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(54) Title: AN ENGINE INLET AIR PIPE MODULE

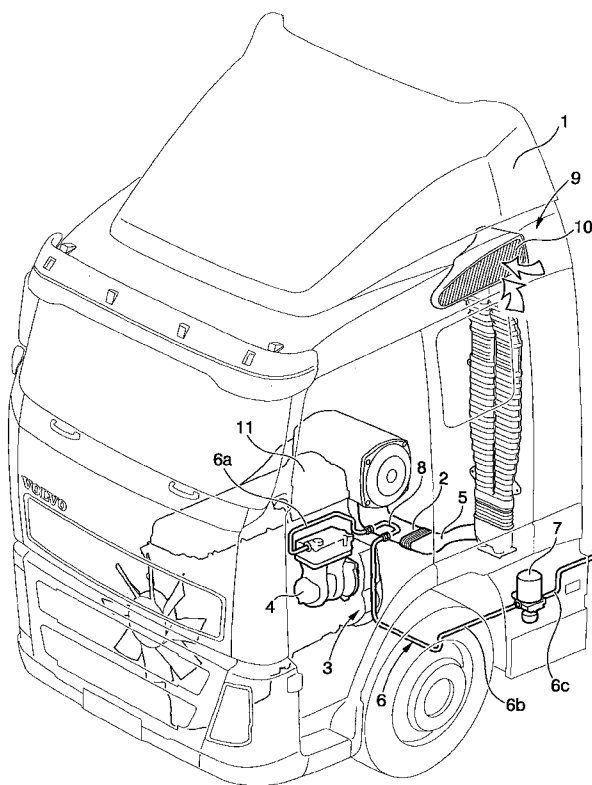


Fig.1

(57) Abstract: The invention relates to an engine inlet air
pipe module (2) for a vehicle (1). The module comprises a
tubular element (12) for conveying air to an engine (11). The
module (2) further comprises a conduit portion (8) arranged
inside the tubular element (12) so as to enable heat exchange
between a fluid flowing in the conduit portion (8) and air
flowing in the tubular element (12).

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An engine inlet air pipe module

TECHNICAL FIELD

The invention relates to an engine inlet air pipe module according to the preamble of claim 1, and a system for cooling compressed air according to the preamble of claim 6.

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The invention is applicable on vehicles, in particular trucks. The invention is, however, not restricted to trucks, but may also be used for example in wheel loaders, articulated haulers, excavators, buses and private cars.

10 BACKGROUND OF THE INVENTION

A lot of components of a truck require compressed air for the function thereof. Examples of such components are air suspension, brakes and various types of auxiliary equipment arranged on the truck. Usually an air compressor is arranged on a truck in order to supply air to one or more air tanks via an air dryer and a pressure regulator. From the tank the air

15 is then distributed to the current components.

The compressed air produced by the air compressor which is normally arranged close to the engine of the truck has sometimes a temperature of 150°C. It is however desired that the temperature of the compressed air is as low as possible. For example, the maximum
20 temperature of the compressed air which can be allowed to enter the air dryer is approximately in the range 60-70°C. This implies that the compressed air has to be cooled in some way.

According to prior art, the fan which is arranged in the front portion of the engine and
25 behind the radiator is also used for cooling the compressed air. A part of the compressed air pipe between the air compressor and the air dryer is routed behind and close to the fan in order to lower the temperature of the compressed air in the pipe. The fan is however arranged to serve different functions of the truck that need cooling and of course the fan has not an unlimited cooling capacity.

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Furthermore, this prior art solution has drawbacks in that the pipe from the air compressor has to be arranged along the side of the engine and has an extension from the air compressor to the front of the engine where the fan is arranged, and then back again to

the air dryer which can be arranged behind the front axle of the truck. Furthermore, an increased power output from the engine results in increased temperature in the engine compartment which makes it more difficult to cool the air in the air compressor pipe.

