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(54) **A VEHICLE**

(57) A vehicle comprising an internal combustion engine, an exhaust system for discharging exhaust gasses from the internal combustion engine, an exhaust after treatment system for treating exhaust gasses from the internal combustion engine , and an exhaust tract connecting the internal combustion engine to the exhaust after treatment system for transferring exhaust gasses from the internal combustion engine to the exhaust after treatment system, the exhaust tract (5) comprising a first exhaust tube (6) connected to the internal combustion engine, a second exhaust tube (7) connected to the exhaust after treatment system, and a flexible tube (8) interconnecting the first and the second exhaust tube (7), the exhaust tract (5) comprising an inner tube (9, 9') having a first inner tube end (10) and a second inner tube end (11), the first inner tube end (10) being connected to an inner side (8A) of the first exhaust tube (6), the second inner tube end (11) being arranged at a position inside the flexible tube (8) and being spaced from an inner side (8A) of the flexible tube (8), the first inner tube end (10) having a larger diameter than the second inner tube end (11), the inner tube (9, 9') comprising a conical wall portion (12) extending from the first inner tube end (10), the conical wall portion (12) being provided with perforations (13), the exhaust after treatment system further comprising a reduction agent injector upstream of the flexible tube (8), whereby the inner tube (9, 9') comprises a cylindrical tubular section (15) extending from a downstream end of the conical wall portion (12) to the second inner tube end (11), the free end of the cylindrical tubular section (15) forming the second inner tube end (11), and in that the flexible tube (8) is slanted in a downwards direction. The upper portion of the free end of the cylindrical tubular section (15) comprises a guiding surface directed downwards which provides heating up the lower part of the inner wall for reducing deposition of the reducing agent thereon.

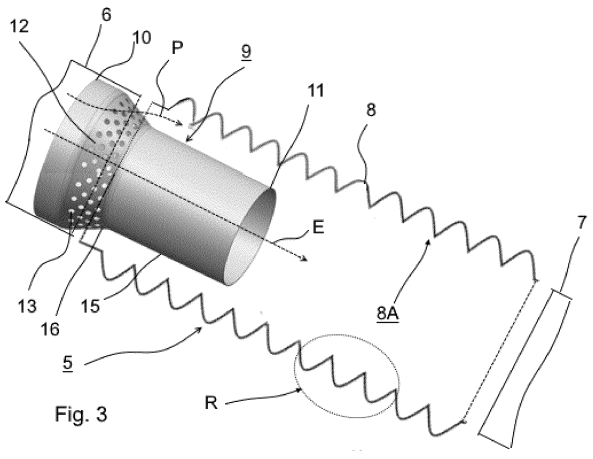

Fig. 3

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Description

[0001] The invention relates to a vehicle according to the preamble of claim 1.

[0002] Such a vehicle is for example known from EP2719873B1. In the known vehicle the flexible tube interconnecting the first and the second exhaust tubes decouples vibrations between the first and the second exhaust tubes, i.e. vibrations between the internal combustion engine and the exhaust gas after treatment system will decoupled. The inner tube comprising a conical wall portion is a perforated conical flow guide and exhaust gasses and reduction agent can flow both longitudinally through the conical flow guide and through the perforations in the wall. As a result of the high temperature of the exhaust gasses the conical flow guide, the inner wall of the flexible tube and the reduction agent are heated and due to the conical flow guide the exhaust gasses containing the reduction agent are thoroughly mixed and thereby deposition of reduction agent in a crystallized form on the inner wall of the flexible tube is reduced. However, it has appeared that in particular with heavy goods vehicles in which the relative displacement between internal combustion engine and exhaust after treatment system is rather large and in which e.g. due to construction the distance between internal combustion engine and exhaust gas after treatment system is rather large a relatively long flexible tube is required. In particular when the internal combustion engine is arranged in a position at a higher level with regard to the exhaust gas after treatment system and as a result the flexible tube slants downwards it has appeared that reduction agent can still crystallize on the inner wall of the relatively large flexible tube when no additional measures are taken, thereby amongst other things reducing the flexibility of the flexible tube. This could undesirably lead to transfer of vibrations from the internal combustion engine to the exhaust gas after treatment system.

[0003] It is thus an object of the present invention to provide an alternative solution in which crystallization of reduction agent on the inner wall of a flexible tube can be further reduced.

