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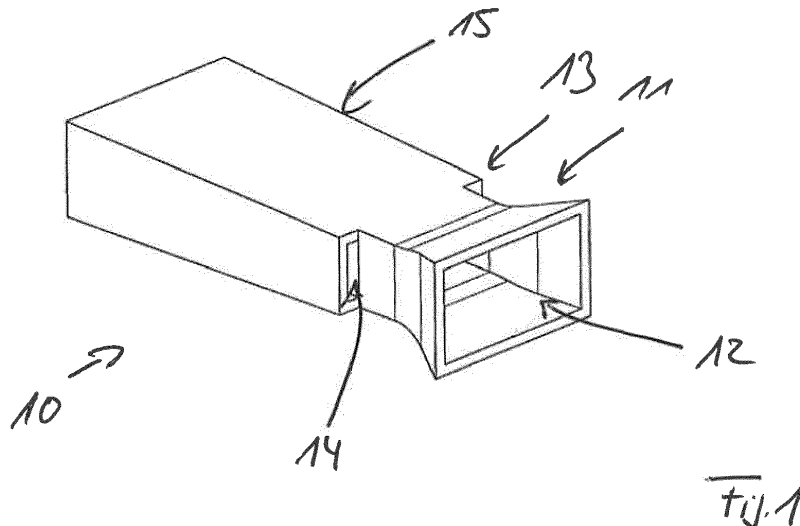
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(54) **GAS/AIR MIXING DEVICE OF A GAS BURNER**

(57) Gas/Air mixing device for a gas burner having a housing and at least one venturi nozzle (10) positioned within the housing. The or each venturi nozzle (10) has an air inlet section (11) with an air inlet opening (12) for air, a gas inlet section (13) with at least two gas inlet openings (14) for gas, and a gas/air outlet section (15) with a gas/air outlet opening (16) for a gas/air mixture.

The air inlet section (11) and the air inlet opening (12) of the or each venturi nozzle (10) each have a rectangular cross-section. The gas inlet openings (14) of the or each venturi nozzle (10) each have a rectangular cross-section. The gas/air outlet section (15) and the gas/air outlet opening (16) of the or each venturi nozzle (10) each have a rectangular cross-section.



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Description

[0001] The present patent application relates to a gas/air mixing device of a gas burner.

[0002] DE 296 17 621 U1 discloses a gas/air mixing device of a gas burner. The gas/air mixing device comprises a housing. A venturi nozzle is positioned within the housing. The venturi nozzle mixes gas and air to provide a gas/air mixture.

[0003] Venturi nozzles known from the prior art comprise an air inlet section with an air inlet opening for the air, a gas inlet section with a gas inlet opening for the gas, and a gas/air outlet section with a gas/air outlet opening for the gas/air mixture. According to the prior art, the air inlet section and the air inlet opening each have a circular cross-section. Further, the gas/air outlet section and the gas/air outlet opening each have a circular cross-section. The gas inlet section and gas inlet opening is ring shaped and positioned around an outlet end of the air inlet section. Such a venturi nozzle is disclosed by DE 197 43 464 C1.

[0004] Against this background, a novel gas/air mixing device of a gas burner is provided.

[0005] The air inlet section and the air inlet opening of the or each venturi nozzle each have a rectangular cross-section. Further, the gas inlet openings of the or each venturi nozzle each have a rectangular cross-section. Further, the gas/air outlet section and the gas/air outlet opening of the or each venturi nozzle each have a rectangular cross-section.

[0006] Such a gas/air mixing device provides better performance, namely a wider modulation range, compared to gas/air mixing devices known from the prior art. Further, the design is compact, requires less space and allows the mixing of gas and air with low noise.

[0007] Preferably, the or each venturi nozzle is symmetrical in two perpendicular planes. Such a gas/air mixing device provides better performance compared to gas/air mixing devices known from the prior art.

[0008] Preferably, the air inlet section of the respective venturi nozzle provides a contraction subsection and an outlet subsection, wherein on two sides of the outlet subsection there is one gas inlet opening. The gas/air outlet section of the respective venturi nozzle provides a diffuser section, wherein the air inlet section protrudes with the outlet subsection into the diffuser section, and wherein the gas inlet openings are positioned on two sides of the air inlet section adjacent to the outlet subsection of the air inlet section. Such a gas/air mixing device provides better performance compared to gas/air mixing devices known from the prior art.

[0009] According to a preferred embodiment, the gas/air mixing device has at least two venturi nozzles positioned side-by-side in a row or almost in a row such that all gas inlet openings of the venturi nozzles are positioned in a row. Such a gas/air mixing device provides a wider modulation range compared to gas/air mixing devices known from the prior art. Further, the design is

compact, requires less space and allows the mixing of gas and air with low noise.

[0010] When the venturi nozzles are positioned side-by-side almost in a row they are not positioned along a straight line but along a line having a very large radius. Such a radius is much larger than the length of the venturi nozzles. Preferably, the radius is at least 10-times larger than the length of the venturi nozzles.

[0011] Preferably, the air inlet opening of at least one venturi nozzle is permanently blocked, while the gas inlet openings and gas/air outlet opening of the same is permanently unblocked. Such a gas/air mixing device provides a better performance. A further advantage is that in case of an increased pressure level inside the gas burner and in case of a back flow of the gas/air mixture into the gas/air mixing device the gas/air mixture will become leaner and leaner which will result to a loss of flame and will stop combustion. There is no risk of a toxic combustion caused by a back flow of the gas/air mixture.

