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Polttomoottorikone

Förbränningsmotor

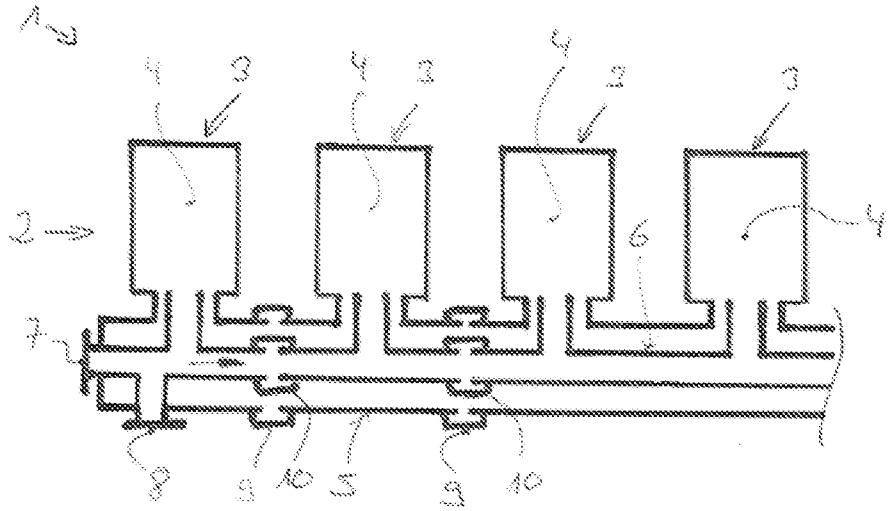
Internal combustion engine

(56) Viitejulkaisut - Anförda publikationer - References cited
US 2014053816 A1, US 2781752 A, WO 2013064200 A1, WO 2014076367 A1

(57) Tiivistelmä - Sammandrag - Abstract

Polttomoottorikone (1), jossa on ainakin yksi sylinteri (3), jossa on kulloistakin sylinteriä (3) varten oleva sylinterinkansi (4), jolloin kulloistakin sylinteriä (3) varten olevaan sylinterinkanteen (4) on kulloinkin asetettu ainakin yksi tulopuolinen kaasunvaihtoventtiili kaasun ja ahtoilman seosta ja/tai ahtoilmaa varten ja kulloinkin ainakin yksi poistopuolinen kaasunvaihtoventtiili pakokaasua varten, jossa on ahtoilmajohto (5) ahtoilman johtamiseksi kulloiseenkin sylinteriin (3), jossa on kaasujohto (6) kaasumaisen polttoaineen johtamiseksi kulloiseenkin sylinteriin (3), jolloin kaasujohto (6) on integroitu ahtoilmajohtoon (5) siten, että ahtoilmajohto (5) ympäröi kaasujohtoa (6) ulkopuolelta ainakin osuuksittain muodostaen kaksiseinämäisen johdon, jolloin ahtoilmajohdon (5) syöttämä ahtoilma virtaa ahtoilmajohtoon (5) integroidun kaasujohdon (6) ympärillä.

An internal combustion engine (1), with at least one cylinder (3), with a cylinder head (4) for the respective cylinder (3), wherein in the cylinder head (4) for the respective cylinder (3) at least one inlet-side gas exchange valve each for a gascharge air mixture and/or for charge air and in each case at least one exhaust-side gas exchange valve for exhaust gas is received, with a charge air line (5) in order to supply charge air to the respective cylinder (3), with a gas line (6), in order to supply gaseous fuel to the respective cylinder (3), wherein the gas line (6) is integrated in the charge air line (5) in such a manner that the charge air line (5) surrounds the gas line (6) at least in sections on the outside forming a double-wall line, wherein the charge air conducted by the charge air line (5) flows about the gas line (6) integrated in the charge air line (5).



Internal combustion engine

The invention relates to an internal combustion engine.