5 SUMMARY OF THE INVENTION

An object of the invention is to provide a device for cooling or heating a fluid and in particular for cooling a fluid such as compressed air, on a vehicle.

10 The object is achieved by an engine inlet air pipe module according to claim 1.

By the provision of an engine inlet air pipe module according to the invention, which module comprises a tubular element for conveying air to an engine, wherein the module comprises a conduit portion arranged inside the tubular element so as to enable heat
15 exchange between a fluid flowing in the conduit portion and air flowing in the tubular element, the fluid such as compressed air can be conveyed through said conduit portion and thereby be cooled in an effective way. The relative low temperature and high flow of the engine inlet air can be used for transferring heat from for example the compressed air to the inlet air. This implies that the pipe for compressed air does not need to be routed to
20 the front of the engine where the fan is situated, and the extension of the pipe inside the engine compartment can be minimized. Instead the pipe for compressed air can extend rearwards from the air compressor to a position behind the engine where the air inlet pipe normally is situated, and further to the position of the air dryer. At the same time the cooling capacity of the fan can be used for cooling other components.

25

By the provision of the module, the connection of pipes to the conduit portion arranged inside the tubular element can be simplified. Connection means for releasably connection of external conduits can be provided, for example in the form of quick couplings. On the other hand, if the conduit portion is not to be used for heat transfer no permanently
30 arranged pipes need to occupy the space around the air inlet pipe. Although the module can be permanently arranged as a part of the engine air inlet pipe, advantageously the module is designed with coupling means arranged at the ends of the tubular element so as to enable the module to be removed. This implies that the entire module can be replaced by another air inlet pipe portion without any conduit portion arranged therein if

desired. Thus, the module enables the air inlet pipe to optionally be used as a heat exchanger for a fluid.

Although, the invention is exemplified by the specific application where compressed air is cooled, also other fluids used on a vehicle could possibly be cooled (or heated) by means of the engine inlet air pipe module according to the invention. The term fluid is meant to comprise liquids as well as gases.

According to another aspect of the invention a system for cooling compressed air from a compressor arranged on a vehicle having an engine inlet air pipe according to claim 6 is provided.

The system comprises an air conduit for conveying compressed air from the compressor to at least one component consuming air, and a portion of the air conduit is arranged inside the engine inlet air pipe so as to enable heat exchange between the compressed air in the conduit and air flowing in the engine inlet air pipe. The relative low temperature and high flow of the engine inlet air can be used for transferring heat from the compressed air to the inlet air. This implies that the pipe for compressed air does not need to be routed to the front of the engine where the fan is situated, and the extension of the pipe inside the engine compartment can be minimized. Instead the pipe for compressed air can extend rearwards from the air compressor to a position behind the engine where the air intake pipe normally is situated, and further to the position of the air dryer. At the same time the cooling capacity of the fan can be used for cooling other components. The system for compressed air preferably comprises an engine inlet air pipe module as described above, although any engine inlet air pipe portion or component where inlet air is flowing towards the intake of the engine can be used.

The invention also relates to a heavy vehicle comprising a module and/or a system according to the invention.

30

Further advantages and advantageous features of the invention are disclosed in the following description and in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the appended drawings, below follows a more detailed description of embodiments of the invention cited as examples.

In the drawings:

- 5 Fig. 1 is a perspective view of a vehicle having an engine inlet air pipe module according to the invention,

Fig. 2 is an enlarged perspective view of the engine inlet air pipe module shown in Fig. 1,

- 10 Fig. 3a and 3b are schematic illustrations of alternative embodiments of the engine inlet air pipe module according to the invention, and

Fig. 4a, 4b, and 4c are different embodiments of the invention where cooling flanges are arranged inside the engine inlet air pipe module.

