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(54) **Engine cooling system**

(57) The present invention relates to an engine cooling system (1), particularly, but not only, for an average industrial vehicle, characterized in that it comprises a second additional radiator (12) placed downstream the main radiator (10) with respect to the direction of the cooling air flow generated by the forward movement of the vehicle and/or by a fan (11) placed behind the main radiator (10).

The cooling system according to the present invention allows to increase of about one third the overall heat exchange surface, that results in an improved efficiency of the system itself, that remains extremely simple, as there is a very restricted number of additional elements, easy to install and very small.

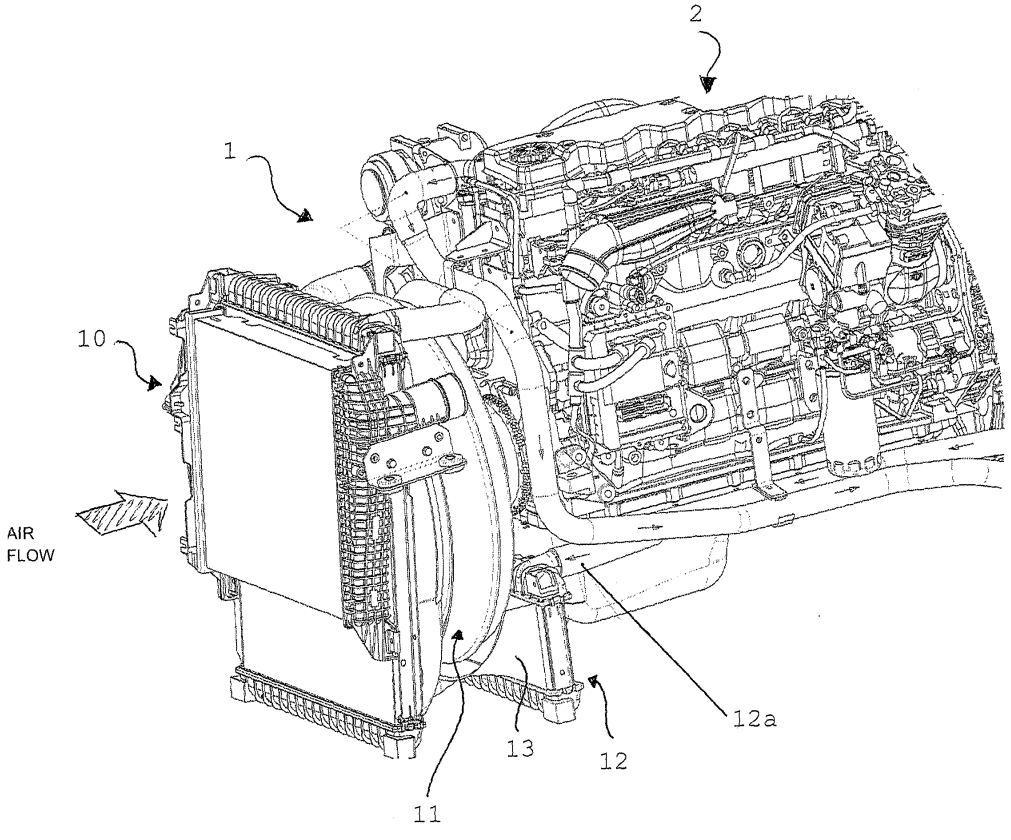

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an engine cooling system, particularly for average industrial vehicles, provided with an improved heat exchange efficiency, and also to a vehicle comprising such system.

DESCRIPTION OF THE PRIOR ART

[0002] In the field of the vehicle engine cooling systems, radiators for air/water heat exchange are known in the art. The water or the coolant that runs through the engine cooling system arrives to the radiator where it is hit by a fresh air current, thus obtaining the desired heat exchange.

[0003] Although the radiator is frontally hit by the air flow because of the vehicle forward movement, in order to improve the heat exchange efficiency it is known to place a fan behind said radiator, usually connected to a viscous-static joint or to an electric engine, suitable for ensuring the required air flow for obtaining the desired heat exchange. Practically, the fan is placed behind the radiator so that it does not interfere with the fresh air flow coming from outside that hits the radiator itself when the vehicle is travelling. The fan creates an intake air flow which passes through the radiator and adds to the air flow generated by the forward movement of the vehicle, from the front part to the rear part of the vehicle.

