



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
25.09.2013 Bulletin 2013/39

(51) Int Cl.:
F28F 9/00 (2006.01) F28D 1/04 (2006.01)

(21) Application number: **13159896.3**

(22) Date of filing: **19.03.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(30) Priority: **19.03.2012 IT TO20120238**

(54) **Heat exchanging assembly having a flexibly variable composition**

(57) Heat exchanging assembly including at least one first heat exchanger (10; 30) comprising a plurality of parallel tubes (11; 31) extending between two opposite sides (13, 14; 33, 34) of the heat exchanger, a first and a second header (15, 16; 35, 36), and connecting devices positioned on the headers, which are provided for mounting a second heat exchanger (30; 50) on the first heat exchanger. The connecting means comprise hinge-like support formations or accessories (17; 37) positioned on the first header (15; 36), which are engageable with of a

first side (33; 54) of the second heat exchanger (30; 50) for defining a rotation axis parallel to a longitudinal axis of the first header, around which the second heat exchanger (30; 50) is rotatable relative to the first heat exchanger (10; 30), and quick fastening formations or accessories (18, 19; 38, 39) positioned on the second header (16; 35), which are engageable with the second side (53) of the second heat exchanger (30; 50) for fixing the second heat exchanger against the first heat exchanger (10; 30).

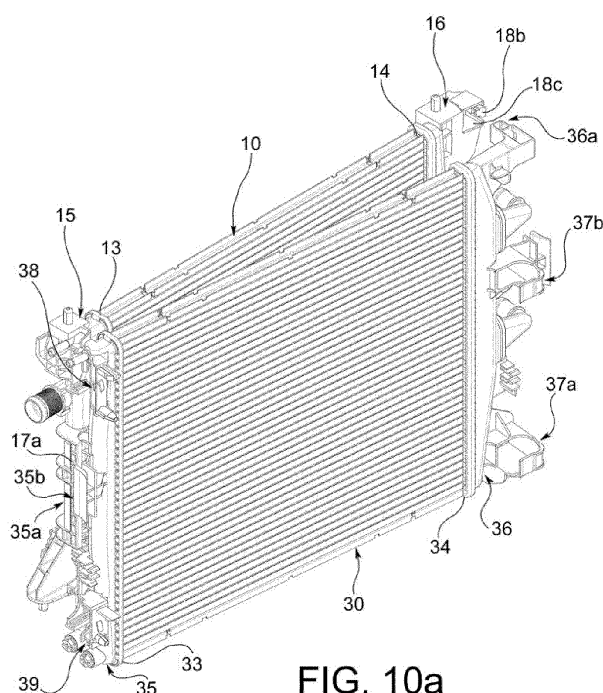


FIG. 10a

Description

[0001] The present invention relates to a heat exchanging assembly, including at least a first heat exchanger comprising
 a plurality of parallel tubes extending between two opposite sides of the heat exchanger,
 a first and a second header, respectively positioned at each of said two opposite sides of the heat exchanger, and
 connecting means positioned on said headers, which are provided for mounting a second heat exchanger on said first heat exchanger,
 wherein said connecting means comprise hinge-like support means positioned on one of said first and second header, which are engageable with one of a first and second side of the second heat exchanger for defining an axis of rotation parallel to a longitudinal axis of said one of said first or second header, around which the second heat exchanger is rotatable relative to the first heat exchanger, and quick fastening means positioned on the other of said first and second header, which are engageable with the other of said first and second side of the second heat exchanger to fix the second heat exchanger against the first heat exchanger.

[0002] An heat exchanging assembly of this type is disclosed, for example, in EP 0 693 665.

[0003] In the automotive industry, there is a known way of providing cooling modules, each comprising a plurality of heat exchangers assembled on to each other in a specific sequence. As a general rule, the most complex composition comprises a high-temperature radiator, a low-temperature radiator and a condenser.

[0004] In conventional heat exchanging assemblies, the various components are assembled according to a specific design which defines a particular sequence of exchangers which are not adaptable to other designs. Known assemblies also include dedicated fastening systems which differ from each other.

[0005] One object of the present invention is therefore to propose a heat exchanging assembly capable of overcoming the aforesaid drawbacks.

[0006] This object is achieved according to the invention by a heat exchanging assembly of the type defined above, and further comprising auxiliary connecting means provided for mounting a third heat exchanger, as an alternative to the second heat exchanger, on said first heat exchanger, said auxiliary connecting means being mounted on attachment seats formed on said headers, wherein said auxiliary connecting means comprise hinge-like support means mountable on said other of said first and second header, which are engageable with one of a first side and second side of the third heat exchanger for defining a rotation axis parallel to a longitudinal axis of said other of said first and second header, around which the third heat exchanger is rotatable relative to the first heat exchanger, and quick fastening means mountable on said one of said first and second header, which

are engageable with the other of said first side and second side of the third heat exchanger for fixing the third heat exchanger against the first heat exchanger.

[0007] By using the heat exchanging assembly according to the invention, it is possible to assemble components having standardized fastening devices, thereby achieving significant advantages in terms of versatility in the composition of the module, lower production costs, elimination of dedicated assembly lines, and simplicity in the process of assembly. The invention also enables a customer to purchase individual elements (exchangers) from different manufacturing plants of the supplier, and to carry out the assembly at his own plant. This aspect could be advantageous in terms of logistics.

[0008] Preferred embodiments of the invention are defined in the dependent claims, which are to be considered as an integral part of the present description.

[0009] Further characteristics and advantages of the heat exchanging assembly according to the invention will be made clearer by the following detailed description of an embodiment of the invention, given with reference to the attached drawings which are provided purely as non-limiting illustrations, in which:

Figure 1 is a perspective view of a first component of a heat exchanging assembly according to the invention;

Figures 2 and 3 are views on an enlarged scale of details of the component of Figure 1, indicated by the arrows II and III;

Figure 4 is a perspective view of a second component of a heat exchanging assembly according to the invention;

Figures 5 and 6 are views on an enlarged scale of details of the component of Figure 4, indicated by the arrows V and VI;

Figure 7 is a perspective view of a third component of a heat exchanging assembly according to the invention;

Figures 8 and 9 are views on an enlarged scale of details of the component of Figure 7, indicated by the arrows VIII and IX;

Figures 10a-10d show different stages of the assembly of a heat exchanging assembly composed of the components of Figures 1, 4 and 7;

Figures 11a-11d are views on an enlarged scale of details of the component of Figure 1, on which mounting accessories have been mounted; and

Figures 12a and 12b show different stages of the assembly of a heat exchanging assembly composed of the components of Figures 1 and 7.

[0010] Figures 1 to 3 show a first heat exchanger, indicated as a whole by 10. The first heat exchanger 10 can be, for example, a high-temperature radiator of a heat exchanging assembly of a motor vehicle.

[0011] The first heat exchanger 10 comprises, in a conventional way, a plurality of parallel tubes 11 extending

between two opposite sides 13, 14 of the heat exchanger, and a first and a second header 15, 16 positioned, respectively, on each of the two opposite sides of the heat exchanger. In particular, the headers 15, 16 are made of plastic material.

[0012] Mounting formations, such as pins, for mounting the first heat exchanger 10 on a support structure (not shown) are formed on the headers 15, 16.

[0013] The heat exchanger 10 further comprises connecting means positioned on the headers 15, 16, which are provided for mounting a second heat exchanger on the first heat exchanger 10.

[0014] With particular reference to Figures 2 and 3, these connecting means comprise hinge-like support means positioned on the first header 15, and quick fastening means, particularly snap-fitting means, positioned on the second header 16.

[0015] As shown in Figure 2, the hinge-like support means comprise a hinge-like support projection 17 formed in an intermediate position on the first header 15, and comprising a pivot portion 17a extending in a direction parallel to the longitudinal axis of the first header 15, and a plurality of support arm portions 17b which connect the pivot portion 17a to the first header 15, thus defining openings which are interposed between them.

[0016] As shown in Figure 3, the quick fastening means comprise an upper quick fastening device 18 and a lower quick fastening device 19, positioned, respectively, on or in the proximity of the upper and the lower end of the second header 16. In particular, the upper quick fastening device 18 comprises at least one resiliently flexible tab 18a, which is provided with a terminal catch 18b adapted to engage with a corresponding formation of a second heat exchanger to be fastened to the first exchanger. The upper quick fastening device 18 further comprises an insertion cavity 18c towards which the tab 18a faces, this cavity being adapted to receive a corresponding formation of the second heat exchanger to be fastened to the first exchanger. For its part, the lower quick fastening device 19 comprises at least one resiliently flexible tab 19a, which is provided with a terminal catch 19b adapted to engage with a corresponding formation of the second heat exchanger to be fastened to the first exchanger. The lower quick fastening device 19 further comprises an insertion cavity 19c towards which the tab 19a faces, this cavity being adapted to receive a corresponding formation of the second heat exchanger to be fastened to the first exchanger.

