducting a first component from an inlet side to an outlet side, wherein said first channel

splits up into a set of sub-channels within the inlet section, the set of sub-channels opening into a set of first outlets arranged at the outlet side and the first outlets being configured to direct a flow of the multi-component material to the mixing element arranged at the outlet side of the first outlets.

The use of a set of sub-channels to direct the flow of low viscosity material to the mixing element arranged at the outlet side of the first outlets in several partial streams and hence at spatially different locations ensures that the volume of low viscosity material arriving at the mixing element is reduced in comparison to prior art mixers and that due to the change in cross-section of the first channel that the resistance the low viscosity material experiences is increased in order to slow down the low viscosity material. Reducing the amount of low viscosity material arriving at the mixing element leads to an improvement of the mixing results achieved, since the respective flows of the multi-component material now comprise approximately the correct ratio of high viscosity material to low viscosity material on entering the mixing element in comparison to prior art mixers.

Thus, the inlet section is designed to achieve the best possible mixing results while using as small a volume of the respective material of the multi-component material as possible in order to limit the waste of multi-component material.

Preferably at least some and preferably all of the sub-channels are of cylindrical shape over at least a part of their length, optionally with the set of sub-channels being arranged such that they extend in parallel to the longitudinal axis. Circular channel diameters have shown the best mixing results in contrast to flat channels that are also conceivable but do not work as well. In this connection it should also notice that in contrast to circular channel designs, flat channel designs potentially face problems with manufacturing accuracy, hence cylindrically shaped sub-channels can also be manufactured in a more facile manner.

Advantageously a ratio of length of the sub-channels of cylindrical shape to inner diameter is at least 8, preferably at least 10 and especially less than 20. In this connection it should be noted that the length of the channels has found to be relevant as the high viscosity material has to flow in parallel to the low viscosity material guided through the first channel and the low viscosity material has to build up back-pressure in the sub-channels prior to exiting these. By selecting the length of the sub-channels appropriately one can set the ratio of high viscosity material to low viscosity material entering the mixing element, with the ratio set being required for a good mixing result of the materials in question.

It is preferred if the first outlets have an at least substantially circular outer and/or inner shape at the outlet side. As mentioned in the foregoing circular channel diameters have shown the best mixing results and are more simple to manufacture.

Preferably the set of sub-channels comprises between 3 and 12 sub-channels, preferably wherein the set of sub-channels comprises between 5 and 10 sub-channels, in particular wherein the set of sub-channels comprises 6 sub-channels.

Providing between 3 and 12 sub-channels enables a tailoring of the inlet section to the difference in viscosity between the different multi-component materials used. For mixtures having a large difference in viscosities six partial streams are considered as ideal. The number of sub-channels also relates to the space available for the high viscosity fluid flowing from the inlet section at the outlet side thereof, too many sub-channels leave no room for the high viscosity material and too few channels are not optimal for a good mixing result.

Advantageously an area of the first channel perpendicular to the longitudinal axis is greater than a sum of the areas of the set of sub-channels perpendicular to the longitudinal axis. By compressing the size of the flow path made available for the first component, the low viscosity material comes into contact with a larger area of

an inner wall of the sub-channel with which it interacts, increasing the resistance on the low viscosity component and hence slowing it down in comparison to prior art mixers.

It is preferred if said first channel splits up into a set of sub-passages prior to splitting up into said set of sub-channels within the inlet section. In this way the cross-section of the flow path of the component flowing through the first channel can be reduced stepwise using two steps.

The set of sub-channels in particular comprises more sub-channels than the set of sub-passages comprises sub-passages, especially wherein twice as many sub-channels are provided as sub-passages. Such an arrangement of sub-channels and sub-passages has shown to yield good mixing results. Moreover, arranging the sub-channels in pairs means they can also be connected one to another using webs to enhance the stability of the sub-channels.

It is advantageous if the set of sub-passages extend between the first channel and the set of sub-passages inclined with respect to the longitudinal axis, in this way a size of the inlet section can be reduced and a flow path of the first component can be directed towards the mixing element.

It is further preferred if the set of sub-passages are arranged in an intermediate section arranged between the inlet side and the outlet side, with a transition between the intermediate section and an outlet end of the inlet section comprising an outlet conversion of the set of sub-passages to the set of sub-channels; and/or with a transition between the intermediate section and an inlet end of the inlet section comprising an inlet conversion of the first channel to the set of sub-passages. Such an arrangement permits the inlet section to be formed from two or more parts that are subsequently connected one to another, thereby facilitating the manufacturing thereof.

Advantageously the inlet section comprises an outlet region and the set of sub-channels are distributed over the outlet region, preferably wherein the set of sub-channels are unevenly distributed over the outlet region. In this way the component flowing from the first outlets is split up over the outlet region to ensure a mixing with a further component.

Preferably the set of sub-channels having the first outlets project from the outlet region, in particular wherein the set of sub-channels having the first outlets project from a base section arranged at a base of the outlet region, preferably wherein the set of sub-passages split up into said set of sub-channels within the base section. Forming the first outlets such that they project beyond the outlet region means that a length of the sub-channels can be designed such that a back-pressure can be built up in the comparatively narrow sub-channels to ensure that the first and second components arrive at the mixing element at approximately the same time and at approximately the same speed to enable a good mixing result.

Advantageously the mixing element has a mixing element area perpendicular to the longitudinal axis that is less than an area of the outlet region perpendicular to the longitudinal axis, wherein the first outlets are arranged projecting from the base section and distributed over an area corresponding to the mixing element area of the mixing element. In this way the flow of the first component can be directed directly at the mixing element.

It is preferred if the inlet section comprises a second channel for conducting a second component from the inlet side to the outlet side, wherein said second channel has a second outlet, in particular only one second outlet, at the outlet region. In this way the low viscosity material is split up into several partial streams that are fed into the high viscosity material at spatially different locations to improve a mixing result.