15

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Figure 1 is a perspective view of a heavy vehicle 1 in the form of a truck provided with an engine inlet air pipe module 2 according to the invention. The truck 1 has a system 3 for cooling compressed air delivered from an air compressor 4 which system utilizes the engine air inlet pipe module 2 for transferring heat from the compressed air to the engine inlet air flowing in an engine inlet air pipe 5. In the illustrated example an air conduit 6 is arranged for conveying compressed air from the air compressor 4 to at least one component (not shown) consuming air. One air conduit part 6a is arranged between the air compressor 4 and the engine inlet air pipe 5, and one part 6b is arranged between the engine inlet air pipe 5 and an air dryer 7, and further one part 6c is arranged between the air dryer 7 and for example an air tank (not shown). A portion 8 of the air conduit is arranged inside the engine inlet air pipe 5 so as to enable heat exchange between the compressed air in the air conduit 6 and air flowing in the engine inlet air pipe 5, and said portion 8 of the air conduit arranged inside the engine inlet air pipe 5 is preferably situated upstream the air dryer 7.

At one end 9 of the engine inlet air pipe 5, an air intake 10 is arranged for introduction of air which flows through the engine inlet air pipe to an engine 11, such as for example a Diesel engine or any other internal combustion engine. The air conduit portion 8 arranged

inside the engine air inlet pipe 5 and the engine air inlet pipe are separated systems in the meaning that the air flowing in the engine inlet air pipe 5 and the compressed air in the air conduit portion 8 are separated by the current air conduit portion 8. In other words the fluid in the conduit portion 8 and the air flowing in the engine inlet air pipe are not allowed
5 to be mixed with each other. Due to the fact that the conduit portion 8 is arranged inside the engine inlet air pipe 5, and being exposed to the inlet air flow, heat transfer between the compressed air and the inlet air can however be accomplished. The engine inlet air module 2 with the air conduit portion 8 arranged inside the module works as a heat exchanger.

10

In Fig. 2 the engine inlet air pipe module 2 is illustrated in an enlarged view. The module 2 comprises a tubular element 12 for conveying air to the engine. The module 2 further comprises said conduit portion 8 arranged inside the tubular element 12 so as to enable heat exchange between a fluid flowing in the conduit portion 8 and air flowing in the
15 tubular element 12. The module 2 has preferably a first connection means 13 for releasably connection of an external conduit 6a to one end of the conduit portion 8 arranged inside the tubular element 12 and/or a second connection means 14 for releasably connection of an external conduit 6b to the other end of the conduit portion 8 arranged inside the tubular element 12. The first connection means 13 and/or the second
20 connection means 14 is arranged on the outside of the tubular element 12, for example on or close to the outer surface 15 of the tubular element 12, although the connections could be arranged between different parts of the air conduit at a distance from the tubular element.

25 By the term "tubular" element any hollow cylinder is comprised. The tubular element can have various shapes, dimensions, and extension directions and length depending on the current need of heat exchange between the inlet air and the fluid flowing in the conduit portion and/or the demands for inlet air to be transported to the engine. Thus, the tubular element may have any suitable cross section such as rectangular (as illustrated in Fig. 2),
30 circular, etc.

Furthermore, the tubular element 12 has two end portions 16, 17 for connection of the module 2. Each end portion 16, 17 is preferably releasably connected to the remaining engine air inlet pipe 5 or to another component constituting a transition portion between
35 the engine air inlet pipe and the engine, or directly to the engine. The connection means

18 of the engine inlet air pipe 5 for connection to the corresponding connection means of the module 2 can be designed to allow another component, such as a regular engine inlet air portion without any air conduit portion for heat exchange function, to replace the module. This implies flexibility in for example the production of a vehicle where the main
5 part of the engine air inlet pipe 5 can be designed in the same way in both cases.

