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(54) **COOLING CIRCUIT FOR A VEHICLE AND VEHICLE COMPRISING A COOLING CIRCUIT**

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CIRCUIT DE REFROIDISSEMENT POUR UN VÉHICULE ET VÉHICULE COMPRENANT UN CIRCUIT DE REFROIDISSEMENT

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Description

TECHNICAL FIELD

[0001] The invention relates to a cooling circuit for a vehicle, particularly a commercial vehicle, wherein the cooling circuit comprises a combustion engine, a retarder cooler for cooling a retarder, an EGR cooler for cooling an exhaust gas of the combustion engine, and a coolant cooler which is coupled to the combustion engine for cooling the combustion engine by means of a coolant. The invention is further related to a vehicle, such as a truck, comprising a cooling circuit.

BACKGROUND OF THE INVENTION

[0002] It is known in the art that available space in the combustion engine compartment of vehicles is restricted. Particularly for commercial vehicles, such as light, medium or heavy duty vehicles, space is constricted due to the space confinements in the vehicle cab where the combustion engine is squeezed between the cooler package and the front axle. Due to advanced emission strategies larger coolers are required making packaging of the respective components and the necessary routing even more complicated.

[0003] WO 2004/085807 A1 discloses a cooling circuit comprising a combustion engine with a coolant cooler, a retarder cooler and an EGR cooler. The retarder cooler and the EGR cooler are equipped with separate cooling circuits. Each cooling circuit comprises a coolant cooler, a coolant pump and a thermostat. Depending on an actual heat load, for instance in case the retarder cooler needs more cooling the separate cooling circuits can be temporarily connected by a valve. By temporarily connecting the two separate cooling circuits, additional cooling capacity can be provided for the retarder cooler. In case the retarder cooler needs less cooling, the valve is closed and the cooling circuits of the EGR cooler and the retarder cooler operate separately. Alternatively, for providing a high cooling capacity, the coolant coolers of the separate cooling circuits can be connected in series while the EGR cooler is bypassed. The cooling capacity in the separate cooling circuits can be varied by bypass lines controlled by the separate thermostats in the cooling circuits.

[0004] US2008/0257317 A1 discloses a cooling system of an engine which is cooled with a coolant. A coolant collecting rail is mounted on top of the cylinder head of the engine. An EGR cooler is mounted to the coolant collecting rail. The EGR cooler receives a part of the engine coolant for cooling the EGR gas. Another part of the engine coolant is collected in the coolant collecting rail which also receives the coolant from the EGR cooler. A retarder cooler can be arranged in the return line between the coolant collecting rail and the coolant cooler.

[0005] DE102006048714 A1 discloses a cooling circuit for a heavy goods vehicle. In the cooling circuit, coolant from the oil cooler may flow to the EGR, then to the coolant collector, then to the retarder, and thereafter to the cooler. The coolant from the cylinder heads and cylinder liners flows to the cooler via the cooler collector, or via the cooler collector and the retarder.

SUMMARY OF THE INVENTION

[0006] It is an object of the invention to provide a cooling circuit for a vehicle which requires fewer components, which is space economic and provides an efficient cooling effect. Another object is to provide a vehicle with a cooling circuit allowing for advanced emission strategies. The objects are achieved by the features of the independent claims. The other claims and the description disclose advantageous embodiments of the invention. Thus, the object is achieved by means of a cooling circuit according to claim 1. The wording "permanently in series" means that the retarder cooler and the EGR cooler are arranged in a joint cooling circuit at least during operation. The coolant flows through both the retarder cooler and subsequently the EGR cooler during operation. The retarder cooler and the EGR cooler are integral parts of the cooling circuit of the combustion engine. It is not necessary to provide separate coolant coolers or coolant pumps for the retarder cooler and the EGR cooler or valves for connecting a cooling circuit containing the retarder cooler and a cooling circuit containing the EGR cooler.

[0007] Expediently, the retarder cooler and the EGR cooler can be high-efficient coolers which may generate a significant heat load to the coolant, while each cooler receives flow of the combustion engine coolant as cooling medium using virtually the same pipes. The number of pipes for supplying coolant to the retarder cooler and the EGR cooler can be reduced. The two coolers can favourably be full flow coolers, receiving the full flow of the coolant evacuated of the combustion engine so that all the coolant from the combustion engine can be fed through the EGR cooler, or can optionally receive only a partial flow of the coolant if required. Because the EGR cooler is configured to cool an exhaust gas from the combustion engine via the coolant from the combustion engine, favourably, the EGR cooler has a high cooling efficiency. The exhaust gas can be cooled in an efficient way. The EGR cooler is configured for conveying the complete coolant flow evacuated from the combustion engine. Whereas in prior art typically an EGR cooler receives only a small amount of the coolant flow, typically around 10% of the coolant flow evacuated from the combustion engine, the full flow EGR cooler can establish an efficient cooling of the recirculated exhaust. Expediently, the EGR cooler provides an efficient cooling with a space efficient and compact piping.