In this connection it is advantageous if the second outlet surrounds the first outlets, and preferably surrounds each of the first outlets in order to ensure an injection of the low viscosity material into the high viscosity material at spatially different locations.

Preferably the first outlets project from the outlet region beyond a height of the second outlet. In this way the second component that needs to establish flow can flow towards the first outlets while the first component builds up sufficient back-pressure in the sub-channels, so that the two components arrive at the mixing element at substantially the same time and the same speed to ensure a thorough through mixing thereof.

It is preferred if an area of the second channel perpendicular to the longitudinal axis at the inlet side is less than an area of the second outlet perpendicular to the longitudinal axis. Increasing the area available for the second component, i.e. the component that has a higher viscosity than the component flowing through the sub-channels, means that the second component is less likely to come into contact with the inner housing wall in the region of the outlet region. The contact between the second contact and the inner housing wall produces a resistance between the two causing the second component to slow down.

It is further preferred if the first and second channels comprise first and second inlets for connecting the mixer to a cartridge comprising first and second containers for storage of the multi-component materials. In this way the inlets into the mixer can also function as a connector to the cartridge.

Advantageously a spacing between the first outlets and a first mixing segment of the mixing element is selected in the range of 0.1 to 1, preferably 0.4 to 0.6, especially around 0.5, times the height of the first mixing segment along the longitudinal

axis. By setting the spacing between the first mixing segment of the mixing element and the first outlets, the mixer can be tailored to the specific viscosities of the multi-component materials to be mixed in the mixer.

According to a further aspect the present invention relates to a multi-component dispenser, the multi-component dispenser comprising: a mixer in accordance with the teaching presented herein; a cartridge, with the cartridge preferably being filed with multi-component material; as well as a dispensing mechanism configured to bring about a movement of said multi-component material from the cartridge and through the mixer.

The advantages discussed in the foregoing in relation to the mixer likewise hold true for the dispensing assembly in accordance with the invention.

The multi-component cartridge of the multi-component dispenser can thus be filled with materials selected from the group of members consisting of topical medications, medical fluids, wound care fluids, cosmetic and/or skin care preparations, dental fluids, veterinary fluids, adhesive fluids, disinfectant fluids, protective fluids, paints and combinations of the foregoing.

Such fluids and hence the dispensing assembly can therefore be expediently used in the treatment of target areas such as the nose (e.g. anti-histaminic creams etc.), ears, teeth (e.g. molds for implants or buccal applications (e.g. aphtas, gum treatment, mouth sores etc.)), eyes (e.g. the precise deposition of drugs on eyelids (e.g. chalazion, infection, anti-inflammatory, antibiotics etc.)), lips (e.g. herpes), mouth, skin (e.g. anti-fungal, dark spot, acne, warts, psoriasis, skin cancer treatment, tattoo removal drugs, wound healing, scar treatment, stain removal, anti-itch applications etc.), other dermatological applications (e.g. skin nails (for example anti-fungal applications, or strengthening formulas etc.) or cytological applications.

Alternatively the fluids and hence the dispensing assembly can also be used in an industrial sector, e.g. in the building industry, the automotive industry etc., for example, as adhesives, paints, and/or as protective coatings.

According to a further aspect the present invention further relates to a method of dispensing multi-component material from a multi-component dispenser in accordance with the present teaching, when filled with multi-component material, the method comprising the steps of: moving said multi-component material from the cartridge into the mixer, with a first component being guided in the first channel; conducting the first component through the first channel and splitting up a flow of the first component in such a way that a set of separated partial-streams of the first component result that subsequently exit said set of first outlets in the direction of the mixing element, and optionally conducting the second component through the second channel to the second outlet such that a stream of material of the second component surrounds each partial-stream of the set of partial-streams of the first component.

By way of such a method the multi-component material can be made available in an expedient manner at the mixing element prior to the actual mixing taking place in the mixer.

Further embodiments of the invention are described in the following description of the Figures. The invention will be explained in the following in detail by means of embodiments and with reference to the drawing in which is shown:

- Figs. 1a & 1b perspective views of a mixer;
- Fig. 2 a perspective view of dispenser;
- Fig. 3a a part schematic view of the mixer of Fig. 1a;
- Fig. 3b an enlarged view of an inlet section of the mixer of Fig. 3a;
- and

Fig. 3c a part schematic part sectional view of the inlet section of the mixer of Fig. 3a.

In the following the same reference numerals will be used for parts having the same or equivalent function. Any statements made having regard to the direction of a component are made relative to the position shown in the drawing and can naturally vary in the actual position of application.

Fig. 1a shows a side view of a first type of mixer 10 having a first type of mixer housing 12. The mixer 10 has a longitudinal axis A extending from an inlet section 14 through the housing 12 to an outlet 22 from the housing 12. A mixing element 16 (see Fig. 3) and part of the inlet section 14 (see Fig. 3) are arranged within the mixer housing 12. One inlet 18a into the inlet section 14 can be seen, as can alignment means 20a, 20b by means of which the inlet section 14 is aligned relative to a cartridge 100 (see Fig. 9).

Fig. 1b shows a second type of mixer 10' in a second type of mixer housing 12'. The mixer of Fig. 1b can for example be used for low ratio mixing of components such as 1:1 or 2:1 mixing ratios.

Fig. 2 shows a multi-component dispenser 98 comprising a multi-component cartridge 100 and the mixer 10. The multi-component cartridge 100 is filled with respective multi-component materials 102a, 102b. The multi-component materials 102a, 102b are stored in respective containers 104a, 104b and can be discharged from the cartridge 100 by means of a plunger (not shown) as a dispensing mechanism configured to bring about a movement of said multi-component material 102a, 102b from the cartridge 100 and into the inlets 18a, 18b of the inlet section 14 of the mixer 10.

The mixer 10 is connected to the cartridge 100, on the one hand, by means of the alignment means 20a, 20b for a coded alignment between the mixer 10 and the cartridge 100. On the other hand, the mixer 10 is connected to the cartridge 100 by a retainer nut (not shown). The retainer nut is adapted to cooperate with the cartridge 100 and engages the mixer housing 12 of the mixer 10 in order to fix the mixer 10 to the cartridge 100.

