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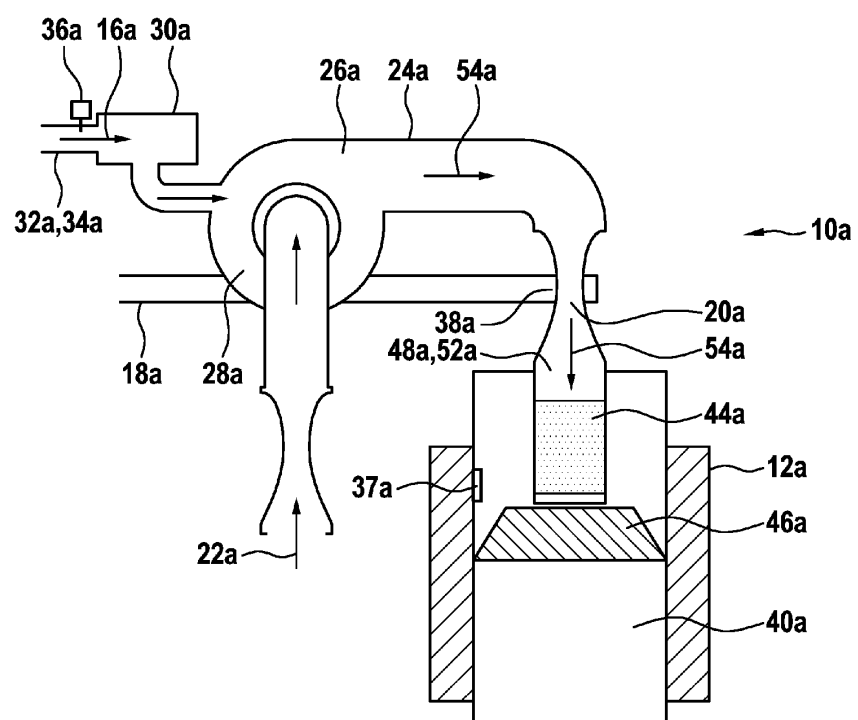
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(54) **FUEL SUPPLY DEVICE AND METHOD FOR OPERATING SUCH A FUEL SUPPLY**

(57) A fuel supply device for a burner is proposed for supplying a fuel (14a; 14b; 14c) and a further fuel (16a; 16b; 16b) to the burner, wherein the fuel supply device comprises at least one fuel path (18a; 18b; 18c) to convey the fuel (14a; 14b; 14c) to the burner, at least one mixing chamber (20a; 20b; 20c) arranged along the at least one fuel path (18a; 18b; 18c) to mix the fuel (14a; 14b; 14c)

with air (22a; 22b; 22c), at least one further fuel path (24a; 24b; 24c) to convey the further fuel (16a; 16b; 16c) to the burner and at least one further mixing chamber (26a; 26b; 26c) arranged along the at least one further fuel path (24a; 24b; 24c) to mix the further fuel (16a; 16b; 16c) with air (22a; 22b; 22c).

Fig. 1



Description

Prior art

[0001] The invention relates to a fuel supply device for a burner for supplying a fuel and/or a further fuel to the burner.

Disclosure of the invention

[0002] A fuel supply device for a burner is proposed for supplying a fuel and/or a further fuel to the burner, wherein the fuel supply device comprises at least one fuel path to convey the fuel to the burner, at least one mixing chamber arranged along the at least one fuel path to mix the fuel with air, at least one further fuel path to convey the further fuel to the burner and at least one further mixing chamber arranged along the at least one further fuel path to mix the further fuel with air. Preferably, the burner is configured to burn a fuel-air mixture and/or is configured to burn a further fuel-air mixture. Optionally, the burner is configured to burn a fuel-further fuel-air mixture. The fuel supply device is in particular configured to handle two different fuels. Preferably, the fuel and the further fuel are different regarding at least one physical parameter, in particular a fluidity and/or a heating value. For example, one of the fuels could be hydrogen and another one of the fuels could be a hydrocarbon or a mixture of hydrocarbons, in particular natural gas.

[0003] Preferentially, the fuel path comprises at least a fuel inlet, the mixing chamber disposed downstream the fuel inlet and, in particular, a fuel-air outlet to discharge the fuel-air mixture disposed downstream the mixing chamber and in particular into the burner. The fuel path is preferably implemented by tubes, pipes, hoses, ducts or the like. Optionally, the fuel supply device comprises a fuel conveying unit, e.g. a fan, a pump or the like, disposed in the fuel path to convey the fuel and the fuel-air mixture along the fuel path. The fuel conveying unit can be arranged downstream or upstream of the mixing chamber. Preferably, the further fuel path comprises at least a further fuel inlet, the further mixing chamber disposed downstream the further fuel inlet and, in particular, a further-fuel-air outlet to discharge the further fuel-air mixture, in particular into the burner. The further fuel path is preferably implemented by tubes, pipes, hoses, ducts or the like. Optionally, the fuel supply device comprises a further fuel conveying unit, e.g. a fan, a pump or the like, disposed in the further fuel path to convey the further fuel and the further fuel-air mixture along the further fuel path. The further fuel conveying unit can be arranged downstream or at the further mixing chamber. Alternatively, the fuel supply device relies on the fuel and/or the further fuel being pressurized outside the fuel supply device or the fuel and/or the further fuel being carried along an air stream created by a fan of the fuel supply device for conveying the air at least through the mixing chamber and/or the further mixing chamber. The

mixing chambers can each have their own air supply with an own fan or share a common air supply with a common fan.

[0004] Preferentially, the fuel supply device is configured to convey one of the fuels at a time. Alternatively, the fuel supply device is configured to convey the fuel and the further fuel at the same time. Optionally, the fuel-air outlet and the further fuel-air outlet are implemented by the same component forming a common outlet to discharge either the fuel-air mixture, the further fuel-air mixture or the fuel-further fuel-air mixture.

[0005] The mixing chamber and/or the further mixing chamber can for example be implemented as cylindrical or cuboid tube, as a tee-piece, as a venturi tube or the like. Alternatively, a casing of a component within the fuel path or the further fuel path, e.g. the fan or a sensor of the fuel supply device, is used as the mixing chamber and/or the further mixing chamber. Preferably, the mixing chamber and the further mixing chamber have different positions within the respective fuel path. Preferentially, a maximum length of the fuel path and a maximum length of the further fuel path from the respective mixing chamber to the respective fuel-air outlet are different. Preferably, a length of a portion of one of the fuel paths starting from the outlet of the respective mixing chamber up to the respective fuel-air outlet is shorter for the easier flowing of one of the fuels, i.e. for the one with the higher fluidity. Preferably, a ratio of the lengths is bigger than 1.5, preferably bigger than 2, preferentially bigger than 3, wherein the lengths have been measured from a discharge port of the respective mixing chamber along the respective fuel path up to the respective fuel-air outlet. Optionally, one of the fuel paths comprises a delaying element, e.g. loops or a sinuous course, to lengthen that fuel path with respect to the other one of the fuel paths. A straight-line distance of the mixing chamber and a distance of the further mixing chamber from the respective fuel-air outlet can be the same or different.

[0006] By such an implementation a fuel supply device having advantageous operative features, in particular having advantageously high fuel efficiency for more than one fuel, can be provided. In particular, an advantageously homogenous mixture of the air with more than one fuel can be achieved. In particular, the fuel path and/or the further fuel path can be adapted to flow characteristic of each of the fuels. For example, a fuel with a relative high fluidity, such as hydrogen, and therefore a fast mixing behaviour can be mixed with the air advantageously close, in particular just-in-time, to the respective fuel-air outlet. In particular, an advantageously high operation security of the fuel supply device can be achieved. For example, a fuel with a relative low fluidity, such as a, in particular a higher-order, hydrocarbon, can be mixed advantageously far from the respective fuel-air outlet. In particular, an advantageously homogenous fuel-air mixture can be achieved.

