Abstract: The present invention relates to a radiator arrangement for a vehicle (1). The radiator arrangement comprises a first radiator (3) provided with an inlet tank (3a) for receiving a first medium which is to be cooled, a cooling section (3b) in which the first medium is cooled by air which flows through the cooling section (3b), and an outlet tank (3c) whereby the cooled first medium is led out from the first radiator (3), and a second radiator (4) provided with an inlet tank (4a) for receiving a second medium which is to be cooled, a cooling section (4b) in which the second medium is cooled by air which flows through the cooling section (4b), and an outlet tank (4c) whereby the cooled second medium is led out from the second radiator (4). The first radiator (3) and second radiator (4) take the form of separate units. The first radiator (3) comprises a pipe element (12, 14) which extends through at least one of its tanks (3a, 3c) and which is adapted to conveying the second medium between one side of the first radiator's tank (3a, 3c) and an opposite side of the first radiator's tank (3a, 3c) where the second radiator (4) is situated.
Radiator arrangement in a motor vehicle

BACKGROUND TO THE INVENTION AND PRIOR ART

The present invention relates to a radiator arrangement in a motor vehicle according to the preamble of claim 1.

Heavy motor vehicles in particular may be provided with a plurality of air-cooled radiators to cool various media such as coolant, charge air, recirculating exhaust gases etc. Air-cooled radiators are usually situated in an air passage at a front portion of a motor vehicle where the various media are cooled by air drawn through them by a radiator fan. Space at the front portion of the vehicle is limited and the capacity of a radiator is related to its size. Cooling a combustion engine involves using a cooling circuit with a circulating coolant which will be at a relatively high temperature. This coolant circuit may be called a high-temperature cooling circuit. A low-temperature cooling circuit may be used to cool other components of a vehicle which require cooling to a lower temperature than the combustion engine. The radiator of the low-temperature cooling circuit is situated in front of the radiator of the high-temperature cooling circuit in the air passage at the front portion of the vehicle so that the coolant in the low-temperature cooling circuit is cooled by air at a lower temperature than the coolant in the high-temperature cooling circuit. The radiator of the high-temperature cooling circuit which cools the combustion engine needs a high capacity and is consequently of relatively large size. Conveying coolant to a forward radiator for a low-temperature cooling circuit entails fitting coolant lines which extend round the radiator of the high-temperature cooling circuit. Such coolant lines occupy space at the side of the radiator of the high-temperature cooling circuit. They therefore limit the width and consequently the capacity of the radiator of the high-temperature cooling circuit.

WO 2008/019117 refers to a heat exchanger for cooling of media with different temperatures. The heat exchanger is integral with an inlet tank, an outlet tank and a radiator section which extends between the tanks. A longitudinal dividing wall is provided in each tank so that separate sections are created for the respective media. In one embodiment one of the media is led to one section of the tank via a pipe which extends through the other section of the tank. The two media are only separated by a
relatively thin dividing wall in each tank. As the dividing wall has a relatively large surface area, a not negligible heat transfer will take place between the media in the respective tanks via the dividing wall. The result is that the heat exchanger will be ineffective if it is intended that the media with the different inlet temperatures should also exhibit a marked temperature difference when they leave the heat exchanger.

SUMMARY OF THE INVENTION

The object of the present invention is to propose a radiator arrangement for cooling of media with different temperatures which requires a relatively small fitting space in a vehicle while at the same time providing effective cooling of the media.

This object is achieved with the radiator arrangement of the kind mentioned in the introduction which is characterised by the features indicated in the characterising part of claim 1. The radiator arrangement thus comprises two separate radiators for cooling of media with different temperatures. The first radiator comprises a pipe element extending through the first radiator's inlet tank or outlet tank and adapted to conveying the second medium between one side of the first radiator's tank and an opposite side of the tank where the second radiator is situated. In this case there is therefore no need for the medium to be conveyed in a pipeline which extends round the first radiator, and consequently no need to devote space at the side of the first radiator to accommodating such a pipeline. This means that the radiators can be wider and have a larger capacity. Alternatively, the space at the side of the radiators may be used for other components of the vehicle.

