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(54) **ADAPTER OF AN ACOUSTIC SYSTEM OF A GAS-DUCTING SYSTEM, ACOUSTIC SYSTEM AND GAS-DUCTING SYSTEM WITH AN ACOUSTIC SYSTEM**

(57) The present invention relates to a gas-ducting system (12), in particular an air-ducting system (12), in particular of an air intake system, in particular of an internal combustion engine, in particular of a motor vehicle. The gas-ducting system (12) comprises an acoustic system (14). The acoustic system (14) has an adapter (20). The adapter (20) comprises a connection pipe section (24) for connecting the adapter (20) to a gas guiding duct (10), in particular a main air guiding duct. Further, the adapter (20) comprises at least two branch pipe sections (26). The branch pipe sections (26) are connected with one end each to the connection pipe section (24). The other end of the branch pipe sections (26) each have at least one part (30) of a fastening means (28) for connecting at least one acoustic device (16, 18).

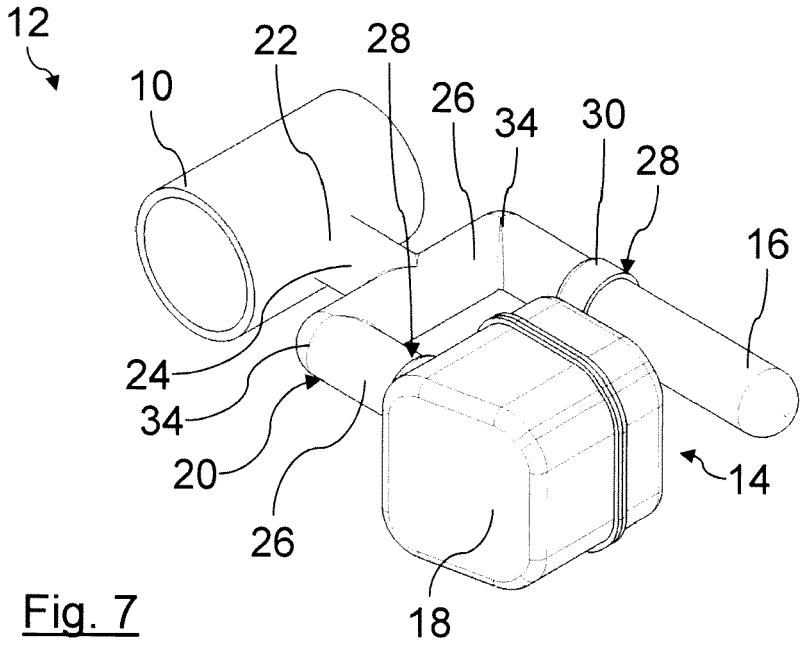

Fig. 7

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Description

Technical Field

[0001] The present invention relates to an adapter of an acoustic system of a gas-ducting system, in particular of an air-ducting system, in particular of an air intake system, in particular of an internal combustion engine, in particular of a motor vehicle.

[0002] The invention further relates to an acoustic system of a gas-ducting system, in particular of an air-ducting system, in particular of an air intake system, in particular of an internal combustion engine, in particular of a motor vehicle.

[0003] The invention besides relates to a gas-ducting system, in particular an air-ducting system, in particular of an air intake system, in particular of an internal combustion engine, in particular of a motor vehicle, comprising an acoustic system.

State of Technology

[0004] The JP 09126074 A discloses an air intake tube of an internal combustion engine. The air intake tube is provided with a tube resonator main tube and a branch tube to be branched therefrom. The main tube is L1 in the path length, while the branch tube is L2 in the path length. The tube resonator has the characteristic that two attenuation peaks are provided at the frequencies which are lower than the frequencies of single tubes of the path length L1 or the path length L2 respectively by about 30 %. The muffling characteristic becomes composite, and the range of the muffling frequency is expanded with the path length L1, L2 as the closest values.

[0005] It is an object of the invention to provide an adapter, an acoustic system and a gas-ducting system of the above-mentioned kind, where a connection of multiple acoustic devices of the acoustic system with a gas guiding duct can of the gas-ducting system be improved and/or simplified.

Disclosure of Invention

[0006] The object is achieved by that the adapter comprises a connection pipe section for connecting the adapter to a gas guiding duct, in particular a main air guiding duct, and at least two branch pipe sections, which are connected with one end each to the connection pipe section, whereby the other end of the branch pipe sections each have at least one part of a fastening means for connecting at least one acoustic device.

[0007] According to the invention, at least two acoustic devices can be combined to the acoustic system. With the adapter, multiple acoustic devices can be connected to the gas guiding duct using only one connection point. Several acoustic devices can be connected each one with its respective branch pipe section. The inventive adapter unifies all connections of acoustic devices of the acoustic system to the gas guiding duct to one connection of the connection pipe section. All individual connections are collected by use of the adapter. Instead of connecting each of these branch pipe sections individually to the gas guiding duct all branch pipe sections are "collected" into only one main connection pipe section. The adapter is a kind of branching device between the gas guiding duct and the acoustic devices.