[0007] In addition, it is proposed that the at least one mixing chamber and the at least one further mixing cham-

ber are arranged in series along the at least one further fuel path. Optionally, the fuel path and the further fuel path merge upstream or inside the mixing chamber. Optionally, the fuel inlet and the further fuel inlet are implemented by the same component forming a common inlet to take in either the fuel or the further fuel. Optionally, the fuel path and the further fuel path diverge from each other upstream of the further mixing chamber. Preferably, the mixing chamber is disposed in the further fuel path downstream the further mixing chamber. Optionally, the fuel path and the further fuel path are merging downstream of the further mixing chamber. In particular, the fuel path bypasses the further mixing chamber. Alternatively, the mixing chamber is disposed in the further fuel path upstream of the further mixing chamber. In that case, the fuel path and the further fuel path diverge preferentially from each other downstream or inside the mixing chamber and upstream of the further mixing chamber. By such an implementation one of the mixing chambers implements a delaying element for the other mixing chamber. The fluid supply device can be realised with advantageously few components. In particular, the mixing chamber and the further mixing chamber can be provided with air with only one fan and no additional piping system to distribute the air between the mixing chambers, since the air can be distributed by the further fuel path.

[0008] In at least one embodiment the at least one mixing chamber and the at least one further mixing chamber are being spaced apart along the at least one further fuel path. A distance between the mixing chamber and the further mixing chamber along the further fuel path is at least higher than 1 cm, preferably higher than 5 cm, preferentially higher than 10 cm. A distance along the further fuel path is preferably measured from the discharge port of the mixing chamber or the further mixing chamber downstream to a fuel port of the further mixing chamber or the mixing chamber. Optionally, the distance along the further fuel path is the smallest distance between the mixing chamber and the further mixing chamber. Alternatively, a straight-line distance is the smallest distance between the mixing chamber and the further mixing chamber. Optionally, the mixing chamber and the further mixing chamber are adjacent to each other or they have a common chamber wall. In an alternative embodiment, the mixing chamber and the further mixing chamber constitute compartments of a single mixing chamber, wherein the compartments are arranged in series along the further fuel path. By such an implementation one of the fuels can be delayed advantageously long before discharging it. In particular, an advantageously long mixing time can be achieved for one of the fuels.

[0009] It is furthermore proposed, that the at least one fuel path and the at least one further fuel path are fluidically separated, at least until the at least one mixing chamber. Optionally, the fuel path and the further fuel path have no common components. In particular, the fuel path bypasses the further mixing chamber and preferably the further fuel inlet. Optionally, the fuel-air outlet and the

further fuel-air outlet are two distinct components, to discharge the fuel-air mixture and the fuel air mixture independently from each other, in particular into the burner. In an alternative embodiment the fuel path and the further fuel path merge downstream of the mixing chamber and downstream the further mixing chamber to discharge the fuel-air mixture and the further fuel-air mixture via the common outlet. By such an implementation the fuel supply device can mix the fuel and the further fuel advantageously independent from each other. In particular, each fuel can be mixed with an advantageously fuel-specific amount of the air, in particular before the fuels are mixed together. An advantageously low risk of an incomplete combustion of one of the fuels can be achieved, in particular with an advantageously low diluting rate for the other one of fuels.

[0010] Furthermore, it is proposed that the fuel supply device comprises a fan to suck in the air, which is arranged within the at least one further mixing chamber. Preferentially, the further mixing chamber has an internal space, which is in particular restricted by walls of the further mixing chamber. Preferably, the further mixing chamber has at least the fuel port to let the further fuel into the internal space of the further mixing chamber. Preferably, the further mixing chamber has at least an air port to let the air into the internal space of the further mixing chamber. Preferably, the further mixing chamber has at least the discharge port to let the further fuel and the air out of the internal space of the further mixing chamber. Preferentially, the further mixing chamber is implemented as a casing of the fan. In particular, a volume of the internal space of the further mixing chamber is smaller than three times, preferably two times, preferentially 1.5 times, a volume needed by the fan to rotate. Alternatively, the volume of the internal space of the further mixing chamber is at least three times, preferably at least five times as big as the volume needed by the fan to rotate. Preferably, the fan is arranged inside the further fuel path. In particular, the fuel port and the discharge port of the further mixing chamber are arranged on different sides of the further mixing chamber with respect to the fan. Alternatively, the further fuel path bypasses the fan within the further mixing chamber. In particular, the fuel port and the discharge port of the further mixing chamber are arranged on the same side of the further mixing chamber with respect to the fan. The fan can be an axial fan or a radial fan. By such an implementation an advantageously compact fuel supply device can be achieved. Furthermore, the further fuel and the air can be advantageously swirled.

[0011] Alternatively, it is proposed that the fuel supply device comprises a fan to suck in the air, which is arranged downstream of the at least one further mixing chamber. Preferentially, the fan is configured to suck in the air through the further mixing chamber. The fan is preferably configured to convey the further fuel, in particular additionally to conveying the air. In particular in such an embodiment, the fan is disposed upstream of

the mixing chamber. Optionally, the fuel supply device comprises two fans, wherein one is arranged inside the further mixing chamber and one is arranged downstream of the further mixing chamber. Preferably, the fuel supply device comprises either the fan in the further mixing chamber or the fan downstream of the further mixing chamber. By such an implementation the fuel supply device does not need an additional further fuel conveying unit to convey the further fuel. A number of, in particular moving, components of the fuel supply device can be kept advantageously low. In particular, a wearing of the fuel supply device can be kept advantageously low.

[0012] It is moreover proposed that the fuel supply device comprises a diverter unit to selectively connect either the at least one fuel path or the at least one further fuel path to a fuel source. The diverter unit is disposed in the fuel path and in the further fuel path. Preferably the diverter unit is disposed upstream of the mixing chamber and/or the further mixing chamber. The fuel inlet and/or the further fuel inlet is configured to be fluidically connected to the fuel source and/or a further fuel source. The diverter unit is configured to fluidically connect and disconnect the fuel inlet and/or the further inlet with the fuel path or the further fuel path. The diverter unit is preferably configured to direct a fluid from the fuel source and/or the further fuel source to either the fuel path or the further fuel path, especially depending on whether the fluid is the fuel or the further fuel. In particular, the diverter unit is configured to switch between a fuel conveying configuration of the fuel supply device via the fuel path and a further fuel conveying configuration of the fuel supply device via the further fuel path. For example, the diverter unit comprises a directional valve, especially a three-way-valve, to direct the fluid from the fuel source to the fuel path or the further fuel path. Alternatively or additionally, the diverter unit comprises a stop valve and/or a control valve arranged in the fuel path and a further stop valve and/or a further control valve in the further fuel path, to direct the fluid from the fuel source to the fuel path or the further fuel path. Alternatively, or additionally, the diverter unit comprises a movable pipe section or hose section which can be inserted in and removed from the fuel path and the further fuel path, especially without tools, e.g. by means of quick release flanges or the like. By such an implementation the fluid supply device can be reconfigured advantageously easily if the fuel source changes, to use one of the fuel paths which is more suitable to handle a fluid from the fuel source as either fuel or further fuel.

