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NOTICE OF ENTITLEMENT

We NIPPONDENSO CO., LTD.

of 1-1 Showa-cho, Kariya-City, Aichi-Pref, 448 JAPAN

being the Applicant and Nominated Person in respect of Australian Patent Application No. 82269/91

state the following:

Michiyasu Yamamoto; Yoshio Suzuki and Ryouichi Sanada are the actual inventors of the invention the subject of the Application.

The applicant and nominated person is the assignee of the invention from the actual inventors.

NIPPONDENSO CO., LTD. is the applicant of the application listed in the declaration under Article 8 of the PCT.

Convention priority is claimed from the following basic application(s) referred to in the declaration under Article 8 of the PCT:

Application Number	Application Date	Country	Country Code
2-211909	10 August 1990	Japan	JP

The basic application referred to in the declaration under Article 8 of the PCT was the first application made in a Convention country in respect of the invention the subject of the Application.

Our address for service is: GRIFFITH HACK & CO
168 WALKER STREET
NORTH SYDNEY NSW 2060

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NIPPONDENSO CO., LTD.
By their Patent Attorney

R. Walker

GRIFFITH HACK & CO

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(71) Applicant(s)
NIPPONDENSO CO., LTD.

(72) Inventor(s)
MICHIYASU YAMAMOTO; YOSHIO SUZUKI; RYOUICHI SANADA

(74) Attorney or Agent
GRIFFITH HACK & CO., GPO Box 4164, SYDNEY NSW 2001

(57) Claim

1. A core element for a laminated heat exchanger comprising:

- a fin plate having a flat surface area;
- a side plate provided on each of two widthwise ends of the fin plate and extending substantially in perpendicular direction to the fin plate; and
- at least one tube sidewall portion being formed by a recess extending in the perpendicular direction on either one of or both side plates, the at least one tube sidewall portion being located inbetween two flat plate joining portions provided on each of the side plates.

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(71) 出願人(米国を除くすべての指定国について)
日本電装株式会社(NIPPONDENSO CO., LTD.)[JP/JP]
〒448 愛知県刈谷市昭和町1丁目1番地 Aichi, (JP)
(72) 発明者;および
(75) 発明者/出願人(米国についてのみ)
山本道泰(YAMAMOTO, Michiyasu)[JP/JP]
鈴木芳雄(SUZUKI, Yoshio)[JP/JP]
真田良一(SANADA, Ryouichi)[JP/JP]
〒448 愛知県刈谷市昭和町1丁目1番地
日本電装株式会社内 Aichi, (JP)
(74) 代理人
弁理士 碓氷裕彦(USUI, Hirohiko)
〒448 愛知県刈谷市昭和町1丁目1番地
日本電装株式会社内 Aichi, (JP)

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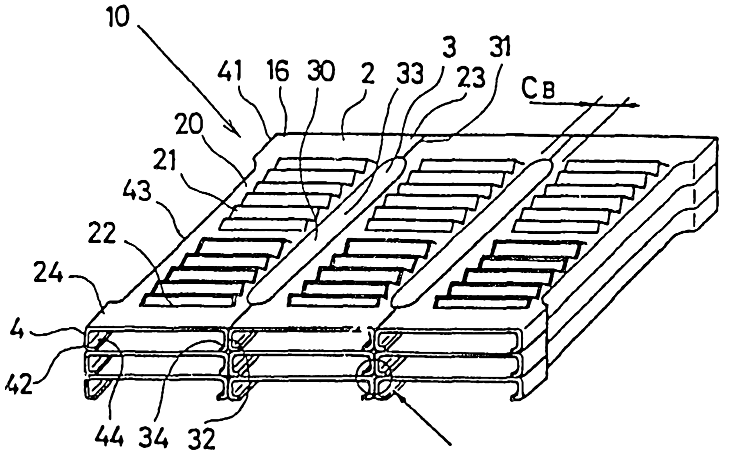

(57) Abstract

A heat exchanger mounted on a motor vehicle in particular characterized in that: there are laminated a plurality of core elements each consisting of two side plates provided at opposite end portions of a fin plate in the flowing direction of a first heat transfer medium, two flat plate portions provided on two side plates, respectively, and a tube portion forming differences in level at positions inwardly of the flat plate portions on the side plates between the flat plate portions, to thereby form a first laminated member; a second laminated member formed in the same manner as above and the first laminated member are opposed to each other and jointed together to form flow paths (tubes) inside of the flat surfaces thus jointed, through which a second heat transfer medium flows, and heat exchange is effected between the first heat transfer medium and the second heat transfer medium. Then, with this arrangement, the thickness of the tubes can be reduced with the joining strength between the core elements being maintained. This arrangement reduces a proportion of the whole core portion accounted for by the tubes, and, conversely, that accounted for by the fin plate can be increased, so that conversely the efficiency of heat exchanging in the core portion and heat radiating performance of the fin plate can be increased.