[0017] Returning to Figure 2, it will also be observed that upper and lower attachment seats 21, 22 are formed, respectively, on or in the proximity of the upper and lower end of the first header 15, for mounting auxiliary connecting means, particularly quick fastening means (which will be described subsequently), which are provided for mounting a third heat exchanger, as an alternative to the second heat exchanger, on the first heat exchanger.

[0018] In Figure 3, on the other hand, it will be observed that upper and lower attachment seats 23, 24 are formed,

respectively, in two axially intermediate positions on the second header 16, for mounting auxiliary connecting means, particularly quick fastening means (which will be described subsequently), which are provided for mounting the third heat exchanger, as an alternative to the second heat exchanger, on the first heat exchanger.

[0019] Preferably, the hinge-like support projection 17, the upper and lower quick fastening devices 18, 19 and the attachment seats 21, 22, 23, 24 are made in one piece with the respective headers 15, 16.

[0020] Figures 4 to 6 show a second heat exchanger, indicated as a whole by 30. The second heat exchanger 30 can be, for example, a low-temperature radiator of a heat exchanging assembly of a motor vehicle.

[0021] The second heat exchanger 30 comprises, in a conventional way, a plurality of parallel tubes 31 extending between two opposite sides 33, 34 of the heat exchanger, and a first and a second header 35, 36 positioned, respectively, on each of the two opposite sides of the heat exchanger. In particular, the headers 35, 36 of the second exchanger are made of plastic material.

[0022] Complementary connecting means are positioned on the headers 35, 36 for mounting the second heat exchanger 20 on the first heat exchanger, these means being complementary to the connecting means provided on the first heat exchanger.

[0023] With particular reference to Figures 5 and 6, the complementary connecting means of the second heat exchanger comprise complementary hinge-like support means positioned on the first header 35 of the second exchanger, and complementary quick fastening means, particularly snap-fitting means, positioned on the second header 36 of the second exchanger.

[0024] As can be seen in Figure 5, the complementary hinge-like support means of the second exchanger comprise a pivot guide projection 35a of curved shape (in the illustrated example, this projection comprises two separate parts, 35a' and 35a''), formed in an intermediate position on the first header 35 of the second exchanger and adapted to be inserted into the opening or openings interposed between the support arm portions 17b of the hinge-like support projection 17 of the first header 15 of the first exchanger, and to be positioned around the pivot portion 17a to form a hinge-like coupling between the first and second heat exchanger, enabling the second heat exchanger to be rotated relative to the first, until a condition is reached in which they are positioned face to face.

[0025] The pivot guide projection 35a is also associated with a return projection 35b opposed to it, which is adapted to engage in rotation with the pivot portion 17a so as to bias the second exchanger 30 towards the position in which it is face to face with the first exchanger 10.

[0026] As can be seen in Figure 6, the complementary quick fastening means of the second exchanger comprise an upper coupling protuberance 36a and a lower coupling protuberance (not visible in the drawings), formed, respectively, on or in the proximity of the upper

and lower end of the second header 36 of the second exchanger, these protuberances being adapted to be inserted, respectively, into the upper and lower insertion cavity 18c, 19c of the second header 16 of the first exchanger 10. The upper and lower coupling protuberances are provided with respective catch formations (not visible in the drawings) adapted to be engaged in a snap-fitting way by the terminal catches 18b, 19b of the flexible tabs 18a, 19a of the quick fastening devices 18, 19 of the second header 16 of the first exchanger 10.

[0027] Preferably, the pivot guide projection 35a, the return projection 35b and the coupling protuberances are made in one piece with the respective headers 35, 36 of the second heat exchanger.

[0028] The second heat exchanger 30 further comprises connecting means positioned on the headers 35, 36 of the second exchanger, which are provided for mounting a third heat exchanger on the second heat exchanger 30.

[0029] With particular reference to Figures 5 and 6, these connecting means comprise hinge-like support means positioned on the second header 36, and quick fastening means, particularly snap-fitting means, positioned on the first header 35.

[0030] As can be seen in Figure 6, the hinge-like support means comprise a hinge-like support projection 37a formed at or in the proximity of the lower end of the second header 36 of the second exchanger, and a pivot guide projection 37b formed in an axially intermediate position on the second header 36 of the second exchanger.

[0031] The hinge-like support projection 37a has a U-shaped portion 37a', the mouth of which faces transversely towards the centre of the second exchanger, and the axial side of which is closed by a bottom wall 37a". Near the mouth, the lateral wall of the U-shaped portion 37a' has a snap-fitting portion 37a'" which forms a constriction of the mouth of the U-shaped portion 37a'. The pivot guide projection 37b has a U-shaped portion 37b', the mouth of which faces transversely towards the centre of the second exchanger, and the axial sides of which are both open. Near the mouth, the lateral wall of the U-shaped portion 37b' of the guide projection has a snap-fitting portion 37b" which forms a constriction of the mouth of the U-shaped portion 37b'.

[0032] As can be seen in Figure 5, the quick fastening means of the second heat exchanger comprise an upper quick fastening device 38 and a lower quick fastening device 39, positioned, respectively, on or in the proximity of the upper and the lower end of the first header 35 of the second exchanger. In particular, the upper quick fastening device 38 comprises at least one resiliently flexible tab 38a, which is provided with a terminal catch 38b adapted to engage with a corresponding formation of a third heat exchanger to be fastened to the second exchanger. The upper quick fastening device 38 further comprises a reference and support pin portion 38c adapted to be inserted into a corresponding cavity of the third heat exchanger to be fastened to the second exchanger.

For its part, the lower quick fastening device 39 comprises at least one resiliently flexible tab 39a, which is provided with a terminal catch 39b adapted to engage with a corresponding formation of the third heat exchanger to be fastened to the second exchanger. The lower quick fastening device 39 further comprises a reference and support pin portion 39c adapted to be inserted into a corresponding cavity of the third heat exchanger to be fastened to the second exchanger.

[0033] Preferably, the hinge-like support projection 37a, the pivot guide projection 37b and the upper and lower quick fastening devices 38, 39 are made in one piece with the respective header 35, 36.

[0034] Figures 7 to 9 show a third heat exchanger, indicated as a whole by 50. The third heat exchanger 50 can be, for example, a condenser of a heat exchanging assembly of a motor vehicle. In the present description, the term "third" denotes another heat exchanger, separate from the first and second exchanger described above, which is not necessarily supplementary to the first two, but can be installed in place of the second heat exchanger, as described below.

[0035] The third heat exchanger 50 comprises, in a conventional way, a plurality of parallel tubes 51 extending between two opposite sides 53, 54 of the heat exchanger, and a first and a second header 55, 56 positioned, respectively, on each of the two opposite sides of the heat exchanger. In particular, the headers 55, 56 of the third exchanger are made of metallic material. If the third heat exchanger 50 is a condenser having a condensation section and a sub-cooling section, it can be provided with a storage reservoir 56' fastened to one of the headers 55, 56; in the illustrated example, the storage reservoir 56' is fixed to the second header 56 of the third exchanger.

[0036] Complementary connecting means are positioned on the headers 55, 56 for mounting the third heat exchanger 50 on the second or the first heat exchanger, these means being complementary to the connecting means provided on the first or second heat exchanger.

[0037] With particular reference to Figures 8 and 9, the complementary connecting means of the third heat exchanger comprise complementary hinge-like support means positioned on the second header 56 of the third exchanger, and complementary quick fastening means, particularly snap-fitting means, positioned on the first header 55 of the third exchanger.

[0038] As can be seen in Figure 9, the complementary hinge-like support means of the third exchanger are formed by the storage reservoir 56' fastened to the second header 56, the elongate body of this reservoir acting as a pivot to define an axis of rotation of the third heat exchanger. Alternatively, if the third heat exchanger is not provided with a storage reservoir 56', the pivot function can be provided directly by the second header 56, or an auxiliary structure fastened to the second header 56 could be provided for this purpose. The storage reservoir 56' is adapted to be inserted into the U-shaped

portions 37a', 37b' of the hinge-like support projection 37a and of the pivot guide projection 37b of the second header 36 of the second exchanger 30, in order to form a hinged coupling between the third and the second heat exchanger, thus enabling the third heat exchanger to be rotated relative to the second until a condition is reached in which they are positioned face to face.

[0039] As can be seen in Figure 8, the complementary quick fastening means of the third heat exchanger comprise an upper quick fastening device 55a and a lower quick fastening device 55b, positioned, respectively, on or in the proximity of the upper and the lower end of the first header 55 of the third exchanger. The upper coupling element 55a can be engaged by the terminal catch 38b of the flexible tab 38a and by the pin portion 38c of the upper quick fastening device 38 of the first header 35 of the second exchanger, in order to retain and support the third heat exchanger by means of the second heat exchanger. The lower coupling element 55b can be engaged by the terminal catch 39b of the flexible tab 39a and by the pin portion 39c of the lower quick fastening device 39 of the first header 35 of the second exchanger, in order to retain and support the third heat exchanger by means of the second heat exchanger.

[0040] Preferably, the upper coupling element 55a and the lower coupling element 55b are welded to the first header 55 of the third heat exchanger.