[0004] In case of industrial vehicles, generally equipped with high or medium-high power engines, the problem of the engine overheating is critical. Particularly in case of average vehicles, which have high-performance engines accommodated in vehicles with reduced dimensions, which do not allow to mount radiators with large heat exchange surfaces.

[0005] An improved efficiency of the engine cooling system results in an improved efficiency of the engine itself, which can thoroughly exploit its power without any risk of overheating. In order to improve the efficiency of the engine cooling system there are two solutions.

[0006] A first solution is to use fans with higher performances, which causes the fan to absorb more power, and therefore causes the engine itself to consume more fuel. Thus this solution may be possible, but it is not advantageous.

[0007] A second solution is to increase the heat exchange surface by increasing the dimensions of the radiator, this solution, however, cannot be adopted on average vehicle, whose dimensions have to be compact. In the engine compartment of such vehicles there is very little room for the accommodation of the radiator, and the dimensions of the main radiator are practically imposed by the overall project of the vehicle and cannot be increased.

SUMMARY OF THE INVENTION

[0008] The problems mentioned above are solved according to the present invention by an engine cooling system particularly for average industrial vehicles, comprising a main radiator, at least a fan placed behind said radiator with respect to the direction of the air flow that it generates, and **characterized in that** it comprises also at least a second additional radiator, placed downstream said fan with respect to the direction of the air flow it generates. More in particular, the cooling system according to the present invention is **characterized in that** said additional radiator is placed downstream the fan and in front of the oil pump, and in that it has smaller dimensions than the main radiator, as to not prevent the cooling effectiveness of the air flow generated by the fan itself.

[0009] Also, more in detail, the additional radiator may advantageously have a surface equal to about 1/3 of the main radiator, thus increasing the heat exchange surface of about 30%.

[0010] This invention refers in particular to what mentioned in the claims attached hereto.

LIST OF THE FIGURES

[0011] The present invention will be explained by means of a detailed description of preferred, but non-exclusive, embodiment shown with the help of the drawings that are attached hereto, which are merely illustrative and not-limitative, in which:

figure 1 shows a perspective view of the cooling system according to the present invention mounted on an engine;
figure 2 shows a side view of a part of the cooling system of figure 1;
figure 3 shows the same cooling system as in the previous figures viewed from a different perspective.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

[0012] Figure 1 shows a cooling system 1 according to the present invention assembled to an internal-combustion engine 2, in particular to the engine of an average industrial vehicle. The cooling system according to the present invention comprises a main radiator 10 placed in correspondence of the front part of the vehicle, thus in front of the engine. Behind said main radiator there is a fan 11, suitable for directing the fresh air flow coming from outside and generated by the forward movement of the vehicle, schematically indicated by the "air flow" arrow in figure 1. The task of the fan 11 is therefore to suck air from the front area of the main radiator 10 and to direct it toward the area occupied by the engine. The direction of the air flow generated by the fan 11 is thus the same as the air flow generated by the forward movement of the vehicle itself.

[0013] Therefore the fan is placed behind the main radiator 10 and substantially involves the whole surface of the radiator itself. This way, the air flow generated by the fan 11 when it is activated by the electric engine or by the viscous-static joint, not shown in the figures, to which it is associated, passes through the whole heat exchange surface of the main radiator.

[0014] According to the present invention, in the cooling system there is also an additional radiator 12 placed behind the fan 11.

[0015] More in particular, the additional radiator 12 advantageously has smaller dimensions with respect to the main radiator 10 as to not stop the air flow going outside the fan 11, namely as to not reduce the efficiency of the heat exchange of the main radiator, and it is placed in correspondence of a perimetral portion of the surface of said main radiator.