The mixer 10 could also be connected to the cartridge 100 by other forms of connection means, such as a bayonet connection or a plug-on connection. Similarly further alignment means 20a, 20b, or alignment means 20a, 20b different from the ones shown in the drawings can be used to connect the mixer 10 to the cartridge 100 in an aligned manner.

In this connection it should be noted that the following description of the mixer 10 relates to a static mixer 10, it is however possible to employ the inlet section 14 described in the following in a dynamic mixer (not shown).

Fig. 3a shows a part schematic view of the mixer 10 of Fig. 1a without the housing 12. The housing 12 is typically attached to the inlet section 14 via an annular protrusion 24 that engages a recess (not shown) formed in the inner surface of the housing 12 and two noses 26 that engage corresponding cut outs (also not shown) present at the housing 12.

The mixer 10 is configured to mix multi-component materials 102a, 102b. For this purpose the mixer 10 comprises the mixing element 16 arranged at the longitudinal axis A of the mixer 10 and the inlet section 14 also arranged at the longitudinal axis A. The mixing element 16 is configured to mix multi-component materials.

For the purpose of mixing the multi-component material 102a, 102b, the mixing element 16 comprises several mixing segments 16' arranged one after the other

along the longitudinal axis A. Each mixing segment 16' is configured to divide and re-combine part flows of the multi-component material 102a, 102b along the longitudinal axis A. In this way the part flows of the multi-component material 102a, 102b are repeatedly divided and re-combined by the mixing element 16 and the several mixing segments 16' along the longitudinal axis A so that the multi-component material 102a, 102b is thoroughly mixed prior to this exiting the outlet 22.

In this connection it should be noted that each mixing segment 16' of the mixing element 16 can have a height in the direction in parallel to the longitudinal axis A selected in the range of 2 to 18 mm, preferably in the range of 4 to 15 mm.

In this connection it should further be noted that a mixing element 16 is typically composed of between 2 and 20, especially of between 4 and 16 mixing segments 16'. The number of mixing segments 16' used for a mixing element 16 depends on the multi-component material 102a, 102b, i.e. the viscosities thereof, to be mixed by the mixing element 16.

The inlet section 14 is configured to guide the multi-component materials 102a, 102b to the mixing element 16 in such a way that a mixing result of the multi-component materials 102a, 102b is improved in the mixer 10.

The specific type of mixing element 16 used can be varied and can be selected as e.g. a quadro mixer, or a T-mixer sold by Sulzer Mixpac Ltd. The present invention is not limited to the specific type of mixing element 16.

The inlet section 14 comprises a first channel 28 (see also Fig. 3a) for conducting a first component 102a of the multi-component material from an inlet side 30 to an outlet side 32.

The first channel 28 splits up into a set of sub-channels 34 within the inlet section 14, with the set of sub-channels 34 opening into a set of first outlets 36 arranged at the outlet side 32. The first outlets 36 are configured to direct a flow of the multi-component material 102a to the mixing element 16 arranged at the outlet side 32.

In this connection it should be noted that the inlet side 30 does not denote a specific surface, but rather relates to that part of the inlet section 14 comprising the inlets 18a, 18b, similarly the outlet side 32 does not denote a specific surface, but rather relates to that part of the inlet section 14 comprising the inlets 18a, 18b the first outlets 36 and a second outlet 54 (see Fig. 3c).

The mixing element 16 has a mixing element area perpendicular to the longitudinal axis A that is less than an area of an outlet region 50 perpendicular to the longitudinal axis A. The first outlets 36 are arranged distributed over an area corresponding to the mixing element area of the mixing element 16 in order to ensure that a flow of streams of the first component 102a, i.e. the low viscosity material, is directed, preferably directly, at the mixing element 16.

In this connection it should be noted that a spacing between the first outlets 36 and the mixing element 16, i.e. a first mixing segment 16' of the several mixing segments 16' of the mixing element 16, along the longitudinal axis A is selected in the range of 0.1 to 1, preferably 0.4 to 0.6, especially around 0.5, times the height of the first mixing segment 16' along the longitudinal axis A. In this connection it should further be noted that the spacing between the first outlets 36 and the first mixing segment 16' is selected in the range of range of 0 to 18 mm, in particular in the range of 0 to 15 mm, preferably in the range of 0.2 to 10 mm, especially preferably in the range of 0.4 to 5 mm, particularly in the range of 0.5 to 4 mm, especially of 1 to 3 mm.

In this way a spacing of the first outlets 36 to the mixing element 16 can be set. The spacing can be set in dependence on the difference in viscosities between the low viscosity component 102a and the high viscosity component 102b. For a large difference in viscosities the spacing between the first outlets 36 and the mixing element 16 is not allowed to be set too large, as the low viscosity component 102a then follows pathways as if the sub-channels 34 are not present. This is because the low viscosity component 102a can then flow close to walls 17 of the mixing element 16 which leads to a reduction in the mixing result of the multi-component materials 102a, 102b.

If the distance is selected as too small or if the first outlets 36 penetrate the mixing segment for a smaller difference in viscosities, then the walls 17 of the mixing element 16 may partly block the first outlets 36. In this connection it should also be noted that if the spacing between the first outlets 36 and the mixing segment is too small then the low viscosity component 102a can also flow too close to the walls 17.

Fig. 3b shows an enlarged view of the inlet section 14 of the mixer 10 of Fig. 3a. The sub-channels 34 are of cylindrical shape over their length between a base section 38 and the first outlets 36 and extend in parallel to the longitudinal axis A.

A web 40 of material is arranged between each pair of sub-channels 34. The webs 40 of material are respectively provided to connect two sub-channels 34 one to another in order to increase their stability and ensure their alignment with respect to the mixing element 16. The webs 40 of material project from the base section 38 between the respective pair of sub-channels 34.

