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(54) A motor vehicle heat exchanger

(57) The invention relates to a motor vehicle heat exchanger (1) comprising a cooling core (4) and two header tanks fluidly connected with the core. The cooling core comprises a plurality of rectangular plates (5) provided with an array of equidistantly spaced stamped collars (6) and inclined louvers (7) between them, where each collar (6) is formed of a base cylindrical portion and a conical portion provided with a circumferential bead at the end

thereof. The face (13) of the first header tank (2) is provided with stamped projections (14) and the face (15) of the second header tank (3) is provided with stamped openings (16) corresponding to the collars (6). The plates (5) are stacked on one another, so as the conical portions of the collars (6) of each plate are inserted into cylindrical base portions of the collars (6) of the surrounding plate (5) and each group of stacked collars (6) forms a flow duct for a fluid medium.

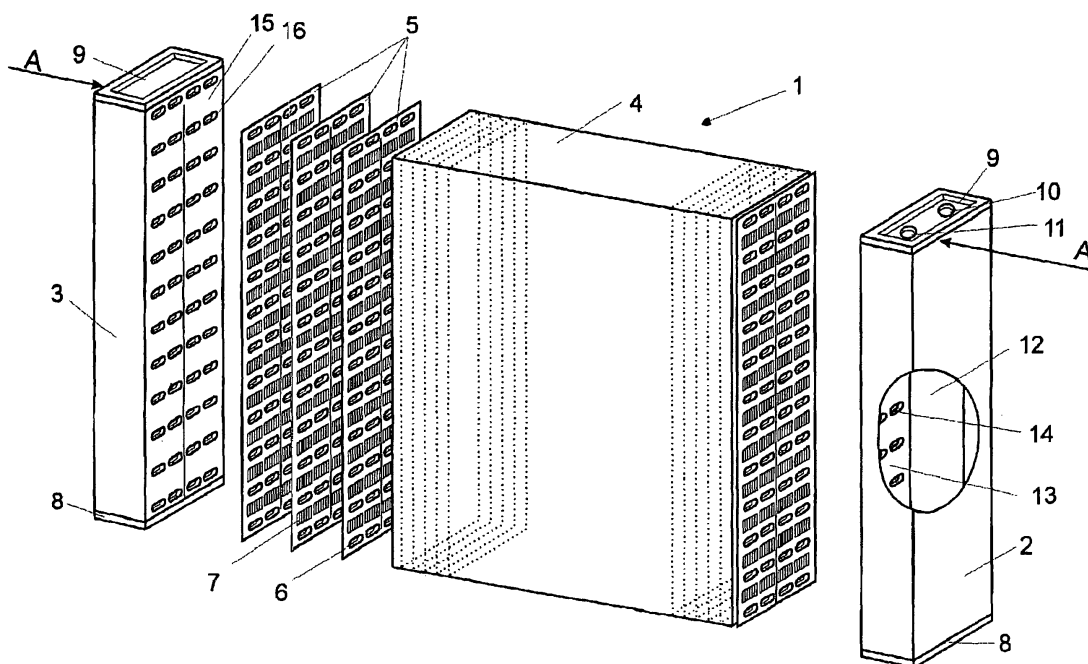


Fig 1

Description

[0001] The invention relates to a motor vehicle heat exchanger, comprising a cooling core and two header tanks fluidly connected with the core.

[0002] At present heat exchangers used in the automotive industry are provided with cooling core consisting of a number of tubes and cooling fins or corrugated tape placed between the tubes. In dependence on the type of the heat exchanger, the tubes and fins have different shapes and arrangements and are produced by various methods like stamping or rolling. Such heat exchangers fulfil their purposes quite well, yet their weakness is relatively complicated process of fabricating the tubes and assembling the cooling core.

[0003] Thus, the object of the present invention is to provide a motor vehicle heat exchanger having an improved cooling core, which is more efficient and easier to manufacture.

[0004] According to the present invention, there is provided a motor vehicle heat exchanger, comprising a cooling core and two header tanks fluidly connected with the core. The cooling core comprises of a plurality of rectangular plates provided with an array of equidistantly spaced stamped collars and inclined louvers between them. Each collar is formed of a base cylindrical portion and a conical portion provided with a circumferential bead at the end thereof, where the inclination of the conical portion ranges from 0° to 3° and the external diameter at the base thereof is substantially equal to the internal diameter of the base cylindrical portion, the height of the conical portion ranges from 0.2 to 0.9 the height of the base cylindrical portion and the diameter of the circumferential bead is less than the internal diameter of the conical portion at the end thereof. The face of the first header tank is provided with stamped projections corresponding to the collars, each projection having the shape of the conical portion of the collar, and the face of the second header tank is provided with stamped openings corresponding to the collars, each opening having the shape of the cylindrical portion of the collar. The plates are stacked on one another, so as the conical portions of the collars are inserted into cylindrical base portions of the collars of the surrounding plate and the projections of the first header tank are inserted into the base cylindrical portions of the collars of the first, rectangular plate and the conical portions of the collars of the last rectangular plate are inserted into the openings of the second header tank. Each group of stacked collars forms a flow duct for a fluid medium.

