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(71) Applicant: **S. Nooijens Beheer B.V.**
6522 DG Nijmegen (NL)

(72) Inventor: **NOOIJENS, Stefan Jozef Maria**
6522 DG NIJMEGEN (NL)

(74) Representative: **Algemeen Octrooi- en Merkenbureau B.V.**
P.O. Box 645
5600 AP Eindhoven (NL)

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(54) **FILLING DEVICE FOR APPLYING INSULATION IN A CAVITY OF A BUILDING, AS WELL AS A RELATED METHOD**

(57) Filling device for applying insulation in a cavity wall of a building, wherein the filling device comprises:

- a mixing chamber for mixing insulation beads with adhesive;
- a mouth having a mouth opening for, with the aid of compressed air, dispensing a mixture of insulation beads and adhesive in the cavity wall of the building;
- a transition part which connects the mixing chamber with the mouth;
- a beads connector arranged for connecting a beads-supply line for supplying insulation beads to the mixing chamber;
- an adhesive connector arranged for connecting an ad-

hesive-supply line for supplying adhesive to the mixing chamber;

- a compressed air connector provided opposite to the mouth opening, and arranged for connecting a compressed air-supply line for supplying compressed air to the filling device in the direction of the mouth opening, wherein a cross section of the mixing chamber and the mouth, in a plane parallel to a mouth openings plane defined by the mouth opening, is substantially round, and wherein the transition part a solid of revolution is which ends tapered from the mixing chamber to the mouth, and wherein the transition part smoothly connects to the mixing chamber

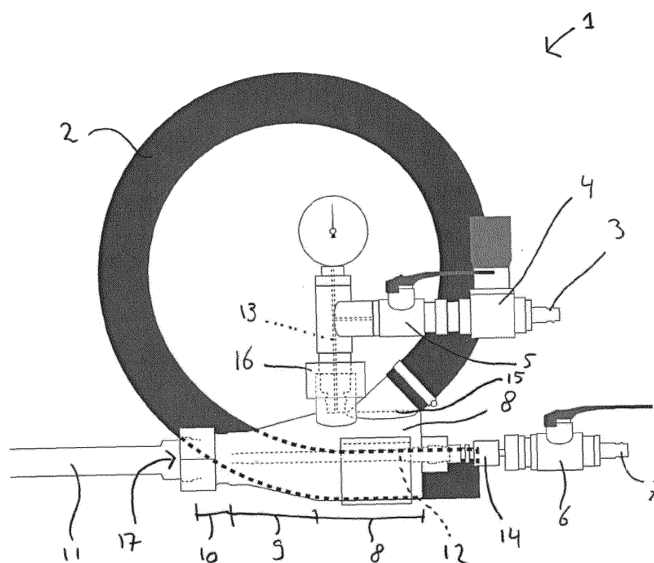


Fig. 1

Description

[0001] The present invention, according to a first aspect thereof, relates to a filling device for applying insulation in a cavity of a building, wherein the insulation comprises a combination of insulation beads and adhesive.

[0002] The present invention is further related to a method for applying insulation in a cavity wall of a building, using the new filling device.

[0003] Filling devices for applying insulation in a cavity wall of a building are already known. Such filling devices comprise a mixing chamber for mixing insulation beads with adhesive, a mouth having a mouth opening for, with the aid of compressed air, dispensing a mixture of insulation beads and adhesive in the cavity of a wall, a beads connector arranged for connecting a beads-supply line for supplying insulation beads to the mixing chamber, an adhesive connector arranged for connecting an adhesive-supply line for supplying adhesive to the mixing chamber and a compressed air connector arranged for connecting a compressed air-supply line for supplying compressed air to the filling device.

[0004] A drawback of the known filling devices is that the speed, i.e. the filling speed, at which the insulation is applied into the cavity is relatively low.

[0005] It is an objective of the present invention to provide a filling device with which the filling speed and/or the efficiency of applying the insulation in the cavity at different drilling diameters can be increased. This objective is achieved using the new filling device according to the claims as appended.

