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(71) **Applicant**: **SCANIA CV AB** [SE/SE]; S-151 87 Södertälje (SE).

(72) **Inventor**: **PERSSON, Kenneth**; Kvistgränd 8, S-179 62 Stenhamra (SE).

(74) **Agent**: **FORSELL, Hans**; Scania CV AB, S-151 87 Södertälje (SE).

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(54) **Title**: EXHAUST GAS AFTERTREATMENT SYSTEM AND MOTOR VEHICLES COMPRISING SUCH AN AFTER-TREATMENT SYSTEM

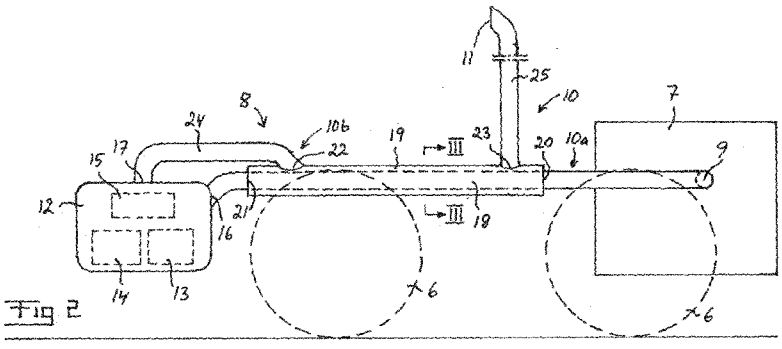


Fig 2

(57) **Abstract**: Exhaust after-treatment system for a motor vehicle, comprising: an exhaust pipe (10), an exhaust after-treatment device (12) arranged in the exhaust pipe, a first exhaust channel (10a) entering into the exhaust pipe, connected to the exhaust after-treatment device's inlet (16), and a second exhaust channel (10b) entering into the exhaust pipe, which is connected to the exhaust after-treatment device's outlet (17) and leads the outward-flowing exhausts from this outlet further in the direction toward the exhaust pipe's exhaust outlet (11). The second exhaust channel (10b) comprises a channel section (19) which extends along and surrounds a channel section (18) in the first exhaust channel (10a), whereby the direction of the exhaust flow in the said channel section (19) of the second exhaust channel is the opposite of the direction of the exhaust flow in the said channel section (18) of the first exhaust channel.

WO 2014/055009 A1

Exhaust gas after-treatment system and motor vehicles comprising such an after-treatment system

FIELD OF THE INVENTION AND PRIOR ART

The present invention relates to an exhaust after-treatment system according to the preamble of patent claim 1. The invention also relates to a motor vehicle comprising such an exhaust after-treatment system.

In a conventional truck, a combustion engine and a cab unit with space for a driver are located in the front section of the truck. From the combustion engine, exhausts are led via an exhaust pipe to an exhaust outlet arranged at the downstream end of the exhaust pipe, from which the exhausts are emitted into the environment. In some trucks, it is desirable that the exhaust outlet is located high up, and in such cases it is suitable to place the exhaust outlet just behind the cab where the part of the exhaust pipe which connects to the exhaust outlet does not obstruct the truck's body work, such as a tipper. Before the exhaust is emitted into the environment via the exhaust pipe's exhaust outlet, the exhaust is made to pass through an exhaust after-treatment device arranged in the exhaust pipe, which usually comprises a catalyst and a particle filter for the purification of the exhausts and a silencing agent which dampens the noise caused by the exhaust. Increasing demands for emission control have resulted in a need to use an after-treatment device which is so large and bulky that it no longer fits into the space between the two front shafts in a truck equipped

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with double front shafts. The exhaust after-treatment device must in such a case be placed in a rear position behind the rearmost front shaft of the truck seen in the longitudinal direction, whereby the exhaust must first be led backwards from the combustion engine to the exhaust after-treatment device via a first exhaust channel, and then forwards from the exhaust after-treatment device in the direction toward the exhaust outlet via a second exhaust channel. These exhaust channels may in certain cases become so bulky that they give rise to restrictions with respect to the possible bodywork options for the truck.

OBJECTIVE OF THE INVENTION

The objective of the present invention is to achieve a solution to the above mentioned problem regarding bulky exhaust after-treatment systems in motor vehicles.

SUMMARY OF THE INVENTION

According to the present invention, the above mentioned objective is achieved with the help of an exhaust after-treatment system with the characteristics defined in patent claim 1.