[0008] Advantageously, the adapter can be used for a modular acoustic system, where different acoustic devices can be combined modular with the gas ducting system.

[0009] By use of the adapter, individual connections of the acoustic devices to the gas guiding duct become unnecessary. So, a number of fixing components such as clamps, spigots, weldings and so on can be reduced. Further, expenditure in manufacturing can be decreased. Besides, the package space can be reduced.

[0010] In addition, an acoustic performance of the acoustic system can be improved by use of the adapter. Particularly, the acoustic performance of the acoustic system with the inventive adapter can be better than an acoustic performance of an acoustic system where the acoustic devices are individually connected to the gas guiding duct.

[0011] Advantageously, at least one branch pipe section and/or the connection pipe section can be realized as a tube, neck or hose. So, the pipe sections easy can be realized.

[0012] Advantageously, at least one branch pipe section and/or the connection pipe section can be straight and/or curved at least partly, in particular over its full length. Advantageously, the adapter, in particular at least one branch pipe section and/or the connection pipe section, and/or at least a part of the gas guiding duct and/or at least a part of at least one acoustic device can contain or consist of plastic and/or composite material.

[0013] Advantageously, the adapter, in particular at least one branch pipe section and/or the connection pipe section, and/or at least a part of the gas guiding duct and/or at least a part of at least one acoustic device can be formed by use of a molding and/or casting process, in particular a blow molding process, an injection (die) molding technique or suchlike.

[0014] Advantageously, the acoustic system can have the function of attenuating the intake noise of the gas guiding system, in particular of an internal combustion engine.

[0015] The invention can be used in combination of automotive ducting of air. The invention can be used with an intake system of an internal combustion engine of a motor vehicle. Especially, it can be used for special applications on low pressure sides of an intake system. The invention can be used in combination with dirty side ducts, air cleaners and/or clean air ducts.

[0016] Favorably, the gas guiding duct can be a main air guiding duct. Advantageously, the air guiding duct can be a clean air duct which can be connected to an air

cleaner.

[0017] The invention can also be used in a technical area beyond automotive engineering. In particular, the invention can be used with industrial engines.

[0018] The invention is not limited to applications for ducting of air. The invention can also be applied for other kinds of gas ducting systems.

[0019] According to a favorable embodiment of the invention, the adapter can comprise or consist of at least one Y-shaped and/or T-shaped and/or different shaped, in particular C-shaped, part.

[0020] Advantageously, the adapter with two branch pipe sections can be Y-shaped. The connection pipe section thereby can form the main leg of the "Y". The two branch pipe sections can form the two branches of the "Y". Alternatively, one of the branch pipe sections can form the main leg.

[0021] Advantageously, the adapter with two branch pipe sections can be T-shaped. The connection section thereby can form the main leg of the "T". The two branch pipe sections can form the horizontal branches of the "T". Alternatively, one connection branch section can form the main leg of the "T". The other branch pipe section and the connection pipe section can form the horizontal branches of the "T".

[0022] Advantageously, the adapter can combine at least one Y-shaped part and/or at least one T-shaped part and/or at least one different shaped, in particular a C-shaped, part.

[0023] According to a further favorable embodiment of the invention, a cross-section, in particular a diameter and/or a form of the cross-section, of the connection pipe section and of at least one branch pipe section can be similar, in particular identical.

[0024] Thus, a homogeneous fluid connection between the connect pipe section and the at least one branch pipe section can be realized.

[0025] Favorably, the diameters of the connection pipe section and the at least one branch pipe section can be similar, in particular identical.

[0026] Alternatively or additionally, the forms of the cross-sections of the connection pipe section and the at least one branch pipe section can be similar, in particular identical.

[0027] Advantageously, at least one branch pipe section and/or the connection pipe section can have a uniform cross-section, in particular a uniform diameter and/or a uniform cross-section profile, at least partly, in particular over its full length.

[0028] According to a further favorable embodiment of the invention, a cross-section, in particular a diameter and/or a form of the cross-section, of the connection pipe section and of at least one branch pipe section can be different.

[0029] Advantageously, the diameters of the connection pipe section and of at least one branch pipe section can be different.

[0030] Favorably, the connection pipe section at least can have the same diameter as the maximum diameter of the individual branch pipe sections.

[0031] Alternatively and/or additionally, the forms of the cross-sections of the connection pipe section and the at least one branch pipe section can be different.

[0032] Advantageously, the forms of the cross-sections of the connection pipe section and at least one branch pipe section can be different and the diameters can be similar, in particular identical.

[0033] Alternatively and/or additionally, the forms of the cross-sections of the connection pipe section and at least one branch pipe section can be similar, in particular identical, and the diameters can be different.

[0034] According to a further favorable embodiment of the invention, at least one branch pipe section can have at least one bypass section.

[0035] The at least one bypass section can have an acoustic function. It can act as a kind of resonator.

