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(54) **Heating device, lamella element for a heating device, and method for manufacturing a lamella element**

(57) What is disclosed is a lamella element comprising at least a plurality of lamellae that are integrally connected and arranged one behind the other. On at least one lamella a bracket is formed which laterally overlaps another lamella.

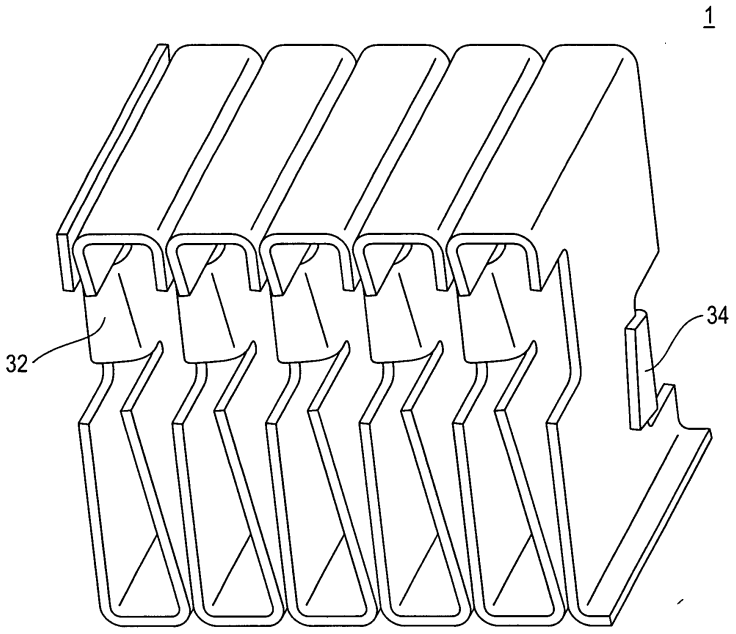

Fig. 9

EP 2 636 981 A1

Description

[0001] The invention concerns a heating device comprising a lamella element, a lamella element for a heating device, and a method for manufacturing the lamella element. The heating device is used in particular for air heating.

[0002] For the use in automotive vehicles, particularly those having consumption-optimized internal combustion engines, such heating devices are used for heating passenger cabin and engine. Nevertheless such heating devices are also suited for other purposes of use within a wide range of applications, for instance in the area of structural installations (indoor air conditioning), industrial installations, and the like. Heating devices, in particular those including PTC heating elements (positive temperature coefficient, thermistor), typically include lamella elements which are employed for heat dissipation. Such heat dissipation is assisted by a flow of air which is produced by a blower.

[0003] Heating devices are known in various designs. For example, conventional heating devices include lamellae which are soldered/brazed to retaining plates or cover plates or otherwise fastened to these by mechanical means. The manufacture of soldered designs does, however, necessitate very high complexity and moreover is not reliable, for in many cases not all the contacting locations of the lamellae are soldered, with a uniform heat dissipation not taking place. As a result the output of the (PTC) radiators may even be impaired to such a degree that the radiator can not be operated within the predetermined specification any more.

[0004] As an alternative for soldered heating devices or radiator elements, mechanical fastening types are furthermore known, such as clamping connections. These do, however, present the drawback that the assembly of such radiator elements or of the radiators is complex and error-prone.

[0005] From EP 0 575 649 B1 a radiator element is known, comprising heating elements composed into prefabricated units and consisting of ribbons of sheet metal that are riveted to each other and encompass a lamella ribbon. The PTC elements used are frequently retained in windows or recesses of plastic frames. For assembly, the pre-fabricated heating element units and the plastic frames provided with PTC elements are stacked and immobilized by means of a retaining frame. This design presents the drawback of the assembly of such a radiator element being complex.

[0006] DE 197 06 199 A1 equally describes an electric heating installation where heating elements supporting PTC elements are stacked with corrugated ribs. The function of positionally securing the corrugated ribs between the heating elements is served by protrusions on the sheets which encompass the PTC elements. This disposition also does not result in improved assembly.

[0007] EP 0 379 873 A2 describes a device for heating gases by using PTC elements framed in a frame rack in which a U-profile is inserted and which is covered by a cover plate. For the purpose of emitting heat to the surrounding air, lamellae having a recess for this purpose are frictionally placed on the arrangement. Although this provides heating units on which heat-emitting lamellae are placed in a clamping manner, such a device may also only be assembled with complexity as the lamellae must be placed on individually. In addition the arrangement has low stability and accordingly is not suited well for stacking.

[0008] In EP 1 061 776 A1 a heating device for air heating is described which has positioning frames comprising means for snap-on, locking clipping on of radiator elements and electrode sheets. The positioning frames thus allow to join together radiator subsets which may be stacked later on. The heating elements used are PTC elements. Crimp lugs serve the function of fastening lamella elements to radiator sheets.

[0009] In EP 1 327 834 B1 a heating device is shown which comprises a lamella element, or a corrugated rib element. The latter includes a multiplicity of lamellae interconnected via lamella return portions. Lamella return portions of one side of the lamella element are fastened to a radiator sheet. Moreover the lamella element is held in its longitudinal direction by the radiator sheet. The radiator sheet thus serves for positional fixation of the lamella element in both its longitudinal and transverse directions.

[0010] It is a drawback of this approach that in a non-fixated condition, a like lamella element has an extremely low rigidity and has a spring-like effect, for which reason assembly is rather complex. Moreover the positional fixation of the lamella element with the radiator sheet is complex in terms of device technology.

[0011] In view of the above, the invention is based on the object of providing a lamella element and a heating device having such a lamella element, which are easy to assemble and/or present a simple design in terms of device technology. It is another object of the invention to provide a simple and low-cost method for manufacturing a lamella element.

[0012] The invention is achieved through the features of claim 1 with regard to the lamella element, through the features of claim 13 with regard to the heating device, and through the features of claim 14 with regard to the method.

[0013] In accordance with the invention, a lamella element for a heating device for air heating comprises a plurality of interconnected lamellae that are arranged one behind the other, in particular in the manner of a ribbon. On at least one of the lamellae a tongue is formed which laterally overlaps another lamella, in particular an adjacent lamella. The tongue acts to restrict a relative movement of the lamellae among each other which are in operative connection with each other via the tongue. The tongue thus serves to increase a mechanical rigidity of the lamella element, in particular in a direction transverse to the longitudinal direction of the lamella element. As a

result of the tongue, such a lamella element thus presents an altogether higher mechanical rigidity in comparison with lamella elements lacking such a tongue, with mounting of the lamella element being facilitated. By way of the number of tongues and the lamellae operatively connected via tongues it is then possible to set a mechanical rigidity of the lamella element.

[0014] Tongues may be formed on both sides of the lamella element in order to restrict relative movements in both directions transverse to the longitudinal direction. As regards the overlap of the lamella by the tongue, a spacing between tongue and overlapped lamella may be present in the normal condition of the lamella element, or the tongue contacts the overlapped lamella. If a spacing is selected, then a slight play between the lamellae which are in operative connection with each other via the tongue is admitted.

[0015] In addition to overlapping it is advantageous if the tongue engages the another lamella or a further lamella. As a result, a relative movement in the longitudinal direction of the lamella element between the lamella having the tongue and the lamella engaged by the tongue is limited. This accordingly results in a limited extraction of the lamella element. Thanks to the lamella element of the invention, no additional component is necessary in contrast with the prior art - such as, e.g., the radiator sheet in EP 1 327 834 B1 discussed at the outset - in order to immobilize it in a longitudinal direction. The lamella element of the invention, in a sense, inherently supports and immobilizes itself through the at least one tongue, for a relative movement of lamellae in the transverse and/or longitudinal directions is being limited. Nevertheless, due to the at least one tongue the lamella element possesses a certain degree of flexibility, for instance for an adaptation to surfaces that are not entirely flat.

[0016] In another aspect of the invention, the tongue is formed on a longitudinal edge of the lamella, and the another lamella is engaged and/or overlapped by the tongue at its longitudinal edge. Such an arrangement of the tongue provides for easy accessibility to the latter, particularly during manufacture.

[0017] The tongue preferably engages a major surface of the another lamella or of a further lamella. This has the advantage that the major surface serves as a large surface of attack for the tongue.

[0018] Advantageously, a tongue may be provided on each longitudinal edge of the lamella. This has the result that the tongues may then overlap and engage other lamellae on both sides of the lamella element, whereby a relative movement of the lamellae being operatively connected via the tongues is restricted in both directions transverse to the longitudinal direction. It is, of course, also possible for a plurality of lamellae to have one or several tongues on one or both longitudinal edges.

[0019] In a preferred manner, the tongues of one lamella each overlap and/or engage respective other adjacent lamellae. Thus it is conceivable, e.g., for one lamella to overlap and/or engage by the tongues the two lamellae immediately adjacent to it.