(57) 要約

特に、自動車に搭載される熱交換器であって、フィンプレートの第1熱媒体の流れ方向に沿った両側端部に設けられた2つの側方プレートと、2つの側方プレートそれぞれに設けられた2つの平板部と、平板部間の側方プレートに平板部より内側に段差を形成するチューブ部とから成るコアエレメントを複数積層し第1の積層体を形成し、同様に形成された第2の積層体とを、それぞれ対向して接合することにより、その接合された平面の内側に第2熱媒体が流れる流路（チューブ）が形成され、前記第1熱媒体と前記第2熱媒体とが熱交換することを特徴とするものである。そして、この構成により、コアエレメント間の接合強度を維持したままチューブの厚さ寸法を減少できる。これは、コア部全体に占めるチューブの割合を減少させ、逆にフィンプレートの占める割合を増大させることができるため、コア部における熱交換効率の向上、さらにはフィンプレートの放熱性能の向上を達成することが出来る。

HEAT EXCHANGER

The present invention relates to a heat exchanger mountable on a motor vehicle and more specifically to a heat exchanger core element used in a laminated radiator or heater core, and to a core made up of such core elements.

Laminated heat exchangers, ie radiators, are commonly known, as for example from Japanese laid-open utility model S54-6664 and Japanese laid-open utility model S63-159669. A laminated heat exchanger according to these prior art documents is shown in Figs. 30 and 31 of the present application. The exchanger 700 comprises a heat exchanger core 704 which is formed by laminating a plurality of fin plates 701. Each fin plate 701 has a tapered cylindrical portion 703 which is formed during a drawing process. The cylindrical portions 703 of upwardly adjacent fin plates 701 are aligned in the vertical direction. The tubes 702 for the engine cooling water are formed in this type of laminated heat exchanger 700 by stapling and laminating the plurality of fin plates 701, thereby joining them so that the cylindrical portions project into each other and form the tubes.

In this type of laminated heat exchanger 700, the cylindrical portions 703 protrude from the flat surfaces of each fin plate 701 such as to allow insertion of the cylindrical portions 703 of adjacent fin plates 701 into one another and provide a large surface area for connecting the cylindrical portions in order to maintain sufficient joint strength between adjoining cylindrical portions 703 and prevent them from separating.

However, in this type of conventional laminated heat exchanger 700, the diameter CB1 of each tube 702 becomes large when the cylindrical portions 703 have to protrude from the flat surfaces of the fin plates 701 to the necessary extent so as to provide for safe laminating of the fin plates and thereby form the tubes 702.

This increases air flow pressure loss through the core portion 704 inbetween the tubes 702, thereby reducing the amount of air which can be introduced into and flow through the core portion 704 of the heat exchanger 700. In addition to this drawback, the surface proportion which the fin plates contribute to the whole core surface is reduced. Accordingly, the heat radiating performance of the fin plates 701 is not satisfactory and the heat exchange efficiency between the air and the engine cooling water flowing through the core is reduced.

It would therefore be advantageous, if the present invention could provide in at least one of its embodiments a core element for a laminated heat exchanger which allows for improvement of the heat radiating performance and enhances the heat exchange efficiency of a heat exchanger core comprising such core elements.

Accordingly, in a first aspect of the present invention, there is provided a core element for a laminated heat exchanger comprising:

- a fin plate having a flat surface area;
- a side plate provided on each of two widthwise opposite ends of the fin plate and extending substantially in perpendicular direction to the fin plate; and
- at least one tube sidewall portion being formed by a recess extending in the perpendicular direction on either one of or both side plates, the at least one tube sidewall portion being located inbetween two flat jointing plate portions provided on each of the side plates.

In another aspect of the present invention, there is provided a laminated heat exchanger core comprising a plurality of core elements as described above, and hereinafter, wherein two or more core elements are arranged and bonded together side by side such that the flat joining plate portions of adjoining core elements abut against each other, the respective tube sidewall portions of adjoining core elements cooperate to form tube sections sealed along the lengthwise ends thereof, and the fin plates of adjoining core elements lie in the same plane, thereby forming a core element sub-assembly extending in a first plane and providing flowpaths for a first heat exchanging medium in lengthwise direction of the core element, and wherein two or more such core element sub-assemblies are laminated one above the other such that corresponding tube sections in each core element sub-assembly are arranged coaxially and cooperate to form leakage-free tubes providing flowpaths for a second heat exchanging medium, the core element sub-assemblies being joined by bonding together the joining flap potions of core elements in a first sub-assembly with the flat joining surface portions of corresponding core elements in a second sub-assembly located beneath the first sub-assembly (ie Fig. 1), or by bonding the joining skirt portions of core elements in a first sub-assembly with the upper portions of the side plates of corresponding core elements in a second sub-assembly located beneath the first sub-assembly (ie Fig. 25), as the case may be.

In yet another aspect of the present invention, there is provided a heat exchanger core formed by laminating a plurality of core elements, the core comprising:

(1) a first laminated core section formed by laminating a plurality of core elements one above another, each core element being substantially U-shaped in cross-section and comprising:

(a) a fin plate disposed along the flowing direction of a first heat exchange medium and having a flat surface portion;

(b) a side plate provided on each of two widthwise opposite side ends of the fin plate, the side plates extending lengthwise of the core element along the flowing direction of the first heat exchange medium and in a direction substantially perpendicular to the flat surface portion of the fin plate;

(c) at least two flat joining portions provided on each one of the two side plates and extending substantially parallel to the flowing direction of the first heat medium, the two flat joining portions being spaced apart from each other in the longitudinal direction of the core element; and

(d) a flowpath forming portion in one or both side plate(s) located between said flat joining portions, the flowpath forming portion being recessed into the core element and with respect to the flat joining portions to extend across the height of the core element; and comprising

(2) a second laminated section formed in the same way as the first laminated core section,

the first laminated core section being joined sidewise to the first laminated core section in such a manner that the side plates of each core element of the first and second core sections facing one another are joined together by means of the at least two flat joining portions provided on the respective side plates of each core element, the respective flowpath forming portions forming a leakage-free flowpath which extends in the laminating direction and inbetween the first and second core sections, a second heat exchange medium being able to flow in said flowpath and exchange heat with the first heat exchange medium through the fin plates.