[0036] Advantageously, the bypass section can be a C-shaped part of the at least one branch pipe section.

[0037] According to a further favorable embodiment of the invention, at least one end of at least one branch pipe section can comprise at least one part of a fastening means for connecting at least one acoustic device, which is comprising or consisting of at least one resonator, in particular a cavity resonator, particularly a Helmholtz resonator, and/or a side branch resonator and/or a tube resonator, in particular a quarter-wave tube resonator, and/or at least one active acoustic device, in particular at least one acoustic device for an active noise reduction and/or means for an active noise cancellation and/or means for an active noise control.

[0038] Favorably, at least one acoustic device can comprise or consist of at least one resonator, in particular a cavity resonator, particularly a Helmholtz resonator, and/or a side branch resonator and/or a tube resonator, in particular a quarter-wave tube resonator.

[0039] Additionally or alternatively, at least one acoustic device can comprise or consist of at least one active acoustic device, in particular at least one acoustic device for an active noise reduction and/or means for an active noise cancellation and/or means for an active noise control.

[0040] The acoustic devices can be adapted to the needed acoustic function. With different acoustic devices, in particular different kinds of resonators, the acoustic function can be adapted to an occurrent noise frequency range.

[0041] According to a further favorable embodiment of the invention, at least one end of at least one branch pipe section can have at least one part of a fastening means for connecting at least one acoustic device, which is different from a side branch resonator and/or a tube resonator, in particular different from a quarter-wave tube resonator. By use of different noise attenuation techniques, an acoustic function of the acoustic system can be widened.

[0042] Advantageously, at least one end of at least one

branch pipe section can have at least one part of a fastening means for connecting at least one cavity resonator and/or at least one active acoustic device.

[0043] According to a further favorable embodiment of the invention, at least one end of the adapter, in particular of the connection pipe section and/or of at least one branch pipe section, can comprise at least parts of a fastening means for a nondestructive removable or not nondestructive removable, one-piece or multipart connection, in particular a material bonding connection and/or positive connection and/or a friction connection, particularly a bolted connection, a plug connection, a kind of a bayonet joint, a clamping connection, a welding connection and/or a pressing connection or the like, of said end of the adapter with a connection point of the gas guiding duct or a connection point, in particular a part of the fastening means, of at least one acoustic device.

[0044] Advantageously, the connection pipe section can be connected to the gas guiding duct by means of any of the existing connection technologies, in particular by clamping, welding, pressing and so on.

[0045] Advantageously, the adapter, in particular the connection pipe section, and the gas guiding duct on one hand and/or the adapter, in particular at least one branch pipe section, and at least one acoustic device on the other hand can be connected in one-piece.

[0046] Advantageously, the adapter and the gas guiding duct on one hand and/or the adapter and at least one acoustic device on the other hand can be obtained by use of the same production technique and/or by use of the same tool for manufacturing. Thus, an additional connection between the adapter and the gas guiding duct and/or between the adapter and the at least one acoustic device can be avoided. So, expenditure in manufacturing, purchased parts and so on can be reduced.

[0047] The object further is achieved by the acoustic system in that, the acoustic system has an adapter which comprises a connection pipe section for connecting the adapter to a gas guiding duct, in particular a main air guiding duct, and at least two branch pipe sections, which are connected with one end each to the connection pipe section, whereby the other end of the branch pipe sections each have at least one part of a fastening means for connecting at least one acoustic device.

[0048] Besides, the object is achieved by the gas-ducting system in that, the acoustic system has an adapter which comprises a connection pipe section for connecting the adapter to a gas guiding duct, in particular a main air guiding duct, and at least two branch pipe sections, which are connected with one end each to the connection pipe section, whereby the other end of the branch pipe sections each have at least one part of a fastening means for connecting at least one acoustic device.

[0049] The above-mentioned advantages and characteristic features of the inventive adapter, the inventive acoustic system and the inventive gas-ducting system apply analogously among each other. The single advantages and characteristic features can be combined among each other.

Brief Description of Drawings

[0050] The present invention together with the above-mentioned and other objects and advantages may best be understood from the following detailed description of the embodiments, but not restricted to the embodiments, wherein is shown schematically

figure 1 a main air guiding duct of an air intake system of an internal combustion engine of a motor vehicle with an acoustic system according to a first embodiment, whereby a side branch resonator and a cavity resonator are connected by a Y-shaped adapter to the main air guiding duct;
figure 2 a longitudinal section of the main air guiding duct with the acoustic system of figure 1;
figure 3 a detailed view of the adapter of figure 1;
figure 4 a main air guiding duct with an acoustic system according to a second embodiment, whereby the adapter is T-shaped;
figure 5 a longitudinal section of the of the main air guiding duct with the acoustic system of figure 4;
figure 6 a detailed view of the adapter of figure 4;
figure 7 a main air guiding duct with an acoustic system according to a third embodiment, whereby the adapter has an alternative T-shaped form;
figure 8 a longitudinal section of the main air guiding duct with the acoustic system of figure 7;
figure 9 a detailed view of the adapter of figure 7;
figure 10 a main air guiding duct with an acoustic system according to a fourth embodiment, whereby the adapter has a combination of T-shaped and C-shaped form with a bypass;
figure 11 a longitudinal section of the main air guiding duct with the acoustic system of figure 10;
figure 12 a detailed view of the adapter of figure 10.