[0020] Preferably all the lamellae of the lamella element are connected via tongues.

[0021] The lamella element may alternately comprise lamellae with and without tongues, with the lamellae having tongues then overlapping and/or engaging the respective lamellae adjacent to them.

[0022] Advantageously a width of the lamella comprising a tongue is not increased in comparison with a lamella without a tongue if the respective tongue is formed in a tongue groove which is realized in a direction from the longitudinal edge of the lamella.

[0023] In a further aspect of the invention, in order to engage and/or overlap a lamella, the tongue extends through a reception groove realized in this lamella at least in portions thereof, so that a width of the lamella element in the range of engagement and/or overlap is not increased. Where tongue grooves for the tongues are formed in addition, a width of the lamella element remains the same, irrespective of the tongues. The reception groove moreover has the result that a translatory movement of the tongue along the longitudinal edge of the overlapped and/or engaged lamella is limited by the walls of the reception groove. Thus, a translatory movement of lamellae operatively connected through tongues toward a top and bottom side of the lamella element is also limited.

[0024] Advantageously the tongue grooves and reception grooves of one respective side of the lamella element are arranged substantially one behind the other when viewed in a longitudinal direction.

[0025] Moreover, two lamellae each may define a fluid passage having an approximately V- shaped cross- section. Advantageously the tongues and the tongue grooves and reception grooves are formed in the area of the lamellae where the lamellae arranged in a V- type configuration present a small distance among each other, so that an axial length of a tongue for overlapping and/or engaging may be comparatively small. The tongues and the tongue grooves and reception grooves of one side of the lamella element are thus staggered from the tongues and the tongue grooves and reception grooves of the other side of the lamella element when viewed in the direction of a longitudinal edge. A distance of a center plane of the lamella element between the top and bottom sides thereof may then be substantially equal from the tongues and tongue grooves and reception grooves of the two sides of the lamella element.

[0026] Advantageously, two lamellae each are connected at adjacent transverse sides to a lamella return portion extending approximately transversely to the longitudinal edge.

[0027] In this case a distance of the respective other transverse sides of these lamellae may be smaller than a width of the lamella return portion, which results in the V-shaped configuration of the lamellae.

[0028] Preferably the lamella element has targeted

material weaknesses in the area of bending portions to precise and to ease bending. These are formed, for example, in the area of lamella return portions and / or in the area of the tongues and can be, for example, in the form of dimple lines or dimple zones.

[0029] In accordance with the invention, a heating device for air heating comprises a heating unit having a lamella element in accordance with the invention. Such heating devices are easy to manufacture due to the extremely compact lamella elements in accordance with the invention which possess a comparatively high mechanical rigidity and are flexible, for the lamella elements may be mounted extremely easily. All in all this results in an extremely cost-efficient heating device. The heating unit preferably includes a heating element, in particular a PCT heating element, which is immobilized on the lamella element. Immobilization may here be carried out on lamella return portions interconnecting the lamellae, with the heating element then being arranged on lamella return portions of one side of the lamella element. Immobilization is furthermore carried out by means of a suitable connection, e.g. a bonded connection and/or a clamping connection.

[0030] If a coverplate for the heating unit of the heating device is provided in order to cover the lamella element and enhance a mechanical rigidity and a sturdiness of the heating unit, it is preferably immobilized on the lamella return portions on that side of the lamella element on which no PCT element is provided. The cover plate is also attached to the lamella element by means of a suitable connection, i.e, for instance, a bonded connection and/or a clamping connection.

[0031] A method according to the invention for manufacturing a lamella element includes the following steps:

- punching one or several tongues from a metallic ribbon or sheet metal ribbon;
- bending the sheet metal ribbon to form lamellae that are arranged one behind the other;
- bending the at least one or the several tongues toward the longitudinal edge of the lamella(e) to be overlapped by the tongue.

[0032] As a result of this method it is possible to manufacture in an extremely easy manner a lamella element comprising at least one tongue which laterally overlaps the one further lamella.

[0033] Advantageously the method includes an additional step:

- bending an end portion of the at least one or several tongues toward the major surface of the lamella(e) to be engaged.

[0034] In the punching step of the method it is possible to simply punch out the tongue grooves and reception grooves together with the tongues.

[0035] Other advantageous developments of the invention are subject matter of further subclaims.

[0036] In the following the invention shall be explained in more detail while referring to schematic drawings, wherein:

Figure 1 is a perspective representation of a lamella element in accordance with a first practical example;

Figures 2 - 8 are various representations of steps for manufacturing the lamella element in accordance with the first practical example;

Figure 9 is a perspective representation of a lamella element in accordance with a second practical example;

Figure 10 is a perspective representation of a lamella element in accordance with a third practical example;

Figure 11 is a perspective representation of a lamella element in accordance with a fourth practical example;

Figure 12 is a perspective representation of a heating unit for a heating device for air comprising a lamella element;

Figure 13 is a perspective representation of a heating unit for a heating device for air comprising two lamella elements;

Figure 14 is a perspective representation of a lamella element in accordance with a fifth practical example before it is compressed;

Figure 15 is a top view on a cut-out part of the lamella element in a transacted form;

Figure 16 is a perspective representation of the lamella element of Figure 15 and

[0037] Figure 17 is a perspective representation of a lamella element in accordance with a sixth practical example.

[0038] A lamella element 1 according to Figure 1 is employed for a heating device for air heating, wherein the heating device may then be employed for heating a passenger cabin and/or a combustion engine or electric motor of an automotive vehicle. This heating device comprises, e.g., PTC-heating elements, with the lamella element then serving the function of heat dissipation.

[0039] The lamella element 1 comprises a multiplicity of lamellae 2 to 22 that are arranged one behind the other. Two lamellae 2 to 22 each are alternatingly connected to a top-side or bottom-side lamella return portion 24 or 26. In Figure 1, only the two left-hand lamella return portions 24 and 26 are provided with reference numerals for the sake of clarity. The upper lamella return portions 24

then form a top side 27 of the lamella element 1, with the lower lamella return portions 26 forming a bottom side 29. A central portion of the lamella return portions 24 and 26 between the lamellae 2 to 22 is configured to be substantially planar. The single lamellae 2 to 22 substantially have a V-shaped arrangement relative to each other to thereby form air passages 28 and 30 presenting an approximately triangular cross-section. For the sake of clarity, only the two left-hand air passages 28 and 30 in Figure 1 are provided with reference numerals. The air passages 28 have a cross-section tapering from the lower lamella return portion 24, whereas the air passages 30 have a cross-section tapering from the upper lamella return portion 26.

[0040] In order to limit, or avoid, a movement of the lamellae 2 to 22 relative to each other in a direction transverse to the longitudinal direction of the lamella element 1, respective tongues 32 and 34 formed integrally with the lamella element 1 are provided. These moreover define a path of extraction of the lamella element 1 in a longitudinal direction. For the sake of clarity, only one tongue 32 of the front side and one tongue 34 of the back side of the lamella element 1 are provided with a reference numeral in Figure 1. The tongues 32 and 34 are formed integrally with every second lamella 4, 8, 12, 16 and 20, with each one of these lamellae 4, 8, 12, 16 and 20 having both tongues 32 and 34.

[0041] The lamella element 1 thus alternatingly includes lamellae 2 to 22 with and without tongues 32 and 34.

[0042] The tongues 32 are each formed on a longitudinal edge 36 in a tongue groove 38 of the lamellae 4, 8, 12, 16 and 20 realized on the longitudinal edge 36. For the sake of clarity, only the longitudinal edge 36 and the tongue groove 38 of lamella 4 are provided with a reference numeral in Figure 1. The tongues 34 of the back side of the lamella element 1 equally extend from the tongue groove of lamellae 4, 8, 12, 16 and 20 realized in a longitudinal edge, which tongue groove is equally not visible in Figure 1. The lamellae 2, 6, 10, 14, 18 and 22 without a tongue each have two reception grooves 40 and 42 which are realized from a longitudinal edge 44 or 46. For the sake of clarity, only the reception grooves 40, 42 and the longitudinal edges 44, 46 of the right-hand lamella 22 in Figure 1 are provided with a reference numeral.

[0043] On the front side of the lamella element 1, the reception grooves 40 of the lamellae 2, 6, 10, 14, 18 and 22 and the tongue grooves 38 together with the tongues 32 of the lamellae 4, 8, 12, 16 and 20 are arranged at a same level and thus one behind the other when viewed in the longitudinal direction. The tongue grooves 38, the tongues 32, and the reception grooves 40 are then staggered toward the upper lamella return portion 26 of the lamella element 1. On the back side of the lamella element 1, the reception grooves 42, the tongue grooves (not represented), and the tongues 34 are also arranged one behind the other when viewed in a longitudinal direction. However, in contrast with the front side of the lamella element 1, they are staggered in a direction toward the lower lamella return portion 24. The tongues 32 and 34 thus overlap and engage the lamellae 2, 6, 10, 14, 18 and 22 in a respective range wherein they have a small distance from the adjacent lamella 4, 8, 12, 16 or 20 as a result of the V-shaped arrangement. As a general rule, the respective lamella 2, 6, 10, 14, 18 and 22 having the smallest distance from the respective lamella 4, 8, 12, 16 or 20 presenting the tongues 32 and 34 is overlapped and engaged by the tongues 32 or 34.