[0005] A heat exchanger of this type may be made by quickly stacking a number of stamped plates of a simple construction, which makes it especially suitable as a motor vehicle heat exchanger. The plates are designed to be simply fabricated from plain metal strips by uncomplicated automated machine processes. All the plates forming the core are identical, so that they can be formed from large rolls of plate strip material and then cut to the proper

size. Such a construction enables the reduction of the mass of a heat exchanger even by 65 % while retaining the same heat exchange area as compared with the typical heat exchanger comprising fins and tubes. Furthermore the inclination of louvers enables self-induced circulation of the heat from the surface of the exchanger.

[0006] The collars have preferably oval, lenticular or circular cross-sections.

[0007] The inclination of louvers is advantageously in the range from 10° to 60° to make the heat exchange particularly effective.

[0008] The cooling core plates are advantageously made of aluminium coated with a cladding layer, copper, aluminium, brass or copper plated steel.

[0009] In particular it is advantageous to use aluminium coated with a cladding layer of thickness within the range from 0.09 mm to 0.5 mm as a material for the plates.

[0010] According to the present invention, there is also provided a heat exchanger integrated with the second heat exchanger having the first and the second header tank having the faces of the same features as the faces of the first and the second header tank of the first heat exchanger, where the rectangular plates are provided with the second array of equidistantly spaced stamped collars and inclined louvers between them, having the same features as the collars and louvers of the first array. The plates are stacked on one another, so as the conical portions of the collars are inserted into cylindrical base portions of the collars of the surrounding plate and projections of the first header tank of the second heat exchanger are inserted into the base cylindrical portions of the collars of the first rectangular plate and the conical portions of the collars of the last rectangular plate are inserted into openings of the second header tank of the second heat exchanger, and each group of stacked collars forms a flow duct for a fluid medium.

[0011] The invention is presented below in connection with the drawings on which:

Fig. 1 is an axonometric view of a partially exploded embodiment of a heat exchanger according to the present invention;

Fig. 2 is a vertical cross-section of a heat exchanger from Fig. 1 along the line A-A;

Fig. 3 is a vertical cross-section of a fragment of two cooling core plates;

Fig. 4 is a horizontal cross-section of a fragment of two cooling core plates corresponding to Fig. 3;

Fig. 5 is a plan view of a cooling core plate;

Fig. 6 is a plan view of another embodiment of a cooling core plate of an integrated two heat exchangers module according to the present invention; and

Fig. 7 is an axonometric view of a partially exploded integrated heat exchanger according to the present invention.

[0012] A heat exchanger 1 shown in Fig. 1 is a motor vehicle radiator. It comprises the first and the second header tanks 2 and 3 which are fluidly connected with the cooling core 4. For simplicity of the drawing the inlet and outlet pipes, brackets, as well as other auxiliary heat exchanging system components were omitted.

[0013] The cooling core 4 comprises of a plurality of rectangular plates 5 made of cladding layer coated aluminium and provided with an array of equidistantly spaced stamped collars 6 and heat exchanging louvers 7 between them. The collars 6 are oval shaped and the louvers 7 are rectangular. The assembling of a cooling core 4 relies on stacking the plates 5 on one another so that the collars 6 of each plate 5 are inserted into the collars 6 of the neighbouring plate 5. During this process the ducts for transferring the coolant between the header tanks 2 and 3 are formed. Details of construction of the collars 6 and louvers 7 are explained in greater detail with reference to the Fig. 2 to Fig. 5. Yet in any case the construction and number of the collars 6 and the louvers 7 are adjusted individually for particular heat exchanger, in dependence of desired, in particular thermal, characteristics thereof.

[0014] Both header tanks 2 and 3 have a rectangular cross section. They were prepared by folding an aluminium flat sheet coated with a cladding layer. Header tanks are closed by bottom end caps 8 and top end caps 9. The upper end cap 9 of the first header tank 2 is provided with an inlet opening 10 for the inlet pipe and with outlet opening 11 for the outlet pipe. After assembling and brazing the heat exchanger, the coolant flows from the inlet opening 10, than through the core 4 to the second header tank 3, backwards, through the core 4, to the first header tank and out through the outlet opening 11. For this purpose the first header tank is provided with an internal longitudinal baffle 12 placed between the openings 10 and 11.

