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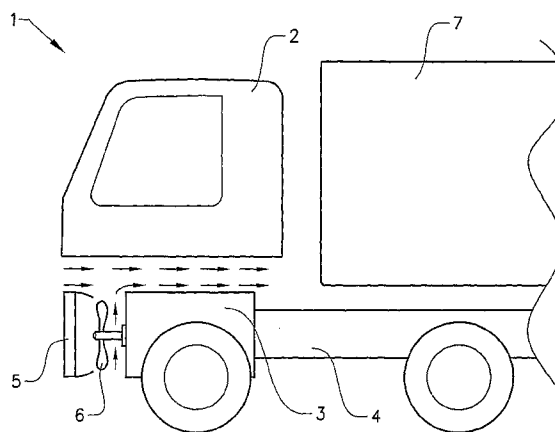


FIG. 2

(57) Abstract: Method for cooling an engine compartment in a heavy vehicle, comprising - determining whether additional cooling capacity is needed, and, if so, - automatically causing a displacement of the cab so as to increase the air gap between the engine and the cab, whereby cooling of the engine compartment is enhanced. The invention also relates to a system for performing the method, and to a vehicle incorporating such a system.

METHOD FOR COOLING AN ENGINE COMPARTMENT

TECHNICAL FIELD

The present invention relates to the field of heavy vehicles, in particular trucks, and
5 especially to a method for cooling an engine compartment in a heavy vehicle.

BACKGROUND OF THE INVENTION

In heavy vehicles, such as for example cab-over-engine vehicles, it is desirable to maintain the engine within a temperature range for optimal performance thereof.

10 Temperatures being higher than desired may result in less than optimal function of the engine. This problem may be particularly pronounced when the vehicle is carrying a heavy load and in relatively high power consuming situations, such as uphill driving or driving involving low speed and consecutive stops. In warm weather, the risk for the engine temperature exceeding prescribed limits is naturally further increased. The heat
15 produced by the engine will not only warm the engine itself, but will migrate to the engine compartment where different components surrounding the engine will be heated.

Surrounding components risk reaching critical temperatures that could cause component failure. Another inconvenience is that the heat from the engine compartment may warm areas in the cab, which is uncomfortable to the driver and will put an extra strain on the
20 available cab cooling systems.

Moreover, as the current trend in engine development is towards engines developing increased power, it is envisaged that the problem of excessive heating of the engine will become more severe with future engine designs.

25

In all, there are lots of reasons for working towards efficient engine cooling systems. Many different cooling systems and solutions are available. A number of solutions include different cooling circuits and cooling fluids, fans for enhancing air flow, and the like.

30 An object of the present invention is to provide a method for cooling the engine, which may be used in combination with previous cooling systems, so as to add to the existing cooling effect.

Another object of the present invention is to provide a method for cooling the engine compartment which is cost-efficient and do not add significantly to the weight of the vehicle.

5 SUMMARY OF THE INVENTION

At least one of the above-mentioned objects is achieved in accordance with the invention by a method for cooling an engine compartment in a heavy vehicle, comprising

- determining whether additional cooling capacity is needed, and, if so,
 - automatically causing a displacement of the cab so as to increase the air gap
- 10 between the engine and the cab, whereby cooling of the engine compartment is enhanced.

Hence, displacement of the cab in order to increase the air gap between the engine and the cab is used to achieve an additional cooling effect of the engine compartment. The

15 increased air gap between the engine and the cab allows for enhanced cooling since the air flow in the engine compartment may be increased. However, the increased air gap allows for enhanced cooling even when no air flow is present. This is believed to be due to the increased air volume between the cab and the engine results in increased heat losses to said air volume. For example, less heat will transfer from the engine

20 compartment to the cab floor. Even a relatively small displacement of the cab will give a noticeable effect. The measure of displacing the cab may be performed without interfering with other systems of the cab or the engine, such as other cooling systems or the like. Accordingly, the method is applicable to numerous types of existing vehicles.

