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(54) **RADIATOR FOR A MOTOR VEHICLE**

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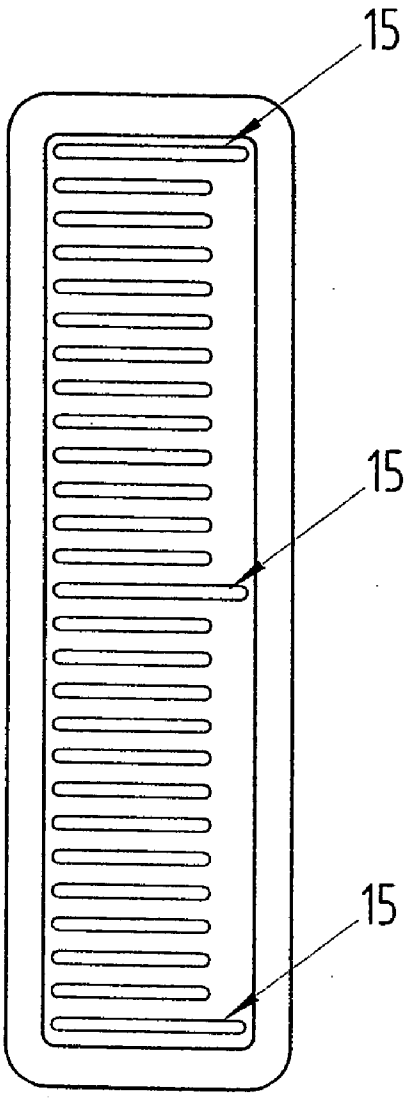
(57) **ABSTRACT**

A radiator for a motor vehicle has a block formed from several parallel tubes, through which flows a coolant, there being provided tubes with at least two different depths. Two or more spaced-apart tubes have a depth greater than a depth of the tubes lying in between and are configured as support tubes. In this way, fatigue strength problems of the radiator are avoided.