[0008] A space efficient packaging of the cooling circuit can be achieved because the combustion engine comprises a coolant output port positioned at a distance from the coolant cooler, wherein the coolant output port is con-

nected to an inlet of the retarder cooler, and wherein the retarder cooler and the EGR cooler are positioned between the coolant output port and the coolant cooler in such a way that they can provide said portion of the fluid path of the coolant from the combustion engine back to the coolant cooler.

[0009] The combustion engine comprises a coolant input port positioned at a first end of the combustion engine, wherein the coolant output port is positioned at a second end of the combustion engine opposite the first end. Favourably, the first end can be the front end of the combustion engine and the second end can be the rear end of the combustion engine. The thermostat of the engine can be arranged at the first end in a distance of the retarder at the rear of the combustion engine. A packaging-friendly arrangement of the combustion engine arranged along the longitudinal extension of the vehicle can be provided. Voluminous pipes can be avoided particularly if the retarder cooler is arranged at the second end of the combustion engine. Particularly, said EGR cooler can be positioned so that said portion of the fluid path of the coolant from the combustion engine back to the coolant cooler can be directed from the second end of the combustion engine towards the first end of the combustion engine. Space consuming additional pipes can be avoided as the EGR cooler is part of the return line of the coolant..

[0010] Advantageously, it is possible to save construction space and pipes by integrating the retarder cooler and the EGR cooler into the fluid path of the coolant transferring the combustion engine coolant by way of example from one end of the combustion engine to the opposite end of the combustion engine, and particularly to a radiator arranged in front of the first end of the combustion engine. Favourably, the coolant cooler is a joint cooler for the retarder cooler and the EGR cooler.

[0011] Advantageously, the coolant can be used to cool highly thermally loaded media, such as the retarder fluid, e.g. retarder oil, and the exhaust gas in the EGR system. Favourably, a major heat load can be introduced into the coolant by the EGR cooler and the retarder cooler as each generates a high heat load at different operational modes of the combustion engine. For instance, in an operational mode of the combustion engine where exhaust gas is recirculated from the exhaust gas output to the air inlet of the combustion engine, i.e. in a medium or high load mode of the combustion engine, the retarder is not in use while in an operational mode where the retarder is active, i.e. when the vehicle is decelerated, exhaust gas is not recirculated from the exhaust output to the combustion engine air inlet. Thus, although being capable of producing a high heat load, the retarder cooler and the EGR cooler can be arranged in series without need to increase the coolant flow or the diameter of the fluid path compared to a situation where only one of such a cooler were arranged in the coolant fluid path.

[0012] The return path of the coolant may for instance lead from the rear part of the combustion engine to the retarder cooler and back to the EGR cooler and from EGR cooler to a thermostat house at the front part of the engine. This results in a very space effective packaging. The number of components and large voluminous pipes can be reduced although coolers receiving the full coolant flow can be used. Favourably, only one thermostat house position, only one upper radiator hose and only one connection from the thermostat to a coolant pump is necessary in the cooling circuit. In particular, the coolant may be fed from the radiator through the combustion engine block to the retarder. The coolant may further be fed from the EGR cooler to the common thermostat house providing a bypass connection. Thereby, large pipes passing at the outside of the combustion engine for supplying the coolant to the retarder can be avoided.

[0013] According to a favourable embodiment, the EGR cooler can be configured to provide a portion of the fluid path of the coolant in a return line from the combustion engine back to the coolant cooler. Advantageously, the routing of the return line in the vicinity of the EGR cooler can be minimized and a compact arrangement can be achieved.

[0014] According to a favourable embodiment, the EGR cooler can be configured to provide a substantially straight portion of the fluid path of the coolant from the combustion engine back to the coolant cooler. Advantageously, a compact routing of the return line in the vicinity of the EGR cooler can be improved.

[0015] According to a favourable embodiment, the coolant cooler can be configured to cool the coolant via an air flow. A standard and efficient coolant cooler component can be employed in the cooling circuit.

[0016] According to a favourable embodiment, the coolant cooler can be formed by a radiator. A standard and efficient coolant cooler component can be employed in the cooling circuit.

[0017] According to a favourable embodiment, the coolant cooler can be positioned at a first end of the combustion engine. Particularly, a short connection from the first end of the combustion engine to the coolant cooler can be achieved.

[0018] According to a favourable embodiment, the combustion engine can be a diesel engine. Favourably, a very efficient cooling and space saving packaging can be achieved thus enabling the vehicle for larger cooler components required for advanced emission regulations for diesel engines.

[0019] According to a favourable embodiment, the EGR cooler can be arranged at an upper part of the combustion engine, thus providing a space efficient arrangement of the EGR cooler and leaving free space on the engine housing for other components or installations on the combustion engine.

[0020] According to another aspect of the invention, a vehicle according to claim 11 is proposed.