In this connection it should be noted that a ratio of length of the sub-channels 34 of cylindrical shape to inner diameter of each sub-channel 34 is 10. The first outlets 36 have a circular outer and inner shape at the outlet side 32.

It should further be noted that the length of each sub-channel 34 can be selected in the range of 5 to 20 mm, preferably in the range of 7 to 13 mm and especially around 10 mm.

It should further be noted that an internal diameter of each of the sub-channels 34 and of each of the first outlets 36 is adapted to the viscosity of the low viscosity material 102a. In this connection diameters in the range of 0.1 to 2 mm, in particular of 0.7 to 1.3 mm and especially of around 1 mm have been found to be advantageous.

These parameters are selected in order to ensure a uniform guiding of partial streams of the first component 102a of the multi-component material directed at the mixing element 16 arranged at the outlet side 32. In this connection it should be noted that it is also important that the diameter of each sub-channel 34 is made with low tolerances.

The inlet section 14 comprises 6 sub-channels 34 in the present instance. It should be noted in this connection that the set of sub-channels 34 could comprise between 3 and 12 sub-channels 34, preferably between 5 and 10 sub-channels 34.

An area of the first channel 28 perpendicular to the longitudinal axis A is greater than a sum of the areas of the set of sub-channels 34 perpendicular to the longitudinal axis A. In the present instance the sum of the areas of the sub-channels 34 amounts to 18.85 mm^2 (1 mm diameter for each sub-channel 34), whereas that of the first channel 28 amounts to 28.3 mm^2 (3 mm diameter for the first channel 28).

Fig. 3c shows a part schematic part sectional view of the inlet section 14 of the mixer 10 of Fig. 3a. The first channel 28 splits up into a set of sub-passages 42 (of

which only one is visible in the section of Fig. 3c) prior to splitting up into said set of sub-channels 34 within the inlet section 14. In the embodiment shown twice as many sub-channels 34 are provided as sub-passages 42.

The set of sub-passages 42 extend between the first channel 28 and the set of sub-channels 34 inclined with respect to the longitudinal axis A. For this purpose the set of sub-passages 42 are arranged in an intermediate section 44 arranged between the inlet side 30 and the outlet side 32.

A transition between the intermediate section 44 and the outlet side 32 comprises an outlet conversion 46 of the set of sub-passages 42 to the set of sub-channels 34.

A transition between the intermediate section 44 and the inlet side 30 comprises an inlet conversion 48 of the first channel 28 to the set of sub-passages 42.

The inlet section 14 further comprises the outlet region 50 and the set of sub-channels 34 are unevenly distributed over the outlet region 50. The set of sub-channels 34 are arranged to project from the outlet region 50. More specifically the set of sub-channels 34 project from the base section 38 arranged at a base 52 of the outlet region 50. The set of sub-passages 42 split up into said set of sub-channels 34 within the base section 38.

The inlet section 14 further comprises a second channel 56 for conducting a second component 102b of the multi-component material from the inlet side 30 to the outlet side 32. The second channel has the second outlet 54 at the outlet region 50. The second outlet 54 is designed such that the material 102b flowing through the second channel that has a higher viscosity than the material 102a flowing through the first channel 28 arrives at the first outlets 36 at approximately the same time as the low viscosity material 102a, such that the low viscosity material

that has been split up in several partial streams is fed into the high viscosity material 102b at spatially different locations prior to entering the mixing element 16, with the first and second materials 102a, 102b entering the mixing element 16 at approximately the same time and speed and at a desired mixing ratio. For this purpose the second outlet 54 is designed to surround each of the first outlets 36. To ensure an improved mixing the first outlets 36 project from the outlet region 50 beyond a height of the second outlet 54 so that the first component 102a can be injected into the second component in an efficient manner.

An area of the second channel 56 perpendicular to the longitudinal axis A at the inlet side 30 is less than an area of the second outlet 54 perpendicular to the longitudinal axis A.

As indicated in Fig. 3c the first and second channels 28, 56 comprise the first and second inlets 18a, 18b for connecting the mixer 10 to the cartridge 100 comprising first and second containers 104a, 104b for the storage of the multi-component materials 102a, 102b.

In use of the mixer 10 the multi-component material 102a, 102b, is dispensed via the multi-component dispenser 98. For this purpose the multi-component material 102a, 102b is guided from the cartridge 100 into the inlets 18a, 18b of the inlet section 14 of the mixer 10.

The first component 102a having a lower viscosity than the second component 102b is guided in the first channel 28. The first component 102a is then conducted through the first channel 28 and split up into partial-flows in the sub-passages 42 present in the intermediate section 44 following the conductance of the first component 102a through the sub-passages 42, the first component 102a is again split up into the set of sub-channels 34 in such a way that a set of separated partial-streams result that subsequently exit said set of first outlets 36 in the direction of

the mixing element 16 for a thorough through mixing with the second component 102b.

The second component 102b, i.e. the component having a higher viscosity than the first component 102a, is conducted through the second channel 56 to the second outlet 54 such that a single stream of material of the second component surrounds each partial-stream of the set of partial-streams of the first component 102a in order to feed the first component 102a of low viscosity material into the second component 102b of high viscosity material such that a pre-mixing of the multi-component material 102a, 102b takes place before introducing the multi-component material 102a, 102b into the mixing element 16. Thereby the mixing results achievable with the mixer 10 can be improved considerably in contrast to prior art mixers.