25 Advantageously, the displacement of the cab includes lifting the cab in relation to the vehicle frame. This will increase the distance between the cab floor and the engine, resulting in a larger intermediate space (air gap) into which air may flow for cooling the engine.

30 Alternatively, or in addition to lifting the cab, the displacement of the cab includes tilting the cab in a backward direction in relation to the vehicle frame. If tilting only, but not lifting, the intermediate space (air gap) between the cab and the engine will naturally only increase at the front end of the vehicle. This will provide for increased air intake at the front of the vehicle. However, if the backward tilt is combined with a lift of the engine, the

effect may be further increased. It is understood that it is also efficient only to lift the cab, without any simultaneous tilting.

Alternatively, or in addition to the above-mentioned methods, the displacement of the cab
5 may include tilting the cab in a sideways direction in relation to the vehicle frame.

Advantageously, the displacement of the cab may be created using suspension means provided between the chassis of the vehicle and the cab. By using existing suspension means, substantially no new equipment must be added to the vehicle in order to
10 effectuate the method. This is cost-efficient as no new parts are needed, and advantageous in terms of fuel consumption when driving as virtually no weight is added to the vehicle.

Advantageously, at least two suspension means being provided between the chassis of
15 the vehicle and the cab may be controlled to perform the displacement of the cab. With two suspension means, it is generally feasible to perform a tilt of the cab. Hence, it is preferred that the two suspension means are provided at the front of the cab such that the cab may be tilted backwards.

20 Preferably, at least four suspension means are provided between the chassis of the vehicle and the cab and may be controlled to perform the displacement of the cab. In this case, each of the four suspension means are advantageously associated with each corner of the cab. With this arrangement, any desired lift or tilt of the cab may be performed.

25 Advantageously, the suspension means form part of the vibration damping system of the cab. Such suspension means are generally suitable for effecting the displacement of the cab, as they are designed to allow for a certain movement of the same. This movement may also be controlled for displacing the cab.

30 Preferably, the suspension means comprises air springs, in which case the displacement is controlled by controlling the pressure in the air springs.

The displacement of the cab may be initiated when parking the vehicle, so as to allow for
35 additional cooling when the vehicle is standing still.

Also, the displacement of the cab may be initiated at low speed driving, when the engine is often generating rather large amounts of heat.

- 5 Advantageously, an engine temperature sensor may be arranged, and the cab is automatically displaced when the engine temperature sensor indicates that the engine temperature exceeds a pre-determined threshold temperature.

Alternatively or in addition to the temperature sensor, the cab may be controlled so as to
10 be automatically displaced if the engine speed exceeds a pre-determined threshold speed.

Optionally, an inclination sensor may be arranged to indicate the inclination of the vehicle, and the cab is automatically displaced when the inclination sensor indicates that the
15 vehicle is driving uphill, which is a situation in which the engine may have an additional need for cooling.

Another option includes the arrangement of an inclination sensor to indicate the inclination of the vehicle, and the cab is automatically displaced when the inclination sensor indicates
20 that the vehicle is driving downhill. Downhill driving may include engine or retarder braking which may result in an additional need for cooling.

Advantageously the cab may automatically displaced when the vehicle is standing still and the engine load is above a pre-determined maximum value. In still-standing
25 situations, high power consumption which may result in an increased need for cooling may occur in particular with working vehicles, such as fire-fighting vehicles which may stand still while power is used for pumping water or concrete mixer vehicles which may stand still while power is used for pumping concrete.

30 Preferably, the heavy vehicle may be a cab-over-engine vehicle.

In a second aspect, the invention relates to a system for cooling an engine in a cab-over-engine vehicle, said system being arranged to perform a method as described above. The
35 invention also relates to a cab-over-engine vehicle comprising such a system.

Other features and advantages of the present invention will appear from the following description of preferred embodiments thereof, which are to be understood as non-limitative examples only.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Reference is made to the appended drawings wherein:

Fig. 1 is a schematic side view of a cab-over-engine vehicle with the cab in an initial position.

10 Fig. 2 is a schematic side view of the vehicle in Fig. 1 when the cab is lifted in accordance with a first embodiment of the invention.