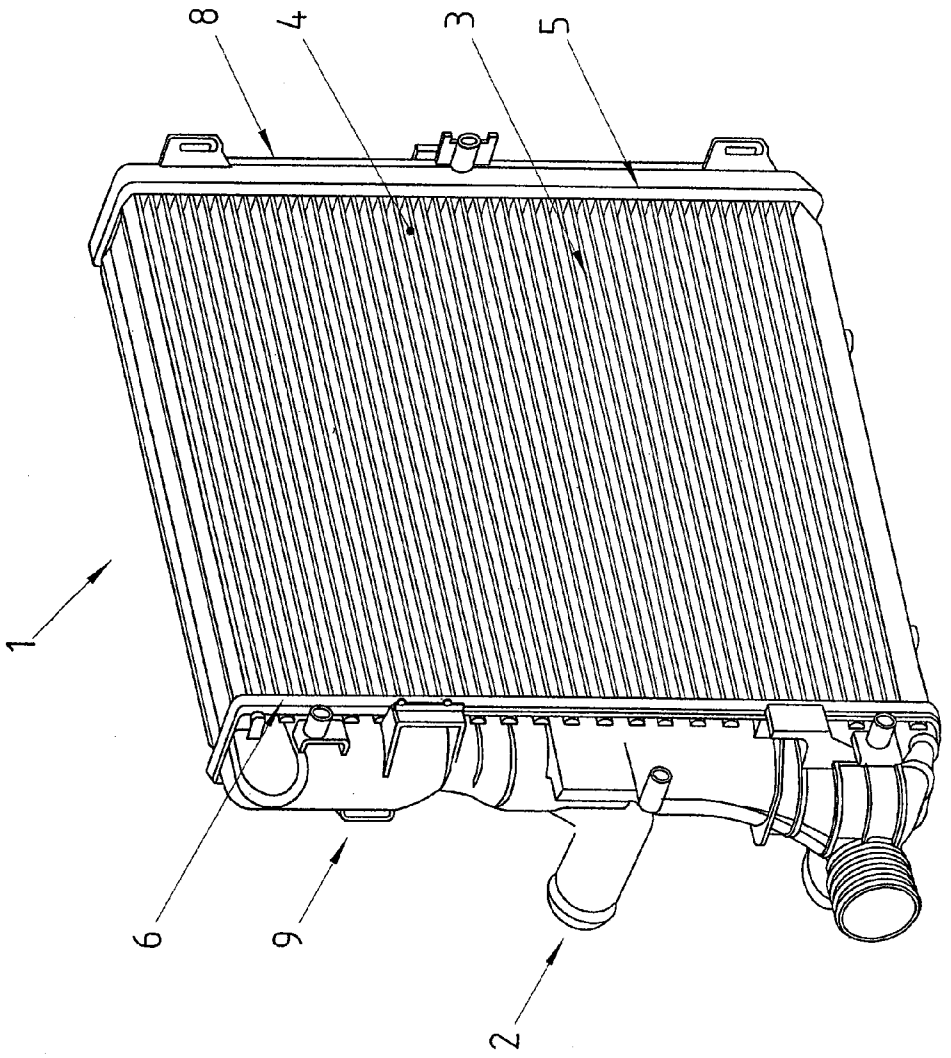


FIG. 1 PRIOR ART

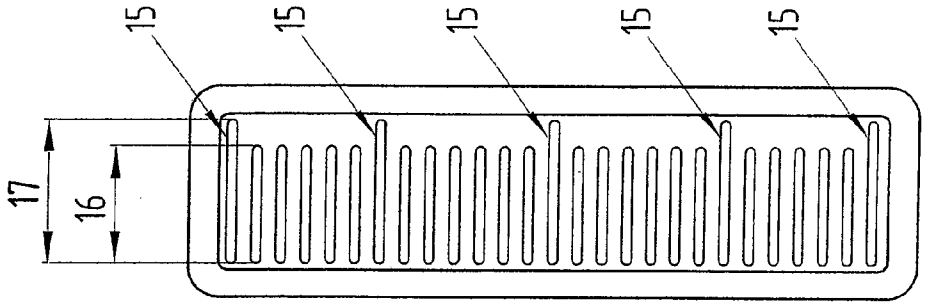


FIG. 2D

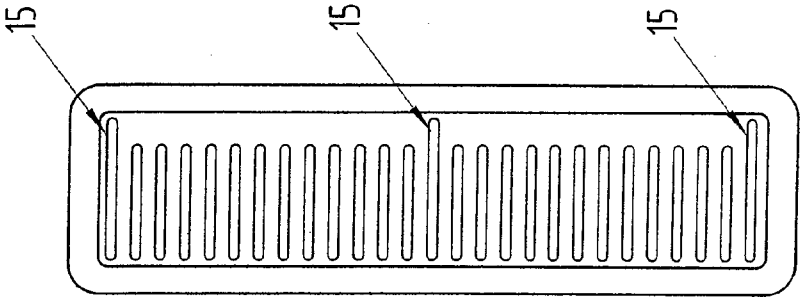


FIG. 2C

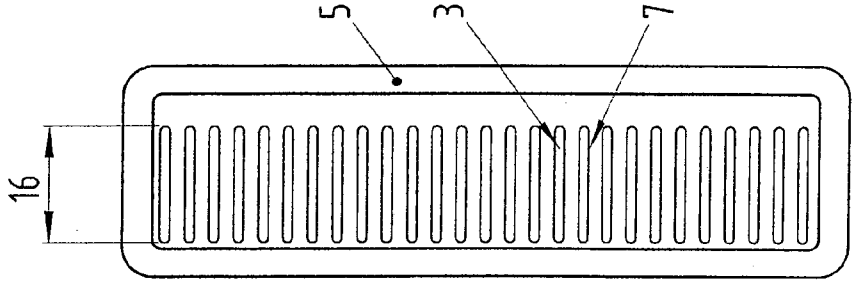


FIG. 2B
PRIOR ART

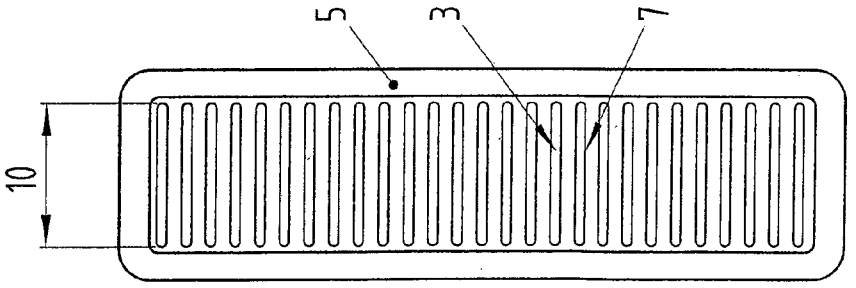


FIG. 2A
PRIOR ART

RADIATOR FOR A MOTOR VEHICLE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority, under 35 U.S.C. § 119, of German application DE 10 2007 020 948.9, filed May 4, 2007; the prior application is herewith incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The invention concerns a radiator for a motor vehicle. The radiator has a block formed from several parallel tubes, through which flows a coolant.

[0003] From U.S. Pat. No. 5,236,336 there is known a radiator for a motor vehicle, having a plurality of individual parallel tubes running between two end plates. The end plates have oblong depressions to receive the individual tube ends. Coolant box parts are secured to the end plates, which cover the tube ends and serve to divert the cool water flowing through the individual tubes. The block depth of the radiator is defined in terms of the width of the individual tubes used in the tube sheet with the cooling fins (ribs) running in between. The block depth in one region of the radiator can be less than that in another region, thanks to tubes of different depth, so that the radiator can be adapted to the circumstances of the chassis.

[0004] A radiator is also presented in published, French patent application FR 2 771 481 A, whose block depth in one region of the radiator is less than that in another region, so that the radiator can be adapted to the factors of the chassis.

[0005] Both of the cited publications describe radiators having different block depths in order to adapt them to the conditions of the chassis. However, in each segment, only uniform block depths are utilized.