List of reference numerals

10, 10'	mixer
12, 12'	housing
14	inlet section
16	mixing element
16'	mixing segment
17	wall
18a, 18b	inlet, inlet
20a, 20b	alignment means, alignment means
22	outlet
24	annular protrusion
26	nose
28	first channel
30	inlet side
32	outlet side
34	sub-channels
36	first outlets
38	base section
40	web
42	sub-passage
44	intermediate section
46	outlet conversion
48	inlet conversion
50	outlet region
52	base of outlet region
54	second outlet
56	second channel
98	multi-component dispenser
100	cartridge
102a, 102b	multi-component material
104a, 104b	container
A	longitudinal axis

Claims

1. A mixer (10, 10') for mixing multi-component materials (102a, 102b), the mixer (10, 10') comprising
 - a mixing element (16) arranged at a longitudinal axis (A) of the mixer (10, 10') for mixing multi-component materials (102a, 102b); and
 - an inlet section (14) arranged at the longitudinal axis (A);wherein said inlet section (14) comprises
 - a first channel (28) for conducting a first component (102a) from an inlet side (30) to an outlet side (32), wherein said first channel (28) splits up into a set of sub-channels (34) within the inlet section (14), the set of sub-channels (34) opening into a set of first outlets (36) arranged at the outlet side (32) and the first outlets (36) being configured to direct a flow of a first component of the multi-component material (102a) to the mixing element (16) arranged at the outlet side (32).
2. A mixer (10, 10') according to claim 1, wherein at least some and preferably all of the sub-channels (34) are of cylindrical shape over at least a part of their length, optionally with the set of sub-channels (34) being arranged such that they extend in parallel to the longitudinal axis (A).
3. A mixer (10, 10') according to claim 2, wherein a ratio of length of the sub-channels (34) of cylindrical shape to inner diameter is at least 8, preferably at least 10 and especially less than 20.

4. A mixer (10, 10') according to at least one of the preceding claims, wherein the first outlets (36) have an at least substantially circular outer and/or inner shape at the outlet side.
5. A mixer (10, 10') according to at least one of the preceding claims, wherein the set of sub-channels (34) comprises between 3 and 12 sub-channels (34), preferably wherein the set of sub-channels (34) comprises between 5 and 10 sub-channels (34), in particular wherein the set of sub-channels (34) comprises 6 sub-channels (34).
6. A mixer (10, 10') according to at least one of the preceding claims, wherein in an area of the first channel (28) perpendicular to the longitudinal axis (A) is greater than a sum of the areas of the set of sub-channels (34) perpendicular to the longitudinal axis (A).
7. A mixer (10, 10') according to at least one of the preceding claims, wherein said first channel (28) splits up into a set of sub-passages (42) prior to splitting up into said set of sub-channels (34) within the inlet section (14), in particular with the set of sub-channels (34) comprising more sub-channels (34) than the set of sub-passages (42) comprises sub-passages (42), especially wherein twice as many sub-channels (34) are provided as sub-passages (42).
8. A mixer (10, 10') according to claim 7, wherein the set of sub-passages (42) extend between the first channel (28) and the set of sub-channels (34) inclined with respect to the longitudinal axis (A); and/or wherein the set of sub-passages (42) are arranged in an intermediate section (44) arranged between the inlet side (30) and the outlet side (32), with a transition between the intermediate section (44) and the outlet side (32) of the inlet section (14) comprising an outlet conversion (46) of the set of sub-

passages (42) to the set of sub-channels (34); and/or with a transition between the intermediate section (44) and the inlet side (30) of the inlet section (14) comprising an inlet conversion (48) of the first channel (28) to the set of sub-passages (42).

9. A mixer (10, 10') according to at least one of the preceding claims, wherein the inlet section (14) comprises an outlet region (50) and the set of sub-channels (34) are distributed over the outlet region (50), preferably wherein the set of sub-channels (34) are unevenly distributed over the outlet region (50).
10. A mixer (10, 10') according to claim 9, preferably when dependent on claim 7 or claim 8, wherein the set of sub-channels (34) having the first outlets (36) project from the outlet region (50), in particular wherein the set of sub-channels (34) having the first outlets (36) project from a base section (38) arranged at a base (52) of the outlet region (50), preferably wherein the set of sub-passages (42) split up into said set of sub-channels (34) within the base section (38).
11. A mixer (10, 10') according to claim 9 or claim 10, wherein the mixing element (16) has a mixing element area perpendicular to the longitudinal axis (A) that is less than an area of the outlet region (50) perpendicular to the longitudinal axis (A), wherein the first outlets (36) are arranged projecting from the base section (38) and distributed over an area corresponding to the mixing element area of the mixing element (16).
12. A mixer (10, 10') according to at least one of the preceding claims, in particular when dependent on one of the claims 9 to 11, wherein the inlet section (14) comprises a second channel (56) for conducting a second component (102b) from the inlet side (30) to the outlet side (32), wherein said

second channel (56) has a second outlet (54), in particular only one second outlet (54), at the outlet region (50), with the second outlet (54) in particular surrounding the first outlets (36), and preferably surrounding each of the first outlets (36).

13. A mixer (10, 10') according to claim 12 and at least one of the claims 9 to 11, wherein the first outlets (36) project from the outlet region (50) beyond a height of the second outlet (54); and/or wherein an area of the second channel (56) perpendicular to the longitudinal axis (A) at the inlet side (30) is less than an area of the second outlet (54) perpendicular to the longitudinal axis (A), and/or wherein the first and second channels (28, 56) comprise first and second inlets (18a, 18b) for connecting the mixer (10, 10') to a cartridge (100) comprising first and second containers (104a, 104b) for storage of the multi-component materials (102a, 102b).
14. A mixer (10, 10') according to at least one of the preceding claims, wherein a spacing between the first outlets (36) and a first mixing segment (16') of the mixing element (16) is selected in the range of 0.1 to 1, preferably 0.4 to 0.6, especially around 0.5, times the height of the first mixing segment (16') along the longitudinal axis (A).
15. A multi-component dispenser (98) comprising:
a mixer (10, 10') in accordance with at least one of the preceding claims;
a cartridge (100), with the cartridge (100) preferably being filled with multi-component material (102a, 102b); as well as
a dispensing mechanism configured to bring about a movement of said multi-component material (102a, 102b) from the cartridge (100) and through the mixer (10, 10').