[0012] Preferred developments of the invention are provided by the dependent claims and the description which follows. Exemplary embodiments are explained in more detail on the basis of the drawing, in which:

Figure 1 shows a first perspective view of a venturi nozzle of a gas/air mixing device of a gas burner;

Figure 2 shows a second perspective view of the venturi nozzle;

Figure 3 shows a first cross section through the venturi nozzle;

Figure 4 shows a second cross section through the venturi nozzle;

Figure 5 shows a perspective view of a gas/air mixing device having four venturi nozzles according to Figures 1-4 positioned in a row;

Figure 6 shows a partial cross section through the gas/air mixing device of Figure 5;

Figure 7 shows another cross section through the gas/air mixing device of Figure 5;

Figure 8 shows another cross section through the gas/air mixing device of Figure 5;

Figure 9 shows a preferred detail of the gas/air mixing device of Figure 5;

Figure 10 shows a perspective view of another gas/air mixing device having four venturi nozzles according to Figures 1-4 positioned in a circular configuration;

Figure 11 shows a perspective view of another gas/air mixing device having six venturi nozzles according to Figures 1-4 positioned in a circular configuration.

[0013] The present application relates to a gas/air mixing device of a gas burner.

[0014] Such a gas/air mixing device of a gas burner comprises a housing and at least one venturi nozzle positioned within the housing.

[0015] Figures 1 to 4 show such a venturi nozzle 10 positioned with the housing of the gas/air mixing according to the present application.

[0016] The venturi nozzle 10 shown in Figures 1 to 4 has an air inlet section 11 with an air inlet opening 12 for air. The air inlet section 11 and the air inlet opening 12 each have a rectangular cross-section. The respective cross-section is running perpendicular to flow of the air through air inlet section 11.

[0017] The air inlet section 11 of the venturi nozzle 10 has a contraction subsection 11 a and an outlet subsection 11 b. The contraction subsection 11 a is provided adjacent to the the air inlet opening 12 and has a contraction angle of total 20° to 60°. An contraction angle of total 20° means that the angle is on each side 10°.

[0018] At the outlet subsection 11 b of the air inlet section 11 no further contraction of the air flow takes place.

[0019] The venturi nozzle 10 shown in Figures 1 to 4 further has a gas inlet section 13 with at least two gas inlet openings 14 for gas. The gas inlet openings 14 each have a rectangular cross-section. The respective cross-section is running perpendicular to flow of the gas through the gas inlet section 13.

[0020] The venturi nozzle 10 shown in Figures 1 to 4 further has a gas/air outlet section 15 with a gas/air outlet opening 16 for a gas/air mixture.

[0021] The air inlet section 11 protrudes with the outlet subsection 11 b of the same into the gas/air outlet section 15.

[0022] The gas/air outlet section 15 and the outlet opening 16 have each a rectangular cross-section. The respective cross-section is running perpendicular to flow of the gas/air mixture through gas/air outlet section 15.

[0023] The gas/air outlet section 15 of the venturi nozzle 10 provides a diffuser section. The diffuser angle of gas/air outlet section 15 is preferably in the range of total 2° to 5°. An angle of total 2° means that the angle is on each side 1°.

[0024] The gas inlet openings 14 are positioned on two sides of the outlet subsection 11 b of the air inlet section 11. The gas inlet openings 14 are positioned adjacent to the outlet subsection 11 b of the air inlet section 12. So, the gas inlet openings 14 are positioned on the opposite end of the air inlet section 11 as the air inlet opening 12.

[0025] The venturi nozzle 10 shown in Figures 1 to 4 is symmetrical in two perpendicular planes.

[0026] The venturi nozzle 10 is symmetrical in a first plane (see Figure 3) running parallel to flow of the air and gas and gas/air mixture and in a second plane (see Figure 4) running parallel to flow of the air and gas and gas/air mixture and running perpendicular to the first plane.

[0027] The contraction angle in the first plane and in the second plane might different. The diffuser angle in the first plane and in the second plane might identical.

[0028] Figures 5 to 7 show a gas/air mixing 20 having a housing 21 and multiple venturi nozzles 10 positioned side-by-side in a row with the housing 21.

[0029] The housing 21 provides an air inlet opening 22

being in communication with the air inlet openings 12 of the venturi nozzles 10.

[0030] The housing 21 further provides gas inlet openings 23, 24, 25 and 26. The gas inlet openings 23, 24, 25 and 26 of the housing 21 are in communication with the gas inlet openings 14 of the venturi nozzles 10. The different gas inlet openings 23, 24, 25 and 26 are provided to allow different installation scenarios for the gas/air mixing device 20. In each installation scenarios only one of said gas inlet openings 26 is connected to a gas pipe 28 (see Figure 8) while the other gas inlet openings 23, 24, 25 are inactive.

[0031] The housing 21 further provides gas/air outlet opening 27 being in communication with the gas/air outlet openings 16 of the venturi nozzles 10.

[0032] The air inlet opening 12 of at least one venturi nozzle 10 is permanently blocked by a blocking element 29, while the gas inlet openings 14 and gas/air outlet opening 16 of the same is permanently unblocked (see Figures 7 and 9).

[0033] Figures 7 and 9 each show details of the gas/air mixing 20 having four venturi nozzles 10. One of the venturi nozzles 10 is permanently blocked by a blocking element 29.

[0034] The acronyms V1 to V4 of Figure 9 identify the four venturi nozzles 10. The venturi nozzle V1 of Figure 9 is permanently blocked. During operation air A will be taken in by a fan through the air inlet openings 12 of the venturi nozzles V2 to V4. As mentioned, the air inlet opening 12 of the venturi nozzle V1 is blocked. No air can enter into said blocked air inlet opening 12. The acronyms A2 to A4 of Figure 9 identify the air flow through the unblocked air inlet openings 12.

[0035] The fan is preferably positioned downstream of the venturi nozzles 10.

[0036] Due to the negative pressure in throats of the venturi nozzles 10, gas G will be taken in through the gas inlet openings 14 and mixed with the air A.

[0037] The resulting gas/air mixture 02 to 04 is sucked in by the fan, and blown into a combustion chamber of the gas burner.

[0038] If, due to an increased pressure inside the combustion chamber of the gas burner, a back flow R1 of the gas/air mixture is flowing back into the direction of the venturi nozzles 10, this occurs at a specific area of the gas/air mixing device 20, namely at a specific venturi nozzle 10 of the same. This specific venturi nozzle 10 can be determined by tests and is permanently blocked by a blocking element 29.

[0039] The back flow R1 of gas/air mixture will enter into that specific venturi nozzle 10 through the gas/air outlet opening 16 of the same.