Internal combustion engines known from practice typically have multiple cylinders. For each cylinder of the internal combustion engine, at least one inlet-side gas exchange valve for charge air and at least one exhaust-side gas exchange valve for gas exchange each is received in a cylinder head of the internal combustion engine. In the case of gas engines and dual-fuel engines, the inlet-side exchange valve in each case serves for introducing a gas-charge air mixture into the combustion chamber of the respective cylinder.

The cylinders of a gas engine and dual-fuel engine can be supplied with charge air via a charge air line and gaseous fuel via a gas line, wherein in gas engines and dual-fuel engines known from practice, charge air line and gas line are always embodied as assemblies which are routed in the direction of the cylinders independently of one another. In order to retain a gas leakage that may form in the region of the gas line and avoid an uncontrolled introduction of such a gas leakage into the surroundings, it is already known from practice to embody gas lines in a double-walled manner. In gas engines and dual-fuel engines known from practice, the charge air lines however are always embodied independently even of such gas lines embodied in a double-walled manner and routed in the direction of the cylinders of the internal combustion engines.

Starting out from this, the present invention is based on the object of creating a new type of internal combustion engine. This object is solved through an internal combustion engine according to Claim 1.

According to the invention, the gas line is integrated in the charge air line in such a manner that the charge air line at least in sections surrounds the gas line on the

outside forming a double-wall line, wherein the charge air flow conducted by the charge air line flows about the gas line integrated in the charge air line.

By integrating the gas line in the charge air line according to the invention, namely in such a manner that the charge air line surrounds the gas line at least in sections on the outside forming a double-wall line and accordingly charge air flows about the gas line integrated in the charge air line, a multiplicity of advantages can be realised.

On the one hand it is prevented that a gas leakage which can form in the region of the gas line enters the surroundings in an uncontrolled manner. On the contrary, such a gas leakage enters the region of the charge air line and, together with the charge air, can be supplied to the respective cylinder for combustion. The gas line integrated in the charge air line is protected by the charge air line. There is no risk of damage for the gas line and attachment parts such as gas valves.

In that the charge air line and the gas line are jointly routed in the direction of the cylinders, installation space can be saved. Interference contours caused by independent lines are avoided. The gas line as a whole can be embodied in a thinner-walled manner since the same has to be designed for the pressure differential between the gas pressure and the gas pressure and not for a pressure differential between gas pressure and ambient pressure. Because of this, weight and costs can be saved. In the case of a dual-fuel engine, a leak test can be easily performed in the liquid fuel mode, in which the gas line per se does not carry any gas, by monitoring if the pressure within the gas line remains constant or increases via the charge air entering the gas line.

Preferentially, the respective cylinder is assigned a main gas valve which is integrated in the charge air line at least in sections in such a manner that the respective main gas valve on the one hand is coupled to the gas line integrated in the charge air line and on the other hand coupled to an inlet port of the cylinder

head via a gas inlet pipe. Preferentially, the respective main gas valve is accessible via a cover plate penetrating the charge air line in the region of the respective main gas valve, which complements the charge air line in the assembled state. Accordingly, the main gas valve can be protected from damage. Furthermore, the main gas valve is easily accessible for maintenance operations via the cover plate. With mounted cover plate, the same complements the charge air line.

According to an advantageous further development of the invention, the gas line is supported within the charge air line via ribs. Preferentially, at least some of the ribs provide flow passages for the gaseous fuel which branch off the gas line in order to conduct the gaseous fuel in the direction of prechamber of the respective cylinder. By way of this, a gas supply of the prechamber of the respective cylinder can be easily and reliably ensured via the ribs. This embodiment is employed in particular with gas engines, in which the actually lean and ignition-reluctant gas-charge air mixture, which flows into the combustion chamber of the respective cylinder via the inlet-side gas exchange valve, is ignited via the gas supplied to the prechamber.

Preferentially, the gas line and the charge air line are embodied as monolithic assembly. Alternatively, the gas line and the charge air line are embodied as separate assemblies which are connected to one another. The monolithic embodiment of gas line and charge air line is preferred for cost reasons and to avoid leakages.