In contrast to the prior art heat exchanger cores described above, a reduction in the diameter of the tubes of the core does not necessarily result in a reduction of the size of the contact area between sidewise adjoining core elements in the core, that is the flat joining portions on the abutting side plates of sidewise adjacently joined core elements. Accordingly, the strength of the joint between sidewise adjoining and bonded core elements is efficiently maintained even if the tube diameter is reduced, and the abutting side plates of sidewise adjoining core elements will not have the tendency to separate from one another. Therefore, it is possible to reduce the tube diameter without affecting the joint strength between core elements. A reduction of tube diameter accordingly provides for a reduction of the pressure loss of the first heat exchange medium in the core due to the tubes, thereby allowing an increase of first heat exchange medium being able to flow into and through the core. Reduction of tube diameter also allows to reduce the contribution the tubes provide to the whole surface of the core and, conversely, to increase the surface proportion the fin plates contribute to the whole core surface. The heat radiating performance of the fin plates can thus be improved and the heat exchange efficiency within the core is improved.

The joining or laminating of a plurality of core element sub-assemblies one over the other (stacking) is facilitated by way of the co-operating joining flap portions and the flat joining surface portions, or the co-operating joining skirt portions and upper portions of the side plates of the core elements, as the case may be; these joining portions also provide for an improved joint strength between the core element sub-assemblies laminated one over the other.

The present invention will be more fully understood from the ensuing description of different preferred embodiments which is provided with reference to the accompanying drawings in which:

Fig. 1 shows in a perspective view a portion of a core of a laminated heat exchanger in a first embodiment of the present invention;

Fig. 2 is an enlarged front view of a detail of Fig.1;

Fig. 3 is a sectional view showing a portion of a laminated heat exchanger incorporating the core described with reference to Fig. 1;

Fig. 4 is a perspective view showing a core element used to laminate part of the core of Fig. 1;

Fig. 5 is a sectional view showing a fin plate of the core element in Fig. 4;

Fig. 6 is a perspective view showing a first step in the process of forming the core element illustrated in Fig. 4;

Fig. 7 is a perspective view showing a moulded part formed after the first step in the process;

Fig. 8 is a perspective view showing a second step in the process of forming the core element;

Fig. 9 is a perspective view showing the moulded part formed during the second step in the process;

Fig. 10 is a perspective view showing a third step in the process of forming the core element;

Fig. 11 is a perspective view showing the moulded part formed during the third step in the process;

Fig. 12 is a perspective view showing a fourth step in the process of forming the core element;

Fig. 13 is a perspective view showing the moulded part formed during the fourth step process;

Fig. 14 is a perspective view showing a core element used as the lowermost and uppermost element in the core of the heat exchanger of Fig. 3;

Fig. 15 is a perspective view showing a portion of a core of a laminated heat exchanger in a second embodiment of the present invention;

Fig. 16 is a sectional view showing a portion of a core of a laminated heat exchanger in a third embodiment of the present invention;

Fig. 17 is a sectional view showing a portion of a core of a laminated heat exchanger in a fourth embodiment of the present invention;

Fig. 18 is a bottom view of the core of Fig. 17;

Fig. 19 is a perspective view showing a core element used in the middle section of the core illustrated in Fig. 17;

Fig. 20 is a perspective view showing a core element used as the uppermost core element of the core illustrated in Fig. 17;

Fig. 21 is a perspective view showing a core element used as the lowermost core element of the core illustrated in Fig. 17;

Fig. 22 is a sectional view showing a portion of a core of a laminated heat exchanger in a fifth embodiment of the present invention;

Fig. 23 is a perspective view showing a core element used as the uppermost core element of the core illustrated in Fig. 22;

Fig. 24 is a perspective view showing a core element used as the lowermost core element of the core illustrated in Fig. 22;

Fig. 25 is a perspective view showing a portion of a core of a laminated heat exchanger in a sixth embodiment of the present invention;

Fig. 26 to Fig. 28 are perspective views showing different examples of modifications applied to a core element previously illustrated;

Fig. 29 is a sectional view similar to Fig. 5 showing a modification of the louvres and slits in a fin plate of a core element;

Fig. 30 is a sectional view showing a portion of a conventional laminated heat exchanger; and

Fig. 31 is a perspective view showing a conventional fin plate.

The structure of a core of a laminated heat exchanger according to the different embodiments of the present invention is generally described with reference to the embodiments shown in Fig. 1 to Fig. 25.