[0015] As shown in Fig. 2 the face 13 of the first header tank 2 is provided with stamped projections 14, corresponding to the internal side of the collars 6 of the neighbouring cooling core 4 plate 5. The projections 14 are pushed inside the collars 6 of this plate 5 during or after assembling the core 4. On the other hand the face 15 of the second header tank 3 is provided with stamped openings 16 corresponding to the projected side of the collars 6 of the neighbouring plate 5, where these collars 6 are pushed in a similar way. The projections 14 and openings 16 were stamped prior folding the tanks.

[0016] After preliminary assembling of the heat exchanger 1, the whole unit is placed inside an oven where it undergoes a one shot brazing operation.

[0017] Fig. 3 shows a fragment of the cooling core plate 5 illustrating the construction details of the collar 6 and louver 7 as formed by the stamping process. As shown,

the collar 6 is formed of a cylindrical portion 17 extending into a conical portion 18 having a small inclination of 2° . The inclination of the conical portion 18 facilitates the process of stacking the plates 5 one on another during the preliminary assembling of the heat exchanger core 4 and ensures that plates forming the core are stacked together due to friction. The conical portion 18 further extends into a circumferential bead 19 having a diameter less than the internal diameter of the conical portion 18 at the end thereof. The bead 19 makes the coolant to flow turbulently, hence improving the heat exchange process.

[0018] The external diameter DCX at the base of the conical portion 18 is substantially equal to the internal diameter DBI of the cylindrical portion 17. Additionally the height HC of the conical portion 18 equals to 0.9 of the height of the cylindrical portion HB. As the coolant flowing ducts are formed by inserting the collars 6 of one plate 5 into the collars 6 of the adjoining plate 5, so as the plates 5 are nested one upon another, the height HB of the cylindrical portion 17 of collars 6 determines the distance (pitch) between two neighbouring plates 5. By changing the height HC of conical portions 18 it is thus possible to define the length of overlap of two adjoining collars 6 and consequently to determine the resistance of flowing ducts to vibrations and burst asunder forces. As may be observed the height HC of the conical portion 18 may be at most equal to the height HB of the cylindrical portion 17. In such a case, the ducts shall be the most durable, as the thickness of the wall of each duct shall equal two times the thickness of the plate 5. On the other hand the lower height of the conical portion 18 ensures better heat exchanging properties. As in case of the construction and number of the collars 6 and the louvers 7, the height of the conical portion 18 should be individually adjusted, in dependence of desired characteristics of a particular heat exchanger.

[0019] The surface of the louver 7 is rectangular and, as shown in Fig. 4, is inclined at an angle of 20° to the surface of the plate 5. The inclination angle should also be individually adjusted in dependence of desired heat exchanging properties.

[0020] Fig. 5 presents a plan view of a cooling core plate 5. As shown the plate 5 comprises four rows, each comprising of equidistantly spaced twelve oval shaped collars 6. Within each row, the collars 6 are separated by equidistantly spaced groups of louvers 7, where each group consist of seven louvers 7.

[0021] Fig. 6 shows another embodiment of a cooling core plate 5. In this embodiment the plates 5, after preliminary assembling, shall form two cooling cores of an integrated vehicle CRFM (Condenser, Radiator, cooling Fan) module. For this reason the size, construction, number and distribution of the radiator collars 6a and the radiator louvers 7a differs to the size, construction, number and distribution of the condenser collars 6b and the condenser louvers 7b. The collars 6a of nested plates 5 shall form the heat exchanging flow ducts of the radi-

ator, while the collars 6b shall form the heat exchanging flow ducts of the condenser.

[0022] The aforementioned integrated module is shown in Fig. 7. Radiator 1 a comprises of two header tanks 2a and 3a and condenser 1b comprises two header tanks 2b and 3b. Corresponding header tanks of the radiator 1a and condenser 1b are connected fluidly by flow ducts of two separate cooling cores 4a and 4b, yet formed as an integrated part from the rectangular plates 5 shown in Fig. 6. For simplicity auxiliary components are omitted in the drawing. All header tanks have a form similar to the header tank 3 (shown in Fig. 1), and are additionally provided with corresponding top end caps 9a and 9b with openings 10a, 11a and 10b, 11b for inlet and outlet pipes. Respective header tanks are also provided with corresponding faces for their connection with the cooling core. After assembling and brazing the integrated module according to this embodiment, the radiator coolant flows from the inlet opening 10a, than through the core 4a, than through the second header tank 3a out through the outlet opening 11a. Similarly the condenser coolant flows from the inlet opening 10b through the core 4b, and out through the outlet opening 11b.

