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(54) FEEDING PLATE FOR HEAT EXCHANGER

(57) The invention is dedicated to a feeding plate (100) that is suitable for regulating the coolant flow rate that goes through said feeding plate (100), regarding its longitudinal axis (L1). More precisely, said feeding plate (100) comprises at least one set (130a, 130b) of holes (131-133) that are longitudinally arranged along the feeding plate (100). The area of each hole (131-133) is increasing regarding the longitudinal axis (L1), each hole's area getting greater while the distance between said hole (131-133) and an input opening (110) is getting larger.

The invention aims also at providing a manifold (10) for heat exchanger (1) that includes such feeding plate (100), and also a heat exchanger (1) including such manifold (10).

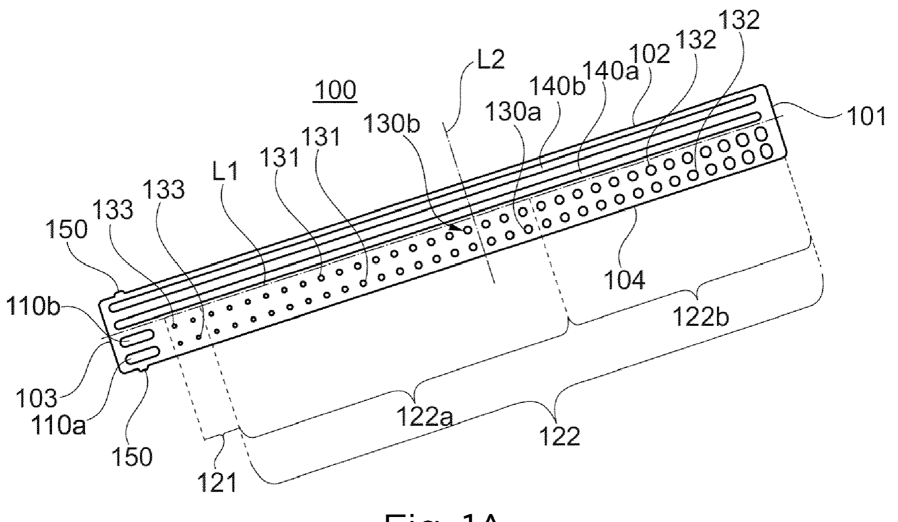

Fig. 1A

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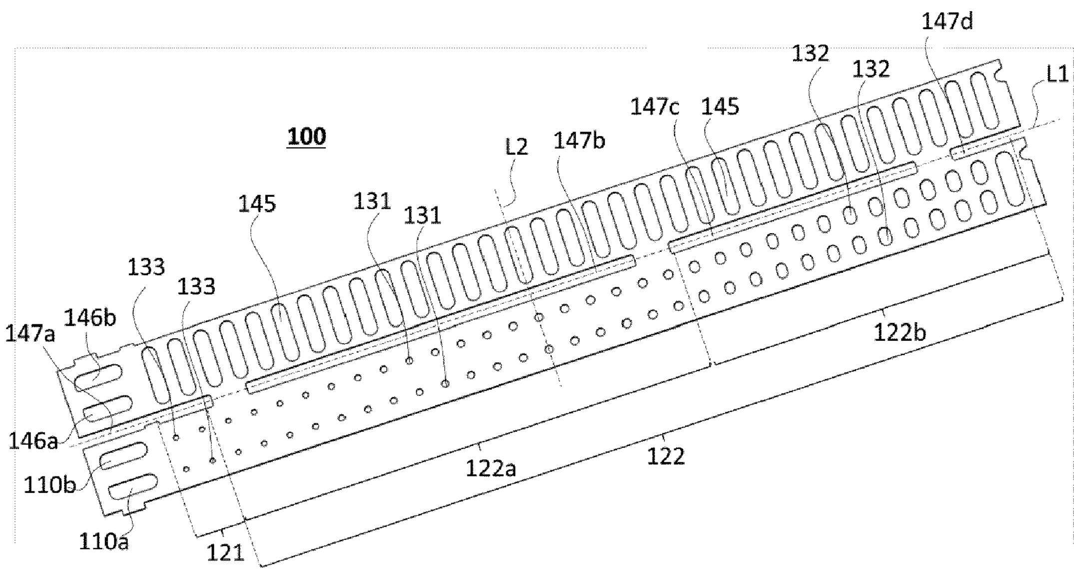

100
147d
132
132
L1
147c
145
L2
147b
145
131
131
133
133
146b
147a
146a
110b
110a
121
122a
122
122b

Fig. 1B

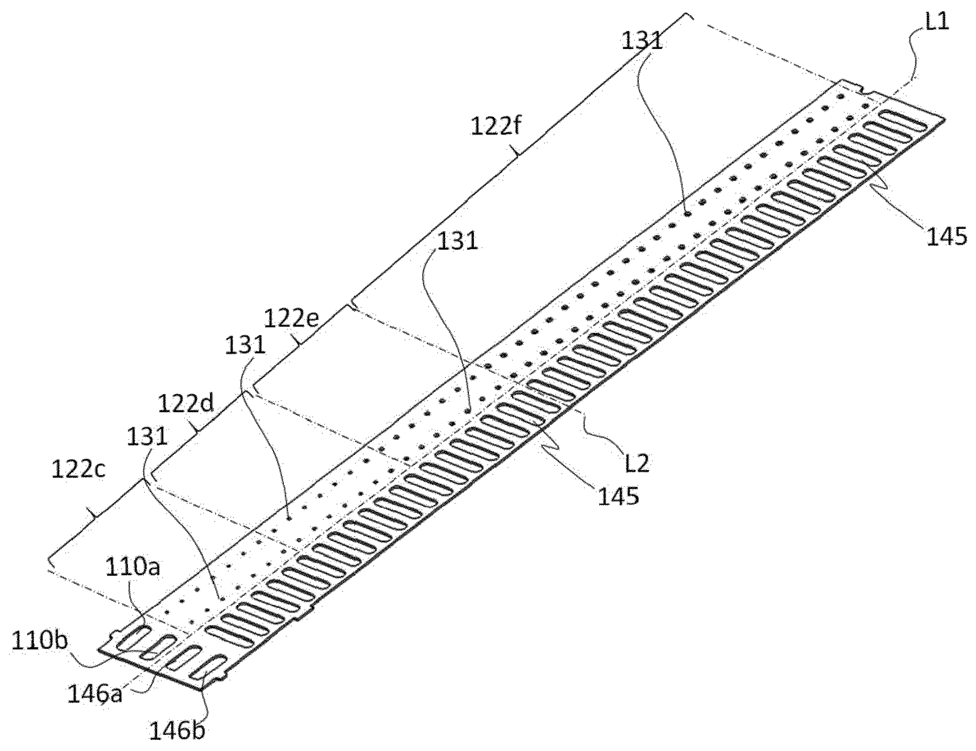

131
L1
122f
145
131
122e
131
122d
131
122c
L2
145
110a
110b
146a
146b

Fig. 1C

Description

[0001] The present invention relates to heat exchangers, especially heat exchangers used in air conditioning systems for automotive vehicle. More particularly, the prevent invention relates to a feeding plate used for such heat exchanger. It also deals with manifold using such feeding plate, and heat exchanger using said manifold.

[0002] Heat exchangers interact with a coolant circulation loop in order to generate heat exchange between said coolant and the outside air of the motor vehicle directed to pass through these heat exchangers. As a non-limitative example, such heat exchanger may be found inside an Heating Ventilation and Air Conditioning unit (HVAC) of automotive vehicles. The coolant may be a gaseous fluid such as an intake air flow for an internal combustion engine, or preferentially a coolant fluid or a refrigerant fluid.