The conduit portion 8 arranged inside the tubular element 12 can have various shapes, dimensions, and extension directions and length depending on the current need of heat exchange between the inlet air and the fluid flowing in the conduit portion 8. The conduit
10 portion 8 may for example be U-shaped. By the U-shape the connection positions of the conduit portion are more or less automatically situated on the same side of the engine air inlet pipe 5 which in some cases may facilitate the connection of the external conduits 6a, 6b to be coupled to the conduit portion 8 inside the tubular element 12. In other embodiments of the invention illustrated in Fig. 3a and 3b the conduit portion 8 arranged
15 inside the tubular element 12 is designed with an extension forming a helical and a serpentine, respectively. Both these designs enable the length of the conduit portion 8 inside the tubular element to be increased while remaining the length of the tubular element 12, i.e. the length of the module 2 does not have to be increased. An increased length of the conduit portion 8 implies enhanced heat transfer between the fluid in the
20 conduit portion 8 and the air flowing in the engine inlet air pipe.

In a preferred embodiment of the invention, the engine inlet air module comprises flanges arranged inside the tubular element to enhance the heat transfer between the fluid in the conduit portion and the air flowing in the tubular element. In the same way with respect to
25 the other aspect of the invention, in the system for cooling compressed air it is preferred that flanges are arranged inside the engine inlet air pipe to enhance the heat transfer between the compressed air in the conduit portion and the air flowing in the engine inlet air pipe. In all embodiments of the invention described herein it is possible to use some kind of flanges to increase the heat transfer.

30

In Figs. 4a, 4b and 4c various types of cooling flange 20a, 20b, 20c are illustrated. Cooling flanges can be arranged in order to increase the exposed surface and thereby the heat transfer between the air flowing in the engine inlet air pipe 5 and the fluid flowing in the conduit portion 8. The cooling flanges can be attached to the conduit portion 8 and/or

the inlet air pipe or tubular element 12 or be formed as an integrated part of the conduit portion and/or the inlet air pipe/tubular element.

In Fig. 4a cooling flanges 20a are arranged on the conduit portion 8, and the cooling
5 flanges are plates having a main extension in radial direction relative to the conduit portion 8. Although the cooling flanges 20a are substantially circular in the illustrated example, a lot of different shapes of the flanges can be used. In Fig. 4b cooling flanges 20b in the form of rectangular plates are arranged on the conduit portion 8. The cooling flanges have a main extension in the axial direction of the conduit portion but extend also
10 in the radial direction. The flanges 20b can be arranged substantially on equal circumferential distances around the conduit portion 8. In Fig. 4c cooling flanges 20c are arranged between the outer surface of conduit portion 8 and the inner surface of the tubular element 12, and extend in radial direction from the conduit portion to the tubular element. The flanges 20c can also have a considerable extension in the axial direction of
15 the conduit portion 8 by being turned wings (although the material thickness of the plates is preferably relatively thin). By these cooling flanges 20c the cooling surface is increased, and the air flow when passing through the tubular element can be directed towards the conduit portion so as to increase the heat exchange capacity of the engine inlet air pipe module according to the invention.

20

It is to be understood that the present invention is not limited to the embodiments described above and illustrated in the drawings; rather, the skilled person will recognize that many changes and modifications may be made within the scope of the appended claims.

CLAIMS

1. An engine inlet air pipe module (2) for a vehicle (1), comprising a tubular element (12) for conveying air to an engine (11), **characterized in that** the module (2) comprises a conduit portion (8) arranged inside the tubular element (12) so as to enable heat exchange between a fluid flowing in the conduit portion (8) and air flowing in the tubular element (12).
5
2. An engine inlet air pipe module according to claim 1, **characterized in that** the module (2) comprises at least one flange (20a, 20b, 20c) arranged inside the tubular element (12) to enhance the heat transfer between the fluid in the conduit portion (8) and the air flowing in the tubular element (12).
10
3. An engine inlet air pipe module according to claim 2, **characterized in that** said at least one flange (20a, 20b, 20c) is arranged on the conduit portion (8).
15
4. An engine inlet air pipe module according to any of claims 1-3, **characterized in that** the module (2) has a first connection means (13) for releasably connection of an external conduit (6a) to one end of the conduit portion (8) arranged inside the tubular element (12) and a second connection means (14) for releasably connection of an external conduit (6b) to the other end of the conduit portion (8) arranged inside the tubular element (12).
20
5. An engine inlet air pipe module according to claim 4, **characterized in that** the first connection means (13) and/or the second connection means (14) is arranged on the tubular element (12).
25
6. A system (3) for cooling compressed air from an air compressor (4) arranged on a vehicle (1) having an engine inlet air pipe (5), comprising an air conduit (6) for conveying compressed air from the air compressor (4) to at least one component consuming air, **characterized in that** a portion (8) of the air conduit is arranged inside the engine inlet air pipe (5) so as to enable heat exchange between the compressed air in the conduit portion (8) and air flowing in the engine inlet air pipe (5).
30