In one embodiment of the present invention the first radiator's tanks and cooling section are situated at a distance from the second radiator's tanks and cooling section. Direct contact between the radiators will result in heat being transferred by conduction at the contact surfaces. As they are made of material with good thermally conductive characteristics, direct contact between the radiators needs as far as possible to be avoided, at least if it is intended also to maintain a temperature difference between the media even after they leave the radiators. Air has good thermally insulating characteristics. The radiators being at a relatively short distance from one another is usually sufficient to reduce the heat exchange between the media in them to an acceptably low level.
In one embodiment of the present invention the second radiator comprises a second pipe element situated in an inlet tank or an outlet tank and adapted to being connected to the first radiator's pipe element so that they constitute a composite pipeline for the second medium, and the radiator arrangement comprises at least one connecting means adapted to releasably connecting the first radiator's pipe element to the second radiator's pipe element. To convey the medium to or from one of the tanks of the second radiator it is appropriate that the tank comprises at least one shorter pipe element. Providing a pipe element in the first radiator and a pipe element in the second radiator makes it relatively easy to create a composite pipeline which conveys the medium to and from a tank of the second radiator. Said connecting means may be fitted at a suitable point for establishing a releasable connection between the radiators. It may be fitted in such a way as to releasably connect the first radiator's tank at a position relative to the second radiator's tank at which the pipe elements create said composite pipeline. Alternatively, the connecting means may be fitted on the pipe elements and establish a direct connection between the pipe elements of the respective radiators.

In one embodiment of the present invention the pipe elements are made of rigid material which in a connected state creates suspension means by which one radiator may be supported by the other radiator. The pipe elements create here a rigid pipeline which holds the radiators together in a specific position relative to one another. It will therefore be sufficient for example to fasten the first radiator in the vehicle when it has capacity to support the second radiator. The fastening of the radiators is thus simplified while at the same time less space will be needed for fastening them. The pipe elements may be made of suitable metal material. They may be of the same material as that of the respective tanks.

In one embodiment of the present invention the first radiator's pipe element and the second radiator's pipe element each have a similar internal cross-sectional area for conveying the second medium. In this case the end surfaces of the pipe elements will be connected to one another, creating a composite pipeline with a constant internal cross-sectional area in a longitudinal direction. The end surfaces may be connected to one another directly or via an intermediate sealing element such as a gasket. Alternatively, the first radiator's pipe element and the second radiator's pipe element may be of different sizes, in which case part of the smaller of said pipe elements will be adapted to being fitted into the larger of said pipe elements. In this case the
longitudinal contact surfaces of the pipe elements will prevent movements of the pipe elements and the radiators relative to one another in any direction except that in which the pipe elements are pushed into and pulled out of one another. Movements in this direction may in a fitted state be prevented by one or more relatively simple fastening means holding the radiators together.

In one embodiment of the present invention the first radiator's pipe element or the second radiator's pipe element has a portion which protrudes somewhat from the radiator's tank. Such a protruding portion of a pipe element may define the distance between the first radiator and the second radiator close to said tank. Both of the pipe elements may possibly protrude suitably far from the respective tank. Two such protruding portions will make it easy to position the radiators at a predetermined distance from one another.

In one embodiment of the present invention the first radiator's tank has a locally larger external dimension in a region where said pipe element extends through the tank. The tank's internal volume is reduced in the region where the pipe element is situated. A locally larger external dimension in this region of the tank will mean that as large an internal space for the first medium can be provided in this region of the tank as in its other regions.

In one embodiment of the present invention the first radiator's inlet tank is situated substantially immediately downstream of the second radiator's inlet tank, and the first radiator's outlet tank is situated substantially immediately downstream of the second radiator's outlet tank, in an air passage with respect to the intended direction of air flow through the radiators. In this case the radiators have the same width. The respective tanks' pipe elements which constitute the composite pipeline between the tanks may here be quite short.