[0006] The invention provides, in a first aspect thereof, in a filling device for applying insulation in a cavity of a building, wherein the filling device comprises:

- a mixing chamber for mixing insulation beads with adhesive;
- a mouth having a mouth opening for, with the aid of compressed air, dispensing a mixture of insulation beads and adhesive in the cavity wall of the building;
- a transition part which connects the mixing chamber with the mouth;
- a beads connector arranged for connecting a beads-supply line for supplying insulation beads to the mixing chamber;
- an adhesive connector arranged for connecting an adhesive-supply line for supplying adhesive to the mixing chamber;
- a compressed air connector provided opposite to the mouth opening, and arranged for connecting a compressed air-supply line for supplying compressed air to the filling device in the direction of the mouth opening;

wherein a cross section of the mixing chamber and the mouth, in a plane parallel to a mouth openings plane defined by the mouth opening, is substantially round, and wherein the transition part a solid of revolution is which

ends tapered from the mixing chamber to the mouth, and wherein the transition part smoothly connects to the mixing chamber.

[0007] The new filling device according to the present invention is based on the inventive insight that the streamlining of the device, for example the airstream of the compressed air and/or the streaming of the insulation beads and/or the adhesive, through the device to the cavity is to be improved to accomplish an increased filling speed.

[0008] To improve the streamlining, it was the insight of the inventor that the compressed air connector is to be provided opposite to the mouth opening, such that the supplied compressed air passes the filling device in rectilinear. This means that the supplied air, so to speak, streams in a straight line from entry into the filling device up to the mouth opening. This reduces the resistance of the air stream.

[0009] The streamlining is further improved because the cross section of the mixing chamber and the mouth, in a plane parallel to a mouth openings plane defined by the mouth opening, is substantially round, and wherein the transition part a solid of revolution is which ends tapered from the mixing chamber to the mouth, and wherein the transition part smoothly connects to the mixing chamber.

[0010] In the mixing chamber, insulation beads are mixed with the adhesive, and the mixed insulation beads and adhesive are applied, via the mouth opening of the mouth, into the cavity. To increase the streamlining of the device even further, with respect to the streaming of the mixed insulation beads and adhesive to the mouth opening, the inventor has realised that this transition part should end tapered from the mixing chamber to the mouth. This means that there is no stepwise transition present in the filling device, for example between the mixing chamber and the mouth. Due to this, the mixed insulation beads and the adhesive are able to flow smoothly from the mixing chamber to the mouth opening. This reduces the resistance that the mixed insulation beads and the adhesive encounter during transport between the mixing chamber and the mouth.

[0011] The filling device is typically a device which can be carried, for example a dosing device, and is thus also to be carried by a person using one or two hands. A mouth piece can further be attached to the mouth, wherein the mouth piece is to be inserted into the cavity during the applying of the insulation.

[0012] The insulation beads are, for example, formed from polystyrene or another thermic isolating material, such as expandable polystyrene comprises an expansion means, for example pentane or foamed plastic parts.

[0013] Foamed plastic, such as for example expanded polystyrene, EPS, is a known isolator and has the advantage of a relatively low density. Further, such foamed plastic beads can be pumped in a simple manner. A well known, very suitable plastic insulation beads is commercially available under the name Neopixels®.

[0014] During use of the filling device, the beads connector is to be connected, via the beads supply line, to a beads container, wherein the beads container comprises a plurality of insulation beads. Further, the adhesive connector is to be connected, via the adhesive supply line, to an adhesive container, wherein the adhesive container comprises an amount of adhesive. The compressed air connector is further to be connected, via the compressed air supply line, to a compressor, wherein the compressor is arranged to provide compressed air having a certain pressure.

[0015] According to the present invention, the adhesive supply line, the compressed air supply line and/or the beads supply line can, for example, be a flexible hose or a tube.

[0016] According to the present invention, the filling device is suitable to fill the cavity of the wall with insulation materials, i.e. insulation beads mixed with adhesive. The filling device is, however, suitable for all kinds of hollow spaces, i.e. not necessarily limited to the cavity of a wall.

[0017] In an embodiment, the filling device further comprises a straight lined venture tube, connected to the compressed air connector, wherein the venture tube extends to within the transition part or to within the mouth.