[0023] The design of the heat exchanger core according to the present invention is exceptionally suitable for the manufacture of motor vehicle radiators and integrated radiator-condenser modules.

Claims

1. A motor vehicle heat exchanger, comprising a cooling core and two header tanks fluidly connected with the core, **characterised in that** the cooling core (4) comprises of a plurality of rectangular plates (5) provided with an array of equidistantly spaced stamped collars (6) and inclined louvers (7) between them, where each collar (6) is formed of a base cylindrical portion (17) and a conical portion (18) provided with a circumferential bead (19) at the end thereof, where the inclination of the conical portion (18) ranges from 0° to 3° and the external diameter (DCX) at the base thereof is substantially equal to the internal diameter (DBI) of the base cylindrical portion (17), the height (HC) of the conical portion (18) ranges from 0.2 to 0.9 the height (HB) of the base cylindrical portion (17) and the diameter (DH) of the circumferential bead (19) is less than the internal diameter (DCX) of the conical portion (18) at the end thereof, and where the face (13) of the first header tank (2) is provided with stamped projections (14) corresponding to the collars (6), each projection (14) having the shape of the conical portion (18) of the collar (6), and the face (15) of the second header tank (3) is provided with stamped openings (16) corresponding to the collars (6), each opening having the shape of the cylindrical portion (17) of the collar (6), and where the plates (5) are stacked on one another, so as the

conical portions (18) of the collars (6) are inserted into cylindrical base portions (17) of the collars (6) of the surrounding plate (5) and the projections (14) of the first header tank (2) are inserted into the base cylindrical portions (17) of the collars (6) of the first, rectangular plate (5) and the conical portions (18) of the collars (6) of the last rectangular plate (5) are inserted into the openings (16) of the second header tank (3), and each group of stacked collars (6) forms a flow duct for a fluid medium.

2. The heat exchanger as claimed in claim 1, **characterised in that** the collars (6) have oval, lenticular or circular cross-sections.
3. A heat exchanger as claimed in claim 1 or 2, **characterised in that** the inclination of louvers (7) is in the range from 10° to 60°.
4. The heat exchanger as claimed in claim 1 to 3, **characterised in that** the plates (5) are made of aluminium coated with a cladding layer; copper, aluminium, brass or copper plated steel.
5. The heat exchanger as claimed in claim 4, **characterised in that** the plates (5) are made of aluminium coated with a cladding layer of thickness within the range from 0.09 mm to 0.5 mm.
6. The heat exchanger as claimed in any of preceding claims, **characterised in that** it is integrated with the second heat exchanger (1b) comprising the first and the second header tank (2b, 3b) having the faces of the same features as the faces (13, 15) of the first and the second header tank (2a, 3a) of the first heat exchanger (1a), where the rectangular plates (5) are provided with the second array of equidistantly spaced stamped collars (6b) and inclined louvers (7b) between them, having the same features as the collars (6a) and louvers (7a) of the first array, and where the plates (5) are stacked on one another, so as the conical portions of the collars (6a and 6b) are inserted into cylindrical base portions of the collars (6a and 6b) of the surrounding plate (5) and projections of the first header tank (2b) of the second heat exchanger (1b) are inserted into the base cylindrical portions of the collars (6b) of the first rectangular plate (5) and the conical portions of the collars (6b) of the last rectangular plate (5) are inserted into openings of the second header tank (3b) of the second heat exchanger (1b), and each group of stacked collars (6b) forms a flow duct for a fluid medium.

