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(54) **Mixing assembly for a firefighting device, firefighting device and method of mixing a fire extinguishing fluid and a foaming agent**

Mischanordnung für eine Brandbekämpfungsvorrichtung, Brandbekämpfungsvorrichtung, und Verfahren zum Mischen von Brandlöschflüssigkeit und Schäumungsmittel

Ensemble de mélange destiné à un dispositif de lutte contre les incendies, dispositif de lutte contre les incendies, et procédé de mélange d'un fluide d'extinction d'incendie et d'un agent moussant

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EP 2 944 355 B1

Description

Technical Field

[0001] The present disclosure generally relates to the field of firefighting devices. In particular, aspects of a firefighting device configured to mix a fire extinguishing fluid with a foaming agent are described.

Background

[0002] Water has long been used for extinguishing fires. There exist nevertheless many situations in which water is not the best choice. Water is typically not effective for extinguishing burning oil and similar non-polar substances. For such substances, firefighting foams have been developed.

[0003] Various types of firefighting foams are commercially available. As an example, Aqueous Film Forming Foam, also called AFFF or A3F, is often used to fight burning non-polar liquids. AFFF is foam made by mixing water and a synthetic foaming agent. The resulting foam typically comprises 1 to 6 liters of foaming agent per 100 liters of mixture.

[0004] The mixture of water and foaming agent can be produced prior to its use and stored in a tank of a firefighting device until a fire has to be extinguished. Other firefighting devices are configured to produce the mixture during the firefighting process. EP 1 595 579 A2 discloses a firefighting device of the latter type.

[0005] The firefighting device of EP1 595 579 comprises a pump for producing pressurized water and an injector for injecting the foaming agent into the pressurized water so as to mix water and foaming agent. The injector is realized as a differential pressure injector of the Venturi type and arranged in a mixing section of the firefighting device downstream of the water pump.

[0006] Further prior art is known from document US 2006/0151184 A1, which discloses a test system for testing firefighting systems.

[0007] Differential pressure injectors typically comprise a linear pipe with a first pipe section having a decreasing cross sectional area followed by a second pipe section of increasing cross sectional area. When feeding pressurized water through the pipe, the water is accelerated along the first pipe section. As a result, the static pressure in the region of smallest cross sectional area (i.e., in the region between the outlet of the first pipe section and the inlet of the second pipe section) will be lower than the static pressure at the inlet of the first pipe section. The resulting pressure difference leads to a suction effect in the region of smallest cross sectional area. This suction effect is exploited for injecting the foaming agent into the flow of pressurized water.

[0008] The linear construction of differential pressure injectors attributes to the axial extension of the firefighting device. For this reason conventional firefighting devices with differential pressure injectors have a certain minimum length that cannot be decreased further without decreasing the size of other components such as, for example, the pump or its motor. Due to prevailing pressure requirements it is, however, often not possible to downsize those components, so that firefighting devices with a differential pressure injector can become quite bulky. This drawback is particularly pronounced when the firefighting device is to be realized as a mobile device.

Summary

[0009] Accordingly, there is a need for a solution that permits a downsizing of firefighting devices with a differential pressure injector.

[0010] According to a first aspect, a mixing assembly for a firefighting device is presented. The mixing assembly comprises an inlet configured to receive pressurized fire extinguishing fluid from a pump of the firefighting device, wherein the fluid is received along a first flow axis. The mixing assembly further comprises a first mixing section with a first differential pressure injector configured to accelerate the fluid along a second fluid axis arranged at a first angle relative to the first flow axis and to inject a foaming agent in the fluid, thereby producing a mixture of the fluid and the foaming agent. Further, the mixing assembly comprises at least one outlet configured to deliver the mixture along a third flow axis, wherein the third flow axis is arranged at a second angle relative to the second flow axis. Each of the first angle and the second angle lies approximately between 60 degrees and 120 degrees. The mixing assemby further includes a second mixing section coupled between the inlet and the at least one outlet, the second mixing section comprising a second differential pressure injector configured to accelerate the fluid along a fourth flow axis and to inject a foaming agent in the fluid, thereby producing a mixture of the fluid and the foaming agent.

[0011] The second flow axis may be offset relative to one or both of the first flow axis and the third flow axis. In other words, the second flow axis, may, but need not, intersect one or both of the first flow axis and the third flow axis.

[0012] The inlet may be in fluid communication with the first mixing section. Likewise, the first mixing section may be in fluid communication with the at least one outlet. One or multiple connecting sections may be arranged between the inlet and the first mixing section and between the first mixing section and the at least one outlet.

[0013] The first flow axis may approximately be parallel to the third flow axis. As an example, the angle between the first flow axis and the third flow axis may be less than approximately 30 degrees. In one variant, the first flow axis and the third flow axis may lie within a single plane.

[0014] Each of the first angle and the second angle may lie approximately between 80 degrees and 100 degrees. As an example, at least one of the first angle and the second angle may approximately be 90 degrees. Generally, the second flow axis may approximately be perpendicular to each of the first flow axis and the third flow axis (e.g., within an angular range of approximately 85 degrees to 95 degrees).

[0015] The fourth flow axis may be arranged at the first angle relative to the first flow axis.

[0016] In one variant, the fourth flow axis may approximately be parallel to the second flow axis. As an example, the angle between the fourth flow axis and the second flow axis may be less than approximately 30 degrees. The fourth flow axis and the second flow axis may lie within a single plane.

[0017] A fluid splitting section may be arranged between the input and each of the first mixing section and the second mixing section. The fluid splitting section may have a T configuration. The fluid splitting section may be configured to split the pressurized fluid received via the inlet in a first fluid portion towards the first mixing section and a second fluid portion towards the second mixing section. In one variant, the first fluid portion and the second fluid portion are approximately equal. In another variant, the first fluid portion and the second fluid portion are different.

[0018] It will be appreciated that the mixing assembly may comprise more than two mixing sections. In such a case the fluid splitting portion section may be configured to split the pressurized fluid in three or more fluid portions.

[0019] The mixing assembly may comprise a mixture combining section arranged between each of the first mixing section and the second mixing section (and any further mixing section) on the one hand and, on the other hand, the at least one output. The mixture combining section may have a T configuration. The mixture combining section may be configured to combine the mixtures of fluid and foaming agent received from each mixing section. The combined mixtures may then be delivered via the one or more outlets.

[0020] The first mixing section, the second mixing section, the fluid splitting section and the fluid combining section may essentially form a rectangular (e.g., quadratic) arrangement. As such, the first mixing section, the second mixing section, the fluid mixing section and the fluid combining section may essentially lie within a single plane.

[0021] The mixing assembly may further comprise a first connection section between the inlet and the first mixing section. The first connection section may have a first bend relative to the first flow axis and a second bend relative to the first flow axis downstream of the first bend. The first flow axis and the first bend of the first connection section may essentially lie within a first plane. The second bend of the first connection portion and the second flow axis may essentially lie within a second plane intersecting the first plane. The first plane may extend essentially perpendicular (e.g., at an angle between 85 degrees and 95 degrees) to the second plane.

[0022] The mixing assembly may further comprise a second connection section between the first mixing section and the at least one outlet. The second connection section may have a first bend relative to the third flow axis anda second bend relative to the third flow axis downstream of the first bend. The second flow axis and the first bend of the second connection section may essentially lie within a third plane. The second bend of the second connection section and the third flow axis may essentially lie within a fourth plane intersecting the third plane. The third plane may extend essentially perpendicular (e.g., at an angle between 85 degrees and 95 degrees) to the fourth plane.

[0023] Also provided is a firefighting device comprising a pump and the mixing assembly presented herein, wherein the inlet of the mixing assembly is coupled to the pump. As an example, the inlet may be coupled to an outlet of the pump. Alternatively, a pipe or pipe system may be used to couple the inlet of the mixing assembly to the pump outlet.

[0024] The pump may define a pump axis. As an example, the pump axis may be defined by an axial extension of a rotating member (e.g., a spindle of a pump motor or gear stage) that drives the pump. As a further example, the pump axis may be defined by the extension of a pump piston pressurizing the fluid. In one variant, the second flow axis extends essentially perpendicular (e.g., at an angle between 85 degrees and 95 degrees) to the pump axis.

[0025] The firefighting device may be a mobile device. As an example, the firefighting device may be portable and/or may be configured to be mounted on a cart with two or more wheels.

[0026] According to a further aspect, a method of mixing a fire extinguishing fluid and a foaming agent in a firefighting device is provided. The method comprises pressurizing the fluid, receiving the pressurized fluid along a first flow axis, and accelerating the fluid by a differential pressure injector along a second flow axis arranged at a first angle relative to the first flow axis and injecting a foaming agent in the fluid, thereby producing a mixture of the fluid and the foaming agent. The method further comprises accelerating the fluid by a second differential pressure injector along a fourth flow axis and injecting the foaming agent in the fluid, thereby producing a second mixture of the fluid and the foaming agent. The method further comprises delivering the mixture along a third flow axis, wherein the third flow axis is arranged at a second angle relative to the first flow axis. Each of the first angle and the second angle lies approximately between 60 degrees and 120 degrees.