Preferentially, the gas line and the charge air line are composed of segments connected to one another, wherein separating joints between adjoining segments are sealed via seals. Alternatively, the gas line and the charge air line extend over multiple cylinders of a cylinder group without separating joints. The embodiment without separating joints of gas line and charge air line is preferred for tightness

reasons. The segmented assembly of gas line and charge air line allows a simpler maintenance in the region of each cylinder.

Preferred further developments of the invention are obtained from the subclaims and the following description. Exemplary embodiments of the invention are explained in more detail by way of the drawing without being restricted to this. There it shows:

Fig. 1: a highly schematic representation of an internal combustion engine with multiple cylinders; and

Fig. 2: a cross section through the internal combustion engine in the region of a cylinder head of a cylinder.

The invention relates to an internal combustion engine, namely an internal combustion engine embodied as gas engine or as dual-fuel engine. In the case of a gas engine, exclusively gaseous fuel is combusted in the cylinders of the same, namely a gas-charge air mixture. The typically lean gas-mixture is ignited with the help of gas, which is supplied to a prechamber of the respective cylinder. In the case of dual-fuel engines, a liquid fuel, such as for example diesel or residual oil is combusted in a first operating mode, which is also described as liquid fuel operating mode. In a second operating mode, which is also described as gas fuel operating mode, a gas-charge air mixture can be combusted in the cylinders of a dual-fuel engine, which is then ignited with the help of ignition oil, wherein as ignition oil preferentially liquid fuel such as diesel or residual oil is utilised.

Fig. 1 shows a highly schematic extract from an internal combustion engine 1 in the region of a cylinder group 2 consisting of multiple cylinders 3 arranged in series. Of each cylinder 3, a cylinder head 4 is shown in each case, wherein in the respective cylinder head 4 for the respective cylinder 3 at least one inlet-side gas exchange valve each for a gas-charge air mixture and/or for charge air and at

least one exhaust-side gas exchange valve for exhaust gas each are received. These inlet-side and exhaust-side gas exchange valves are not shown in Fig. 1.

In the case of a gas engine or a dual-fuel engine, which is operated in the gas fuel operating mode, a gas-charge air mixture is introduced into the respective cylinder 3 via the respective inlet-side gas exchange valve of the respective cylinder 3, wherein in the case of a dual-fuel engine operated in a liquid fuel operating mode exclusively charge air is introduced into the respective cylinder via the respective inlet-side gas exchange valve.

The internal combustion engine 1, furthermore, comprises a charge air line 5 in order to supply the respective cylinder 3 with charge air, and a gas line 6, in order to supply the respective cylinder 3 with the gaseous fuel, wherein according to the invention the gas line 6 is integrated in the charge air line 5 in such a manner that the charge air line 5 surrounds the gas line 6 at least in sections on the outside forming a double-wall line, wherein the charge air conducted by the charge air line 5 flows about the gas line 6 integrated in the charge air line 5. This is evident from Fig. 1 which shows a gas line 6 integrated in the charge air line 5 in such a manner so that the charge air conducted by the charge air line 5 flows about the gas line 6. Accordingly, a gas leakage cannot enter the surroundings but merely the region of the charge air line 5 in order to be subsequently supplied to the respective cylinder 3 together with the charge air. Fig. 1 shows gas connections 7, 8 of the gas line 6 via which the gas line 6 can be supplied with gas.

In Fig. 1 it is provided for the two left cylinders 3 that the charge air line 5 and the gas line 6 integrated in the charge air line 5 is composed of segments, namely of cylinder-individual segments, wherein separating joints in the region of adjoining segments are sealed via seals 9, 10, namely separating joints of the charge air line 5 via seals 9 and separating joints of the gas line 6 via seals 10. These seals 9, 10 can be provided via sealing couplings, flange connections and/or compensators.

It is also possible that, as shown in Fig. 1 for the two right cylinders 3, the gas line 6 and charge air line 5 are embodied without separating joints and then extend preferentially free of separating joints over multiple cylinders 3 of a cylinder group 2. In this case, seals for sealing separating joints can be omitted.

It is possible to embody the charge air line 5 and the gas line 6 integrated in the charge air line 5 as separate assemblies and subsequently connect these to one another, for example by screwing together.