[0051] In the drawings, equal or similar elements are referred to by equal reference numerals. The drawings are merely schematic representations, not intended to portray specific parameters of the invention. Moreover, the drawings are intended to depict only typical embodiments of the invention and therefore should not be considered as limiting the scope of the invention.

Embodiment(s) of Invention

[0052] In figures 1 and 2 a main air guiding duct 10 of an air intake system 12 of an internal combustion engine of a motor vehicle with an acoustic system 14 according to a first embodiment is shown. The function of the acoustic system 14 is to attenuate the intake noise of the internal combustion engine. The main air guiding duct 10 is

connecting a not shown air filter with the not shown cylinders of the internal combustion engine. Exemplary, the main air guiding duct 10 can be a clean air duct. It can be located on the low pressure side of the intake system.

[0053] The acoustic system 14 comprises two acoustic devices, namely a side branch resonator 16 and a cavity resonator 18, and an adapter 20 for connecting the side branch resonator 16 and the cavity resonator 18 with the main air guiding duct 10 at one connection point 22.

[0054] A detailed view of the adapter 20 is shown in figure 3. The adapter 20 comprises a connection pipe section 24 for connecting the adapter 20 to the main air guiding duct 10. Further, the adapter 20 has two branch pipe sections 26 for connecting the side branch resonator 16 and the adapter 20.

[0055] The adapter 20 is Y-shaped. The connection pipe section 24 thereby forms the main leg of the "Y". The two branch pipe sections 26 form the two branches of the "Y". The branch pipe section 26 which is connected to the cavity resonator 18 is in line with the connection pipe section 24. The branch pipe section 26 which is connected to the side branch resonator 16 runs inclined to the connection pipe section 24.

[0056] The connection pipe section 24 and the branch pipe sections 26 are realized as tubes each. The connection pipe section 24 and the branch pipe sections 26 are straight over their full lengths each. The branch pipe sections 26 and the connection pipe section 24 have uniform diameters and uniform cross-section profiles over there full lengths each. The diameters and forms of the cross-sections of the connection pipe section 24 and of the branch pipe sections 26 are similar.

[0057] The branch pipe sections 26 are one-piece connected with one end each to the connection pipe section 24. The connection pipe section 24 is one-piece connected to the main air guiding duct 10. The main air guiding duct 10 and the adapter 20 are formed in one piece of plastic. One-piece connections are material bond connections, which are not nondestructive removable. In total, the main air guiding duct 10 and the adapter 20 are made in one piece. The adapter 20 and the main air guiding duct 10 being obtained by use of the same production technique, for example an injection molding process or a blow molding process, with the same tool for manufacturing.

[0058] The side branch resonator 16 and the cavity resonator 18 are connected to the corresponding branch pipe sections 26 each by use of an according fastening means 28. Exemplary, the fastening means 28 are plug-in connections each. A plug-in connection is a multipart friction connection, which is nondestructive removable. The ends of the of the branch pipe sections 26 which are averted to the connection pipe section 24 each have a female connector 30 of the corresponding fastening means 28.

[0059] The cavity resonator 18 exemplary is a Helmholtz resonator. The side branch resonator 16 exemplary is a quarter-wave tube resonator. The cavity resonator 18 and the side branch resonator 16 have a connection point in form of a plug connector 32 each. The plug connectors 32 are parts of the fastening means 28 and correspond to the respective female connectors 30 of the branch pipe sections 26.

[0060] Figures 4 to 6 depict a main air guiding duct 10 with an acoustic system 14 according to a second embodiment. Those parts which are equal to those of the first embodiment according to figures 1 to 3 have the same reference numbers. Different to the first embodiment, in the second embodiment the adapter 20 with two branch pipe sections 26 is T-shaped. The branch pipe section 26 which is connected to the side branch resonator 16 thereby forms the main leg of the "T". The branch pipe section 26 which is connected to the cavity resonator 18 and the connection pipe section 24 form the horizontal branches of the "T".

[0061] The branch pipe section 26 which is connected to the cavity resonator 18 is in line with the connection pipe section 24. The connection branch section which is connected to the side branch resonator 16 runs perpendicular to the connection pipe section 24.

[0062] Figures 7 to 9 depict a main air guiding duct 10 with an acoustic system 14 according to a third embodiment. Those parts which are equal to those of the first embodiment according to figures 1 to 3 have the same reference numbers. Different to the first embodiment, in the third embodiment the adapter 20 is T-shaped. The branch pipe section 26 thereby forms the main leg of the "T". The two branch pipe section 26 form the horizontal branches of the "T".