[0027] The method may be performed by a firefighting device as presented herein.

Brief Description of the Drawings

[0028] Further aspects, advantages and optional features of the present disclosure will become apparent from the following description of exemplary embodiments when considered in conjunction with the drawings. In the drawings,

Fig. 1 shows a perspective view of a mobile firefighting system according to one aspect of the present disclosure;

Fig. 2 shows a side view of the firefighting device of Fig. 1;

Fig. 3 shows a front view of the firefighting device of Fig. 1;

Fig. 4 shows a perspective view of a mixing assembly according to one aspect of the present disclosure;

Fig. 5 shows a front view of the mixing assembly of Fig. 4;

Fig. 6 shows a side view of the mixing assembly of Fig. 4;

Fig. 7 shows a side cross sectional view of the mixing assembly of Fig. 4;

Fig. 8 shows an equivalent fluid circuit for the firefighting system of Fig. 1; and

Fig. 9 shows a diagram of a method suitable for understanding the disclosure, but not forming part of the invention.

Detailed Description

[0029] Fig. 1 illustrates an embodiment of a firefighting system 100 comprising a mobile firefighting device 102 and a reservoir 104 for a liquid foaming agent such as AFFF. The reservoir 104 is coupled via a hose 106 to the firefighting device 102. Figs. 2 and 3 show different views of the firefighting device 102, wherein the reservoir 104 has not been depicted.

[0030] The firefighting device 102 of Figs. 1 to 3 comprises a pump 108 with a pump inlet 110. The pump inlet 110 has a coupling configured to be coupled to a water hose. The firefighting 102 further comprises a pump motor 112 configured to operate the pump 108. In the present embodiment the motor 112 is realized as an internal combustion motor. A fuel tank 114 for the motor 112 is integrated into the firefighting device 102. It will be appreciated that in other embodiments the motor 112 can be an electric motor, in which case the fuel tank 114 could be omitted.

[0031] As also shown in Figs. 1 to 3, the firefighting device 102 comprises a mixing assembly 116. The mixing assembly 116 has a fluid inlet 118 coupled to a fluid outlet 120 of the pump 108. The mixing assembly 116 further comprises two fluid outlets 122. The fluid outlets 122 are, in a present example, configured with Storz-D couplings. It will be appreciated that an alternative coupling type could be used as well. Moreover, in other realizations of the mixing assembly 116 only a single outlet 122 or more than two outlets 122 may be used.

[0032] The mixing assembly 116 further comprises two mixing sections 124, 126 arranged between the fluid inlet 118 and the fluid outlets 122. Each mixing section 124, 126 comprises a differential pressure injector (not shown) configured to inject foaming agent from the reservoir 104 into a water stream accelerated along the respective injector. To this end, each mixing section 124, 126 (i.e., each injector) is fluidly coupled via the hose 106 to the reservoir 104 as will be described in more detail below.

[0033] The various components of the mobile firefighting device 102 described above are rigidly coupled to each other and supported in a rack 128 with a handle 132. The rack 128 may be provided with wheels (not shown) to form a cart. In other variants, the wheels may be omitted, but the firefighting device 102 may remain portable.

[0034] In the following, the configuration of the mixing assembly 116 will be described in more detail with reference to Figs. 4 to 7.

[0035] As shown in Fig. 4, the inlet 118 of the mixing assembly 116 is configured to receive pressurized water from the pump 108 along a flow axis 140. The flow axis 140 is essentially defined by a straight pipe section connecting the inlet 118 with a fluid splitting section 142 of the mixing assembly 116. The fluid splitting section 142 has a T configuration to split, or divert, the pressurized water received along the flow axis 140 into two portions, or streams, along a flow axis 144. The flow axis 144 extends perpendicular to the flow axis 140 along which the fluid is received from the pump 140. A first water portion is thus directed via a first bend of 90 degrees in the fluid splitting section 142 towards the first mixing section 124 and a second water portion is directed via a second bend in the fluid splitting section 142 in the opposite direction towards the second mixing section 126. Then, at a third bend of 90 degrees downstream the first bend, the first water portion is fed to the first mixing section 124. In a similar manner, the second water portion is fed via a fourth bend of 90 degrees downstream the second bend to the second mixing section 126.

[0036] Each of the mixing sections 124, 126 comprises a differential pressure injector 146 of the Venturi type as exemplarily shown for mixing section 124 in Fig. 7. The differential pressure injector 146 comprises in a conventional manner a linear arrangement of a first pipe section having a decreasing cross sectional area followed by a second pipe section of increasing cross sectional area. In the region of smallest cross sectional area between the first pipe section and the second pipe section an injection inlet 148 for the foaming agent is arranged. The injection inlet 148 is configured to be coupled to the hose 106 that leads to the reservoir 104 (see Fig. 1). The injector 146 further comprises an adjustment element 150 configured to adjust the amount of foaming agent injected in the pressurized water flow.

[0037] The injectors 146 in the two mixing sections

124, 126 are configured to accelerate the pressurized water along a respective flow axis 152, 154 that is collinear with an axial extension of the corresponding mixing section 124, 126. The corresponding axis 152, 154 is arranged at an angle of 90 degrees relative to the axes 140, 144. As can be seen from Figs. 4 to 6, the axes 144, 152 and 154 lie within a first plane and the axes 140 and 144 lie within a second plane that extends perpendicular to the first plane.

[0038] The mixtures of water and foaming agent produced in the mixing sections 124, 126 are deflected by a respective bend of 90 degrees at the downstream end of each mixing section 124, 126 towards each other along an axis 156. The two mixtures are then combined at a mixture combining section 158 arranged approximately in the middle between the two mixing sections 124, 126. In the mixture combining section 158, the resulting combined mixture is deflected at a respective bend of 90 degrees towards the two outlets 122. Each outlet 122 defines a further flow axis 146 that is arranged perpendicular to and offset from the flow axes 152, 154 defined by the injectors 146.

[0039] As can be gathered from Fig. 5, the axes 144, 152, 154 and 156 lie within a single plane. Moreover, the fluid splitting section 142, the two mixing sections 124, 126 and the mixture combining section 158 form a rectangular pipe structure that is likewise located within a single plane. The plane defined by the axes 142, 152, 154 and 156 extends perpendicular to the plane defined by the axes 156 and 164 and to the plane defined by the axes 140 and 144. Moreover, the plane defined by the axes 156 and 164 extends at a certain offset defined by the length of the mixing sections 124, 126 parallel to the plane defined by the axes 140 and 144.

[0040] As has already been explained above, the two outlets 122 may be combined into a single outlet. This single outlet may have a larger cross sectional area than each of the two outlets 122.

[0041] With reference to Fig. 4, it can be said that the inlet 118 of the mixing assembly 116 is connected to the mixing section 124 via a first connection section 170 that has a first bend relative to the first flow axis 140 (towards the flow axis 144) and a further bend relative to the first flow axis 140 (from the flow axis 144 towards the flow axis 152) downstream of the first bend. In a similar manner a second connection section 172 can be identified between the mixing section 124 and the outlets 122. The second connection section 172 has a first bend relative to the flow axis 164 (from the axis 152 towards the axis 156) and a further bend relative to the flow axis 164 (from the flow axis 156 towards the flow axis 164) downstream of the first bend. Similar connection sections may be identified for the other mixing section 126.

[0042] In the following the operation of the firefighting system 100 illustrated in Figs. 1 to 7 will be described with reference to Figs. 8 and 9. Fig. 8 shows an equivalent fluid circuit of the firefighting system 100 of Fig. 1, and Fig. 9 shows a diagram of a method illustrating the operational principle of the firefighting system 100.

[0043] With reference to Fig. 8, the pump 108 is operated upon starting the motor 112 and draws in water via water inlet 110. The water may be drawn in via a hose 178 coupled to a water supply 180. The motor 112 is typically operated at up to 3500 or 4000 rpm, and the pump 108 typically draws in 500 l/min.

[0044] The pump 108 pressurizes the water (step 902 in Fig. 9) and outputs the pressurized water via its outlet 120. The pressurized water is received at the inlet 118 of the mixing assembly 116 along the axis 140 (step 904).