16. A method of dispensing multi-component material (102a, 102b) from a multi-component dispenser (98) according to claim 15, in particular when dependent on claim 12 or claim 13, when filed with multi-component material (102a, 102b), the method comprising the steps of:
- moving said multi-component material (102a, 102b) from the cartridge (100) into the mixer (10, 10'), with a first component (102a) being guided in the first channel (28);
 - conducting the first component (102a) through the first channel (28) and splitting up a flow of the first component (102a) in such a way that a set of separated partial-streams of the first component (102a) result that subsequently exit said set of first outlets (36) in the direction of the mixing element (16), and optionally
 - conducting the second component (102b) through the second channel (56) to the second outlet (54) such that a stream of material of the second component (102b) surrounds each partial-stream of the set of partial-streams of the first component (102a).

Fig.1a

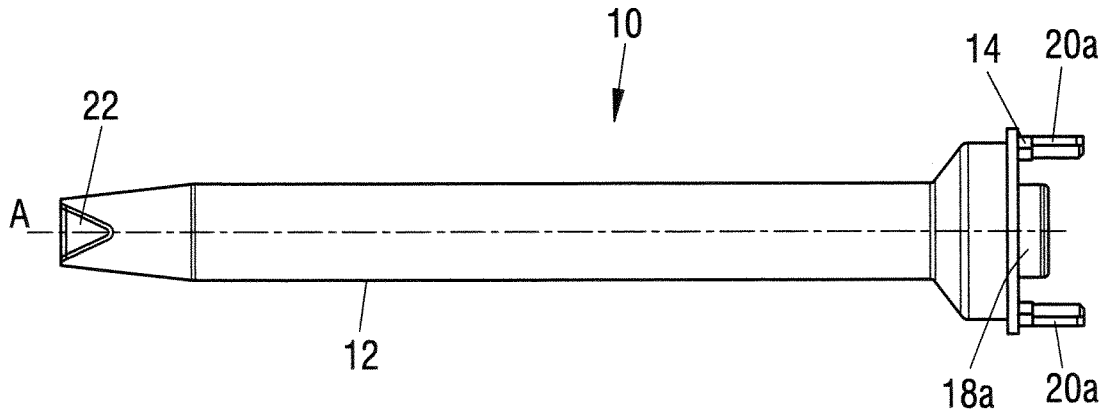


Fig.1b

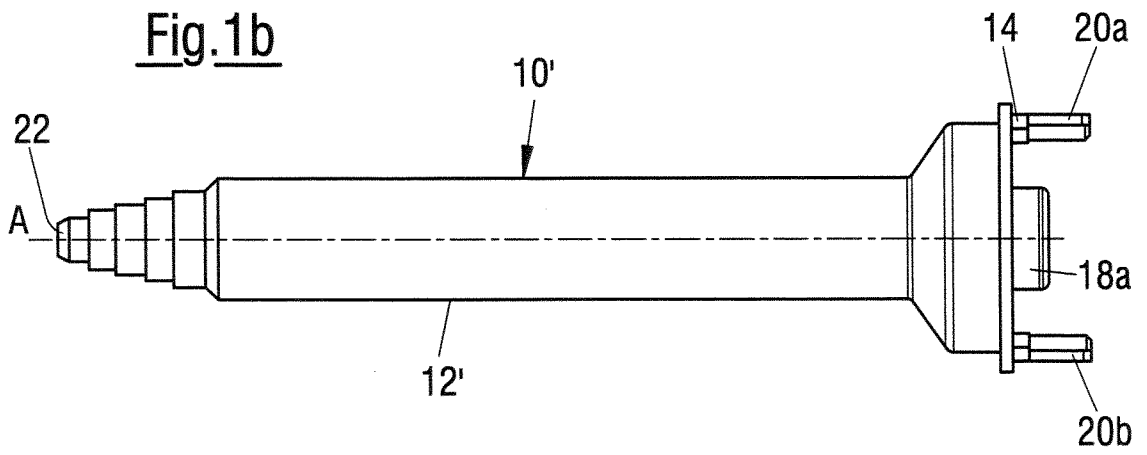


Fig.2

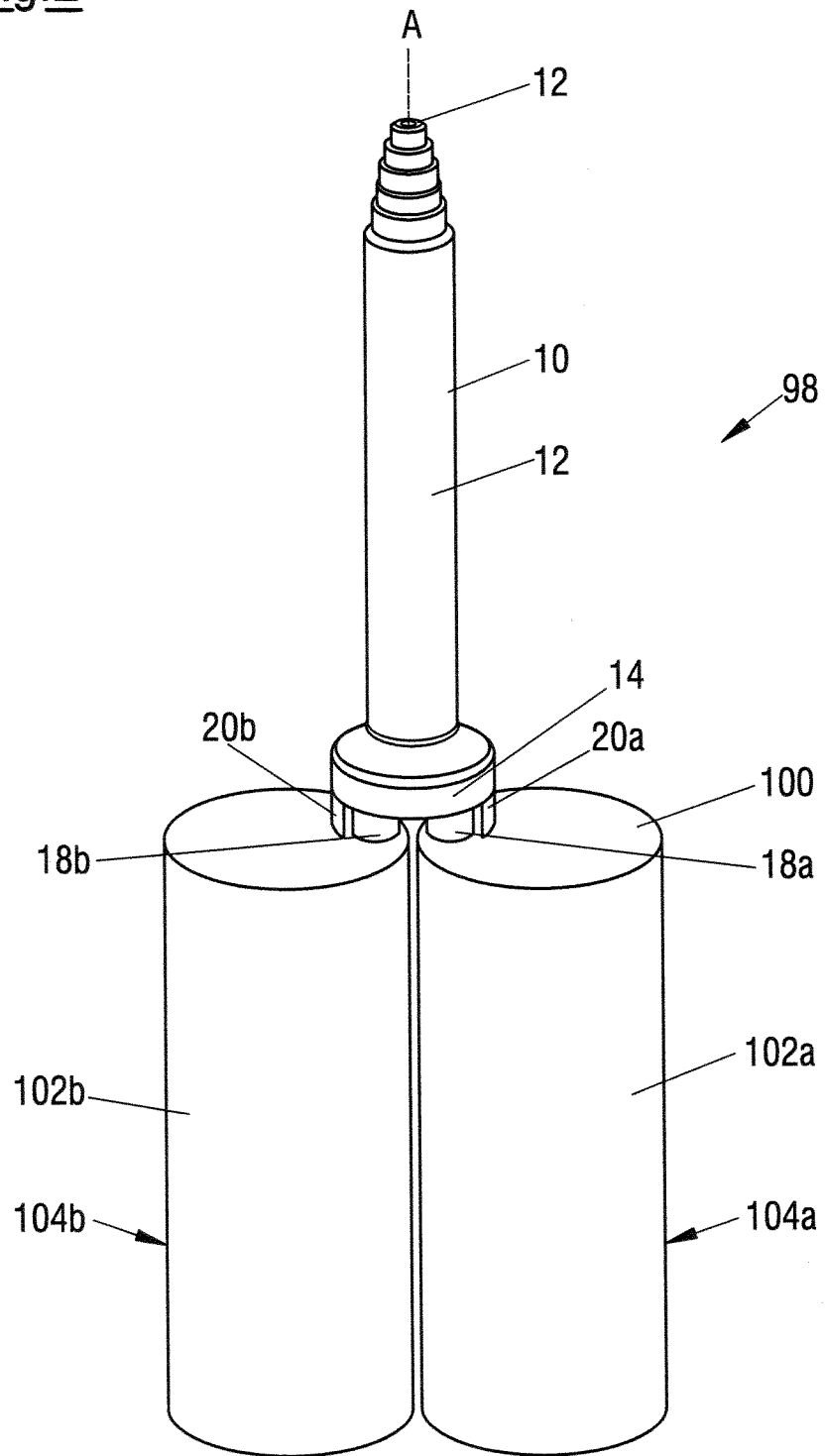


Fig.3a

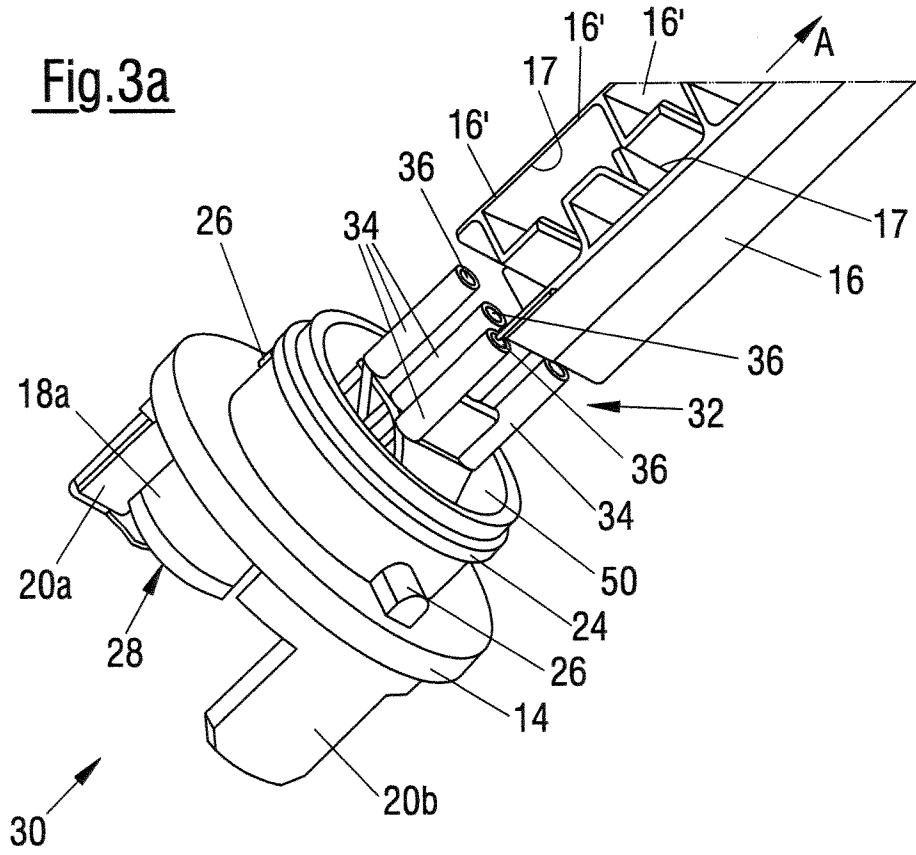


Fig.3b

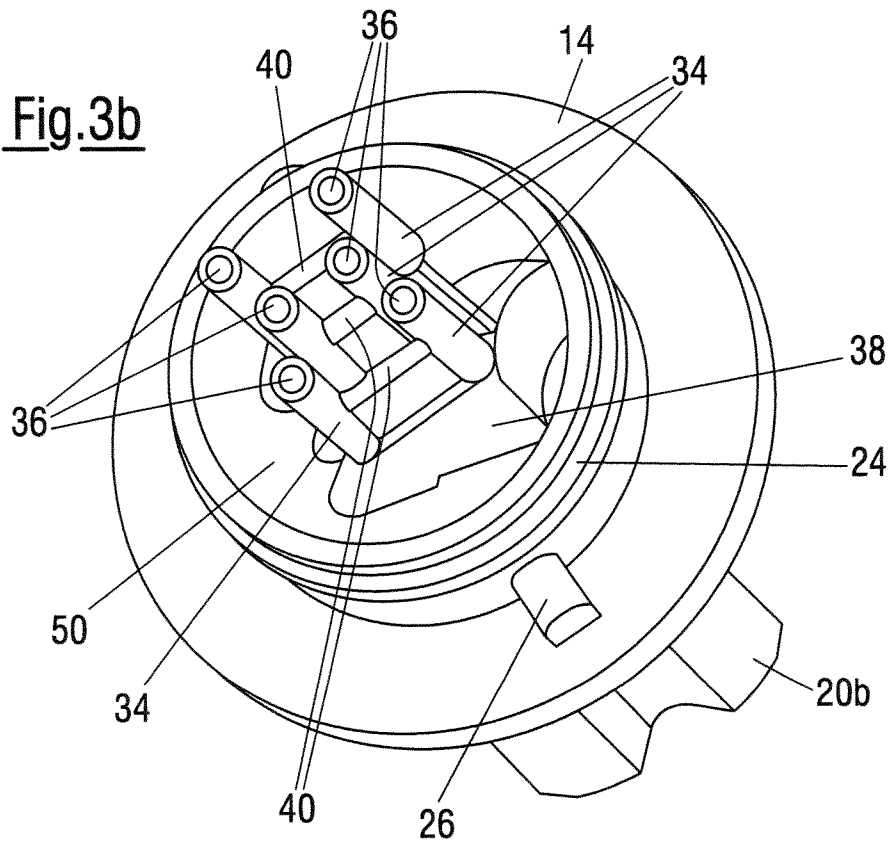
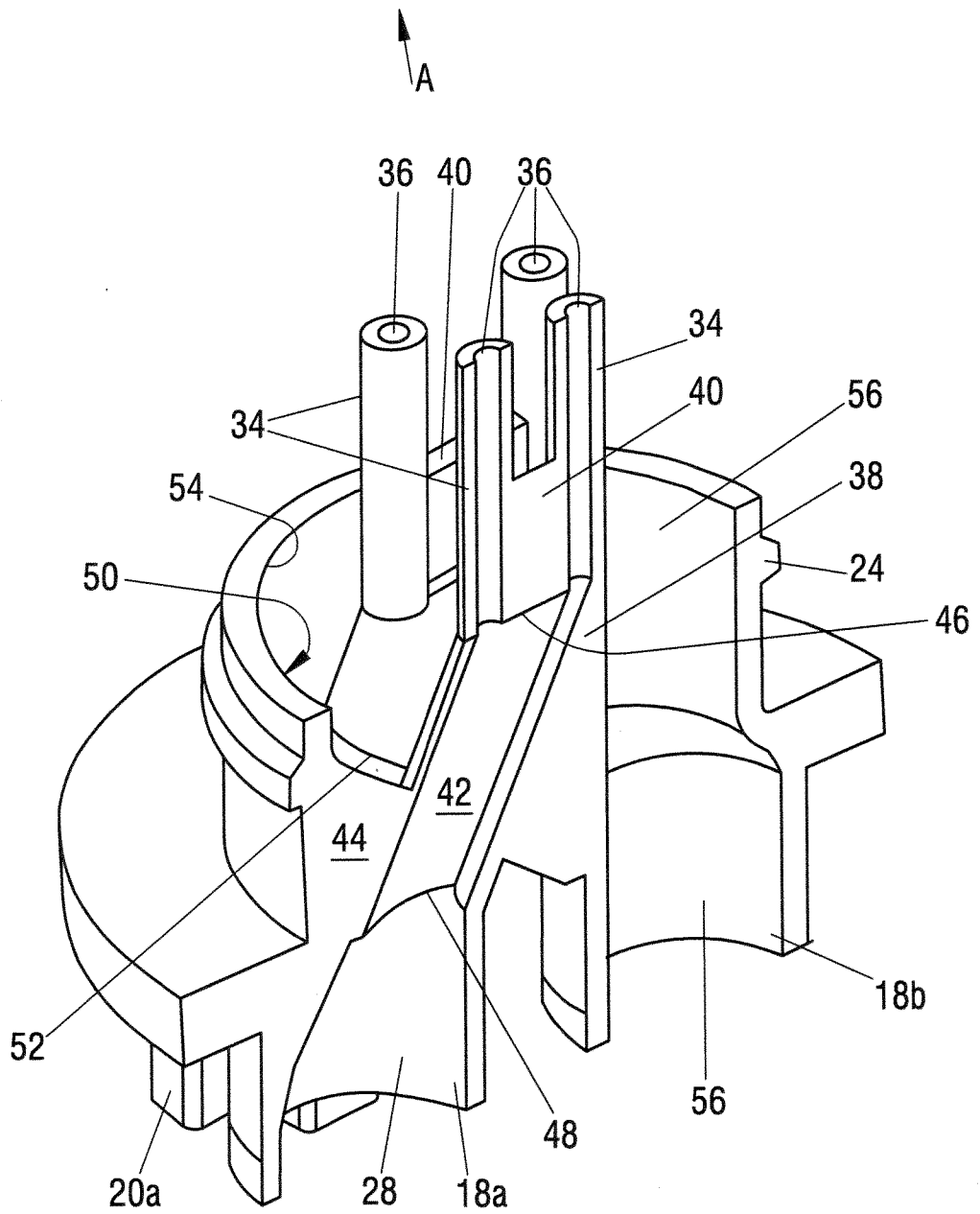


Fig.3c



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/084696

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01F5/00 B01F5/06 B01F13/00
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)
B01F 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 A	WO 2005/095225 A1 (5 MIX LTD [GB]; HERMON GARY JOHN [GB]; LEECH ANDREW CHARLES [GB]) 13 October 2005 (2005-10-13) page 1, line 3 - line 7 page 2, line 1 - line 21 page 3, line 13 - line 21 page 3, line 36 - line 38 page 4, line 20 - line 32 page 12, line 1 - line 36 page 15, line 26 - page 16, line 5 page 16, line 29 - page 21, line 12 figures	1-6,9-16 7,8
X A	EP 1 731 216 A1 (LEMUTH GMBH [DE]) 13 December 2006 (2006-12-13) paragraph [0001] paragraph [0032] - paragraph [0036] figures	1-6,9-16 7,8
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search 12 March 2019	Date of mailing of the international search report 21/03/2019
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Real Cabrera, Rafael
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/084696

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	paragraph [0001] paragraph [0066] - paragraph [0073] paragraph [0078] - paragraph [0083] figures -----	10,13, 15,16

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International application No

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