[0003] These heat exchangers are conventionally arranged on the front face of motor vehicles in order to capture the outside fresh air, ahead of the engine placed in its compartment of the motor vehicle.

[0004] These heat exchangers may consist of radiators, condensers or supercharged air coolers. In these heat exchangers, several cylindrical tubes are stacked on top of each other with heat dissipating elements arranged in-between. The coolant circulates inside the tubes thanks to manifolds located at their ends in order to feed tubes with coolant. While circulating inside tubes, the coolant transfers calories with the outside air which passes through the dissipating elements of the heat exchanger.

[0005] More precisely, in such heat exchangers, the coolant flows into the intake manifold by its longitudinal end. As the intake manifold is in communication with the heat exchanger tubes, the coolant is thus orientated with said tubes. Nevertheless, it has been noticed that the efficiency of such heat exchangers is too low, as the coolant temperature distribution is too high between the two longitudinal ends of said heat exchangers.

[0006] Document US2007/0209386 is known, in which a heat exchanger used as an evaporator provided for improving its lower manifold efficiency is disclosed. The upper manifold comprises a flow dividing plate the divides said manifold into an upper and a lower space that are held in communication by some passing holes made onto the flow dividing plate. Passing holes are not used for feeding the heat exchanger tubes. On the contrary, the coolant flows through the passing holes of the flow dividing plate, from the lower space attached to said tubes, to the upper space of the manifold. Then, the coolant flows out of the heat exchanger via an outlet of the manifold. Thus, the outtake manifold disclosed in US20017/0209386 doesn't improve the coolant temperature distribution.

[0007] The invention aims at providing a new feeding plate in order to solve at least one of the foregoing problems and to further carry out other advantages.

[0008] Another object of the invention is to optimize the coolant flow inside a heat exchanger manifold.

[0009] Another object of the invention is to increase the heat exchanger efficiency, by optimizing heat transfer between coolant flowing along the heat exchanger and the air flow that circulates around said heat exchanger.

[0010] According to a first aspect of the invention, at least one of the aforementioned goals is achieved with a feeding plate for a heat exchanger manifold, said feeding plate elongating along a longitudinal axis and having at least one set of holes for feeding the heat exchanger with coolant, each set of holes being distributed along said longitudinal axis, characterized in that holes are configured for providing a constant coolant flow rate through said holes and along at least a part of the longitudinal axis.

[0011] This advantageous configuration thus makes it possible to better feed the tubes of the heat exchanger with coolant. Consequently, as a result of this functional feature, it makes possible to improve the overall efficiency of the heat exchanger, by improving heat transfer between coolant that is flowing into the tubes and ambient air that flows around the heat exchanger. The feeding plate according to the first aspect of the invention thus comprises a plurality of holes longitudinally arranged between a first and a second end of said feeding plate. At least a part of the holes is configured, with respect to its dimensions and/or its shape, in particular, to allow substantially constant flow rate for each of said holes of at least a portion of the corresponding set.

[0012] The feeding plate according to the first aspect of the invention can advantageously comprise at least one of the following improvements, the technical features of each improvement being able to be taken either alone or in combination with another:

- holes of each set are configured in order to provide, for each hole of said part of the holes, a coolant flow rate distribution lower than 10% through said hole and along at least one part of the longitudinal axis of the feeding plate. In other words, regarding the coolant flow rate for each hole of the part of the set that is concerned by the functional feature of the invention accordingly to its first aspect, said coolant flow rates are comprised in a relative distribution range of [0%;10%]. In a preferred embodiment, the coolant flow rate distribution is comprised between 0% and 5%, preferably equal to 2%;

- at least one part of the holes of each set has different areas regarding the other holes of said set. Area of the holes may be different regarding their shape and/or their dimension along at least one direction, as a diameter for example;

- at least one hole's area of each set is different from the area of the other holes of said corresponding set. Preferentially, each hole of each set has a different area from those of all the other holes of said corresponding set;

- in a first alternative of the feeding plate according to the first aspect of the invention, each set comprise at least three sections distributed along the longitudinal axis, all the holes of each said sections having the same hole diameter, and hole diameters of each section being different from the ones of other sections;

- regarding the first alternative, the at least three sections are located within the first half of the feeding plate, according to the longitudinal axis;

- regarding the first alternative, hole diameter of every holes located on the sections of the first half of the feeding plate are increasing from one section to the adjacent another section along the longitudinal axis;

- regarding the first alternative, the feeding plate comprises one more section located onto the second half of the feeding plate, adjacently to the at least three sections located onto the first half of said feeding plate, every holes of said one more section having the same diameter;

- regarding the first alternative, the diameter of every holes of the one more section located on the second half of the feeding plate is greater than holes of each sections located onto the first half of the feeding plate;

- in a second alternative, each set comprises a section along which holes area is monotonically increasing along the longitudinal axis. In other words, holes of the section have an area that is increasing along the longitudinal axis: from one first longitudinal end of the feeding plate to the second longitudinal end of said feeding plate, for each adjacent holes of the section, the hole located closed to the first longitudinal end has a lower area than the one of the hole that is located closed to the second longitudinal end;

- regarding the second alternative, the section comprises a first part along which the holes area increases linearly. In other words, for holes located onto the first part of the feeding plate's section, the relationship between the holes area and their position along the longitudinal axis of the feeding plate is of the type of a linear regression;

- regarding the second alternative, the section comprises a second part along which the holes area increases parabolically. In other words, for holes located onto the second part of the feeding plate's section, the relationship between the holes area and their position along the longitudinal axis of the feeding plate is of the type of a parabolic regression, or a square root regression;

- regarding the second alternative, the first part of the section extends through at least two third of said feeding plate;

- regarding the second alternative, the second part extends through at least one third of the feeding plate;

- regarding the second alternative, the first part of the section is located closed to a first longitudinal end of the feeding plate, preferentially the first longitudinal end from which coolant flows inside the feeding plate and/or the heat exchanger manifold, i.e. closed from an inlet. The second part of the section is located adjacently to the first part, closed to a second longitudinal end of the feeding plate;

- regarding the second alternative, the holes located onto the first part of each set's section are circular, and/or the holes located onto the second part of said section are elliptical or oblong;

- for anyone of the abovementioned alternatives, each holes of each set are regularly spaced, a pitch between two adjacent holes of one set being constant;

- for anyone of the abovementioned alternatives, each set comprises a portion along which holes all have the same area, i.e. the same shape and/or the same dimensions along at least one direction, for example a diameter;

- for anyone of the abovementioned alternatives, for each set, the area of holes located onto the portion is different from the area of holes located onto the section of said corresponding set. In a preferred embodiment, the area of holes located onto the portion is smaller than each area of the holes located onto the section of said corresponding set;

- for anyone of the abovementioned alternatives, the portion of each set is located at one longitudinal end of the feeding plate and the section of said corresponding set is located at a second longitudinal end of the feeding plate, the first longitudinal end being on a side of said feeding plate from which the coolant is intended to flow inside the heat exchanger manifold;

- for anyone of the abovementioned alternatives, the at least one set of holes is located at a lateral edge of said feeding plate;

- for anyone of the abovementioned alternatives, all the sets of the feeding plate are located at a same lateral edge of said feeding plate, and regarding to a median longitudinal axis of the feeding plate;