[0045] The pressurized water received via the inlet 118 of the mixing assembly 116 is split at the fluid splitting section 142 into two pressurized water portions that are fed to the two mixing sections 124, 126, respectively. In the mixing sections 124, 126, the pressurized water is accelerated by the injectors 146 along the flow axes 152, 154, respectively. At the same time, the injectors 146 inject foaming agent from the reservoir 104 in the accelerated fluid portions, thereby producing a mixture of the fluid and the foaming agent (step 906). The mixing ratio of each injector 146 can be adjusted via the adjustment element 150 (see Fig. 4). As an example, the resulting mixture may comprise 3 to 4 liters of foaming agent per 100 liter of the mixture.

[0046] The mixtures generated by the injectors 146 are then combined at the mixture combining section 158 and delivered along flow axes 164 via the outlets 122 (step 908). The outlets 122 are connected via a dedicated hose to a conventional firefighting pistol that comprises a shut-off valve 182 as well as a flow control valve 184 with a fixed or adjustable orifice.

[0047] In the mixing assembly 116 illustrated in Figs. 4 to 7, the axial extension of the injector 146 is not aligned with (i.e., parallel to) the axes 140, 164 along which the pressurized water is received and along which the resulting mixture is delivered. Rather, the flow axes 152, 154 defined by the injectors 146 have an oblige extension relative to the axes 140, 164. As such, the axial extension of the mixing assembly 116, and of the firefighting device 102 as a whole, can be reduced. The maximum length reduction is obtained when the axes 152, 154 are arranged perpendicular to the axes 140, 164. It will be appreciated that a substantial length reduction is still obtained at angles between the axes 152, 154 on the one hand and the axes 140, 164 on the other hand that lie approximately between 60 degrees and 120 degrees.

[0048] In the present embodiment two mixing sections 124, 126 are provided. It will be appreciated that in other embodiments the mixing assembly 116 may comprise only one mixing section. In such a case the axis defined by the injector arranged within the mixing section may intercept the axis along which the fluid is received and the axis along which the mixture is delivered. The provision of two or more mixing sections, on the other hand, permits to efficiently increase the volume of foaming agent that can be injected in the pressurized water delivered by the pump 108.

Claims

1. A mixing assembly (116) for a firefighting device (102), the mixing assembly comprising:

   an inlet (118) configured to receive pressurized fire extinguishing fluid from a firefighting device pump (108), wherein the fluid is received along a first flow axis (140);
   a first mixing section (124) with a first differential pressure injector (146) configured to accelerate the fluid along a second flow axis (152) arranged at a first angle relative to the first flow axis (140) and to inject a foaming agent in the fluid, thereby producing a mixture of the fluid and the foaming agent; and
   at least one outlet (122) configured to deliver the mixture along a third flow axis (164), wherein the third flow axis (164) is arranged at a second angle relative to the second flow axis (152);
   wherein each of the first angle and the second angle lies approximately between 60 and 120 degrees; and
   a second mixing section (126) coupled between the inlet (118) and the at least one outlet (122), the second mixing section (126) comprising a second differential pressure injector (146) configured to accelerate the fluid along a fourth flow axis (154) and to inject a foaming agent in the fluid, thereby producing a mixture of the fluid and the foaming agent.

2. The mixing assembly of claim 1, wherein the first flow axis (140) is approximately parallel to the third flow axis (164).

3. The mixing assembly of claim 1 or 2, wherein each of the first angle and the second angle lies approximately between 80 degrees and 100 degrees.

4. The mixing assembly of any of the preceding claims, wherein the second flow axis (152) is approximately perpendicular to each of the first flow axis (140) and the third flow axis (164).

5. The mixing assembly of any of the preceding claims, wherein the fourth flow axis (154) is approximately parallel to the second flow axis (152).

6. The mixing assembly of any of the preceding claims, further comprising a fluid splitting section (142) arranged between the inlet (118) and each of the first mixing section (124) and the second mixing section (126).

7. The mixing assembly of any of the preceding claims, further comprising a mixture combining section (158) arranged between each of the first mixing section (124) and the second mixing section (126) and the at least one outlet (122).

8. The mixing assembly of any of the preceding claims, further comprising a first connection section (170) between the inlet (118) and the first mixing section (124), wherein the first connection section (170) has a first bend relative to the first flow axis (140) and a second bend relative to the first flow axis (140) downstream of the first bend.

9. The mixing assembly of claim 8, wherein the first flow axis (140) and the first bend of the first connection section (170) essentially lie within a first plane, and the second bend of the first connection portion (170) and the second flow axis (152) essentially lie within a second plane intersecting the first plane.

10. The mixing assembly of any of the preceding claims, further comprising a second connection section (172) between the first mixing section (124) and the at least one outlet (122), wherein the second connection section (172) has a first bend relative to the third flow axis (164) and a second bend relative to the third flow axis (164) downstream of the first bend.

11. The mixing assembly of claim 10, wherein the second flow axis (152) and the first bend of the second connection section (172) essentially lie within a third plane, and the second bend of the second connection section (172) and the third flow axis (164) essentially lie within a fourth plane intersecting the third plane.

12. A firefighting device (102) comprising:

    a pump (108);
    the mixing assembly (116) of any of the preceding claims, wherein the inlet (118) of the mixing assembly (116) is coupled to the pump (108).

13. The firefighting device of claim 12, wherein the pump (108) defines a pump axis, wherein the second flow axis extends essentially perpendicularly to the pump axis.

14. A method (900) of mixing a fire extinguishing fluid and a foaming agent in a firefighting device (102), the method comprising:

    pressurizing (902) the fluid;
    receiving (904) the pressurized fluid along a first flow axis (140) ;

accelerating (906) the fluid by a first differential pressure injector (146) along a second flow axis (152) arranged at a first angle relative to the first flow axis (140) and injecting a foaming agent in the fluid, thereby producing a first mixture of the fluid and the foaming agent;
accelerating (906) the fluid by a second differential pressure injector (146) along a fourth flow axis (154) and injecting the foaming agent in the fluid, thereby producing a second mixture of the fluid and the foaming agent; and
delivering (908) the first and second mixture along a third flow axis (164), wherein the third flow axis (164) is arranged at a second angle relative to the second flow axis (152);
wherein each of the first angle and the second angle lies approximately between 60 and 120 degrees.

Patentansprüche

1. Mischanordnung (116) für eine Brandbekämpfungsvorrichtung (102), wobei die Mischanordnung umfasst:

   einen Einlass (118), der ausgebildet ist, um ein unter Druck stehendes Feuerlöschfluid von einer Brandbekämpfungsvorrichtungspumpe (108) aufzunehmen, wobei das Fluid entlang einer ersten Strömungsachse (140) aufgenommen wird;
   einen ersten Mischabschnitt (124) mit einem ersten Differenzdruckinjektor (146), der ausgebildet ist, um das Fluid entlang einer zweiten Strömungsachse (152) zu beschleunigen, die in einem ersten Winkel relativ zur ersten Strömungsachse (140) angeordnet ist, und um ein Schäumungsmittel in das Fluid zu einzubringen, und somit ein Gemisch aus dem Fluid und dem Schäumungsmittel zu erzeugen; und
   wenigstens einen Auslass (122), der ausgebildet ist, um das Gemisch entlang einer dritten Strömungsachse (164) abzugeben, wobei die dritte Strömungsachse (164) in einem zweiten Winkel relativ zu der zweiten Strömungsachse (152) angeordnet ist
   wobei jeder des ersten und des zweiten Winkels ungefähr zwischen 60 und 120 Grad liegt; und
   einen zweiten Mischabschnitt (126), der zwischen den Einlass (118) und den wenigstens einen Auslass (122) gekoppelt ist, wobei der zweite Mischabschnitt (126) einen zweiten Differenzdruckinjektor (146) umfasst, der ausgebildet ist, um das Fluid entlang einer vierten Strömungsachse (154) zu beschleunigen und ein Schäumungsmittel in das Fluid einzubringen, und somit ein Gemisch aus dem Fluid und dem Schäumungsmittel zu erzeugen.

2. Mischanordnung nach Anspruch 1, wobei die erste Strömungsachse (140) ungefähr parallel zu der dritten Strömungsachse (164) verläuft.

3. Mischanordnung nach Anspruch 1 oder 2, wobei jeder des ersten Winkels und des zweiten Winkels ungefähr zwischen 80 Grad und 100 Grad liegt.

4. Mischanordnung nach einem der vorhergehenden Ansprüche, wobei
   die zweite Strömungsachse (152) ungefähr senkrecht zu jeder der ersten Strömungsachse (140) und der dritten Strömungsachse (164) verläuft.

5. Mischanordnung nach einem der vorhergehenden Ansprüche, wobei
   die vierte Strömungsachse (154) ungefähr parallel zu der zweiten Strömungsachse (152) verläuft.

6. Mischanordnung nach einem der vorhergehenden Ansprüche, ferner umfassend
   einen Flüssigkeitsteilungsabschnitt (142), der zwischen dem Einlass (118) und jedem von dem ersten Mischabschnitt (124) und dem zweiten Mischabschnitt (126) angeordnet ist.