[0021] Expediently, the vehicle can be a particularly a light, medium or heavy duty vehicle, particularly a truck. The vehicle provides improved cooling efficiency for an

EGR cooler and a retarder cooler as well as a space efficient packaging by using fewer components compared to the prior art. Using fewer components fro the same cooling capacity saves construction space and allows the installation of larger cooler components providing improved emission control of a combustion engine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The present invention together with the above-mentioned and other objects and advantages may best be understood from the following detailed description of the embodiments, but not restricted to the embodiments, wherein is shown schematically:

Fig. 1a, 1b an embodiment of a cooling circuit comprising a retarder and an EGR cooler in series (Fig. 1a) shown in a perspective view and a view of the opposite side (Fig. 1 b); and

Fig. 2 an example embodiment of a vehicle according to the invention, comprising a cooling circuit according to Figs. 1a, 1b.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0023] In the drawings, equal or similar elements are referred to by equal reference numerals. The drawings are merely schematic representations, not intended to portray specific parameters of the invention. Moreover, the drawings are intended to depict only typical embodiments of the invention and therefore should not be considered as limiting the scope of the invention.

[0024] Fig. 1a shows a first perspective view of an embodiment of a cooling circuit 90 comprising a combustion engine 10, an EGR cooler 40 and a retarder cooler 30. Exhaust gas of the combustion engine 10 can be fed into an exhaust gas recirculation system (EGR system) wherein the EGR cooler 40 cools the exhaust gas discharged from the combustion engine 10. The combustion engine 10 is coupled to a retarder 32 for braking the vehicle, wherein the retarder is cooled by the retarder cooler 30.

[0025] The EGR cooler 40 is connected to the retarder cooler 30 and arranged in series with respect to the coolant flow. Fig. 1b depicts a view of the opposite side of the embodiment of the cooling circuit 90.

[0026] The combustion engine 10 is coolant cooled wherein the coolant is cooled in a coolant cooler 20 which may be part of a cooler package 26. Referring to both Figures 1 a and 1 b, the coolant, e.g. water, is conveyed through a coolant input port 45 to the combustion engine 10 at a first end 14 of the combustion engine 10. The coolant is evacuated at a second end 16 of the combustion engine 10 through a coolant output port 46. The first end 14 of the combustion engine 10 may be arranged by way of example close to the coolant cooler 20 of the cooler package 26, the first end 14 constituting e.g. a front end of the combustion engine 10. The second end 16 opposite to the first end 14 may be arranged at a distance from the coolant cooler 20 and constitutes e.g. a rear end of the combustion engine 10. The coolant cooler 20 comprises a radiator or may be formed as a radiator.

[0027] Air is sucked through the coolant cooler 20 by way of a fan 28 which is arranged at the first end 14, e.g. a front side of the combustion engine 10. At the second end 16, a transmission 22 is followed by a gear box 24. The retarder 32 is mounted to the gear box 24 arranged at the second end 16, e.g. the rear side, of the combustion engine 10.

[0028] In the EGR system of the combustion engine 10 exhaust gas is fed from an exhaust output port 56 through the EGR cooler 40 to an EGR valve 58 in which the exhaust gas is mixed with fresh air fed in through an air pipe 70 (shown partially interrupted) and fed to an input manifold in the middle portion 12 of the combustion engine 10. The EGR cooler 40 is arranged in an upper portion 12u of the combustion engine 10.

[0029] The combustion engine coolant is cooled in the coolant cooler 20 and fed to the combustion engine 10 through a pipe 50 between the coolant cooler 20 and the coolant input port 45 of the combustion engine 10.

[0030] A coolant fluid path 60 constituting a coolant return line between the coolant output port 46 and the coolant cooler 20 comprises in subsequent order a pipe 42a extending from the coolant output port 46 to the retarder cooler 30, the retarder cooler 30, a pipe 42b extending from the retarder cooler 30 to the EGR cooler 40, the EGR cooler 40, a pipe 44 extending from the EGR cooler 40 to a thermostat house (hidden in the combustion engine casting, not to be seen the drawing), the thermostat house and a pipe 48 from the thermostat house to the coolant cooler 20.

[0031] If the thermostat closes, the coolant can flow through a bypass connection 18 directly to the coolant input port 45 of the combustion engine 10.

[0032] The retarder cooler 30 and the EGR cooler 40 form a part of the coolant fluid path 60. Favourably, the EGR cooler 40 as well as the retarder cooler 30 is a full flow cooler receiving 100% of the coolant flow evacuated of the combustion engine 10. The number of pipes for the coolant flow can be reduced as the EGR cooler 40 is arranged along the combustion engine block of the combustion engine 10 as a substantially straight portion of the fluid path 60 of the coolant, while the coolant from the retarder 32 and retarder cooler 30 being fed through the EGR cooler 40 towards the first end 14 of the combustion engine 10.