[0013] Moreover, it is proposed that in at least one embodiment the at least one fuel path comprises at least one fuel inlet, in particular the above-mentioned fuel inlet, to fluidically connect the at least one fuel path to a fuel source and that the at least one further fuel path comprises at least one further fuel inlet, in particular the above-mentioned fuel inlet, to fluidically connect the at least one further fuel path to a further fuel source. The fuel inlet and the further fuel inlet are in particular fluidi-

cally separated from each other. Optionally, the fuel inlet and the further fuel inlet are spaced apart, in particular to connected the fuel source and the further fuel source independently from each other with the respective one of the fuel inlet and the further fuel inlet. Alternatively, the fuel inlet and the further fuel inlet are part of a combined inlet port with separated fuel channels, in which the fuel inlet and the further fuel inlet for example share a common wall or are arranged next to each other. By such an implementation, a number of times to connect, in particular switch, the fuel sources to the fuel supply device can be kept advantageously low. In particular the fuel supply device can be kept advantageously operating, even if one of the fuels runs out.

[0014] It is also proposed that the fuel supply device comprises a fuel sensor to identify the fuel, in particular being used during an operation of the burner. Preferably, the fuel supply device comprises a control unit to control the diverter unit, in particular in dependence of an input signal created by the fuel sensor. A "control unit" is in particular to be understood as a unit with control electronics. The control electronics comprises preferentially at least a processor, a memory and operating instructions to be processed by the processor saved in the memory. Additionally or alternatively, the fuel supply device, in particular the diverter unit, comprises at least one operating element to manually control the diverter unit. The fuel sensor can be configured to analyse the fuel or the further fuel directly or to analyse a flame fed by the fuel. For example, the fuel sensor can be a natural gas analyser, mass spectrometer or another gas sensing device to analyse the fuel or the further fuel directly. The fuel sensor to analyse the fuel directly is preferentially arranged upstream or inside the diverter unit. Alternatively, the fuel sensor to analyse the fuel directly is arranged downstream the divert unit. For example, the fuel sensor to analyse the flame can be an ionisation current detector, which is in particular configured to be disposed within the burner. The ionisation current detector is in particular configured to distinguish between a hydrocarbon fuel and a carbon-free fuel, e.g. hydrogen, in particular in combination with a visual flame detector to verify the existence or absence of a flame. Optionally, the fuel supply device comprises an output element, e.g. a LED, a display, a speaker or the like. The output element is for example configured to indicate a measurement of the fuel sensor to a user and/or whether a configuration of the fluid supply device is suitable for the identified fuel. By such an implementation the fuel supply device can automatically switch between different configuration depending on the available fuel. A time required to operate, in particular reconfigure, the fuel supply device can be kept advantageously short. Furthermore, a risk of operating the fuel supply device in a configuration not or less suited for the available fuel can be kept advantageously low. In particular, the fuel supply device can be operated, in particular by itself, advantageously efficient and safe.

[0015] Furthermore, it is proposed that the fuel supply

device comprises a closing device arranged in the at least one fuel path to disrupt or restore the at least one fuel path upstream the mixing chamber. Preferably, the closing device is configured to obstruct the further fuel to enter the fuel path via a fuel port of the mixing chamber. The closing device is implemented for example as a stop valve, a non-return valve or the like. In a configuration of the fuel supply device in which the further fuel path is open, the closing device blocks the fuel path. In a configuration of the fuel supply device in which the fuel path is open, the closing device is also open. Preferably, the closing device is controlled by the control unit and/or has a common actuator with the diverter unit. Preferably, the closing device is disposed within a fuel port of the mixing chamber. Alternatively, the closing device is disposed in the fuel path apart from the mixing chamber. Optional an analogous further closing device of the fuel supply device is disposed in the further fuel path upstream of the mixing chamber to obstruct the fuel to enter the further fuel path via an air port of the mixing chamber. Preferably, the fan is configured to counteract an entering of the fuel into the further fuel path via the air port of the mixing chamber. By such an implementation a risk of a leakage of one of the fuels or of a wearing due to one of the fuels entering one of the fuel paths, which is not configured to convey the respective fuel, can be kept advantageously low.

[0016] Furthermore, a burner is proposed with a burner chamber and a fuel supply device according to the invention. Preferentially, the burner comprises a distribution unit arranged within the burner chamber. The distribution unit comprises preferably at least one plenum, optionally one plenum per fuel path, connected to the fuel-air outlet and/or the further fuel-air outlet. The distribution unit preferably comprises a multitude of openings fluidically connected to the plenum to, in particular homogeneously, distribute one of the fuel-air-mixtures inside the burning chamber. Optionally, the distribution unit has fuel-specific openings, that are connected to either to the fuel-air outlet or the further fuel-air outlet. Preferably, the burner comprises a heat exchanger disposed within the burner chamber to transfer heat from an exhaust of one of the burned fuel-air mixtures to a heat carrier, e.g. domestic water or heating water. By such an implementation a burner can be achieved, which can handle at least two fuels advantageously efficiently.

[0017] In addition, a method for operating a fuel supply device according to the invention is disclosed. The method comprises preferably a supply step, in which a fuel source is connected manually or by an external supply system automatically to the fuel supply device. Preferentially, the method comprises a reconfiguration step, in which the fuel path is opened by the control unit or manually. Preferably, the further fuel path is closed by the control unit or manually in the reconfiguration step. Preferably, the method comprises a further reconfiguration step, in which the further fuel path is opened by the control unit or manually. Preferably, the fuel path is closed by the control unit or manually in the further reconfiguration

step. Optionally, the method comprises at least one fuel identifying step, in which the fuel and/or the further fuel is identified by the fuel sensor or by a user input. Preferably, the control unit decides whether the reconfiguration step or the further reconfiguration step is executed in dependence of the fuel identifying step. If the fuel identifying step is not yet executed or inconclusive, the control unit chooses preferably one of the reconfiguration steps in accordance with a standard configuration saved in the memory. Preferentially, the method comprises a conveying step in which the fuel and/or the further fuel is conveyed by the fuel conveying unit, the further fuel conveying unit and/or the fan from the fuel source to the fuel-air outlet and/or the further fuel-air outlet. Optionally, the method comprises a hybrid configuration step, in which the control unit or a user opens the fuel path and the further fuel path, in particular at least partially. By such an implementation a method can be achieved, with which the fuel and the further fuel can be handled advantageously efficiently with the same fuel supply device.

[0018] It is moreover proposed that hydrogen is conveyed as fuel via the at least one fuel path. In particular, the control unit executes the reconfiguration step, when the fuel sensor identifies a fluid from the fuel source as hydrogen or as carbon-free fuel. By such an implementation hydrogen can be mixed advantageously just in time. The fluid supply device can be operated advantageously safely.

[0019] In addition, it is proposed that hydrocarbon is conveyed as further fuel via the at least one further fuel path. In particular, the control unit executes the further reconfiguration step, when the fuel sensor identifies a fluid from the fuel source or the further fuel source as a hydrocarbon. By such an implementation the hydrocarbon can be given advantageously much time to be mixed with the air before the hydrocarbon is discharged via the further fuel-air outlet.

[0020] Furthermore, it is proposed that when a fuel sensor, in particular the above-mentioned fuel sensor, of the fuel conveying device detects a high-flame speed fuel, a diverter unit, in particular the above-mentioned diverter unit, of the fuel conveying device automatically connects the at least one fuel path to a fuel source and disconnects the at least one further fuel path from the fuel source, and that when the fuel sensor detects a low-flame speed fuel, the diverter unit automatically connects the at least one further fuel path to the fuel source and disconnects the at least one fuel path from the fuel source. A "high-flame speed fuel" and a "low-flame speed fuel" are in particular fuels that differ in fluidity relative to each other. The control unit may discriminate between a high-flame speed fuel and a low-flame speed fuel by a fuel parameter measured by the fuel sensor, e.g. by means of a threshold for an absolute value or a change of said fuel parameter. Alternatively, the control unit retrieves the fluidity of an already identified fuel, e.g. if the fuel parameter measured by the fuel sensor is not directly dependent to a fluidity of a fuel, from a database stored

in the memory of the control unit or from an external database. By such an implementation, the fuel supply device can be operated advantageously efficient and safe in an advantageously automatic manner.