7. Mischanordnung nach einem der vorhergehenden Ansprüche, ferner umfassend
   einen Mischungszusammenführungsabschnitt (158), der zwischen jedem von dem ersten Mischabschnitt (124) und dem zweiten Mischabschnitt (126) und dem wenigstens einen Auslass (122) angeordnet ist.

8. Mischanordnung nach einem der vorhergehenden Ansprüche, ferner umfassend
   einen ersten Verbindungsabschnitt (170) zwischen dem Einlass (118) und dem ersten Mischabschnitt (124), wobei der erste Verbindungsabschnitt (170) eine erste Biegung relativ zur ersten Strömungsachse (140) und eine zweite Biegung relativ zur ersten Strömungsachse (140) stromabwärts der ersten Biegung aufweist.

9. Mischanordnung nach Anspruch 8, wobei
   die erste Strömungsachse (140) und die erste Biegung des ersten Verbindungsabschnitts (170) im Wesentlichen in einer ersten Ebene liegen, und die zweite Biegung des ersten Verbindungsabschnitts (170) und die zweite Strömungsachse (152) im Wesentlichen in einer zweiten Ebene liegen, die die erste Ebene schneidet.

10. Mischanordnung nach einem der vorhergehenden Ansprüche, ferner umfassend
    einen zweiten Verbindungsabschnitt (172) zwischen

dem ersten Mischabschnitt (124) und dem wenigstens einen Auslass (122), wobei der zweite Verbindungsabschnitt (172) eine erste Biegung relativ zur dritten Strömungsachse (164) und eine zweite Biegung relativ zur dritten Strömungsachse (164) stromabwärts der ersten Biegung aufweist

11. Mischanordnung nach Anspruch 10, wobei die zweite Strömungsachse (152) und die erste Biegung des zweiten Verbindungsabschnitts (172) im Wesentlichen in einer dritten Ebene liegen, und die zweite Biegung des zweiten Verbindungsabschnitts (172) und die dritte Strömungsachse (164) im Wesentlichen in einer vierten Ebene liegen, die die dritte Ebene schneidet.

12. Brandbekämpfungsvorrichtung (102), umfassend:

eine Pumpe (108);
die Mischanordnung (116) nach einem der vorhergehenden Ansprüche, wobei der Einlass (118) der Mischanordnung (116) mit der Pumpe (108) gekoppelt ist.

13. Brandbekämpfungsvorrichtung nach Anspruch 12, wobei die Pumpe (108) eine Pumpenachse definiert, wobei sich die zweite Strömungsachse im Wesentlichen senkrecht zu der Pumpenachse erstreckt.

14. Verfahren (900) zum Mischen eines Feuerlöschfluids und eines Schäumungsmittels in einer Brandbekämpfungsvorrichtung (102), wobei das Verfahren umfasst:

Unterdrucksetzen (902) des Fluids;
Aufnehmen (904) des unter Druck stehenden Fluids entlang einer ersten Strömungsachse (140);
Beschleunigen (906) des Fluids mittels eines ersten Differenzdruckinjektors (146) entlang einer zweiten Strömungsachse (152), die in einem ersten Winkel relativ zu der ersten Strömungsachse (140) angeordnet ist, und Einbringen eines Schäumungsmittels in das Fluid, wodurch ein erstes Gemisch aus dem Fluid und dem Schäumungsmittel erzeugt wird;
Beschleunigen (906) des Fluids mittels eines zweiten Differenzdruckinjektors (146) entlang einer vierten Strömungsachse (154) und Einbringen des Schäumungsmittels in das Fluid, wodurch ein zweites Gemisch aus dem Fluid und dem Schäumungsmittel erzeugt wird; und
Abgeben (908) des ersten und zweiten Gemischs entlang einer dritten Strömungsachse (164), wobei die dritte Strömungsachse (164) in einem zweiten Winkel relativ zu der zweiten Strömungsachse (152) angeordnet ist;
wobei jeder des ersten Winkels und des zweiten Winkels ungefähr zwischen 60 und 120 Grad liegt.

Revendications

1. Ensemble mélangeur (116) pour dispositif de lutte contre les incendies (102), l'ensemble mélangeur comprenant :

une entrée (118) conçue pour recevoir un fluide d'extinction d'incendie sous pression à partir d'une pompe de dispositif de lutte contre les incendies (108), dans laquelle le fluide est reçu le long d'un premier axe d'écoulement (140) ;
une première section de mélange (124) avec un premier injecteur à pression différentielle (146) conçu pour accélérer le fluide le long d'un deuxième axe d'écoulement (152) disposé à un premier angle par rapport au premier axe d'écoulement (140) et pour injecter un agent moussant dans le fluide, produisant ainsi un mélange du fluide et de l'agent moussant ; et
au moins une sortie (122) conçue pour distribuer le mélange le long d'un troisième axe d'écoulement (164), dans lequel le troisième axe d'écoulement (164) est agencé à un deuxième angle par rapport au deuxième axe d'écoulement (152) ;
dans lequel chacun du premier angle et du deuxième angle se situe approximativement entre 60 et 120 degrés ; et
une seconde section de mélange (126) accouplée entre l'entrée (118) et l'au moins une sortie (122), la seconde section de mélange (126) comprenant un second injecteur à pression différentielle (146) conçu pour accélérer le fluide le long d'un quatrième axe d'écoulement (154) et pour injecter un agent moussant dans le fluide, produisant ainsi un mélange du fluide et de l'agent moussant.

2. Ensemble mélangeur selon la revendication 1, dans lequel le premier axe d'écoulement (140) est approximativement parallèle au troisième axe d'écoulement (164).

3. Ensemble mélangeur selon la revendication 1 ou 2, dans lequel chacun du premier angle et du deuxième angle se situe approximativement entre 80 degrés et 100 degrés.

4. Ensemble mélangeur selon l'une quelconque des revendications précédentes, dans lequel le deuxième axe d'écoulement (152) est approximativement perpendiculaire à chacun du premier axe d'écoulement (140) et du troisième axe d'écoulement (164).

5. Ensemble mélangeur selon l'une quelconque des revendications précédentes, dans lequel le quatrième axe d'écoulement (154) est approximativement parallèle au deuxième axe d'écoulement (152).

6. Ensemble mélangeur selon l'une quelconque des revendications précédentes, comprenant en outre une section de séparation de fluide (142) agencée entre l'entrée (118) et chacune de la première section de mélange (124) et de la seconde section de mélange (126).

7. Ensemble mélangeur selon l'une quelconque des revendications précédentes, comprenant en outre une section de combinaison de mélange (158) agencée entre chacune de la première section de mélange (124) et de la seconde section de mélange (126) et l'au moins une sortie (122).

8. Ensemble mélangeur selon l'une quelconque des revendications précédentes, comprenant en outre une première section de raccordement (170) entre l'entrée (118) et la première section de mélange (124), dans laquelle la première section de raccordement (170) a un premier coude par rapport au premier axe d'écoulement (140) et un second coude par rapport au premier axe d'écoulement (140) en aval du premier coude.

9. Ensemble mélangeur selon la revendication 8, dans lequel le premier axe d'écoulement (140) et le premier coude de la première section de raccordement (170) se situent essentiellement dans un premier plan, et le second coude de la première partie de raccordement (170) et le deuxième axe d'écoulement (152) se situent essentiellement dans un deuxième plan coupant le premier plan.

10. Ensemble mélangeur selon l'une quelconque des revendications précédentes, comprenant en outre une seconde section de raccordement (172) entre la première section de mélange (124) et l'au moins une sortie (122), dans lequel la seconde section de raccordement (172) a un premier coude par rapport au troisième axe d'écoulement (164) et un second coude par rapport au troisième axe d'écoulement (164) en aval du premier coude.

11. Ensemble mélangeur selon la revendication 10, dans lequel le deuxième axe d'écoulement (152) et le premier coude de la seconde section de raccordement (172) se situent sensiblement dans un troisième plan, et le second coude de la seconde section de raccordement (172) et le troisième axe d'écoulement (164) se situent sensiblement dans un quatrième plan coupant le troisième plan.

12. Dispositif de lutte contre les incendies (102) comprenant :

une pompe (108) ;
l'ensemble mélangeur (116) selon l'une quelconque des revendications précédentes, dans lequel l'entrée (118) de l'ensemble mélangeur (116) est accouplée à la pompe (108).

13. Dispositif de lutte contre les incendies selon la revendication 12, dans lequel la pompe (108) définit un axe de pompe, dans lequel le deuxième axe d'écoulement s'étend essentiellement perpendiculairement à l'axe de pompe.