[0063] Each branch pipe section 26 has an elbow 34 with a bend by 90°. On the sides of the elbows 34 facing the connection pipe section 24, the branch pipe sections 26 run in-line and perpendicular to the connection pipe section 24. On the side of the elbows 34 averted to the connection pipe section 24, the branch pipe sections 26 run parallel to each other and parallel to the connection pipe section 24 away from the main air guiding duct 10.

[0064] Figures 10 to 12 depict a main air guiding duct 10 with an acoustic system 14 according to a fourth embodiment. Those parts which are equal to those of the second embodiment according to figures 2 to 6 have the same reference numbers. Different to the second embodiment, in the fourth embodiment the T-shaped adapter 20 is combined with a C-shaped part. The branch pipe section 26 with the cavity resonator 18 has a C-shaped bypass section 36. The bypass section 36 has a further acoustic function.

[0065] According to a not shown fifth embodiment of the invention, the section pipe section has a bigger diameter as the maximum diameter of the individual branch pipe sections.

[0066] According to a not shown sixth embodiment of the invention, the forms of the cross-sections of the connection pipe section and the branch pipe sections are different.

[0067] According to a not shown seventh embodiment

of the invention, the forms of the cross-sections of the connection pipe section and the branch pipe sections are different and the diameters are similar, exemplary identical.

[0068] According to a not shown eighth embodiment of the invention, the forms of the cross-sections of the connection pipe section and the branch pipe sections are similar, exemplary identical, and the diameters are different.

[0069] According to a not shown ninth embodiment of the invention, a cross-section, exemplary a diameter and/or a form of the cross-section, of the branch pipe sections are different.

Claims

1. Adapter (20) of an acoustic system (14) of a gas-ducting system (12), in particular of an air-ducting system, in particular of an air intake system, in particular of an internal combustion engine, in particular of a motor vehicle, wherein the adapter (20) comprises a connection pipe section (24) for connecting the adapter (20) to a gas guiding duct (10), in particular a main air guiding duct, and at least two branch pipe sections (26), which are connected with one end each to the connection pipe section (24), whereby the other end of the branch pipe sections (26) each have at least one part (30) of a fastening means (28) for connecting at least one acoustic device (16, 18).

2. Adapter according to claim 1, **characterized in that** the adapter (20) comprises or consists of at least one Y-shaped and/or T-shaped and/or different shaped, in particular C-shaped, part.

3. Adapter according to claim 1 or 2, **characterized in that** a cross-section, in particular a diameter and/or a form of the cross-section, of the connection pipe section (24) and of at least one branch pipe section (26) is similar, in particular identical.

4. Adapter according to one of the previous claims, **characterized in that** a cross-section, in particular a diameter and/or a form of the cross-section, of the connection pipe section (24) and of at least one branch pipe section (26) is different.

5. Adapter according to one of the previous claims, **characterized in that** at least one branch pipe section (26) has at least one bypass section (36).

6. Adapter according to one of the previous claims, **characterized in that** at least one end of at least one branch pipe section (26) comprises at least one part (30) of a fastening means (28) for connecting at least one acoustic device (16, 18), which is comprising or consisting of at least one resonator, in particular a cavity resonator, particularly a Helmholtz resonator (18), and/or a side branch resonator (16) and/or a tube resonator, in particular a quarter-wave tube resonator, and/or at least one active acoustic device, in particular at least one acoustic device for an active noise reduction and/or means for an active noise cancellation and/or means for an active noise control.

7. Adapter according to one of the previous claims, **characterized in that** at least one end of at least one branch pipe section (26) has at least one part (30) of a fastening means (28) for connecting at least one acoustic device (18), which is different from a side branch resonator and/or a tube resonator, in particular different from a quar-ter-wave tube resonator.

8. Adapter according to one of the previous claims, **characterized in that** at least one end of the adapter (20), in particular of the connection pipe section (24) and/or of at least one branch pipe section (26), comprises at least parts (30) of a fastening means (28) for a nondestructive removable or not nondestructive removable, one-piece or multipart connection, in particular a material bonding connection and/or positive connection and/or a friction connection, particularly a bolted connection, a plug connection, a kind of a bayonet joint, a clamping connection, a welding connection and/or a pressing connection or the like, of said end of the adapter (20) with a connection point (22) of the gas guiding duct (10) or a connection point, in particular a part (32) of the fastening means (28), of at least one acoustic device (16, 18).

9. Acoustic system (14) of a gas-ducting system (12), in particular of an air-ducting system (12), in particular of an air intake system, in particular of an internal combustion engine, in particular of a motor vehicle, **characterized in that** the acoustic system (14) has an adapter (20), in particular an adapter (20) according to one of the previous claims, which comprises a connection pipe section (24) for connecting the adapter (20) to a gas guiding duct (10), in particular a main air guiding duct, and at least two branch pipe sections (26), which are connected with one end each to the connection pipe section (24), whereby the other end of the branch pipe sections (26) each have at least one part (30) of a fastening means (28) for connecting at least one acoustic device (16, 18).