[0021] The fuel supply device according to the invention and/or the method according to the invention are/is herein not to be restricted to the application and implementation described above. In particular, for fulfilling a function herein described, the fuel supply device according to the invention and/or the method according to the invention may comprise a number of individual elements, components, units and method steps, which differs from the number herein mentioned.

Drawings

[0022] Further advantages may be gathered from the following description of the drawings. In the drawings three exemplary embodiment of the invention are shown. The drawings, the description and the claims comprise a plurality of features in combination. The person skilled in the art will expediently also consider the features individually and will bring them together in further purposeful combinations.

[0023] The drawing shows:

- In fig. 1 a schematic view of a burner according to the invention with a fuel supply device according to the invention comprising a further fuel path being open,
- In fig. 2 a schematic view of the burner according to the invention with a fuel path of the fuel supply device being open,
- In fig. 3 a schematic flow chart of a method according to the invention,
- In fig. 4 an alternative embodiment of a burner according to the invention and
- In fig. 5 a further alternative embodiment of a burner according to the invention

Description of the exemplary embodiment

[0024] Figure 1 shows a burner 12a. In particular, the burner 12a is configured to burn a fuel 14a (cf. Fig. 2) and/or a further fuel 16a. The fuel 14a is in particular hydrogen. The further fuel 16a is in particular a hydrocarbon, in particular natural gas. The burner 12a comprises a burner chamber 40a, in particular to burn the fuel 14a or the further fuel 16a. The burner 12a comprises in particular a distribution unit 44a. The distribution unit 44a is configured to distribute a mixture of the fuel 14a with air 22a or a mixture of the further fuel 16a with air 22a inside the burner chamber 40a. Preferably, the distribution unit 44a is disposed inside burner chamber 40a. In figure 1 the distribution unit 44a shows a cylindrical base body. In other embodiments the distribution unit 44a comprises a half-spherical base body, a half-cylindrical base body, a plate shaped base body or the like.

The distribution unit 44a comprises a multitude of openings to discharge the fuel 14a or the further fuel 16a together with the air 22a into the burner chamber 40a. Optional the burner 12a comprises a bluff body 46a disposed inside the burner chamber 40a to counteract a flame lift-off from the distribution unit 44a.

[0025] The burner 12a comprises a fuel supply device 10a. The fuel supply device 10a is configured to supply the fuel 14a or the further fuel 16a to the burner 12a, in particular to the distribution unit 44a. The fuel supply device 10a comprises at least a fuel path 18a to convey the fuel 14a to the burner 12a. The fuel supply device 10a comprises at least a mixing chamber 20a arranged along the fuel path 18a to mix the fuel 14a with air 22a. The mixing chamber 20a is for example embodied as a venturi tube. Preferably, the fuel supply device 10a comprises a fuel inlet 32a to let in the fuel 14a into the fuel path 18a. Preferably, the fuel supply device 10a comprises a fuel-air outlet 48a to discharge a fuel-air mixture 50a from the fuel path 18a (cf. Fig. 2). The fuel supply device 10a comprises at least a further fuel path 24a to convey the further fuel 16a to the burner 12a. The fuel supply device 10a comprises at least a further mixing chamber 26a arranged along the further fuel path 24a to mix the further fuel 16a with air 22a. Preferably, the fuel supply device 10a comprises a further fuel inlet 34a to let in the fuel 14a into the fuel path 18a. Preferentially, the fuel inlet 32a and the further fuel inlet 34a are implemented by the same component. Preferably, the fuel supply device 10a comprises a further fuel-air outlet 52a to discharge a further fuel-air mixture 54a from the fuel path 18a. Preferentially, the fuel-air outlet 48a and the further fuel-air outlet 52a are implemented by the same component.

[0026] The mixing chamber 20a and the further mixing chamber 26a are arranged in series along the further fuel path 24a. The mixing chamber 20a and the further mixing chamber 26a are being spaced apart along the further fuel path 24a. In particular, the mixing chamber 20a is arranged downstream of the further mixing chamber 26a. The mixing chamber 20a is preferably closer to the fuel-air outlet 48a than the further mixing chamber 20a. The fuel supply device 10a comprises a fan 28a to suck in the air 22a, which is arranged within the further mixing chamber 26a. In particular, a casing of the fan 28a implements the further mixing chamber 26a. Preferably, the further mixing chamber 26a comprises an air port to let the air into the further mixing chamber 22a. Preferably, the further mixing chamber 26a comprises a fuel port to let in the further fuel 16a into the mixing chamber. Preferably, the further mixing chamber 26a comprises a discharge port to let the further fuel-air mixture 54a or the air 22a out of the further mixing chamber 26a towards the mixing chamber 20a.

[0027] The fuel supply device 10a comprises a diverter unit 30a to selectively connect either the fuel path 18a or the further fuel path 24a to a fuel source. Preferentially, the fuel supply device 10a comprises at least a configuration, in which the fuel source, in particular the fuel inlet

32a, is connected to the fuel path 18a, i.e. the fuel path 18a is open (cf. Fig. 2). The further fuel path 24a is disconnected from the further fuel inlet 34a, when the fuel path 18a is open. The fuel supply device 10a comprises at least a further configuration, in which the fuel source, in particular the further fuel inlet 34a, is connected to the further fuel path 24a. The fuel path 18a is disconnected from the fuel inlet 32a, when the further fuel path 24a is open. Preferably, the diverter unit 30a comprises a three-way valve to selectively connect either the fuel path 18a or the further fuel path 24a to a fuel source.

[0028] The fuel supply device 10a comprises a fuel sensor 36a to identify the fuel 14a or the further fuel 16a, in particular being used during an operation of the burner 12a. The fuel sensor 36a is configured to analyse the fuel 14a and/or the further fuel 16a, in particular a fluid from the fuel source. Preferentially, the fuel sensor 36a is disposed upstream of the diverter unit 30a. Alternatively or additionally to the fuel sensor 36a, the fuel supply device 10a comprises a flame sensor 37a disposed within the burner chamber 40a as an indirect fuel sensor.

[0029] The fuel supply device 10a comprises a closing device 38a arranged in the fuel path 18a to disrupt or restore the fuel path 18a upstream the mixing chamber 20a. In particular, in the further configuration, in which the further fuel inlet 34a is connected to the further fuel path 24a, the closing device 38a disconnects the mixing chamber 20a from the fuel path 18a. In particular, in the configuration, in which the fuel inlet 32a is connected to the fuel path 18a (cf. Fig. 2), the closing device 38a connects the mixing chamber 20a to the fuel path 18a. The mixing chamber 20a comprises a fuel port to let the fuel 14a into the mixing chamber 20a. The mixing chamber 20a comprises an air port to let the air 22a into the mixing chamber 20a. The mixing chamber 20a comprises a discharge port to let the fuel-air mixture 50a out of the mixing chamber 20a. Preferably, the discharge port is identical to the fuel-air outlet 48a and the further fuel-air outlet 52a. In the further configuration, in which the further fuel inlet 34a is connected to the further fuel path 24a, the further fuel path 24a is connected to the further mixing chamber 26a via the air port of the mixing chamber 20a to convey the further fuel-air mixture 54a through the mixing chamber 20a to the further fuel-air outlet 52a. In the configuration, in which the fuel inlet 32a is connected to the fuel path 24a, the further fuel path 24a is connected to the further mixing chamber 26a via the air port of the mixing chamber 20a to supply the air 22a to the mixing chamber 20a.