In contrast with this it is also possible, however, to embody charge air line 5 and gas line 6 as monolithic assembly, for example as monolithic casting. Such a monolithic embodiment is simple in terms of design and manufacture.

Fig. 2 shows a schematic cross section through a cylinder 3 of an internal combustion engine, namely through the cylinder head 4 of the cylinder 3 together with a charge air line 5 mounted on the cylinder head 4, in which the gas line 6 is integrated in terms of the invention.

Fig. 2 shows highly schematically an inlet port 11 provided by the cylinder head 4, in order to supply the gas-charge air mixture, which is to be combusted in the cylinder 3, to an inlet valve of the cylinder head 4 which is not shown. In Fig. 2, the charge air line 5 is screwed to the cylinder head 4 via a flange connection 12. In contrast with this it is also possible to integrate the charge air line 5 together with the gas line 6 integrated in the charge air line 5 in a so-called rocker arm box of a valve control of the respective cylinder 3 and subsequently fasten the rocker arm box on the cylinder head 4.

From Fig. 2 it is evident that the gas line 6 is integrated in the charge air line 5 in such a manner that the charge air conducted by the charge air line 5 flows about the gas line 6.

Fig. 2, furthermore, shows a main gas valve 13 which is likewise integrated in the charge air line 5, namely at least partly. In order to make possible an accessibility to the respective main gas valve 13, the charge air line 5, in the region of each main gas valve 13, is interrupted or complemented by a cover plate 14. In particular when the cover plate 14 is disassembled, the same opens the respective main gas valve 13 for maintenance purposes. In particular when the respective cover plate 14 is assembled on the charge air line 5, the respective main gas valve 13 is not accessible for maintenance operations, but this cover plate 14 then rather complements the charge air line 5.

The main gas valve 13 integrated in the charge air line is coupled, on the one hand, to the gas line 6 in order to make possible a transfer of gas from the gas line 6 in the direction of the main gas valve 13, while on the other hand the main gas valve 13 is in connection with a gas inflow pipe 15 likewise integrated in the charge air line 5. By way of this gas inflow pipe 15, the gas flowing via the respective main gas valve 13 is supplied to the inlet port 11 of the respective cylinder head 4.

Preferentially, the gas inflow pipe 15 according to Fig. 2 projects with an end section facing away from the main gas valve 13 into the inlet port 11 of the cylinder head 4. Accordingly, charge air and gas in Fig. 2 are mixed in the region of the inflow port 11 in order to provide the gas-charge air mixture and introduce this gas-charge air mixture into the combustion chamber of the respective cylinder 3 via at least one inlet-side gas exchange valve that is not shown.

According to Fig. 2, which shows an extract from an internal combustion engine designed as gas engine, the gas line integrated in the charge air line 5 is supported within the charge air line 5 via ribs 16.

In Fig. 2, at least some of the ribs 16, namely for each cylinder 3 at least one of the ribs 16, are embodied as ducts 17 for gas in order to branch gas off the gas line 6 and conduct the same in the direction of a prechamber of the respective cylinder 3 which is not shown in detail. In Fig. 2, the shown rib 16 is connected to a prechamber gas line 18 in order to conduct the gas via the prechamber gas line 18 in the direction of the prechamber which is not shown, wherein a prechamber gas valve 19 is assigned to the prechamber gas line 18. By way of this, gas, in the case of gas engines, can be supplied to the prechamber in a particularly simple and installation space-saving manner in order to ignite the lean gas/charge air-mixture via the gas supplied to the prechamber, which gas/charge air-mixture is supplied to the combustion chamber of the cylinder via inlet port 11.

The purpose of the present invention therefore is to integrate, in a gas engine or a dual-fuel engine, the gas line 6 in the charge air line 5 namely by providing a double-wall line so that the charge air line surrounds the gas line on the outside. Charge air flowing via the charge air line 5 accordingly flows about the gas line 6.

By way of this a multiplicity of advantages can be described which have already been described.