- for a first configuration of the feeding plate according to the first aspect of the invention, and for anyone of the abovementioned alternatives, said feeding plate comprises at least two sets of holes for feeding the heat exchanger with coolant. Pair of holes taken respectively on each set, at the same longitudinal position of the feeding plate, are intended to collaborate with one tube of the heat exchanger;

- for the first configuration abovementioned, pitches of each set of the feeding plate are equals. In other words, the distance between two adjacent holes is the same for both sets of the feeding plate;

- for the first configuration abovementioned, each corresponding holes of each set of the feeding plate are aligned in a direction that is perpendicular to the longitudinal axis;

- for a second configuration of the feeding plate according to the first aspect of the invention, and for anyone of the abovementioned alternatives, said feeding plate comprises only one set of holes for feeding the heat exchanger with coolant;

- the feeding plate according to the first aspect of the invention comprises at least one opening extending longitudinally from one longitudinal end to one another end of the feeding plate. The at least one opening is intended to collect the coolant that flows from the heat exchanger tubes to its manifold, through the feeding plate. In one embodiment, the feeding plate according to the first aspect of the invention comprises only one opening, said opening extending longitudinally from one end to another end of said feeding plate. In another embodiment, the feeding plate according to the first aspect of the invention comprises as many openings as the number of its hole sets;

- the at least one opening may be radially delimited by a closed shape, i.e. at least one opening may be bounded by material constitutive of the feeding plate; or the at least one opening may have an open shape;

- the at least one opening of the feeding plate according to the first aspect of the invention has an oblong shape, the oblong shape extending along the longitudinal axis;

- regarding to the medium longitudinal axis of the feeding plate, the at least one opening is located on one lateral edge of the feeding plate, and the at least one set of holes is located on another lateral edge of said feeding plate. In the case on which the feeding plate comprises many sets of holes and/or many openings, sets are all located on a first lateral edge of the feeding plate, and openings are all located on another lateral edge of said feeding plate, the other lateral edge being located on an opposite side from the first lateral edge and regarding to the medium longitudinal axis;

- the feeding plate 4according to the first aspect of the invention is more precisely, but not limited to, dedicated to an inner manifold, and advantageously to an inner condenser tank.

[0013] According to a second aspect of the invention, a manifold for heat exchanger is provided. The manifold according to the second aspect of the invention comprises:

- a header box intended to be connected to a plurality of tubes of the heat exchanger, each tube being connected through an opening of said header box;

- the feeding plate according to the first aspect of the invention or anyone of its improvements, holes of said feeding plate being longitudinally aligned with the header box openings in order to allow coolant to flow into tubes;

- an intermediate plate located on the other side of the feeding plate regarding to the header box, said intermediate plate comprising at least one longitudinal openings between one end and another end of said intermediate plate, said at least one longitudinal openings being aligned with the corresponding set of holes of the feeding plate in order to allow coolant to flow into tubes;

- a cover plate located onto the intermediate plate, said intermediate plate being located between the feeding plate and the cover plate.

[0014] Thus, the feeding plate according to the first aspect of the invention takes place inside the heat exchanger manifold, between the header box and the cover plate. Thus, the feeding plate regulate the coolant flow inside the manifold and inside the heat exchanger tubes that are intended to be connected with said manifold. This advantageous configuration allows a static regulation of the coolant that flows inside the manifold, through the feeding plate.

[0015] The manifold according to the second aspect of the invention can advantageously comprise at least one of the following improvements, the technical features of each improvement being able to be taken either alone or in combination with another:

- the intermediate plate of the heat exchanger manifold comprises a number of longitudinal openings equal to the number of sets of the feeding plate, each longitudinal opening of said intermediate plate being upwardly aligned with each corresponding set of said feeding plate. This advantageous configuration allows to improve the coolant flow inside the manifold;

- the cover plate of the heat exchanger manifold may comprise some longitudinal channels in order to allow coolant to flow into the tubes. In a preferred embodiment, each channel is shaped as a depression of said cover plate;

- the heat exchanger manifold according to the second aspect of the invention comprises a distribution plate located between the header box and the feeding plate, said distribution plate comprising a plurality of openings longitudinally aligned with the corresponding holes of said feeding plate. The distribution plate facilitates the entrance of coolant inside heat exchanger tubes, by providing space between the tube ends that are inserted through the header box and the lower face of the feeding plate;

- the heat exchanger manifold is preferentially of the type of an intake manifold.

[0016] According to a third aspect of the invention, a heat exchanger is provided, said heat exchanger comprising:

- the manifold according to the second aspect of the invention or anyone of its improvements, said manifold being an upper manifold for the heat exchanger;

- an inner manifold;

- a plurality of tube extending between the upper and the inner manifold.

[0017] The heat exchanger according to the third aspect of the invention provide a more efficient heat transfer between the coolant flowing into its tubes and the ambient air that flows around said tubes, thanks to the coolant flow rate regulation provided by the feeding plate.

[0018] In another embodiment of the invention, the manifold according to the second aspect of the invention or anyone of its embodiments may be an inner manifold for the heat exchanger.

[0019] Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder in one hand, and from non-limiting various embodiments that are described hereafter with references to figures in the other hand, wherein:

- FIGURE 1A features a perspective view of a first example of the feeding plate according to the first aspect of the invention;

- FIGURE 1B features a perspective view of a second example of the feeding plate according to the first aspect of the invention;

- FIGURE 1C features a perspective view of a third example of the feeding plate according to the first aspect of the invention;

- FIGURE 2 illustrates an exploded perspective view of an example of the manifold according to the second aspect of the invention;

- FIGURE 3 illustrates a perspective view of an example of the heat exchanger according to the third aspect of the invention.

[0020] Of course, features and different embodiments of the invention may be combined with one another in various combinations, as well as they are not incompatible or exclusive to one another. More particularly, it will be possible to imagine variants of the invention comprising only a selection of the features described hereinafter, without the other characteristics described, if said selection of features provides a technical advantage or if it allows to distinguish the invention from prior art.

[0021] In particular, the embodiments described hereafter are combinable if said combination is functional from the technical point of view.

[0022] In the following figures, features common to several figures have the same reference.

[0023] Regarding to FIGURE 1A, a feeding plate 100 for a heat exchanger manifold and according to the first aspect of the invention will be described hereafter.

[0024] As shown, the feeding plate 100 has a rectangular shape, elongating along a longitudinal axis L1 and a lateral axis L2. Along the longitudinal axis L1, the feeding plate 100 is bounded with two longitudinal ends 101, 103; along the lateral axis L2, the feeding plate 100 is bounded with two lateral ends 102, 104.

[0025] The feeding plate 100 has a thickness that is far thinner than the longitudinal and/or lateral dimensions of said feeding plate.

[0026] The feeding plate is advantageously made with metal, or with plastic. It can be produced thanks to a stamping process, especially when said feeding plate 100 is in metal, or through a moulding process, especially when said feeding plate 100 is in plastic.

[0027] To facilitate the feeding plate 100 assembly onto the manifold with whom it suitable to collaborate, said feeding plate 100 comprises two lugs 150, each lug 150 being located onto a longitudinal edge of the feeding plate 100. More precisely, the lugs 150 are located at a same longitudinal position of the feeding plate 100.

[0028] As it will be described hereafter in regard with FIGURES 2 and 3, the feeding plate 100 is suitable for controlling a coolant flow rate that is introduced into tubes of the heat exchanger. To this purpose, the feeding plate 100 has at least one set 130a, 130b of holes 131, 132, 133, each set 130a, 130b of holes 131-133 being distributed along the longitudinal axis L1. Moreover, holes 131-133 are configured for providing a constant coolant flow rate through said holes 131-133 and along at least a part of the longitudinal axis L1. More precisely, holes 131-133 of each set 130a, 130b are configured in order to provide, for each hole 131-133 of said part of the holes, a coolant flow rate distribution lower than 10% through said hole 131-133 and along at least one part of the longitudinal axis L1 of the feeding plate 100. In a preferred embodiment, the coolant flow rate distribution is equal to 2%.