[0018] A venture is an, intentionally, provided narrowing in a streaming channel for liquid or gas. As the passing medium, i.e. the air, encounters an increased speed a lowering of the pressure arises at that specific spot; the venture-effect. The mixed insulation beads and adhesive are sucked along, sucked with, from the mixing chamber by the venture-effect.

[0019] In a further embodiment, the venture tube is releasably connected to the compressed air connector.

[0020] The advantage hereof is that the venture tube can be exchanged when its partly or fully congested. The venture tube may be connected in a manner like screwed, glued, or a like, to the compressed air connector.

[0021] In another embodiment, the beads connector is arranged in such a way that the insulation beads are supplied to the mixing chamber in an angle with respect to a direction of the supplied compressed air, wherein the angle is between 10° and 70° degrees, preferably between 50° and 70° degrees.

[0022] The beads connector is, for example, formed by a round tube, that is cut off or sawn under a certain angle. The round tube is thus not cut off or sawn in a perpendicular manner. The round tube is, subsequently, attached to the mixing chamber under the here above reference angle, for example welded.

[0023] Because the insulation beads enter the mixing chamber under an angle with respect to the direction of the compressed air, these will be mixed more efficient with the adhesive, and thus the mixed insulation beads and adhesive are supplied to the mouth opening in a more streamlined manner.

[0024] In a further embodiment, the adhesive connector is arranged in such a way that the adhesive is supplied to the mixing chamber substantially perpendicular with

respect to a direction of the supplied compressed air.

[0025] In another embodiment, the filling device comprises the adhesive-supply line, and wherein the adhesive-supply line comprises a closing valve for closing the adhesive-supply line and a control valve for controlling an amount of adhesive through the adhesive-supply line, wherein the closing valve and the control valve are comprised in the adhesive-supply line in such a way that the supplied adhesive through the adhesive-supply line first passes the control valve and subsequently passes the closing valve before it is supplied to the mixing chamber.

[0026] At the end of the filling cycle, whenever the cavity is filled with the insulation, the attachment piece and/or the mouth piece is blocked at least partly by the insulation present in the wall. The ensured that the supplied compressed air can not, or can not easily, be discharged via the attachment piece and/or the mouth piece. Because of this, the compressed air will, at least partly, also enter the beads supply line. This has the undesired effect that the mixture of beads and adhesive also enter the beads supply line, such that a congestion and/or contamination can occur in the beads supply line.

[0027] It was the insight of the inventor that it is desirable to limit the total amount of adhesive present in the adhesive supply line, between the closing valve and the mixture chamber, such that the effect described here above is limited as much as possible. This total amount of adhesive is reduced when the order of the closure valve and the control valve in the adhesive supply line is taken into account. The closure valve is to be provided as closely as possible to the mixing chamber, such that, when the closing valve is being closed, the amount of adhesive in the adhesive supply line, between the closing valve and the mixing chamber, is being minimized.

[0028] In a detailed example, the diameter of the adhesive supply line between the closing valve and the mixing chamber is smaller than a diameter of the adhesive supply line between the closing valve and the control valve.

[0029] By narrowing the adhesive supply line between the closing valve and the mixing chamber, the total amount of adhesive that is stored in there between is also reduced. This reduces the effect described here above even further.

[0030] In a further embodiment, the filling device comprises the beads supply line, wherein the beads supply line is arranged in a loop such that the supplied insulation beads traverse the loop before they are supplied to the mixing chamber.

[0031] The example here above has the advantage that the streamlining of the insulation beads through the mixing chamber in the direction of the mouth opening is improved, as the insulation beads are provided to the mixing chamber in the desired angle.

