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(54) Title: COOLING ARRANGEMENT ON AN AGRICULTURAL VEHICLE

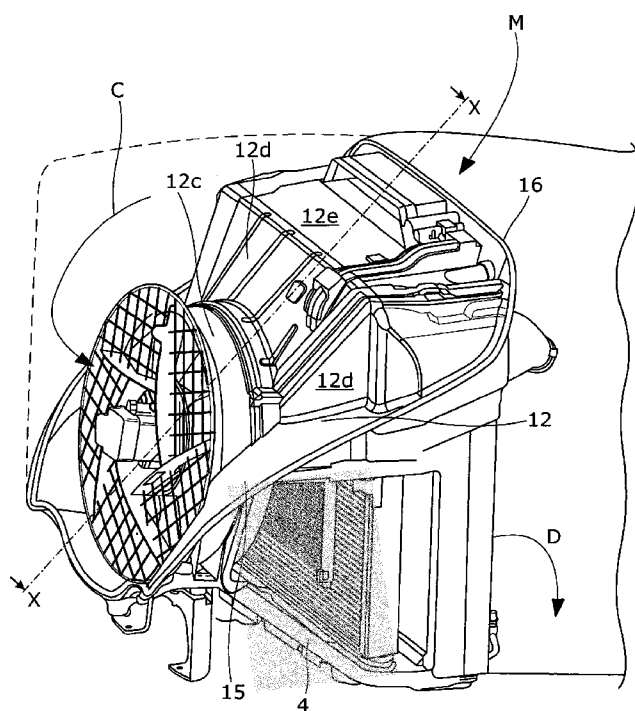


Fig. 4

(57) **Abstract:** A cooling arrangement on an agricultural vehicle comprising a radiator and a fan with a fan shroud located in a bonnet having a pivotable hood. When the bonnet is closed a part of the fan shroud defines a first and second air compartment under the bonnet.



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Cooling Arrangement on an Agricultural Vehicle

This invention relates to a cooling arrangement on an agricultural vehicle. More specifically, the invention relates to a cooling arrangement in a bonnet of an agricultural vehicle.

Agricultural vehicles, such as agricultural tractors require air to cool a number of components on a vehicle. Air may be passed through radiators to cool working media, such as a water cooler for the engine, a transmission oil cooler, a hydraulic oil cooler, an intercooler and possibly a condenser for an air-conditioning system.

With the increasing development of higher powered tractors, there is an increasing need to provide efficient cooling systems. Tractors typically have two air intake ducts located in the bonnet to conduct air from outside to components needing cooling. One intake duct may conduct air driven by a fan through a radiator, while another air intake may conduct air to another component requiring cooling. Given that the engine is located under the bonnet, space under a tractor bonnet is greatly restricted. Therefore air ducts have to be restricted in size and position which can lead to inefficiency in cooling components.

It is an object of the present invention to provide an improved air cooling system under the bonnet of a tractor wherein two air compartments are defined.

According to the invention, there is provided a cooling arrangement on an agricultural vehicle comprising a radiator and a fan with a fan shroud located in a bonnet, said bonnet having a pivotable hood wherein when the bonnet is closed a part of the fan shroud defines a first and a second air compartment.

In this way, when the vehicle is in use, two air compartments are defined having a large a cross sectional area as possible but whilst occupying minimal space under the bonnet. When the bonnet is closed, the fan shroud contacts the bonnet and two discrete air compartments are formed.

Preferably, the fan shroud is provided with sealing means. This way when the bonnet is closed the two air compartments are separated from each other so that air cannot flow between the bonnet and fan shroud between the two compartments.

Preferably, the first compartment is positioned between the hood and the fan shroud.

Preferably, the second compartment is positioned downstream of the fan.

Preferably, the hood when closed comprises a grill which extends in a generally vertical plane at the front of the vehicle as well as in a generally horizontal plane across a front portion of the vehicle.

Preferably, the fan shroud is provided with a flange for attaching the sealing means thereto. More preferably, the flange extends from a lower part of the fan shroud, along opposing sides and over an upper part of the fan shroud.

The bonnet preferably comprises at least one moveable side part.

The invention will now be described, by way of example only, with reference to the following drawings in which:

Figure 1 is a side view of an agricultural tractor with the bonnet closed,

Figure 1a is a perspective view of the bonnet of figure 1,

Figure 1b is a side view of the bonnet of figure 1a with a hood of the bonnet raised in which a cooling arrangement in accordance with the invention is shown,

Figure 2 is a side view of a front part of the tractor bonnet of figure 1b, and

Figures 3 and 4 are perspective views of the cooling arrangement of figure 2 in which the bonnet panels and chassis are removed,

Figure 5 shows a cross section along line X-X of figure 4 which shows the cooling arrangement, and

Figure 6 shows a detailed view of the front of the vehicle of figure 4.

Figure 1 is a side view of an agricultural tractor 1 having a front bonnet 2 which houses an engine and a cooling arrangement (not seen) in accordance with the invention. The bonnet 2 extends from a driver's cab 1a to the front of the tractor. A grill or mesh 3 is positioned at the front of the bonnet through which air passes and enters the cooling arrangement shown in figures 2, 3 and 4. The arrow indicates the forward direction of travel.

Figure 1a is a perspective view of the bonnet of figure 1. The bonnet 2 comprises a hood 2a and two opposing side parts 2b. When the bonnet 2 is closed as shown in figures 1 and 1a, the hood 2a has a fairly flat upper surface which extends in a generally horizontal manner from the cab. Towards the front of the vehicle, the upper surface of the hood 2a starts to slope downwards and has an almost vertical front part at the front of the tractor. The hood 2a has an overhang which extends a small vertical distance along each of the two long opposing side edges. Each side of the bonnet 2 is formed from a side part 2b and the overhang of hood 2a. The front part of the hood 2a and a part of the upper surface of the hood is provided with the grill or mesh 3.