[0044] The tongues 32 are formed in an approximately central position in the tongue grooves 38 and have a first tongue portion 48 which, starting out from the lamella 4, 8, 12, 16 or 20, is at an angle with the adjacent lamella 2, 6, 10, 14, 18 to then overlap the latter in its respective reception groove 40. The same is true for the tongue 34 of the back side of the lamella element 1. Due to the overlap of the tongues 32 and 34, a relative movement of the lamellae 2 to 22 in a direction transverse to the longitudinal direction, i.e., approximately in the direction of a fluid flowing through the V-shaped air passages 28 and 30, is restricted. As the tongues 32 and 34 overlap the lamellae 2, 6, 10, 14, 18 and 22 in the reception grooves 40 and 42, respectively, a relative movement of the lamellae 2 to 22 in a direction approximately along the longitudinal edge 44 is thus limited in that the tongues 32 and 34 may abut against a groove wall 50 and 52 of the respective reception grooves 40 and 42.

[0045] For the purpose of engaging, the tongues 32 and 34 have a tongue end portion 54 or 56 which, after the tongue 32 or 34 has passed through the respective reception groove 40 or 42, is bent toward the major surface 58 or 60 of the lamellae 2, 6, 10, 14, 18 or 22 comprising the reception groove 40 and 42. The left and right lamellae 2 and 22 in Figure 1 are each only engaged by one respective tongue 32 and 34 while the other lamellae 6, 10, 14 and 18 are engaged by two tongues 32 and 34 of the respective adjacent lamellae 4, 8, 12, 16 and 20. The engagement by the tongues 32 and 34 has the effect of limiting extraction of the lamella element 1 in a longitudinal direction.

[0046] In the normal position shown in Figure 1, the lamellae 2 to 22 are somewhat spaced apart from each other to admit a relative movement of the lamellae 2 to 22 in a longitudinal direction upon compression. The lamella element 1 thus possesses a certain residual spring effect in the direction of compression starting out from the normal position. Starting out from the normal position, the tongues 32 and 34 limit extraction in an extracting direction of the lamella element 1.

[0047] In the subsequent Figures 2 to 8 a method for manufacturing the lamella element 1 of the invention of Figure 1 is explained.

[0048] The starting product used for manufacturing the lamella element 1 of Figure 1 is a metallic ribbon 62, for example of aluminum, as represented in Figure 2. The metallic ribbon 62 may be part of a coil (not represented).

[0049] In accordance with Figure 3, the metallic ribbon 62 is guided through a rolling die 64 having two rollers in order to punch the tongues 32, 34, the tongue grooves 38, and the reception grooves 40 and 42 of Figure 1 from the metallic ribbon 62.

[0050] Figure 4 then represents the metallic ribbon 62 with punched reception grooves 40 and 42, tongue grooves 38, and tongues 32 and 34, with only one each of the named elements being provided with a reference numeral for the purpose of clarity. It may be seen in Figure 4 that the tongues 32 and 34 are each formed by two finger-type punched voids 65 and 66 extending approximately in parallel with each other. A length of the tongues 32 and 34 thus about corresponds to a depth of the tongue groove 38.

[0051] Following punching, in Figure 4 the metallic ribbon 62 is cut to a desired length from the coil, for instance by a cutting tool, and in this phase it is possible to set the number of lamellae of the lamella element 1 of Figure 1.

[0052] According to Figure 5, the severed and punched metallic ribbon 62 of Figure 4 is bent by a suitable forming machine into a lamella element 1 having the lamellae 2 to 22 which presently are arranged in a U shape relative to each other.

[0053] It is conceivable not to cut the metallic ribbon 62 prior to bending with the aid of the suitable forming machine, but to produce it continuously, i.e., with a great length. The metallic ribbon 62 is then cut to the correct length prior to its incorporation in the heating device - and thus after bending - with the aid of a cutting tool. This is sensible, for instance, in the case of short lamella elements 1.

[0054] In order to produce the V-shaped arrangement of the lamellae 2 to 22 of the lamella element 1 of Figure 1, the metallic ribbon 62 from Figure 5 is inserted into a holding jig 67 wherein the lamella element 1 is retained laterally and can support itself against the holding jig 67 by its lamella 22 that is on the right in Figure 6. The lamella element 1 is then subjected from its left-hand lamella 2 to a forming force 69 in the longitudinal direction, whereby the lamella element 1 is compressed. The compression brings about a V-shaped arrangement of the lamellae 2 to 22 relative to each other, resulting in the lamella element 1 of Figure 7 where the tongues 32 and 34 (see Figure 1) are not bent yet.

[0055] Figure 8 shows the lamella element 1 where the tongues 32 and 34 have their tongue portion 48 bent to thus overlap the lamellae 2, 6, 10, 14, 18 and 22. In this arrangement a relative movement of the lamellae 2 to 22 in a direction transverse to the longitudinal direction is avoided, resulting in a lamella element 1 which presents a comparatively high rigidity while it may nevertheless be flexibly adapted to certain circumstances such as, for instance, non-planar surfaces. It is already conceivable to employ the lamella element 1 of Figure 8 for a heating device. In order to obtain the lamella element 1 according to Figure 1, an additional step of bending the tongue end portions 54 and 56 of the tongues 32 and 34 toward the major surfaces 58 and 60 of Figure 1 is performed for engagement.

[0056] Bending the tongues 32 and 34 may be carried out, e.g., by two consecutively arranged rollers which move in a longitudinal direction across the reception grooves 40 or 42. For bending the tongues 32 as in Figure 8, the rollers would then move from the right side through the reception grooves 40 to thus sequentially bend the tongues 32. In this case the first roller is configured to bend the respective tongue 32 into the position shown in Figure 8, while the second roller subsequently bends tongue end portion 54 of the tongue in accordance with Figure 1. By way of example, the second roller may be configured in the manner of a toothed wheel, with the teeth of the roller then being able to plunge between the lamellae in order to bend the tongue 32. For bending the tongue 34, the pair of rollers would then move from left to right in Figure 8.

[0057] It is possible for a tongue 32 or 34 of Figure 1 to overlap not only one lamella but several lamellae.

[0058] According to Figure 9 the tongues 32, 34 of the lamella element 1 are wider in comparison with the first practical example. The tongues 32 and 34 overlap and engage the individual lamellae with a larger area. This results in a greater stiffness of the lamella element 1.

[0059] Figure 10 shows a lamella element 70 with two lamellae 72 and 74. This is the minimum number of lamellae of a lamella element. A tongue 76 of the left lamella 72 overlaps and engages the right lamella 74. With an additional tongue 78 a lamella of a further lamella element (not shown) could be overlapped and engaged. The lamella element 70 comprises one return portion 80. Each lamella 72 and 74 comprises a bending portion 82 respectively 84 bent in opposite directions and in a direction transverse to the longitudinal direction of the lamella element 70. The bending portions 82 and 84 extend essentially at a parallel distance from the return portion 80.

[0060] According to Figure 11 a lamella element 86 comprises significantly more lamellae in comparison with the previous embodiments.

[0061] In accordance with Figure 12 a heating unit 88 is provided for the heating device for air heating. The latter comprises a lamella element 90. The lamella return portions 26 - of which only one is provided with a reference numeral in Figure 12 for the sake of clarity - serve to define a first side 92, with these lamella return portions 26 being disposed adjacent the tongues 32 visible in Figure 12. From this side 92 a multiplicity of electric heating elements 94 - of which only one is provided with a reference numeral in Figure 12 for the sake of clarity - are fixed on the lamella element 90. The heating elements 94 are, e.g., PCT heating elements. These have an approximate width that corresponds to the width of the lamella element 90, and extend approximately over an entire length of the lamella element 90. The heating elements 94 are connected by means of a suitable material, form-type, or frictional connection, with bonding being suited as a material connection and clamping as a fric-

tional or form-type connection by way of example. Heat is then passed on via the electric heating elements 94 to the lamella element 90 , which in turn passes the heat to a fluid flowing through the lamella element 90.