[0033] The coolant which is cooled in the coolant cooler 20 circulates in subsequent order through the combustion engine 10, the retarder cooler 30 and the EGR cooler 40 and the coolant cooler 20.

[0034] Although the retarder cooler 30 and the EGR cooler 40 are arranged in series in the coolant fluid path 60, only one of the coolers 30, 40 is active at a time, so

that a substantial heat load is introduced to the coolant only by one of the two coolers 30, 40 at a time. At times when the retarder 32 is active and requires cooling by the retarder cooler 30, the vehicle is decelerating. In such an operational mode, exhaust is not recirculated. At times when exhaust gas is recirculated in the EGR system and requires cooling by the EGR cooler 40, the combustion engine 10 is operated at a higher load range in which the retarder 32 is inactive. Each cooler 30 or 40 can introduce a high thermal load into the coolant without deteriorating the cooling efficiency of the other cooler 40 or 30 as the thermal load of each cooler 30, 40 is introduced in different operation modes of the combustion engine 10.

[0035] The exhaust gas cooled in the EGR cooler 40 is flowing through a pipe 52 between the exhaust output port 56, through the EGR cooler 40 where it is cooled by the coolant and through a pipe 54 to the EGR valve 58. A bypass valve for the exhaust gas for bypassing the EGR cooler 40 may be provided but is not shown in detail.

[0036] Referring to Fig. 2, a preferred vehicle 100 according to the invention is shown, comprising a combustion engine with a cooling circuit 90 conveying a coolant according to Figs. 1a, 1b. The vehicle 100 is preferably a light, medium or heavy duty vehicle such as a truck.

[0037] The invention allows for a very effective packaging by avoiding, for instance, big pipes along the combustion engine 10 as the EGR cooler 40 (Fig. 1a, 1b) is a part of the return path of the coolant from the combustion engine 10 to the vehicle radiator.

Claims

1. A cooling circuit (90) for a vehicle (100), particularly a commercial vehicle, wherein the cooling circuit (90) comprises a combustion engine (10), a retarder cooler (30) for cooling a retarder (32), an EGR cooler (40) for cooling an exhaust gas of the combustion engine (10), and a coolant cooler (20) which is coupled to the combustion engine (10) for cooling the combustion engine (10) by means of a coolant, wherein the EGR cooler (40) is configured to cool exhaust gas from the combustion engine (10) via the coolant from the combustion engine (10), the retarder cooler (30) is arranged permanently in series with the EGR cooler (40) in a fluid path (60) of the coolant forming a return line for the coolant from the combustion engine (10) to the coolant cooler (20), **characterized in that**

   - the EGR cooler (40) is configured for conveying the complete coolant flow evacuated from the combustion engine;
   - the combustion engine (10) comprises a coolant input port (45) positioned at a first end (14) of the combustion engine (10) and a coolant output port (46) being positioned at a second end (16) of the combustion engine (10) opposite the first end (14); and
   - the coolant output port (46) being positioned at a distance from the coolant cooler (20) and the coolant output port (46) being connected to an inlet of the retarder cooler (30).

2. The cooling circuit according to claim 1, **characterized in that** the coolant cooler (20) is a joint coolant cooler for the retarder cooler (30) and the EGR cooler (40).

3. The cooling circuit according to claim 1 or 2, **characterized in that** the EGR cooler (40) is configured to provide a portion of the fluid path (60) of the coolant in the return line from the combustion engine (10) to the coolant cooler (20).

4. The cooling circuit according to any preceding claim, **characterized in that** the EGR cooler (40) is configured to provide a substantially straight portion of the fluid path (60) of the coolant from the combustion engine (10) to the coolant cooler (20).

5. The cooling circuit according to any preceding claim, **characterized in that** the coolant cooler (20) is configured to cool the coolant via an air flow.

6. The cooling circuit according to any preceding claim, **characterized in that** the coolant cooler (20) is formed by a radiator.

7. The cooling circuit according to any preceding claim, **characterized in that** the coolant cooler (20) is positioned at the first end (14) of the combustion engine (10).

8. The cooling circuit according to claim 3 and any preceding claim, **characterized in that** said EGR cooler (40) is positioned so that said portion of the fluid path (60) of the coolant from the combustion engine (10) back to the coolant cooler (20) is directed from the second end (16) of the combustion engine (10) towards the first end (14) of the combustion engine (10).

9. The cooling circuit according to any preceding claim, **characterized in that** the combustion engine (10) is a diesel combustion engine.

10. The cooling circuit according to any preceding claim, **characterized in that** the EGR cooler (40) is arranged at an upper part (15) of the combustion engine (10).