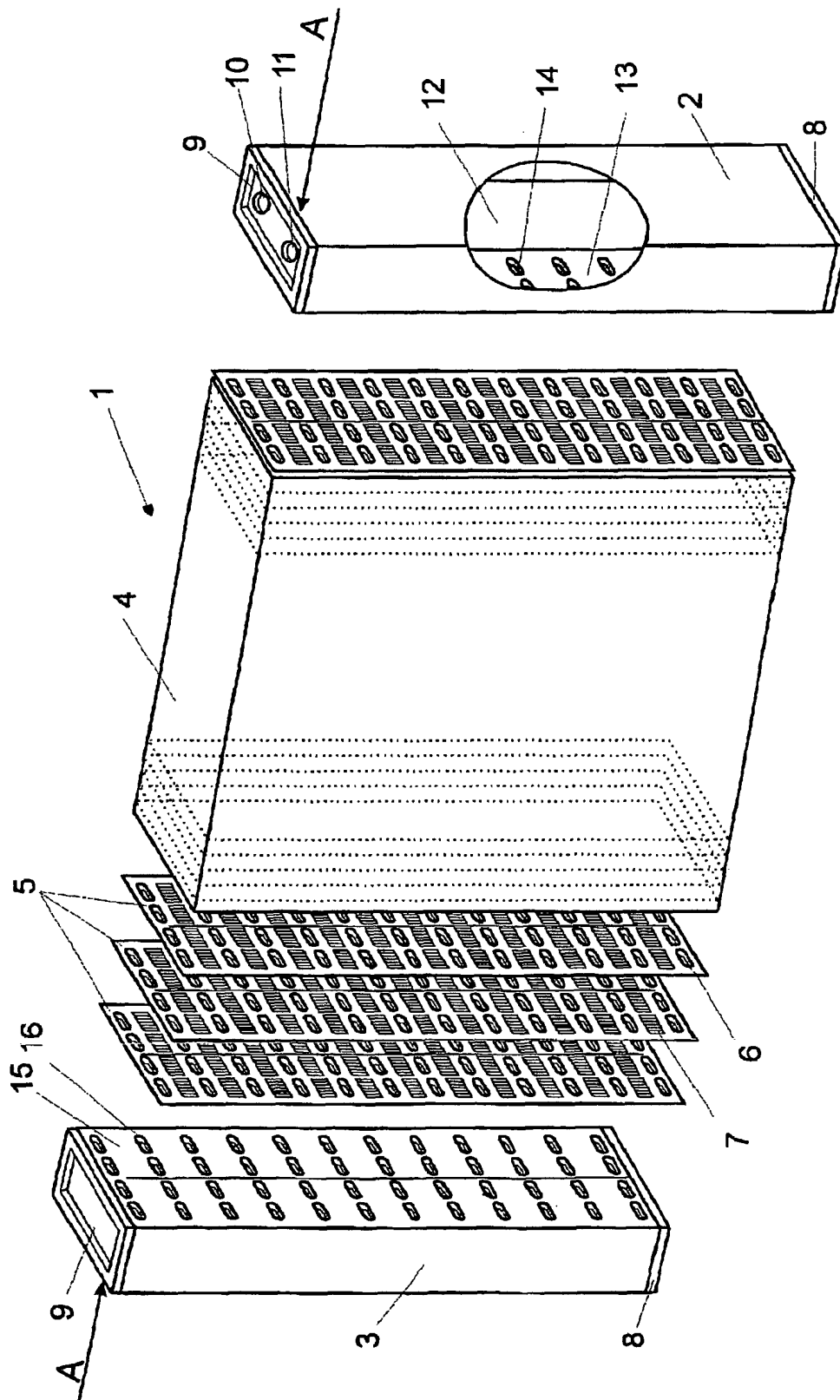


Fig 1

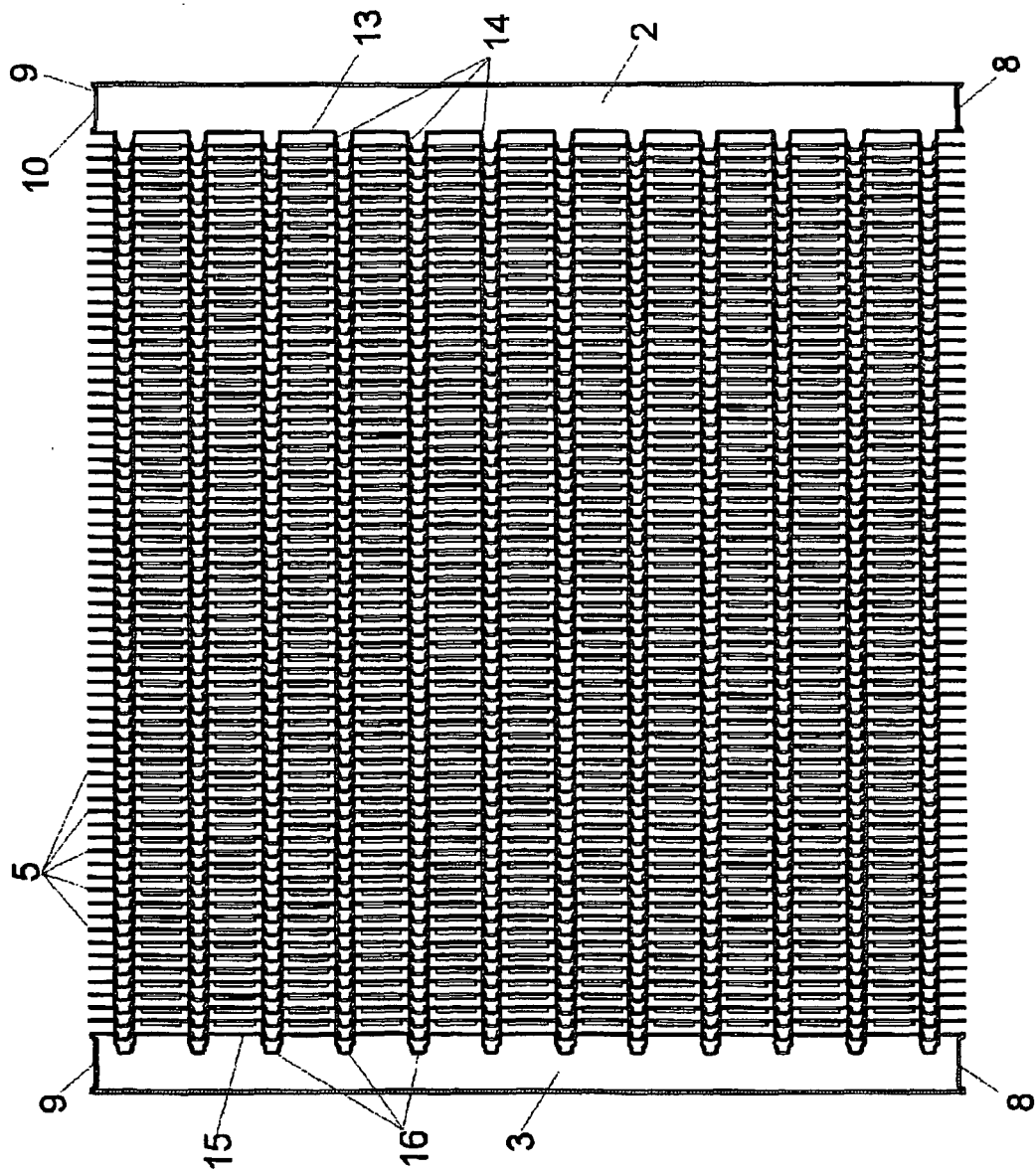