[0032] In another example, the invention provides in a filling device, wherein:

- the filling device comprises an attachment piece

and/or the mouth piece, mounted to the mouth, wherein the attachment piece and/or the mouth opening has an outer diameter between 13 - 19 millimetre, preferably substantially 13.5mm or 15.5mm or 17.5mm suitable for drilling diameter 14mm or 16mm or 18mm;

- a length of the loop is between 520mm - 680mm, preferably between 550mm - 650mm, even more preferably about 600mm;
- a venture tube is connected to the compressed air connector, wherein the venture tube extends to within the transition part of to in the mouth, and wherein the venture tube has an inner diameter of between 3mm - 5mm, preferably between 3.5mm - 4.5mm, even more preferably about 4mm;
- a length of the attachment piece and/or the mouth piece and/or the mouth is between 60mm - 200mm, preferably between 100mm - 130mm, even more preferably substantially 116mm;
- a length of the venture tube is between 120mm - 150mm, preferably between 130mm - 140mm, even more preferably about 135mm.

[0033] It was the insight of the inventor that several aspects of the filling device are of importance for increasing the speed and density. These aspect concern the length of the loop, the length and diameter of the venture tube and the length of the attachment piece and/or the mouth piece of the filling device.

[0034] Extensive research has shown that the aspects described above provide a contribution to the increasing speed and density of the applying of the insulation in the cavity. The combination of the here above described lengths and diameters seems, surprisingly, to work excellent. That is, using the here above described setting, a filling device is provided with an increased filling speed, and, at the same time, maintains the density of the applied insulation.

[0035] It was the insight of the inventor that it is not a single aspect that contributes the most to the filling speed, but it is in fact the combination of the above described aspects that provide the desired effect, that is the increased filling speed.

[0036] The filling speed is here measured in litres insulation beads per second. This is thus related to the total amount of volume of the mixture of insulation beads and adhesive that is applied by the filling device per second.

[0037] It seems that the ratio of the attachment piece and/or the mouth piece with respect to the diameter of the venture tube contributes substantially to the filling device. It is not the case that, as a skilled person would have expect, the diameter of the venture tube is to be as large as possible. This comes at the expense of space that is available for the beads to flow to the mouth opening. Using drilling diameter of substantially 14mm, 16mm and 188, it seems that the inner diameter of the venture tube needs to be around 4 mm having a tolerance of

about 0,5mm. This provides a sufficient suction effect with respect to the mixture of beads and adhesive, while it leaves sufficient space in the mixing chamber such that the mixture of beads and adhesive, without too much resistance, can flow to the mouth opening.

[0038] According to the present invention, the drilling diameter is the diameter of the hole that is drilled in the wall to reach the cavity of the wall. The drilling diameter is to be adjusted to the diameter of the attachment piece or the diameter of the mouth opening of the filling device, such that the attachment piece and/or the mouth piece, without damaging the rocks, can be inserted through the hole in the rocks such that it reaches the space in between the walls.

[0039] The present invention is next explained with respect to the appended figures, wherein only examples of the embodiments of the filling device of the present invention are shown. The figures or the description thereof does not have a limiting impact on the scope of protection of the present invention. In the figures:

Fig. 1 shown a schematic view of a filling device, including the adhesive supply line, the beads supply line and the compressed air supply line according to the present invention;

Fig. 2a shows a schematic side view of a filling device according to the present invention.

Fig. 2b shows a schematic rear view of a filling device according to the present invention; and

Fig. 3 shows a venture tube to be used in a filling device according to the present invention.

Fig. 1a shows a schematic view of a filling device 1 having connected thereto an adhesive supply line 3, a beads supply line 2 and a compressed air line 7.

[0040] The filling device 1 is suitable for applying insulation in a cavity of a building. A cavity is a wall which consist of two parallel parts, an outer- and an inner wall. The open space between both walls is called the cavity. The cavity prevents that moisture penetrates from the outside to the inside, and also has an isolating function. For additional heath isolation, insulation material can be applied in the cavity.

[0041] The filling device is also suitable to provide other spaces with insulation, but shall mainly be used for providing insulation in cavity walls of existing buildings.

[0042] A mixing chamber 8 is provided in the filling device 1, wherein the mixing chamber is arranged for mixing the insulation beads, also called insulation granules, with adhesive.