Reference shall be made first to Fig. 1 to Fig. 14 which illustrate a first embodiment of the present invention; in Fig. 1 there is illustrated a portion of a core 10 of a laminated heat exchanger illustrated in Fig. 3; such a laminated heat exchanger 1 is used, for example, as a radiator of a vehicle engine.

The heat exchanger 1 comprises the core 10 for performing the actual heat exchange between air flowing through the core and engine cooling water which flows in tubes 40 extending between an upper and a lower tank 11 and 12, respectively, in which the engine cooling water can be stored temporarily. A packing 13a for preventing leakage of the engine cooling water is disposed in the joining area of the upper tank with the core 10; similarly, a packing 13b is disposed in the joining area of the lower tank 12 with the core 10. The core 10 comprises upper and lower core plates 14 and 15, a plurality of laminated core elements 16, and a plurality of upper and lower core end elements 17. The upper and lower core plates 14 and 15 are made of thin aluminium plates, which are respectively caulk-joined to the upper tank 11 and lower tank 12 at outer peripheral portions thereof. The upper and lower core plates 14 and 15 have a plurality of tapered cylindrical portions 18 and 19 which project towards the plurality of upper and lower core end elements 17; the tapered cylindrical portions 18 and 19 are joined to the respectively adjacent upper and lower core end elements 17 in a fluid-tight manner. The plurality of tube portions 18 and 19 are formed by deep drawing (burring process) the upper and lower core plates 14, 1

Fig. 4 shows a core element 16 used in the middle section of the laminated core 10 illustrated in Fig. 1. The core element 16 is substantially U-like in cross-section along the flow direction of the air in the core 10 as indicated by arrow A in Fig. 4, and is made by drawing a thin metal plate. The core element 16 comprises a fin plate 2 and two side plates 3 and 4 which are respectively arranged at side- or widthwise ends of the fin plate 2 and extend in a substantially perpendicular direction thereto. As shown in Fig. 4, the fin plate 2 has a flat surface portion 20 which can be formed with a plurality of louvres 21 and a plurality of slits 22 to improve heat radiating performance of the fin plate 2 as can be seen in Fig. 5. Further, the fin plate 2 has joining surface portions 23 and 24, which are respectively located at the lengthwise ends thereof, namely the air inlet and the outlet-side, respectively, with respect to the air flow direction through the core 10; the joining surface portions 23, 24 of the core element 16 serve to support and join thereto a core element located on the level immediately above it as is described below.

Further, each side plate 3, 4 has on the inlet-side a first flat joining plate portion 31, 41, on the outlet-side a second flat joining plate portion 32, 42, a tube sidewall portion 33, 43 which extends between the first and second flat joining plate portion, and a joining flap portion 34, 44 which extends substantially parallel to the fin plate 2. This inlet and outlet-side flat joining plate portions 31, 41 and 32, 42, respectively extend in a direction perpendicular to the plane of the fin plate 2 (downward in Fig. 1) from the corresponding terminal side ends at the inlet and outlet-side ends of the fin plate 2.

The tube sidewall portion 33, 43 in each side plate 3, 4 is made up by a bay- or channel-like section located between the inlet-side flat joining plate portion 31, 41 and the outlet-side flat joining plate portion 32, 42; each tube sidewall portion 33, 43 has a straight middle section which is recessed with respect to the surfaces of the flat joining plate portions 31 and 41, 32 and 42, and two corner portions 35 and 36, 45 and 46, respectively provided at opposite ends of the straight middle section, the corner portion connecting the middle section to the flat surfaces of the respectively adjoining inlet-side flat joining plate portion 31, 41 and outlet-side flat joining plate portion 32, 42. A flowpath 30, through which engine cooling water can flow, can be formed inbetween the sidewise adjoining core elements 16, as can be seen in Fig. 3, by means of two tube sidewall portions 33, 34 facing one another.

The joining flap porcions 34, 44 are integrally provided at the terminal tips of the inlet-side flat joining plate portion 31, 41, outlet-side flat joining plate portion 32, 42, and the tube sidewall portion 33, 43; the joining flap portions 34, 44 are respectively inwardly bent from the side plates 3, 4 to form a shoulder and adjacent straight flat strip which is parallel with respect to the fin plate 2. The joining flap portions 34, 44 can be brazed to corresponding joining surface portions 23, 24 provided on the fin plate 2 of a core element 16 located on a level immediately thereunder in order to facilitate laminating one core element to another. The laminating process of a core 10 is described hereinafter.

As can be seen from Fig. 1, the core 10 is made up of a plurality of core elements 16 (in Fig. 1 only nine core elements are shown for illustration purposes. The core 10 comprises an arbitrary number of above described core elements 16 arranged sidewise adjoining each other with their respective fin plates 2 extending in one same horizontal plane and with the respective inlet and outlet-side flat joining plate portions of facing side plates flatly abutting against each other; the core elements 16 arranged in the same plane are fixedly joined together by brazing together said co-operating flat joining plate portions 31, 41 and 32, 42 to form a core sub-assembly.