[0016] More in detail, according to a preferred embodiment of the present invention, the additional radiator 12 may advantageously have a surface equal to about 1/3 of the surface of the main radiator and may be placed in correspondence of the lower portion of said main radiator. Moreover, always according to the preferred embodiment shown in the attached figures, the additional radiator 12 takes the coolant directly from the engine, and thus the temperature of the fluid in the additional radiator 12 is very high, exceeding 90°C. Since normally the air that is directed by the fan 11 toward the engine after having passed through the main radiator 10 has a temperature of about 70°C, the difference of temperature between the air coming from the fan 11 which hits the additional radiator 12 and the fluid which runs through such radiator is enough for the heat exchange, thus obtaining a first cooling of the fluid coming from the engine.

[0017] With particular reference to figures 1 and 3, the cooling fluid arrives to the additional radiator 12 from the engine by means of the first going pipe 12a, and it is cooled thanks to the heat exchange between fluid and air coming from the fan 11, then it is sent back to the engine by means of the first return pipe 12b. In the case of the embodiment shown in the figures, at the end of the first return pipe 12b there is a thermostat 14 which detects the temperature of the fluid pre-cooled in the additional radiator 12 and decides whether to send back this fluid to the main radiator 10 for a further cooling. In the latter case the fluid is sent from the thermostat 14 to the main radiator 10 by means of the second going pipe 10a.

[0018] Then the cooled fluid goes from the main radiator 10 to the engine by means of a second return pipe 10b.

[0019] Also with reference to the attached figures, the additional radiator 12 may be appropriately equipped with a flow conveyor 13.

[0020] Said flow conveyor 13 may be formed for example by a deflector or by a flange having a flow input profile suitable to match with a part of the perimeter of said fan 11 and a flow output profile suitable to match with a part of the perimeter of said additional radiator 12.

[0021] The fan 11, in fact, sucks air from the front area to the main radiator with an axial input flow which becomes radial when coming out of the fan. The air released by the fan has therefore a radial direction which is directed by the conveyor 13 in a direction substantially perpendicular to the heat exchange surface of the additional radiator 12. According to the embodiment of the present invention shown here as an example, the additional radiator may have, as said, a surface equal to about 1/3 of the surface of the main radiator.

[0022] The dimensions of the additional radiator are suitable for guaranteeing a good additional heat exchange surface, since having 1/3 of additional heat exchange surface results in an improvement of about 10% with respect to a system equipped only with the main radiator, but at the same time they are suitable to not prevent the air flow going out of the fan 11. It has been proved, in fact, that if the additional radiator had a too large surface, the delivering of air from the fan would be hindered, with a consequent decrease of the cooling effectiveness of the main radiator.

[0023] Thanks to the profile of the conveyor 13, the air flow that is substantially radial is directed again toward the surface of the additional radiator with a direction substantially perpendicular to this surface. In order to obtain this effect, the conveyor 13 has an input part with a substantially annular structure which follows the perimeter of the fan 11, and joints as to match with at least the lower border and the side borders of said additional radiator 12.

[0024] According to a possible alternative embodiment of the present invention, which is not shown in the attached figures, behind the additional radiator 12 there may advantageously be two or more electric fans. This way it is possible to reduce the loss of efficiency that may be possibly detected in correspondence to the main radiator 10, and at the same time to increase the heat exchange efficiency of the additional radiator 12.

[0025] Also, the shown embodiment relates to an average industrial vehicle which may be possibly equipped with automatic gearbox.

[0026] Thus, as regards the cooling system scheme, there two alternatives according to whether the vehicle is equipped with automatic gearbox or with manual shift gearbox.

[0027] In case the vehicle is equipped with manual shift gearbox, the cooling fluid going out of the engine is directly sent to the additional radiator 12, and from it to the thermostat 14, as said. If the thermostat detects that the cooling fluid temperature still exceeds a predetermined threshold value, a valve controlled by the thermostat 14 sends back the cooling fluid to the main radiator 10, and the fluid goes out of the main radiator and comes back to the engine, closing the circuit.

[0028] In case the vehicle is equipped with automatic gearbox, the circuit of the cooling fluid going out of the engine brings the fluid to the gearbox heat exchanger, and only after that the fluid arrives to the additional radiator 12.