[0043] The mixture of insulation beads and adhesive is dispensed, via a mouth 10 having a mouth opening 17, under the influence of compressed air, in the cavity wall of the building. In the present example, there is an attachment piece and/or the mouth piece 11 screwed on the mouth, wherein the attachment piece and/or the mouth piece 11 is arranged to penetrate to within the cavity of the cavity wall. The attachment piece and/or the

mouth piece 11 serves as an extension of the mouth. The diameter of the attachment piece and/or the mouth piece 11 is, generally, adjusted to the diameter of the hole which is drilled in the wall to get to the cavity. Typical drilling diameters are 18, 16 or 14 mm.

[0044] The filling device 1 further comprises a transition part 9 which connects the mixing chamber 8 with the mouth 10. The transition part 9 is thus arranged to support the streaming of the mixture of insulation beads with adhesive, in the mixing chamber, in the direction of the mouth 10.

[0045] The beads connector 15 is arranged for connecting a beads supply line 2 for supplying insulation beads to the mixing chamber 8. As is shown in figure 1, the beads supply line 2 is arranged as a loop, such that the beads in the loop traverse an arc before they are supplied to within the mixing chamber 8. The circumferential speed of the beads through the loop equals the speed at which the beads enter the mixing chamber. This has the advantage that the insulation beads already enter the mixing chamber under a particular angle, wherein the angle is chosen such that the resistance that the beads encounter during streaming to the mouth is being minimized.

[0046] The adhesive connector 16 is arranged for connecting an adhesive supply line 3 for supplying adhesive to the mixing chamber 8. Within the adhesive supply line 3, a closing valve 5 and a control valve 4 are provided for completely closing, or opening, the supply of the adhesive, and for controlling the amount of supplied adhesive, respectively.

[0047] The adhesive connector 16 is located perpendicular to the mixing chamber, that is perpendicular to the direction of the compressed air in the filling device 1.

[0048] As explained here above, the supplied adhesive first passes the control valve 4 and then the control valve 5 before it reaches the mixing chamber 8. This has the advantage that the adhesive present in the adhesive supply line 13, between the closing valve 5 and the mixing chamber 8, is being decreased. At closing the adhesive supply line 3, by the closing valve 5, a risk arises that the adhesive present in the adhesive supply line 13, between the closing valve 5 and the mixing chamber 8, is pressed in the beads supply line 2. This has the adverse effect that the beads supply line 2 is congested, or contaminated. By adjusting the order of the control valve 4 and the closing valve 5 in the adhesive supply line 3, the amount of adhesive between the adhesive supply line 3 and the mixing chamber 8 is reduced, which has a positive impact on the adverse effect described here above.

[0049] As is clearly shown in figure 1, the diameter of the adhesive supply line 13, between the closing valve 5 and the mixing chamber 8, is smaller than the diameter of the adhesive supply line 3 before the control valve 3. Due to this, an even smaller amount of adhesive shall be retained between the closing valve 5 and the mixing chamber 8.

[0050] The filling device is further provided with a com-

pressed air connector 7 for connecting a compressed air supply line for supplying compressed air to the filling device 1 in the direction of the mouth opening 17.

[0051] The underlying idea of the invention is that the cross section of the mixing chamber 8 and the mouth 10, in a plane parallel to a mouth opening plane determined by the mouth opening 17, is substantially round (see figure 2b), and that the transition part 9 is a solid of revolution which runs tapered from the mixing chamber 8 into the mouth 10 and wherein the transition part connects to the mixing chamber 8 in a step free manner.

[0052] Figure 1 thus shows an example of a filling device according to the present invention, wherein:

- the filling device comprises an attachment piece and/or the mouth piece, mounted to the mouth, wherein the attachment piece and/or the mouth opening has an outer diameter between 13 - 19 millimetre, preferably substantially 13.5mm or 15.5mm or 17.5mm suitable for drilling diameter 14mm or 16mm or 18mm;
- a length of the loop is between 520mm - 680mm, preferably between 550mm - 650mm, even more preferably about 600mm;
- a venture tube is connected to the compressed air connector, wherein the venture tube extends to within the transition part of to in the mouth, and wherein the venture tube has an inner diameter of between 3mm - 5mm, preferably between 3.5mm - 4.5mm, even more preferably about 4mm;
- a length of the attachment piece and/or the mouth piece and/or the mouth is between 60mm - 200mm, preferably between 100mm - 130mm, even more preferably substantially 116mm;
- a length of the venture tube is between 120mm - 150mm, preferably between 130mm - 140mm, even more preferably about 135mm.