A number of such core sub-assemblies, each extending in a (horizontal) plane, are stacked one above the other in such a manner that the joining flap portions 34, 44 of each core element 16 in one core sub-assembly flatly abut on and are brazed to the joining surface portions 23, 24 on the fin plate 2 of respectively corresponding core elements 6 in a core sub-assembly located in a plane immediately thereunder. Furthermore, the core sub-assemblies are laminated one above the other in such a manner that the tube sidewall portions 33, 43 forming the flowpaths 30 for the cooling water in each sub-assembly are respectively aligned so as to form tubes 40 of an arbitrary length depending on the number of core elements

16 laminated one above the other, the lengthwise abutting ends of facing tube sidewall portions 33, 43 being sealed.

A method of forming the core element 16 illustrated in Fig. 4 is described with reference to Figs. 6 to 13. In a first step of the process, a thin aluminium plate covered with a brazing material of, for example, about 0.06 mm to 0.15 mm is bent as shown in Fig. 6 using a U-shaped upper mould 101 and a rectangular lower counter mould 102 to form the plate into a moulded part 110 having a U-like cross-sectional shape as shown in Fig. 7.

Next, in the second step of the process, the width of the central section of moulded part 110 is reduced by a pair of side moulds 113, 114 having curved surfaces 111, 112 at both ends thereof, as can be seen in Fig. 8, to form tube sidewall portions 33a, 43a on the herewith moulded part 120 illustrated in Fig. 9.

In the third step of the process. the moulded part 120 is further deformed by a pair of side moulds 121,122 and a split inner mould 123 inserted into the moulded part 120 to form the joining flap portions 34, 44 and finish forming the tube sidewall portions 33, 43. In this third step, after the joining flaps 34, 44 have been formed, the split mould 123 is split into three pieces in order to remove the mould from the moulded part 120. Specifically, the split mould 123 comprises a pair of lateral moulds 126, 127 having concave portions 124, 125 for forming the tube sidewall portions 33, 43 and a central mould 128 which moves upwards and downwards to move the lateral moulds 126, 127 from side to side after the joining flap portions 34, 44 are formed.

The third step in the process is described in detail. When the pair of lateral moulds 126, 127 are inserted in the moulded part 120, the central mould 128 moves upwards to push the pair of lateral moulds 126, 127 aside so that they separate from each other. At this time, a press step is performed wherein the pair of side moulds 121, 122, which have concave portions 129, 130 such that they fit the concave portions 124, 125 of the pair of lateral moulds 126, 127 and L-shaped portions 131, 132 for forming the joining flap portions 34, 44, sandwich the moulded part 120 in co-operation with the pair of lateral moulds 126, 127. The tube sidewall portions 33, 43 and the joining flap portions 34, 44 are thus formed on the moulded part 140 as shown in Fig. 11. The fin plate's 2 final configuration is achieved in the fourth step of the process using an upper mould 141 and a lower mould 142 as shown in Fig. 12, thereby forming the plurality of louvres 21 and slits 22; the finalised core element 16 is shown in Fig. 13.

In Fig. 14 there is illustrated a core element 17 which is used in the uppermost as well as the lowermost level or plane of the core 10 of the heat exchanger illustrated in Fig. 3. This core element 17 comprises a connecting plate 5, which is equivalent to the fin plate 2 of the core element 16 illustrated in Fig. 4 but for the provision of heat transfer enhancing means (louvres and slits 21, 22); the connecting plate 5 has a completely flat surface by means of which the core elements 17 can respectively be brazed to the upper and lower core plates 14, 15 in the heat exchanger illustrated in Fig. 3.

The core element 17 further comprises two side plates 6, 7 which are similar in construction and arrangement to the side plates 3,4 of the core element 16 illustrated in Fig. 4, and accordingly are located on both side- or widthwise terminal ends of the connecting plate 5, extend substantially perpendicularly thereto, have inlet and outlet-side flat plate joining portions 61, 71 and 62, 72, tube sidewall portions 63, 73 and joining flap portions 64, 74. Just as with the tube sidewall portions 33, 43 of the core element 16, a corner portion 65, 66, 75, 76 is respectively formed on the lengthwise ends of the middle section of the tube sidewall portions 63, 73. As can be seen in Fig. 3, the cylindrical portions 18, 19 of the upper and lower core plates 14, 15 can be inserted into the flowpath 30 formed by the tube sidewall portions 63, 73 of adjoining core elements 17. As can be furthermore seen from Fig. 3, the joining flap portions 64, 74 of the core elements 17, which are located at the upper end of the core 10, are brazed to the joining surface portions 23, 24, respectively, of a core element 16 located on a level immediately below it. The core elements 17 located at the lower end of the core 10 are arranged in an inverted manner so that the joining flap portions 64, 74 thereof are brazed to the joining flap portions 34, 44 of respectively above located core elements 16.

The operation and further details relating to the construction of the core 10 of the laminated heat exchanger illustrated in Fig. 3 will be described with reference to Figs. 1 to 4. Since the upper and lower core plates 14, 15, the plurality of core elements 16 and the upper and lower core elements 17 are clad with a brazing material on their surfaces, these elements can be assembled together to form the core 10 by stacking and arranging them as has been previously described and then heating the assembly in a furnace under pressure. During this process, the flat surface portions 20 of the fin plates 2 of the core elements 16 arranged in each one of the stacking planes are joined together at their respective abutting terminal widthwise edges to form a multi-level fin arrangement for improving heat exchange between the air and the engine cooling water. In addition, the tube sidewall portions 33, 43 of sidewise adjoining core elements 16 in each plane and the tube portions 63, 73 of adjoining core elements 17 located at the upper and lower ends of the core 10, respectively, cooperate to form the tubes 40 for the cooling water, which extend in the vertical direction of the laminated heat exchanger 1 between the upper and lower water tanks 11 and 12.