[0062] The heating unit 88 moreover comprises a cover plate 96 which is arranged in contact with a side 98 of the lamella element 90 that faces away from the side 92. The side 90 is formed by the lamella return portions 24 of the lamella element 90, with only one lamella return portion being provided with a reference numeral in Figure 12 for the sake of clarity. The cover plate 96 has a width corresponding to the width of the lamella element 90 and extends over the entire length of the latter. A first and a second end portion 100 and 102 of the cover plate 96 are bent toward the lamella element 90 so as to approximately form a right angle with the remaining cover plate 96 and each overlap the latter on an end face. The cover plate 96 thus is configured in an approximate U shape, with the end portions 100 and 102 then each forming one leg of the cover plate 96. The lamella element 90 is immobilized in its longitudinal direction by the cover plate 96 as a result of the end portions 100 and 102. The end portions 100 and 102 each terminate approximately in the area of the tongues 32 and thus do not cover the lamella element 90 completely on the end face thereof.

[0063] Starting out from a longitudinal side of the end portion 102, which is not visible in Figure 12, a connecting link 104 extends approximately at a right angle with the end portion 102 in a direction away from the lamella element 90. This connecting link serves for fastening of the heating unit 88 to the heating device. In addition the connecting link 104 serves for coupling the heating unit 88 with a supply voltage.

[0064] The heating device may comprise a plurality or multiplicity of the heating units 88 represented in Figure 12 which are, e.g., disposed above or behind each other and/or side by side such that the air passages 28 and 30 - cf. Figure 1 - substantially extend in a same direction.

[0065] Figure 13 shows a heating unit 105 including two lamella elements 90 and 106. In accordance with Figure 12, the lamella element 90 has a cover plate 96 and a multiplicity of heating elements 94 whereon the further lamella element 106 is fixed by its lamella return portions 24. This fixation is achieved in correspondence to the fixation of the lamella elements 90 on the heating elements 94. The lamella elements 90 and 106 thus extend at a parallel spacing from each other and present a same orientation, with the heating elements 94 then being arranged between them. On the further lamella return portions 26 of the lamella element 106 a further cover plate 108 is immobilized which has a same width as the lamella element 106 and extends over the entire length of the latter. Other than the cover plate 96 associated to the lamella element 90 it has only one end portion 110 that is bent toward the lamella element 106 approximately at a right angle. A further end portion 112 of the cover plate 108 extends adjacent the connecting link 104 of the cover plate, away from the lamella element 106 approximately in the longitudinal direction thereof, and serves as a further connecting link 112. Moreover the connecting links 104 and 112 serves for coupling the heating unit 105 with the supply voltage. At a current feed of the connecting links 104 and 112 the system of Figure 13 heats. The cover plate 108 may be immobilized on the lamella element 106 in correspondence to the cover plate 96.

[0066] In Figure 14 a lamella element 114 is shown after bending in the suitable forming machine according to Figure 5. Different to the lamella element 62 in Figure 5 the lamella element 114 has in its bending areas targeted material weaknesses 116 showing in an enlarged part of Figure 14. The targeted material weaknesses 116 can be in the form of notches, especially pressed notches, incisions or dimples (dimple line or dimple zone) for example. Further the targeted material weaknesses 116 could be on one or both sides of the lamella element 114.

[0067] The bending to form the rectangular type lamella element according to the preceding practical example, see for example Figure 4, is often susceptible to variations in the fin raw material (the aluminium roll), and can sometimes cause irregular "bending" during the bending process. To avoid this the targeted material weaknesses 116 are formed in the lamella return portions of the lamella element 114. These are introduced during the die cut process, or during any other step more appropriate.

[0068] Figure 15 shows the lamella element 114 before the bending in the suitable forming machine. It is recognizably that the targeted material weaknesses 116 extend essentially perpendicularly to the longitudinal axis of the lamella element 114 and over the entire width of the lamella element 114. The targeted material weaknesses 116 are formed on one side of the lamella element 114.

[0069] Therefore the purpose of the targeted material weaknesses 116 is that the bending process is a consistent process.

[0070] Figure 16 discloses the lamella element 114 of Figure 15 after compressing according to Figure 6. The targeted material weaknesses 116 are arranged in an inner edge area of the lamella element 114 between the lamella return portion 26 and the lamellae connected by the lamella return portion 26.

[0071] Figure 17 represents a lamella element 118 having in addition or instead to the targeted material weaknesses of Figure 14 in its bending area of the tongues 76 and 78 targeted material weaknesses in the form of a dimple zone 120.

[0072] What is disclosed is a lamella element comprising at least a plurality of lamellae that are integrally connected and arranged one behind the other. On at least one lamella a bracket is formed which laterally overlaps another lamella.

List of Reference Symbols:

[0073]

1	lamella element
2 - 22	lamella
24	lamella return portion
26	lamella return portion
27	top side
28	air passage
29	bottom side
30	air passage
32	tongue
34	tongue
36	longitudinal edge
38	tongue groove
40	reception groove
42	reception groove
44	longitudinal edge
46	longitudinal edge
48	tongue portion
50	groove wall
52	groove wall
54	tongue end portion
56	tongue end portion
58	major surface
60	major surface
62	metallic ribbon
64	rolling die
65	punched void
66	punched void
67	holding jig
69	forming force
70	lamella element
72	lamella
74	lamella
76	tongue
78	tongue
80	return portion
82	bending portion
84	bending portion
86	lamella element
88	heating unit
90	lamella element
92	side
94	heating elements
96	cover plate
98	side
100	end portion
102	end portion
104	connecting link
105	heating unit
106	lamella element
108	cover plate
110	end portion
112	end portion
114	lamella element
116	targeted material weaknesses
118	lamella element
120	dimple zone

Claims

1. A lamella element comprising at least a majority of interconnected lamellae (2 to 22) that are arranged one behind the other, and a tongue (32, 34) which is formed on a lamella (4, 8, 12, 16, 20) and laterally overlaps another lamella (2, 6, 10, 14, 18, 22).

2. The lamella element according to claim 1, wherein the tongue (32, 34) additionally engages the another or a further lamella (2, 6, 10, 14, 18, 22).

3. The lamella element according to claim 1 or 2, wherein the tongue (32, 34) is formed on a longitudinal edge (36, 46) of the lamella (4, 8,12, 16, 20) and engages and/or overlaps the another lamella (2, 6, 10, 14, 18, 22) at the longitudinal edge (44) thereof.

4. The lamella element according to claim 2 or 3, wherein the tongue (32, 34) engages the another or a further lamella (2, 6, 10, 14, 18, 22) at the major surface (58, 60) thereof.

5. The lamella element according to claim 3 or 4, wherein a tongue (32, 34) is formed on each longitudinal edge (36) of the lamella (4, 8, 12, 16, 20).

6. The lamella element according to claim 5, wherein the tongues (32, 34) of a lamella (4, 8, 12, 16, 20) each overlap and/or engage different lamellae (2, 6, 10, 14, 18, 22).

7. The lamella element according to the preceding claims, wherein all the lamellae (2 to 22) are connected via tongues (32, 34).

8. The lamella element according to the preceding claims, wherein it alternatingly comprises lamellae (2 to 22) with and without tongues (32, 34), with the lamellae (4, 8, 12, 16, 20) having tongues (32, 34) overlapping and/or engaging the respective lamellae (2, 6, 10, 14, 18, 22) adjacent to them.

9. The lamella element according to any one of claims 3 to 8, wherein a respective tongue (32, 34) is formed in a tongue groove (38) realized from the longitudinal edge (36) of the lamella (4, 8, 12, 16, 20).

10. The lamella element according to the preceding claims, wherein the tongue (32, 34), in order to engage and/or overlap a lamella (2, 6, 10, 14, 18, 22), extends through a reception groove (40, 42) realized in this lamella (2, 6, 10, 14, 18, 22) at least in portions thereof.

11. The lamella element according to claim 10, wherein the tongue grooves and reception grooves (38, 40, 42) of a respective side of the lamella element (1)

are arranged substantially one behind another when viewed in a longitudinal direction.

12. The lamella element according to claim 10 or 11, wherein the lamellae (2 to 22) have a V-shaped arrangement relative to each other, and the tongues (32, 34) and the tongue grooves and reception grooves (38, 40, 42) are each formed in a range wherein the lamellae (2 to 22) connected to the tongue (32, 34) have a comparatively small spacing.

13. The lamella element according to the preceding claims, wherein targeted material weaknesses (116, 120) are formed in the area of bending portions.

14. A heating device for air heating comprising at least one heating unit (88, 105) comprising a lamella element (90, 106) according to any one of the preceding claims, wherein the heating unit (88, 105) has at least one heating element (94) which is fixed on lamella return portions (24, 26) of a first side (92) of the lamella element (1) which interconnect the lamellae (2 to 22).

15. The heating device according to claim 14, wherein the at least one heating unit (88, 105) comprises a cover plate (96, 108) fixed on lamella return portions (24, 26) of a further side (98) of the lamella element (1) which interconnect the lamellae (2 to 22).