[0053] In this example, the adhesive supply line, the beads supply line and the compressed air supply line are omitted. The filling device 101 comprises an adhesive connector 102, a beads connector 103 and a compressed air connector 104. The beads connector 103 is arranged in such a way that the insulation beads are supplied to the mixing chamber 8 in an angle α with respect to a direction of the compressed air, wherein the angle is preferably between 10° and 70°, more preferably between 50° and 70° degrees. The angle is defined between the mixing chamber 105, at the circumference thereof, and the beads connector 103.

[0054] The beads connector 103 is fixedly welded to the mixing chamber 105, wherein the beads connector 103 is not cut off, or sawn, in a perpendicular manner, but under a certain angle. This increases the effective passage of the beads connector 103 with the mixing chamber 105.

[0055] In figure 2a it is clearly shown that the transition part 106 runs tapered from the mixing chamber 105 to the mouth 107. This is thus a continuous, gradual, transition, such that no step or the like occurs here.

[0056] The length of the transition part 106 is in the present configuration between 30mm - 50mm, preferably substantially 40mm.

[0057] In the present figure, the length of the mixing chamber 105 is about 55mm - 75mm, preferably substantially 65mm.

[0058] The length of the mouth 106 is preferably about 20mm - 25mm, preferably substantially 23mm.

[0059] Figure 3 shows 201 a side view of a venture tube 202 to be used in a filling device according to the present invention. The venture tube 202 is here connected to a compressed air connector 203, wherein the venture tube 202, in use, extends to within the transition part of to within the mouth. It is advantageous if the venture tube 202 is releasably connected to the compressed air connector 203, such that it can be replaced or cleaned.

Claims

1. Filling device for applying insulation in a cavity wall of a building, wherein the filling device comprises:

- a mixing chamber for mixing insulation beads with adhesive;
- a mouth having a mouth opening for, with the aid of compressed air, dispensing a mixture of insulation beads and adhesive in the cavity wall of the building;
- a transition part which connects the mixing chamber with the mouth;
- a beads connector arranged for connecting a beads-supply line for supplying insulation beads to the mixing chamber;
- an adhesive connector arranged for connecting an adhesive-supply line for supplying adhesive to the mixing chamber;
- a compressed air connector provided opposite to the mouth opening, and arranged for connecting a compressed air-supply line for supplying compressed air to the filling device in the direction of the mouth opening;

wherein a cross section of the mixing chamber and the mouth, in a plane parallel to a mouth opening plane defined by the mouth opening, is substantially round, and wherein the transition part is a solid of revolution which ends tapered from the mixing chamber to the mouth, and wherein the transition part smoothly connects to the mixing chamber, and wherein the filling device comprises the adhesive-supply line, and wherein the adhesive-supply line comprises a closing valve for closing the adhesive-supply line and a control valve for controlling an

amount of adhesive through the adhesive-supply line, wherein the closing valve and the control valve are comprised in the adhesive-supply line in such a way that the supplied adhesive through the adhesive-supply line first passes the control valve and subsequently passes the closing valve before it is supplied to the mixing chamber.

2. Filling device according to claim 1, wherein a diameter of the adhesive-supply line between the closing valve and the mixing chamber is smaller than a diameter of the adhesive-supply line between the closing valve and the control valve.

3. Filling device according to any of the previous claims, wherein the filling device comprises the beads-supply line, wherein the beads-supply line is arranged in a loop such that the supplied insulation beads traverse the loop before they are supplied to the mixing chamber.

