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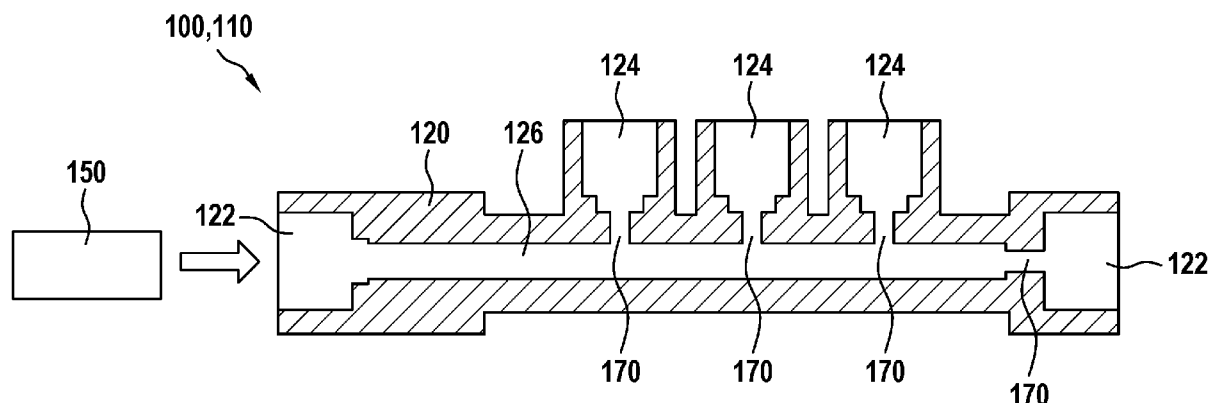
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(54) MANIFOLD AND HIGH-PRESSURE H2-SYSTEM

(57) The present invention relates to a manifold (110) for a high-pressure H₂-system (100), the manifold (110) comprising a main body (120) with a number of radial interfaces (124) to connect the manifold (110) to a refueling infrastructure (150) and the high-pressure H₂-system (100), wherein the number of radial interfaces (124) are fluid communicatingly connected via a main bore (126) along the main body (120), wherein the main body

(120), comprises at least one throttle (170) between the main bore (126) and at least one of the number of radial interfaces (124), wherein the at least one throttle (170) comprises a throttle length (171) and a throttle diameter (172). Furthermore, the invention relates to a high-pressure H₂-system (100) comprising at least one manifold (110).

Fig. 1**EP 4 560 180 A1**

Description

[0001] The present invention relates to a manifold for a high-pressure H₂-system. Furthermore, the invention relates to a high-pressure H₂-system with at least one manifold.

Prior art

[0002] Known manifolds for high-pressure systems for hydrogen comprise of various structures with one or more inlets and a number of outlets to distribute the hydrogen. The known manifolds for high-pressure systems for hydrogen are designed up to 700 bar and even higher in the future. The usage of the manifolds with a gas like hydrogen requires a deliberate choice of material for the manifolds.

[0003] Since the inner diameters of a manifold are designed to enable a favourable flow of the fluid through the manifold. Those known manifolds tend to vary in the uniformity of the flow, the pressure and/or the balancing of the distribution of the hydrogen by manifold's outlets to tanks of high-pressure system H₂ system during refuelling cycle.

[0004] High-pressure systems for hydrogen are typically used in different use cases, for example as a fuel providing system for modern drive units in vehicles or for stationary electric power sources.

Disclosure of the invention

[0005] The invention claims a manifold for a high-pressure H₂-system with the features of independent claim 1. Furthermore, the invention discloses a high-pressure H₂-system with at least one manifold with the features of independent claim 10. Further advantages and details of the invention result from the depending on claims, the description and the drawings. In this context, features described in relation to the manifold according to the invention naturally also apply in relation to the high-pressure H₂-system according to the invention and vice versa in each case, so that reference is or can always be made mutually regarding the disclosure concerning the individual aspects of the invention.

[0006] According to the first aspect of the invention, the invention discloses a manifold for a high-pressure H₂-system, the manifold comprising a main body with a number of radial interfaces to connect the manifold to a refuelling infrastructure and the high-pressure H₂-system, wherein the number of radial interfaces are fluid communicatingly connected via a main bore along the main body, wherein the main body, comprises at least one throttle between the main bore and at least one of the number of radial interfaces, wherein the at least one throttle comprises a throttle length and a throttle diameter.