7. A system according to claim 6, **characterized in that** at least one flange (20a, 20b, 20c) is arranged inside the engine inlet air pipe (5) to enhance the heat transfer between the compressed air in the conduit portion (8) and the air flowing in the engine inlet air pipe (5).

5

8. A system according to claim 7, **characterized in that** said at least one flange (20a, 20b, 20c) is arranged on the conduit portion (8).

10

9. A system according to any of claims 6 to 8, **characterized in that** the system comprises an air dryer (7) connected to the air conduit (6), said portion (8) of the air conduit arranged inside the engine inlet air pipe (5) being situated upstream the air dryer (7).

15

10. A system (3) for cooling compressed air from an air compressor (4) arranged on a vehicle (1) having an engine inlet air pipe (5), comprising an engine inlet air pipe module (2) according to any of claims 1-5.

20

11. A heavy vehicle (1) comprising an engine inlet air pipe module (2) according to any of claims 1-5.

25

12. A heavy vehicle (1) comprising a system for cooling compressed air according to any of claims 6-9.

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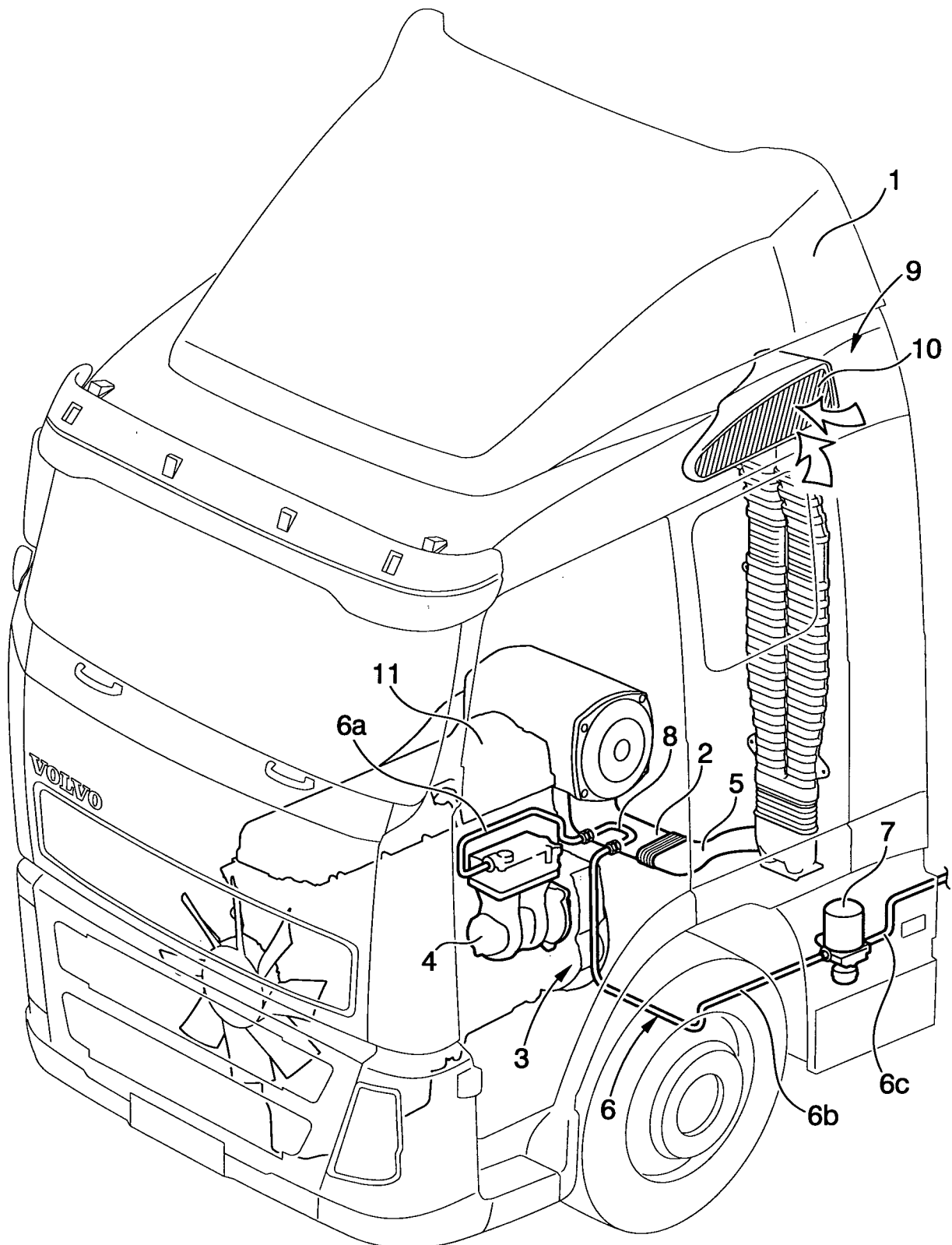