Fig 2

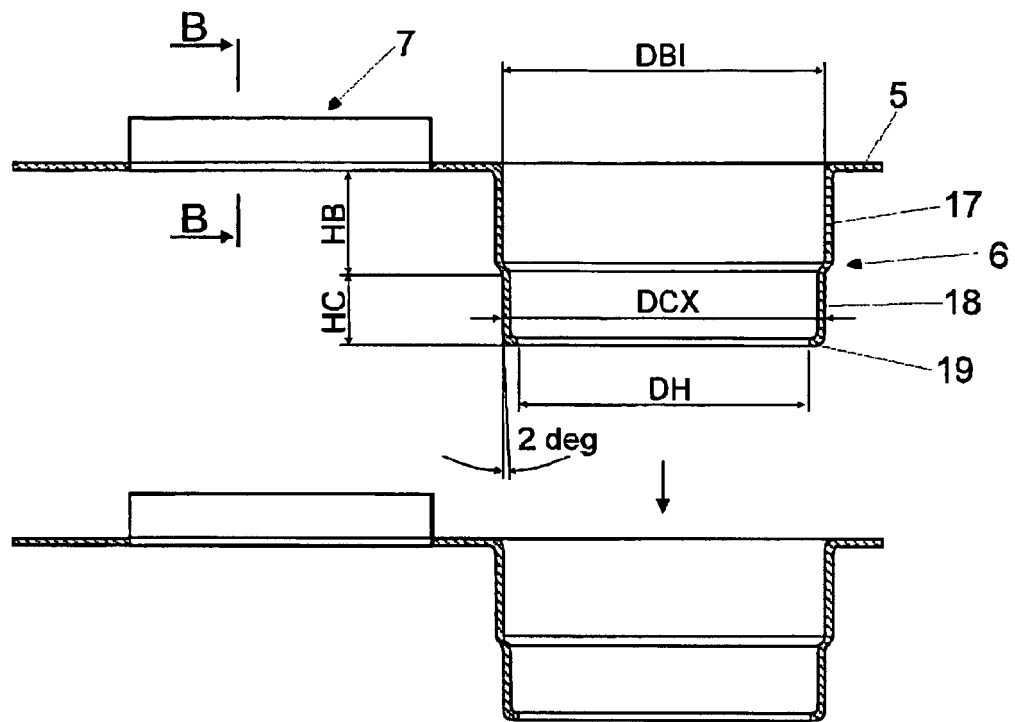


Fig 3

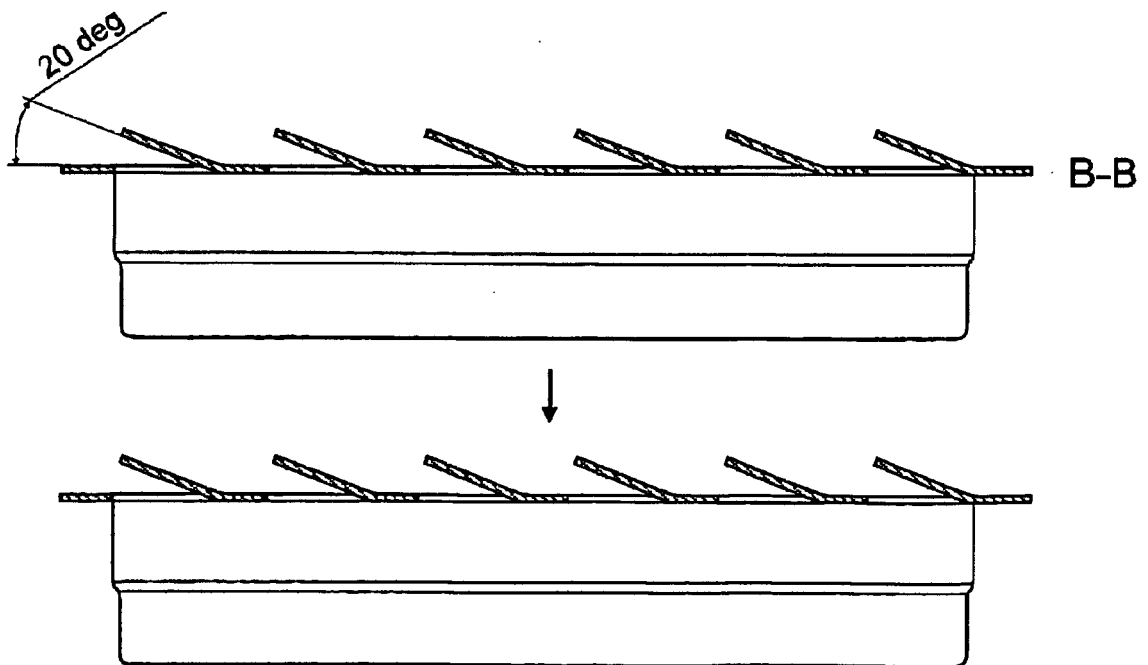