16. A method for manufacturing a lamella element (1), in particular according to any one of claims 1 to 13, including the steps of:

- punching one or several tongues (32, 34) from a metallic ribbon (62);
- bending the metallic ribbon (62) to form lamellae (2 to 22) that are arranged one behind the other;
- bending the at least one or the several tongues (32, 34) toward the longitudinal edge (44) of the lamella or lamellae (2, 6, 10, 14, 18, 22) to be overlapped.

17. The method according to claim 16, including the additional step of:

- bending a tongue end portion (54, 56) of the bent one or several tongues (32, 34) toward the major surface (58, 60) of the lamella or lamellae (2, 6, 10, 14, 18, 22) to be engaged.

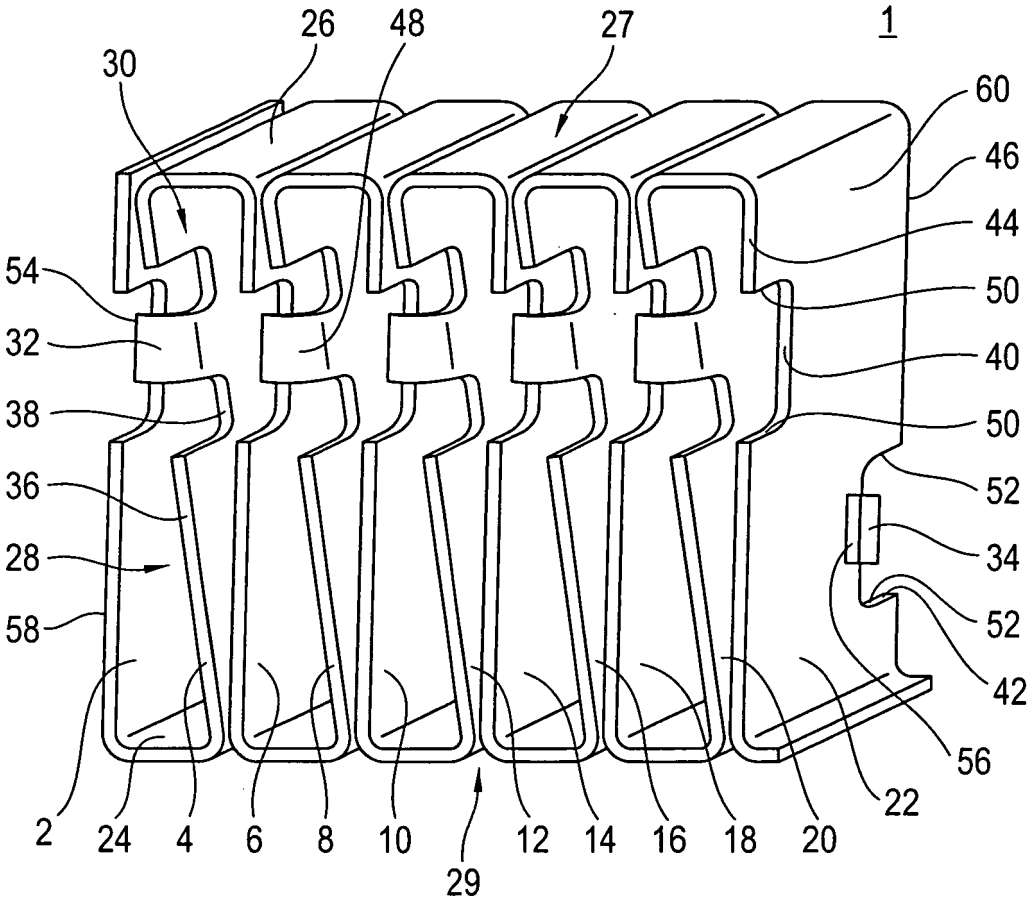
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Fig. 1

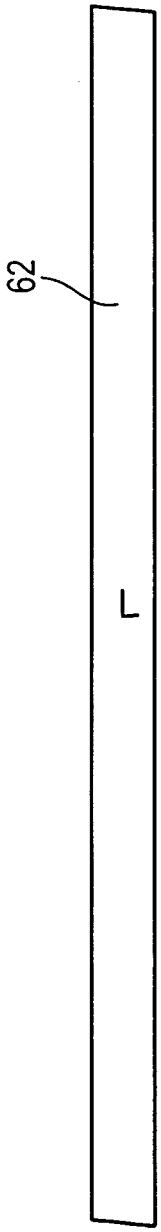


Fig. 2

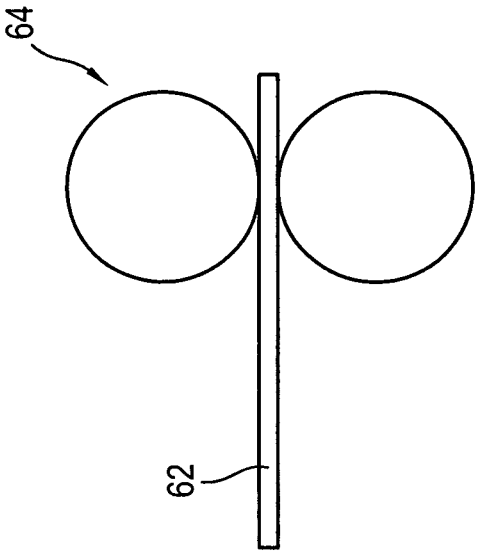


Fig. 3

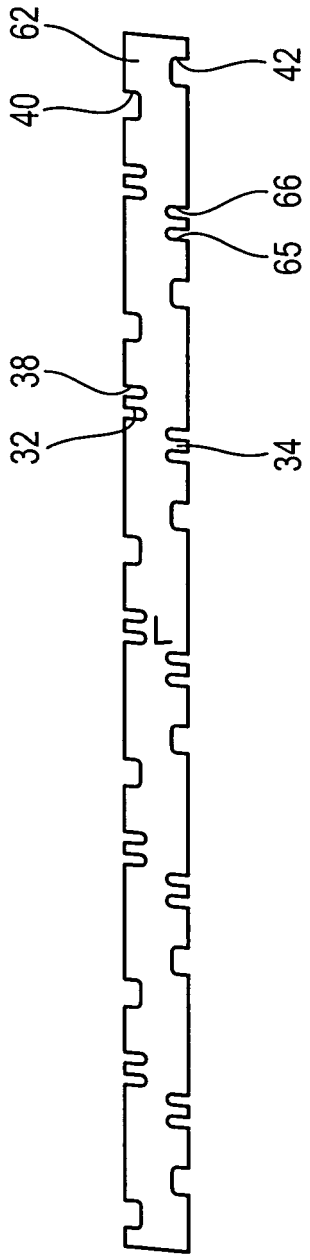


Fig. 4

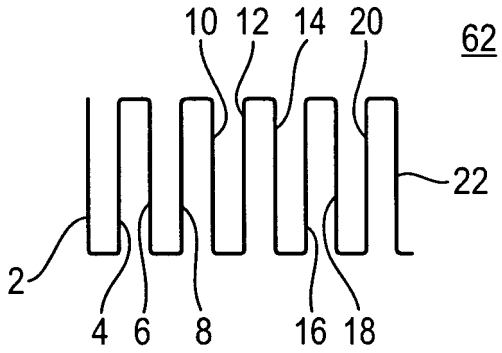
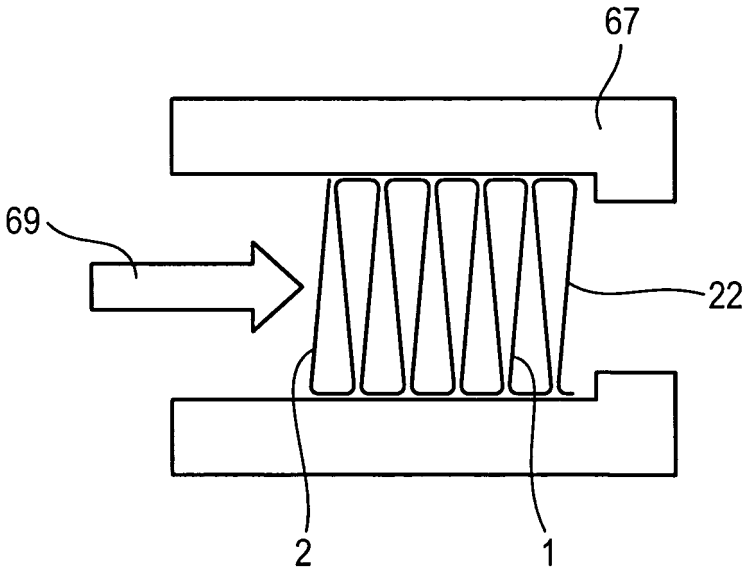