[0006] In vehicles with different motorization, it is customary today to adapt the cooling performance within a vehicle platform by modification of the radiator, or rather the block depth, to the particular cooling demand. The initial basis is always the largest radiator, i.e., the greatest required block depth. The radiator is then joined to add-on elements at the air intake and outlet sides, being for the most part identical for all variants (e.g., coolant condenser or fan frame).

[0007] Since the radiator manufacturers work in grids, there are definite block depth dimensions and it can happen that blocks only half as deep as is possible for the size will be placed in large tube sheets. Sometimes there are substantial fatigue strength problems, since the unequal supporting effect of the block leads to warping during heating. It makes no difference whether the tubes are arranged in the middle of the tube sheet or displaced to one side.

SUMMARY OF THE INVENTION

[0008] It is accordingly an object of the invention to provide a radiator for a motor vehicle which overcome the above-mentioned disadvantages of the prior art devices of this general type, which can be configured with a large tube sheet and a rather small block depth so as to avoid the mentioned fatigue strength problems.

[0009] With the foregoing and other objects in view there is provided, in accordance with the invention, a radiator for a motor vehicle. The radiator contains a block having several parallel tubes through which flows a coolant and the tubes have at least two different depths. At least two spaced-apart ones of the tubes have a first depth being greater than a second depth of the tubes lying in between. The tubes having the first depth function as support tubes.

[0010] The inventive radiator contains a block formed from several parallel tubes, through which flows a coolant, while two or more spaced-apart tubes have a depth greater than the depth of the tubes lying in between and are configured as support tubes. The tubes with greater depth bring about a stiffening of the tube sheet, which improves the fatigue strength of the radiator.