4. Filling device according to claim 3, wherein:

- the filling device comprises an attachment piece and/or the mouth piece, mounted to the mouth, wherein the attachment piece and/or the mouth opening has an outer diameter between 13 - 19 millimetre, preferably substantially 13.5mm or 15.5mm or 17.5mm suitable for drilling diameter 14mm or 16mm or 18mm;
- a length of the loop is between 520mm - 680mm, preferably between 550mm - 650mm, even more preferably about 600mm;
- a venture tube is connected to the compressed air connector, wherein the venture tube extends to within the transition part of to in the mouth, and wherein the venture tube has an inner diameter of between 3mm - 5mm, preferably between 3.5mm - 4.5mm, even more preferably about 4mm;
- a length of the attachment piece and/or the mouth piece and/or the mouth is between 60mm - 200mm, preferably between 100mm - 130mm, even more preferably substantially 116mm;
- a length of the venture tube is between 120mm - 150mm, preferably between 130mm - 140mm, even more preferably about 135mm.

5. Filling device according to any of the previous claims, further comprising:

- a venture tube connected to the compressed air connector, wherein the venture tube extends to within the transition part of to in the mouth.

6. Filling device according to claim 5, wherein the venture tube is releasably connected to the compressed air connector.

7. Filling device according to any of the previous claims, wherein the beads connector is arranged in such a way that the insulation beads are supplied to the mixing chamber in an angle with respect to a direction of the supplied compressed air, wherein the angle is between 10° and 70° degrees, preferably between 50° and 70° degrees. 5
8. Filling device according to any of the previous claims, wherein the adhesive connector is arranged in such a way that the adhesive is supplied substantially perpendicular with respect to a direction of the supplied compressed air to the mixing chamber. 10

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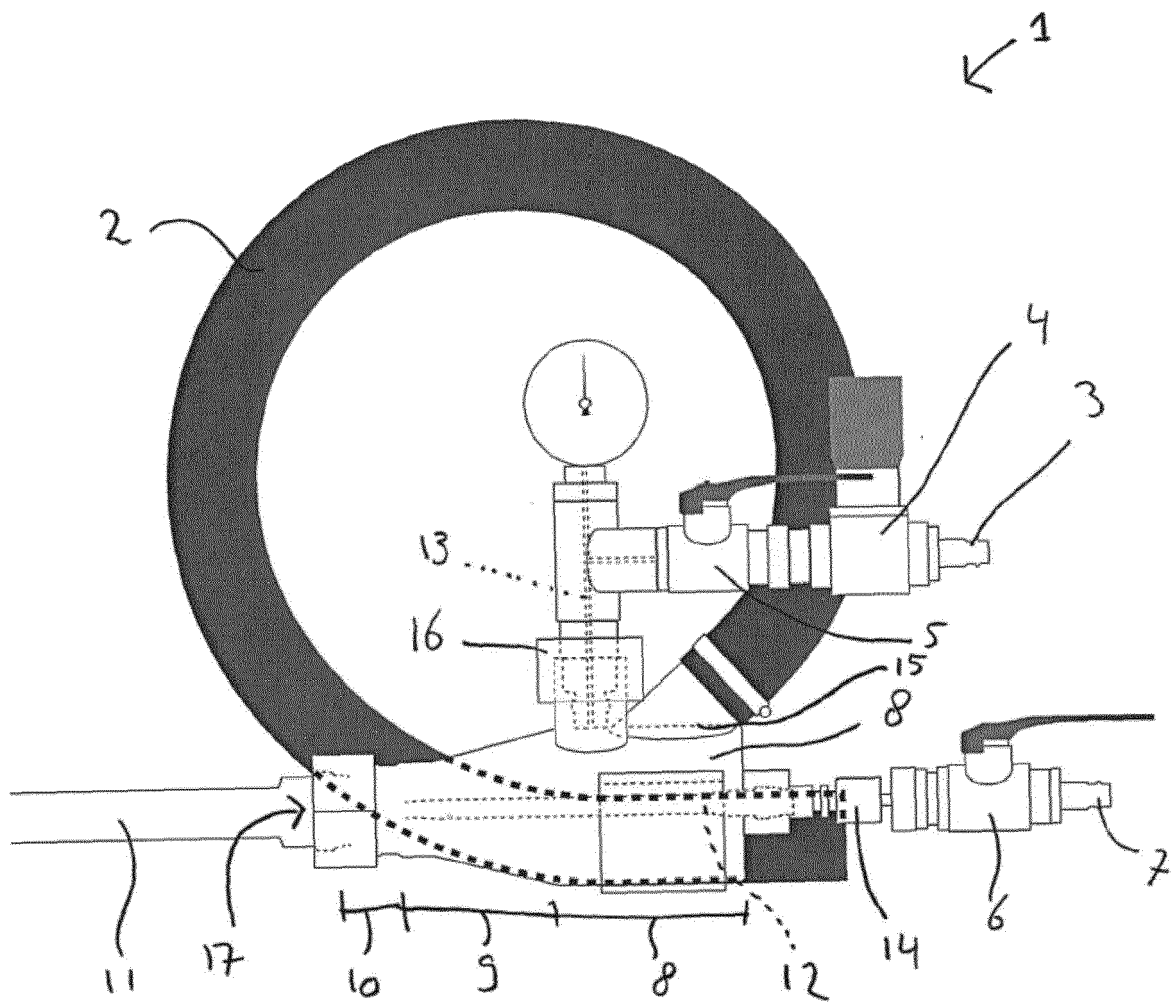