Figure 1b is a side view of the bonnet 2 with the hood 2a in an open position. The hood 2a may be lifted to give access to the parts under it by pivoting it about a pivot axis located close to the cab 1a. When the hood 2a is lifted, it moves away from the side parts 2b. The larger the tractor, the higher is the

front of the hood when pivoted open. In the open position, the hood is often too high for person to reach and then apply the necessary force to pivot it down to close it. The bonnet hood may be provided with a retractable belt 18 which extends between a spring mounted roller and an attaching means. Either one of the roller or attaching means is positioned on the hood 2a with the other part, attaching means or roller being positioned on the tractor, for example the chassis. When the hood 2a is open the belt extends vertically from the hood 2a to the chassis. To close the hood, the driver simply pulls a mid portion of the belt towards him or her which causes the hood to pivot downwards. As the hood 2a is closed, the belt retracts in length by the roller rolling the belt under tension from the roller spring.

As shown in figure 6, the front of the hood is provided with a locking means 50 for securing the hood to a front part of the tractor in a closed position. Additionally, or alternatively for easy closure of the hood and to prevent damage to the hood, guidance means is provided comprising two rollers 52 and two tracks 53. In figure 6, the hood is provided with two rollers 52 either side of the locking means 50. Tracks 53 extend in a substantially upright manner from a front part of the tractor which enables the rollers 52 to roll between the tracks 53 and guide the locking means 50 to the front of the tractor for engagement as the hood is lowered.

Each side part 2b comprises moveable side panels 6a, 6b and 6c (in which a grill may be integrated). Side panels 6a are located towards the front of the tractor and extend approximately from a fan 5 to radiators 6 as shown in figure 3. If more than one radiator 6 is fitted, the radiators are usually mounted in a series becoming increasingly closer towards the engine. Panels 6b and 6c are located to the rear of the bonnet and cover the engine. Moveable side panels 6a and 6b are pivotally attached to each side part 2b so that they can be moved with respect to the side parts to give access to components of the cooling system and/or engine system under the bonnet. The pivoting means may comprise spring means. Alternatively, side panels 6a and 6b may be fully, or partly removable from the side parts 2b to give access.

The edges of the panels 6a and 6b or the edges of the side parts 2b into which panels 6a and 6b fit are provided with a sealing means such as a rubber tubing 14 (Fig. 2) to prevent the escape of air to the atmosphere.

If side panel 6a is removable, it is attached to side part 2b by clamps and hooks at the locations marked E in figures 1a and 1b. To enable the side panels 6a to be easily removed, a hand grip 17 can be provided on the side panels 6a which allows a person to easily get a grip of the panels.

Figure 2 is a side view of a front part of the bonnet 2 in which the side panel 6a has been omitted so that the cooling arrangement inside the bonnet can be seen. A mounting plate 4 is provided which extends from under the fan 5 which is positioned at the front of the tractor behind the grill 3 to under the radiator or radiators 6 which are positioned in front of the engine (not shown) with respect to the forward direction of travel of the tractor. The tractor is provided with two parallel frames 7 which form the chassis. The mounting

plate 4 extends widthways across both frames 7 and is provided with a fan mounting surface 8 and radiator mounting surfaces 9. The side profile of the mounting plate 4 is that of a laterally extended Z in that the fan mounting surface 8 and radiator mounting surfaces 9 are generally horizontal and are connected by a sloping surface 13 such that the fan mounting surface is elevated with respect to the radiator mounting surfaces. Since the frames 7 are horizontal, a support element 10 fixes the front of the plate 4 under the fan mounting surface 8 to the frames 7. The support element 10 is affixed to the frames 7 by bolts. The radiator mounting surface 9 of the plate is secured directly to the frames 7 by bolt means. On the underside of the plate 4 at the area of the fan mounting surface 8, attachment means are provided for attaching a light or heater core thereto. In, or on the plate 4 at the area of the radiator mounting surface 9, bore holes and/or channels are provided for receiving pipes from the radiator or radiators 6 and/or channels for delivering liquid to the radiator or radiators 6.

Two air flows are indicated by arrows A and B. Air Arrow A shows an air flow for an air intake for the combustion of the engine and arrow B for cooling the radiators 6 and the engine. The fan 5 pushes air through the radiators 6 and the engine.

Figures 3 and 4 are perspective views of the cooling arrangement 11 in which the chassis and bonnet have been omitted. The difference between figure 3 and 4 is that in figure 4 an extended fan shroud 12 is shown. As shown in figures 3 and 4 fan 5 is mounted on mounting plate 4 so that it is tilted towards the radiators 6. Fan 5 is secured to the fan mounting surface 8 by fan attachment means extending through bores in the plate 4. Radiators 6 are attached in series to plate 4 by bolt means. The radiators 6 are in a spaced arrangement from the fan 5 with the fan mounting surface 8 at one end of the sloping surface 13 and the radiator mounting surfaces 9 at the other end.

The extended fan shroud is assembled from a number of parts bolted together. Preferably, the extended shroud comprises at least three or four parts. In figure 4 the extended fan shroud 12 is shown having a lower part 12a which extends from the bottom half of a fan ring 12c in a forward direction with respect to the forward direction of travel of the tractor and an upper part 12b which extends rearwards from the upper half of the fan ring 12c towards the radiators 6 over plate 4. The upper part 12b is formed by two side parts 12d (only one is shown in figure 4) and a central part 12e. Side parts 12d may therefore be connected to either side of central part 12e to form an upper part 12b. Alternatively, central part 12e could itself comprise two half parts, each of which is connected to a side part 12e to form the upper part 12b.

A flange 15 is provided with sealing means 16. The flange 15 extends from a lower part of the fan shroud 12a diagonally along opposing sides of the upper part 12b and across parts 12b and 12d of upper part 12b. Preferably the bonnet 2 may be provided with sealing means 16. Sealing means 16 may, for example comprise rubber tubing.