[0004] In order to achieve this object the invention provides a vehicle according to claim 1. The present invention is based on the insight that in the known vehicle the perforated conical flow guide only heats up the portion of the inner wall of the flexible tube adjacent the conical flow guide and that portions of the inner wall of the flexible tube more downstream of the conical flow guide are less heated, which could result in deposition of reduction agent in crystallized form. In particular when longer flexible tubes are used this deposition in more downstream portions of the flexible tube can be pronounced. Although it would be possible to dimension the conical wall portion such that its downstream end extends into the second exhaust tube in order to overcome said problem in case long flexible tubes which slant downwards are used this could, during vibrations of the vehicle, lead to the lengthened conical wall portion undesirably hitting the inner wall of the flexible tube, which could lead to damage to the flexible tube. By according to the invention using a cylindrical tubular section of which the free end forms the second inner tube end, i.e. the free end only extends within the flexible tube and does not extend into the second exhaust tube, on the one hand it appears that the inner wall of the flexible tube can be sufficiently heated over a sufficient length thereof to reduce deposition of reduction agent thereon, while on the other hand it can be prevented that the cylindrical tube hits the inner wall of the flexible tube during vibrations of the vehicle. Depending on the angle of the flexible tube slanting downwards there might be a risk of deposition of reduction agent on a lower part of the inner wall of the flexible tube. As a result of the guiding surface hot exhaust gas is directed downwards to this lower part of the inner wall of the flexible tube thereby heating up this lower part as a result of which deposition of reduction agent thereon is reduced.

[0005] In a further embodiment of a vehicle according to the invention the length of the conical wall portion is between 15 % and 25 % of the total inner tube length. In a further embodiment of a vehicle according to the invention the perforations have a diameter of 4 mm $\pm$ 50% and cover 18 $\pm$ 10% of the surface area of the conical wall portion. By these measures exhaust gasses and reduction agent can flow through the perforations in the conical wall portion and be efficiently mixed as a result of which the inner wall of the flexible tube is efficiently heated up thereby reducing deposition of reduction agent in a crystallized form on the inner wall of the flexible tube.

[0006] The invention will be further explained with reference to the Figures, in which non-limiting exemplary embodiments of a according to the invention are shown:

Figure 1 schematically shows an embodiment of vehicle with an internal combustion engine and an exhaust tract according to the invention in a side view;
Figure 2 schematically shows an enlarged part of Fig. 1;
Figure 3 schematically shows an inner tube according to an embodiment of a vehicle according to the invention; and
Figure 4 schematically shows an inner tube according to another embodiment of a vehicle according to the invention.

[0007] In Figure 1 an embodiment of a vehicle 1 according to the invention is schematically shown. The vehicle 1 comprises an internal combustion engine 2, an exhaust system 3 for discharging exhaust gasses from the internal combustion engine 2 and an exhaust after treatment system 4 for treating exhaust gasses from the internal combustion engine 2. An exhaust tract 5 connects the internal combustion engine 2 to the exhaust after treatment system 4 for transferring exhaust gasses from the internal combustion engine 2 to the exhaust after treatment system 4 and comprises a first exhaust tube 6

(see Figs. 2 and 3) connected to the internal combustion engine 2, a second exhaust tube 7 connected to the exhaust after treatment system 4 and a flexible tube 8 interconnecting the first and the second exhaust tubes 6, 7. The exhaust after treatment system 4 also comprising a reduction agent injector 4A upstream of the flexible tube 8, which reduction agent injector 4A is connected to a supply 4B of reduction agent.

[0008] As shown in Figure 3 the exhaust tract 5 comprises an inner tube 9 having a first inner tube end 10 and a second inner tube end 11. The first inner tube end 10 is connected to an inner side of the first exhaust tube 6 and the second inner tube end 11 is arranged at a position inside the flexible tube 8 and is spaced from an inner side 8A of the flexible tube 8. The first inner tube end 10 has a larger diameter than the second inner tube end 11.

[0009] The inner tube 9 has a conical wall portion 12 extending from the first inner tube end 10. The conical wall portion 12 is provided with perforations 13 so that exhaust gasses and reduction agent can flow longitudinally (indicated by arrow E) through the innertube 9 and thus through the conical wall portion 12 as well as through the perforations 13 in the conical wall portion 12 as indicated by arrow P. The perforations 13 have a diameter between XX mm and YY mm.