The exhaust after-treatment system according to the invention comprises:

- an exhaust pipe which leads exhausts from a combustion engine in a motor vehicle to an exhaust outlet which is arranged at the downstream end of the exhaust pipe to emit the exhausts into the environment,

-an exhaust after-treatment device arranged in the exhaust pipe, showing an inlet for receipt of exhausts from the exhaust pipe and an outlet where the exhausts are emitted to the exhaust pipe after passage through the exhaust after-treatment device,

- a first exhaust channel included in the exhaust pipe, which is connected to the exhaust after-treatment device's inlet and which is intended to receive exhausts and lead them further to the exhaust after-treatment device, and

- a second exhaust channel included in the exhaust pipe, which is connected to the exhaust after-treatment device's outlet and leads the outward-flowing exhausts from this outlet further in the direction toward the exhaust pipe's exhaust outlet.

The second exhaust channel comprises a channel section which extends along and surrounds a channel section in the first exhaust channel, whereby the direction of the exhaust flow in the said channel section of the second exhaust channel is in the opposite direction to the exhaust flow in the said channel section of the first exhaust channel. Thus, the exhausts may be led in a first direction up to the exhaust after-treatment device and in the opposite, second direction away from the exhaust after-treatment device without requiring much space, for example in a truck with double front shafts which has the exhaust after-treatment device placed behind the rearmost front shaft. Thanks to the solution provided by the invention, it is possible to maintain great flexibility with respect to the design of the bodywork of a truck with double front shafts and an exhaust outlet which is located high up and behind the cab unit, the truck being equipped with an exhaust after-treatment device which is so bulky that it must be placed behind the rearmost front shaft instead of in the space between the two front shafts. By virtue of the warm exhausts,

having passed through the exhaust after-treatment device, being brought to flow through a space surrounding the first exhaust channel arranged upstream of the exhaust after-treatment device, the cooling of the exhausts brought about by the surrounding air in the first exhaust channel will be counteracted by the heat of the exhausts which flow through the said surrounding space. Thus, the exhaust after-treatment device will be heated quicker after a cold start, so that for example an SCR-catalyst included in an exhaust after-treatment device is heated more quickly to the operating temperature at which the SCR-catalyst starts to function efficiently.

Other favourable features of the exhaust after-treatment system according to the invention are set out in the non-independent patent claims and in the description below.

The invention also pertains to a motor vehicle showing the characteristics defined in patent claim 10.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described below with the help of example embodiments, with reference to the enclosed drawings. Exhibited in:

Fig 1 is a schematic side view of a motor vehicle equipped with an exhaust after-treatment system according to one embodiment of the present invention,

Fig 2 id a schematic side-view of the exhaust after-treatment system in the motor vehicle according to Fig 1, and

Fig 3 is a section according to the line III-III in Fig 2.

DETAILED DESCRIPTION OF EMBODIMENTS ACCORDING TO THE INVENTION

Fig 1 illustrates a motor vehicle 1 equipped with an exhaust after-treatment system according to one embodiment of the present invention. The motor vehicle 1 comprises a vehicle frame 2, a cab unit 3 with a driver space, arranged in the front part of the motor vehicle and a truck body work 4 arranged behind the cab unit. The cab unit 3 and the bodywork 4 are carried by the vehicle frame 2. In the illustrated example, the motor vehicle 1 is a truck equipped with a body work 4 in the form of a tipper. The exhaust after-treatment system according to the invention could however also be installed in a truck equipped with another type of body work or in another type of heavy goods vehicle.

In the illustrated example, the motor vehicle 1 comprises a first front shaft 5a and a second front shaft 5b, the second front shaft 5b being located behind the first front shaft 5a seen in the longitudinal direction of the motor vehicle. Each of the front shafts 5a and 5b is equipped with two or more wheels 6. A combustion engine 7 (see Fig 2) is located at the front end of the motor vehicle below the cab unit 3. The combustion engine 7 is located in front of the second front shaft 5b and near the first front shaft 5a.

Fig 2 illustrates the motor vehicle's exhaust after-treatment system 8. This after-treatment system 8 comprises an exhaust pipe 10 which leads exhausts from the motor vehicle's combustion engine 7 to an exhaust outlet 11, which is located at the downstream end of the exhaust pipe and via which the exhausts are emitted into the environment. An exhaust after-treatment device 12 is connected to the exhaust pipe 10 between the combustion engine 7 and the exhaust outlet 11. In the illustrated example, the exhaust after-treatment device 12 is located behind the second front shaft 5b seen in the longitudinal direction of the motor vehicle, while the exhaust pipe's exhaust outlet 11 is located between the two front shafts 5a and 5b seen in the motor vehicle's longitudinal direction.