[0007] As described in detail later the main body usually comprises at least one axial interface, with the excep-

tion of 3D printed manifolds which may not have an axial interface.

[0008] The manifold in general preferably comprises a pipe like shape and/or a cylindrical shape. The main function of the manifold is to distribute the hydrogen between interfaces. The axial and radial interfaces are preferably interchangeable regarding the function as input and/or output interfaces. The number of radial interfaces extend radially from the main body. Preferably, the number of radial interfaces extend parallel to each other and/or in line with each other from the main body.

[0009] The manifold preferably comprises at least one input interface, while the rest of the interfaces are preferably used as output interfaces and/or are closed off by, for example, screw plugs. The interfaces preferably each comprise attachment means for attaching the manifold to the refuelling infrastructure and to the high-pressure H₂-system. The interfaces preferably are understood as connection means for connecting the manifold to the refuelling infrastructure and/or to the high-pressure H₂-system.

[0010] The fluid is distributed among the interfaces via the main bore along the main body. The main bore is preferably understood as a bored, drilled and/or otherwise machined cavity along the main body. The main bore is preferably designed in such a way that its diameter does not change within at least one region of the main body. Preferably, the main bore has a constant or almost constant inner diameter along its whole length or at least 90% of its length inside the main body.

[0011] The high-pressure H₂-system preferably comprises at least one tank for hydrogen and/or at least one consumer-means for hydrogen, for example an engine and/or drive unit of a vehicle. The refuelling infrastructure is preferably understood as some kind of fuel station, a stationary or mobile tank unit and/or some other source of fuel, preferably hydrogen.

[0012] The manifold comprises the main body, which is preferably understood as a single piece of material. The main body comprises a main bore along the main body. The inner diameter of the main bore is preferably constant or almost constant in a major portion of the main body. The main body is preferably understood as a linear main body and/or a main body along a virtual axis. The axial interfaces of the manifold are preferably arranged in line with the virtual axis of the main body. The radial interfaces are preferably arranged radially to the virtual axis of the main body.

[0013] The main body of the manifold is especially advantageous, because of the at least one throttle is located between the main bore and at least one of the number of radial interfaces. Additionally, or alternatively, the main body comprises at least one throttle between the main bore and at least one axial interface. The at least one throttle comprises a throttle length and a throttle diameter. The throttle length is to be understood along a flow of gas through the throttle. The throttle diameter is to be understood as a width of a cross section of the

throttle. The throttle is preferably understood as a reduction of an inner diameter of a path for the flow of the hydrogen. With other words, the throttle is preferably machined to a smaller diameter than neighbouring sections to the throttle or pressed into the manifold as a single attached component along a path for the flow of hydrogen.

[0014] The throttle is especially advantageous because of the arrangement of the throttle between the main bore and at least one axial interface and/or between the main bore and at least one of the number of radial interfaces. Preferably, the throttle is machined through or pressed into a respective axial interface and/or radial interface.

[0015] According to an advantageous design of the invention, a manifold is provided, wherein the main body is made of, but not limited to, austenitic stainless steel and/or that the manifold or at least the main body is made by a forging method, and/or a casting method and/or a machining method and/or a 3D printing method and/or a die casting method. The choice of austenitic stainless steel for the main body is especially advantageous for the usage of the manifold with a high-pressure H₂-system since austenitic stainless steel provides favourable resistance against hydrogen embrittlement. The preferable methods for producing the manifold include a machining method combined with a forging method, a casting method or 3D printing, in order to reduce costs of production, increase quality of the manifold and/or allow for an easy and fast production cycle.

[0016] A manifold designed in this way is particularly advantageous because the manifold enables an advantageous flow of hydrogen, whereby a uniform flow of hydrogen is made possible by the manifold and the throttle in a particularly simple manner. The manifold according to the invention provides a high stability for the distribution of hydrogen for high-pressure H₂-systems.