In particular, any gas leakage that may develop can be supplied to the cylinder for combustion together with the charge air.

In particular, installation space, weight and costs can be additionally reduced.

Furthermore, the gas line is protected from damage by the charge air line, just like further components of the gas line, such as for example the main gas valves.

List of reference numbers

1	Internal combustion engine
2	Cylinder group
3	Cylinder
4	Cylinder head
5	Charge air line
6	Gas line
7	Gas connection
8	Gas connection
9	Seal
10	Seal
11	Inlet port
12	Flange connection
13	Main gas valve
14	Cover plate
15	Gas inflow pipe
16	Rib
17	Flow passage
18	Prechamber gas line
19	Prechamber gas valve

Claims

1. An internal combustion engine (1),
with at least one cylinder (3),
with a cylinder head (4) for the respective cylinder (3), wherein in the cylinder head (4) for the respective cylinder (3) at least one inlet-side gas exchange valve each for a gas-charge air mixture and/or for charge air and in each case at least one exhaust-side gas exchange valve for exhaust gas is received,
with a charge air line (5) in order to supply charge air to the respective cylinder (3),
with a gas line (6) in order to supply gaseous fuel to the respective cylinder (3),
characterized in that
the gas line (6) is integrated in the charge air line (5) in such a manner that the charge air line (5) surrounds the gas line (6) at least in sections on the outside forming a double-wall line, wherein the charge air conducted by the charge air line (5) flows about the gas line (6) integrated in the charge air line (5).

2. The internal combustion engine according to Claim 1, characterized in that the respective cylinder (3) is assigned a main gas valve (13), which at least in sections is integrated in the charge air line (5) in such a manner that the respective main gas valve (13) on the one hand is coupled to the gas line (6) integrated in the charge air line (5) and on the other hand is coupled to an inlet port (11) of the cylinder head (4) via a gas inflow pipe (15).

3. The internal combustion engine according to Claim 2, characterized in that the gas inflow pipe (15) projects into the inlet port (11) of the cylinder head (4) and charge air flows about the same.

4. The internal combustion engine according to Claim 2 or 3, characterized in that the respective main gas valve (13) is accessible via a cover plate (14) penetrating the charge air line (5) in the region of the respective main gas valve (13).

5. The internal combustion engine according to any one of the Claims 1 to 4, characterized in that the gas line (6) is supported within the charge air line (5) via ribs (16).

6. The internal combustion engine according to Claim 5, characterized in that at least some of the ribs (16) provide flow ducts (17) for gaseous fuel, which branch off the gas line (6) in order to conduct gaseous fuel in the direction of a prechamber of the respective cylinder (3).

7. The internal combustion engine according to Claim 6, characterized in that the flow duct (17) provided by the respective rib (16) merges into a prechamber gas line (18) which leads into the prechamber of the respective cylinder and which is preferentially assigned a prechamber gas valve (19).

8. The internal combustion engine according to any one of the Claims 1 to 7, characterized in that the gas line (6) and the charge air line (5) are embodied as separate assemblies which are connected to one another.

9. The internal combustion engine according to any one of the Claims 1 to 7, characterized in that the gas line (6) and the charge air line (5) are embodied as monolithic assembly.

10. The internal combustion engine according to any one of the Claims 1 to 9, characterized in that the gas line (6) and the charge air line (5) extend without separating joints over multiple cylinders (3) of a cylinder assembly.

11. The internal combustion engine according to any one of the Claims 1 to 9, characterized in that the gas line (6) and the charge air line (5) are assembled of interconnected segments, wherein separating joints between adjoining segments are sealed via seals (9, 10).