As shown in Fig. 2, a gap S is present in the joining section where four core elements 16 or two core elements 16 and two core elements 17 come together; this gap S could give reasons for concern as far as leakage of water from the tube 40 is concerned. However, if the thickness of the core elements 16 and 17 is about 0.1 mm, the bending angle R defined between the side plates 3, 4, 6, 7 and the fin plate 2 (or connecting plate 5), and between the side plates 3, 4, 6, 7 and the joining flap portions 34, 44, 64, 74, can respectively be reduced to about 0.2 mm. As a result, the above gap S can be sealed with a brazing material cladded on the core elements 16, 17, or by extra brazing material.

If the diameter CB of the tube 40 (refer to Fig. 1 and Fig. 3) is to be made smaller in order to reduce pressure loss in the air flowing through the core 10, this can be achieved by reducing the amount the tube sidewall portions 33, 43 of adjoining core elements 16 and the tube sidewall portions 63, 73 of adjoining core elements 17 are recessed with respect to the thereto adjoining flat plate joining portions 31, 32, 41, 42 or 61, 62, 71, 72 of the side plates 3, 4 or 6, 7, respectively. This does not require a reduction in the size or location of the inlet and outlet-side flat plate joining portions 31, 41; 32, 42 of adjoining core elements 16 and the inlet and outlet-side flat plate portions 61, 71; 62, 72 of adjoining core elements 17, when compared to the size and location given for larger diameters CB of the tubes 40.

In other words, even if the diameter CB of the tubes 40 is reduced, the strength of the joint between adjoining core elements 16 or 17 is sufficiently maintained and, accordingly, separation or delamination of respectively adjoining side plates 3 and 4 or 6 and 7 of side-or widthwise adjoining core elements 16 or 17 is suppressed. The diameter CB of the tubes 40 can thus be reduced without influencing the strength of the joints between core elements and, therefore, of the entire core assembly.

It is therefore also possible to reduce the pressure loss the air experiences while flowing through the core 10, thereby increasing the amount of air which can be introduced into the core 10 for heat exchange purposes. In addition, since the proportion the tubes 40 contribute to the whole core surface can be reduced, it is conversely possible to increase the proportion the fins surfaces contribute to the whole core surface, the fins having a higher heat transfer capacity to the air flowing through the core than the tubes, thereby improving the heat radiating performance of the core 10 as a whole.

In Fig. 15 there is illustrated a part of a core 10 of a laminated heat exchanger according to a second embodiment of the present invention. The core element 16 according to this aspect of the invention is similar to the one described with reference to Fig. 4 but for the differences explicitly noted below. The core element 16 is provided as previously described on one of its side plates, namely side plate 4 depicted on the left in Fig. 15, with a tube sidewall portion 43 which is recessed with respect to the inlet-side flat plate joining portion 41 and the outlet-side flat plate joining portion 42. On the other hand, the side plate 3 depicted on the right hand side of Fig. 15 is provided with a projecting sidewall portion 37 which protrudes in widthwise direction of the core element 16 and relative to the inlet-side flat plate joining portion 31 and the outlet-side flat plate joining portion 32 of that side plate 3. The projecting sidewall portion 37 and the tube sidewall portion 43 have a substantially corresponding shape but for the extent the projecting sidewall portion 37 protrudes from the core element 16 with respect to the flat plate joining portions 31, 32, which amount is smaller than the amount the tube sidewall portion 43 is recessed into the core element 16 with respect to the flat plate joining portions 41, 42; this is so as to allow the formation of a flowpath 30 when the projecting sidewall portion 37, of a core element 16 partly protrudes into the recess formed by the tube sidewall portion 43 of a sidewise adjoining core element 16. Such a core element configuration provides effective means for positioning sidewise adjoining core elements with respect to one another when the core 10 is assembled, thereby avoiding misalignment between the inlet-side flat joining portions 31, 41 and the outlet-side flat plate joining portions 32, 42 of core elements 16 arranged in the same plane.

In Fig. 16 there is illustrated a core of a laminated heat exchanger according to a third embodiment of the present invention. The upper and lower core plates 14, 15 of the core 10 are provided as flat plates in contrast to the core plates with the cylindrical portions 18, 19 illustrated in the embodiment according to Fig. 3. Instead of the cylindrical portions 18, 19, communication holes 18a, 19a are formed in the upper and lower core plates 14, 15 in order to allow communication between the upper and lower tanks 11, 12 by means of the tubes 40.

In Fig. 17 to Fig. 21, there is shown a fourth embodiment of the present invention. Fig. 17 and Fig. 18 respectively show a portion of the core of a laminated heat exchanger in different views. The horizontally extending fins 204, perpendicularly hereto extending flowpaths 205, and tubes 206 of this core 200 are formed by laminating the plurality of core elements 201, upper end core elements 202 and lower end core elements 203 between the upper and lower core plates 14, 15 with communication holes 18a, 19a in a similar manner as has been described above with reference to the other embodiments.