[0017] According to an advantageous design of the invention, a manifold is provided, wherein the main body comprises at least one axial interface, wherein the main body, comprises at least one throttle between the main bore and at least on axial interface and/or wherein the main body comprises at least one of the throttle between the main bore and each of the at least one axial interface and/or between the main bore and each of the number of radial interfaces. The possible features of the throttle are already described before. It is especially advantageous for the design of the manifold to have a throttle between the main bore and each of the at least one axial interface and/or between the main bore and each of the number of radial interfaces. Thereby, the uniform flow of hydrogen as well as the stability of the gas flow inside the manifold is advantageously increased. The throttles are preferably designed similar or identical between the main bore and each of the at least one axial interface and/or between the main bore and each of the number of radial interfaces. Thereby, the production of the manifold is simplified, tool

changes for the machining of the manifold are minimized and the costs are reduced. The manifold designed in this way is particularly advantageous because the manifold enables an advantageous uniform flow of hydrogen with high pressure, whereby an equal distribution of the hydrogen is made possible by the manifold in a particularly simple manner.

[0018] According to an advantageous design of the invention, a manifold is provided, wherein the throttle length correlates to the throttle diameter by a factor between 1 and 4, especially between 2 and 3. The throttle length is preferably longer than the throttle diameter. The throttle diameter is designed in order to provide a high stability and fatigue strength of the manifold and its main body as well as an advantageous throttling of a flow of hydrogen. A factor between 1 and 4, especially between 2 and 3, for the throttle length in relationship to the throttle diameter enables the throttle to unify the provision and distribution of hydrogen by the manifold advantageously while also designing of the manifold with a focus on high stability and reduced costs. The manifold designed in this way is particularly advantageous because the manifold enables an advantageous uniform flow of hydrogen with high pressure, whereby an equal distribution of the hydrogen is made possible by the manifold in a particularly simple manner.

[0019] According to an advantageous design of the invention, a manifold is provided, wherein the throttle diameter correlates to the main bore by a factor between 0,1 and 0,9, especially between 0,2 and 0,4 and/or that the throttle diameter is smaller than 3 mm, preferably smaller than 2,4 mm. The throttle comprises a diameter smaller than the diameter of the main bore. Preferably the throttle diameter correlates to between 0,1 and 0,9, especially between 0,2 and 0,4, times the diameter of the main bore. Exemplarily the throttle diameter is smaller than 3 mm, preferably smaller than 2,4 mm, in order to provide an advantageous uniform flow and distribution of hydrogen by the manifold. The manifold designed in this way is particularly advantageous because the manifold enables an advantageous uniform flow of hydrogen with high pressure, whereby an equal distribution of the hydrogen is made possible by the manifold in a particularly simple manner.

[0020] According to an advantageous design of the invention, a manifold is provided, wherein an inner diameter of the main bore and an inner diameter of the at least one axial interface and/or an inner diameter of the number of radial interfaces are at least partially identical. Identical diameters are preferably because the number of tool changes while producing the manifold is advantageously reduced. The manifold with the inventive throttle as well as main bore, at least one axial interface and/or at least one radial interfaces with at least partially identical inner diameter is able to provide an advantageous uniform flow of hydrogen, whereby an equal distribution of the hydrogen is made possible by the manifold in a particularly simple manner.

[0021] According to an advantageous design of the invention, a manifold is provided, wherein the at least one axial interface and/or the number of radial interfaces comprise at least one connection means for connecting the manifold to a pipe unit and/or the manifold and/or the high-pressure H₂-system. The at least one connection means is for example designed as a clamping means, screwing means and/or push-in means for connecting a pipe unit to the respective interface. The pipe unit is either defined as a part of the high-pressure H₂-system or as part of the manifold, whereby the pipe unit is preferably connectable and disconnectable to the manifold by the at least one connection means. The manifold designed in this way is particularly advantageous because the manifold enables an advantageous uniform flow of hydrogen with high pressure, whereby an equal distribution of the hydrogen is made possible by the manifold in a particularly simple manner.