Fig 4

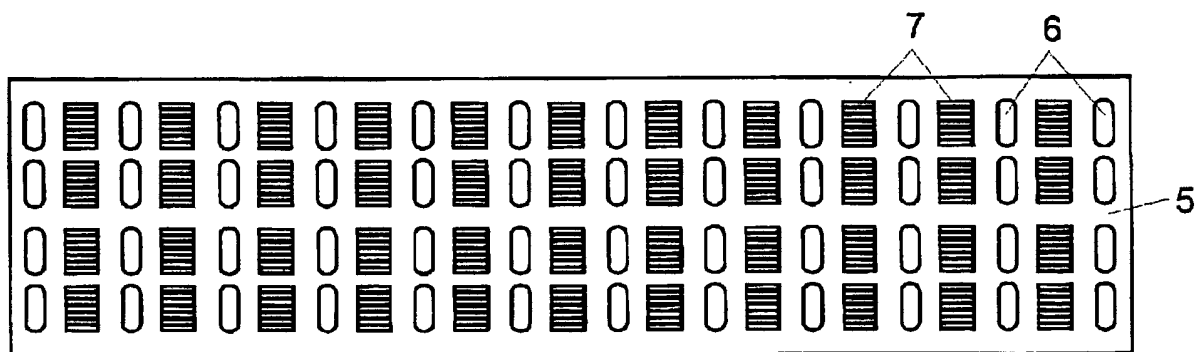


Fig. 5