In Figure 5 the cooling arrangement 11 is shown. The cooling arrangement shown comprises a fan 5 and radiators 6 in which the radiators are located downstream of the fan. It is envisaged that the fan 5 and the radiators 6 could be arranged the other way around so that the radiators are mounted upstream of the fan. In such an arrangement, the radiators are mounted in front of the fan with respect to the forward direction of travel.

When the bonnet 2 is closed and in contact with the sealing means 16 two air compartments are defined. A first air compartment C and a second air compartment D. Sealing means 16 prevents air passing between the flange 15 and hood 2a at the border of the two compartments C, D. First air compartment C is partially positioned above cooling fan 5, between the grill 3 of hood 2a and extended fan shroud 12. Its outer perimeter is defined by flange 15. Compartment C is a low pressure area. The dotted line in Figure 2 and 4 represents the grill 3 of the bonnet 2 when closed. With reference to figure 1a in which the bonnet is closed, grill 3 is formed in the hood 2a so that it has a vertical, or generally vertical part 3a and a generally horizontal part 3b. Grill part 3b extends from grill part 3a towards the rear of the vehicle past fan 5. Air flowing through compartment C is conducted by a duct to components on the tractor requiring cooling.

Second air compartment D is positioned downstream of the fan 5 and as shown herein is located behind the radiators 6. Compartment D is a high pressure area and is enclosed by the hood 2a, the flange 15 and bonnet side panels 6b, 6c. Air which passes through the radiators 6 enters compartment D and then flows out to the atmosphere through a grill mounted in panel 6c, or through the frames 7.

By compartment it is meant a partially or fully enclosed area in which a surface which fully or partially encloses the area may, or may not be airtight.

When the bonnet 2 is closed and sealed, the panels 6a form an extension of the fan shroud between lower part 12a and upper part 12b so that air is channelled between the upper part 12b, side panels 6a and mounting plate 4 to the radiator 6. As a result, a complete fan shroud which extends from the fan to the radiator is formed from the upper part 12b, side panels 6a and plate 4. Thereby the mounting plate 4 guides air directly to the radiators 6.

When the bonnet 2 is closed and the sealing means 16 contacts the bonnet 2 (or flange) two discrete air compartments C and D are defined.

Claims

1. A cooling arrangement on an agricultural vehicle comprising a radiator and a fan with a fan shroud located in a bonnet, said bonnet having a pivotable hood, characterised in that when the bonnet is closed a part of the fan shroud defines a first and second air compartment under the bonnet.
2. A cooling arrangement as claim 1 wherein the fan shroud is provided with sealing means.
3. A cooling arrangement as claimed in any preceding claim wherein the first compartment is positioned between the hood and the fan shroud.
4. A cooling arrangement as claimed in claim 1 wherein the second compartment is positioned downstream of the fan.
5. A cooling arrangement as claimed in any preceding claim wherein the hood comprises a grill so that when the hood is closed the grill extends in a generally vertical plane at the front of the vehicle as well as in a generally horizontal plane across a front portion of the vehicle.
6. A cooling arrangement as claimed in claim 5 wherein the grill extends past the fan in a direction towards the rear of the vehicle.
7. A cooling arrangement as claimed in any preceding claim wherein the fan shroud is provided with a flange for attaching the sealing means thereto.
8. A cooling arrangement as claimed in claim 7 wherein the flange extends from a lower part of the fan shroud, along opposing sides and over an upper part of the fan shroud.
9. A cooling arrangement as claimed in any proceeding claim wherein the bonnet comprises at least one moveable side part.