[0030] Fig. 3 shows a flow chart of a method 42a for operating the fuel supply device 10a. The method 42a comprises preferably a supply step 56a. The method 42a comprises optionally a fuel identifying step 62a. The method 42a comprises preferably a reconfiguration step 58a. The method 42a comprises preferably a further reconfiguration step 60a. The method 42a comprises preferably a conveying step 64a. In the supply step 56a the fuel source is connected manually or by an external

supply system automatically to the fuel supply device 10a. Preferably, a fluid from the fuel source is analysed by the fuel sensor 36a and/or the flame sensor 37a. In particular, a control unit of the fuel supply device 10a decides whether the fluid from the fuel source is the fuel 14a or the further fuel 16a. When the fuel sensor 36a of the fuel conveying device detects a high-flame speed fuel, the diverter unit 30a of the fuel conveying device automatically connects the at least one fuel path 18a to a fuel source and disconnects the at least one further fuel path 24a from the fuel source, and that when the fuel sensor 36a detects a low-flame speed fuel, the diverter unit 30a automatically connects the at least one further fuel path 24a to the fuel source and disconnects the at least one fuel path 18a from the fuel source. If the fluid is the fuel 14a, the control unit of the fuel supply device 10a executes preferably the reconfiguration step 58a. In particular, in the reconfiguration step 58a the diverter unit 30a connects the fuel inlet 32a with the fuel path 18a. In particular, in the reconfiguration step 58a the closing device 38a connects the mixing chamber 20a, in particular the fuel port of the mixing chamber 20a, with the fuel path 18a. In particular, in the reconfiguration step 58a the diverter unit 30a disconnects the further fuel inlet 34a from the further fuel path 24a. If the fluid from the fuel source is the further fuel 16a, the control unit of the fuel supply device 10a executes preferably the further reconfiguration step 58a. In particular, in the further reconfiguration step 60a the diverter unit 30a connects the further fuel inlet 34a with the further fuel path 24a. In particular, in the further reconfiguration step 60a the closing device 38a disconnects the mixing chamber 20a, in particular the fuel port of the mixing chamber 20a, from the fuel path 18a. In particular, in the further reconfiguration step 58a the diverter unit 30a disconnects the fuel inlet 32a from the fuel path 18a. In particular, during the conveying step 64a, hydrogen is conveyed as fuel 14a via the fuel path 18a. In particular, during the conveying step 64a, a hydrocarbon is conveyed as further fuel 16a via the further fuel path 24a.

[0031] In Figures 4 and 5 two further embodiments of the invention are shown. The following description and the drawings are essentially limited to the differences between the embodiments, wherein features of components with the same denomination, especially components with the same reference numeral, can also be extracted from the drawings and/or the description of the other embodiments, in particular of Figures 1 to 3. The letter a is added to the reference signs of the embodiment shown in Figures 1 to 3, whereas in the embodiments shown in Figures 4 and 5 the letter a is substituted by the letters b and c respectively for the ease of distinguishing the embodiments.

[0032] Figure 4 shows a burner 12b. The burner 12b comprises a burner chamber 40b. The burner 12b comprises a fuel supply device 10b. The fuel supply device 10b is configured to supply a fuel 14b and/or a further fuel 16b to the burner 12b. The fuel supply device 10b

comprises at least a fuel path 18b to convey the fuel 14b to the burner 12b. The fuel supply device 10b comprises at least a mixing chamber 20b arranged along the fuel path 18b to mix the fuel 14b with air 22b. The fuel supply device 10b comprises at least a further fuel path 24b to convey the further fuel 16b to the burner 12b. The fuel supply device 10b comprises at least a further mixing chamber 26b arranged along the further fuel path 24b to mix the further fuel 16b with air 22b. In particular, a diverter unit 30b of the fuel supply device 10b comprises a control valve in the fluid path 18b. In particular, the diverter unit 30b of the fuel supply device 10b comprises a further control valve in the further fluid path 24b. The fuel supply device 10b comprises a fan 28b to suck in the air 22b, which is arranged downstream of the further mixing chamber 26b. Regarding further details of burner 12b and/or fuel supply device 10b please refer to the Figures 1 to 3 and their description.

[0033] Figure 5 shows a burner 12c. The burner 12c comprises a burner chamber 40c. The burner 12c comprises a fuel supply device 10c. The fuel supply device 10c is configured to supply a fuel 14c and/or a further fuel 16c to the burner 12c. The fuel supply device 10c comprises at least a fuel path 18c to convey the fuel 14c to the burner 12c. The fuel supply device 10c comprises at least a mixing chamber 20c arranged along the fuel path 18c to mix the fuel 14c with air 22c. The fuel supply device 10c comprises at least a further fuel path 24c to convey the further fuel 16c to the burner 12c. The fuel supply device 10c comprises at least a further mixing chamber 26c arranged along the further fuel path 24c to mix the further fuel 16c with air 22c. The fuel path 18c and the further fuel path 24c are fluidically separated. In particular, the fuel supply device 10c comprises a further fan 66c to suck the air 22c into the mixing chamber 20c. The at least one fuel path 18c comprises at least one fuel inlet 32c to fluidically connect the at least one fuel path 18c to a fuel source. The at least one further fuel path 24c comprises at least one further fuel inlet 34c to fluidically connect the at least one further fuel path 24c to a further fuel source. Preferably, the fuel inlet 32c of the fuel supply device 10c is spaced apart from the further fuel inlet 34c of the fuel supply device 10c. The mixing chamber 20c is preferably closer to a fuel-air outlet 48c of the fuel supply device 10c than the further mixing chamber 26c is to a further fuel-air outlet 52c of the fuel supply device 10c. In particular, the fuel supply device 10c comprises at least one configuration in which the fuel path 18c and the further fuel path 24c are open at the same time. Preferably, an additional mixing chamber to mix the fuel 14c with the further fuel 16c, in particular to mix a fuel-air mixture 48c with a further fuel-air mixture 50c, is implemented by the burner chamber 40c and/or a distribution unit 44c of the burner 12c. Regarding further details of burner 12c and/or fuel supply device 10c please refer to the Figures 1 to 4 and their description.

Claims

1. Fuel supply device for a burner for supplying a fuel (14a; 14b; 14c) and/or a further fuel (16a; 16b; 16b) to the burner, with at least one fuel path (18a; 18b; 18c) to convey the fuel (14a; 14b; 14c) to the burner, at least one mixing chamber (20a; 20b; 20c) arranged along the at least one fuel path (18a; 18b; 18c) to mix the fuel (14a; 14b; 14c) with air (22a; 22b; 22c), at least one further fuel path (24a; 24b; 24c) to convey the further fuel (16a; 16b; 16c) to the burner and at least one further mixing chamber (26a; 26b; 26c) arranged along the at least one further fuel path (24a; 24b; 24c) to mix the further fuel (16a; 16b; 16c) with air (22a; 22b; 22c).
2. Fuel supply device according to claim 1, **characterized in that** the at least one mixing chamber (20a; 20b) and the at least one further mixing chamber (26a; 26b) are arranged in series along the at least one further fuel path (24a; 24b).
3. Fuel supply device according to claim 2 **characterized in that** the at least one mixing chamber (20a; 20b) and the at least one further mixing chamber (26a; 26b) are spaced apart along the at least one further fuel path (24a; 24b).
4. Fuel supply device according to claim 1, **characterized in that** the at least one fuel path (18a; 18c) and the at least one further fuel path (24a; 24c) are fluidically separated, at least until the at least one mixing chamber (20a; 20c).
5. Fuel supply device according to any of the preceding claims, **characterized by** a fan (28a) to suck in the air (22a), which is arranged within the at least one further mixing chamber (26a).
6. Fuel supply device according to any of the preceding claims, **characterized by** a fan (28b; 28c) to suck in the air (22b; 22c), which is arranged downstream of the at least one further mixing chamber (26b; 26c).
7. Fuel supply device according to any of the preceding claims, **characterized by** a diverter unit (30a; 30b) to selectively connect either the at least one fuel path (18a; 18b) or the at least one further fuel path (24a; 24b) to a fuel source.
8. Fuel supply device according to any of Claims 1 to 6, **characterized in that** the at least one fuel path (18c) comprises at least one fuel inlet (32c) to fluidically connect the at least one fuel path (18c) to a fuel source and **in that** the at least one further fuel path (24c) comprises at least one further fuel inlet (34c) to fluidically connect the at least one further fuel path (24c) to a further fuel source.