Fig. 5



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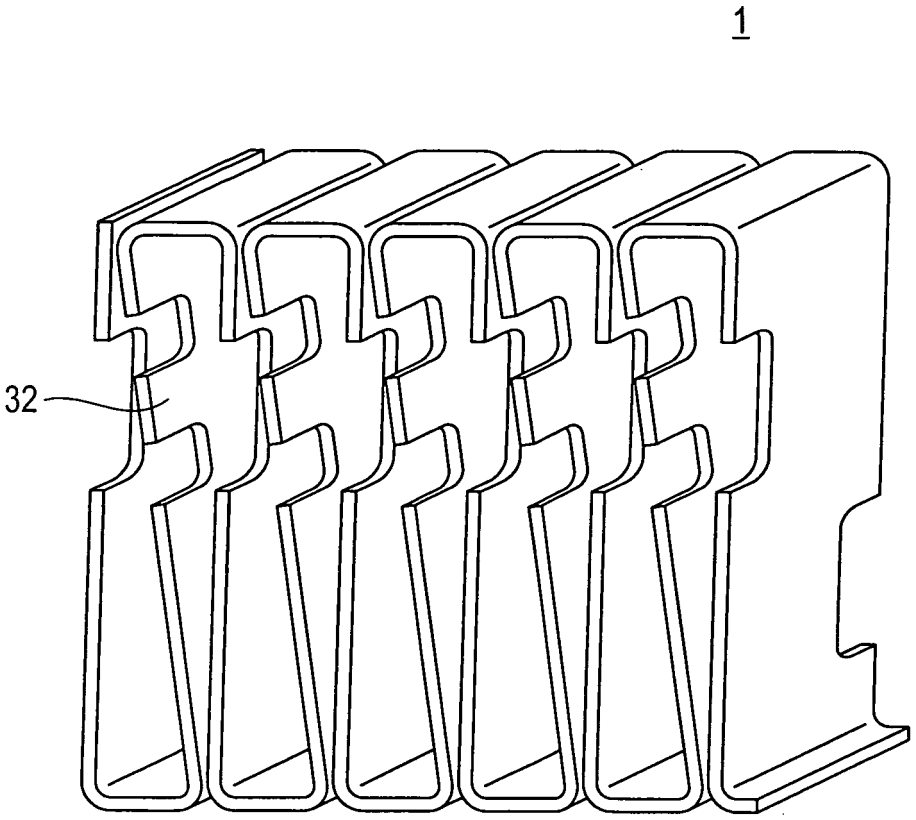

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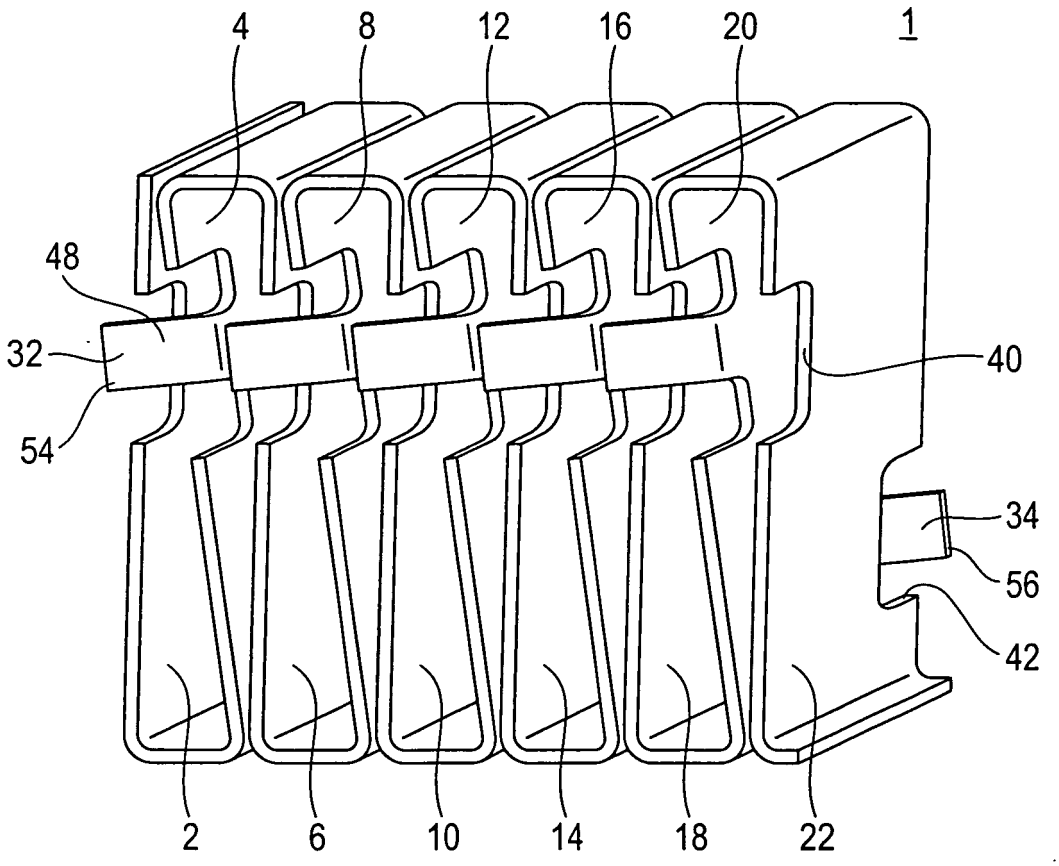

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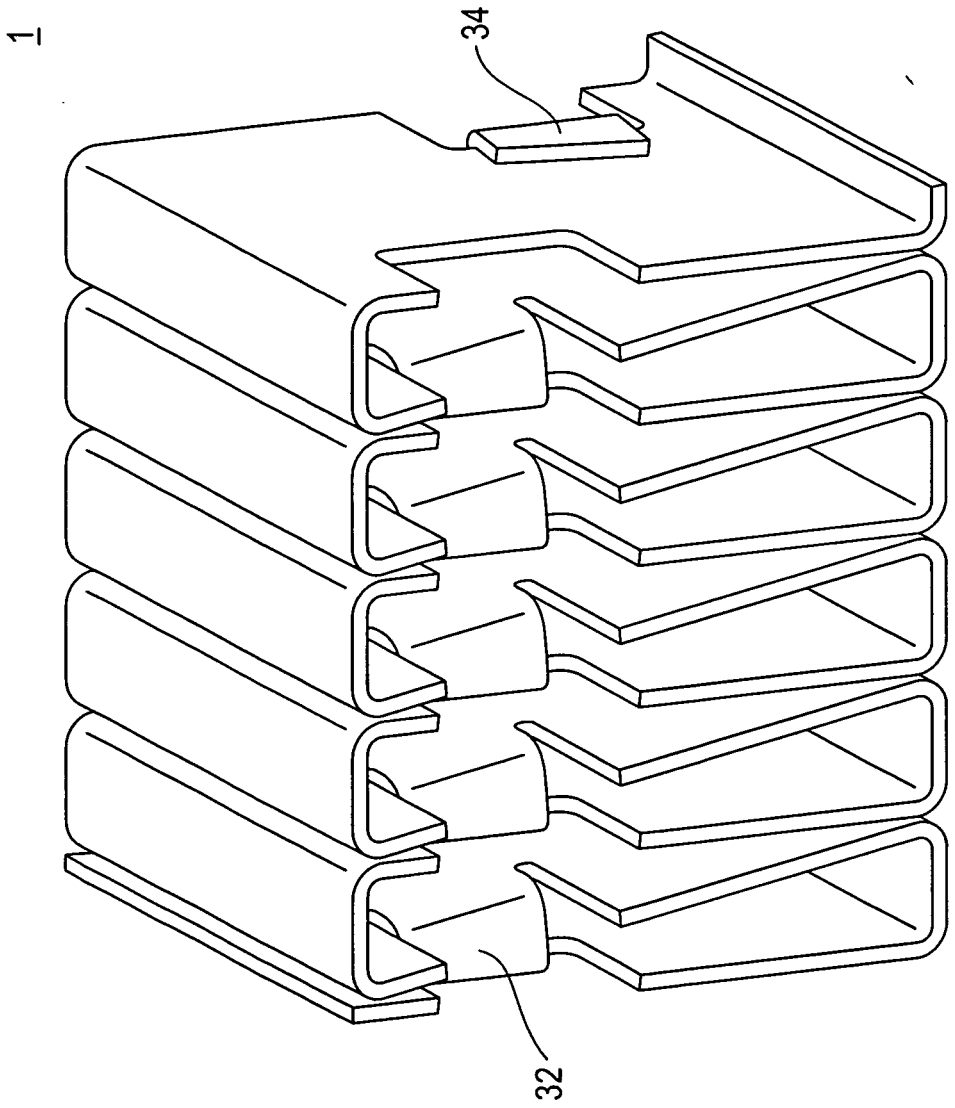