The exhaust after treatment device 12 may comprise a separate exhaust after treatment unit or a set of two or more exhaust after treatment units connected in series and/or parallel, the respective exhaust after-treatment units consisting of for example a catalyst or a particle filter. The exhaust after-treatment device 12 may also comprise silencers in order to dampen the noise caused by the exhausts. In the illustrated example, the exhaust after-treatment device 12 includes a first exhaust after-treatment unit in the form of a catalyst 13, for example an SCR-catalyst, a second exhaust after-treatment unit in the form of a particle filter 14 and a silencer 15, which are schematically identified with dashed lines in Fig 2.

The exhaust pipe 10 includes a first exhaust channel 10a, through which the exhausts from the combustion engine 7 are led

to the exhaust after-treatment device 12, and a second exhaust channel 10b, through which the exhausts, after their passage through the exhaust after-treatment device 12, are led from the exhaust after-treatment device to the exhaust outlet 11. In the illustrated example, the first exhaust channel 10a is connected, at its upstream end to an outlet 9 of the combustion engine 7. and at its downstream end to an inlet 16 of the exhaust after-treatment device 12, while the second exhaust pipe 10b is connected at its upstream end to an outlet 17 of the exhaust after-treatment device 12, and at its downstream end to the exhaust outlet 11.

The second exhaust channel 10b comprises a channel section 19 which extends along and surrounds a channel section 18 in the first exhaust channel 10a, whereby the direction of the exhaust flow in the said channel section 19 of the second exhaust channel 10b is the opposite of the direction of the exhaust flows in the said channel section 18 of the first exhaust channel 10a. These channel sections 18 and 19 are parallel with each other and coaxially arranged, as illustrated in Fig 2 and 3.

In the illustrated embodiment, the said channel section 19 of the second exhaust channel 10b is annular when viewed in a cross-section, while the said channel section 18 of the first exhaust channel 10a is circular when viewed in a cross-section. The channel sections 18 and 19 may also have another cross-section form, such as for example an elliptical or polygonal cross-section form.

In the illustrated embodiment the said channel section 18 in the first exhaust channel 10a shows an axially directed inlet 20 at its upstream end and an axially directed outlet 21 at its downstream end, while the said channel section 19 of the second exhaust channel 10b shows a radially directed inlet 22 at its upstream end and a radially directed outlet 23 at its downstream end. In the illustrated embodiment the second exhaust channel 10b includes another channel section 24, which is separate from the first exhaust channel 10a and which forms a connection between the exhaust after-treatment device's outlet 17 and the inlet 22 in the channel section 19. The second exhaust channel 10b also includes another channel section 25, which is separate from the first exhaust channel 10a and which forms a connection between the outlet 23 in the channel section 19 and the exhaust outlet 11. In the illustrated example, the channel section 25 runs vertically upwards between the cab unit 3 and the truck bodywork 4 of the motor vehicle. The exhaust outlet 11 could of course alternatively be located in another place on the motor vehicle 1 than as showed in Fig 1 and 2.

The invention is not limited in any way to the embodiments described above, but numerous possible modifications thereof should be obvious to a person skilled in the area, without such person departing from the spirit of the invention as defined by the appended patent claims.

PATENT CLAIMS

1. Exhaust after-treatment system for a motor vehicle comprising:

- an exhaust pipe (10) which leads exhausts from a combustion engine in a motor vehicle to an exhaust outlet (11) which is arranged at the downstream end of the exhaust pipe to emit the exhausts into the environment,

- an exhaust after-treatment device (12) arranged in the exhaust pipe (10), which shows an inlet (16) for the receipt of exhausts from the exhaust pipe and an outlet (17) for emitting the exhausts into the exhaust pipe after their passage through the exhaust after-treatment device,

- a first exhaust channel (10a) included in the exhaust pipe (10), which is connected to the exhaust after-treatment device's inlet (16) and which is intended to receive exhausts and lead them further to the exhaust after-treatment device (12), and

- a second exhaust channel (10b) included in the exhaust pipe (10), which is connected to the exhaust after-treatment device's outlet (17) and leads the outward-flowing exhausts from this outlet further in the direction toward the exhaust pipe's exhaust outlet (11),

characterised by the second exhaust channel (10b) comprising a channel section (19) which extends along and surrounds a channel section (18) in the first exhaust channel (10a), whereby the direction of the exhaust flow in the said channel section (19) of the second exhaust channel (10b) is opposite to the direction of the flow of exhausts in the said channel section (18) of the first exhaust channel (10a).