[0029] The cooling system according to the present invention is characterized by the presence of an additional radiator 12 placed downstream the main radiator 10 and of the fan 11 associated to it, without any distinction due to the presence or to the absence of the automatic gearbox, causing some differences in the architecture of the system.

[0030] In any case, in the additional radiator 12 takes place the first cooling step of the engine coolant, which is then sent to the main radiator. This way, since the main radiator receives the coolant at a lower temperature with respect to a traditional system, the ATB index increases with the fan absorbing the same power, with an increase of the overall efficiency of the system up to 10% with respect to a traditional system of the type known.

[0031] The engine cooling system according to the present invention achieves the task and the aims proposed.

[0032] In particular it has been shown that the engine cooling system according to the present invention achieves the aim to increase the surface that can be used for the heat exchange, envisaging a larger heat exchange surface without changing the dimensions of the main radiator and embodying a system that comprises an additional heat exchanger maintaining the overall small dimensions.

[0033] More in detail, the present invention achieves the aim to provide an engine cooling system with improved performances without any intervention on the radiator and on the main circuit, which remain mostly unchanged, and without any need for more space than that already present in the engine compartment of an average industrial vehicle. Since no intervention to the base system is required, the cooling system according to the present invention may be mounted on industrial vehicles with very low intervention costs.

[0034] Therefore it has been showed that the cooling system according to the present invention is extremely advantageous both in terms of improved functioning efficiency, and in terms of decrease of the required interventions for mounting the system itself, with a consequent reduced costs.

[0035] The cooling system according to the present invention allows, the power absorbed by the fan being equal, to remarkably increase the cooling efficiency, which results in an improved efficiency of the engine, the fuel consumption being the same.

[0036] The present embodiment may be modified and some details may be changed by the person skilled in the art, without departing from the scope of the invention described in the attached claims.

Claims

1. Engine cooling system (1) particularly for average industrial vehicles, of the type comprising a main radiator (10), at least a fan (11) placed behind said radiator (10) with respect to the direction of the cooling air flow, and **characterized in that** it comprises also at least an additional radiator (12), placed downstream said fan (11) also with respect to the direction of the cooling air flow.

2. Engine cooling system (1) according to the previous claim, **characterized in that** the cooling fluid runs through said additional radiator (12) before being possibly sent to said main radiator (10).

3. Engine cooling system (1) according to the previous claim, **characterized in that** it comprises at least a first going pipe (12a) for conveying the engine cooling fluid from the engine (2) to said additional radiator (12) and at least a first return pipe (12b) suitable for conveying the cooling fluid from the additional radiator (12) back to a thermostat (14) placed on the engine (2).

4. Engine cooling system (1) according to one or more of the previous claims, **characterized in that** it comprises also a second going pipe (10a) suitable for conveying the pre-cooled cooling fluid going out of additional radiator (12) from said thermostat (14) placed on the engine to the main radiator (10), and at a second return pipe (10b) suitable for conveying the cooling fluid from the main radiator (10) back to the engine (2).

5. Engine cooling system (1) according to the claims 3 or 4, **characterized in that** said thermostat (14) is connected to a valve suitable for deviating the flow of the cooling fluid coming from the first return pipe (12b) to the engine or to the main radiator (10) by means of the second going pipe (10a).

6. Engine cooling system (1) according to any of the previous claims, **characterized in that** the additional radiator (12) has smaller dimensions than said main radiator (10).

7. Engine cooling system (1) according to the previous claim, **characterized in that** said additional radiator (12) has a heat exchange surface equal to about one third of the heat exchange surface of the main radiator (10).

8. Engine cooling system (1) according to the previous claim, **characterized in that** said additional radiator (12) is placed in correspondence of the lower part of said main radiator (10).

9. Engine cooling system (1) according to one or more of the previous claims, **characterized in that** it comprises also a flow conveyor (13) connected to said additional radiator (12) and suitable for directing the air going out of said fan (11) with radial direction into

a direction substantially perpendicular to the surface of said additional radiator (12).