[0010] According to the invention the inner tube 9 comprises a cylindrical tubular section 15 extending from a downstream end 16 of the conical wall portion 12 to the second inner tube end 11, the free end of the cylindrical tubular section 15 forming the second inner tube end 11. The free end of the cylindrical tubular section 15 thus ends well before the second exhaust tube 7. Hereby on the one hand that the inner wall 8A of the flexible tube 8 can be sufficiently heated over a sufficient length thereof to reduce deposition of reduction agent thereon while on the other hand it can be prevented that the cylindrical tube 11 hits the inner wall 8A of the flexible tube 8 during operating conditions of the vehicle 1.

[0011] Depending on the angle of the flexible tube 8 slanting downwards and also the length of the flexible tube 8 there might be a risk of deposition of reduction agent on a lower part R of the inner wall 8A of the flexible tube 8 as indicated in Figure 3. In the embodiment as shown in Figure 4 the inner tube 9' has a cylindrical tubular section 15' of which an upper portion 15A' of the free end of the cylindrical tubular section 15' comprises a guiding surface 17 directed downwards so that the lower part area R of the inner wall 8A of the flexible tube 8 can be heated up sufficiently to reduce deposition of reduction agent thereon.

[0012] In both the embodiments shown in Figures 3 and 4 the length of the conical wall portion 12 is between 15 % and 25 % of the total inner tube length and the perforations 13 have a diameter of 4 mm ± 50% and cover 18 ± 10% of the surface area of the conical wall portion 12.

Claims

1. A vehicle (1) comprising an internal combustion engine (2), an exhaust system (3) for discharging exhaust gasses from the internal combustion engine (2), an exhaust after treatment system (4) for treating exhaust gasses from the internal combustion engine (2), and an exhaust tract (5) connecting the internal combustion engine (2) to the exhaust after treatment system (4) for transferring exhaust gasses from the internal combustion engine (2) to the exhaust after treatment system (4), the exhaust tract (5) comprising a first exhaust tube (6) connected to the internal combustion engine (2), a second exhaust tube (7) connected to the exhaust after treatment system (4), and a flexible tube (8) interconnecting the first and the second exhaust tube (7), the exhaust tract (5) comprising an inner tube (9, 9') having a first inner tube end (10) and a second inner tube end (11), the first inner tube end (10) being connected to an inner side (8A) of the first exhaust tube (6), the second inner tube end (11) being arranged at a position inside the flexible tube (8) and being spaced from an inner side (8A) of the flexible tube (8), the first inner tube end (10) having a larger diameter than the second inner tube end (11), the inner tube (9, 9') comprising a conical wall portion (12) extending from the first inner tube end (10), the conical wall portion (12) being provided with perforations (13), the exhaust after treatment system (4) further comprising a reduction agent injector (4A) upstream of the flexible tube (8), **characterized in that** the inner tube (9, 9') comprises a cylindrical tubular section (15, 15') extending from a downstream end of the conical wall portion (12) to the second inner tube end (11), the free end of the cylindrical tubular section (15, 15') forming the second inner tube end (11), and **in that** the flexible tube (8) is slanted in a downwards direction, wherein an upper portion (15A') of the free end of the cylindrical tubular section (15') comprises a guiding surface (17) directed downwards.

2. A vehicle (1) according to claim 1, wherein the length of the conical wall portion (12) is between 15 % and 25 % of the total inner tube length.

3. A vehicle (1) according to claim 1 or 2, wherein the perforations (13) have a diameter of 4 mm ± 50% and cover 18 ± 10% of the surface area of the conical wall portion (12).