Fig.1

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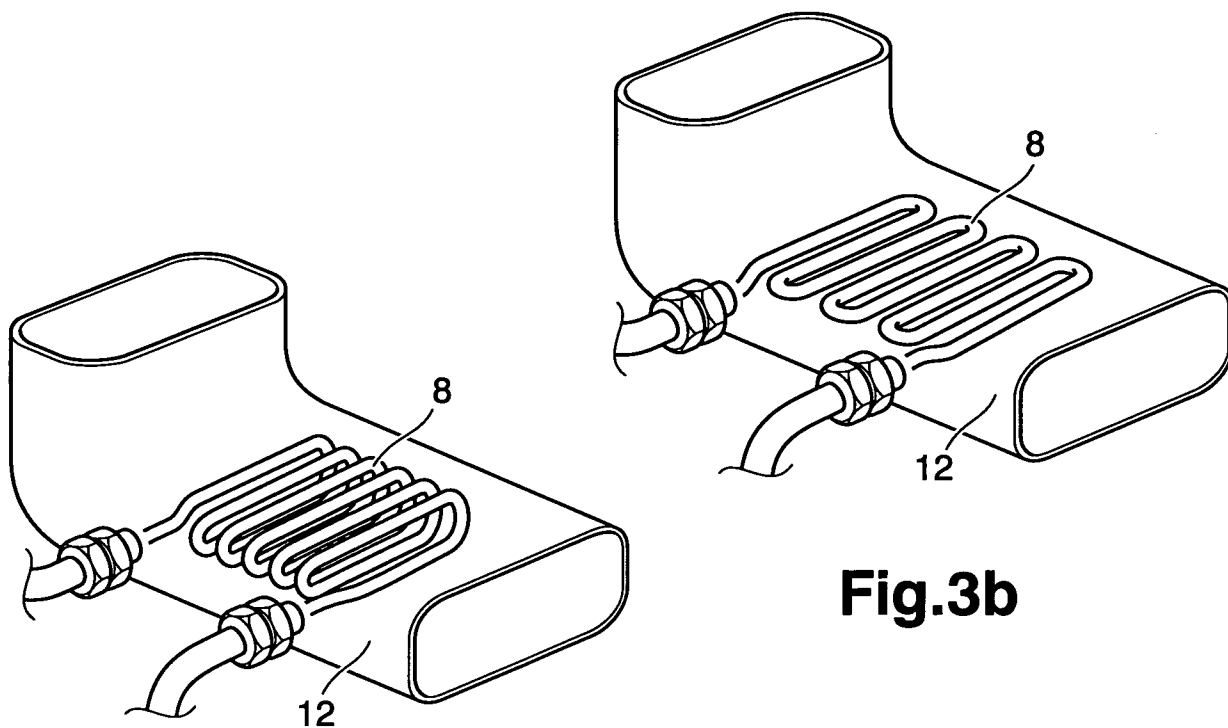
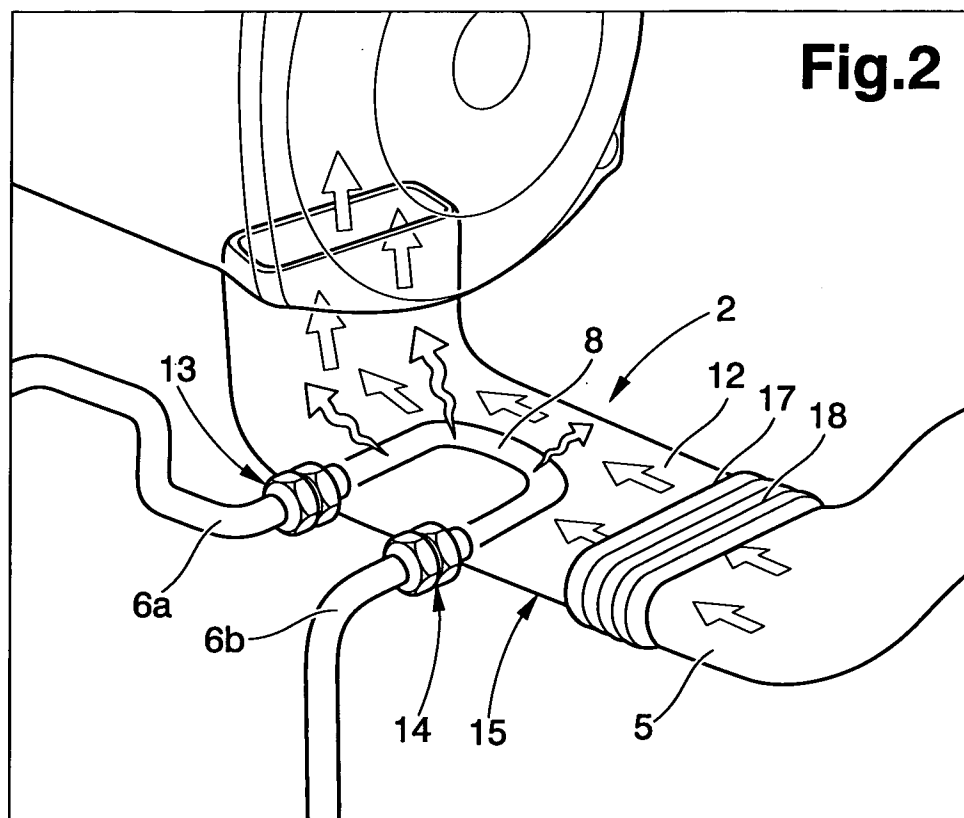