14. Procédé (900) de mélange d'un fluide d'extinction d'incendie et d'un agent moussant dans un dispositif de lutte contre les incendies (102), le procédé comprenant :

la mise sous pression (902) du fluide ;
la réception (904) du fluide sous pression le long d'un premier axe d'écoulement (140) ;
l'accélération (906) du fluide par un premier injecteur à pression différentielle (146) le long d'un deuxième axe d'écoulement (152) agencé à un premier angle par rapport au premier axe d'écoulement (140) et l'injection d'un agent moussant dans le fluide, produisant ainsi un premier mélange du fluide et de l'agent moussant ;
l'accélération (906) du fluide par un deuxième injecteur à pression différentielle (146) le long d'un quatrième axe d'écoulement (154) et l'injection de l'agent moussant dans le fluide, produisant ainsi un second mélange du fluide et de l'agent moussant ; et
la distribution (908) du premier et du second mélange le long d'un troisième axe d'écoulement (164), dans lequel le troisième axe d'écoulement (164) est agencé à un deuxième angle par rapport au deuxième axe d'écoulement (152) ;
dans lequel chacun du premier angle et du deuxième angle se situe approximativement entre 60 et 120 degrés.

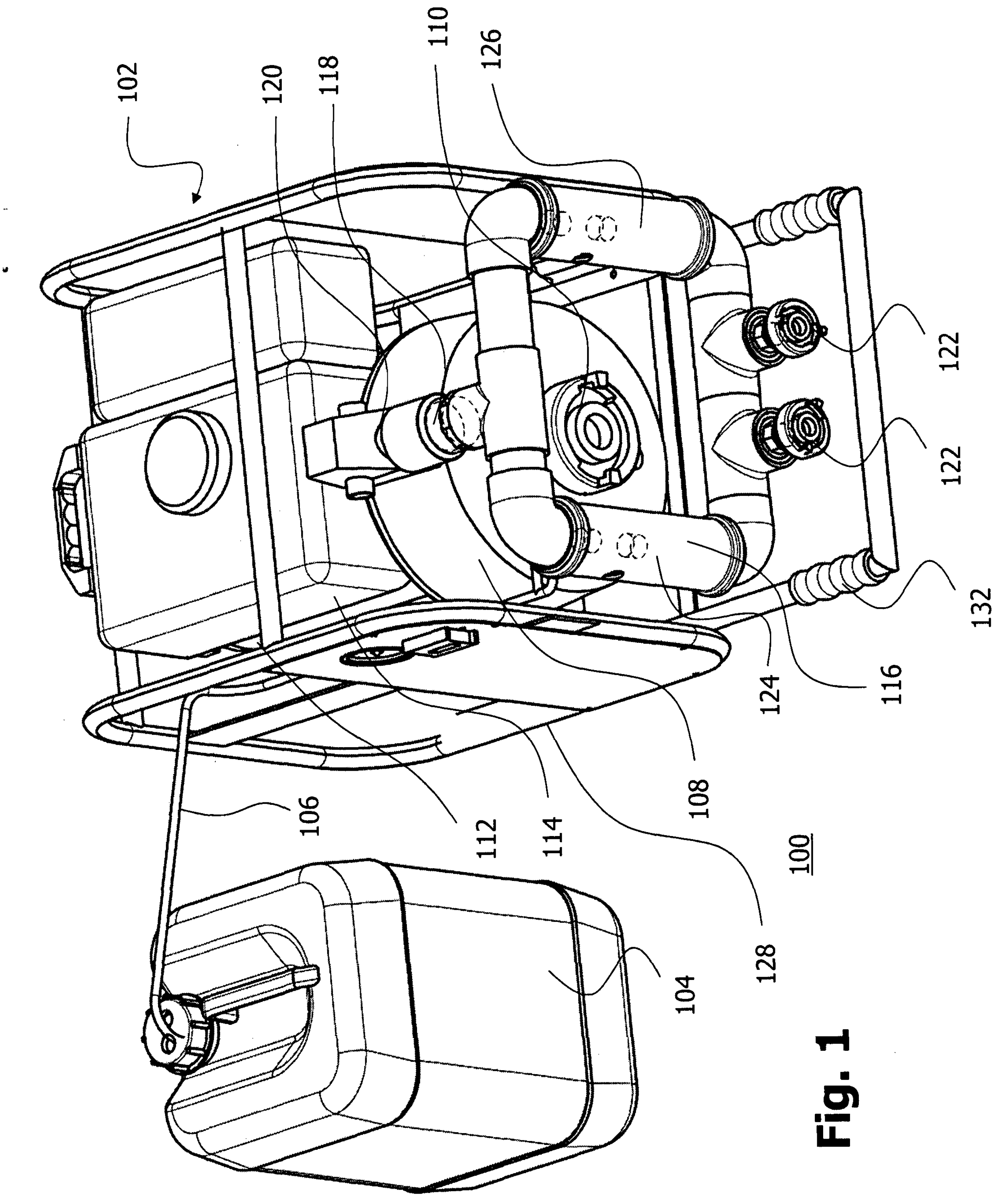

102
120
118
110
126
122
122
132
116
124
108
128
114
112
106
104
100

Fig. 1

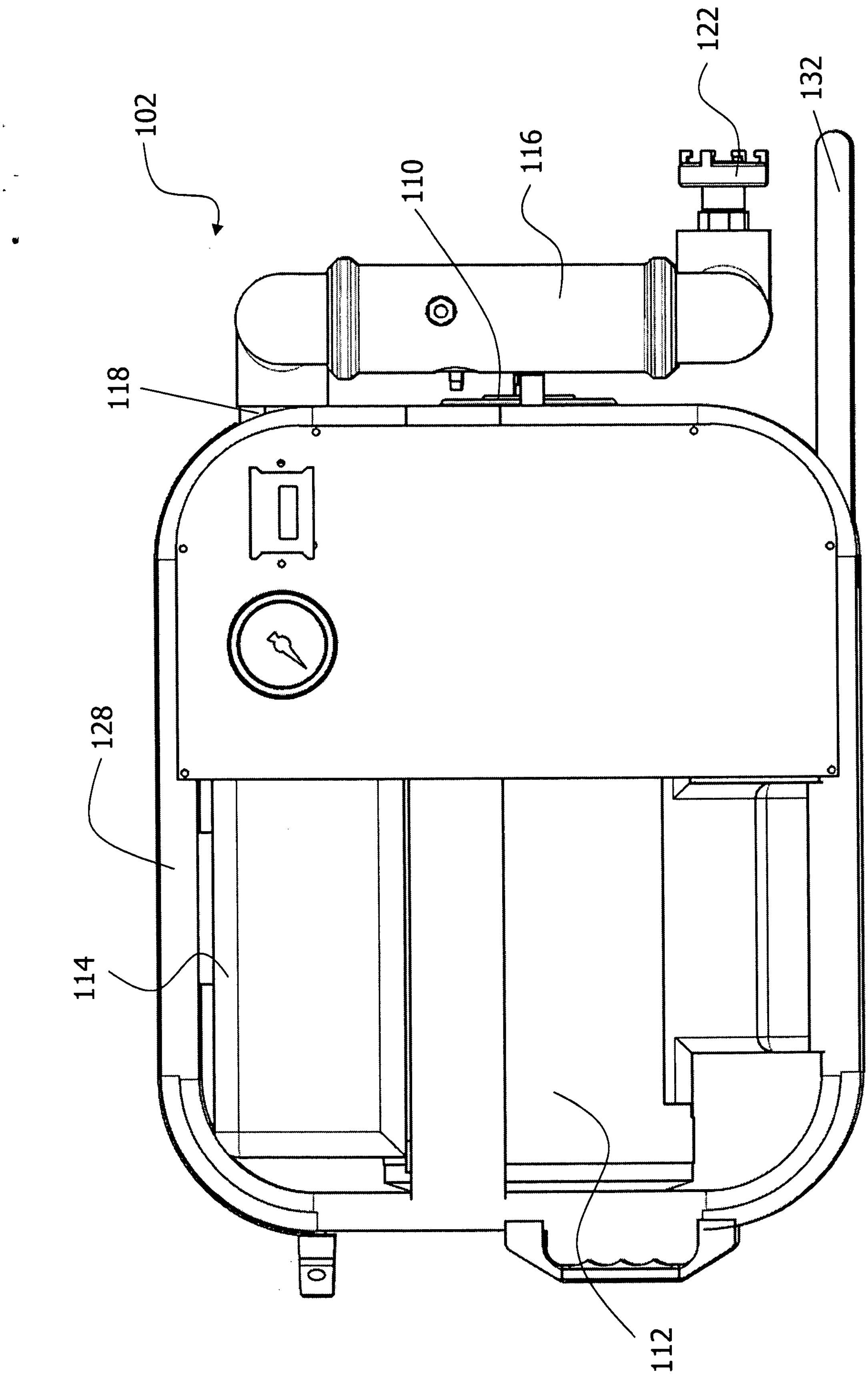


Fig. 2

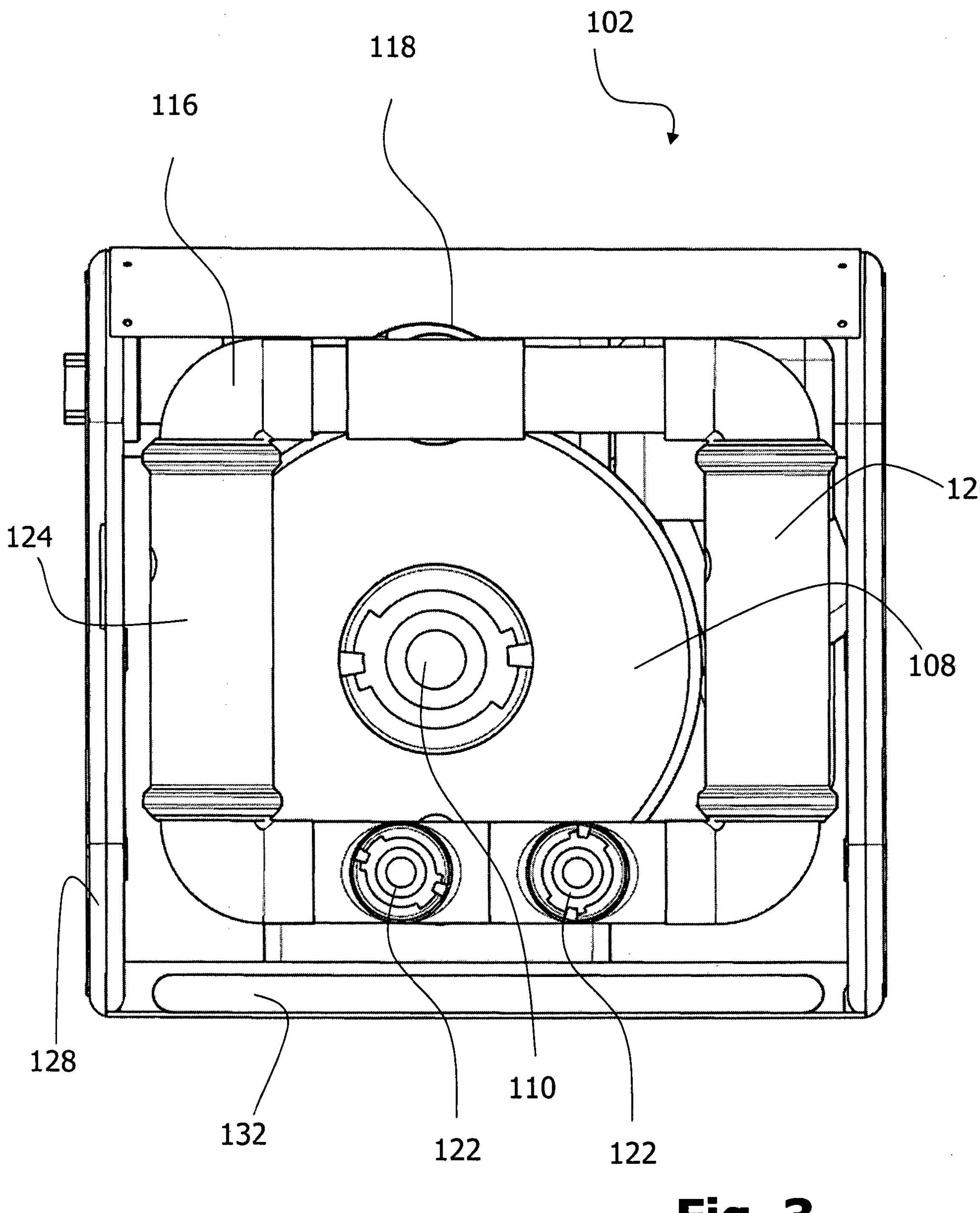


Fig. 3

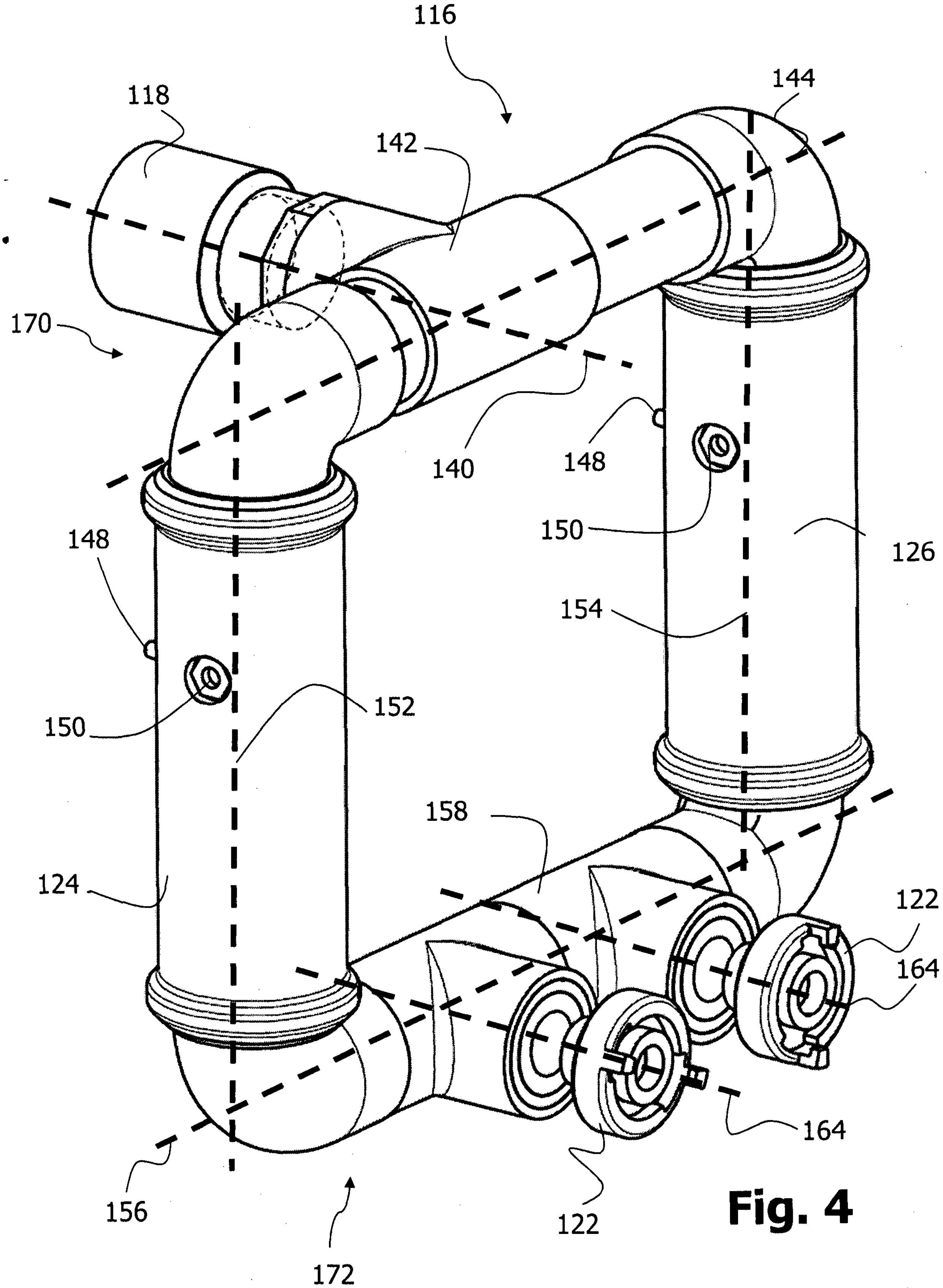

116
118
142
144
170
140
148
150
126
148
154
150
152
158
124
122
164
164
156
122
172