Fig. 3 is a schematic side view of the vehicle in Fig. 1 when the cab is tilted in accordance with a second embodiment of the invention.

Fig. 4 is a block diagram illustrating an embodiment of control of the suspension means of
15 the vehicle in Fig. 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 is a schematic side view of a cab-over-engine vehicle 1, wherein a system implementing an embodiment in accordance to the invention may be arranged. The
20 illustrated cab-over-engine vehicle 1 is a rigid trailer. However, it is understood that the invention may be applied to any type of relatively heavy cab-over-engine vehicle such as a semi-trailer, refuse collection truck, etc. The vehicle 1 has a conventional cab 2 which is situated immediately over the engine compartment 3. The engine compartment 3 is located in the front of the vehicle frame 4. The load compartment 7 is carried by the frame
25 and situated behind the cab 2.

For visibility, several details, such as the side panels of the cab 1, are not depicted in the drawings.

30 Immediately in front of the engine compartment 3, an air intake grille 5 is arranged forming a grid like structure through which air may pass. In this embodiment, a rotary fan 6 is arranged right behind the grille 5 so as to propagate air through the grille 5 and urge the air flow towards the engine compartment 3 as illustrated by the arrows in Fig. 1.

Hence, in the conventional position as illustrated in Fig. 1, there is a certain amount of air flowing around the engine and contributing to the cooling thereof.

Fig. 2 illustrates a vehicle where the cab has been displaced so as to enhance the air flow around the engine according to a first embodiment of a method in accordance with the invention. In this case, the cab 2 is subject to a parallel displacement and lifted upwardly from the frame 4. Hence, the distance between the cab 2 and the frame 4 including the engine compartment 3 is increased, which leads to an increased air flow around the engine compartment 3, as indicated by the arrows in Fig. 2. Hence, the cooling effect achieved by the air flow is enlarged in relation to the position in Fig. 1.

The distance between the engine compartment 3 and the cab 2 is exaggerated in Fig. 2, for the sake of visibility. In fact, even a relatively small increase of the distance between the engine compartment and the cab 2 will result in a better cooling effect. It is believed that a displacement of about 30 to 60 mm, most preferred 40 to 50 mm, will be suitable for use in many vehicles.

Preferably, the cab 2 should not be raised so as to extend above the roof of the loading space 7, as this could increase the air resistance of the vehicle and hence the fuel consumption.

Fig. 3 illustrates a vehicle 1 wherein the cab 2 has been displaced so as to enhance air flow around the engine according to a second embodiment in accordance with the invention. The cab 2 is tilted backwards towards the loading space 7 of the vehicle. Hence, the distance between the cab 2 and the engine compartment 3 is increased at the front of the vehicle. This leads to an increased air intake as illustrated by the arrows in Fig. 3, and thus to an increased cooling of the engine compartment 3.

Although not illustrated in Figs 1 to 3, it is readily understood that the cab 2 is attached to the frame 4 via suspension means. Further, the displacement of the cab 2 in relation to the frame 4 is controlled using such suspension means.

There are several existing suspension and/or damping systems that may be used to perform the desired displacement of the cab if adequately controlled. See e. g.

WO 2004/018243 describing a suspension system including a strut module having a strut, an air spring and a control module, US 2005/0274557 or EP1 584 545.

In particular, it is preferred to use an actively controlled air spring suspension system.

5

Fig. 4 is a block diagram illustrating the function of control of the suspension means. A sensor or indicator 10 provides an input signal to a control unit 20. For example, the sensor could be a temperature sensor 10 provided in the engine compartment 3, in which case the control unit 20 will compare the temperature value obtained by the sensor 10 with a predetermined threshold temperature and initiate displacement of the cab 2 if the temperature value exceeds the threshold. Alternatively, the sensor 10 could be an inclination sensor 10, arranged at the frame 4 of the vehicle, and indicating the inclination of the vehicle. In this case, the control unit 20 could compare the inclination value to a preset threshold inclination so as to initiate displacement of the cab if the vehicle is traveling uphill.