10. Engine cooling system (1) according to the previous claim, **characterized in that** said flow conveyor (13) may be formed by a deflector or by a flange having a flow input profile suitable to match with a part of the substantially circular perimeter of said fan (11) and a flow output profile suitable to match with a part of the perimeter of said additional radiator (12).

11. Engine cooling system (1) according to one or more of the previous claims, **characterized in that** the additional radiator (12) is also equipped with one or more electric fans placed at the opposite side of that facing the fan (11).

12. Industrial vehicle comprising an engine cooling system (1) according to any of the previous claims.

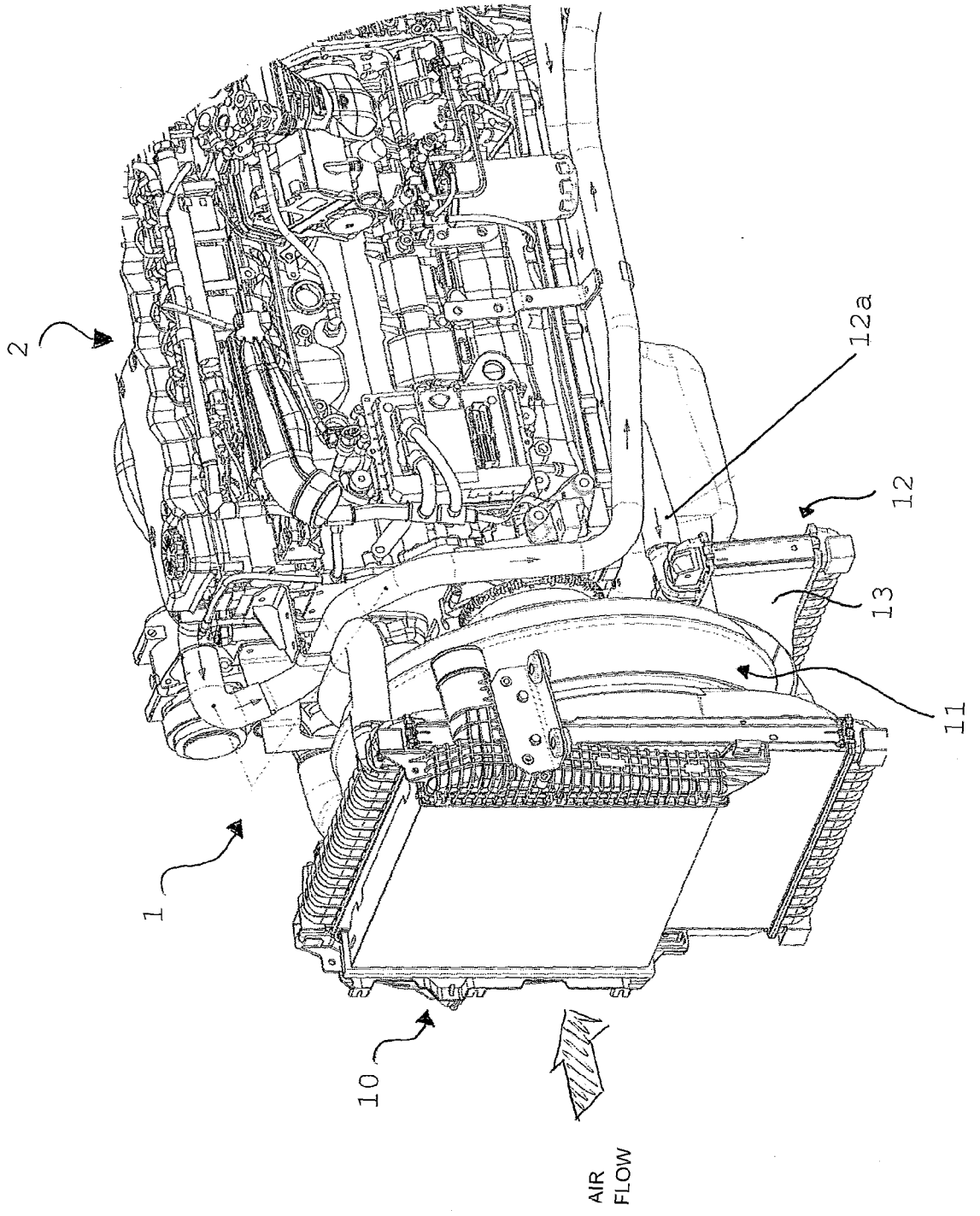

Fig. 1