Fig. 4

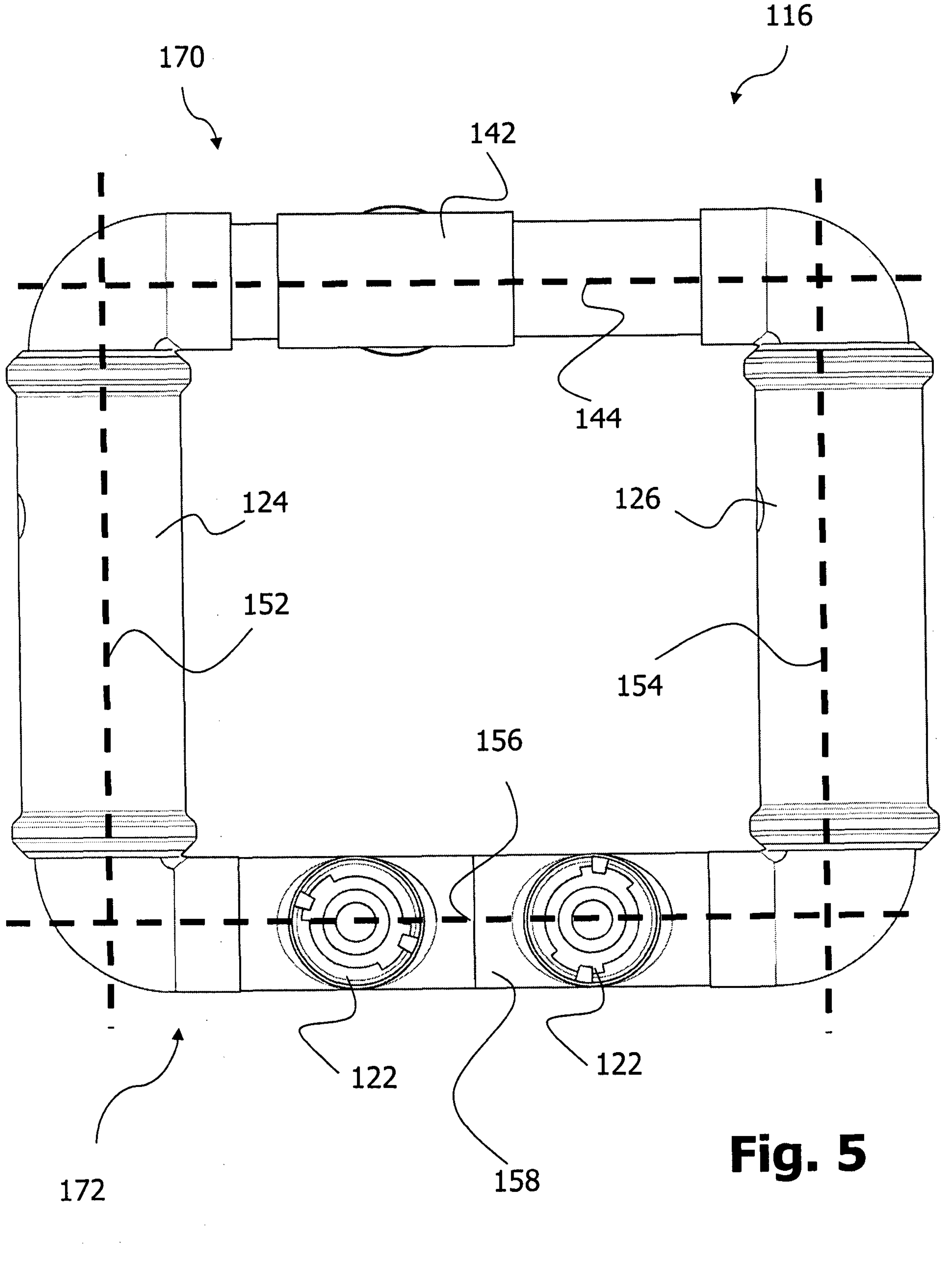


Fig. 5

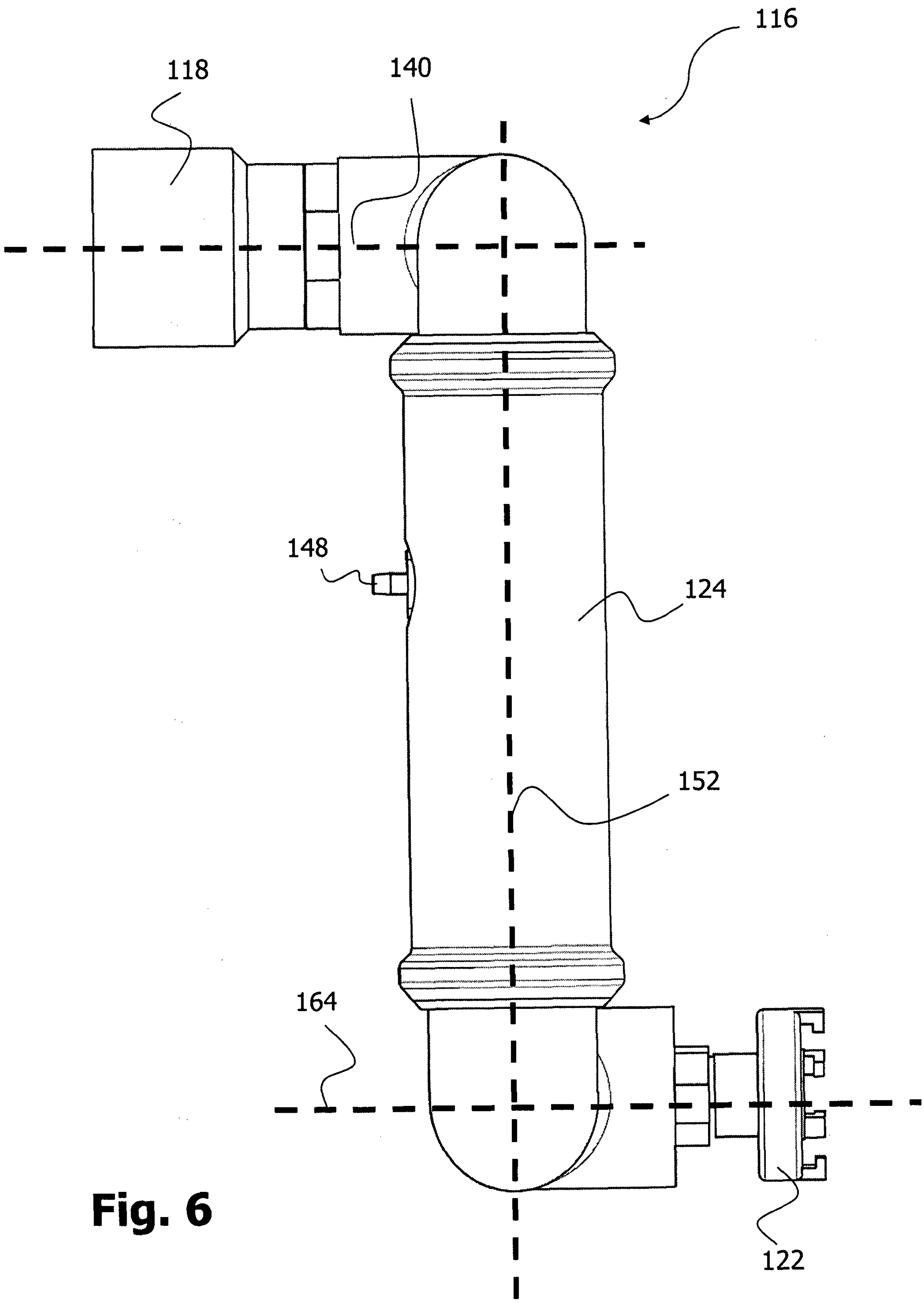


Fig. 6

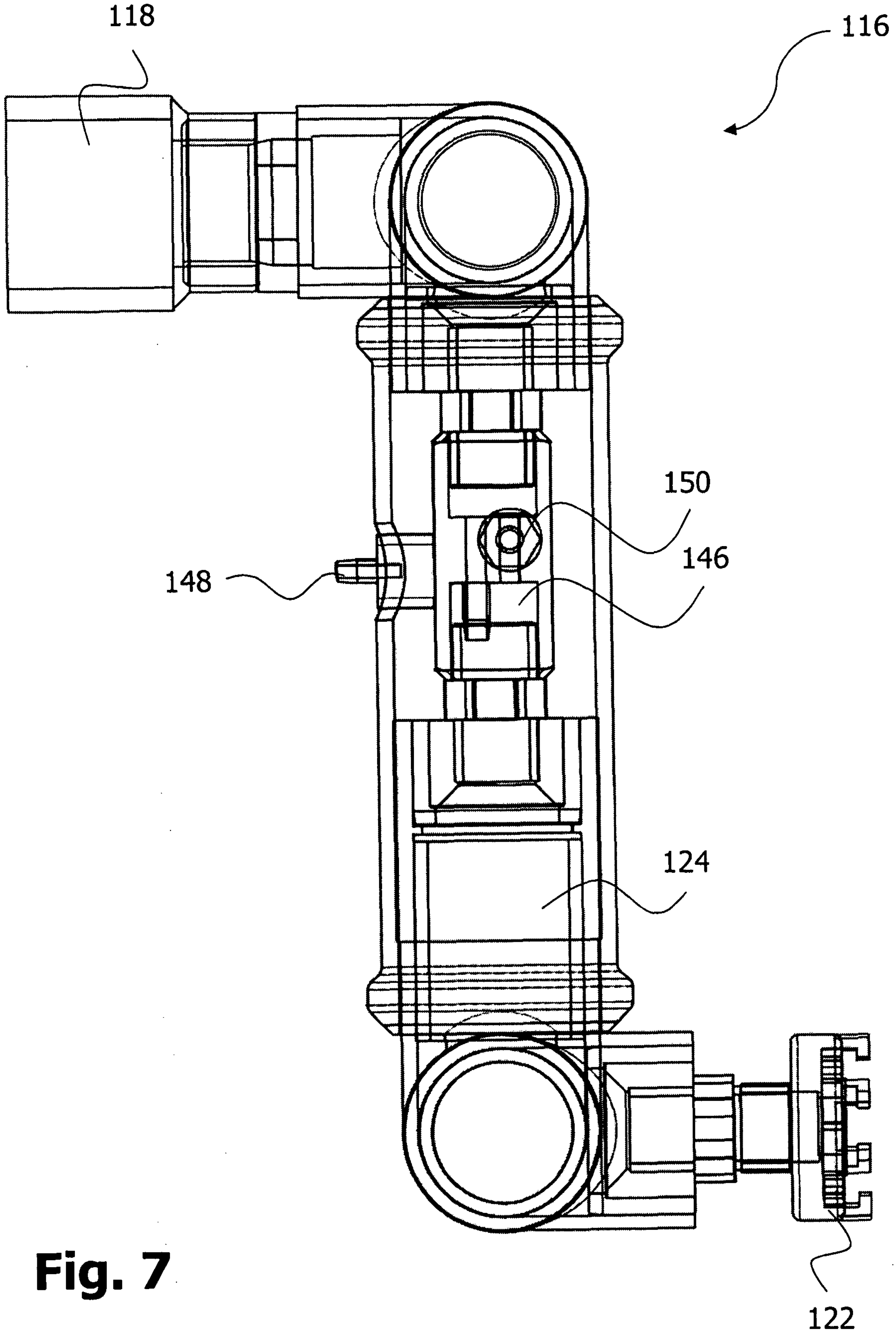


Fig. 7

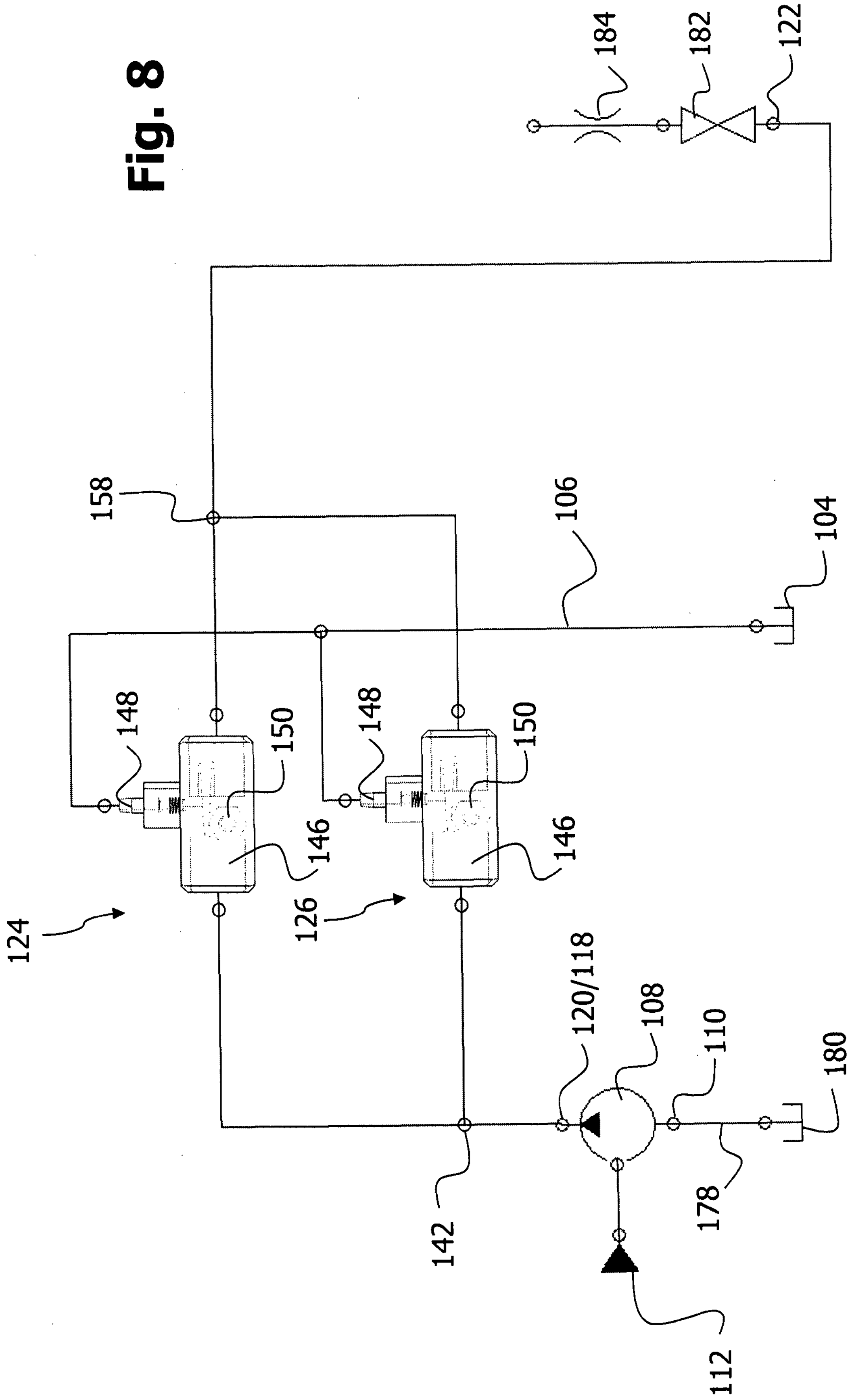
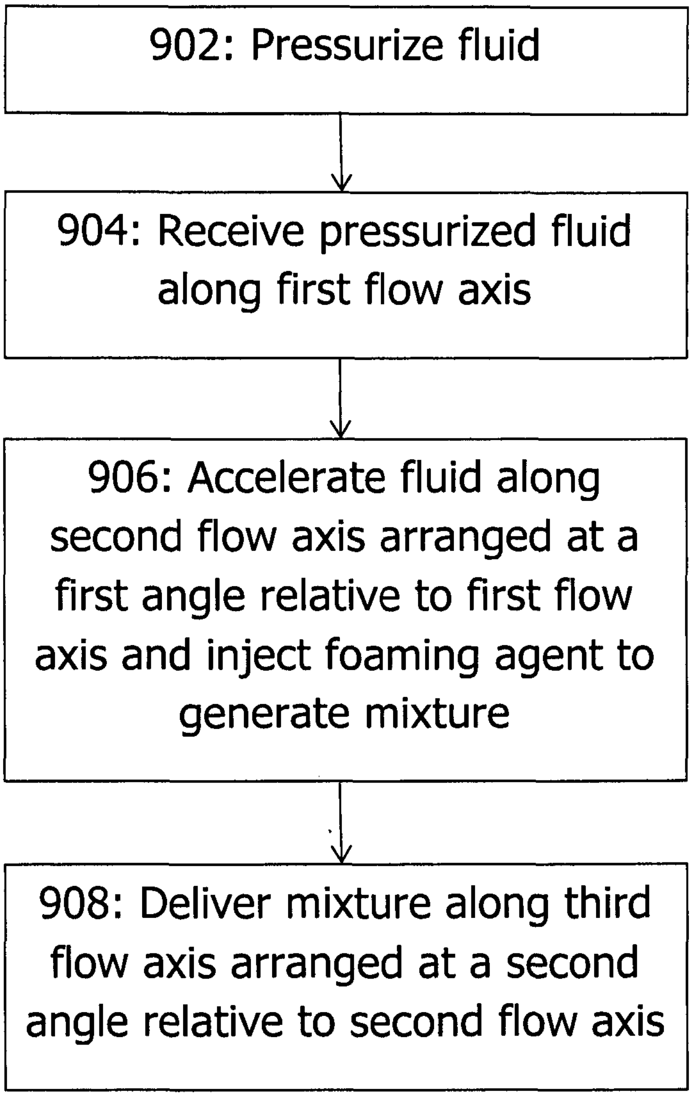

184
182
122
158
106
104
148
150
148
150
146
146
124
126
120/118
108
110
180
142
178
112

Fig. 8


902: Pressurize fluid
904: Receive pressurized fluid along first flow axis
906: Accelerate fluid along second flow axis arranged at a first angle relative to first flow axis and inject foaming agent to generate mixture
908: Deliver mixture along third flow axis arranged at a second angle relative to second flow axis

900

Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1595579 A2 **[0004]**
- EP 1595579 A **[0005]**
- US 20060151184 A1 **[0006]**