9. Fuel supply device according to any of the preceding claims, **characterized by** a fuel sensor (36a; 36b; 36c) to identify the fuel (14a; 14b; 14c).
10. Fuel supply device according to any of the preceding claims, **characterized by** a closing device (38a) arranged in the at least one fuel path (18a) to disrupt or restore the at least one fuel path (18a) upstream the mixing chamber (20a). 5
11. Burner with a burner chamber (40a; 40b; 40c) and a fuel supply device according to any of the preceding claims. 10
12. Method for operating a fuel supply device according to any of the claims 1 to 10. 15
13. Method according to claim 12, **characterized in that** hydrogen is conveyed as fuel (14a; 14b; 14c) via the at least one fuel path (18a; 18b; 18c). 20
14. Method according to claim 12 or 13, **characterized in that** a hydrocarbon is conveyed as further fuel (16a; 16b; 16c) via the at least one further fuel path (24a; 24b; 24c). 25
15. Method according to at least one of claims 12 to 14, **characterized in that** when a fuel sensor (36a; 36b) of the fuel conveying device detects a high-flame speed fuel, a diverter unit (30a; 30b) of the fuel conveying device automatically connects the at least one fuel path (18a; 18b) to a fuel source and disconnects the at least one further fuel path (24a; 24b) from the fuel source, and that when the fuel sensor (36a; 36b) detects a low-flame speed fuel, the diverter unit (30a; 30b) automatically connects the at least one further fuel path (24a; 24b) to the fuel source and disconnects the at least one fuel path (18a; 18b) from the fuel source. 30
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Fig. 1