[0041] With reference to Figures 10a-10d, a description will now be given of a process for assembling the three exchangers 10, 30, 50 described above on to each other.

[0042] Initially, the hinge-like support projection 17 of the first heat exchanger 10 and the pivot guide projection 35a on the first side 33 of the second heat exchanger 30 are coupled to each other in order to form a hinged coupling which defines an axis of rotation, parallel to the longitudinal axis of the first header 15 of the first exchanger, around which the second heat exchanger 30 is rotatable relative to the first heat exchanger (Figure 10a).

[0043] The second exchanger 30 is then rotated so as to position it face to face against the first exchanger 10. At this point, the upper coupling protrusion 36a and the lower coupling protrusion of the second heat exchanger engage in the corresponding insertion cavities 18c, 19c in the second side of the first heat exchanger 10, and are engaged, in turn, by the terminal catches of the flexible tabs 18a, 19a of the second side of the first heat exchanger 10 to fix the second heat exchanger against the first heat exchanger (Figure 10b).

[0044] The hinge-like support projection 37a and the pivot guide projection 37b of the second heat exchanger 30 and the storage reservoir 56' on the second side 53 of the third heat exchanger 50 are then coupled together to form a hinged coupling which defines an axis of rotation parallel to the longitudinal axis of the second header 36 of the second exchanger, around which the third heat exchanger 50 is rotatable relative to the assembly formed by the first and second heat exchanger (Figure 10c).

[0045] The third exchanger 50 is then rotated so as to position it face to face against the first exchanger 30. At this point, the upper 55a and lower 55b coupling elements of the first side of the third heat exchanger engage with the terminal catches of the corresponding flexible tabs 38a, 39a and the corresponding pin formations 38c, 39c of the first side of the second heat exchanger 30, in order to fix the third heat exchanger against the assembly formed by the first and second heat exchanger (Figure 10d).

[0046] The combination of exchangers can be varied from that which is shown in the mounting sequence in Figures 10a-10d, depending on the specific requirements of the conditions of installation of the heat exchanging assembly. For example, the first heat exchanger 10 can be omitted, in which case the heat exchanging assembly will be composed of the second and the third heat exchanger only.

[0047] In another possible combination, the second heat exchanger 30 can be omitted, in which case the heat exchanging assembly will be composed of the first and the third heat exchanger only. This possible combination is shown in Figures 11a-11d and 12a, 12b.

[0048] Figures 11a-11b show, respectively, the upper and lower ends of the first header 15 of the first heat exchanger 10, and Figures 11c-11d show, respectively, the upper and lower ends of the second header 16 of the first heat exchanger 10.

[0049] In Figure 11a it can be seen that an upper quick fastening device 138, which is functionally similar to the upper quick fastening device 38 of the second heat exchanger 30, is mounted, by snap-fitting for example, in the upper attachment seat 21 of the first header 15 of the first heat exchanger 10. The upper quick fastening device 138 therefore comprises at least one resiliently flexible tab 138a, provided with a terminal catch 138b, and also a reference and support pin portion 138c, adapted to engage with the upper coupling element 55a on the first side of the third heat exchanger.

[0050] In Figure 11b it can be seen that a lower quick fastening device 139, which is functionally similar to the upper quick fastening device 39 of the second heat exchanger 30, is mounted, by snap-fitting for example, in the lower attachment seat 22 of the first header 15 of the first heat exchanger 10. The lower quick fastening device 139 therefore comprises at least one resiliently flexible tab 139a, provided with a terminal catch 139b, and also a reference and support pin portion 139c, adapted to engage with the lower coupling element 55a on the first side of the third heat exchanger.

[0051] In Figure 11c it can be seen that a pivot guide accessory 137b, functionally similar to the pivot guide projection 37b of the second header 36 of the second heat exchanger 30, is mounted, by snap-fitting for example, in the upper attachment seat 23 of the second header 16 of the first heat exchanger 10. The pivot guide accessory 137b therefore comprises a U-shaped portion 137b', the mouth of which, in use, faces transversely towards

the centre of the first exchanger, and the axial sides of which are both open. Near the mouth, the lateral wall of the U-shaped portion 137b' of the pivot guide accessory 137b has a snap-fitting portion 137b" which forms a constriction of the mouth of the U-shaped portion 137b'.

[0052] In Figure 11d it can be seen that a hinge-like support accessory 137a, functionally similar to the hinge-like support projection 37a of the second header 36 of the second heat exchanger 30, is mounted, by snap-fitting for example, in the lower attachment seat 24 of the second header 16 of the first heat exchanger 10. The hinge-like support accessory 137a therefore comprises a U-shaped portion 137a', the mouth of which, in use, faces transversely towards the centre of the first exchanger, and the lower axial side of which is closed by a bottom wall 137a". Near the mouth, the lateral wall of the U-shaped portion 137a' has a snap-fitting portion 137a"" which forms a constriction of the mouth of the U-shaped portion 137a'.

[0053] With reference to Figures 12a-12b, a description will now be given of an example of a process for assembling on to each other the first exchanger 10, provided with the accessories 137a, 137b, 138, 139, and the third heat exchanger 50.

[0054] Initially, the hinge-like support accessory 137a and the pivot guide accessory 137b installed on the first heat exchanger 10 and the storage reservoir 56' on the second side 53 of the third heat exchanger 50 are coupled together to form a hinged coupling which defines an axis of rotation parallel to the longitudinal axis of the second header 16 of the first exchanger, around which the third heat exchanger 50 is rotatable relative to the first heat exchanger (Figure 12a).

[0055] The third exchanger 50 is then rotated so as to position it face to face against the first exchanger 10. At this point, the upper 55a and lower 55b coupling elements of the first side of the third heat exchanger engage with the terminal catches of the corresponding flexible tabs 138a, 139a and the corresponding pin formations 138c, 139c positioned on the first side of the first heat exchanger 30, in order to fix the third heat exchanger against the first heat exchanger (Figure 12b).

[0056] In the present description, combinations of one, two or three heat exchangers have been illustrated; however, it is also possible to consider using more than three components of the heat exchanging assembly, in order to meet the specific requirements of actual installation conditions.

Claims

1. Heat exchanging assembly including at least one first heat exchanger (10; 30) comprising a plurality of parallel tubes (11; 31) extending between two opposite sides (13, 14; 33, 34) of the heat exchanger, a first and a second header (15, 16; 35, 36) respec-

tively positioned at each of said two opposite sides of the heat exchanger, and connecting means positioned on said headers, which are provided for mounting a second heat exchanger (30; 50) on said first heat exchanger, wherein said connecting means comprise hinge-like support means (17; 37) positioned on one (15; 36) of said first and second header, which are engageable with one (33; 54) of a first side and second side of the second heat exchanger (30; 50) for defining a rotation axis parallel to a longitudinal axis of said one of said first and second header, around which the second heat exchanger (30; 50) is rotatable relative to the first heat exchanger (10; 30), and quick fastening means (18, 19; 38, 39) positioned on the other (16; 35) of said first and second header, which are engageable with the other (34; 53) of said first side and second side of the second heat exchanger (30; 50) for fixing the second heat exchanger against the first heat exchanger (10; 30); the heat exchanging assembly being **characterized in that** it further comprises auxiliary connecting means provided for mounting a third heat exchanger (50), as an alternative to the second heat exchanger (30), on said first heat exchanger, said auxiliary connecting means being mounted on attachment seats (21, 22, 23, 24) formed on said headers, wherein said auxiliary connecting means comprise hinge-like support means (137a, 137b) mountable on said other (16) of said first and second header, which are engageable with one (54) of a first side and second side of the third heat exchanger (50) for defining a rotation axis parallel to a longitudinal axis of said other (16) of said first and second header, around which the third heat exchanger (50) is rotatable relative to the first heat exchanger (10), and quick fastening means (138, 139) mountable on said one (15) of said first and second header, which are engageable with the other (53) of said first side and second side of the third heat exchanger (50) for fixing the third heat exchanger against the first heat exchanger (10).

2. Assembly according to Claim 1, wherein said connecting means are formed as a single piece with said headers, and said auxiliary connecting means are snap-fitted on said attachment seats (21, 22, 23, 24) formed on said headers.