Fig. 1

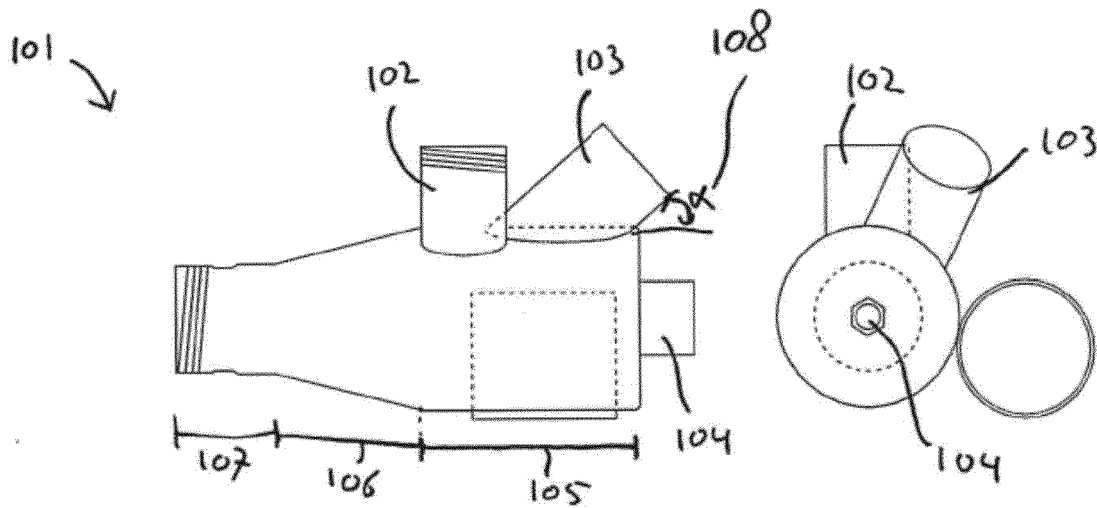


Fig. 2a

Fig. 2b

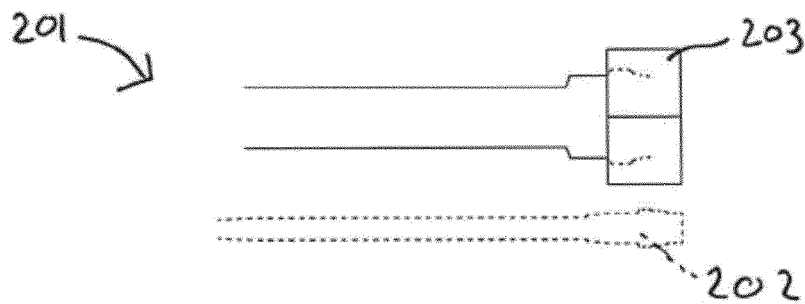


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
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Place of search Munich		Date of completion of the search 19 October 2016	Examiner Innecken, Axel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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

EP 16 17 4090

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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