[0029] As visible on FIGURE 1A, the feeding plate 100 has several parts, each part having holes 131-133 with different size and/or shape and/or area. In particular, the feeding plate 100 comprises:

- a section 122 along which holes area is monotonically increasing along the longitudinal axis L1. In other words, holes 131, 132 of the section 122 have an area that is increasing along the longitudinal axis L1: regarding the longitudinal axis L1, and for example from the left side of FIGURE 1A to the right side of said FIGURE 1A, for each pair of adjacent holes 131, 132 of the section 122, the hole 131, 132 located closed to the left longitudinal end of said feeding plate 100 has a lower area than the area of the hole 131, 132 that is located closed to the right longitudinal end;
- a portion 121 along which holes 131-133 all have the same area, i.e. the same shape and/or the same dimensions along at least one direction, for example a diameter. The portion 121 of each set 130a, 130b is advantageously located at one longitudinal end of the feeding plate 100, the first longitudinal end being on a side of said feeding plate 100 from which the coolant is intended to flow inside the heat exchanger manifold.

[0030] As visible on FIGURE 1A, the section 122 comprises a first part 122a along which the holes area increases linearly, and a second part 122b along which the holes area increases parabolically.

[0031] The first part 122a of the section 122 extends through at least two third of the feeding plate 100, a surface along which the second part 122b extends being the half of a surface a surface along which the first part 122a extends.

[0032] The first part 122a of the section 122 is located closed to a first longitudinal end of the feeding plate 100 from which coolant flows inside said feeding plate 100. In other words, hole areas are smaller closer to the longitudinal side from which the feeding plate collaborate with an inlet of the heat exchanger manifold. The second part 122b of the section 122 is located adjacently to the first part, regarding to the longitudinal axis L1, and closed to a second longitudinal end of the feeding plate 100, opposite from the first longitudinal end. This configuration allows to better regulate the coolant flow rate that flows through the feeding plate 100 and to the heat exchanger tubes.

[0033] As visible on FIGURE 1A, the holes 131, 132 located onto the first part 122a of each set 130a, 130b are circular, and the holes 131, 132 located onto the second part 122b of each set 130a, 130b are elliptical or oblong.

[0034] Each hole 131-133 of each set 130a, 130b and of each portion 121 and each section 122 are regularly spaced, a pitch between two adjacent holes 131-133 of one set 130a, 130b being constant over the corresponding portion 121 and the corresponding section 122.

[0035] For each set 130a, 130b, the area of holes 131-133 located onto the portion 121 is different from the area of holes 131-133 located onto the section 122 of said corresponding set 130a, 130b, and more precisely, the area of holes 131-133 located onto the portion 121 is smaller than each area of the holes 131-133 located onto the section 122 of said corresponding set 130a, 130b.

[0036] In FIGURE 1A, the feeding plate 100 comprises two sets 130a, 130b of holes 131-133, as described therebefore. Both sets 130a, 130b are located at a lateral edge of said feeding plate. Each set 130a, 130b is laterally located from the other one. More precisely, all the sets 130a, 130b of the feeding plate 100 are located at a same lateral edge of said feeding plate 100, and regarding to a median longitudinal axis L1 of the feeding plate 100.

[0037] Pair of holes 131-133 taken respectively on each sets 130a, 130b of the feeding plate 100, at the same longitudinal position of said feeding plate 100, are intended to collaborate with one same tube of the heat exchanger. Consecutively, each corresponding hole 131-133 of each set 130a, 130b of the feeding plate 100 are aligned along the lateral axis L2, and a distance between two adjacent holes 131-133 is the same for both sets 130a, 130b of the feeding plate 100.

[0038] As describer therebefore, each holes of the feeding plate 100 is intended to contribute to output coolant from the manifold with whom it collaborate.

[0039] To input coolant from an inlet of the manifold that is visible onto FIGURE 2 and into said manifold, the feeding plate 100 comprises at least one input opening 110a, 110b. More precisely, the feeding plate 100 comprise a number of input opening 110a, 110b that is equal to a number of sets 130a, 130b, the number being equal to 2 onto the example illustrated in FIGURE 1A.

[0040] Each input opening 110a, 110b has an oblong shape that extends longitudinally. Input openings both have the same dimensions and/or the same area and/or the same shape.

[0041] To collect the coolant that flows back from the heat exchanger tubes into the manifold, through the feeding plate 100, said feeding plate 100 comprises at least one opening 140a, 140b that extends longitudinally from one longitudinal end to one another end of the feeding plate 100. In the example illustrated in FIGURE 2, the feeding plate 100 comprises a number of openings 140a, 140b that is equal to the number of sets 130a, 130b, this number being equal to 2 for example. Each opening 140a, 140b is bounded by material constitutive of the feeding plate that is shaped as a closed line: in FIGURE 1A, each opening 140a, 140b has an oblong shape that extends along the longitudinal axis L1.

[0042] Regarding to the medium longitudinal axis of the feeding plate 100, the openings 140a, 140b are located on another lateral edge of the feeding plate 100 regarding the lateral edge on which said feeding plate 100 comprises its sets 130a, 130b of holes 131-133.

[0043] Regarding to FIGURE 1B, a second example of the feeding plate 100 according to the first aspect of the invention will be described.

[0044] For clarity reasons, the feeding plate 100 illustrated in FIGURE 1B will be described only through its differences regarding the feeding plate illustrated in FIGURE 1A, as its main structural features remain valid for the feeding plate illustrated in FIGURE 1B, and as those differences only deal with (i) the characteristics configured for outputting the coolant from the feeding plate and/or the manifold and/or the heat exchanger, and (ii), some longitudinal aperture that will be described hereafter.

[0045] Contrary to FIGURE 1A, the feeding plate 100 illustrated in FIGURE 1B comprises a plurality of lateral openings 145, instead of the openings 140 that can be seen in FIGURE 1A. Each lateral opening 145 has an oblong shape elongating along the lateral axis L2.

[0046] Advantageously, the feeding plate 100 illustrated in FIGURE 1B comprises as many lateral openings 145 as holes 131, 132, 133 for feeding the heat exchanger, preferably suitable to be aligned with tubes of the heat exchanger.

[0047] Every lateral opening 145 may be aligned with a hole 131-133 of the set 130a, 130b of holes, regarding the longitudinal axis L1.

[0048] As visible in FGIURE 1B, a longitudinal pitch between two adjacent lateral opening 145 is constant. In other words, the longitudinal distance between two adjacent lateral opening 145 is constant.

[0049] To output coolant from an outlet of the manifold that is visible onto FIGURE 2 and into said manifold, the feeding plate 100 illustrated in FIGURE 1B comprises two output openings 146a, 146b. The output openings 146a, 146b are located at one longitudinal end of the feeding plate 100, advantageously the same longitudinal end than the input openings 110a, 110b.

[0050] Each output opening 146a, 146b has an oblong shape that extends longitudinally. Output openings both have the same dimensions and/or the same area and/or the same shape.

[0051] Output openings 146a, 146b have the same shape and/or dimension and/or area tan the input openings 110a, 110b.

[0052] The feeding plate 100 illustrated in FIGURE 1B comprises many longitudinal apertures 147a-147d located along a central longitudinal axis L1, regarding the lateral axis L2.