In another embodiment of the invention the radiator arrangement comprises a sealing element adapted to creating a tight connection between the first radiator's pipe element and the second radiator's pipe element. To prevent leakage it is in most cases necessary to fit a sealing element at a suitable point in a connection region between the pipe elements. The sealing element may for example be a gasket, an O-ring or a tubular sealing element.
BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are described below by way of examples with reference to the attached drawings, in which

Fig. 1  depicts a radiator arrangement according to the present invention as seen from above.
Fig. 2  depicts the radiator arrangement in Fig. 1 as seen from behind,
Fig. 3a depicts a section in the plane A-A in Fig. 2,
Fig. 3b depicts a section in the plane B-B in Fig. 2,
Fig. 4a depicts a section through the inlet tanks according to a second embodiment of the radiator arrangement,
Fig. 4b depicts a section through the outlet tanks according to the second embodiment of the radiator arrangement,
Fig. 5a depicts a section through the inlet tanks according to a third embodiment of the radiator arrangement and
Fig. 5b depicts a section through the outlet tanks according to the third embodiment of the radiator arrangement.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Fig. 1 depicts schematically a vehicle 1 powered by a combustion engine 2. A first radiator 3 and a second radiator 4 are situated in an air passage 5 at a front portion of the vehicle. The first radiator 3 is intended to cool a coolant which cools the engine and circulates in a high-temperature cooling circuit of the vehicle. The second radiator 4 is intended to cool a coolant which circulates in a low-temperature cooling circuit of the vehicle. The coolant in the low-temperature cooling circuit will in most operating conditions be at a lower temperature than the coolant in the high-temperature cooling circuit. An air flow 6 through the air passage 5 and the radiators 3, 4 is created by a coolant fan 7 and the draught caused by the vehicle's forward movement. The second radiator 4 is located upstream of the first radiator 3 with respect to the intended direction of air flow through the air passage 5. The first radiator 3 and the second radiator 4 are substantially panel-like and situated in parallel planes in the air passage. The air flow in the air passage takes place mainly at right angles to the planes of the radiators 3, 4. The first radiator 3 and the second radiator 4 take the form of two separate units releasably connectable to one another by one or more fastening means 8.
In this case four fastening means are used, each comprising a screw which connects a respective protruding portion of the first radiator 3 to a protruding portion of the second radiator 4. These fastening means may be of substantially any desired functional configuration. The first radiator 3 has a fastening element 9 by which it can be fastened in a frame structure 10 of the vehicle by means of screws, bolts etc. This fastening element may likewise be of substantially any desired functional configuration.

Fig. 2 depicts the first radiator 3 in more detail. It comprises an inlet tank 3a provided with a first pipe element 11 with an aperture for receiving coolant in the high-temperature cooling circuit which cools the engine 2. The first pipe element 11 is adapted to being connected to a coolant hose in the high-temperature cooling circuit. The first pipe element 11 is in this case situated at an upper portion of the inlet tank 3a. The first radiator 3 comprises a second pipe element 12 with an aperture for receiving coolant in the low-temperature cooling circuit. The second pipe element 12 is adapted to being connected to a coolant hose in the low-temperature cooling circuit. This second pipe element extends through the inlet tank 3a in a central region 3a1 of this tank. This tank is wider in the region 3a1 than elsewhere. The first radiator 3 comprises a cooling section 3b in which the coolant in the high-temperature cooling circuit is cooled by air in the air passage 5. The coolant is conveyed in the cooling section 3b through elongate horizontal tubular elements 3bi situated at constant mutual spacing. A cooling air flow is arranged to pass through the cooling section 3b in the passages between these tubular elements. Heat transfer means 3b2 which may be called ranks are provided in said passages to increase the air contact surface with the tubular element so that the coolant provides more effective cooling in the tubular elements 3b1. The heat transfer means 3b2 may be made of sheetmetal material forming a zigzag structure, dividing the passages between adjacent tubular elements 3b1 into a large number of flow ducts.