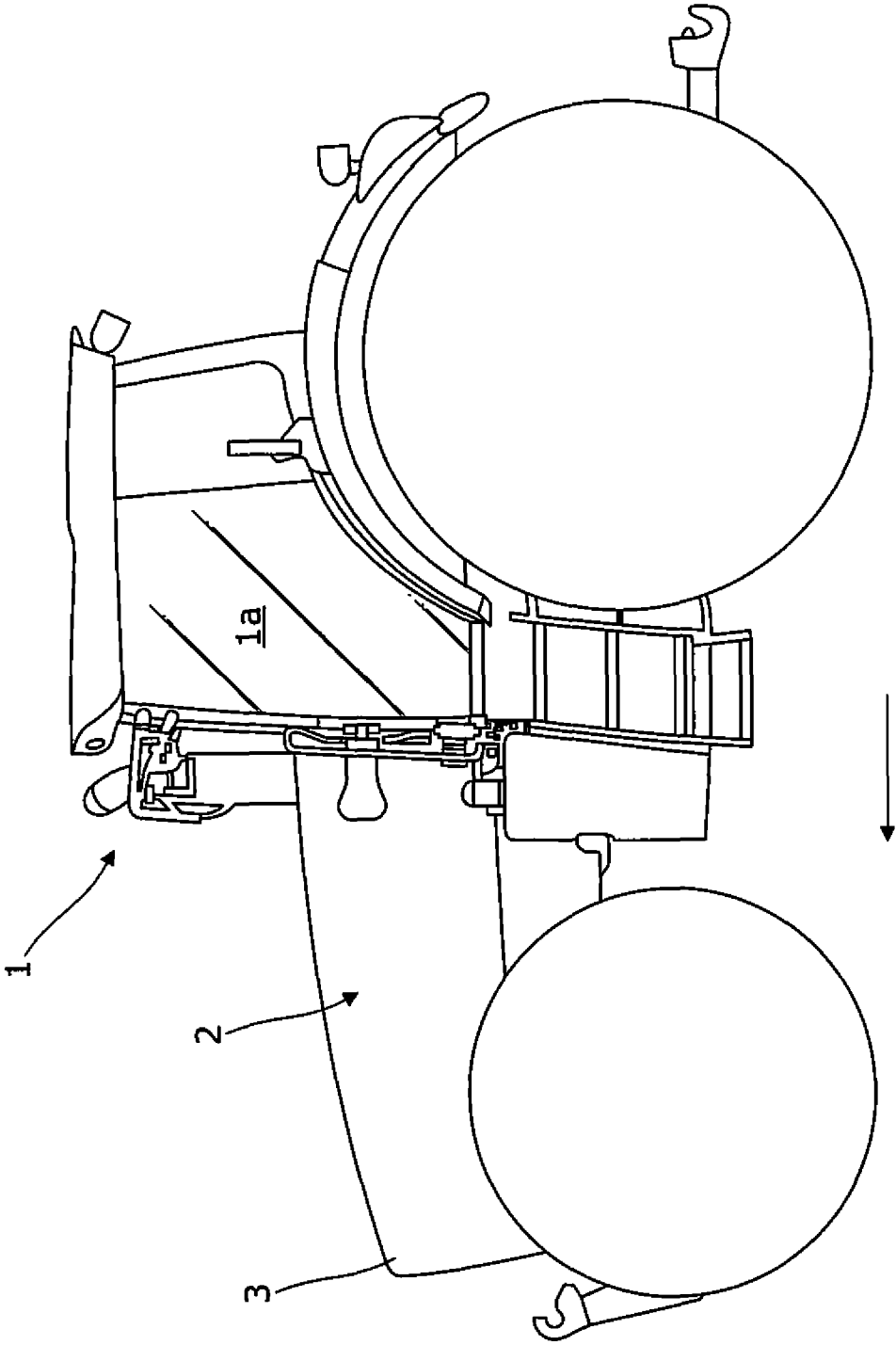
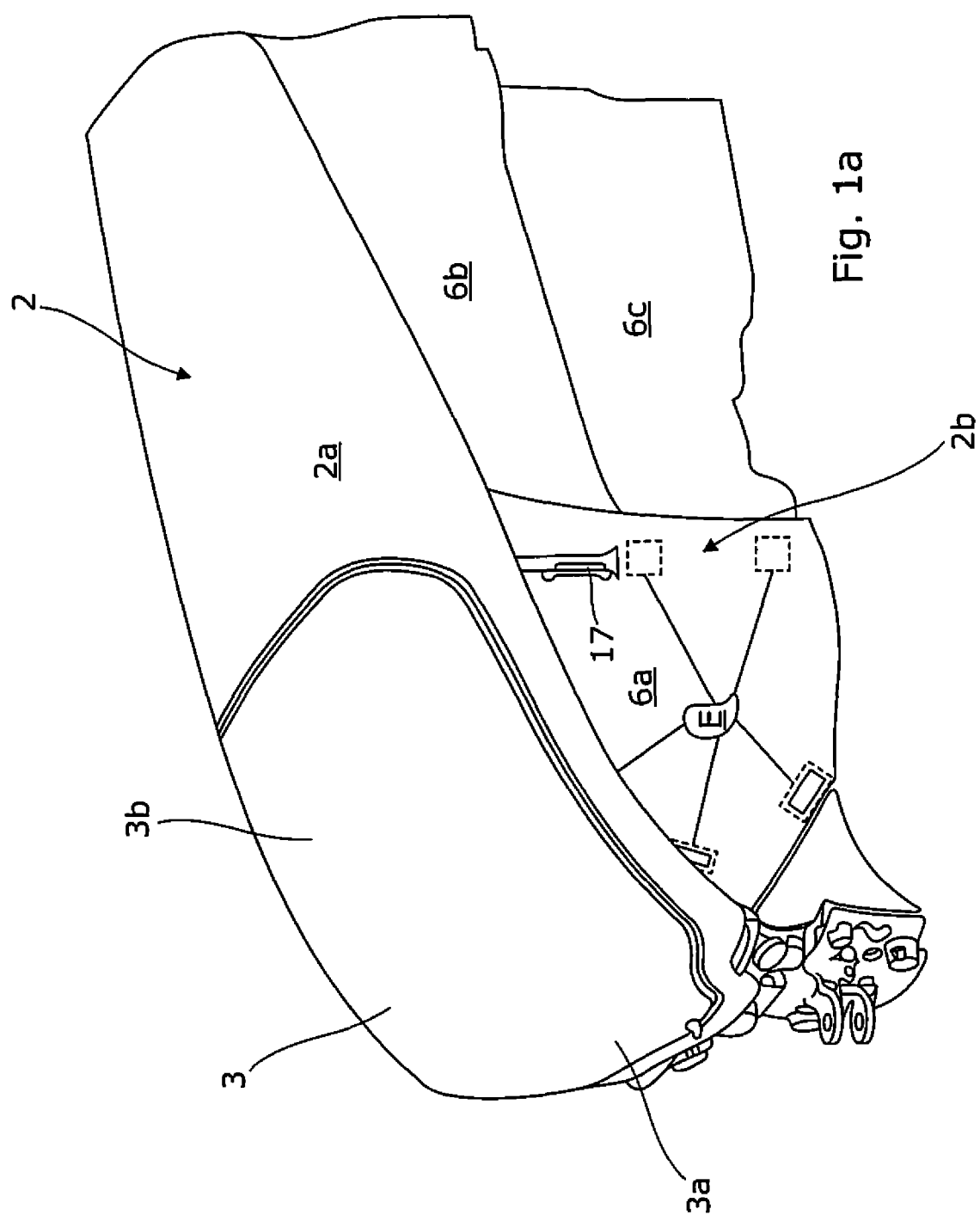