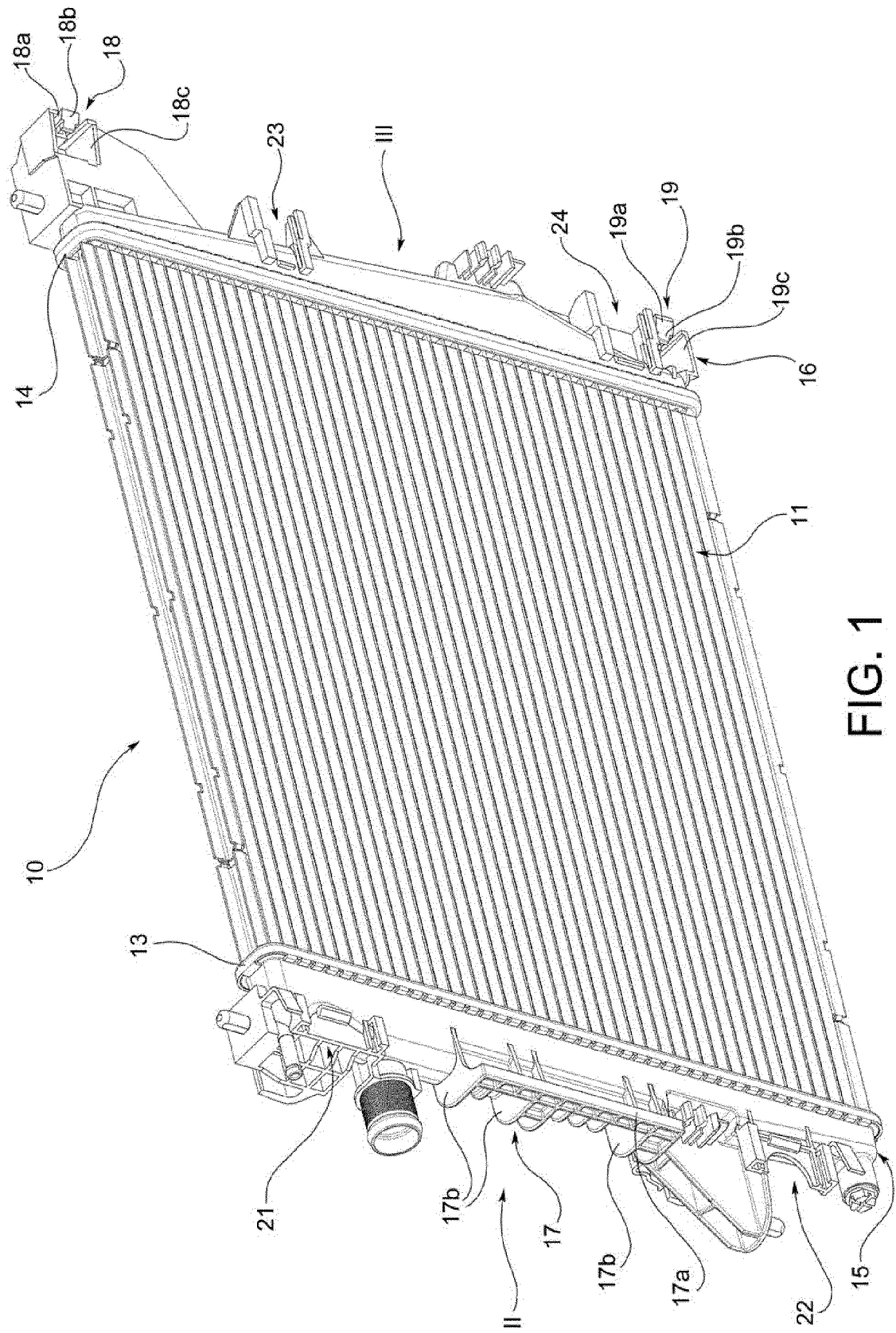


FIG. 1

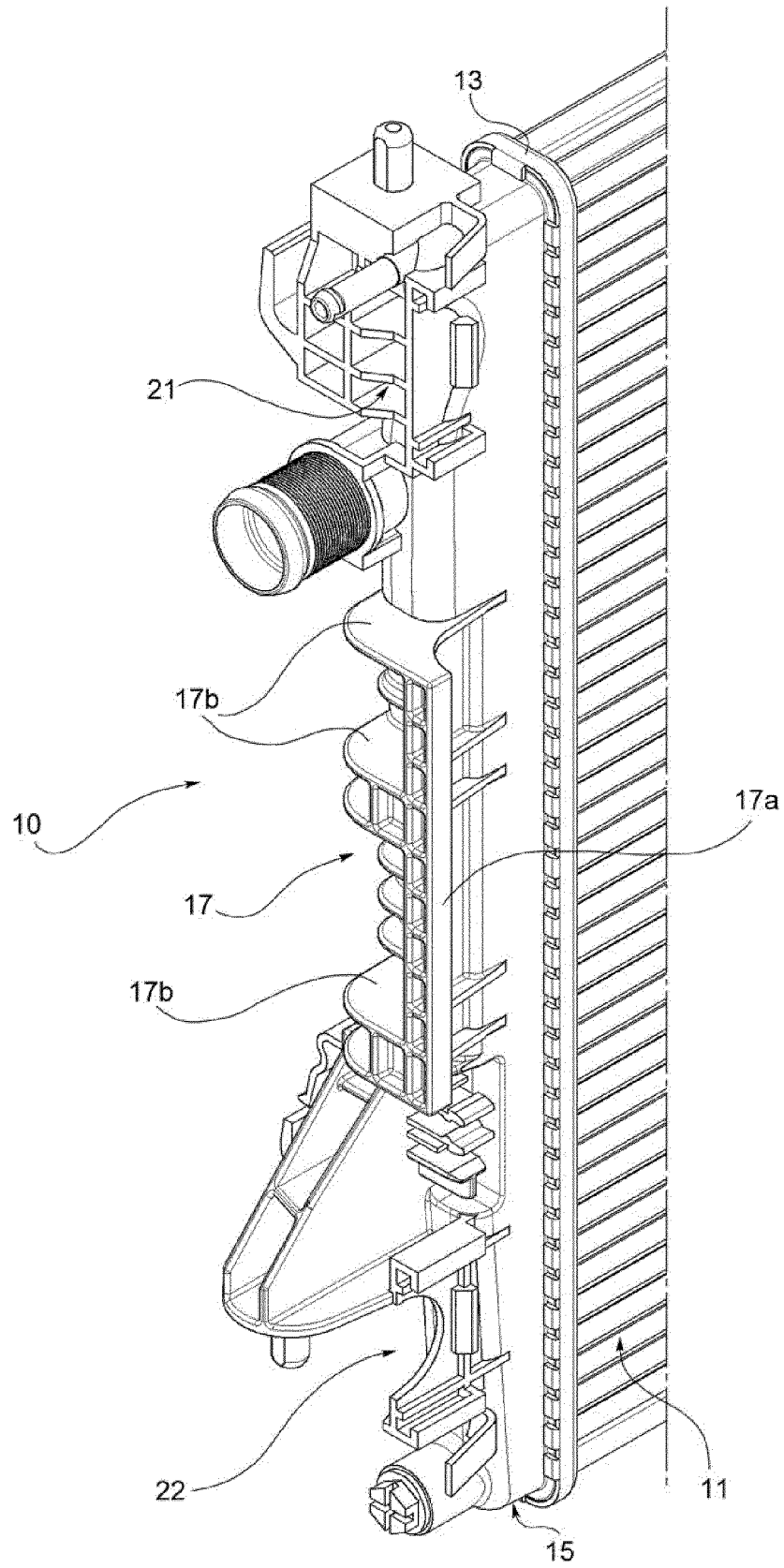


FIG. 2

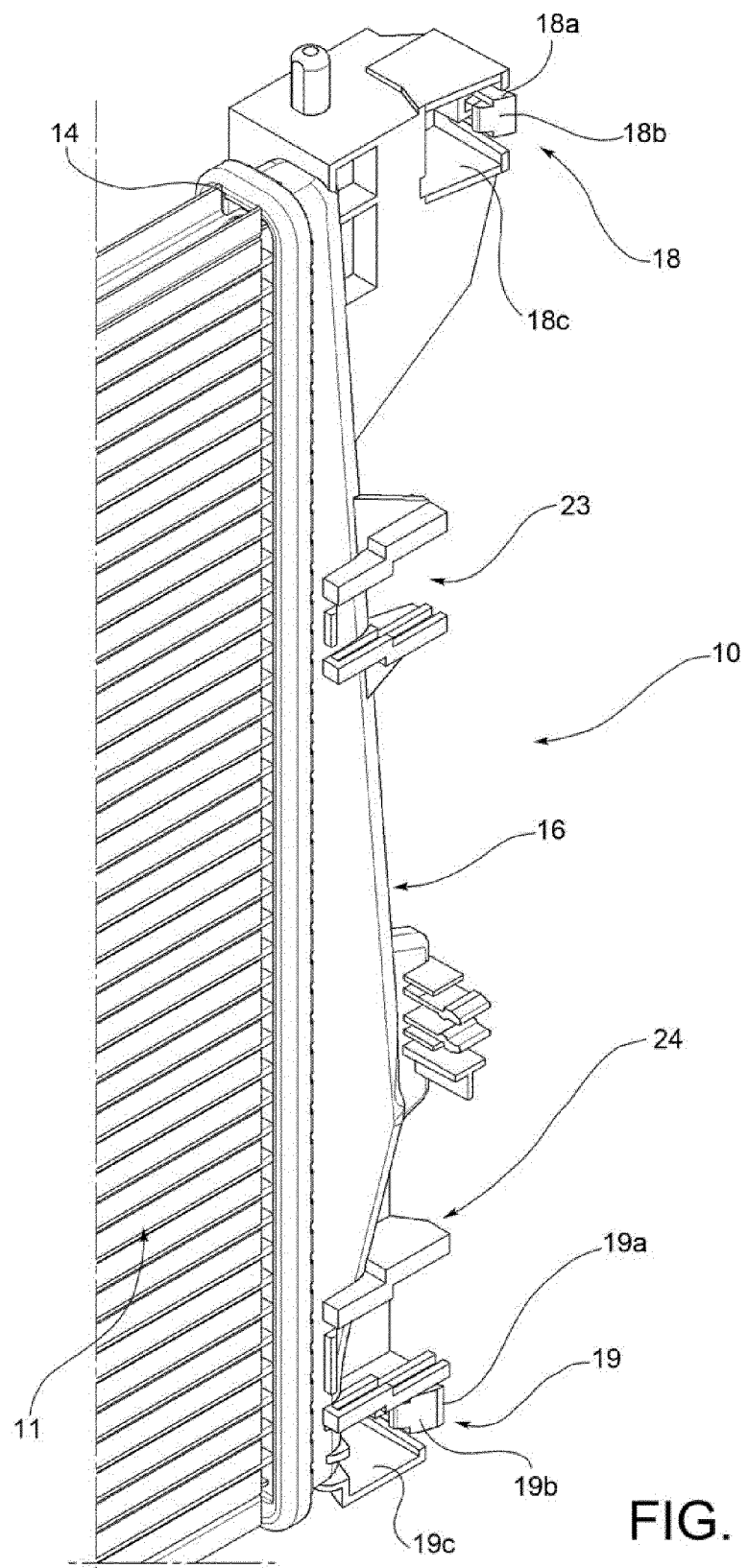