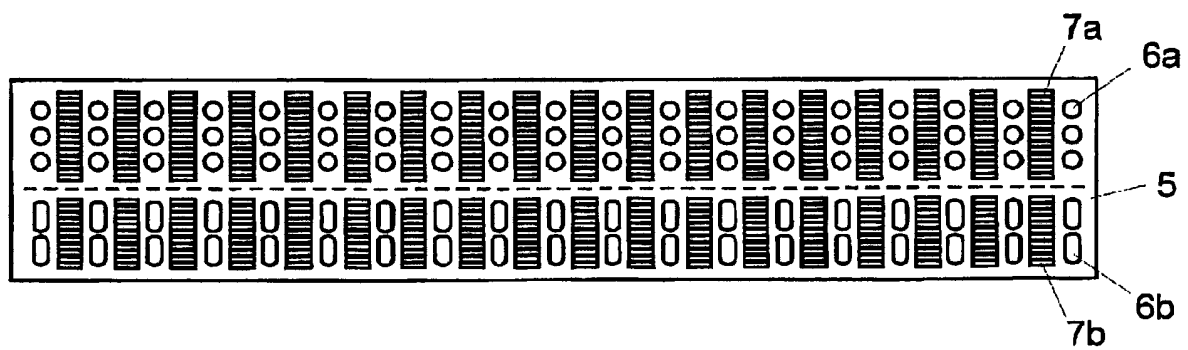


Fig. 6

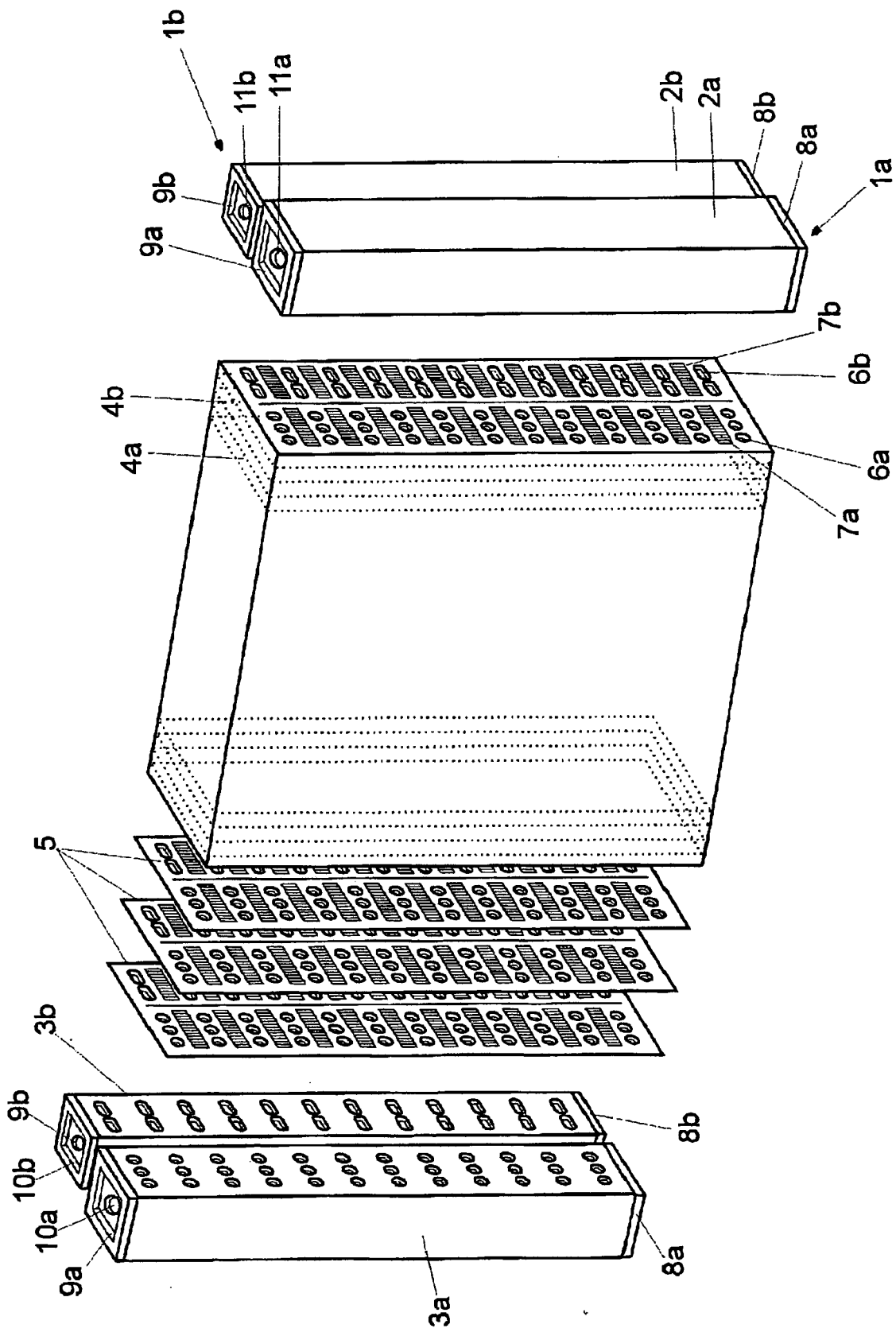


Fig 7