Fig. 19 shows a core element 201 used to form the main or central part of the core 200. The core element 201 comprises a fin plate 210 and two side plates 220, 230, respectively located at the widthwise ends of the fin plate 210 and extending substantially perpendicularly thereto. A plurality of louvres 211 and a plurality of slits 212 are formed on the fin plate 210 just as in the first embodiment described with reference to Fig. 4. The side plates 220, 230 on both widthwise ends of the fin plate 210 are respectively provided with an inlet-side flat plate joining portion 221, 231, an outlet-side flat plate joining portion 222, 232, and a tube sidewall portion 223, 233, all of which are formed in the same way as in the first embodiment illustrated in Fig. 4. However, the side plates 220, 230 have, instead of joining flap portions, first skirt portions 224, 234, which are respectively formed in downward extension of the inlet-side flat plate joining portion 221, 231 and the outlet-side flat plate joining portion 222, 232 and are outwardly offset relative thereto by an amount corresponding to the thickness of the side plates 220, 230, and second skirt portions 225, 235, which are respectively formed in downward extension of the tube sidewall portion 223, 233 and are also outwardly offset relative thereto by an amount corresponding to the thickness of the side plates 220, 230.

With such a configuration, when the core elements 201 are laminated to form the core illustrated in Fig. 17, the inside surface of the first skirt portions 224, 234 are brazed to the outside surfaces of the upper section of the inlet-side flat plate joining portion 221, 231 and outlet-side flat plate joining portions 222, 232, respectively, of a core element 201 on the level immediately thereunder; furthermore, the inside surface of the second skirt portions 225, 235 and the outside surface of the upper section of the tube sidewall portions 223, 233 of the core element on the level immediately thereunder are also brazed together.

Fig. 20 shows a core element 202 used at the upper end of the core 10 illustrated in Fig. 17. The upper end core element 202 is designed so as to maintain water-tightness between the upper core plate 14 and a core element 201 arranged on a level immediately below the upper end core element 202. The upper end core element 202 has a connecting plate 240 and two side plates 250, 260 arranged at the widthwise ends of the connecting plate 240 and extending substantially perpendicularly thereto as has been described with reference to other embodiments before. The configuration of the upper end core element 202 is similar to the one described with reference to Fig. 14 but for the differences explicitly noted below. The inlet-side flat plate joining portions 251, 261 and the outlet-side flat plate joining portions 252, 262 extend substantially perpendicularly to the connecting plate 240. On the other hand, the tube sidewall portions 253, 263 extend in an inclined manner from the connecting plate 240 so as to provide tapered surfaces on both side plates 250, 260. Joining flap portions 254, 264 having a flat plate like shape are respectively formed at the lower sections of the inlet-side flat plate joining portions 251, 261, the outlet-side flat plate joining portions 252, 262 and the tube sidewall portions 253, 263, and extend in the same vertical planes as these, that is the joining flap portions 254, 264 of this embodiment are not bent as is the case with the core element illustrated in Fig. 14. The joining flap portions 254, 264 can therefore be mounted and brazed onto the upper sections of the inlet- and outlet-side flat plate joining portions 221, 231 and 222, 232, and the tube sidewall portions 223, 233 of a core element 201 located on a level immediately thereunder.

Fig. 21 shows a core element 203 which is used at the lower or bottom end of the core illustrated in Fig. 17. The lower end core element 203 is designed so as to maintain water-tightness between the lower core plate 15 and a core element 201 located at a level immediately above the lower end core element 203. The lower end core element 203 has a fin plate 270 and side plates 280, 290 just as in the above described core element 201 illustrated in Fig. 19; the side plates 280, 290 themselves are provided with inlet-side flat plate joining portions 281, 291, outlet-side flat plate joining portions 282, 292 and tube sidewall portions 283, 293; the side plates 280, 290 further comprise first skirt portions 284, 294, and second skirt portions 285, 295 as described with reference to Fig. 19. The first and second skirt portions 284, 294 and 285, 295 of a lower end core element 203 are inserted into the communication hole 19a of the lower core plate 15 so as to project from a lower plane therefrom as can be seen in Fig. 17.

In Fig. 22 to Fig. 24 there is shown a fifth embodiment of the present invention. Fig. 22 shows a portion of the core of a laminated heat exchanger. The core 300 has upper end core elements 302 and lower end core elements 303 which have shapes modified from those of the upper end core elements and lower end core elements in the fourth embodiment, respectively, the middle section core elements 201, however, being of the same configuration as described with reference to Fig. 19.

Fig. 23 shows the upper end core element 302. The upper end core element 302 has a connecting plate 310 and, at both widthwise ends thereof, substantially perpendicularly thereto extending side plates 320, 330 as has been described before. Inlet-side flat plate joining portions 321, 331, outlet-side flat plate joining portions 322, 332, tube sidewall portions 323, 333 (but without tapering) and joining flap portions 324, 334 are respectively formed on both side plates 320, 330 as has been described with reference to Fig. 20

Fig. 24 shows the lower end core element 303. The lower end core element 303 has a connecting plate 340 and, at both widthwise ends thereof, substantially perpendicularly thereto extending side plates 350, 360. The side plates 350, 360 are respectively provided at their lower ends with first skirt portions 354, 364, which are inwardly offset relative to the inlet-side flat plate joining portions 351, 361 and outlet-side flat plate joining portions 352, 362 by an amount corresponding to the thickness of the side plates 350, 360 and extend parallel thereto, and second skirt portions 355, 365, which are inwardly offset relative to the tube side-wall portions 353, 363 by an amount corresponding to the thickness of the side plates 350, 360 and also extend parallel thereto.