FIG. 3

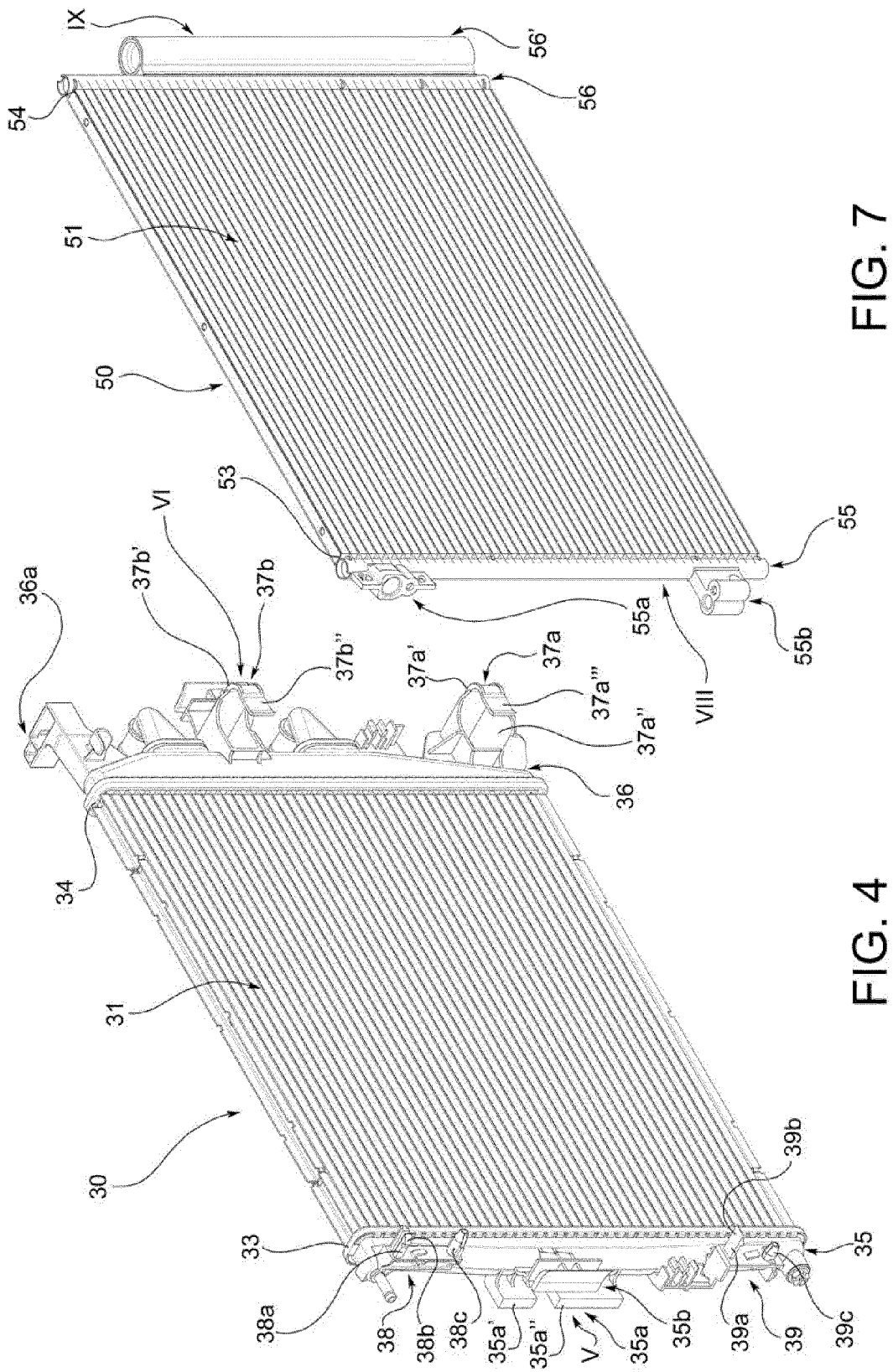


FIG. 7

FIG. 4

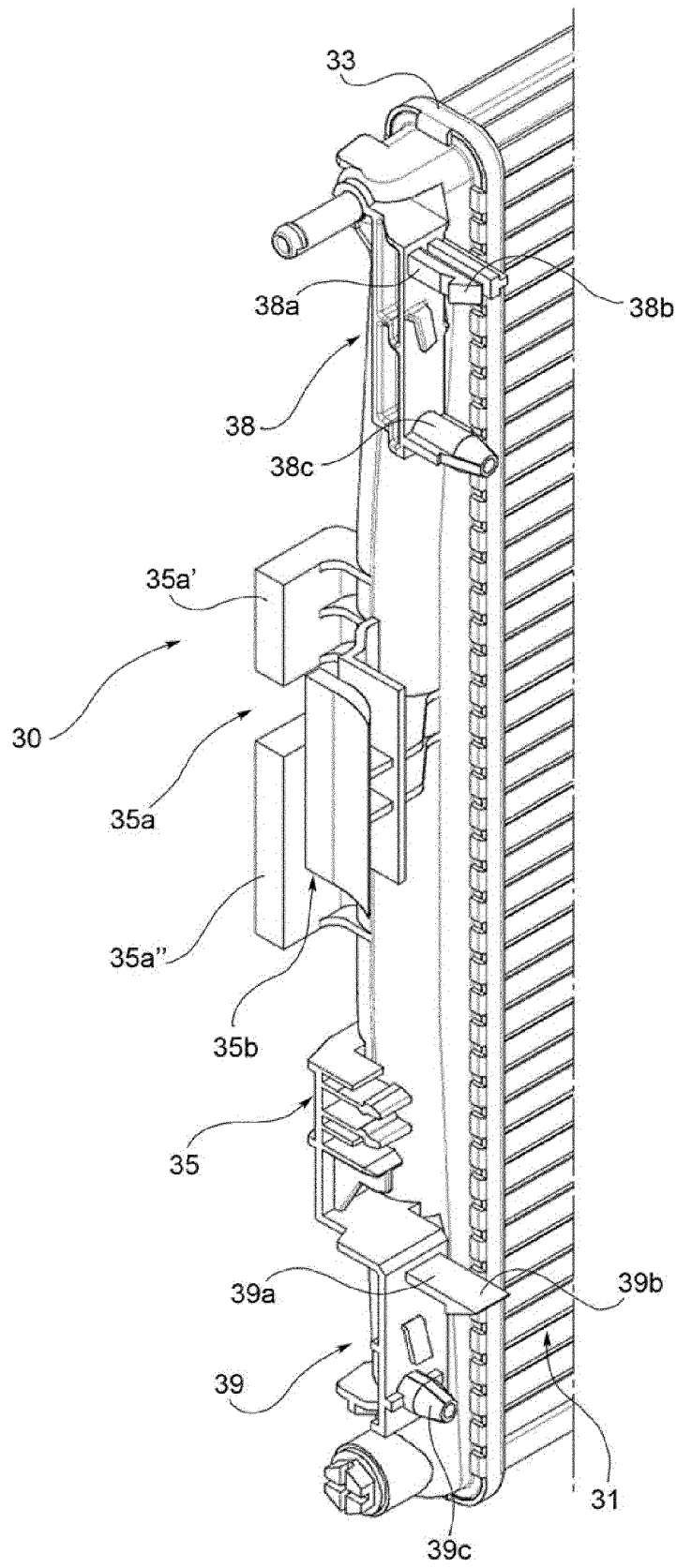
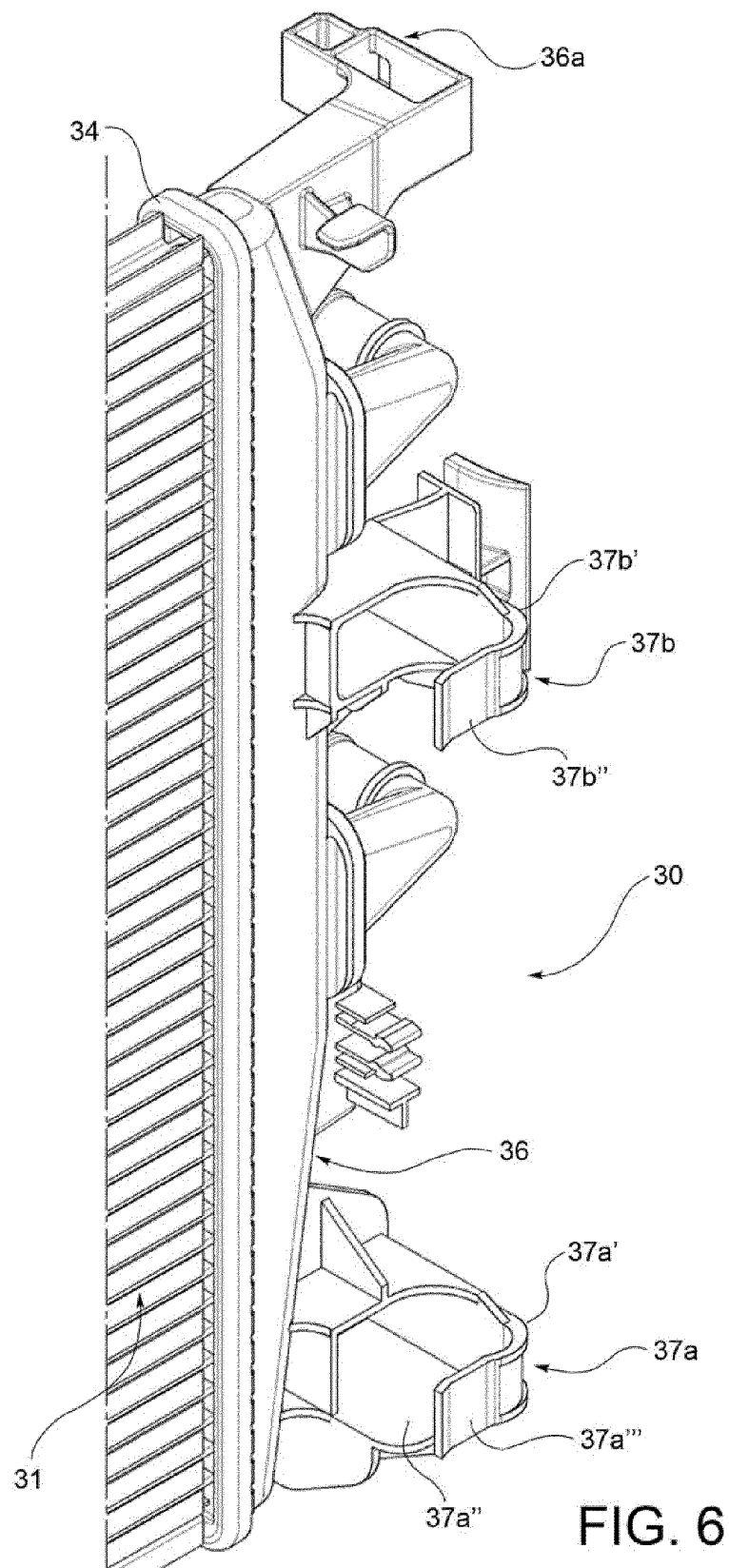