10. Gas-ducting system (12), in particular an air-ducting system (12), in particular of an air intake system, in particular of an internal combustion engine, in particular of a motor vehicle, comprising an acoustic system (14), in particular according to claim 9, **characterized in that** the acoustic system (14) has an

adapter (20), in particular according to one of the claims 1 to 8, which comprises a connection pipe section (24) for connecting the adapter (20) to a gas guiding duct (10), in particular a main air guiding duct, and at least two branch pipe sections (26), which are connected with one end each to the connection pipe section (24), whereby the other end of the branch pipe sections (26) each have at least one part (30) of a fastening means (28) for connecting at least one acoustic device (16, 18).

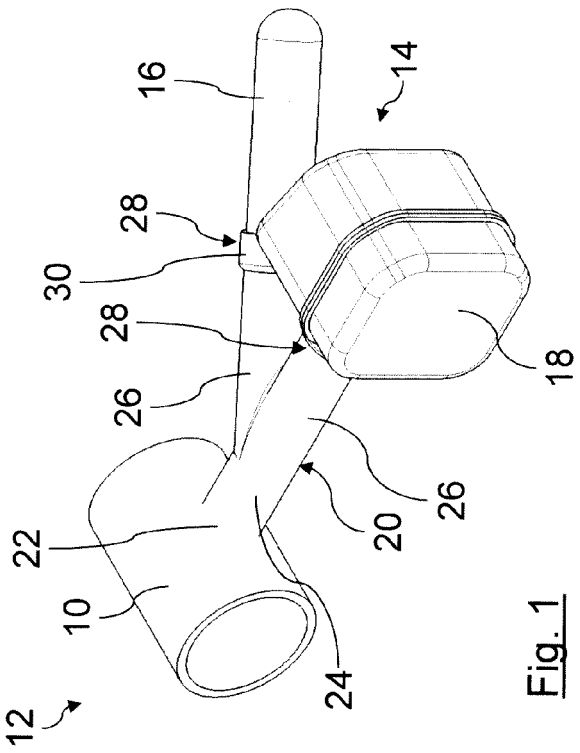

Fig. 1

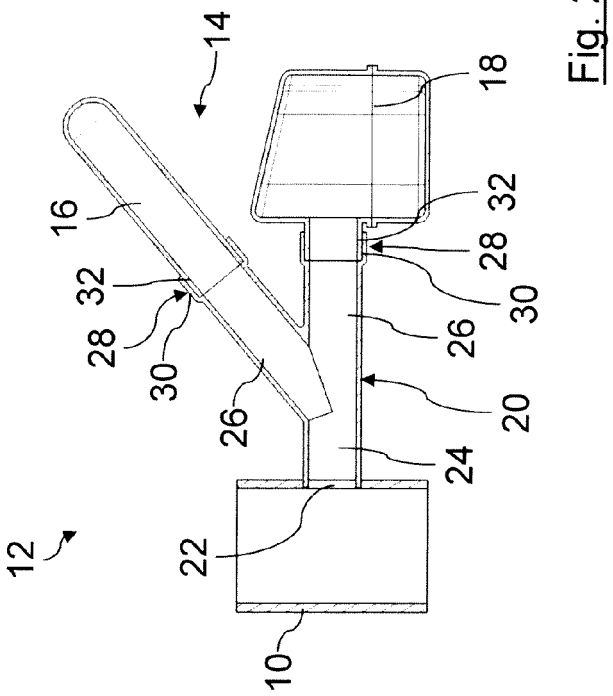

Fig. 2

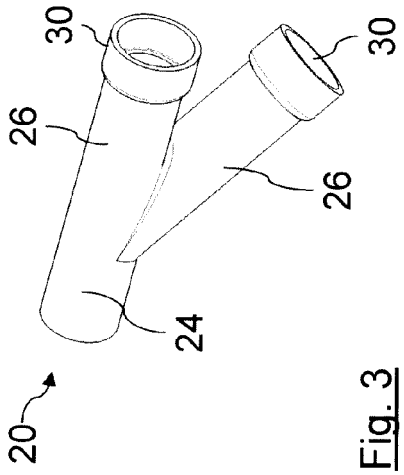

Fig. 3

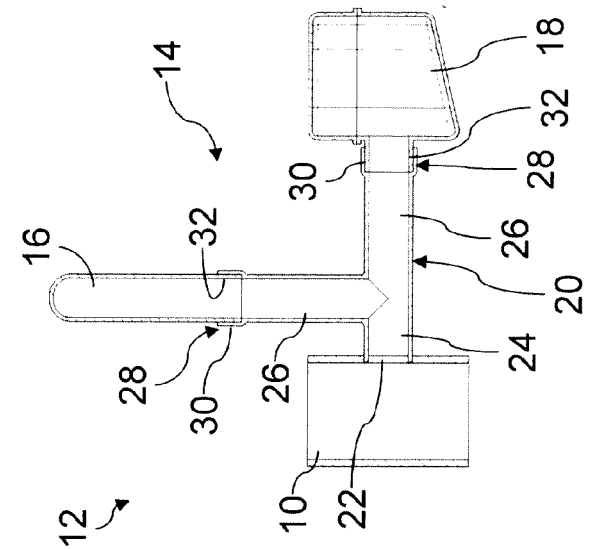

Fig. 5