[0053] A first longitudinal aperture 147a is located at one longitudinal end of the feeding plate 100, on the side of the output 147 and input 110 apertures. The first longitudinal aperture 147a roughly extends along the portion 121 of the feeding plate 100, as described therebefore regarding FIGURE 1A.

[0054] A second longitudinal aperture 147b is located adjacently to the first longitudinal aperture 147a, regarding the longitudinal axis L1. The second longitudinal aperture 147b roughly extends along the first part 122a of the portion 122 of the feeding plate 100, as described therebefore regarding FIGURE 1A.

[0055] A third longitudinal aperture 147c is located adjacently to the second longitudinal aperture 147b, regarding the longitudinal axis L1. The third longitudinal aperture 147c roughly extends along the second part 122b of the portion 122 of the feeding plate 100, as described therebefore regarding FIGURE 1A.

[0056] A fourth longitudinal aperture 147d is located at one another longitudinal end of the feeding plate 100, in regard to the longitudinal end along which the first longitudinal aperture is located. The fourth longitudinal aperture 147d roughly extends along the two or three last holes 132 of the second part 122b of the portion 122, regarding the longitudinal axis L1 and as the second part 122b and the portion 122 being described therebefore regarding FIGURE 1A.

[0057] Considering the lateral axis L2, the lateral dimensions and/or the lateral shape of every longitudinal apertures 147a-147d are identical.

[0058] Regarding to FIGURE 1C, a third example of the feeding plate 100 according to the first aspect of the invention will be described.

[0059] For clarity reasons, the feeding plate 100 illustrated in FIGURE 1C will be described only through its differences regarding the feeding plate illustrated in FIGURE 1A, as its main structural features remain valid for the feeding plate illustrated in FIGURE 1C, and as those differences only deal with diameters and/or shape and/or area of holes of the at least one set of holes that is configured for feeding the manifold and/or the heat exchanger with coolant.

[0060] As visible in FIGURE 1C, the feeding plate 100 comprise two set 130a, 130b of holes 131, and each set 130 comprises at three sections 122c, 122d, 122e distributed along the longitudinal axis L1, all the holes 131 of each said sections 122c-122e having the same hole diameter and/or the same area and/or the same shape. Moreover, the hole diameters of each section 122c-122e are different from the ones of other sections :

- the diameter and/or the shape and/or the area of the holes 131 of the first section 122c is different from the diameter and/or the shape and/or the area of the holes 131 of the second 122d and the third 122e section; and

- the diameter and/or the shape and/or the area of the holes 131 of the second section 122d is different from the diameter and/or the shape and/or the area of the holes 131 of the first 122c and the third 122e section; and

- the diameter and/or the shape and/or the area of the holes 131 of the third section 122e is different from the diameter and/or the shape and/or the area of the holes 131 of the first 122c and the second 122d section.

[0061] As visible in FIGURE 1C, the three sections 122c-122d are located within the first half of the feeding plate 100, according to the longitudinal axis L1, and on the side of the input 110 and output 146 openings.

[0062] In the specific design of the feeding plate 100 illustrated in FIGURE 1C, hole diameter of every holes 131 located on the sections 122c-122e of the first half of said feeding plate 100 are advantageously increasing from one said section 122c-122e to an adjacent another said section 122c-122e along the longitudinal axis L1. In other words, the diameter of holes 131 located onto the first section 122c that is located close to the input openings 110 the diameter of holes 131 located onto the second section 122d that is adjacent to the first section 122c located close to the input openings 110 ; and the diameter of holes 131 located onto the second section 122c that is adjacent to the first section 122c located close to the input openings 110 is smaller than the diameter of holes 131 located onto the third section 122e that is located close to the lateral axis L2 as illustrated onto FIGURE 1C.

[0063] The feeding plate 100 also comprises one more section 122f located onto the second half of said feeding plate 100, adjacently to the third section 122e as described previously, every holes of said one more section 122f having the same diameter and/or shape and/or area. Advantageously, the diameter of every holes of the one more section 122f located on the second half of the feeding plate 100 is greater than the diameter of holes of each sections 122c-122e located onto the first half of the feeding plate 100.

[0064] Regarding to FIGURE 2, a manifold 10 according to the second aspect of the invention will be described hereafter. Advantageously, but in a non-limiting manner, the manifold 10 is an intake manifold 10. The manifold 10 illustrated in FIGURE 2 comprises:

- a header box 500 intended to be connected to a plurality of tubes of the heat exchanger;

- the feeding plate 100 as described therebefore in anyone of FIGURE 1A, 1B or 1C;

- an intermediate plate 300 located on the other side of the feeding plate 100 regarding to the header box 500;

- a distribution plate 200 located between the header box 500 and the feeding plate 100;

- a cover plate 400 located onto the intermediate plate 300.

[0065] The header box extends along the longitudinal axis L1 with a U shape in a cross section. The header box 500 comprises a rectangular plate 560 with many openings 550a, 550b for connecting each tube of the heat exchanger. More precisely, each opening 550a, 550b of the header box 500 is suitable for at least fluidly connecting and/or mechanically coupling one tube of the heat exchanger, an end of each tube being able to be inserted through the corresponding opening 550a; 550b of said header box 500. To this purpose, each opening 550a, 550b of the header box 500 extends laterally along the lateral axis L2, with an oblong shape.

[0066] The header box 500 comprises a plurality of openings 550a, 550b that are regularly spaced along the longitudinal axis L1. The header box 500 advantageously comprises 2 sets of openings 550a, 550b. One first set of openings 550a is suitable for feeding tubes with coolant that flows from the feeding plate 100 into the corresponding tube; and a second set of opening 550b is suitable for collecting coolant that flows from the tube into the manifold 10.

[0067] The rectangular plate 560 is laterally bounded with two lateral edges 530, 540, each lateral edge 530, 540 having a slot 560 for inserting each lateral lug 150 of the feeding plate 100.

[0068] At one longitudinal end, the header box 500 comprises an inlet 510 and an outlet 520 that is located on a lateral side of said inlet 510 regarding the lateral axis L2. The inlet is suitable for connecting said manifold 10 to a coolant circuit in order to drive said coolant from the coolant circuit into the manifold 10 and/or to the heat exchanger. The outlet 520 is suitable for connecting said manifold 10 to the coolant circuit in order to flow said coolant from the manifold 10 to the coolant circuit.

[0069] The header box 500 also comprises an inlet opening 515 that is situated at one longitudinal end of the rectangular plate 560, closed to the inlet 510, and the header box 500 also comprises an outlet opening 525 that is situated laterally to the inlet opening 515.

[0070] The distribution plate 200 as a rectangular shape. The distribution plate 200 is configured to be inserted inside the header box 500, between the two lateral edges 530, 540.

[0071] The distribution plate 200 comprises a plurality of openings 250a, 250b that are longitudinally aligned with the corresponding holes t1-133 of the feeding plate 100 and also with the openings 550a, 550b of the header box 500. The distribution plate 200 facilitates the entrance of coolant inside heat exchanger tubes, by providing space between the tube ends that are inserted through the openings 550a, 550b of the header box 500 and a lower face of the feeding plate 100.

[0072] The distribution plate 200 also comprises two inlet openings 210 that are situated at one longitudinal end of said distribution plate 200 and in order to be vertically aligned with the inlet opening 515 of the header box 500, such as a fluidic communication is possible between the header box 500 inlet opening 515 and the distribution plate 200 inlet openings 210. The distribution plate 200 also comprises two outlet openings 220 that are situated at the same longitudinal end of said distribution plate 200 than its inlet openings 210. The outlet openings 220 are suitable for being vertically aligned with the outlet opening 525 of the header box 500, such as a fluidic communication is possible between the header box 500 outlet opening 515 and the distribution plate 200 outlet openings 220. The outlet openings 220 of the distribution plate200 are located laterally to its inlet openings 210.