FIG. 5



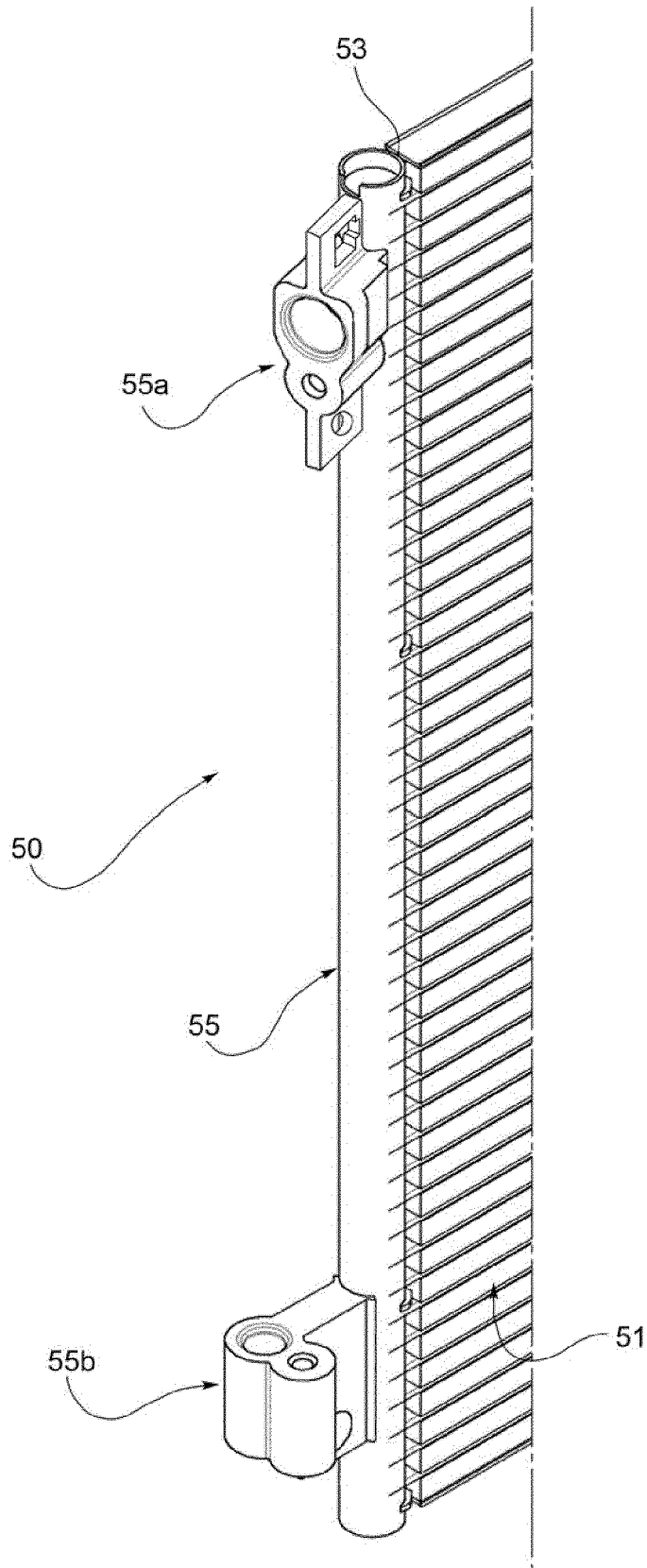


FIG. 8

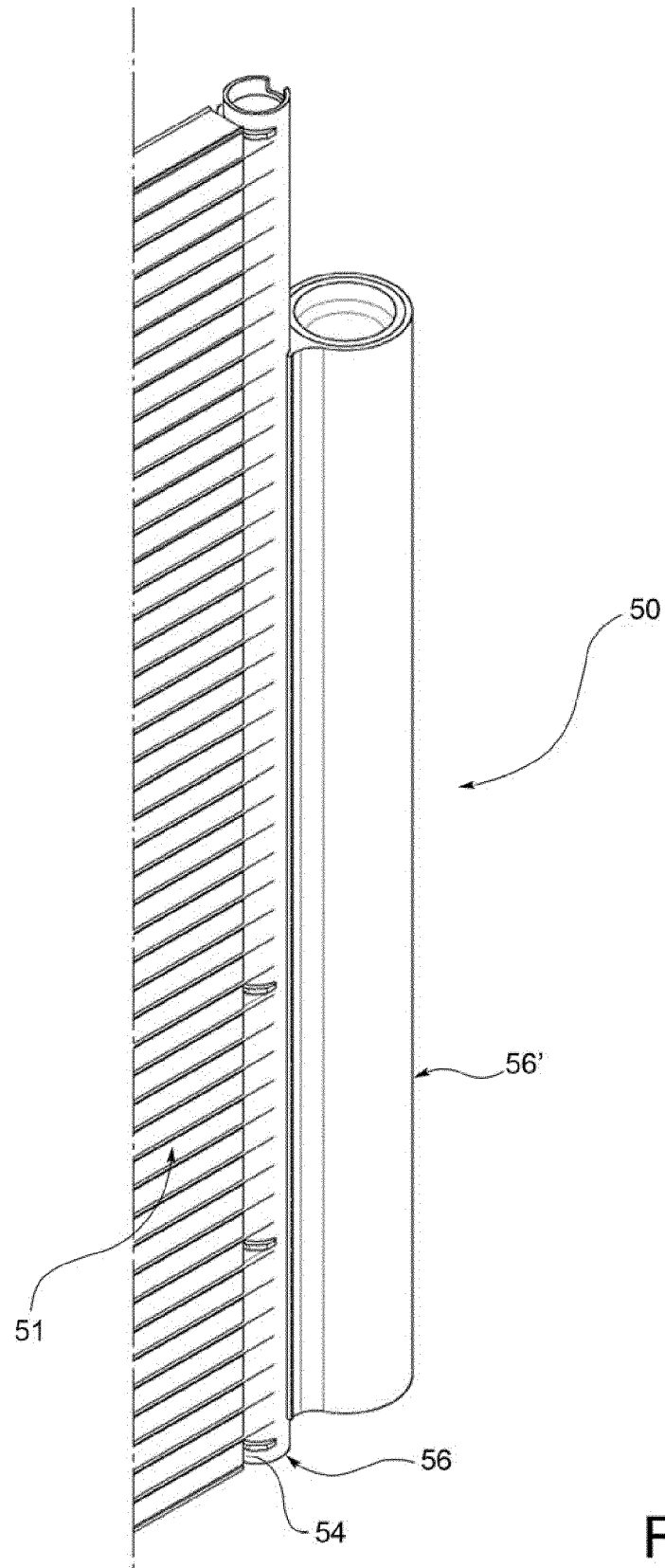