Patenttivaatimukset

1. Polttomoottorikone (1),

jossa on ainakin yksi sylinteri (3),

jossa on kulloistakin sylinteriä (3) varten tarkoitettu sylinterinkansi (4), jolloin kulloistakin sylinteriä (3) varten tarkoitettuun sylinterinkanteen (4) on kulloinkin asetettu ainakin yksi tulopuolinen kaasunvaihtoventtiili kaasun ja syöttöilman seosta ja/tai syöttöilmaa varten ja kulloinkin ainakin yksi poistopuolinen kaasunvaihtoventtiili pakokaasua varten,

jossa on syöttöilmajohto (5) syöttöilman johtamiseksi kulloiseenkin sylinterin (3),

jossa on kaasujohto (6) kaasumaisen polttoaineen johtamiseksi kulloiseenkin sylinteriin (3),

t u n n e t t u siitä, että

kaasujohto (6) on integroitu syöttöilmajohtoon (5) sillä tavalla, että syöttöilmajohto (5) ympäröi kaasujohtoa (6) ulkopuolelta ainakin osuuksittain muodostaen kaksiseinämäisen johdon, jolloin syöttöilmajohdon (5) kuljettama syöttöilma virtaa syöttöilmajohtoon (5) integroidun kaasujohdon (6) ympärillä.

2. Patenttivaatimuksen 1 mukainen polttomoottorikone, t u n n e t t u siitä, että kulloiseenkin sylinteriin (3) on järjestetty pääkaasuventtiili (13), joka on integroitu syöttöilmajohtoon (5) ainakin osuuksittain sillä tavalla, että kulloinenkin pääkaasuventtiili (13) on toisaalta kytketty syöttöilmajohtoon (5) integroituun kaasujohtoon (6) ja toisaalta kaasun tulovirtausputken (15) kautta sylinterinkannen (4) tulokanavaan (11)-.

3. Patenttivaatimuksen 2 mukainen polttomoottorikone, t u n n e t t u siitä, että kaasun tulovirtausputki (15) ulottuu sylinterinkannen (4) tulokanavaan (11) ja syöttöilma virtaa sen ympärillä.

4. Jonkin patenttivaatimuksen 2 tai 3 mukainen polttomoottorikone, t u n n e t t u siitä, että kulloiseenkin pääkaasuventtiiliin (13) päästään käsiksi sulkukannen (14) kautta, joka läpäisee syöttöilmanjohdon (5) kulloisenkin pääkaasuventtiilin (13) alueella.

5. Jonkin patenttivaatimuksen 1-4 mukainen polttomoottorikone, t u n n e t t u siitä, että kaasujohto (6) on syöttöilmajohdon (5) sisällä tuettu kohoruoteiden (16) avulla.

6. Patenttivaatimuksen 5 mukainen polttomoottorikone, t u n n e t t u siitä, että ainakin jotkin kohoruoteista (16) muodostavat kaasumaista polttoainetta varten tarkoitettuja virtauskanavia (17), jotka haarautuvat kaasujohdosta (6)

kaasumaisen polttoaineen johtamiseksi kulloisenkin sylinterin (3) esikammion suuntaan.

7. Patenttivaatimuksen 6 mukainen polttomoottorikone, t u n n e t t u siitä, että kulloisestakin kohoruoteesta (16) muodostunut virtauskanava (17) muuttuu esikammiokaasujohdoksi (18), joka päätyy kulloisenkin sylinterin esikammioon ja johon on edullisesti järjestetty esikammiokaasuventtiili (19).

8. Jonkin patenttivaatimuksen 1-7 mukainen polttomoottorikone, t u n n e t t u siitä, että kaasujohto (6) ja syöttöilmajohto (5) on toteutettu erillisinä rakenneryhminä, jotka on yhdistetty toisiinsa.

9. Jonkin patenttivaatimuksen 1-7 mukainen polttomoottorikone, t u n n e t t u siitä, että kaasujohto (6) ja syöttöilmajohto (5) on toteutettu monoliittisenä rakenneryhmänä.

10. Jonkin patenttivaatimuksen 1-9 mukainen polttomoottorikone, t u n n e t t u siitä, että kaasujohto (6) ja syöttöilmajohto (5) ulottuvat erotussaumattomasti useisiin sylinteriryhmän sylintereihin (3).

11. Jonkin patenttivaatimuksen 1-9 mukainen polttomoottorikone, t u n n e t t u siitä, että kaasujohto (6) ja syöttöilmajohto (5) on koottu toisiinsa yhdistetyistä segmenteistä, jolloin toisiinsa rajoittuvien segmenttien väliset erotussaumat on tiivistetty tiivistein (9, 10).