Fig. 1



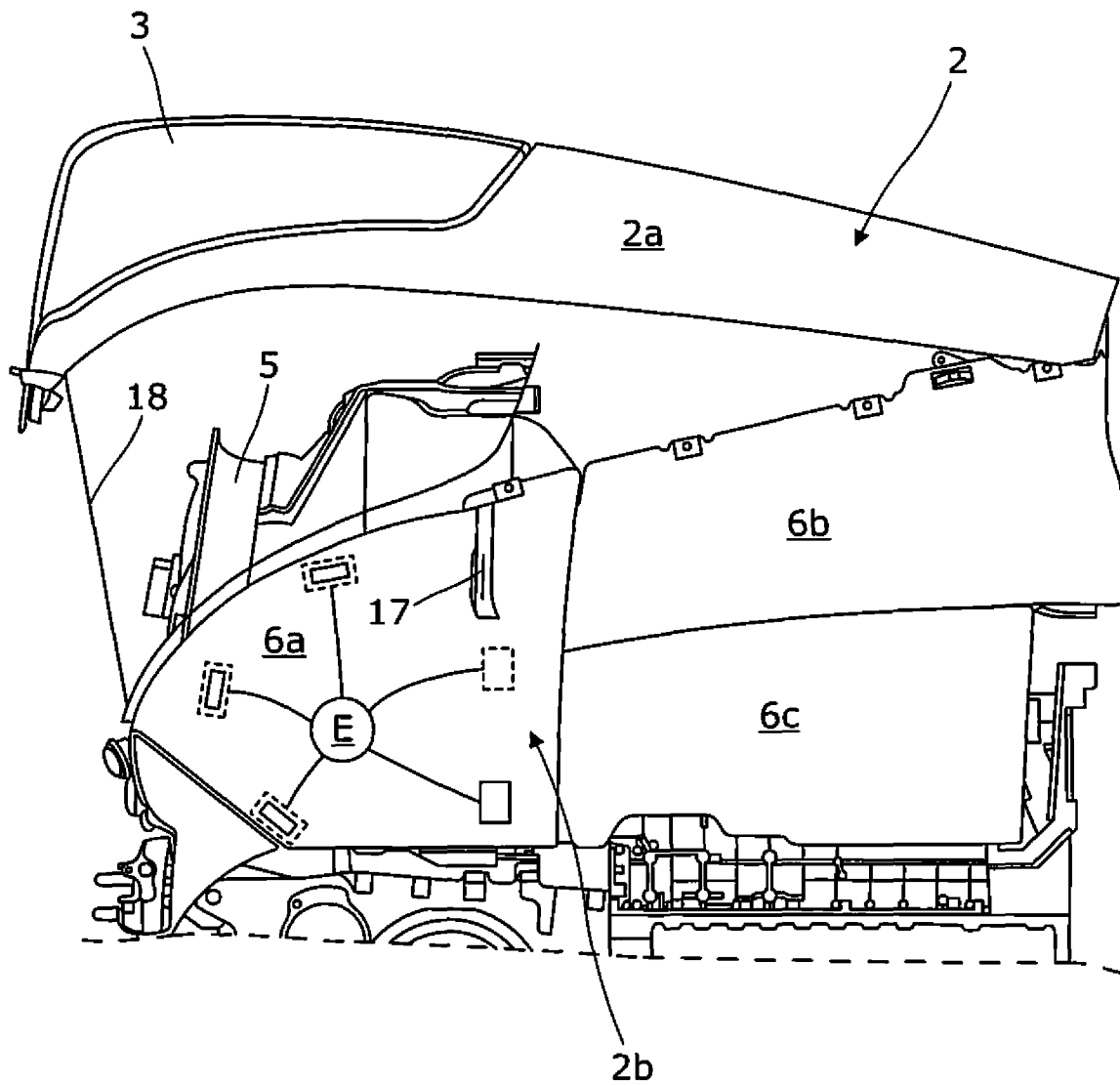


Fig. 1b

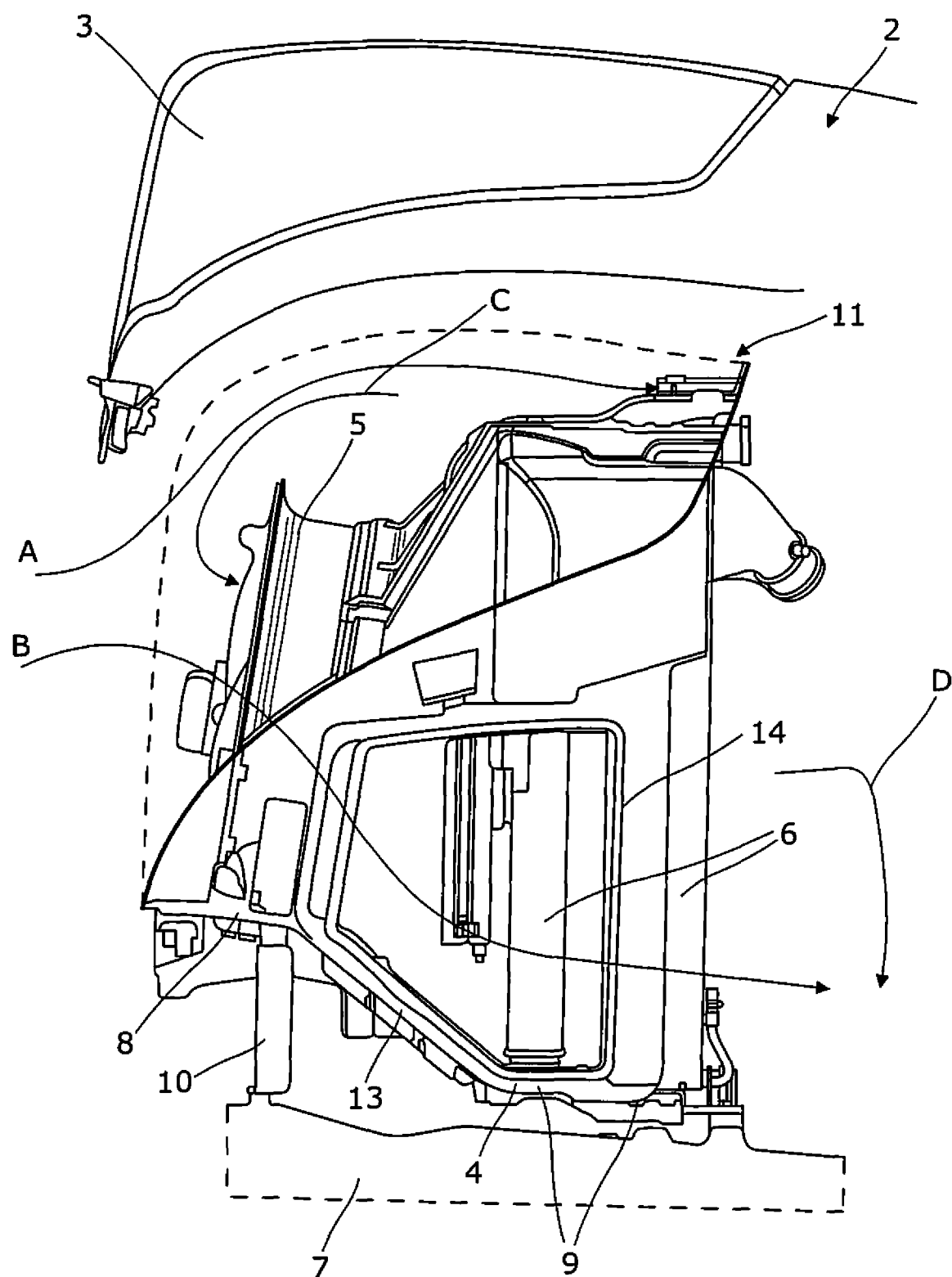


Fig. 2

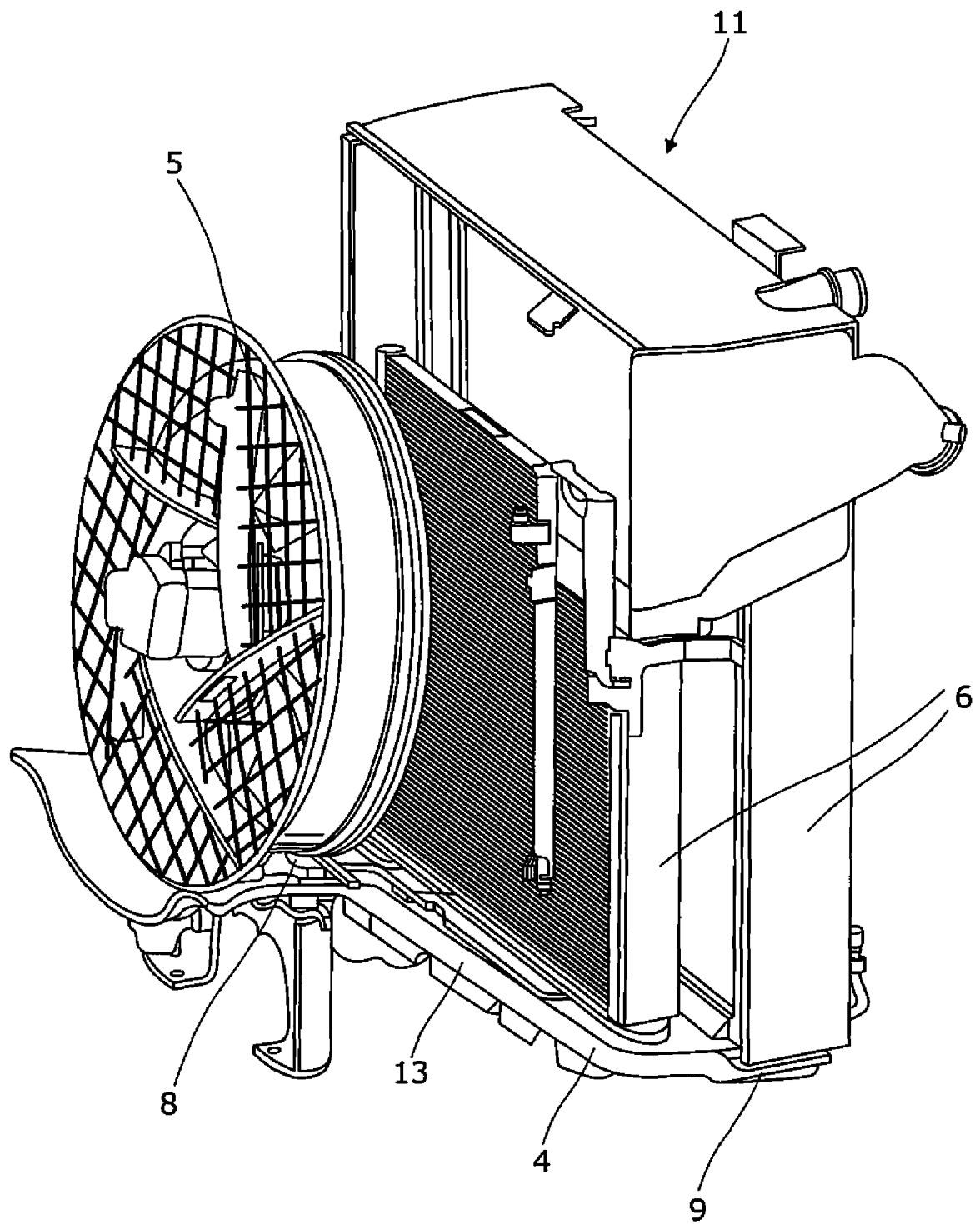


Fig. 3

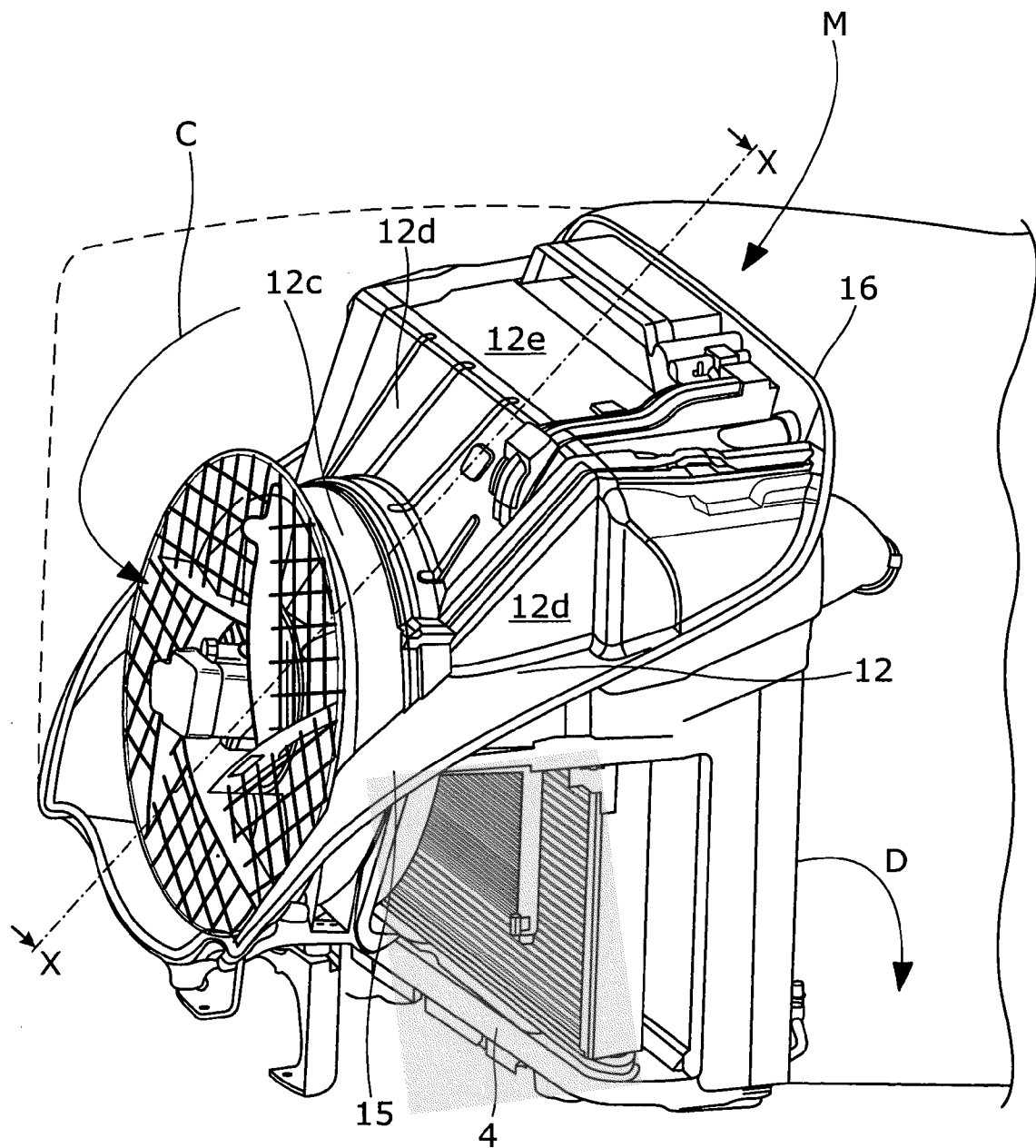


Fig. 4

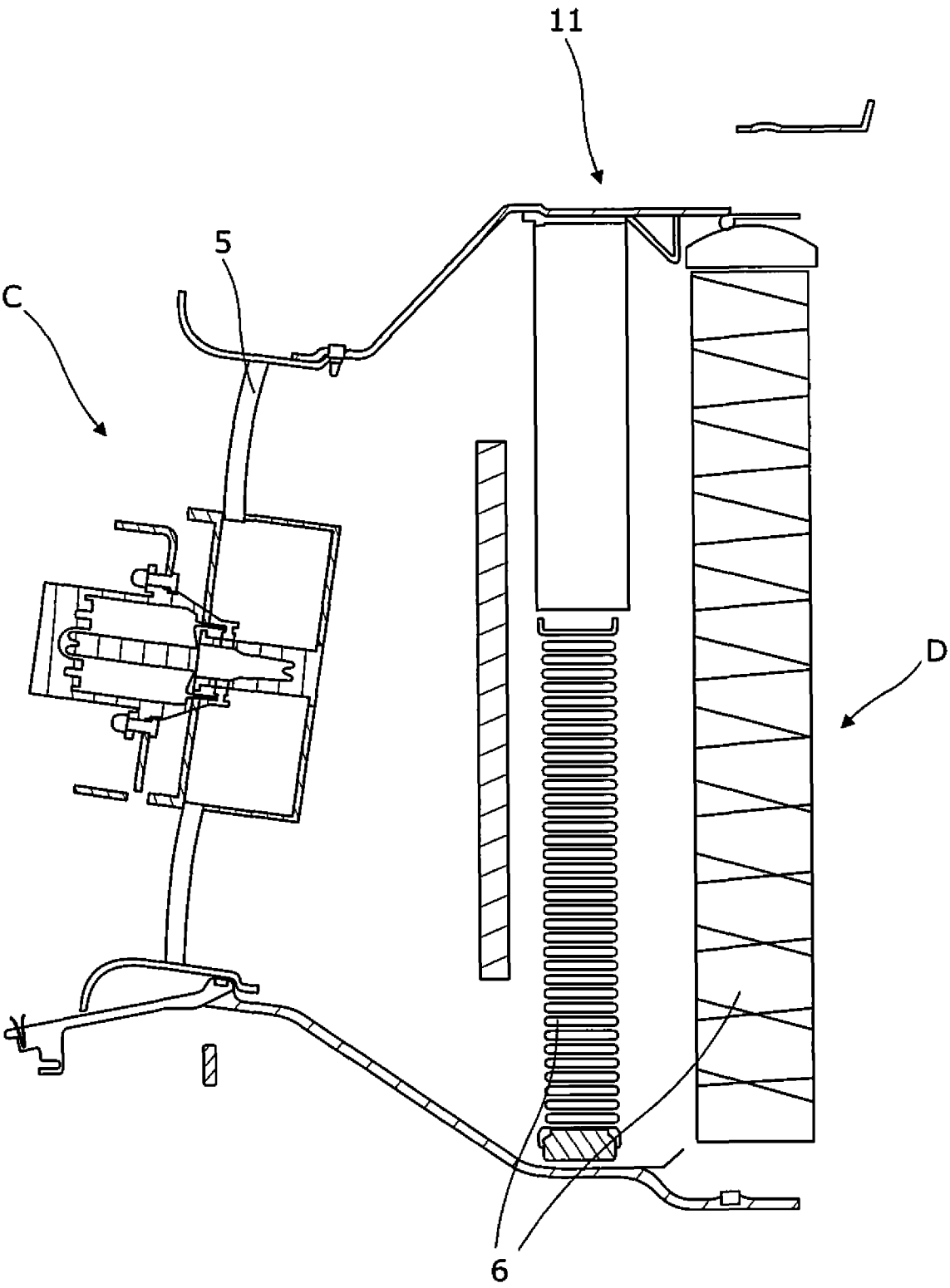