[0022] According to an advantageous design of the invention, a manifold is provided, wherein the main body comprises a chamfered and/or a rounded and/or a sharp edge transition section between the throttle and the main bore and/or between the throttle and the at least one axial interface and/or the at least one of the number of radial interfaces. The chamfered and/or a rounded transition section between the throttle and the main bore and/or between the throttle and the at least one axial interface and/or the at least one of the number of radial interfaces enables a smoother flow of hydrogen through the manifold, especially through the throttles of the manifold. By chamfering and/or rounding a transition section, turbulences inside the manifold and the flow of hydrogen are reduced. The manifold designed in this way is particularly advantageous because the manifold enables an advantageous uniform flow of hydrogen with high pressure, whereby an equal distribution of the hydrogen is made possible by the manifold in a particularly simple manner.

[0023] According to an advantageous design of the invention, a manifold is provided, wherein the at least one axial interface and/or the number of radial interfaces comprise at least one inner diameter, wherein the inner diameter is larger than the throttle diameter. It is an advantageous design of the at least one axial interface and/or the number of radial interfaces to increase the inner diameter before and/or behind the throttle, depending on the direction of flow of the hydrogen. With other words, it is advantageous for the manifold, to design the throttle diameter as the smallest diameter in the flow path of hydrogen inside the manifold. Preferably, the inner diameter of the main bore correlates or is identical to a diameter of a respective axial and/or radial interface behind the throttle of the respective axial and/or radial interface. The manifold designed in this way is particularly advantageous because the manifold enables an advantageous uniform flow of hydrogen, whereby an equal distribution of the hydrogen is made possible by the manifold in a particularly simple manner.

[0024] According to an advantageous design of the

invention, a manifold is provided, wherein the manifold comprises at least one pipe unit connected to the at least one axial interface and/or to at least one of the number of radial interfaces, wherein an inner diameter of the at least one pipe unit and an inner diameter of the main bore and/or an inner diameter of the respective at least one axial interface and/or the at least one respective radial interface are at least partially identical. The pipe unit is preferably understood as a pipe, tube and/or some other kind of gas-bearing pipeline. The pipe unit preferably continues the distribution of the hydrogen from the refuelling infrastructure to the high-pressure H₂-system and/or inside the high-pressure H₂-system. The pipe unit is very advantageous when an inner diameter of the at least one pipe unit and an inner diameter of the main bore and/or an inner diameter of the respective at least one axial interface and/or the at least one respective radial interface are at least partially identical. A manifold designed in this way is particularly advantageous because the manifold enables an advantageous uniform flow of hydrogen, whereby an equal distribution of the hydrogen is made possible by the manifold in a particularly simple manner.

[0025] According to a second aspect of the invention, the invention discloses a high-pressure H₂-system. The high-pressure H₂-system comprises at least one manifold according to the first aspect. The described high-pressure H₂-system has all the advantages already described for the manifold according to the first aspect of the invention. The manifold and the high-pressure H₂-system are preferably attached to each other, for example by screwing, pressing, /or clamping.

[0026] A manifold for a high-pressure H₂-system and a high-pressure H₂-system according to the invention are explained in more detail below with reference to figures. The figures show schematically:

Figure 1 in a sectional side view a manifold of a high-pressure H₂-system,

Figure 2 in a detailed sectional side view a manifold of a high-pressure H₂-system, and

Figure 3 in a detailed sectional side view an axial interface of a manifold.

[0027] Features with the same function or principle of operation are each provided with the same reference signs in Figs. 1 to 3.

[0028] In Fig. 1, a sectional side view of a manifold 110 of a high-pressure H₂-system 100 is shown. The manifold 110 comprises a main body 120 with two axial interfaces 122 and three radial interfaces 124 to connect the manifold 110 to a refuelling infrastructure 150 and to the high-pressure H₂-system 100. The fluid is distributed among the two axial interfaces 122 and the three radial interfaces 124 via the main bore 126 along the main body 120. The main body 120 comprises four throttles 170

between the main bore 126 and one of the axial interfaces 122 and between the main bore 126 and the three radial interfaces 124.

[0029] In Fig. 2, a detailed sectional side view of a manifold 110 of a high-pressure H₂-system 100 is shown. The manifold 110 is only shown partially and comprises a main body 120 with axial interfaces 122 and radial interfaces 124 to connect the manifold 110 to a refuelling infrastructure 150 and to the high-pressure H₂-system 100. The fluid is distributed among the axial interface 122 and radial interface 124 via the main bore 126 along the main body 120. The main body 120 comprises throttles 170 between the main bore 126 and the shown axial interface 122 and between the main bore 126 and the shown radial interface 124. The throttles 170 each comprise a throttle length 171 and a throttle diameter 172. The axial interface 122 comprises a connection means 130 for connecting the manifold 110 to a pipe unit 102. The shown axial interface 122 and the shown radial interface 124 comprise an inner diameter 125, wherein the inner diameters 125 are larger than the throttle diameter 172.