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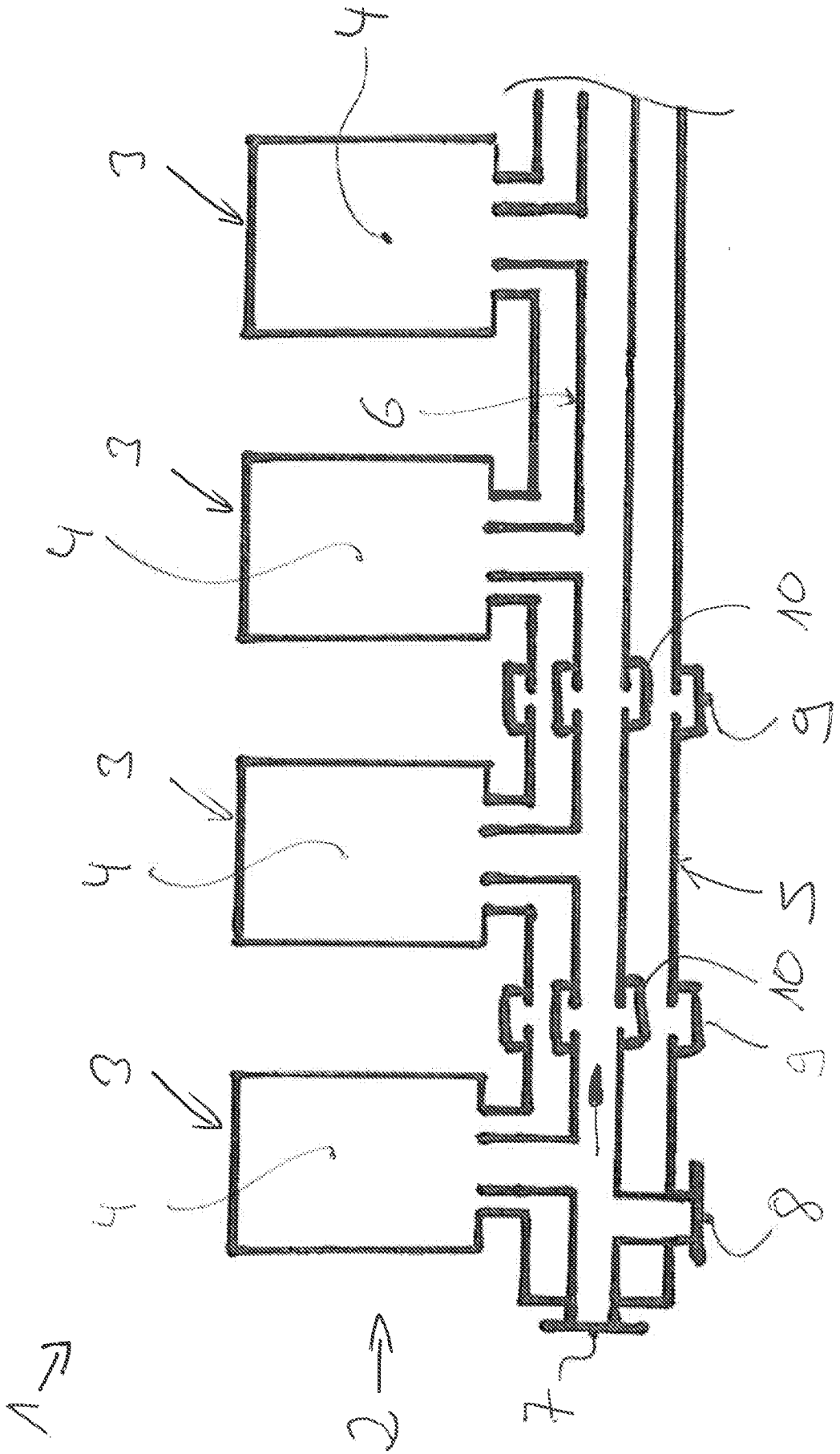