[0040] The back flow R1 of gas/air mixture will mix with the gas G, and in this way make the gas/air mixture taken in by the other venturi nozzles 10 leaner.

[0041] So, the higher the pressure inside the combustion chamber, the more gas/air mixture R1 will be mixed with the gas G flowing into the throats of the venturi nozzles 10.

zles 10. Therefore, the gas/air mixture 02 to 04 will become leaner and leaner, and ultimately will lead to loss of flame, resulting in safe shut-down of the gas burner. In this way the risk of toxic combustion due to recirculation of gas/air mixture is eliminated.

[0042] In Figures 7 and 9, the gas/air mixing device 20 has a number $N=4$ venturi nozzles 10, wherein the air inlet opening 12 of a number $N1=1$ of venturi nozzles 10 is permanently blocked while the inlet openings 12 of a number $N2=3$ of venturi nozzles 12 are permanently unblocked. This is only one example.

[0043] In general, the following applies: The gas/air mixing device 20 has a number N of venturi nozzles 10, wherein the air inlet opening 12 of a number $N1$ of venturi nozzles 10 is permanently blocked while the inlet opening 12 of a number $N2$ of venturi nozzles 10 is permanently unblocked, wherein $N1+N2=N$ and wherein $N1 \leq N2$.

[0044] Instead of blocking an air inlet opening 12 of a venturi nozzle 10 it would also be possible to use a feed-back channel guiding the back flow $R1$ of gas/air mixture into a gas inlet opening of one of the venturi nozzles 10. However, blocking an air inlet opening 12 of a venturi nozzle 10 is preferred.

[0045] Figures 10 and 11 show gas/air mixing devices 20', 20" each having at least four venturi nozzles 10 positioned in a circumferential arrangement such that the gas/air outlet sections 15 of the venturi nozzles 12 are all aligned towards a center of the circumferential arrangement in which a gas/air outlet opening 27 of the housing 21 of the gas/air mixing devices 20', 20" is positioned. Figures 10, 11 only show a lower housing part of the housing 21. An upper housing part providing at least one gas inlet opening of the housing 21 is not shown.

[0046] Also in Figures 10 and 11 it is possible that the air inlet opening 12 of at least one venturi nozzle 10 is permanently blocked by a blocking element 29. This provided the same advantage as explained for Figures 7 and 9.

List of reference signs

[0047]

10	venturi nozzle
11	air inlet section
11a	contraction subsection
11b	outlet subsection
12	air inlet opening
13	gas inlet section
14	gas inlet opening
15	gas/air outlet section
16	gas/air outlet opening
20, 20', 20"	gas/air mixing device
21	housing
22	air inlet opening
23	gas inlet opening
24	gas inlet opening

25	gas inlet opening
26	gas inlet opening
27	gas/air outlet opening
28	gas pipe
29	blocking element

Claims

1. Gas/Air mixing device (20, 20', 20") for a gas burner, having
 - a housing (21),
 - at least one venturi nozzle (10) positioned within the housing, the or each venturi nozzle (10) having:
 - an air inlet section (11) with an air inlet opening (12) for air,
 - a gas inlet section (13) with at least two gas inlet openings (14) for gas,
 - a gas/air outlet section (15) with a gas/air outlet opening (16) for a gas/air mixture,
 - characterized in that**
 - the air inlet section (11) and the air inlet opening (12) of the or each venturi nozzle (10) each have a rectangular cross-section,
 - the gas inlet openings (14) of the or each venturi nozzle (10) each have a rectangular cross-section;
 - the gas/air outlet section (15) and the gas/air outlet opening (16) of the or each venturi nozzle (10) each have a rectangular cross-section.
2. Gas/Air mixing device as claimed claim 1, **characterized in that** the or each venturi nozzle (10) is symmetrical in two perpendicular planes.
3. Gas/Air mixing device as claimed claim 1 or 2, **characterized in that** the air inlet section (11) of the respective venturi nozzle (10) provides a contraction subsection (11a) and an outlet subsection (11 b), wherein on two sides of the outlet subsection (11 b) there is one gas inlet opening (14).
4. Gas/Air mixing device as claimed in claim 3, **characterized in that** the gas/air outlet section (15) of the respective venturi nozzle (10) provides a diffuser section, wherein the air inlet section (11) protrudes with the outlet subsection (11 b) into the diffuser section, and wherein the gas inlet openings (14) are positioned on two sides of the air inlet section (11) adjacent to the outlet subsection (11 b) of the air inlet section (11).
5. Gas/Air mixing device as claimed in one claims 1 to 4, **characterized by** at least two venturi nozzles (10)

positioned side-by-side in a row or almost in a row such that all gas inlet openings (14) of the venturi nozzles (10) are positioned in a row.

6. Gas/Air mixing device as claimed in one of claims 1 to 4, **characterized by** at least four venturi nozzles (12) positioned in a circumferential arrangement such that the gas/air outlet section (15) of the venturi nozzles (12) are all aligned towards a center of the circumferential arrangement. 5
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7. Gas/Air mixing device as claimed claim 5 or 6, **characterized in that** the air inlet opening (12) of at least one venturi nozzle (10) is permanently blocked by a blocking element (29), while the gas inlet openings (14) and gas/air outlet opening (16) of the same is permanently unblocked. 15

8. Gas/Air mixing device as claimed claim 7, **characterized by** a number N venturi nozzles (10), wherein the air inlet opening (12) of a number N1 of venturi nozzles (10) is permanently blocked while the inlet opening (12) of a number N2 of venturi nozzles (10) is permanently unblocked, wherein $N1+N2=N$ and wherein $N1 \leq N2$. 20
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9. Gas/Air mixing device as claimed claim 8, **characterized in that** $N1=1$ and $N2 \geq 1$.