The first radiator 3 comprises also an outlet tank 3c which receives the coolant after it has been cooled in the cooling section 3b. This first radiator comprises a third pipe element 13 with an aperture for leading coolant out from the radiator. The third pipe element 13 is adapted to being connected to a coolant hose in the high-temperature cooling circuit. This third pipe element is situated at an upper portion of the outlet tank 3c. The outlet tank 3c comprises also a fourth pipe element 14 with an aperture for leading coolant out to the low-temperature cooling circuit. The fourth pipe element
14 is adapted to being connected to a coolant hose in the low-temperature cooling circuit. This fourth pipe element extends through the outlet tank 3c in a centrally situated region 3c₁ which is wider than the remainder of this tank.

The second radiator 4 comprises an inlet tank 4a with a fifth pipe element 15 which is connected to the second pipe element 12 of the first radiator's inlet tank 3a. The pipe elements 12, 15 constitute in a connected state a pipeline which conveys coolant from the low-temperature cooling circuit to the inlet tank 4a. The second radiator 4 comprises a cooling section 4b in which the coolant in the low-temperature cooling circuit is cooled by air which flows through the cooling section 4b. The coolant is led into this cooling section through elongate tubular elements 4b₁ which are situated at a distance from one another. Heat transfer means 4b₂ are provided in said passages to increase the air's contact surface with the tubular element 4b₁ so that the coolant provides more effective cooling in these tubular elements. The heat transfer means 4b₂ have a zigzag structure which divides the passages between adjacent tubular elements 4b₁ into a large number of flow ducts. The second radiator 4 comprises an outlet tank 4c with a sixth pipe element 16 adapted to being connected to the fourth pipe element 14 of the first radiator 3. The pipe elements 14, 16 constitute in a connected state a pipeline which leads coolant out from the tank 4c.

The first radiator's inlet tank 3a is situated substantially immediately downstream of the second radiator's inlet tank 4a, the first radiator's cooling section 3b is situated substantially immediately downstream of the second radiator's cooling section 4b, and the first radiator's outlet tank 3c is situated substantially immediately downstream of the second radiator's outlet tank 4c. The first radiator 3 and the second radiator 4 have in this case the same width. The cooling air flow in the air passage 5 passes first through the second radiator's cooling section 4b and then through the first radiator's cooling section 3b. The air undergoes a temperature increase when it cools the coolant in the second radiator's cooling section 4b. It will thus be at a higher temperature when it cools the coolant in the first radiator's cooling section 3b. This means that the coolant in the low-temperature cooling circuit is cooled to a lower temperature than the coolant in the high-temperature cooling circuit.

Fig. 3a depicts a vertical section in the plane A-A through the inlet tanks 3a, 4a in Fig. 2. It shows the second pipe element 12 extending through the tank 3a from a connecting portion 12a, for connecting a coolant hose on one side of the tank 3a, to an
end surface 12b on an opposite side of the tank 3a. The end surface 12b is in the same plane as an external surface of the tank 3a. The second radiator's inlet tank 4a comprises a fifth pipe element 15 which has a protruding portion with an end surface 15a. The second pipe element's end surface 12b is adapted to being fitted against the fifth pipe element's end surface 15a with an intermediate gasket 17. Fastening means 8 are used to press the first radiator's inlet tank 3a and the second radiator's inlet tank 4a towards one another so as to create a tight connection between the second pipe element's end surface 12b, the gasket 17 and the fifth pipe element's end surface 15a. The second pipe element 12 and the fifth pipe element 15 each have a similar internal cross-sectional area and thus constitute a composite pipeline with a continuous internal cross-sectional area through which the coolant in the low-temperature cooling circuit is conveyed to the second radiator's inlet tank 4a. The distance between the inlet tanks 3a, 4a of the radiators 3, 4 is defined in this case by how far the fifth pipe element 15 protrudes from the second radiator's inlet tank 4a.