2. Exhaust after-treatment system according to claim 1, **characterised** by the exhaust after-treatment device (12) comprising a silencer (15) for dampening of noise caused by the exhausts.

3. Exhaust after-treatment system according to claim 1 or 2, **characterised** by the exhaust after-treatment device (12) comprising a catalyst (13) and/or a particle filter (14).

4. Exhaust after-treatment system according to any of claims 1-3, **characterised** by said channel section (19) in the second exhaust channel (10b) being annular seen in a cross-section.

5. Exhaust after-treatment system according to any of the claims 1-4, **characterised by** said channel section (19) in the second exhaust channel (10b) having a radially directed outlet (23) at its downstream end.

6. Exhaust after-treatment system according to any of claims 1-5, **characterised by** said channel section (19) in the second exhaust channel (10b) having a radially directed inlet (22) at its upstream end.

7. Exhaust after-treatment system according to claim 6, **characterised by** the second exhaust channel (10b) comprising another channel section (24), which is separate from the first exhaust channel (10a) and which forms a connection between the exhaust after-treatment device's

outlet (17) and the inlet (22) of the above mentioned channel section (19) in the second exhaust channel (10b).

8. Exhaust after-treatment system according to any of claims 1-7, **characterised by** said channel section (18) in the first exhaust channel (10a) having an axially directed inlet (20) at its upstream end.

9. Exhaust after-treatment system according to any of claims 1-8, **characterised by** said channel section (18) in the first exhaust channel (10a) having an axially directed outlet (21) at its downstream end.

10. Motor vehicle including a combustion engine (7), **characterised** by an exhaust after-treatment system (8) according to any of claims 1-9 being connected to the combustion engine (7).

11. Motor vehicle according to claim 10, **characterised by** :
- the motor vehicle (1) comprising a first front shaft (5a) and a second front shaft (5b), the second front shaft (5b) being located behind the first front shaft (5a) seen in the longitudinal direction of the motor vehicle,
- the combustion engine (7) being located at the motor vehicle's front end in front of the second front shaft (5b),
- said exhaust after-treatment device (12) being located behind the second front shaft (5b) seen in the longitudinal direction of the motor vehicle, and

- the exhaust pipe's exhaust outlet (11) being located in front of the second front shaft (5b) seen in the longitudinal direction of the motor vehicle.