10. Gas/Air mixing device as claimed claim 8, **characterized in that** $N1=1$ and $N2 \geq 2$. 30

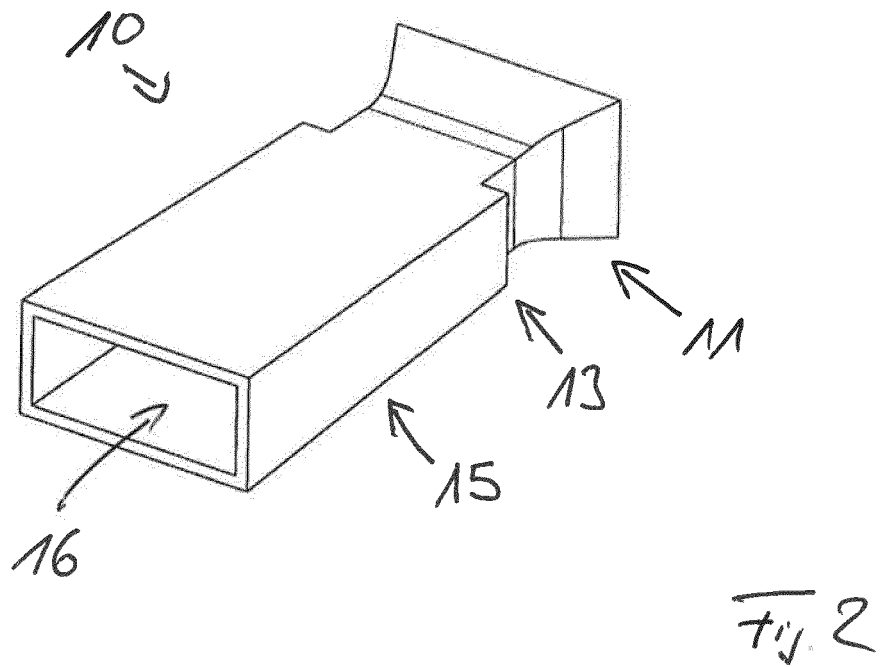
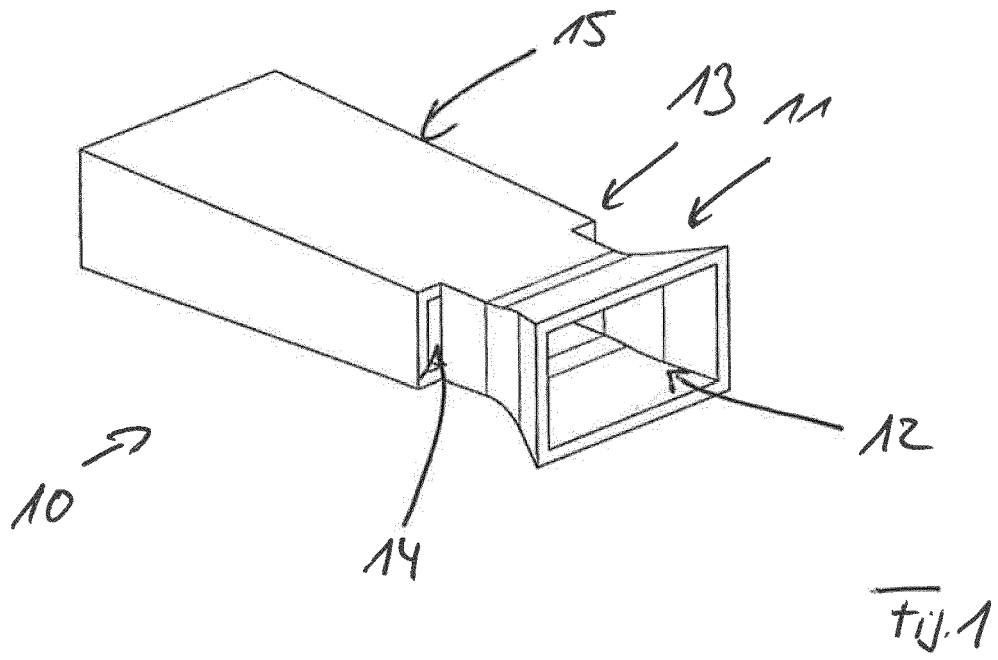