Fig. 3b depicts a vertical section in the plane B-B through the outlet tanks 3c, 4c in Fig. 2. The fourth pipe element 14 extends through the outlet tank 3c from a connecting portion 14a, for connecting a coolant hose on one side of the tank 3c, to an end surface 14b on an opposite side of the tank 3c. The end surface 14b is in substantially the same plane as an external surface of the tank 3c. The second radiator's tank 4c comprises a sixth pipe element 16 which has a protruding portion with an end surface 16a. The fourth pipe element's end surface 14b is adapted to being fitted against the sixth pipe element's end surface 16a with an intermediate gasket 17. Fastening means 8 are used to press the first radiator's outlet tank 3c and the second radiator's outlet tank 4c together to create a tight connection between the fourth pipe element's end surface 14b, the gasket 17 and the sixth pipe element's end surface 16a. The fourth pipe element 14 and the sixth pipe element 16 are of similar internal cross-sectional area and thus constitute a pipeline with a continuous internal cross-sectional area through which coolant is led out from the outlet tank 4c to the low-temperature cooling circuit. The distance between the outlet tanks 3c, 4c of the radiators 3, 4 is defined by how far the sixth pipe element 16 protrudes from the second radiator's outlet tank 4c.

Fig. 4a depicts a section similar to Fig. 3a in an alternative embodiment. The second pipe element 12 extends through the inlet tank 3a from a connecting portion 12a, for connecting a coolant hose on one side of the tank 3a, to an end surface 12b on an opposite side of the tank 3a. The end surface 12b is situated on a protruding portion
and is therefore at a distance from an external surface of the tank 3a. The second radiator's inlet tank 4a comprises a fifth pipe element 15 which has an end surface 15a situated on a protruding portion. The fifth pipe element 15 has an outside diameter substantially corresponding to an inside diameter of the second pipe element 12. The pipe element 15 has an externally situated annular recess for fitting an O-ring 18. In this case the pipe element 15 with the O-ring 18 will be inserted into the pipe element 12 until the latter's end surface 12b comes into contact with an external surface of the second radiator's inlet tank 4a. In the fitted state the O-ring 18 prevents coolant from leaking out into the connecting region between the pipe elements 12, 15. The distance between the inlet tanks 3a, 4a of the radiators 3, 4 is defined in this case by how far the second pipe element 12 protrudes from the first radiator's inlet tank 3a.

Fig. 4b depicts a section similar to Fig. 3b in the alternative embodiment. The fourth pipe element 14 extends through the outlet tank 3c from a connecting portion 14a, for connecting a coolant hose on one side of the tank 3c, to an end surface 14b on an opposite side of the tank 3c. The end surface 14b is situated on a protruding portion and is therefore at a distance from an external surface of the tank 3c. The second radiator's outlet tank 4c comprises a sixth pipe element 16 which has an end surface 16a which is situated on a protruding portion and is therefore at a distance from an external surface of the tank 4c. The sixth pipe element 16 has an outside diameter substantially corresponding to the inside diameter of the fourth pipe element 14. The pipe element 16 has an externally situated annular recess for fitting an O-ring 18. In this case the smaller pipe element 16 will be inserted into the larger pipe element 14 until the latter's end surface 14b comes into contact with an external surface of the tank 4c. In the fitted state the O-ring 18 prevents coolant from leaking out into the connecting region between the pipe elements 14, 16. The distance between the outlet tanks 3c, 4c of the radiators 3, 4 is defined in this case by how far the fourth pipe element 14 protrudes from the first radiator's outlet tank 3c.

Fig. 5a depicts a section similar to Fig. 3a in a further alternative embodiment. The second pipe element 12 extends through the inlet tank 3a from a connecting portion 12a, for connecting a coolant hose on one side of the tank 3a, to an end surface 12b on an opposite side of the tank 3a. The end surface 12b is situated on a protruding portion and is therefore at a distance from an external surface of the tank 3a. The second radiator's inlet tank 4a comprises a fifth pipe element 15 which has an external end surface 15a adapted to coming into contact with the second pipe element's end surface
12b. Fastening means 8 are used to press the first radiator's inlet tank 3a and the second radiator's inlet tank 4a towards one another. The second pipe element 12 and the fifth pipe element 15 are of similar internal cross-sectional area and thus constitute a composite pipeline with a constant internal cross-sectional area in which the coolant in the low-temperature cooling circuit is conveyed to the second radiator's inlet tank 4a. The composite pipeline comprises a tubular sealing means 19. The sealing means 19 has a first end portion 19a adapted to abutting sealingly against an internal surface of the second pipe element 12, and a second end portion 19b adapted to abutting sealingly against an internal surface of the fifth pipe element 15. The tubular sealing means is adapted to being movable within the pipeline between a first extreme position defined by a first stop surface 12c in the second pipe element 12 and a second extreme position defined by a second stop surface 15b in the fifth pipe element 15. The distance between the inlet tanks 3a, 4a of the radiators 3, 4 is defined in this case by how far the second pipe element 12 protrudes from the first radiator's inlet tank 3a.