[0030] In Fig. 3, a detailed sectional side view of a manifold 110 of a high-pressure H₂-system 100 is shown. The manifold 110 comprises a main body 120 with one shown axial interface 122. The fluid is distributed among the axial interface 122 and radial interface 124 (not shown) via the main bore 126 along the main body 120. The main body 120 comprises a shown throttle 170 between the main bore 126 and the shown axial interfaces 122.

Claims

1. Manifold (110) for a high-pressure H₂-system (100), the manifold (110) comprising a main body (120) with a number of radial interfaces (124) to connect the manifold (110) to a refuelling infrastructure (150) and the high-pressure H₂-system (100), wherein the number of radial interfaces (124) are fluid communicatingly connected via a main bore (126) along the main body (120), wherein the main body (120), comprises at least one throttle (170) between the main bore (126) and at least one of the number of radial interfaces (124), wherein the at least one throttle (170) comprises a throttle length (171) and a throttle diameter (172).
2. Manifold (110) according to claim 1,
characterized in

that the main body (120) comprises at least one axial interface (122), wherein the main body (120), comprises at least one throttle (170) between the main bore (126) and at least on axial interface (122) and/or
that the main body (120) comprises at least one

of the throttle (170) between the main bore (126) and each of the at least one axial interface (122) and/or between the main bore (126) and each of the number of radial interfaces (124).

3. Manifold (110) according to any of the previous claims,
characterized in
that the throttle length (171) correlates to the throttle diameter (172) by a factor between 1 and 4, especially between 2 and 3.
4. Manifold (110) according to any of the previous claims,
characterized in

that the throttle diameter (172) correlates to the main bore (126) by a factor between 0,1 and 0,9, especially between 0,2 and 0,4 and/or
that the throttle diameter (172) is smaller than 3 mm, preferably smaller than 2,4 mm.
5. Manifold (110) according to any of the previous claims,
characterized in
that an inner diameter of the number of radial interfaces (124) and/or at least one of the axial interface (122) are at least partially identical and the throttle diameter (172) are at least partially identical.
6. Manifold (110) according to any of the previous claims,
characterized in
that the at least one axial interface (122) and/or the number of radial interfaces (124) comprise at least one connection means (130) for connecting the manifold (110) to a pipe unit (102) and/or the manifold (110) and/or the high-pressure H₂-system (100).
7. Manifold (110) according to any of the previous claims,
characterized in
that the main body (120) comprises a chamfered and/or a rounded and/or sharp transition section between the throttle (170) and the main bore (126) and/or between the throttle (170) and the at least one axial interface (122) and/or the at least one of the number of radial interfaces (124).
8. Manifold (110) according to any of the previous claims,
characterized in
that the at least one axial interface (122) and/or the number of radial interfaces (124) comprise at least one inner diameter (125), wherein the inner diameter (125) is larger than the throttle diameter (172).
9. Manifold (110) according to any of the previous

claims,

characterized in

that the manifold (110) comprises at least one pipe unit (102) connected to the at least one axial interface (122) and/or to at least one of the number of radial interfaces (124), wherein an inner diameter of the at least one pipe unit (102) and an inner diameter of the main bore (126) and/or an inner diameter of the respective at least one axial interface (122) and/or the at least one respective radial interface (124) are at least partially identical.

- 10.** High-pressure H₂-system (100) comprising at least one manifold (110) according to any of the previous claims.