FIG. 9

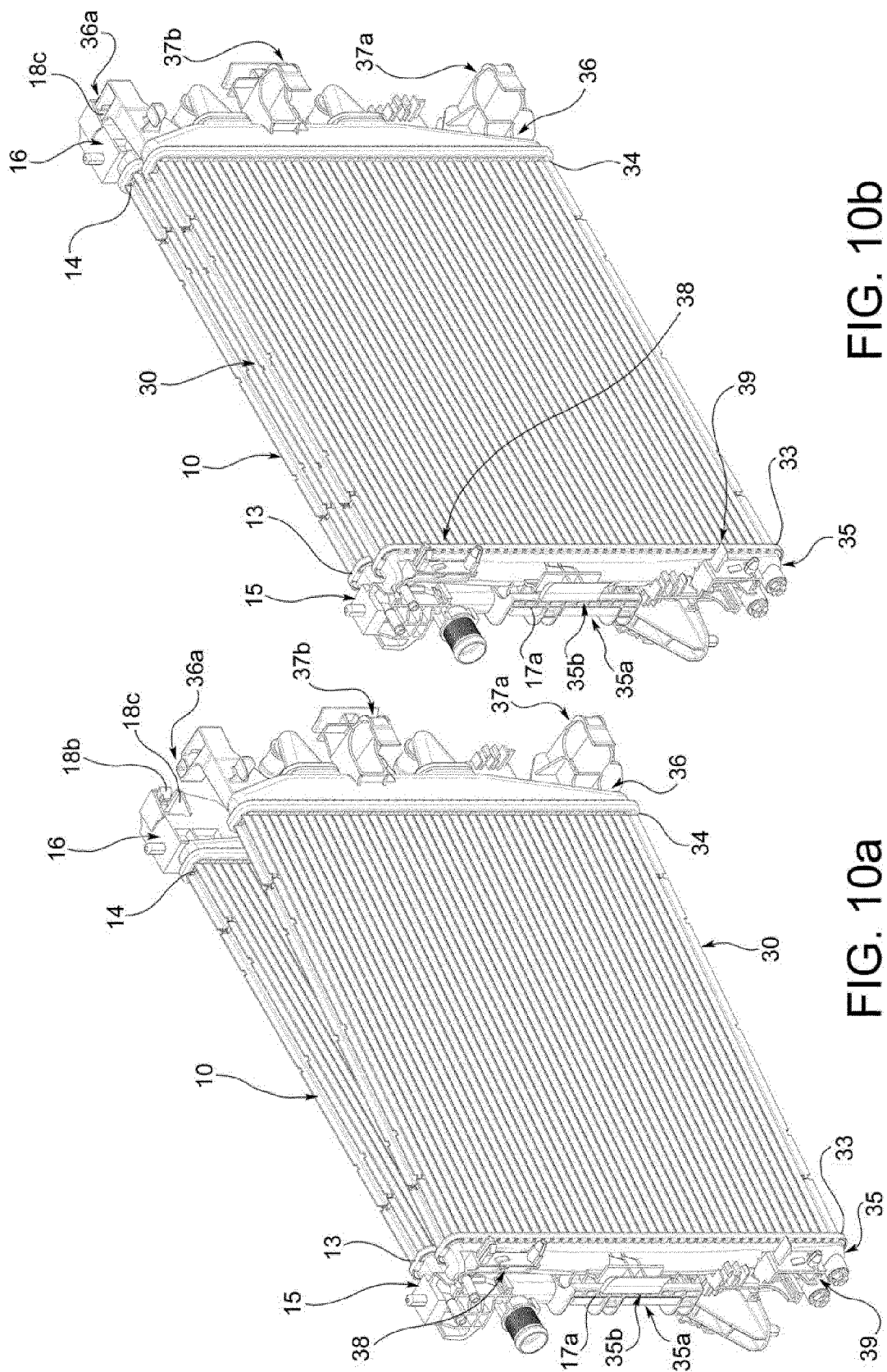
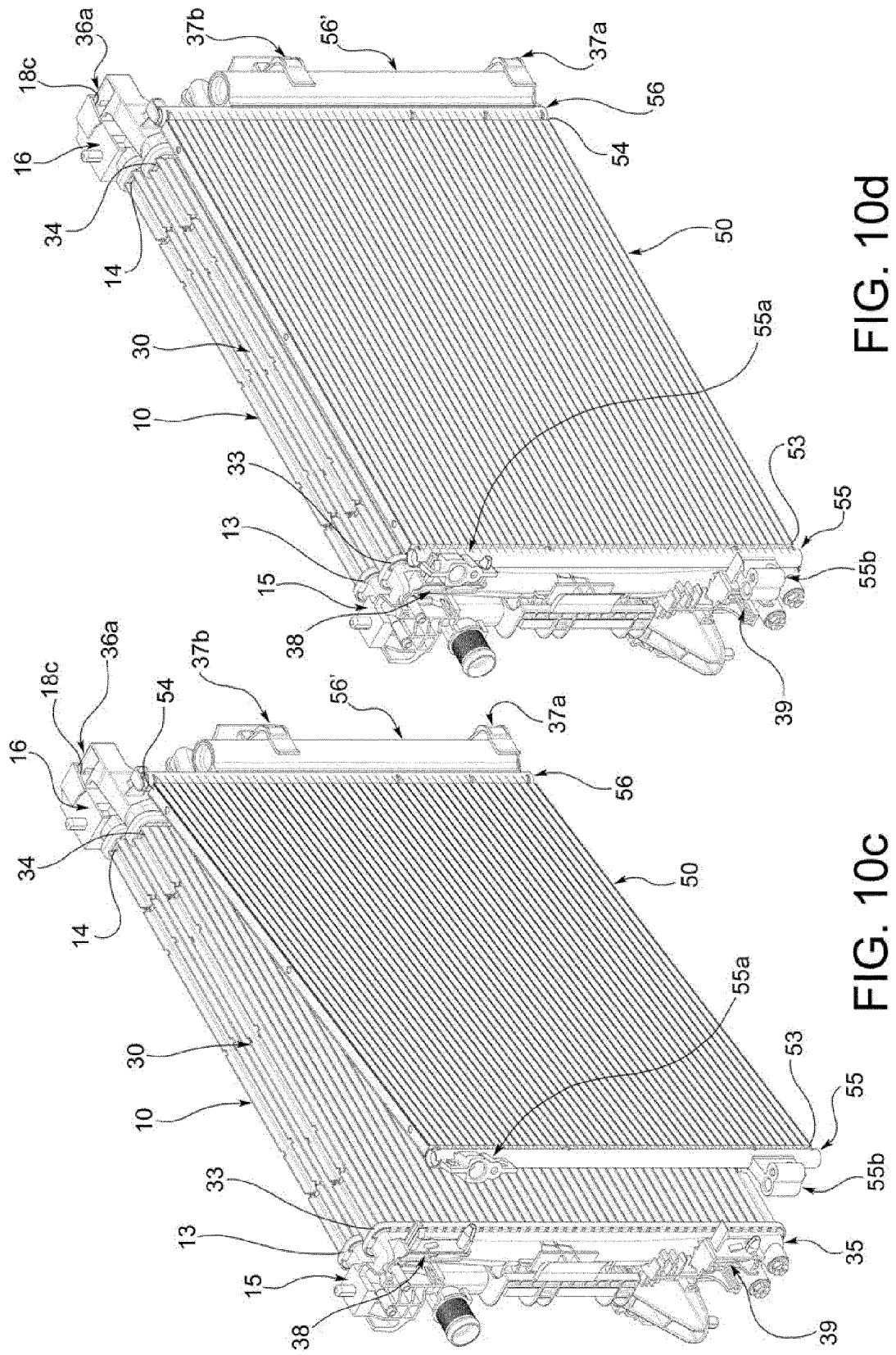