11. A vehicle (100) comprising a cooling circuit (90) according to any preceding claim.

Patentansprüche

1. Kühlkreis (90) für ein Fahrzeug (100), insbesondere ein Nutzfahrzeug, wobei der Kühlkreis (90) einen Verbrennungsmotor (10), eine Retarder-Kühleinrichtung (30) zur Kühlung eines Retarders (32), eine AGR-Kühleinrichtung (40) zur Kühlung eines Abgases des Verbrennungsmotors (10) und eine Kühlmittel-Kühleinrichtung (20) umfasst, die mit dem Verbrennungsmotor (10) zur Kühlung des Verbrennungsmotors (10) mittels eines Kühlmittels gekoppelt ist, wobei die AGR-Kühleinrichtung (40) so konfiguriert ist, dass sie Abgas von dem Verbrennungsmotor (10) über das Kühlmittel von dem Verbrennungsmotor (10) kühlt, die Retarder-Kühleinrichtung (30) permanent in Serie mit der AGR-Kühleinrichtung (40) in einem Fluidweg (60) des Kühlmittels angeordnet ist, der eine Rückführleitung des Kühlmittels von dem Verbrennungsmotor (10) zu der Kühlmittel-Kühleinrichtung (20) bildet, **dadurch gekennzeichnet, dass**

   - die AGR-Kühleinrichtung (40) zur Förderung der vollständigen Kühlmittelströmung konfiguriert ist, die von dem Verbrennungsmotor evakuiert wird,
   - der Verbrennungsmotor (10) einen Kühlmitteleingangskanal (45), der an einem erste Ende (14) des Verbrennungsmotors (10) angeordnet ist, und einen Kühlmittelausgangskanal (46) umfasst, der an einem zweiten Ende (16) des Verbrennungsmotors (10) angeordnet ist, das dem ersten Ende (14) entgegengesetzt ist, und
   - der Kühlmittelausgangskanal (46) in einem Abstand von der Kühlmittel-Kühleinrichtung (20) angeordnet ist und der Kühlmittelausgangskanal (46) mit einem Einlass der Retarder-Kühleinrichtung (30) verbunden ist.

2. Kühlkreis (90) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kühlmittel-Kühleinrichtung (20) eine gemeinsame Kühlmittel-Kühleinrichtung für die Retarder-Kühleinrichtung (30) und die AGR-Kühleinrichtung (40) ist.

3. Kühlkreis (90) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die AGR-Kühleinrichtung (40) konfiguriert ist, um einen Abschnitt des Fluidwegs (60) des Kühlmittels in der Rückführleitung von dem Verbrennungsmotor (10) zu der Kühlmittel-Kühleinrichtung (20) bereitzustellen.

4. Kühlkreis nach irgendeinem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** die AGR-Kühleinrichtung (40) konfiguriert ist, um einen im Wesentlichen geraden Abschnitt des Fluidwegs (60) des Kühlmittels von dem Verbrennungsmotor (10) zu der Kühlmittel-Kühleinrichtung (20) bereitzustellen.

5. Kühlkreis nach irgendeinem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** die Kühlmittel-Kühleinrichtung (20) zur Kühlung des Kühlmittels über eine Luftströmung konfiguriert ist.

6. Kühlkreis nach irgendeinem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** die Kühlmittel-Kühleinrichtung (20) von einem Radiator gebildet wird.

7. Kühlkreis nach irgendeinem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** die Kühlmittel-Kühleinrichtung (20) an dem ersten Ende (14) des Verbrennungsmotors (10) angeordnet ist.

8. Kühlkreis nach Anspruch 3 und irgendeinem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** die AGR-Kühleinrichtung (40) so angeordnet ist, dass der Abschnitt des Fluidwegs (60) des Kühlmittels von dem Verbrennungsmotor (10) zurück zu der Kühlmittel-Kühleinrichtung (20) von dem zweiten Ende (16) des Verbrennungsmotors (10) in Richtung des ersten Endes (14) des Verbrennungsmotors (10) gerichtet ist.

9. Kühlkreis nach irgendeinem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** der Verbrennungsmotor (10) ein Diesel-Verbrennungsmotor ist.

10. Kühlkreis nach irgendeinem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** die AGR-Kühleinrichtung (40) an einem oberen Abschnitt (15) des Verbrennungsmotors (10) angeordnet ist.

11. Fahrzeug (100) mit einem Kühlkreis (90) nach irgendeinem vorhergehenden Anspruch.

Revendications

1. Circuit de refroidissement (90) pour un véhicule (100), en particulier un véhicule utilitaire, dans lequel le circuit de refroidissement (90) comprend un moteur à combustion (10), un refroidisseur de ralentisseur (30) pour refroidir un ralentisseur (32), un refroidisseur d'EGR (40) pour refroidir un gaz d'échappement du moteur à combustion (10), et un refroidisseur de liquide de refroidissement (20) qui est couplé au moteur à combustion (10) pour refroidir le moteur à combustion (10) au moyen d'un liquide de refroidissement, où le refroidisseur d'EGR (40) est configuré pour refroidir le gaz d'échappement provenant du moteur à combustion (10) par l'intermédiaire du liquide de refroidissement provenant du moteur à combustion (10), le refroidisseur de ralen-

tisseur (30) est agencé de façon permanente en série avec le refroidisseur d'EGR (40) dans un trajet de fluide (60) du liquide de refroidissement formant une ligne de retour pour le liquide de refroidissement depuis le moteur à combustion (10) jusqu'au refroidisseur de liquide de refroidissement (20), **caractérisé en ce que**