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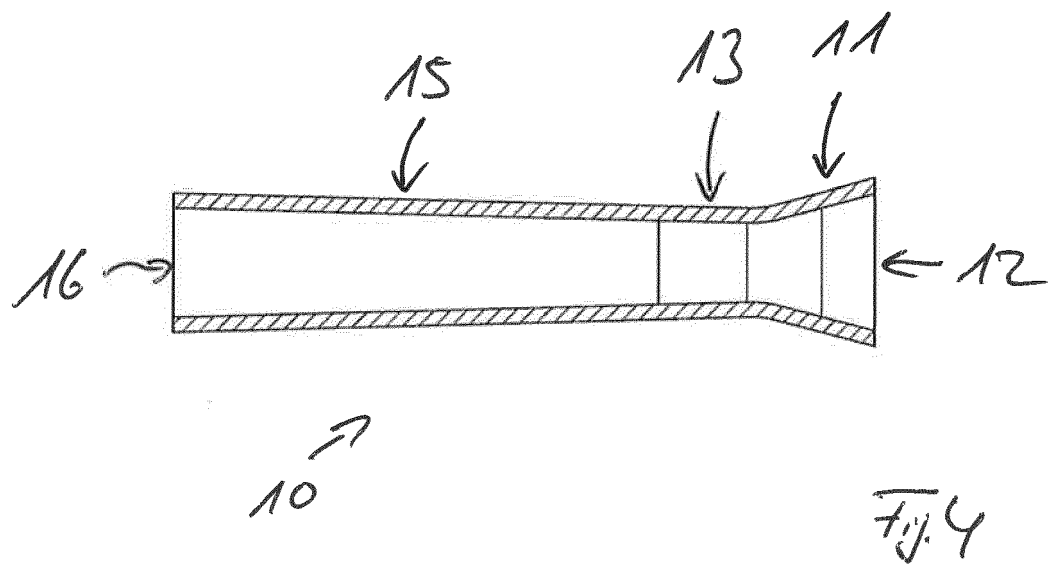
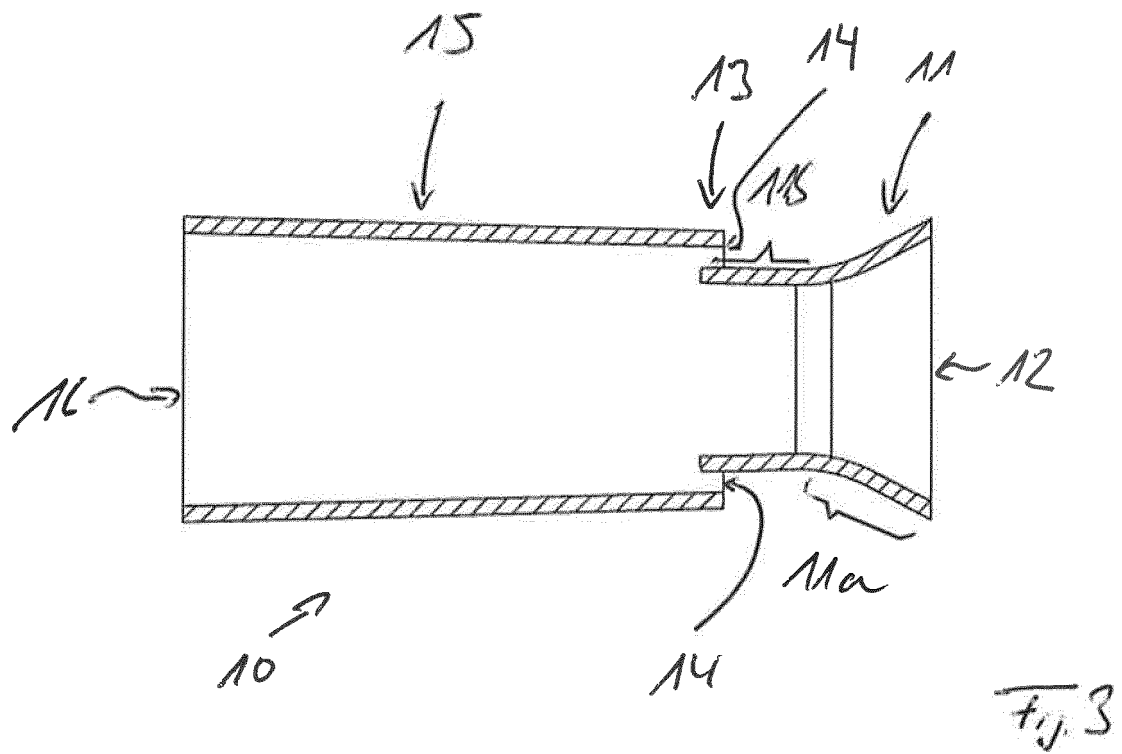