FIG. 10b

FIG. 10a



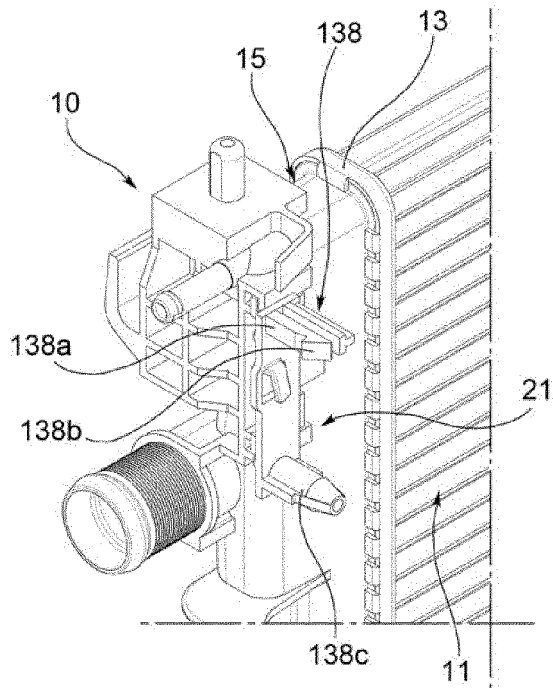


FIG. 11a

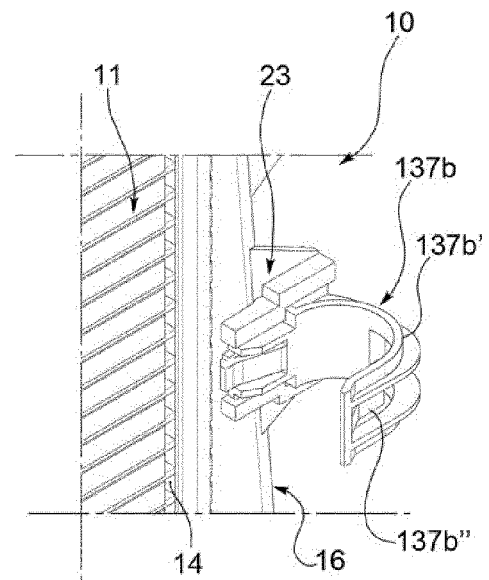


FIG. 11c

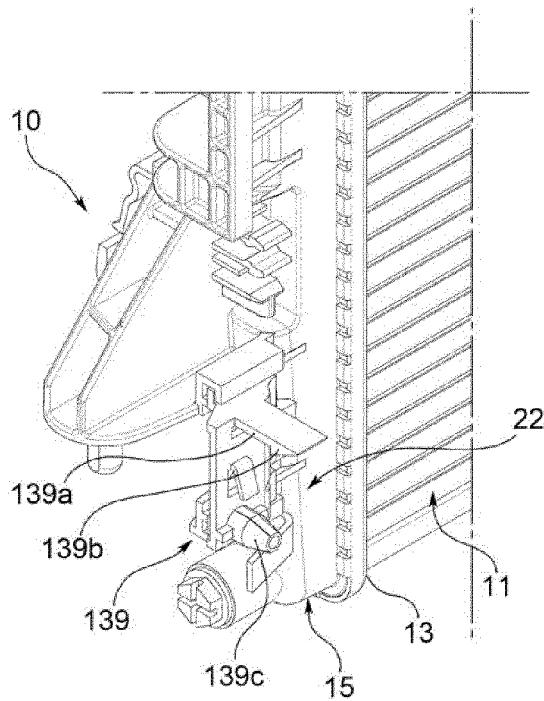


FIG. 11b

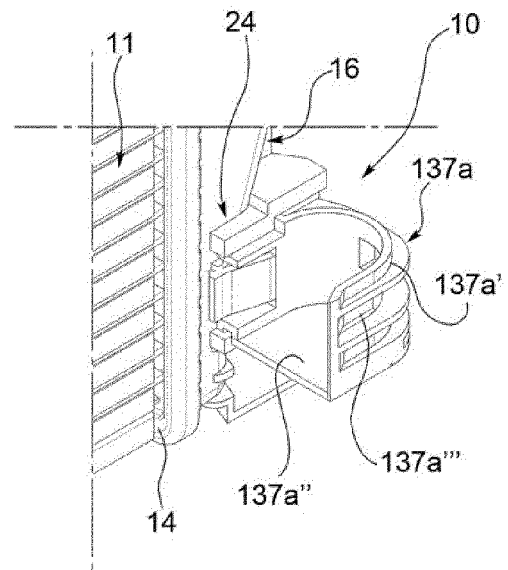


FIG. 11d

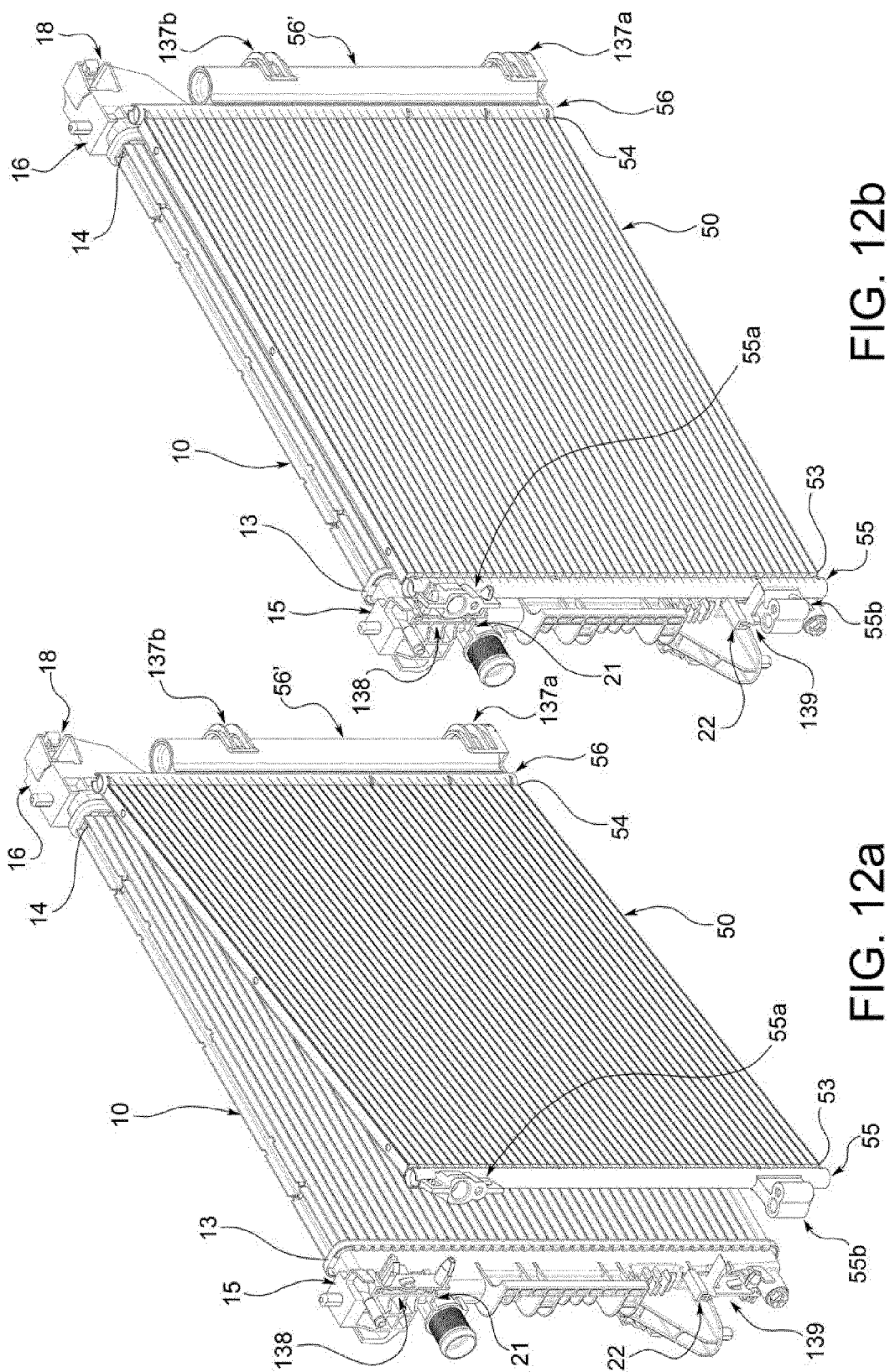


FIG. 12b

FIG. 12a



EUROPEAN SEARCH REPORT

Application Number
EP 13 15 9896

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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