- le refroidisseur d'EGR (40) est configuré pour acheminer le flux total de liquide de refroidissement évacué du moteur à combustion ;
- le moteur à combustion (10) comprend un orifice d'entrée de liquide de refroidissement (45) positionné au niveau d'une première extrémité (14) du moteur à combustion (10) et un orifice de sortie de liquide de refroidissement (46) étant positionné au niveau d'une deuxième extrémité (16) du moteur à combustion (10) opposée à la première extrémité (14) ; et
- l'orifice de sortie de liquide de refroidissement (46) étant positionné à une distance du refroidisseur de liquide de refroidissement (20) et l'orifice de sortie de liquide de refroidissement (46) étant relié à une entrée du refroidisseur de ralentisseur (30).

2. Circuit de refroidissement selon la revendication 1, **caractérisé en ce que** le refroidisseur de liquide de refroidissement (20) est un refroidisseur de liquide de refroidissement commun pour le refroidisseur de ralentisseur (30) et le refroidisseur d'EGR (40).

3. Circuit de refroidissement selon la revendication 1 ou 2, **caractérisé en ce que** le refroidisseur d'EGR (40) est configuré pour fournir une partie du trajet de fluide (60) du liquide de refroidissement dans la ligne de retour depuis le moteur à combustion (10) jusqu'au refroidisseur de liquide de refroidissement (20).

4. Circuit de refroidissement selon l'une des revendications précédentes, **caractérisé en ce que** le refroidisseur d'EGR (40) est configuré pour fournir une partie sensiblement droite du trajet de fluide (60) du liquide de refroidissement depuis le moteur à combustion (10) jusqu'au refroidisseur de liquide de refroidissement (20).

5. Circuit de refroidissement selon l'une des revendications précédentes, **caractérisé en ce que** le refroidisseur de liquide de refroidissement (20) est configuré pour refroidir le liquide de refroidissement par l'intermédiaire d'un flux d'air.

6. Circuit de refroidissement selon l'une des revendications précédentes, **caractérisé en ce que** le refroidisseur de liquide de refroidissement (20) est formé par un radiateur.

7. Circuit de refroidissement selon l'une des revendications précédentes, **caractérisé en ce que** le refroidisseur de liquide de refroidissement (20) est positionné au niveau de la première extrémité (14) du moteur à combustion (10).

8. Circuit de refroidissement selon la revendication 3 et l'une des revendications précédentes, **caractérisé en ce que** ledit refroidisseur d'EGR (40) est positionné de sorte que ladite partie du trajet de fluide (60) du liquide de refroidissement depuis le moteur à combustion (10) revenant au refroidisseur de liquide de refroidissement (20) soit dirigée de la deuxième extrémité (16) du moteur à combustion (10) vers la première extrémité (14) du moteur à combustion (10).

9. Circuit de refroidissement selon l'une des revendications précédentes, **caractérisé en ce que** le moteur à combustion (10) est un moteur à combustion diesel.

10. Circuit de refroidissement selon l'une des revendications précédentes, **caractérisé en ce que** le refroidisseur d'EGR (40) est agencé au niveau d'une partie supérieure (15) du moteur à combustion (10).