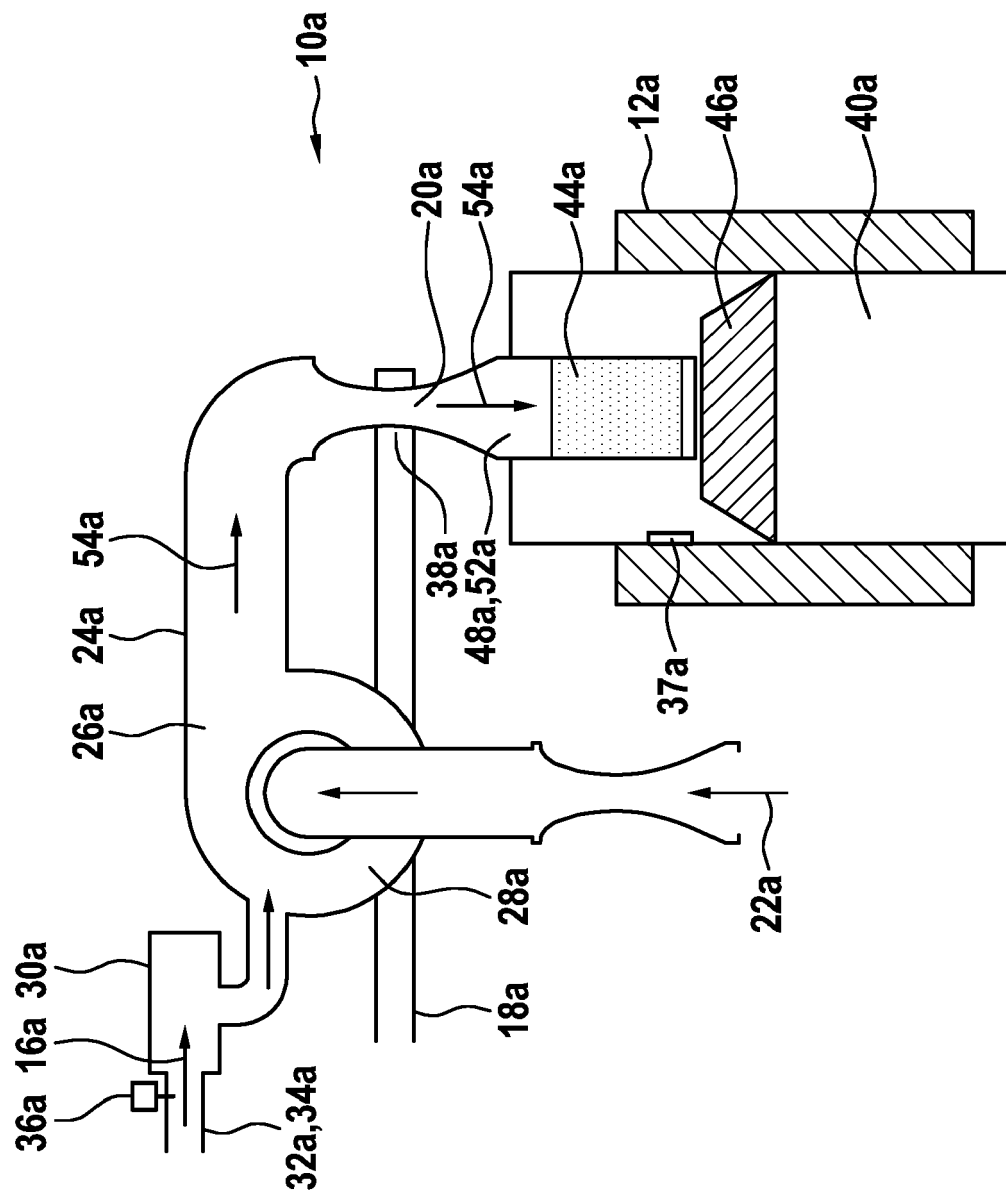


Fig. 2

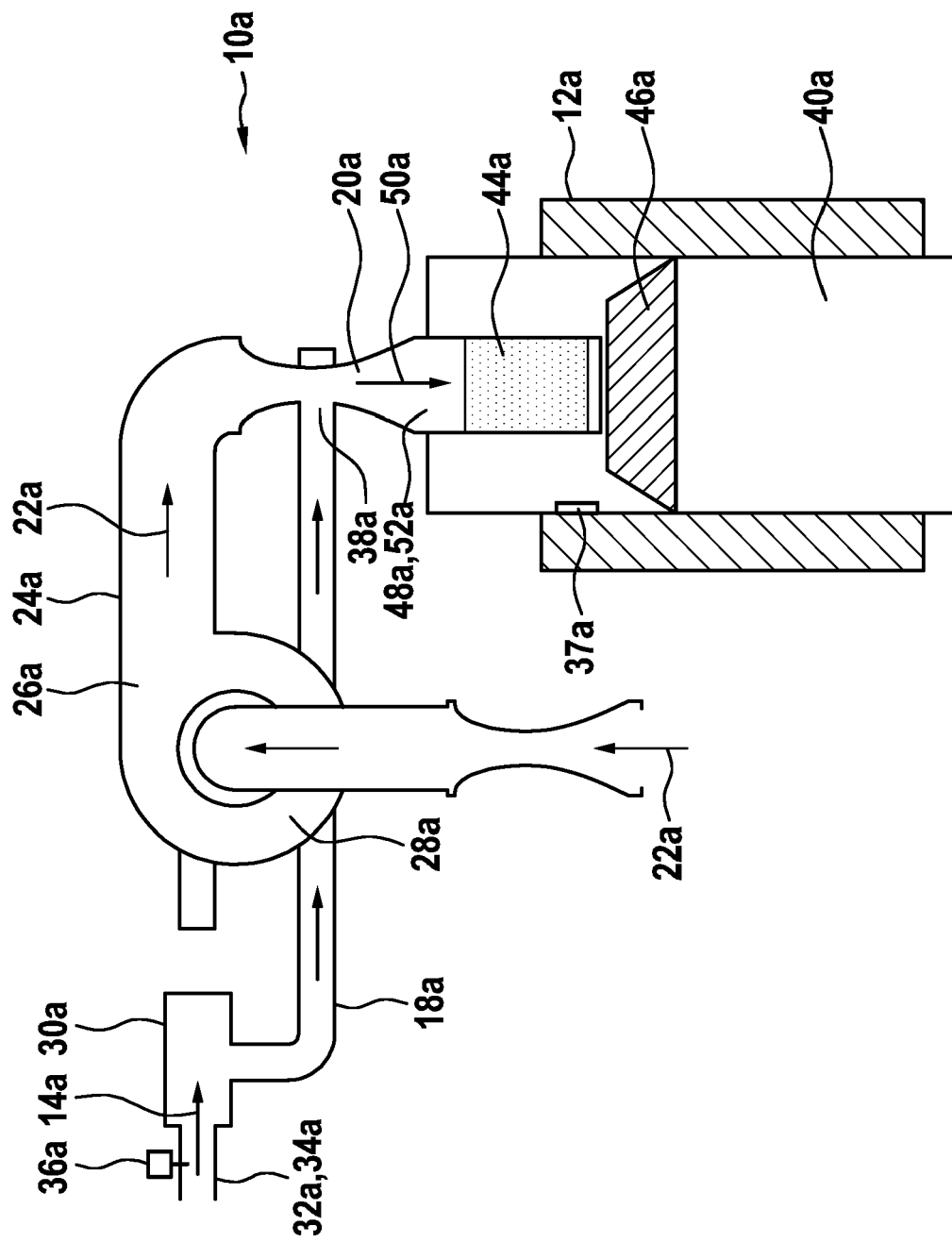
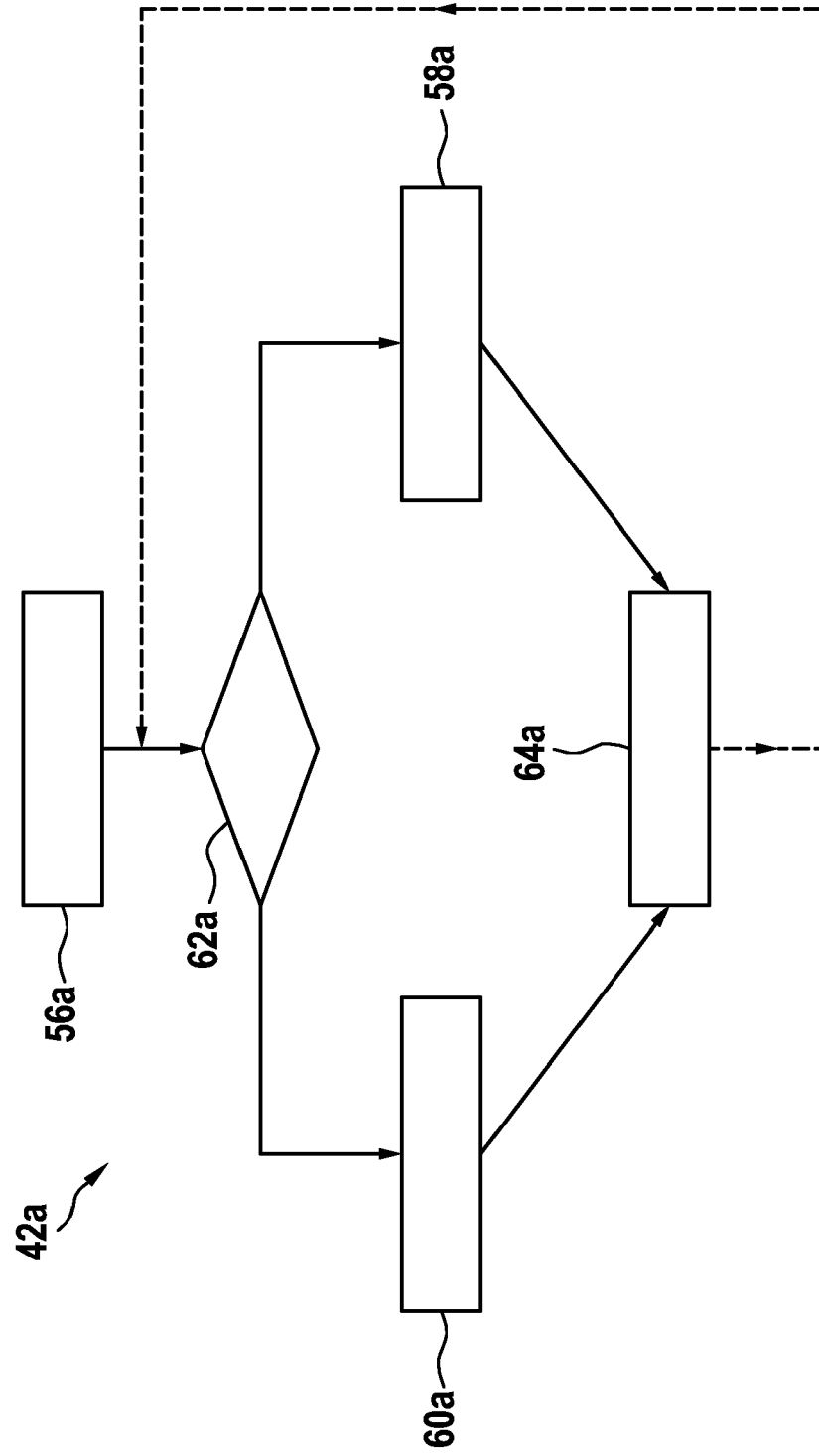