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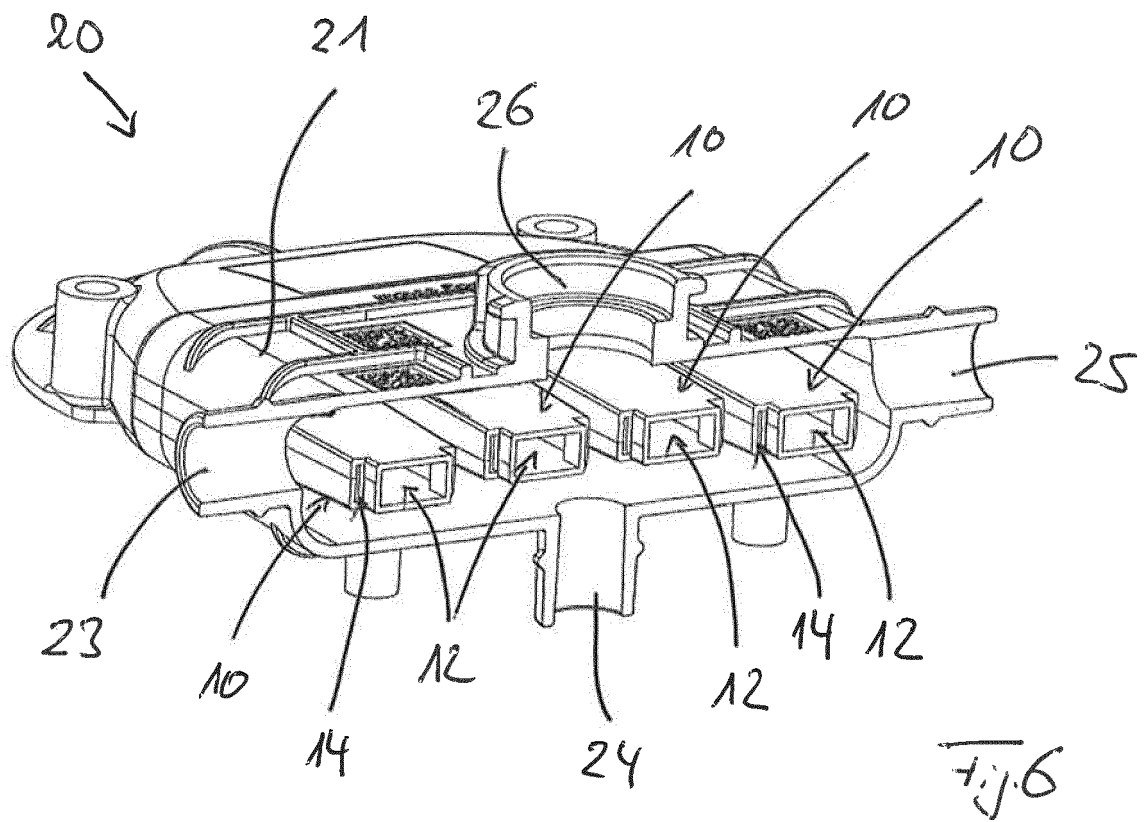
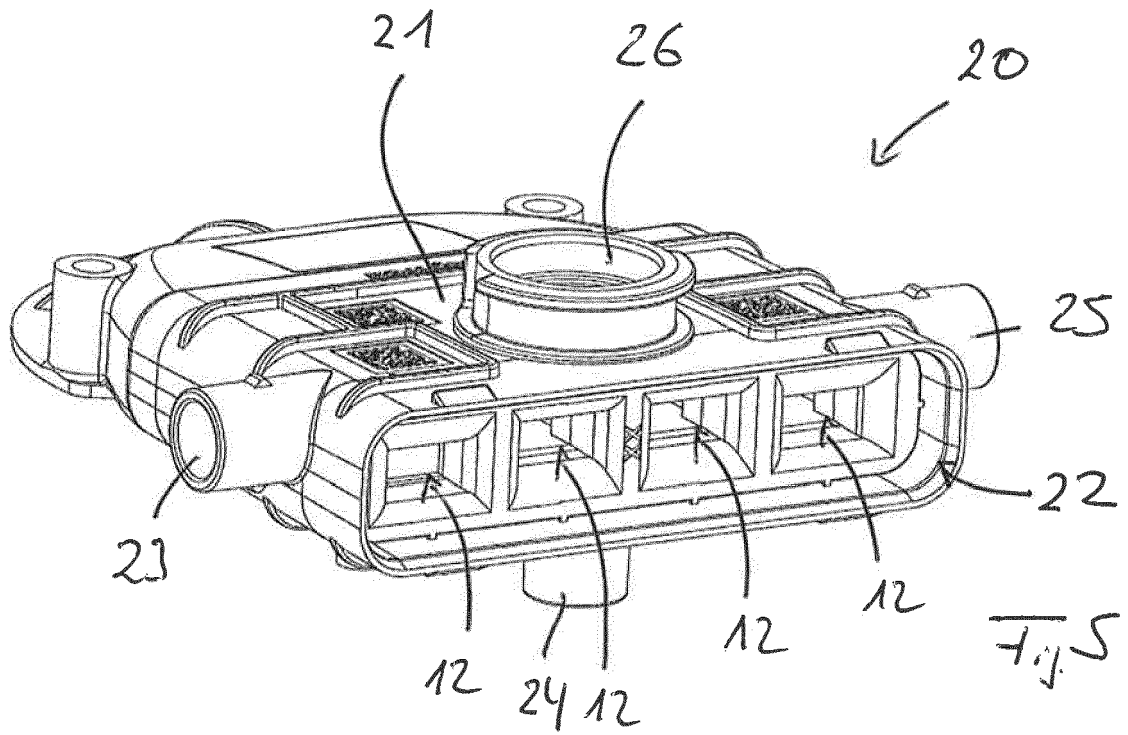
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