Fig.3a

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Fig.4a

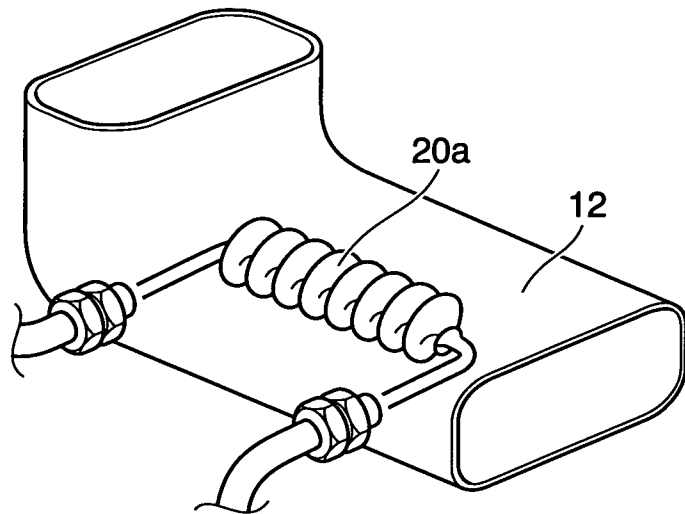


Fig.4b

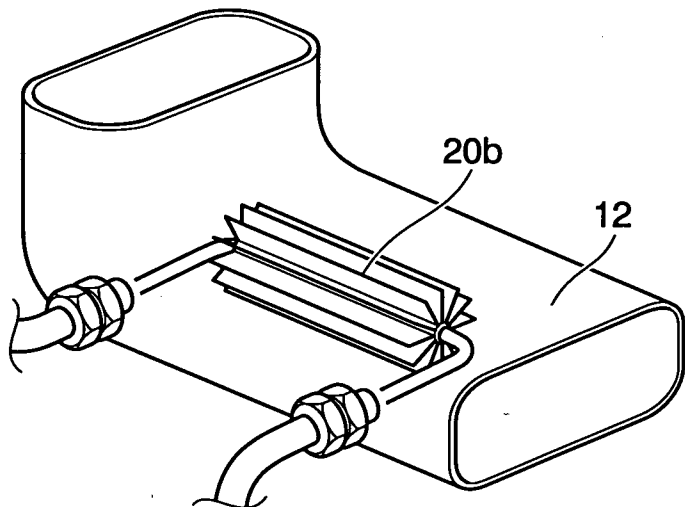
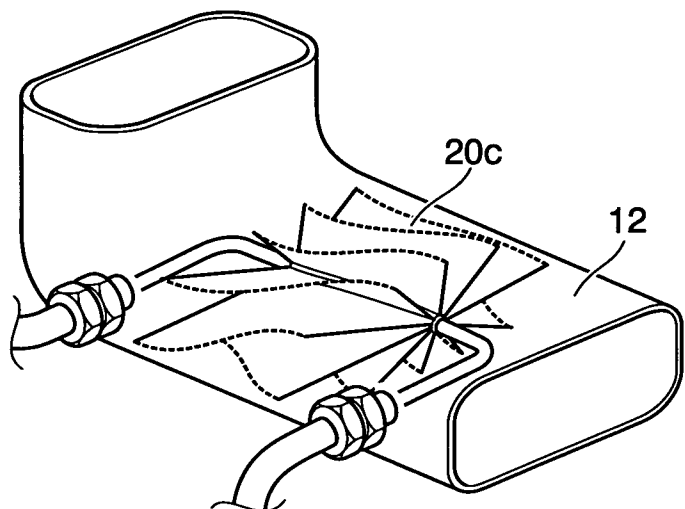


Fig.4c



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2007/001138

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: F02M, B60K

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.
X	EP 1172546 B1 (MAN NUTZFAHRZEUGE AKTIENGESELLSCHAFT), 8 Sept 2004 (08.09.2004), figure 1, claims 1-5 --	1,6,10-12
X	DE 4202077 A1 (AUDI AG), 29 July 1993 (29.07.1993), figures 1,2, abstract --	1,6,10-12
X	US 6138648 A (M. ZENTGRAF), 31 October 2000 (31.10.2000), figures 1-3, abstract -- -----	1,6,10-12

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Date of the actual completion of the international search

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/06/2008

International application No.

PCT/SE2007/001138

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