11. Véhicule (100) comprenant un circuit de refroidissement (90) selon l'une des revendications précédentes.

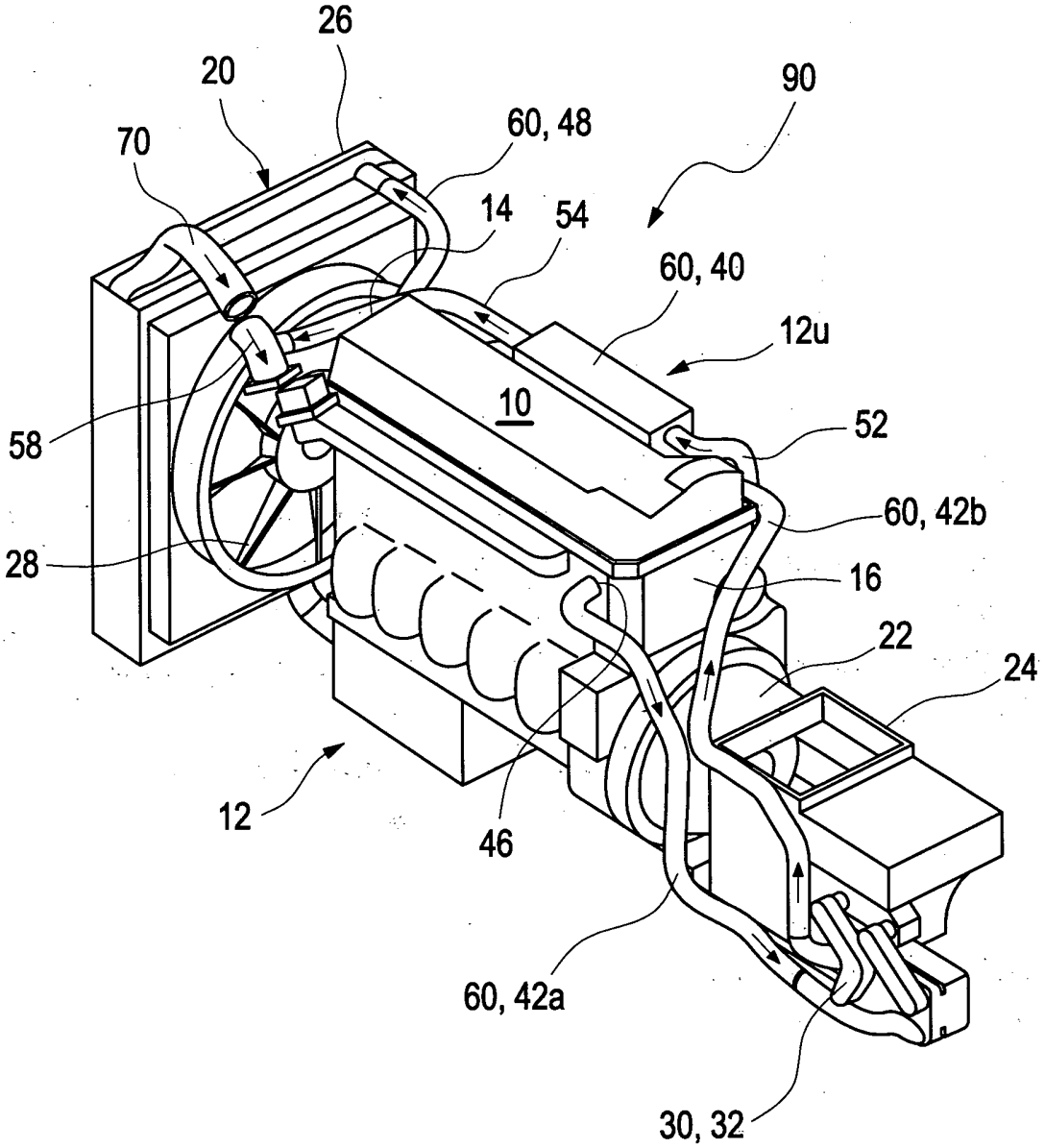
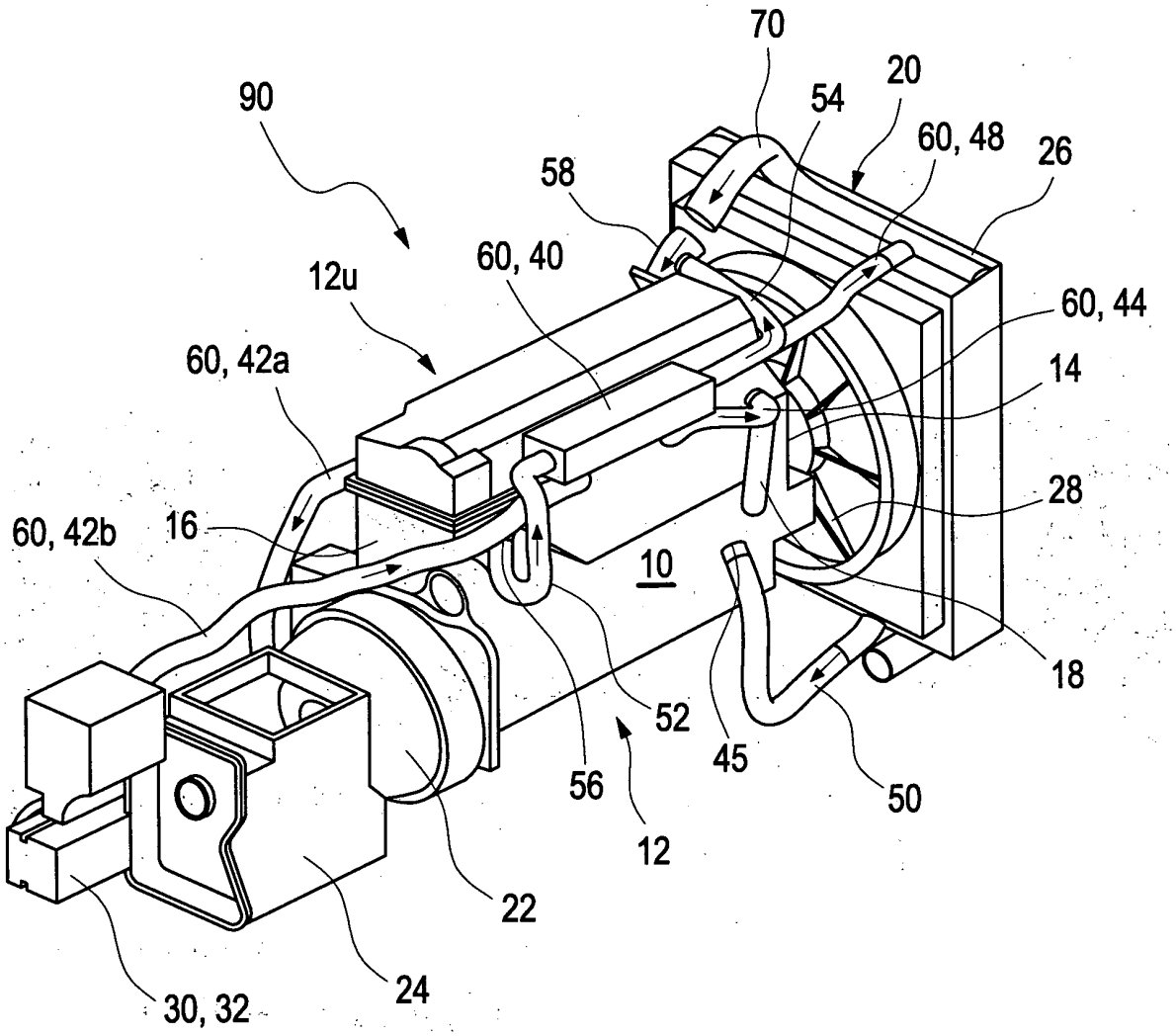