[0011] In advantageous embodiment of the invention, the first and the last tube have a depth that is greater than the depth of the tubes lying in between, and are configured as support tubes. This configuration gives the radiator improved stability when using not very many tubes.

[0012] In another advantageous embodiment of the invention, the radiator is provided with support tubes at the ends and in the middle region that have a depth which is greater than the depth of the other tubes. This configuration is used when a greater stability is needed.

[0013] In accordance with an added feature of the invention, a number of the support tubes is greater than two and between the support tubes are disposed shorter tubes of the tubes, and a spacing between neighboring the support tubes is regular.

[0014] In accordance with another feature of the invention, cooling fins run between the tubes.

[0015] In accordance with a further feature of the invention, the block has a tube sheet and the tubes and the support tubes are disposed centrally in the tube sheet.

[0016] In accordance with an additional feature of the invention, the tubes and the support tubes are disposed displaced to one side of the block.

[0017] In accordance with a concomitant feature of the invention, the block has a tube sheet with a constant depth over an entire height of the block for the support tubes.

[0018] Of course, the above mentioned features and those yet to be discussed hereafter can be used not only in the particular indicated combination, but also in other combinations or standing alone, without leaving the scope of the present invention.

[0019] Other features which are considered as characteristic for the invention are set forth in the appended claims.

[0020] Although the invention is illustrated and described herein as embodied in a radiator for a motor vehicle, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

[0021] The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWING

[0022] FIG. **1** is a diagrammatic, perspective view of a radiator according to the prior art;

[0023] FIG. **2**A is a diagrammatic, sectional view through the radiator of the prior art;

[0024] FIG. **2**B is a diagrammatic, sectional view through another radiator of the prior art;

[0025] FIG. **2**C is a diagrammatic, cross-sectional view through a radiator according to a first embodiment of the invention; and

[0026] FIG. **2**D is a diagrammatic, cross-sectional view through a radiator according to a second embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0027] Referring now to the figures of the drawing in detail and first, particularly, to FIG. **1** thereof, there is shown a radiator **1** for a motor vehicle according to the prior art. The radiator **1** serves to lower the temperature of the coolant flowing in. A non-illustrated coolant pump pumps the heated coolant through an inlet opening **2** and through a plurality of parallel tubes **3** in the radiator. Between the tubes **3** there are cooling fins or ribs. By thermal conduction, the heat is transported to the outer surfaces of the tubes **3**, where it is surrendered via the cooling fins to the air flowing through the radiator **1**. The tubes **3** with the cooling fins running between them together form one block **4** of the radiator **1**. End plates (or tube sheets) **5**, **6** have oblong passages **7** (see FIG. **2**A), which receive the ends of the individual tubes. Coolant box parts **8**, **9** are attached to the end plates, which cover the tube ends and serve to divert or distribute or collect the coolant flowing through the individual tubes **3**.

[0028] As can be seen from FIGS. **2**A to **2**D, the tubes **3** have an oblong cross section. FIG. **2**A shows a schematic cross section through a radiator **1** identical to the radiator **1** shown in FIG. **1**. Only one of the tube sheets **5** is shown. A depth **10** of the tubes **3** is shown by the direction of an arrow. As can be seen from FIG. **2**A, the depth **10** of the tubes **3** basically corresponds to the depth of the tube sheet **5**. The depth **10** corresponds to the direction of flow of the air through the radiator **1**.

[0029] Since the radiator manufacturers work in grids, the radiators **1** are built with a definite block depth for different vehicles. It may happen that only short blocks **4** will be used in a large tube sheet **5**, as can be seen in FIG. **2**B. It can be seen from FIGS. **2**A and **2**B that the passages **7** for the individual tubes **3** are larger when using a large block (FIG. **2**A) than when using a small block (FIG. **2**B). But the size of the tube sheet **5** is always the same. This necessarily causes fatigue strength problems, since the unequal supporting effect of the block in FIG. **2**B on occasion causes warping due to the heating process. It makes no difference whether the tubes **3** are disposed in the middle of the tube sheet **5** or shifted to one side (as in FIG. **2**B).