Naturally, the control unit 20 could take other information than that provided by the sensor 10 into account. For example, the control unit 20 could include a set of rules saying for example that the cab shall be displaced only if the threshold temperature has been exceeded for a certain period of time. In particular, rules for replacing the cab could advantageously be implemented using a certain delay, such that the cab will not be repeatedly displaced and replaced with very short time intervals, which might be annoying experience to the driver. A person skilled in the art could readily envisage suitable programming protocols in order to achieve a well-functioning control of the displacement.

25

Further, it is readily understood that more than one sensor 10 may be applied to provide the control unit 20 with desired information. Several sensors 10 of different types may be used. Also, output from existing systems in the vehicle may be used as input to the control unit 20, such as a signal indicating if the vehicle is in a parked position.

30

The control unit 20 controls the activators 30, 32, 34, 36 which controls the suspension units 40, 42, 44, 46 which suspends the cab 2, so as to elongate or shorten each suspension unit 40, 42, 44, 46 to achieve the desired displacement of the cab 2. In the illustrated embodiment, four suspension units 40, 42, 44, 46 are arranged, one in each corner of the cab 2. This configuration will provide a large degree of freedom when

35

controlling the displacement of the cab, as the displacement of each corner thereof may be controlled independently.

However, it is understood that two or three suspension means with corresponding

5 actuators may be sufficient to achieve adequate displacement of the cab. If two suspension means are used, they may advantageously be arranged at the front end of the cab 2. If three suspension means are used, two of them may advantageously be arranged at the front end of the cab 2, and the third in a central position at the back end 2 of the cab.

10

In the preferred air spring suspension system, the suspension means 40, 42, 44, 46 comprise air springs, the pressure of each air spring being individually controllable by means of a solenoid valve. The air spring suspension means simultaneously function as damping means to dampen the vibrations of the cab during driving. Advantageously, an
15 active control of the pressure of the air springs is used also to control the dampening characteristics of the springs, using adequate control means.

Numerous alternative embodiments may be envisaged within the scope of the appended claims. For example, although air spring suspension systems are preferred, it is

20 understood that the displacement may be effected using e.g. hydraulic suspension systems. Also, it is understood that the method may use only one controllable suspension such as an air spring. In this case, the cab must however be suspended in some other way (non-controllable) at at least two locations. Alternatively, two, three, four or more than four controllable suspension means such as air springs may be used.

25

Although the description has been made in relation to a cab-over-engine vehicle, it is understood that also other types of vehicles, where displacement of the cab could cause an increased air gap between the engine compartment and the cab, may benefit from the present invention.

30

CLAIMS

1. Method for cooling an engine compartment (3) in a heavy vehicle (1), comprising
 - determining whether additional cooling capacity is needed, and, if so,
 - automatically causing a displacement of the cab (2) so as to increase the air gap
- 5 between the engine and the cab (2), whereby cooling of the engine compartment (3) is enhanced.
2. Method according to claim 1, wherein the displacement of the cab (2) includes lifting the cab (2) in relation to the vehicle frame.
- 10 3. Method according to claim 1 or 2, wherein the displacement of the cab includes tilting the cab (2) in a backward direction in relation to the vehicle frame.
4. Method according to any one of the previous claims, wherein the displacement of the
- 15 cab includes tilting the cab (2) in a sideways direction in relation to the vehicle frame.
5. Method according to any one of the previous claims, comprising creating the displacement of the cab (2) using suspension means (40, 42, 44, 46) provided between the chassis (4) of the vehicle and the cab (2).
- 20 6. Method according to claim 5, comprising controlling at least two suspension means (40, 42) being provided between the chassis (4) of the vehicle and the cab (2).
7. Method according to claim 5 or 6, comprising controlling at least four suspension
- 25 means (40, 42, 44, 46) being provided between the chassis (4) of the vehicle and the cab (2).
8. Method according to any one of the claims 5 to 7, wherein the suspension means (40, 42, 44, 46) form part of the vibration damping system of the cab (2).
- 30 9. Method according to any one of the claims 5 to 8, wherein the suspension means (40, 42, 44, 46) comprise air springs.
10. Method according to claim 9, wherein the displacement is controlled by controlling the
- 35 pressure in said air springs.