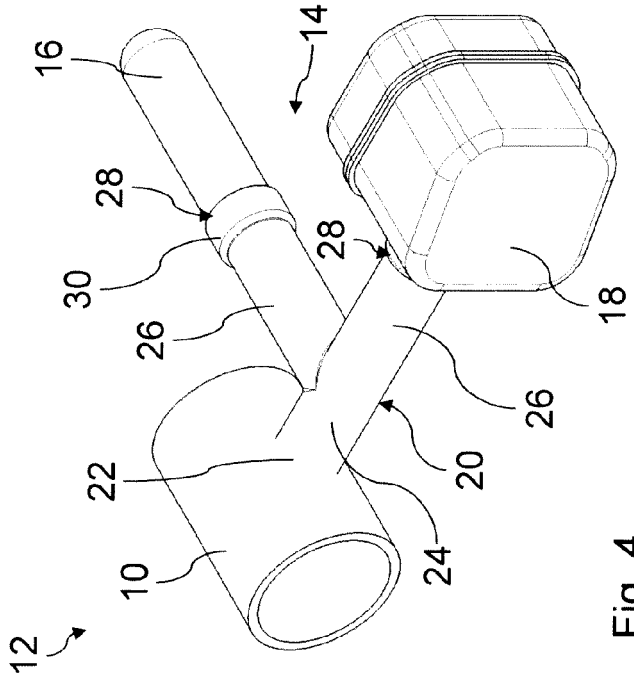

Fig. 4

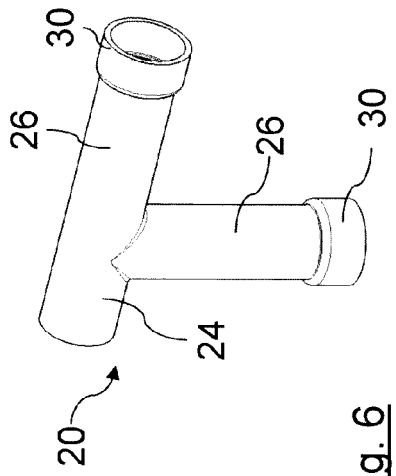

Fig. 6

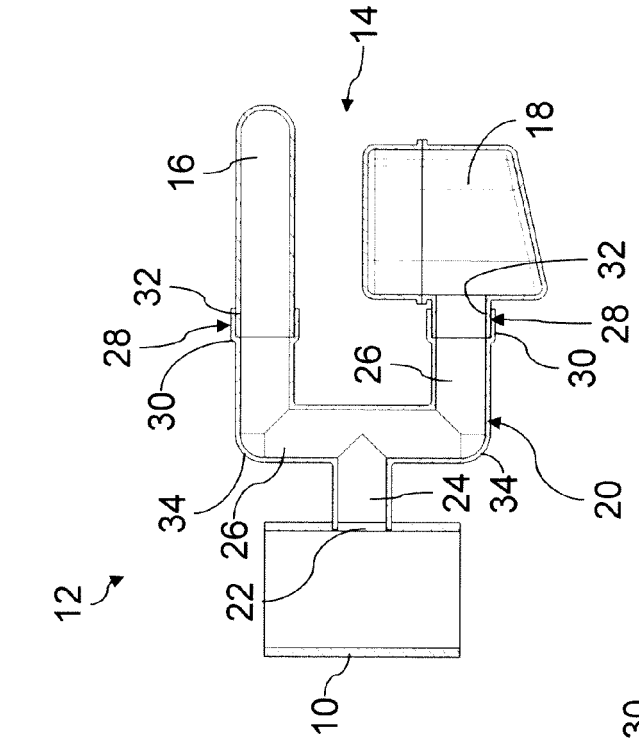

Fig. 8

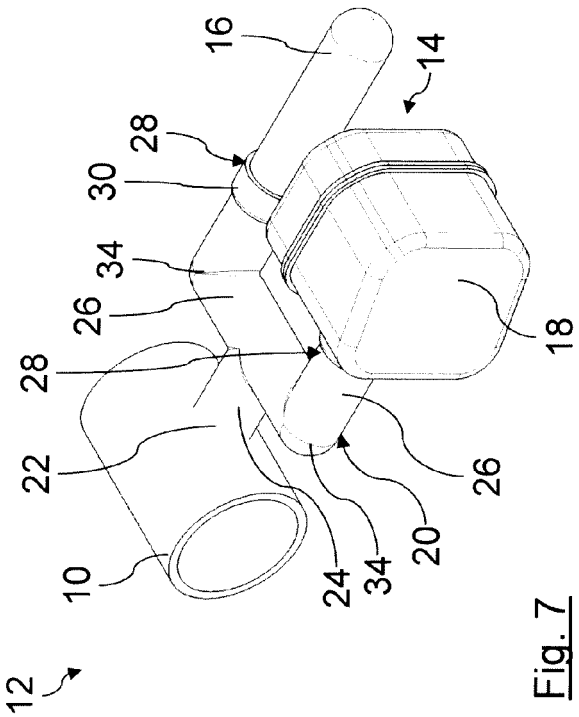

Fig. 7

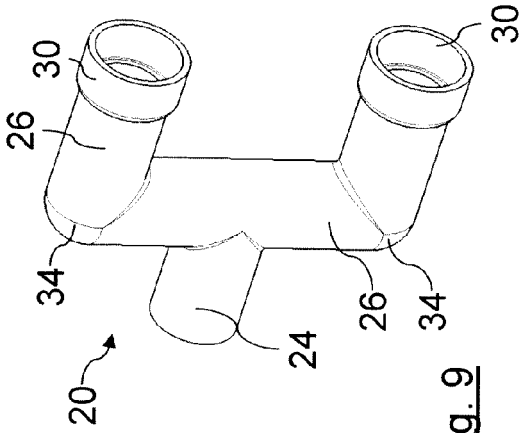

Fig. 9

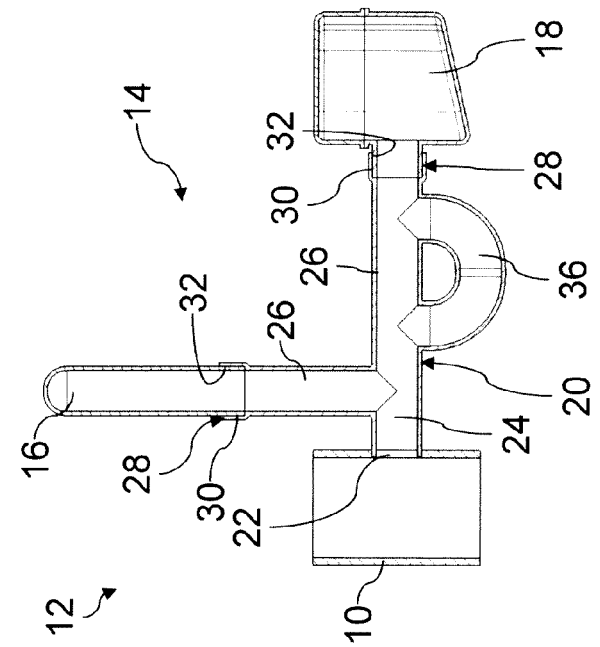

Fig. 11

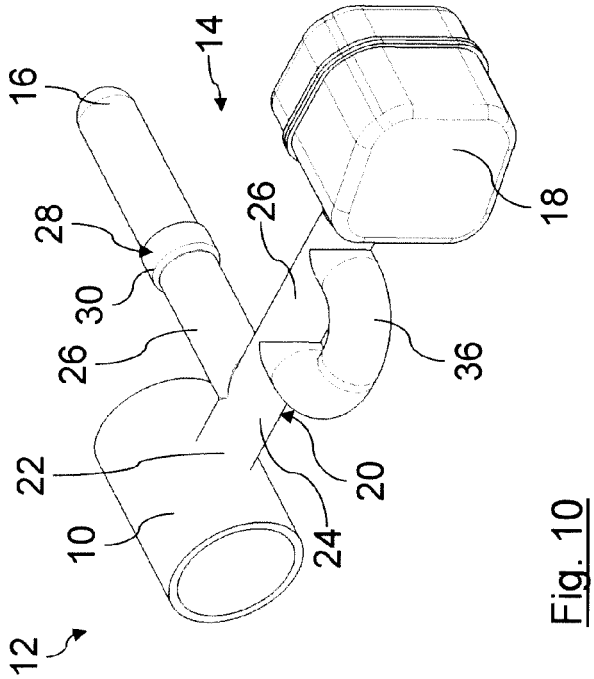

Fig. 10

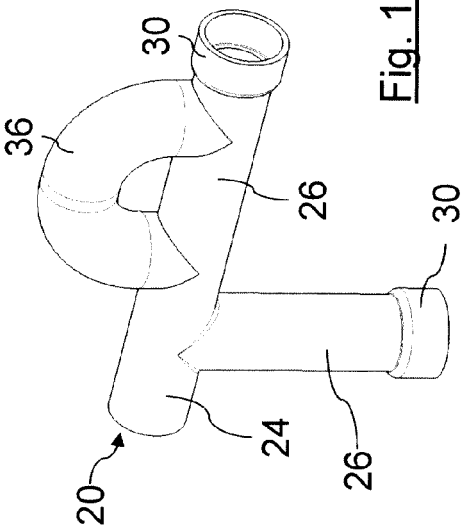

Fig. 12

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 January 2016	Juvenelle, Cyril

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