26
20
90
70
60, 48
14
54
60, 40
12u
10
58
52
60, 42b
28
16
22
24
12
46
60, 42a
30, 32

Fig. 1 a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60, 40
12u
60, 44
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14
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60, 42b
16
10
18
52
45
56
50
12
22
24
30, 32

Fig. 1 b

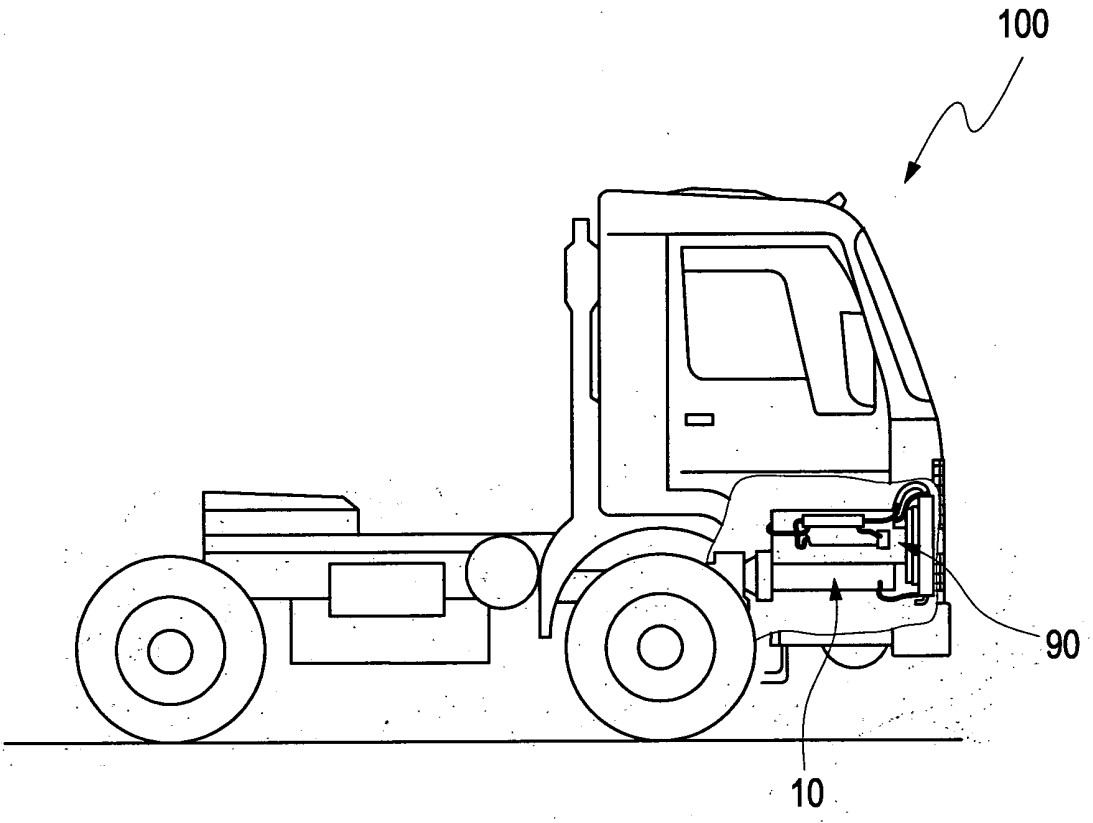

Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- DE 102006048714 A1 **[0005]**