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Fig. 1

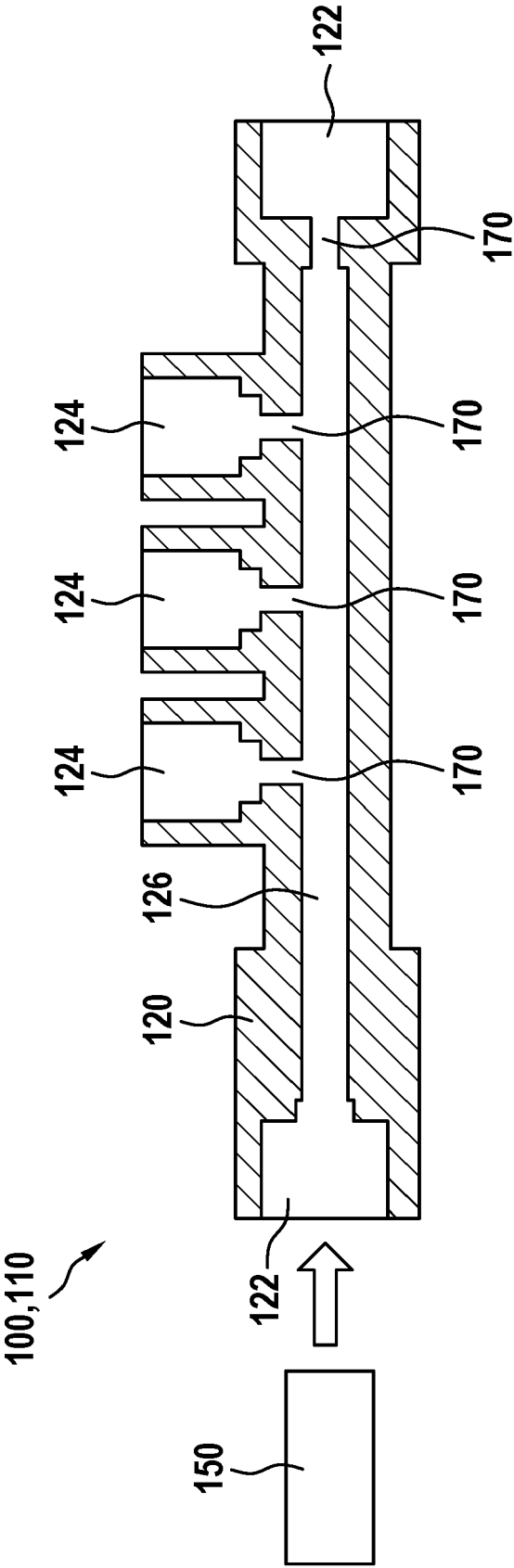


Fig. 2

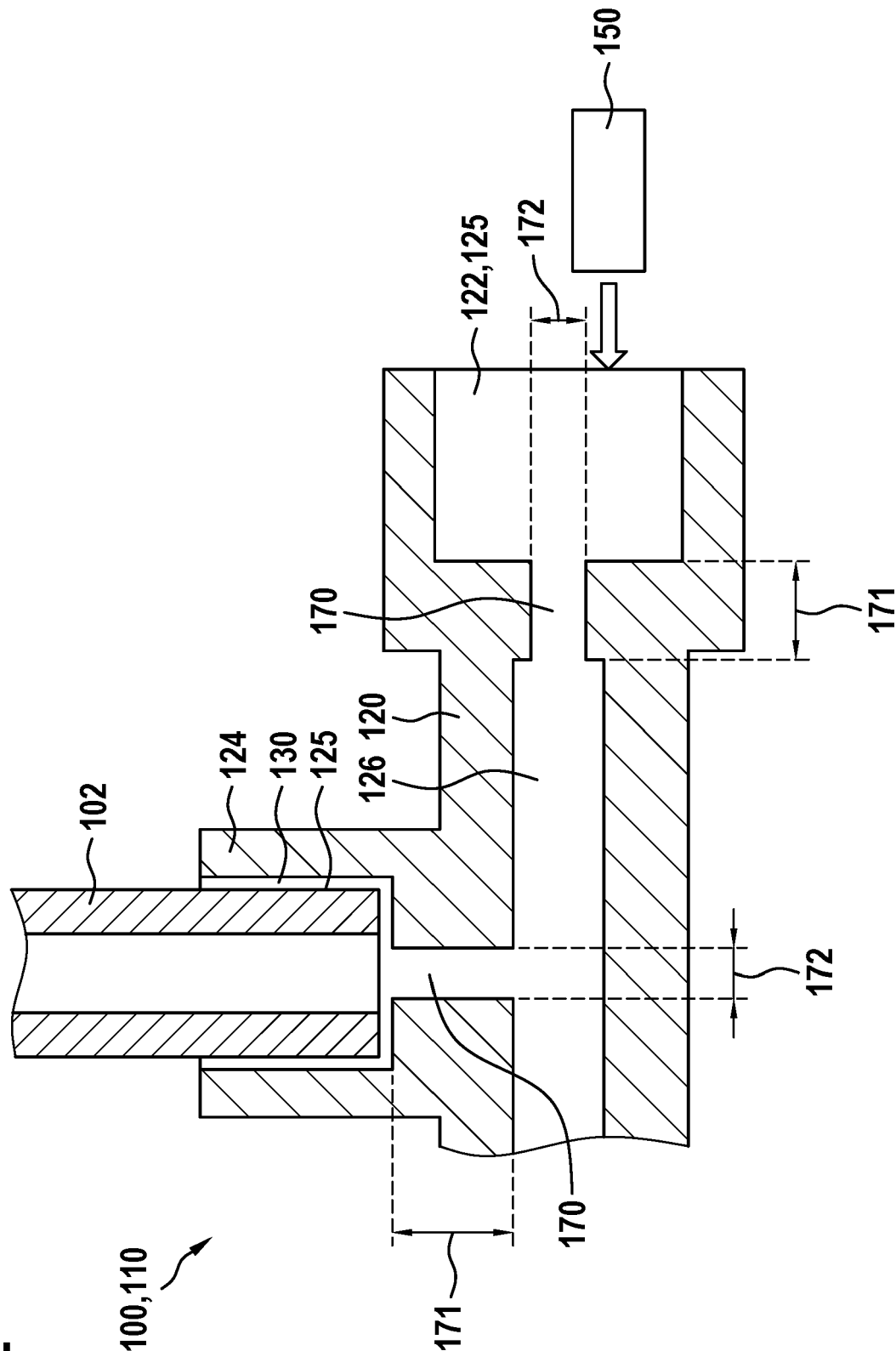