Fig. 3



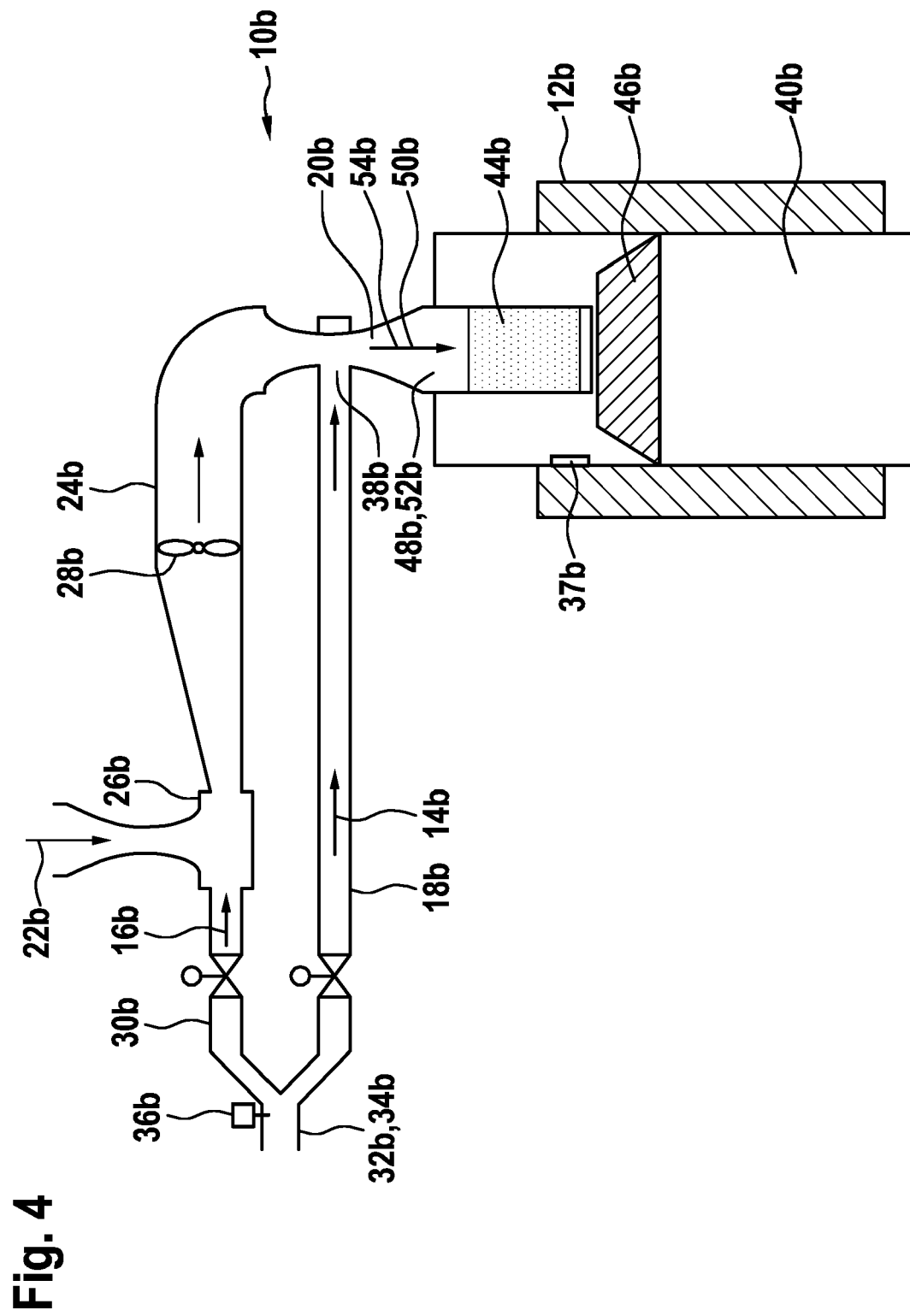
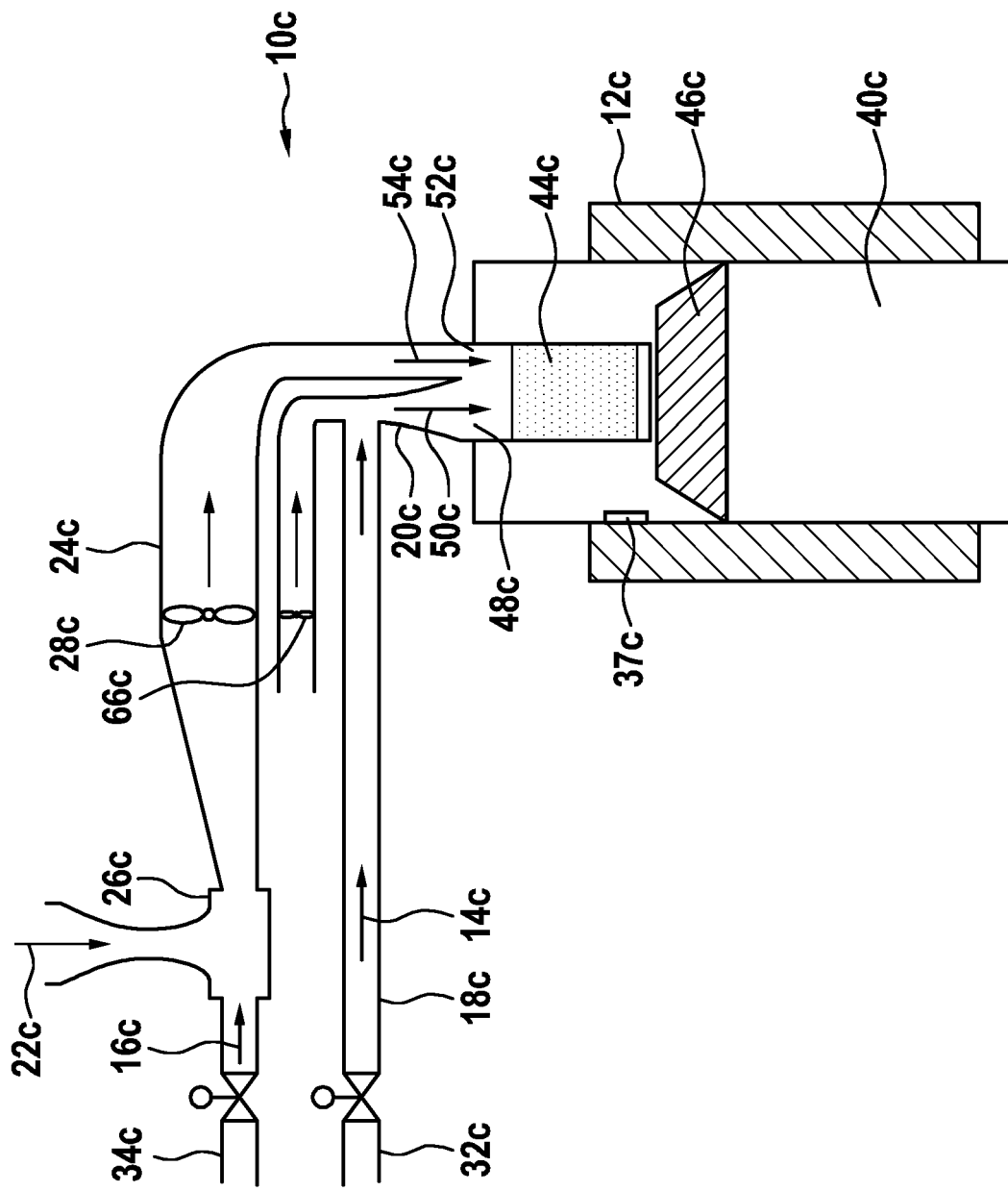


Fig. 5





EUROPEAN SEARCH REPORT

Application Number

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A	* paragraph [0002]; figures 1, 5 * * paragraphs [0009], [0010] * * paragraphs [0016], [0018] * * paragraphs [0025], [0026], [0030] * * claim 1 *	7, 15	F23D14/62
X	US 5 718 573 A (KNIGHT BRIAN A [US] ET AL) 17 February 1998 (1998-02-17) * column 1, lines 5, 6; figures 1, 6, 7 * * column 2, line 31 - column 3, line 51 * * column 4, line 11 - line 25 *	1-4, 8, 10-12, 14	
X	CN 112 066 371 A (UNIV XI AN JIAOTONG) 11 December 2020 (2020-12-11)	1, 4, 8, 10-14	
A	* claims 1, 7; figures 1-4 *	5, 6	
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 June 2022	Examiner Hauck, Gunther
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.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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