[0030] According to the invention, therefore, when using small block dimensions (FIG. **2**B), two or more tubes from a rather large block are used as supports at the critical sites. These tubes are hereafter called support tubes **15**.

[0031] FIG. **2**C shows a preferred embodiment of the invented radiator **1**. A small block dimension with a large tube sheet **5** is used here. Three tubes **3**, however, are replaced by three larger support tubes **15**. The support tubes **15** are situated at the ends and in the middle region of the block **4**, but a different configuration is possible. The support tubes **15** make it possible to improve the fatigue strength of the radiator **1**, because large stresses can be avoided.

[0032] FIG. **2**D demonstrates another embodiment of the invented radiator **1**. Here, again, a small block dimension is used with a large tube sheet **5**. Five tubes **3** are replaced by five deeper support tubes **15**. This configuration is particularly suited to radiators **1** with rather long sheet parts **5**, **6**, while a larger number of support tubes **15** is advantageous. The support tubes **15** are distributed preferably uniformly over the radiator block **4**. Of course, one can use more or fewer support tubes **15**, as long as the support function is guaranteed. The number of support tubes **15** depends on the size of the radiator block **4**. Longer radiator blocks **4** require more support tubes **15** than short radiator blocks **4**. The number of support tubes **15** also depends on the ratio between the depth **17** of the tube sheet (or the depth of the support tubes **15**) and the depth **16** of the smaller block dimension. When the depth **16** of the smaller block dimension is very small in comparison to the depth **17** of the tube sheet **5**, this leads to intensified fatigue strength problems. When very small block dimensions are used, the use of several support tubes **15** is desirable.

[0033] It is also conceivable to have several support tubes **15** alongside each other. Thus, the first two tubes and the last two tubes in the block can be configured as support tubes **15**, which provides increased fatigue strength.

[0034] Since the pipe fitting geometry is configured for the largest block dimension, neither are there any difficulties with the package situation of the add-on parts.

[0035] Furthermore, use of the larger tubes **15** has the advantage that the pressure loss at the water side in the radiator **1** is less, since there is more cross section available.

[0036] The preceding description of the sample embodiments according to the present invention serves only for illustrative purposes and is not meant to limit the invention. Especially in regard to several preferred sample embodiments, the practitioner will discover that various changes and modifications in form and details can be done without departing from the notion and scope of the invention. Accordingly, the disclosure of the present invention should not be restrictive. Instead, the disclosure of the present invention illustrates the scope of the invention, which is presented in the following claims.

1. A radiator for a motor vehicle, the radiator comprising:
a block having several parallel tubes through which flows a coolant, said tubes having at least two different depths, at least two spaced-apart ones of said tubes have a first depth being greater than a second depth of said tubes lying in between, said tubes having said first depth are support tubes.

2. The radiator according to claim **1**, wherein a first tube of said tubes and a last tube of said tubes have said first depth which is greater than said second depth of said tubes lying in between, said first and last tubes are said support tubes.

3. The radiator according to claim **1**, wherein said tubes not configured as said support tubes have a same depth.

4. The radiator according to claim **1**, wherein a number of said support tubes is greater than two and between said support tubes are disposed shorter tubes of said tubes, and a spacing between neighboring said support tubes is regular.

5. The radiator according to claim **1**, wherein a number of said support tubes is at least three said support tubes, two of said support tubes lying at ends of said block and one of said support tube is disposed in a middle region of said block.

6. The radiator according to claim **1**, further comprising cooling fins running between said tubes.

7. The radiator according to claim **1**, wherein said block has a tube sheet and said tubes and said support tubes are disposed centrally in said tube sheet.

8. The radiator according to claim **1**, wherein said tubes and said support tubes are disposed displaced to one side of said block.

9. The radiator according to claim **1**, wherein said block has a tube sheet with a constant depth over an entire height of said block for said support tubes.

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