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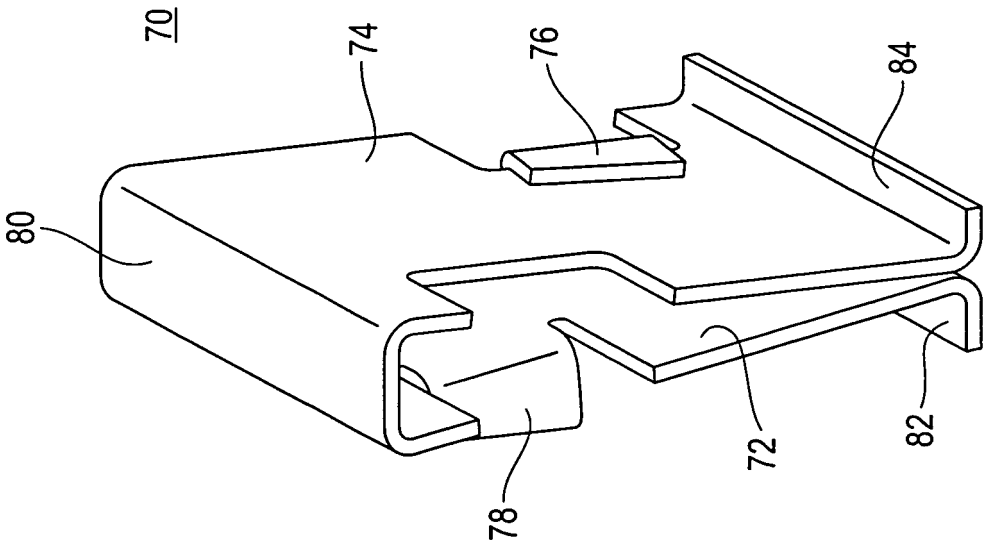
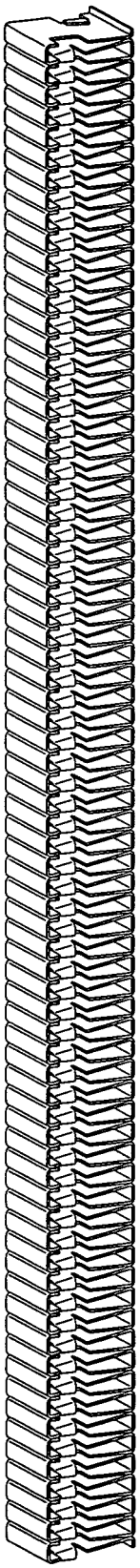


Fig. 10



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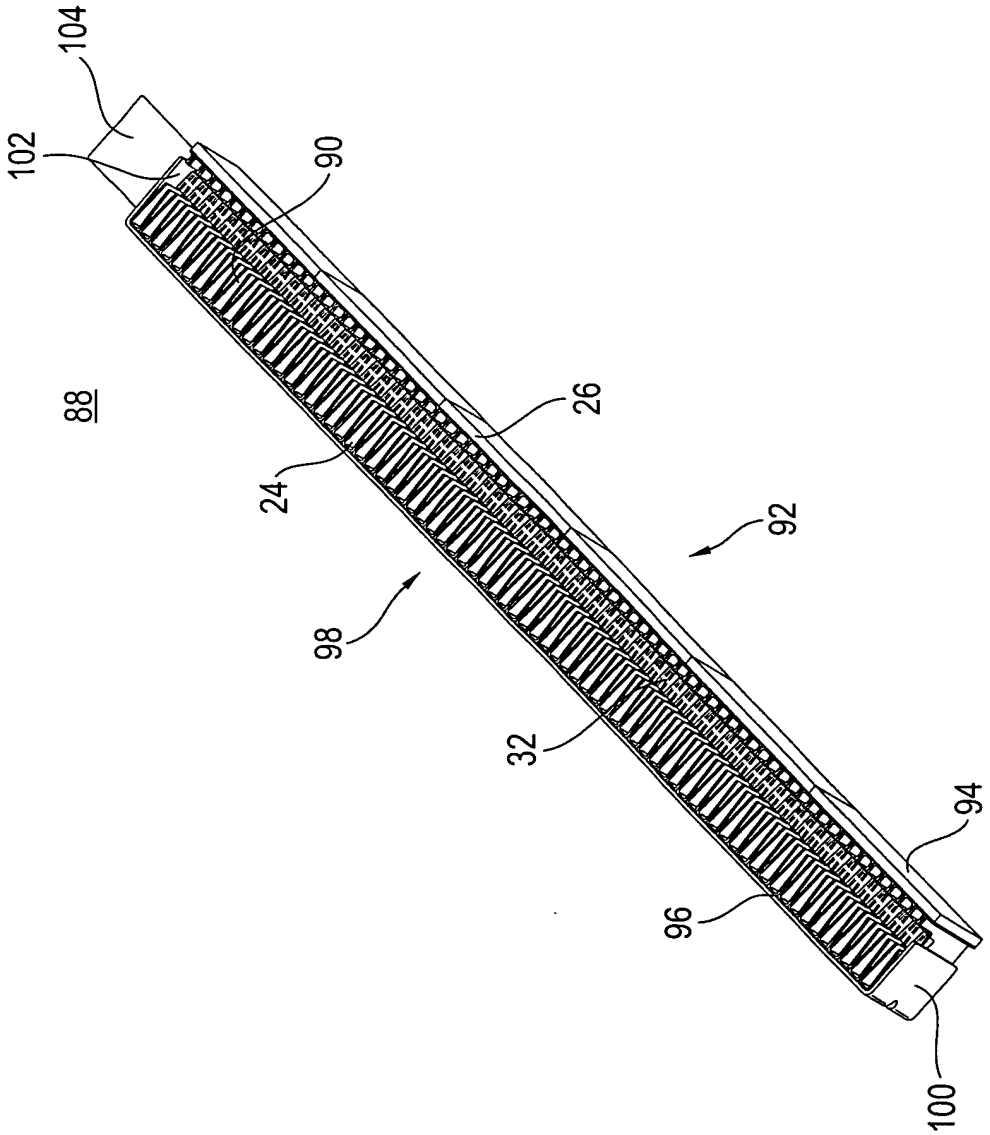