Fig. 5

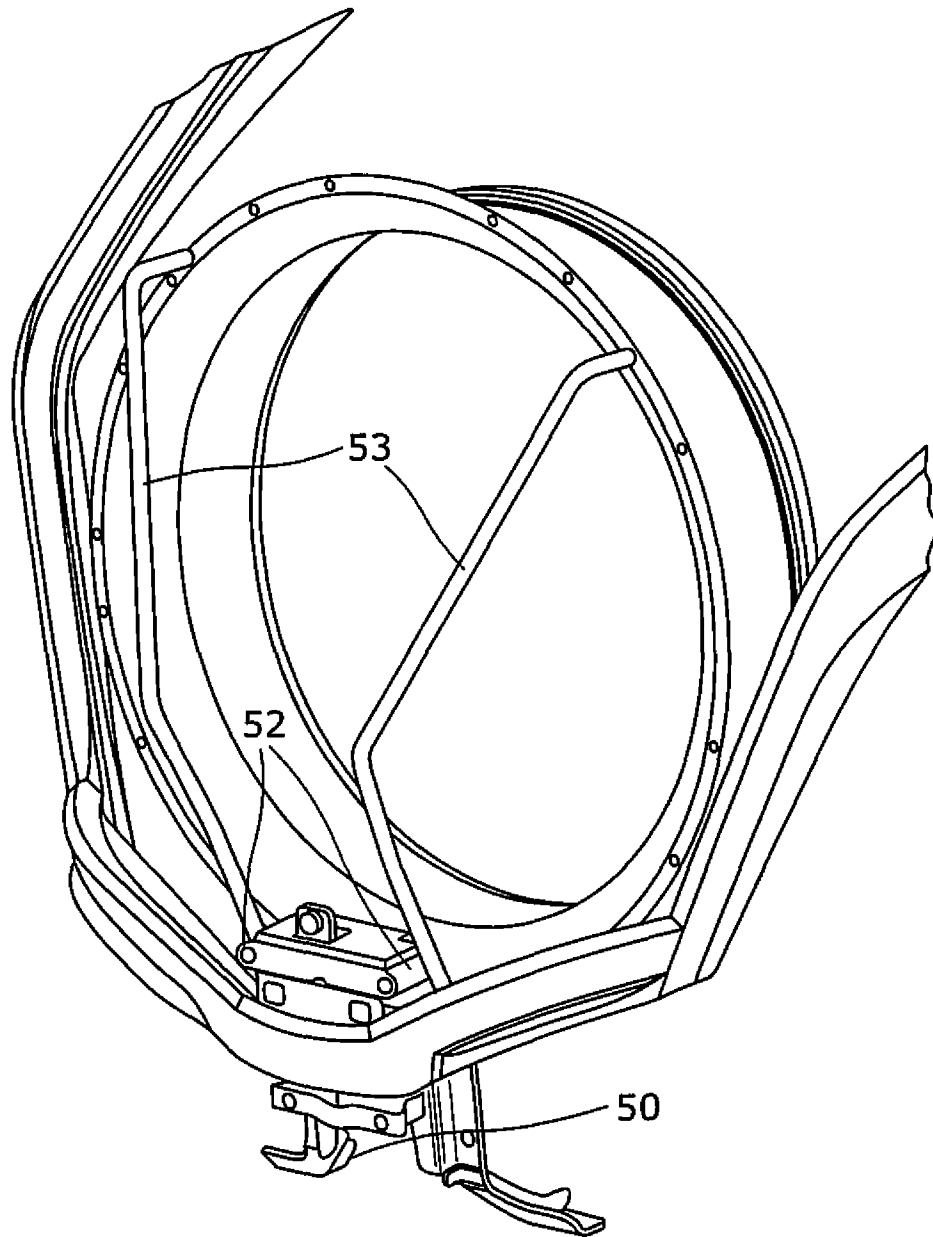


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

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ADD.

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)

F01P B62D B60K

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 2003/015361 A1 (BLAND MARK [US]) 23 January 2003 (2003-01-23) paragraphs [0017] - [0023] figures 1-4	1-9
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☒ 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

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INTERNATIONAL SEARCH REPORT

International application No

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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