Fig. 1

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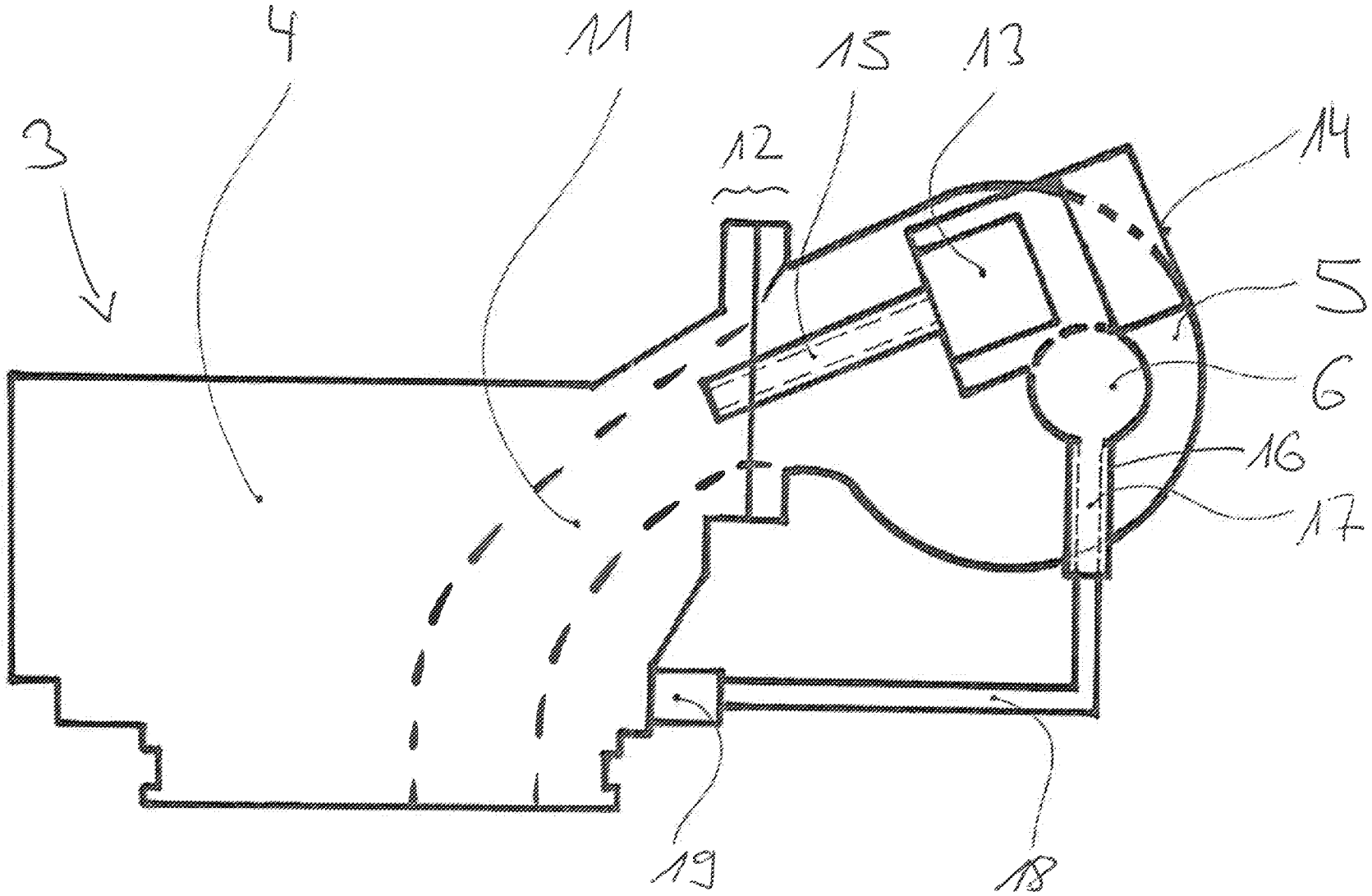

Fig. 2