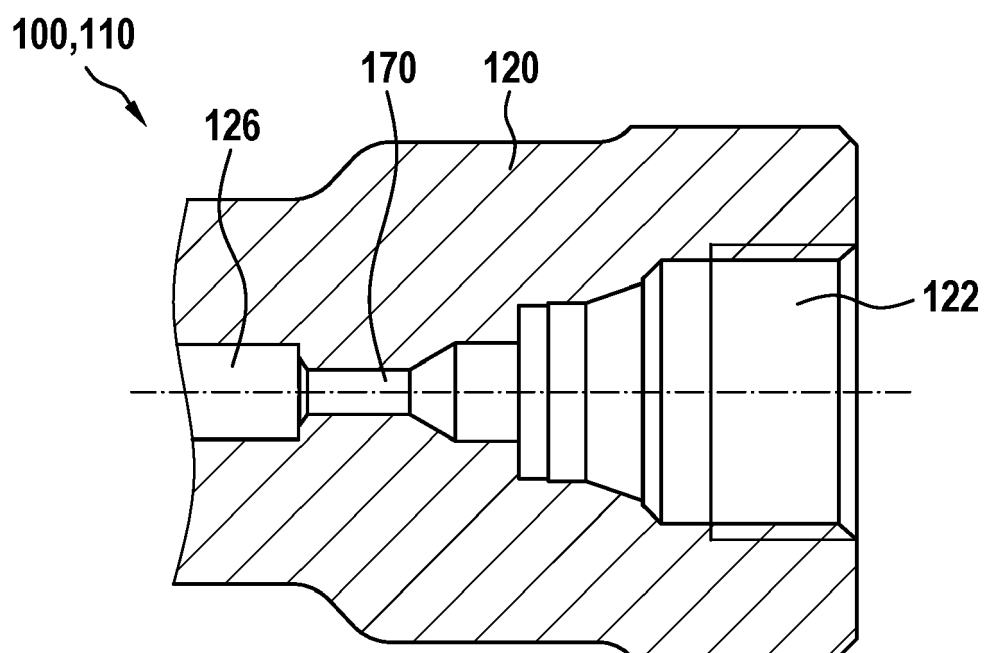


Fig. 3





EUROPEAN SEARCH REPORT

Application Number

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