Fig. 5b depicts a section similar to Fig. 3b in the further alternative embodiment. The fourth pipe element 14 extends through the outlet tank 3c from a connecting portion 14a, for connecting a coolant hose on one side of the tank 3c, to an end surface 14b on an opposite side of the tank 3c. The end surface 14b is situated on a protruding portion and is therefore at a distance from an external surface of the tank 3c. The second radiator's outlet tank 4c comprises a sixth pipe element 16 which has an external end surface 16a adapted to coming into contact with the fourth pipe element's end surface 14b. Fastening means 8 are used to press the first radiator's outlet tank 3c and the second radiator's outlet tank 4c towards one another. The fourth pipe element 14 and the sixth pipe element 16 are of similar internal cross-sectional area and thus constitute a pipeline with a continuous internal cross-sectional area through which coolant is led out from the second radiator's outlet tank 4c to the low-temperature cooling circuit. The pipeline is provided with a tubular sealing means 19. The sealing means 19 has a first end portion 19a adapted to abutting sealingly against an internal surface of the fourth pipe element 14, and a second end portion 19b adapted to abutting sealingly against an internal surface of the sixth pipe element 16. The tubular sealing means 19 is adapted to being movable within the pipeline between a first extreme position defined by a first stop surface 14c in the fourth pipe element 14 and a second extreme position defined by a second stop surface 16b in the sixth pipe element 16. The distance between the outlet tanks 3c, 4c of the radiators 3, 4 is defined by how far the fourth pipe element's end surface 14b protrudes from the first radiator's outlet tank 3c.
According to the invention the coolant in the low-temperature cooling circuit is thus conveyed to the second radiator's inlet tank 4a via a pipeline 12, 15 which extends through the first radiator's inlet tank 3a. Similarly, the coolant is led out from the second radiator's outlet tank 4c via a pipeline 14, 16 which extends through the first radiator's outlet tank 3c. This means that the low-temperature cooling circuit which conveys coolant to and from the second radiator 4 which is situated in front of the first radiator 3 need not comprise coolant lines which extend round the first radiator 3. There is therefore no need for coolant lines to be provided at the side of the radiators 3, 4. The radiator arrangement according to the invention makes it possible either for the radiators 3, 4 to be wider and more effective or for the space at their side to be used for other components of the vehicle. A further advantage of the present invention is that the continuous pipe element 12, 14 may be used to support the second radiator 4 via fastening means 8. The separate radiators 3, 4 will thus constitute a composite unit in a fitted state. It is therefore sufficient to use fastening means 9 to fasten the first radiator 3 in the frame 10.

The invention is in no way restricted to the embodiments depicted in the drawings but may be varied freely within the scopes of the claims. In the embodiments described above, coolant in a high-temperature cooling circuit and coolant in a low-temperature cooling circuit are cooled in the radiators 3, 4 but it is possible to cool other types of media in these radiators.
Claims

1. A radiator arrangement for a vehicle (1), which arrangement comprises a first radiator (3) provided with an inlet tank (3a) for receiving a first medium which is to be cooled, a cooling section (3b) in which the first medium is cooled by air which flows through the cooling section (3b), and an outlet tank (3c) whereby the cooled first medium is led out from the first radiator (3), and a second radiator (4) provided with an inlet tank (4a) for receiving a second medium which is to be cooled, a cooling section (4b) in which the second medium is cooled by air which flows through the cooling section (4b), and an outlet tank (4c) whereby the cooled second medium is led out from the second radiator (4), which first radiator (3) and second radiator (4) take the form of separate units, characterised in that the first radiator (3) comprises a pipe element (12, 14) which extends through the first radiator’s inlet tank (3a) or outlet tank (3c) and which is adapted to conveying the second medium between one side of the first radiator’s tank (3a, 3c) and an opposite side of the first radiator’s tank (3a, 3c) where the second radiator (4) is situated.