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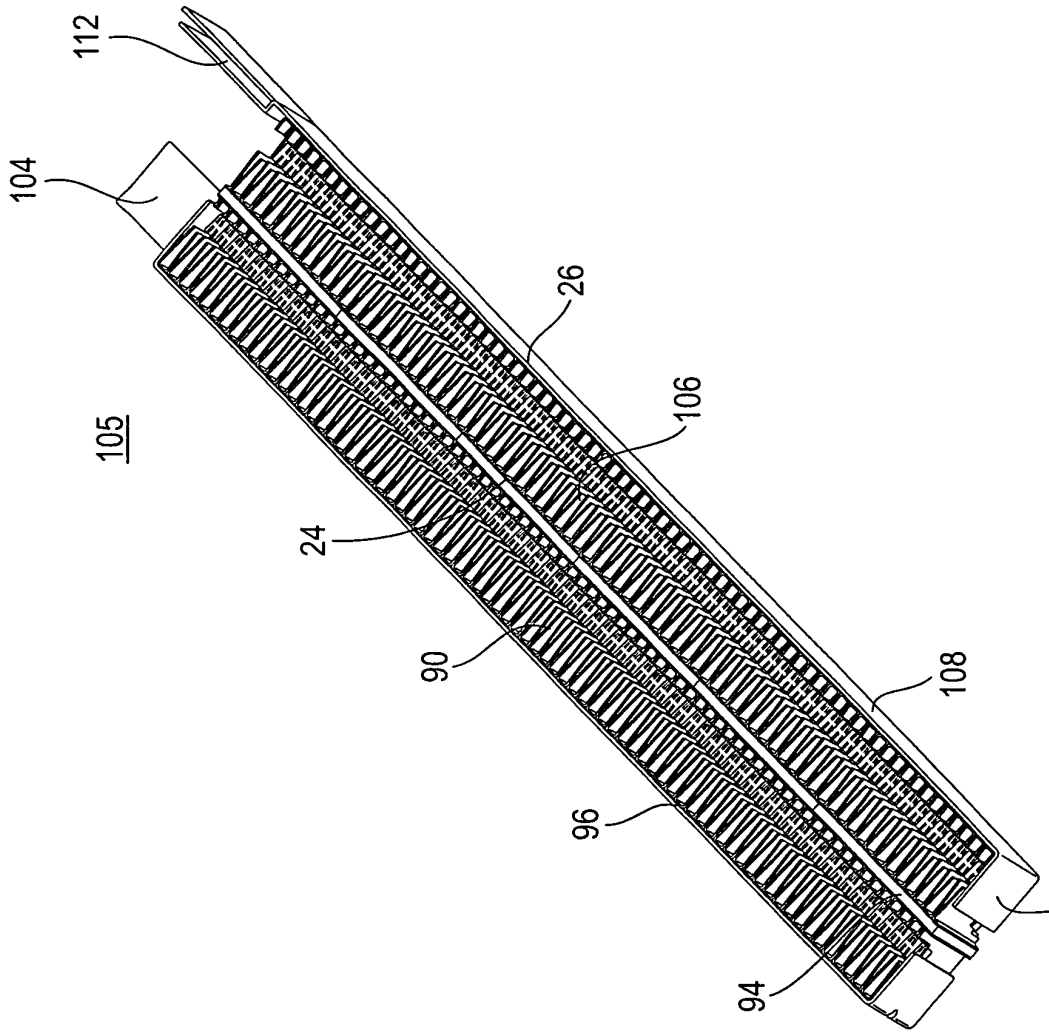
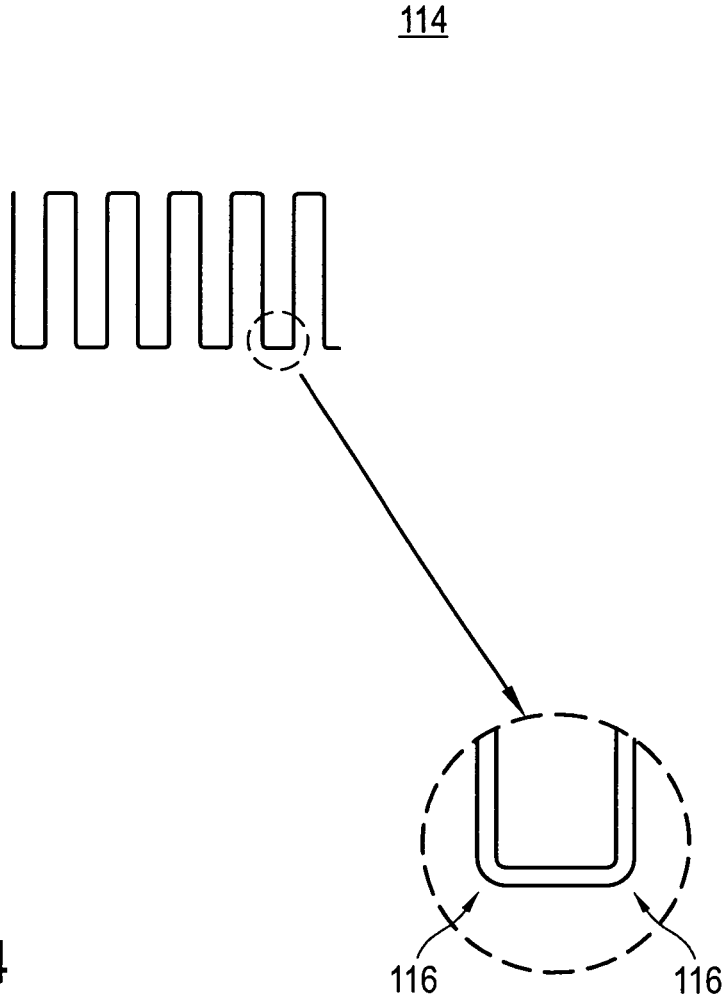


Fig. 13



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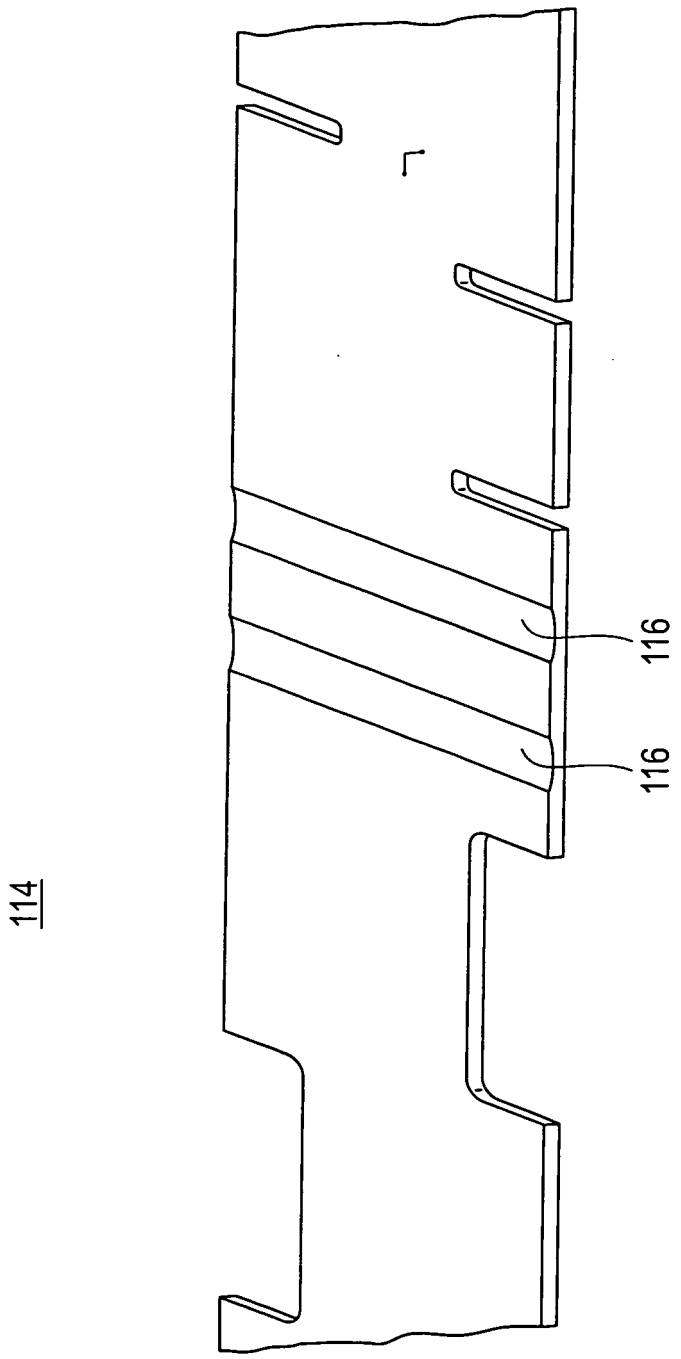

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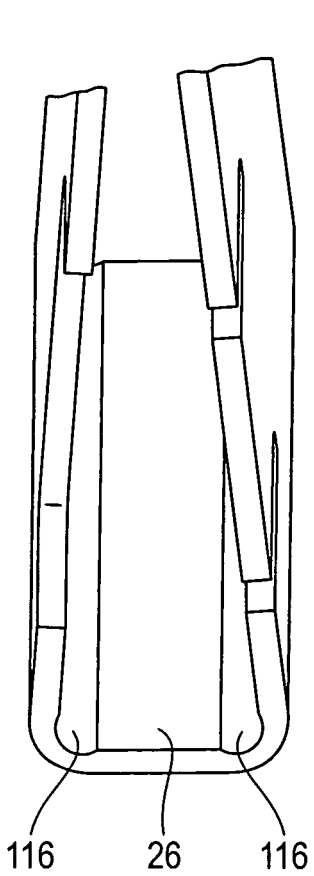

Fig. 16

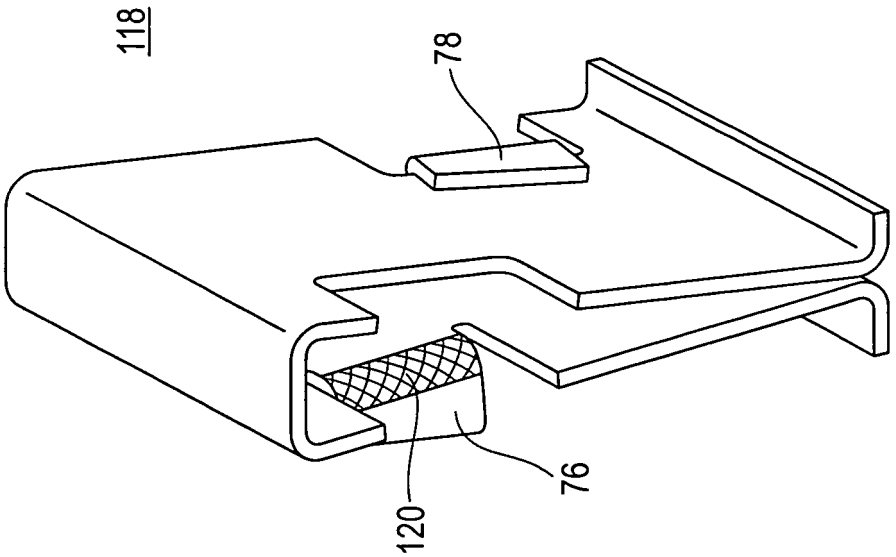

Fig. 17

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EUROPEAN SEARCH REPORT

Application Number
EP 12 15 8839

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 August 2012	Leclaire, Thomas

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