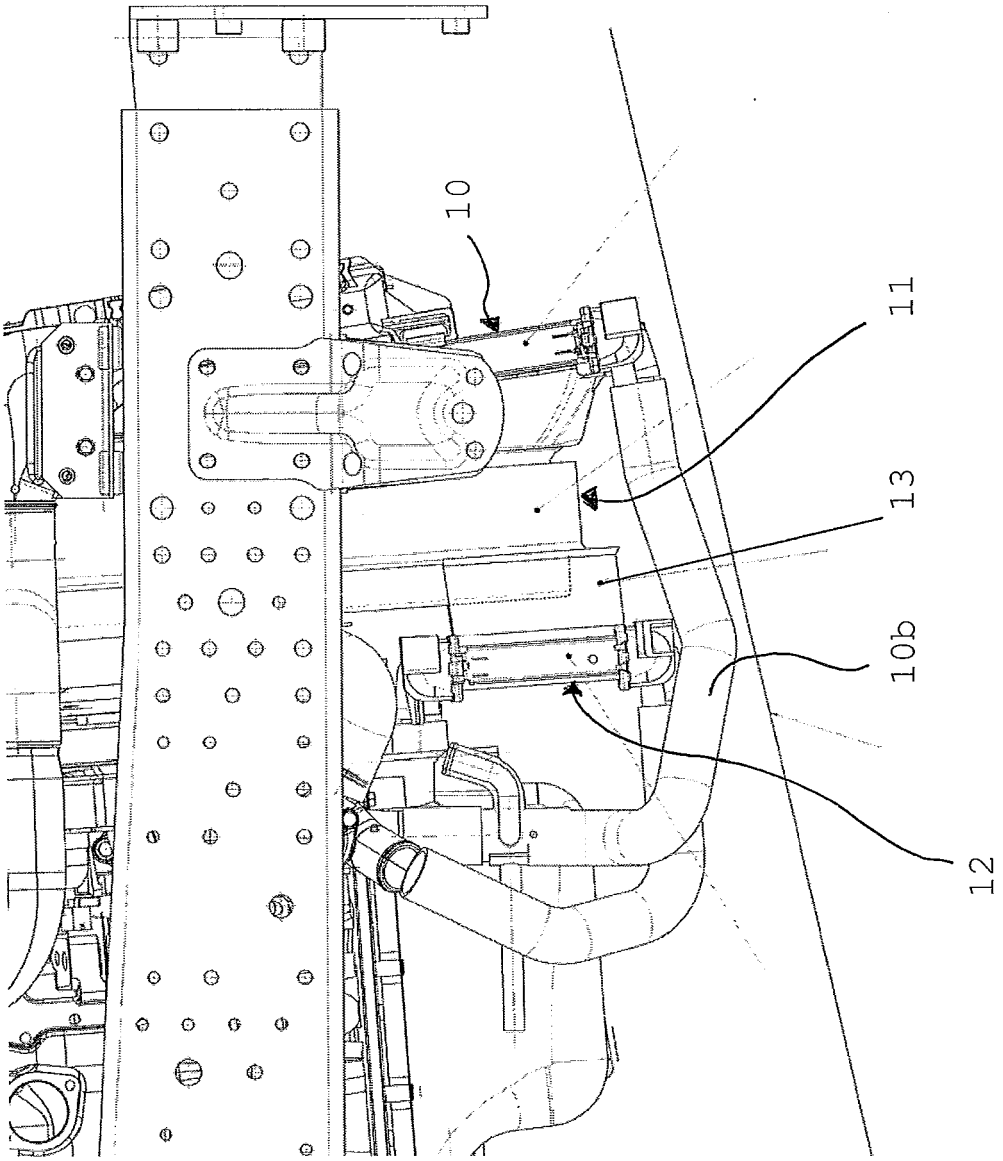

Fig. 2

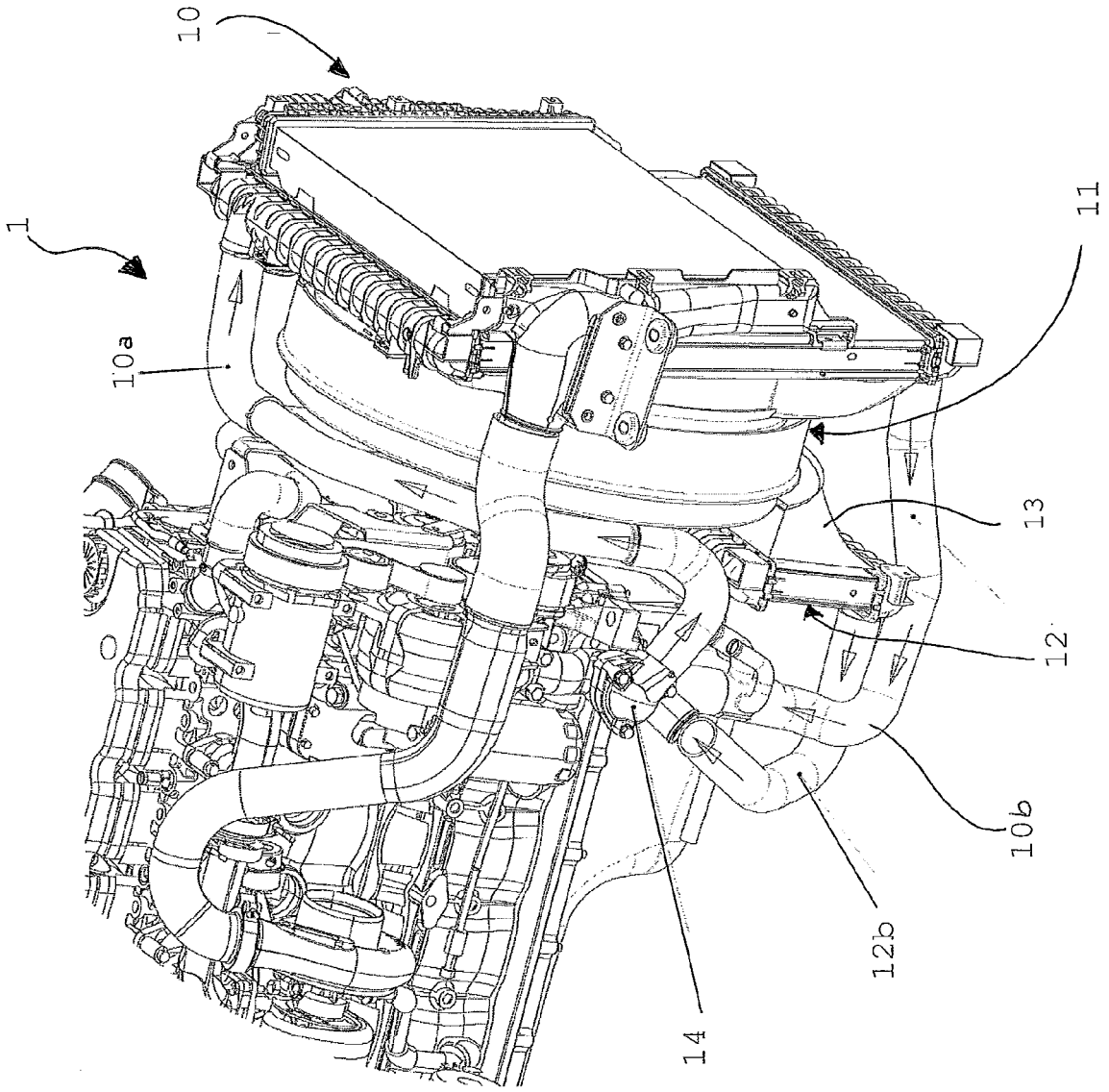

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5601

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1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 July 2009	Luta, Dragos

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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