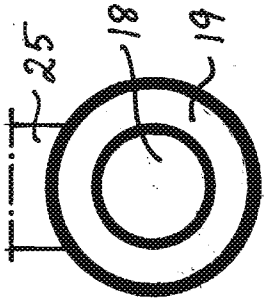


Fig 3

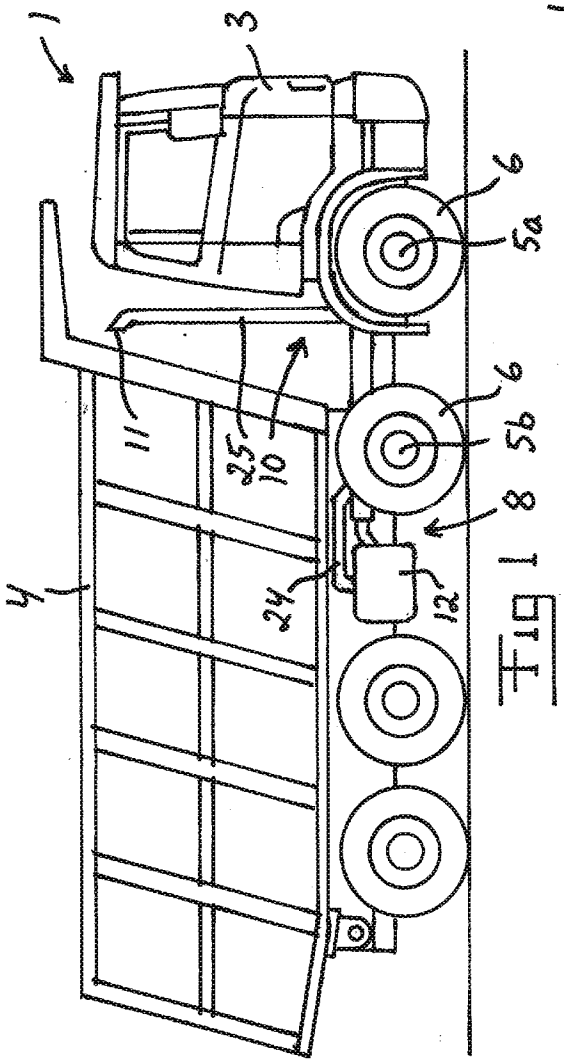


Fig 1

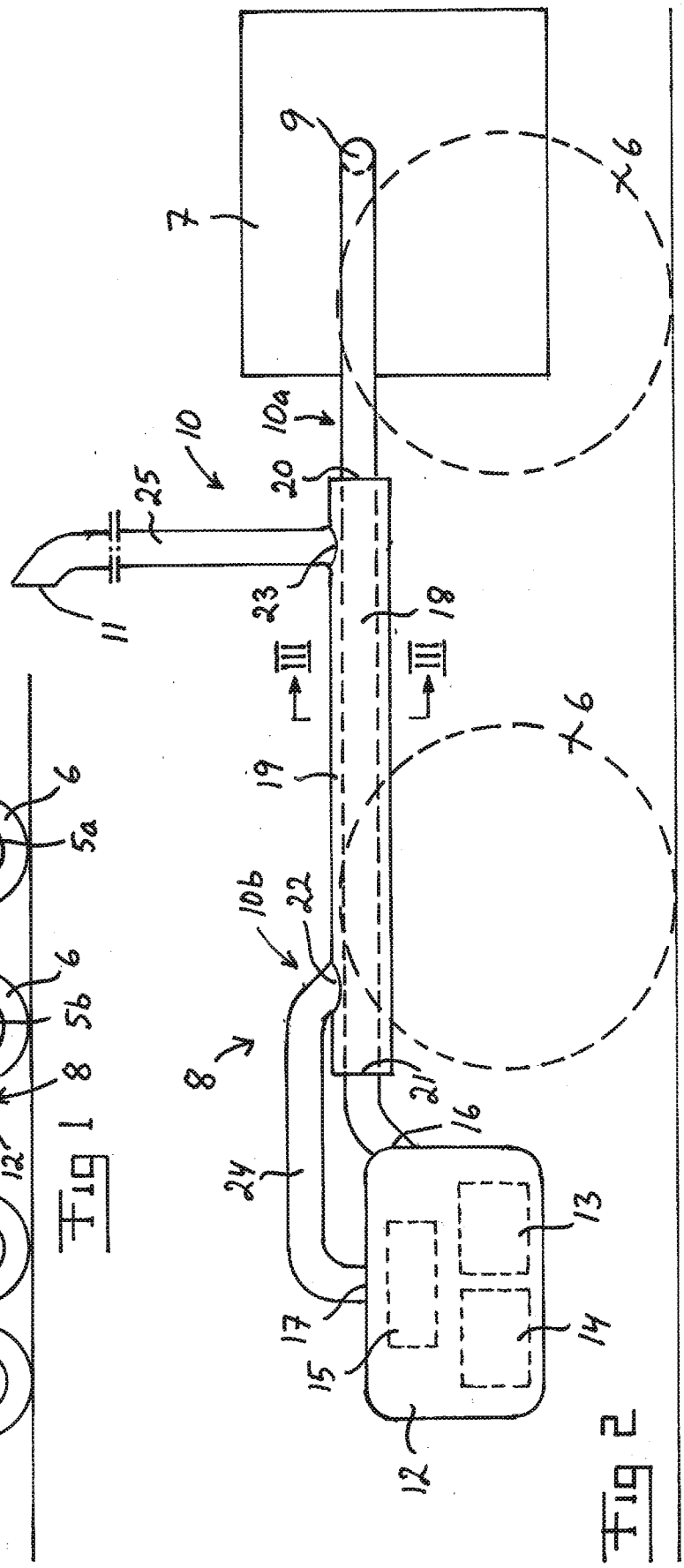


Fig 2

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	WO 9743528 A1 (SILENTOR AS ET AL), 20 November 1997 (1997-11-20); abstract; figure 1 --	1-2, 10
X	WO 2005001252 A1 (EMITEC EMISSIONSTECHNOLOGIE ET AL), 6 January 2005 (2005-01-06); abstract; figure 1 --	1, 10

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/SE
Patent- och registreringsverket
Box 5055
S-102 42 STOCKHOLM
Facsimile No. + 46 8 666 02 86

Authorized officer
David Shanks
Telephone No. + 46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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