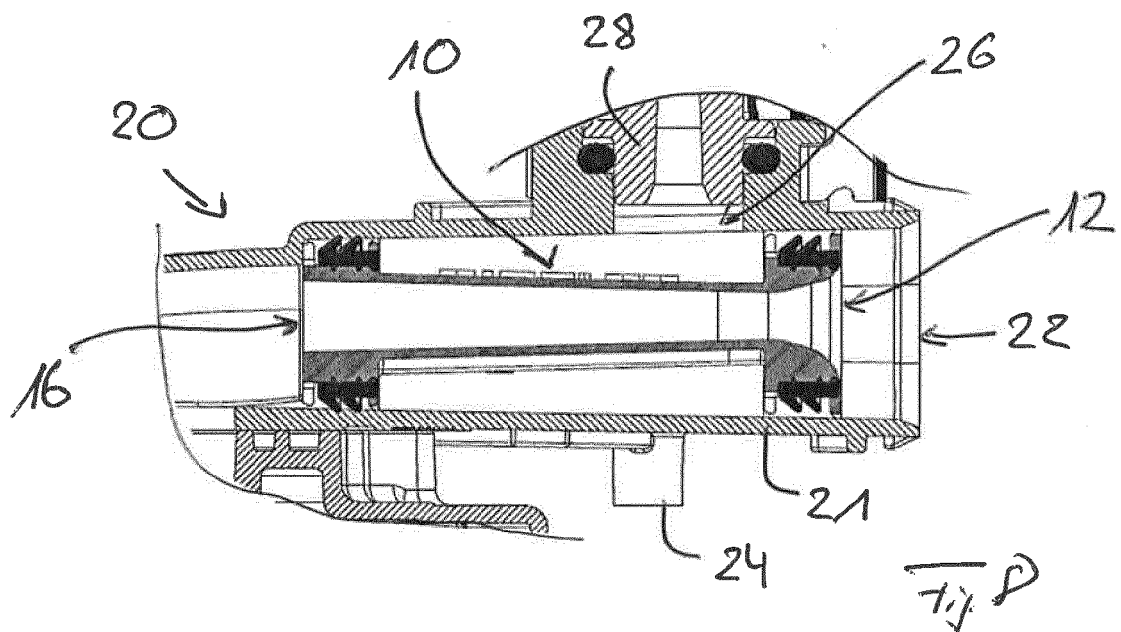
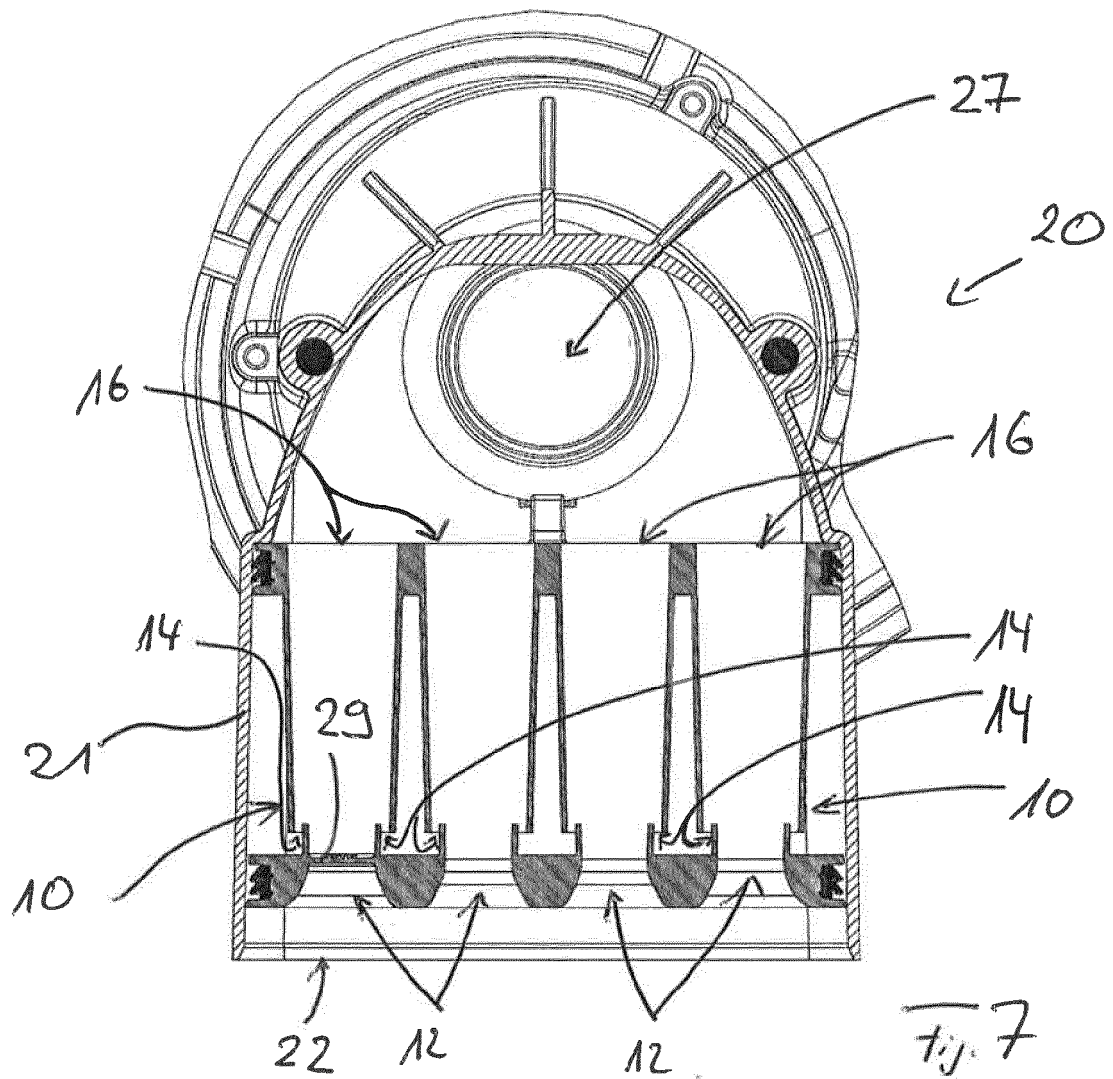
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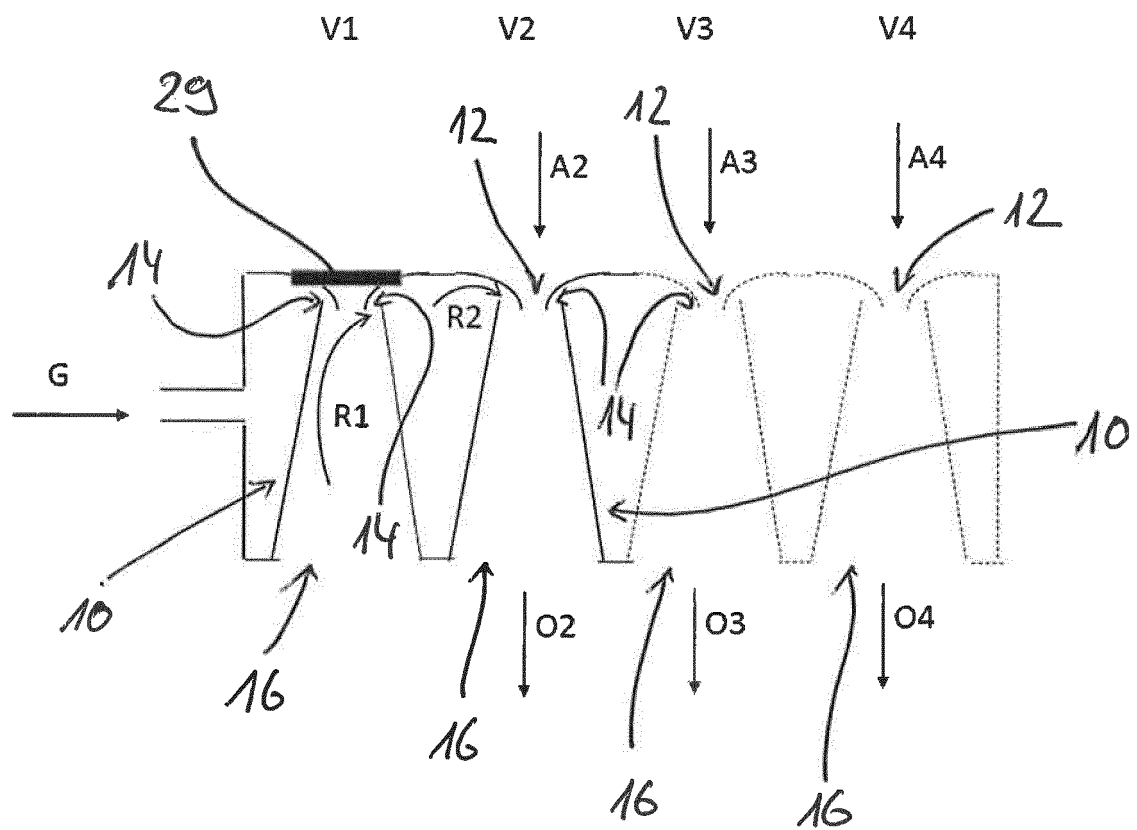