[0073] As described before, the feeding plate 100 is located onto the distribution plate 200, and holes 131-133 of the feeding plate 100 are longitudinally aligned with the header box 500 openings 550a, 550b and also with the distribution plate 200 openings 250a, 250b in order to allow coolant to flow throw the manifold 10 into the heat exchanger tubes.

[0074] The intermediate plate 300 as a rectangular shape. The intermediate plate 300 is configured to be associated with the feeding plate 100, said intermediate plate 300 being inserted between said feeding plate 100 and the manifold 10 cover plate 400.

[0075] The lateral dimensions of the feeding plate 100, the distribution plate 200 and the intermediate plate 300 are likely the same. The longitudinal dimensions of the feeding plate 100, the distribution plate 200 and the intermediate plate 300 are likely the same. The thickness of the distribution plate 200 and the intermediate plate 300 is likely the same, while the feeding plate 100 is thinner than both the distribution plate 200 and the intermediate plate 300.

[0076] The intermediate plate 300 illustrated in FIGURE 2 comprises four longitudinal openings 330a, 330b, 340a, 340b that extend between one end and another end of said intermediate plate 300. More precisely, the intermediate plate 300 comprises two longitudinal feeding openings 330a, 330b that allows coolant to flow through the manifold 10 to the heat exchanger tubes. Those longitudinal feeding openings 330a, 330b are vertically aligned with the feeding plate 100 sets 130a, 130b of holes 131-133, such as a fluidic communication is possible between said longitudinal feeding openings 330a, 330b and said feeding plate 100 sets 130a, 130b of holes 131-133.

[0077] The intermediate plate 300 also comprises two longitudinal collecting openings 340a, 340b that allows coolant to flow from the heat exchanger tubes into the manifold 10 and in direction of manifold 10 outlet 520. Those longitudinal collecting openings 340a, 340b are vertically aligned with the feeding plate 100 openings 140a, 140b, such as a fluidic communication is possible between said feeding plate 100 openings 140a, 140b and said longitudinal collecting openings 340a, 340b.

[0078] Each longitudinal openings 330a, 330b, 340a, 340b of the intermediate plate 300 has an oblong shape, as it extends along the longitudinal axis L1 of the manifold 10.

[0079] The intermediate plate 300 is located between the feeding plate 100 and the cover plate 400.

[0080] The cover plate 400 has a widely rectangular shape and comprises four longitudinal channels 410 that extends from one longitudinal end to the other in order to make it possible the coolant to flow through the longitudinal axis and into the heat exchanger tubes.

[0081] Regarding to FIGURE 3, a heat exchanger 1 according to the third aspect of the invention will be described hereafter.

[0082] The heat exchanger 1 comprises:

- the manifold 10 as described therebefore, said manifold 10 being an upper manifold 10 for the heat exchanger 1;
- an inner manifold 30;
- a plurality of tubes 20 extending between the upper 10 and the inner 30 manifolds.

[0083] In summary, the invention relates in particular to a feeding plate 100 that is suitable for regulating the coolant flow rate that goes through said feeding plate 100, regarding its longitudinal axis L1. More precisely, said feeding plate 100 comprises at least one set 130a, 130b of holes 131-133 that are longitudinally arranged along the feeding plate 100. The area of each hole 131-133 is increasing regarding the longitudinal axis L1, each hole's area getting greater while the distance between said hole 131-133 and an input opening 110 is getting larger. The invention is also dedicated to a manifold 10 comprising such feeding plate 100, and a heat exchanger 1 that includes such manifold 10.

[0084] Of course, the invention cannot and should not be limited to the embodiments and examples specifically described hereabove, and various adjustments can be made from these examples without departing from the scope of the invention. In particular, the various characteristics, forms, variants and embodiments of the invention may be combined with one another in various combinations insofar as they are not incompatible or exclusive of one another.

Claims

1. Feeding plate (100) for a heat exchanger (1) manifold (10), said feeding plate (100) elongating along a longitudinal axis (L1) and having at least one set (130a, 130b) of holes (131-133) for feeding the heat exchanger (1) with coolant, each set (130a, 130b)

of holes (131-133) being distributed along said longitudinal axis (L1), **characterized in that** holes (131-133) are configured for providing a constant coolant flow rate through said holes (131-133) and along at least a part of the longitudinal axis (L1).

2. Feeding plate (100) according to claim 1, wherein at least one part of the holes (131-133) of each set (130a, 130b) has different areas regarding the other holes (131-133) of said set (130a, 130b).

3. Feeding plate (100) according to claim 2, wherein each set (130a, 130b) comprises a section (122) along which holes (131-133) area is monotonically increasing along the longitudinal axis (L1).

4. Feeding plate (100) according to claim 3, wherein the section (122) comprises a first part (122a) along which the holes (131-133) area increases linearly.

5. Feeding plate (100) according to anyone of claims 3 or 4, wherein the section (122) comprises a second part (122b) along which the holes (131-133) area increases parabolically.

6. Feeding plate (100) according to claim 5, wherein the first part (122a) of the section (122) extends through at least two third of said feeding plate (100).

7. Feeding plate (100) according to anyone of claims 5 or 6, wherein the holes (131-133) located onto the first part (122a) of each set's section (122) are circular, and/or the holes (131-133) located onto the second part (122b) of said section (122) are elliptical or oblong.

8. Feeding plate (100) according to anyone of the preceding claims, wherein each hole (131-133) of each set (130a, 130b) are regularly spaced, a pitch between two adjacent holes (131-133) of one set (130a, 130b) being constant.

9. Feeding plate (100) according to anyone of the preceding claims, wherein each set (130a, 130b) comprises a portion (121) along which holes (131-133) all have the same area.

10. Feeding plate (100) according to claim 9, wherein, for each set (130a, 130b), the area of holes (131-133) located onto the portion (121) is different from the area of holes (131-133) located onto the section (122) of said corresponding set (130a, 130b).

11. Feeding plate (100) according to claim 10, wherein the area of holes (131-133) located onto the portion (121) is smaller than each area of the holes (131-133) located onto the section (122) of said corresponding set (130a, 130b).

12. Feeding plate (100) according to anyone of claims 9 to 11, wherein the portion (121) of each set (130a, 130b) is located at one longitudinal end of the feeding plate (100) and the section (122) of said corresponding set (130a, 130b) is located at a second longitudinal end of the feeding plate (100), the first longitudinal end being on a side of said feeding plate (100) from which the coolant is intended to flow inside the heat exchanger (1) manifold (10).

13. Feeding plate (100) according to anyone of the preceding claims, wherein the at least one set (130a, 130b) of holes (131-133) is located at a lateral edge of said feeding plate (100).