2. A radiator arrangement according to claim 1, characterised in that the first radiator’s tanks (3a, 3c) and cooling section (3b) are situated at a distance from the second radiator’s tanks (4a, 4c) and cooling section (4b).

3. A radiator arrangement according to claim 1 or 2, characterised in that the second radiator (4) comprises a second pipe element (15, 16) situated in an inlet tank (4a) or an outlet tank (4c) and adapted to being connected to the first radiator’s pipe element (12, 14) so that they constitute a composite pipeline for the second medium, and that the radiator arrangement comprises at least one connecting means (8) adapted to releasably connecting the first radiator’s pipe element (12, 14) to the second radiator’s pipe element (15, 16).

4. A radiator arrangement according to claim 3, characterised in that the pipe elements (12, 14, 15, 16) are made of rigid material which in a connected state serves as suspension means by which one radiator (3) supports the other radiator (4).

5. A radiator arrangement according to claim 3 or 4, characterised in that the first radiator’s pipe element (12, 14) and the second radiator’s pipe element (15, 16) each have a similar internal cross-sectional area for conveying the second medium.
6. A radiator arrangement according to claim 3 or 4, characterised in that the first radiator's pipe element (12, 14) and the second radiator's pipe element (15, 16) are of different sizes such that part of the smaller of said pipe elements (15, 16) is adapted to being fitted within the larger of said pipe elements (12, 14).

7. A radiator arrangement according to any one of claims 3 to 6 above, characterised in that the first radiator's pipe element (12, 14) or the second radiator's pipe element (15, 16) has a protruding portion which protrudes somewhat from the radiator's tank (3a, 3c, 4a, 4c).

8. A radiator arrangement according to any one of the foregoing claims, characterised in that the first radiator's tank (3a, 3c) has a locally larger dimension in a region (3a₁, 3c₁) where said pipe element (12, 14) extends through the tank (3a, 3c).

9. A radiator arrangement according to any one of the foregoing claims, characterised in that the first radiator's inlet tank (3a) is situated substantially immediately downstream of the second radiator's inlet tank (4a) and that the first radiator's outlet tank (3c) is situated substantially immediately downstream of the second radiator's outlet tank (4c), in an air passage (5) with respect to the intended direction of air flow through the radiators (3, 4).

10. A radiator arrangement according to any one of claims 3 to 10 above, characterised in that it comprises a sealing element (17, 18, 19) adapted to creating a tight connection between the first radiator's pipe element (12, 14) and the second radiator's pipe element (15, 16).
INTERNATIONAL SEARCH REPORT

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: B60H, F01 P, F28D, F28F

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, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>WO 2008037606 A1 (VALEO SYSTEMES THERMIQUES ET AL), 3 April 2008 (2008-04-03); abstract; page 1, line 13 - line 20; page 2, line 13 - line 30; page 7, line 10 - line 22; page 8, line 13 - line 17; page 12, line 1 - page 13, line 18; page 23, line 24 - line 25; figures --</td>
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<td>WO 200801 9117 A2 (MODINE MFG CO ET AL), 14 February 2008 (2008-02-1 4); whole document --</td>
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<td>Y</td>
<td>US 201 2047731 A1 (ERRICK STEVEN DAVID ET AL), 4 October 201 2 (201 2-1 0-04); abstract; paragraphs [0008], [001 0], [001 1], [001 5], [001 7]; figure 2 --</td>
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search 31-07-201 4

Date of mailing of the international search report 31-07-201 4

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Form PCT/ISA/210 (second sheet) (July 2009)
# DOCUMENTS CONSIDERED TO BE RELEVANT

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International Patent Classification (IPC)
F28F 9/00 (2006.01 )
B60H 7/00 (2006.01 )
F01P 17/04 (2006.01 )
F28D 7/04 (2006.01 )
F28F 27/02 (2006.01 )