11. Method according to any one of the previous claims, wherein the displacement of the cab (2) is automatically initiated when parking the vehicle.

5 12. Method according to any one of the previous claims, wherein the displacement of the cab (2) is automatically initiated at low speed driving.

13. Method according to any one of the previous claims, wherein an engine temperature sensor (10) is arranged, and the cab (2) is automatically displaced when the engine
10 temperature sensor indicates that the engine temperature exceeds a pre-determined threshold temperature.

14. Method according to any one of the previous claims, wherein the cab (2) is automatically displaced if the engine speed exceeds a pre-determined threshold speed.
15

15. Method according to any one of the previous claims, wherein an inclination sensor (10) is arranged to indicate the inclination of the vehicle, and the cab (2) is automatically displaced when the inclination sensor indicates that the vehicle is driving uphill.

20 16. Method according to any one of the previous claims, wherein an inclination sensor (10) is arranged to indicate the inclination of the vehicle, and the cab (2) is automatically displaced when the inclination sensor indicates that the vehicle is driving downhill.

17. Method according to any one of the previous claims, wherein the cab (2) is
25 automatically displaced when the vehicle is standing still and the engine load is above a pre-determined value.

18. Method according to any one of the previous claims, wherein the heavy vehicle is a cab-over-engine vehicle.
30

19. System for cooling an engine in a cab-over-engine vehicle, said system being arranged to perform a method in accordance with any one of the preceding claims.

20. Heavy vehicle comprising a system for cooling an engine being arranged to perform a
35 method in accordance with any one of the claims 1 to 18.