Fig. 9

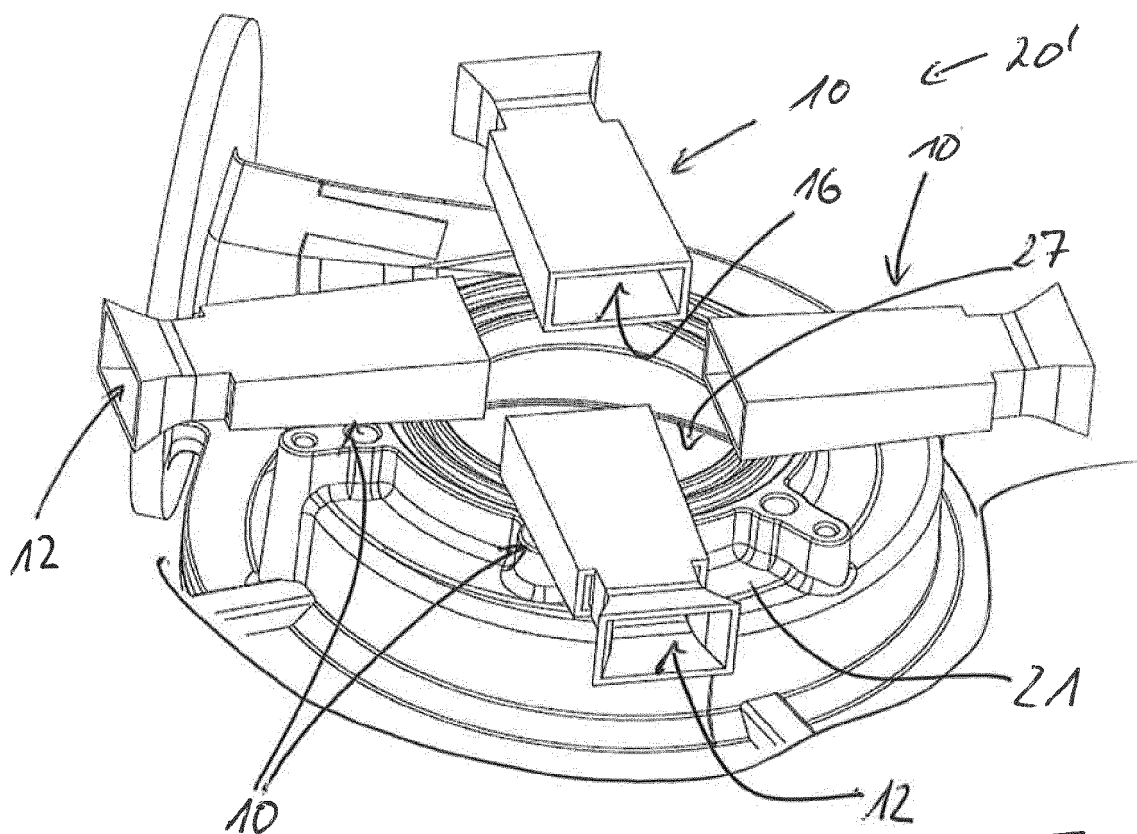


Fig. 10

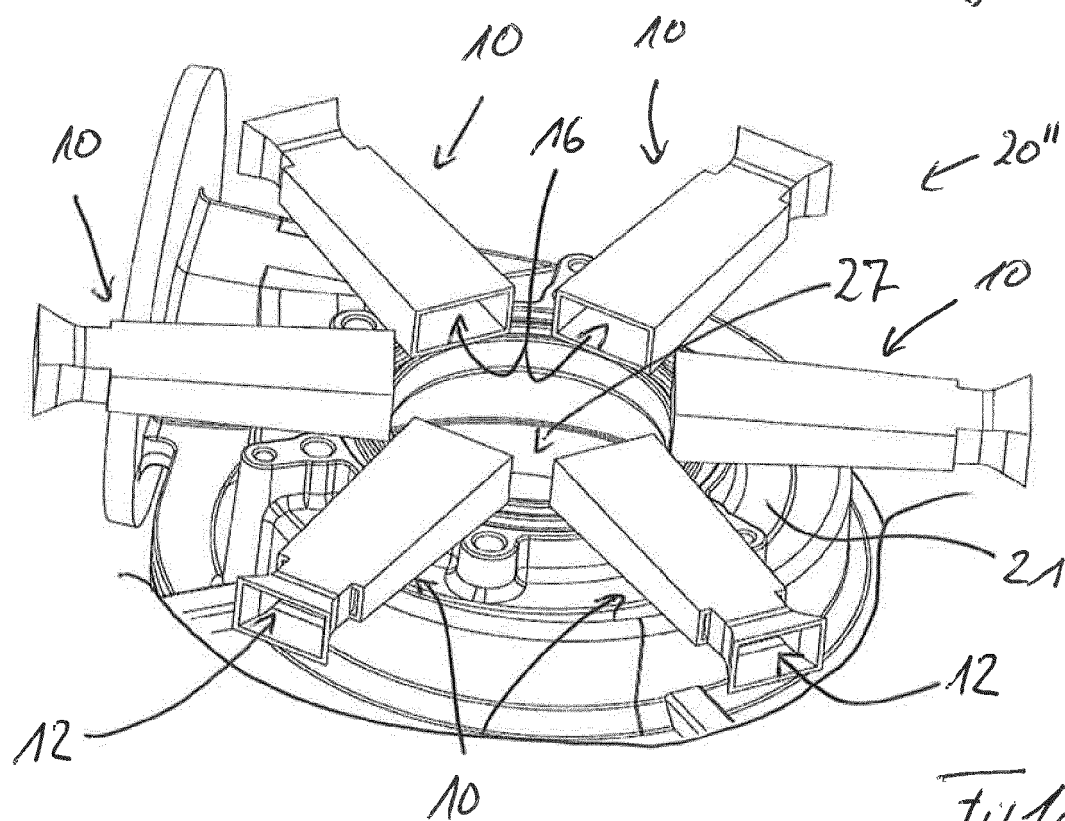


Fig. 11



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 EP 17 17 6034

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Place of search Munich		Date of completion of the search 30 November 2017	Examiner Rudolf, Andreas
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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