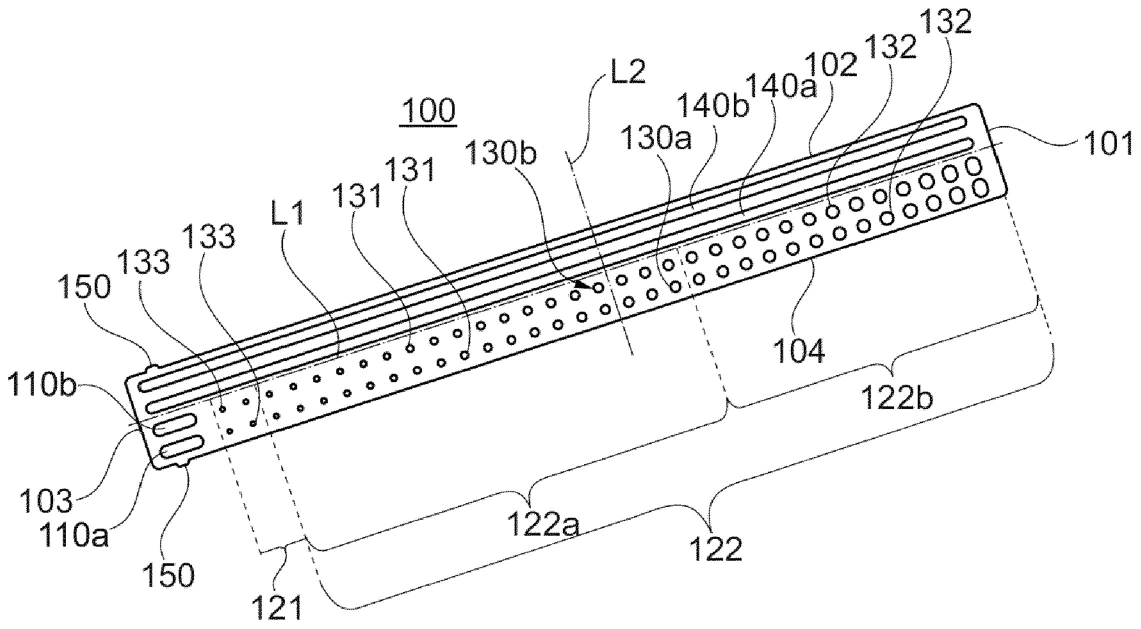
14. Feeding plate (100) according to anyone of the preceding claims, wherein said feeding plate (100) comprises at least two sets (130a, 130b) of holes (131-133) for feeding the heat exchanger (1) with coolant.

15. Manifold (10) for heat exchanger (1), said manifold (10) comprising:

- a header box (500) intended to be connected to a plurality of tubes (20) of the heat exchanger (1), each tube (20) being connected through an opening (550a, 550b) of said header box (500);
- the feeding plate (100) according to anyone of the preceding claims, holes (131-133) of said feeding plate (100) being longitudinally aligned with the header box (500) openings (550a, 550b) in order to allow coolant to flow into tubes (20);
- an intermediate plate (300) located on the other side of the feeding plate (100) regarding to the header box (500), said intermediate plate (300) comprising at least one longitudinal openings (330a, 330b, 340a, 340b) between one end and another end of said intermediate plate (300), said at least one longitudinal openings (330a, 330b, 340a, 340b) being aligned with the corresponding set (330a, 330b) of holes (131-133) of the feeding plate (100) in order to allow coolant to flow into tubes (20);
- a cover plate (400) located onto the intermediate plate (300), said intermediate plate (300) being located between the feeding plate (100) and the cover plate (400).

16. Heat exchanger (1) comprising:

- the manifold (10) according to claim 15, said manifold (10) being an upper manifold (10) for the heat exchanger (1);
- an inner manifold (30);
- a plurality of tubes (20) extending between the upper (10) and the inner (30) manifold.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140b
130a
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110a
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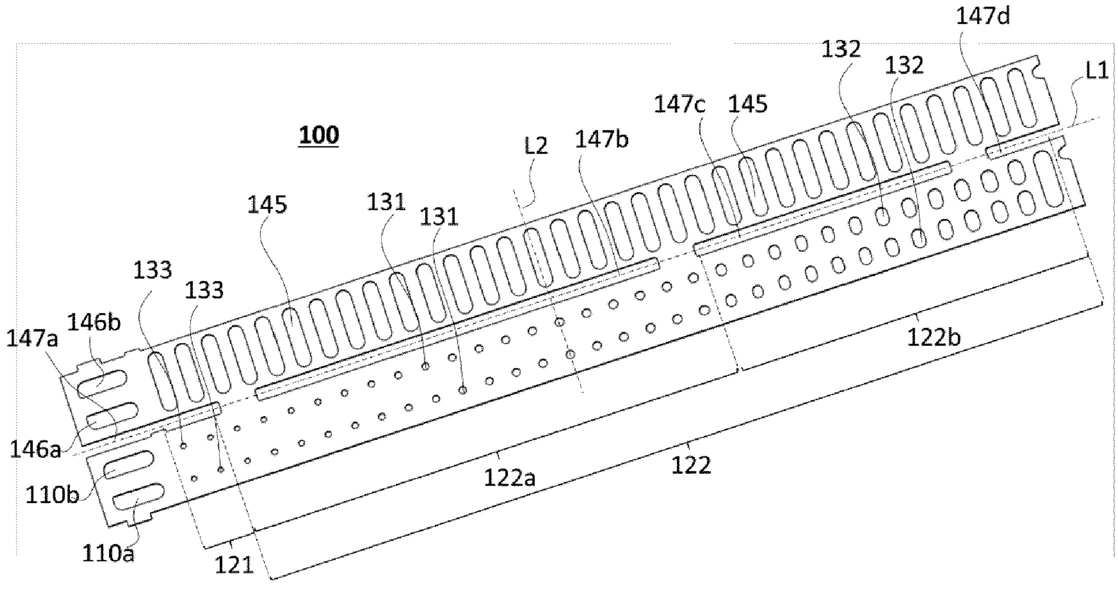
101
104
122b
122a
122
121

Fig. 1A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L1
147c
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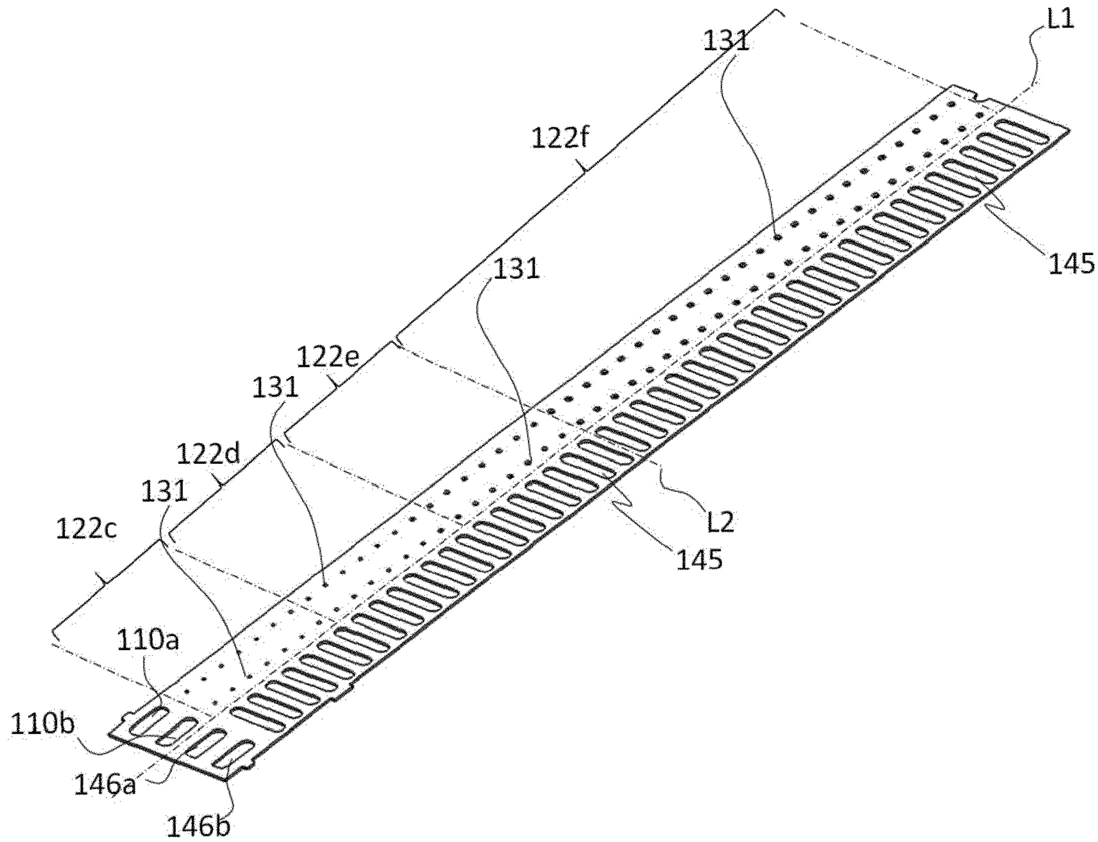
146b
146a
110b
110a
122b
122a
122
121