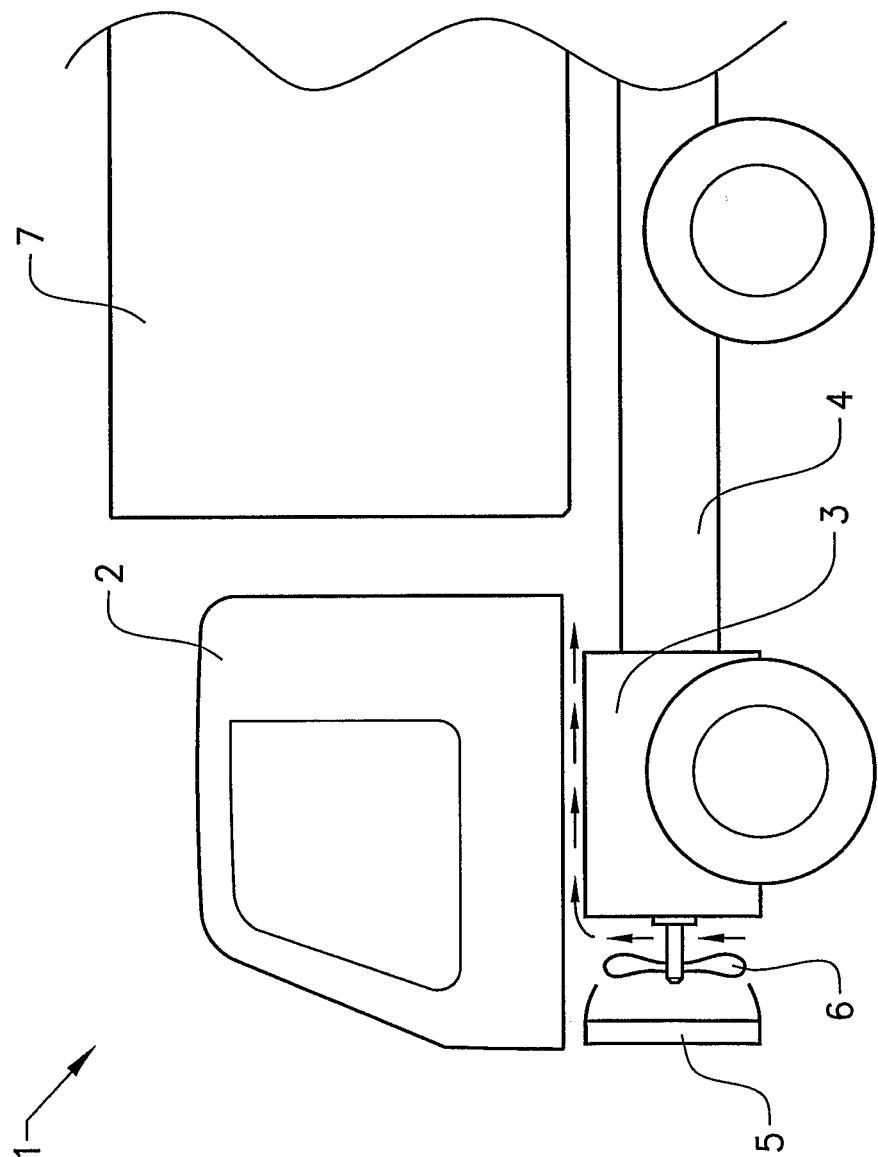


FIG. 1

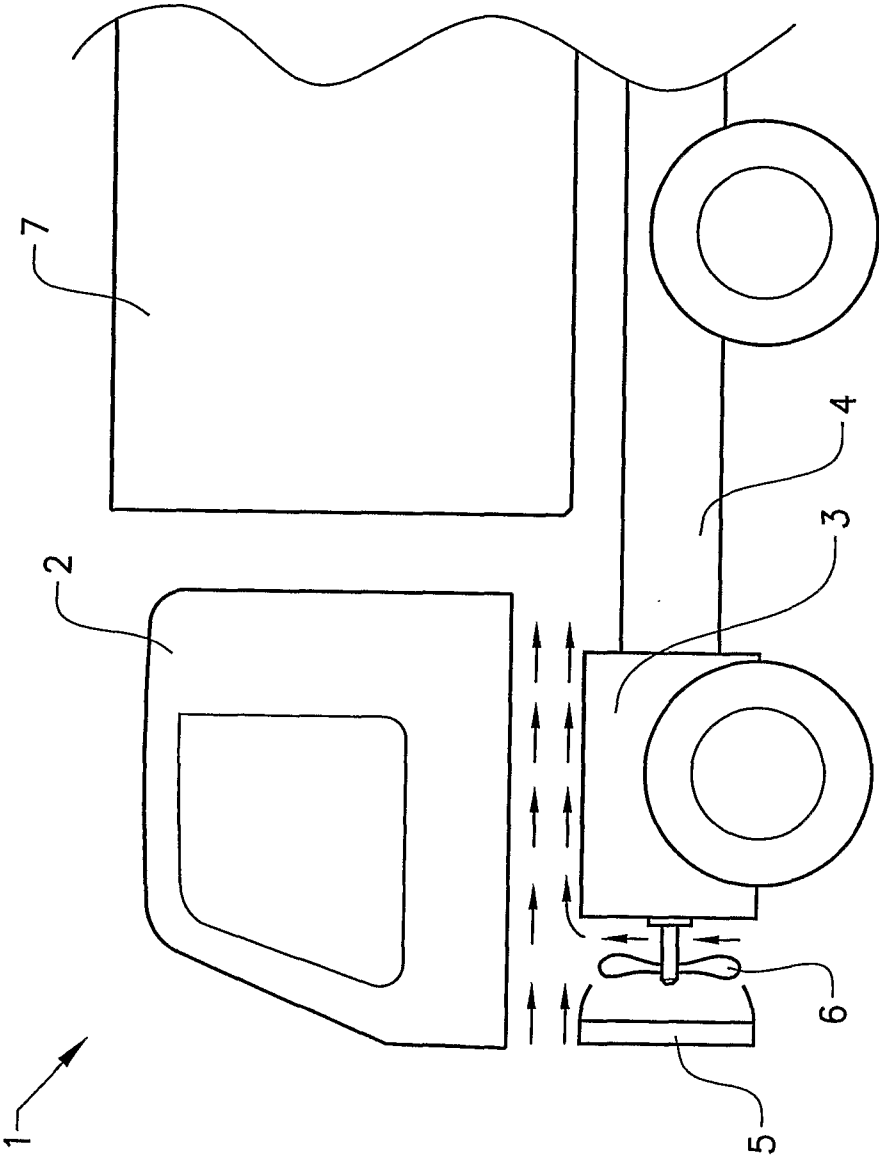


FIG. 2

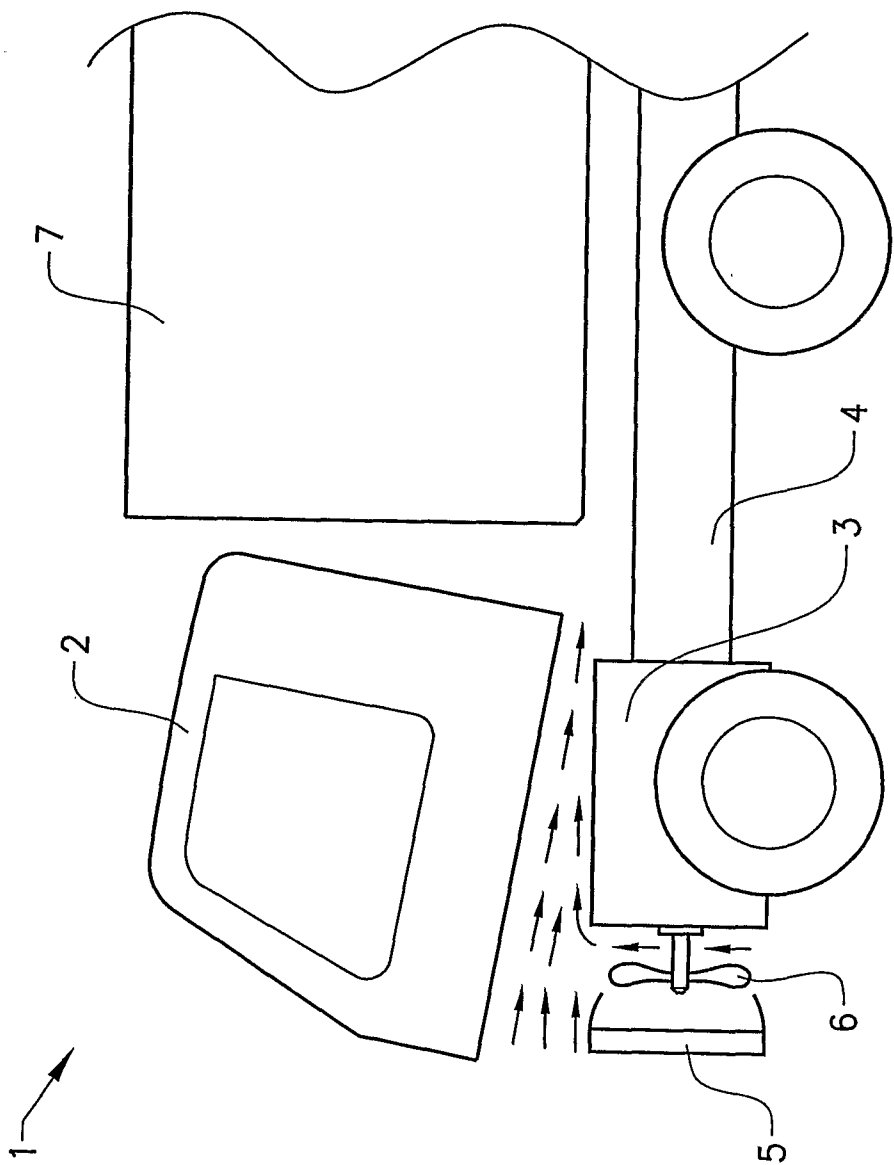


FIG. 3

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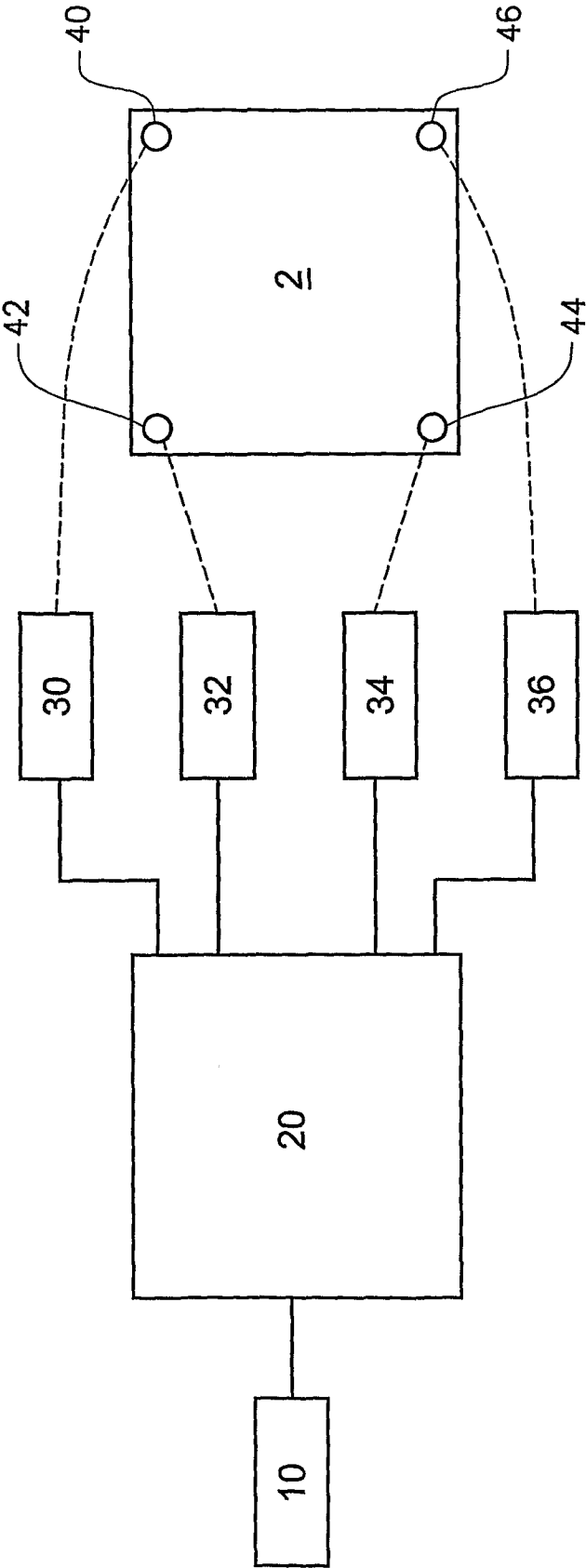


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2007/000607

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: B60K, B62D

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, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 20040041894 A, HYUNDAI MOTOR CO LTD, 2004-05-20: (abstract) Retrieved from: EPODOC database --	1-20
A	KR 20040080567 A, HYUNDAI MOTOR CO LTD, 2004-09-20: (abstract) Retrieved from: EPODOC database --	1-20
A	US 5275249 A (NELSON, R), 4 January 1994 (04.01.1994), figure 1, abstract --	1-20
A	WO 8303575 A1 (CATERPILLAR TRACTOR CO), 27 October 1983 (27.10.1983), figure 1, abstract --	1-20

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

15 February 2008

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2007/000607**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2006248437 A, NISSAN DIESEL MOTOR CO LTD, 2006-09-21: (abstract) Retrieved from: PAJ database -- -----	1-20

International patent classification (IPC)**B60K 11/08** (2006.01)**B62D 33/063** (2006.01)**Download your patent documents at www.prv.se**

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

26/01/2008

International application No.

PCT/SE2007/000607

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