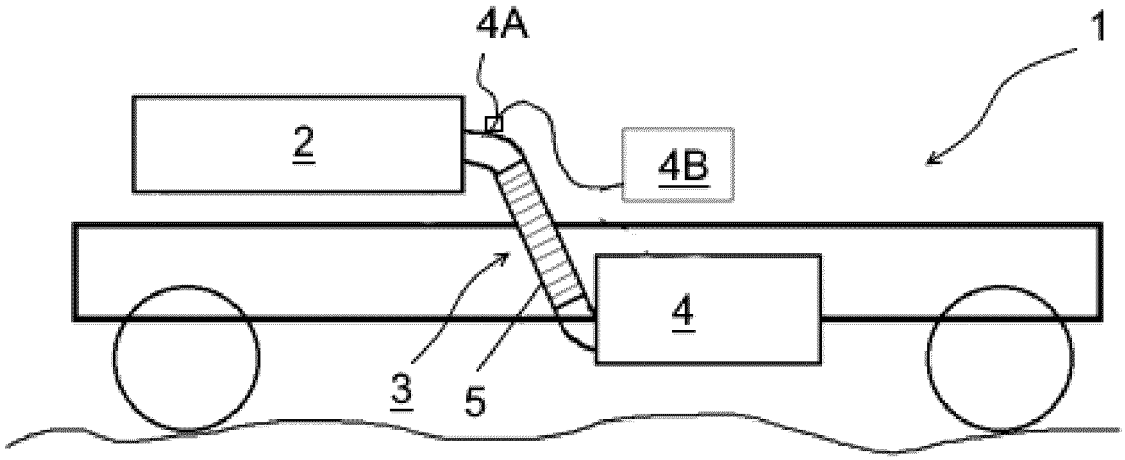

Fig. 1

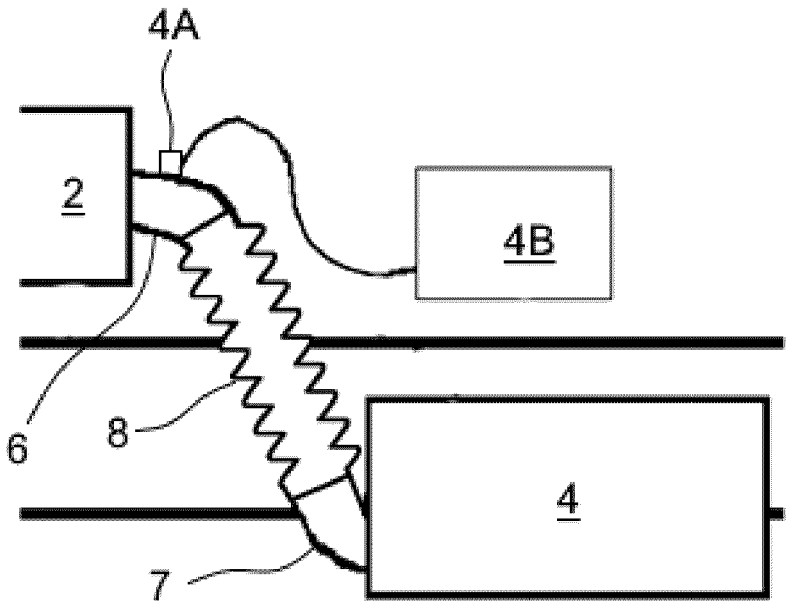

Fig. 2

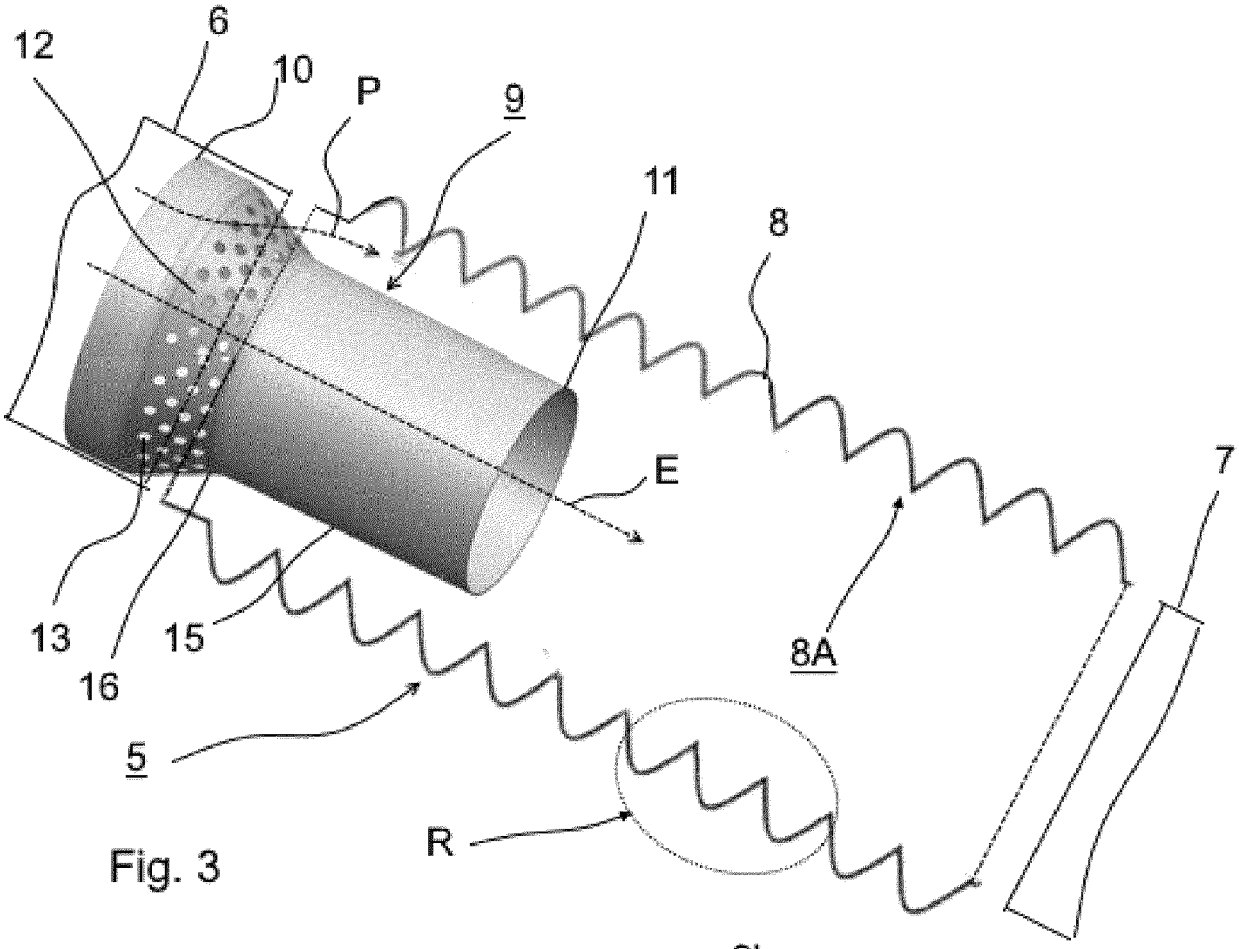

Fig. 3

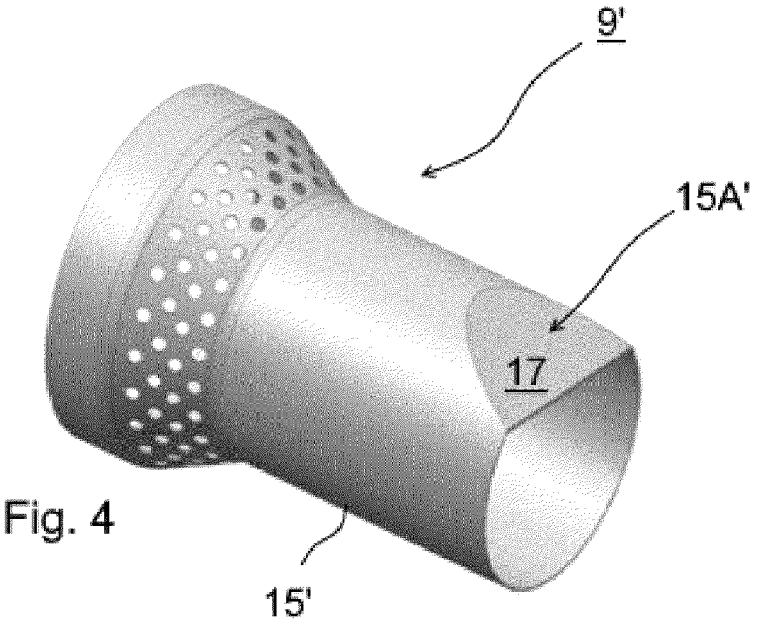

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 24 18 1760

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2005/103459 A1 (DAIMLER CHRYSLER AG [DE]; KERRES WILHELM [DE] ET AL.) 3 November 2005 (2005-11-03) * page 6, line 31 - page 9, line 11; figure 1 *	1-3	INV. F01N3/20
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			F01N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 September 2024	Kolland, Ulrich

CATEGORY OF CITED DOCUMENTS

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REFERENCES CITED IN THE DESCRIPTION

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