Fig. 1B


131
L1
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122e
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122d
131
L2
122c
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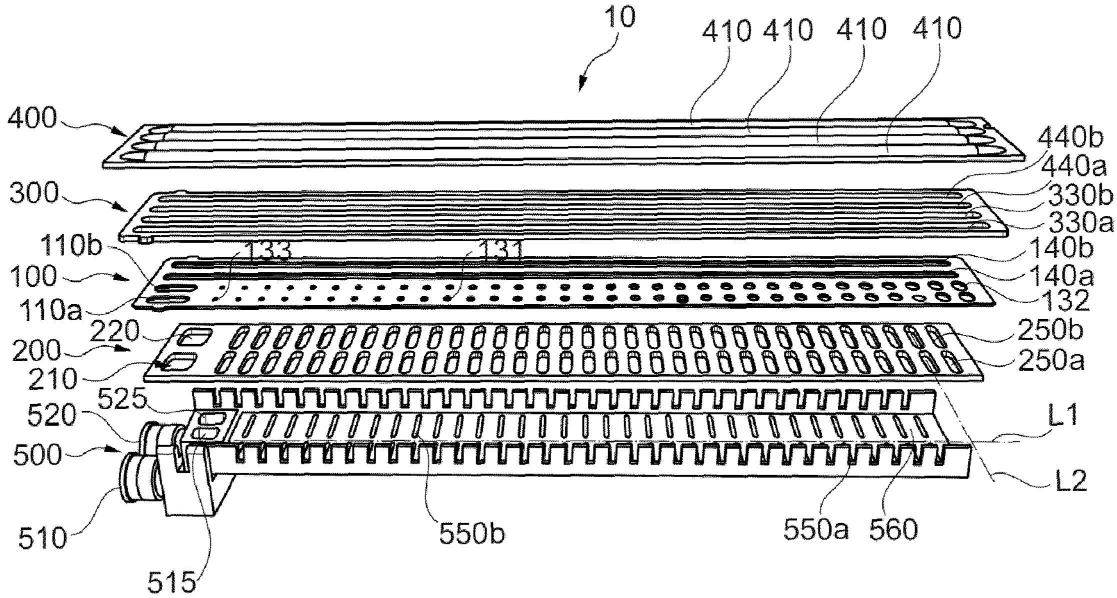
110a
110b
146a
146b

Fig. 1C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300
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200
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250a
525
520
L1
500
L2
510
550b
550a 560
515

Fig. 2

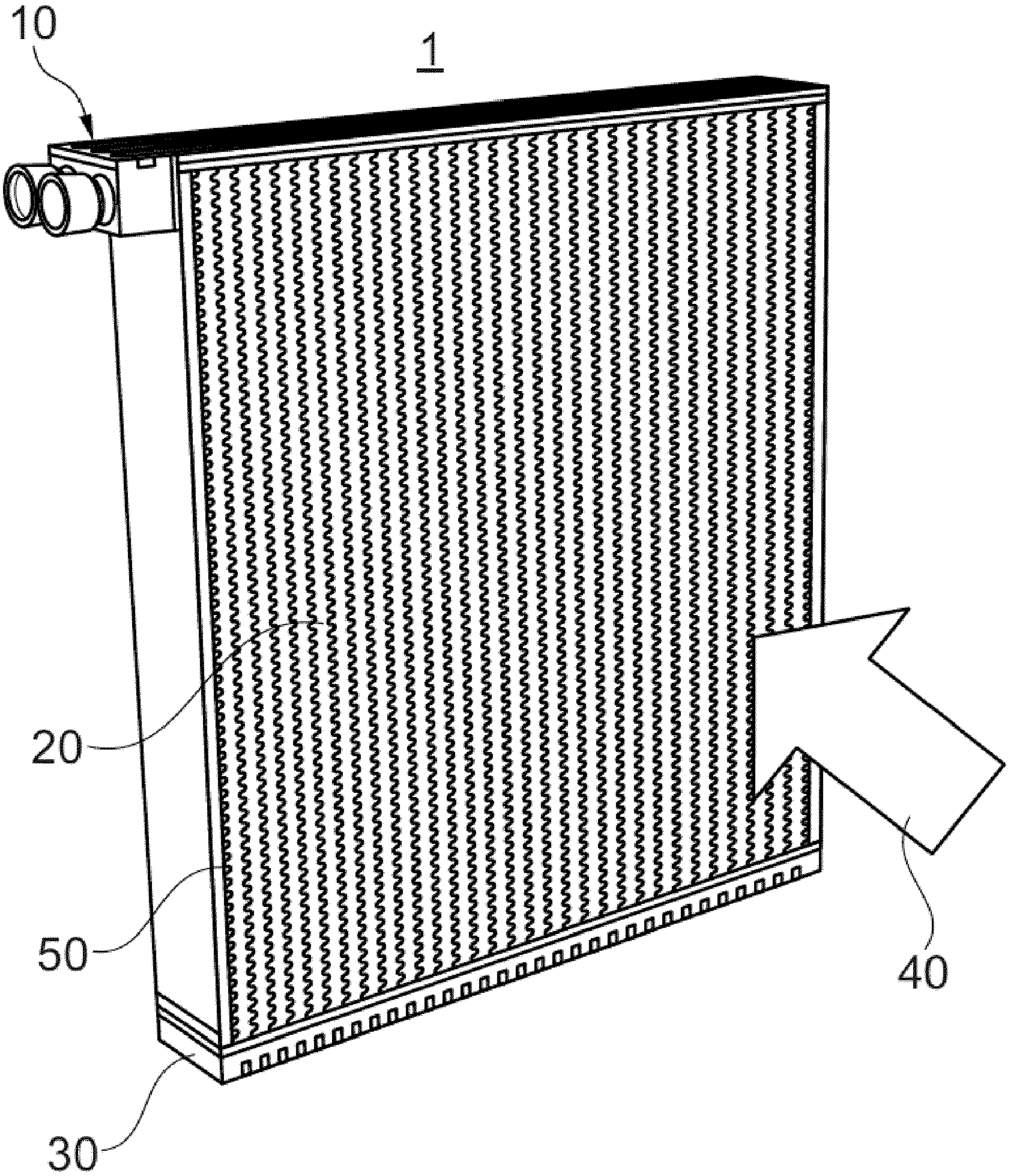

Fig. 3

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Application Number
EP 18 15 3416

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Place of search	Date of completion of the search	Examiner
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