The lower end core element 303 are arranged in an inverted manner in the core 300 such that the first skirt portions 354, 364 and the second skirt portions 355, 365 thereof can be inserted into a corresponding one of the core elements 201 on the level immediately above them so that the first and second skirt portions 354, 364 and 355, 365 can be brazed onto the hereto correspondingly abutting first skirt portions 224, 234 and second skirt portions 225, 235 of said core elements 201.

In Fig. 25 is illustrated a portion of a core according to a sixth embodiment of the present invention. The core elements 201 used in this core 10 are the result of a combination of certain features of the core elements described in relation to the second and fourth embodiments of the invention (compare Fig. 15 and Fig. 19). A projecting sidewall portion 226 is formed on the side plate 220 depicted on the right hand side in Fig. 23, and a tube sidewall portion, which is largely recessed, is formed on the side plate 230 depicted on the left hand side in Fig. 25. The core elements 201 in this embodiment are therefore similar to those in the second embodiment in that they provide for easiness in positioning sidewise adjoining core elements 201 relative to one another during the assembly of core sub-assemblies which have a plurality of core elements assembled in one and the same (horizontal) plane, thereby avoiding misalignment between the inlet-side flat plate joining portions 221, 231 and the outlet-side flat plate joining portions 222, 232, respectively. The means for stacking and joining core elements 201 one above another are provided by first skirt portions 224, 234, which are respectively formed in parallel offset extension to the inlet- and outlet-side flat plate joining portions 221, 231 and 222, 232, and by second skirt portions 225, 235 formed in parallel offset extension of the tube sidewall portions 223, 233, as was described with reference to Fig. 19.

Although the present invention in its different, above described, embodiments is preferably to be applied to a radiator, it may also be applied to a heater core of a hot-water heater, an evaporator or condenser of a cooler, or various other laminated heat exchangers such as an oil cooler.

Although a core is preferably constructed by firstly laminating a plurality of core elements in the direction of the width of the core and then in the vertical direction of the laminated heat exchanger (the flowing direction of the second heat medium), a core may also be constructed by laminating two vertical rows comprising a plurality of stacked core elements and then joining the core rows along the flowing direction of the second heat medium in the laminated heat exchanger. This assembly is preferred if the heat exchanger is to have a widthwise narrow but otherwise in its height unrestricted exchanger core. Also, if restrictions are given with regard to the dimensions of the laminated heat exchanger in its overall height, but not on its widthwise extension, two core element sub-assemblies having a plurality of horizontally arranged and joined core elements may be laminated one above the other to provide a flowpath for the first heat medium (air).

In the above embodiments, the tube sidewall portions are preferably provided on both side plates of a core element. However, the tube portions may be provided only on the side plate on one side.

Although the plurality of flat plate joining portions are provided at the upstream and downstream ends, in terms of the flowing direction of the air flowing through the core, of the side plates, the plurality of flat plate joining portions may be alternatively provided in any lengthwise locations on the side plates. For example, two flat plate joining portions may be provided near the middle of the side plates. It is also possible to use core elements 400 and 500 which have heat exchange enhancing means as shown in Figs. 26 and 27, which core elements respectively have dimples 403 or ribs 503 formed on the tube sidewall portions 402 or 503 thereof.

Further, a core element 600 as illustrated in Fig. 28 may also be used; such a core element 600 has further, intermediate flat plate joining portions 603, 604 added to the side plates 601, 602 in order to provide each side plate 601, 602 with two tube sidewall portions 605, 606; 607, 608. Therefore, two or more intermediate flat plate joining portions 603, 604 may be added to the side plates 601, 602 on both sides of the core element in order to form three or more tube sidewall portions on the core elements.

The sectional shapes of the louvres and slits are also not limited to those described with reference to Fig. 5 and may have any appropriate shape or configuration. For example, the shapes of the louvre 25 and slit 26 of the fin plate 2 as depicted in Fig. 29 may also be used.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A core element for a laminated heat exchanger comprising:

- a fin plate having a flat surface area;
- a side plate provided on each of two widthwise ends of the fin plate and extending substantially in perpendicular direction to the fin plate; and
- at least one tube sidewall portion being formed by a recess extending in the perpendicular direction on either one of or both side plates, the at least one tube sidewall portion being located inbetween two flat plate joining portions provided on each of the side plates.

2. A heat exchanger core element according to claim 1, wherein the fin plate is provided with means for enhancing heat radiation.

3. A heat exchanger core element according to claim 2, wherein the means for enhancing heat radiation comprise a plurality of louvres and slits formed in the fin plate.

4. A heat exchanger core element according to any one of claims 1 to 3, wherein the side plates are provided with alignment means, the alignment means of sidewise adjoining and abutting core elements co-operating such that the flat plate joining portions and the tube sidewall portions of abutting side plates are aligned with respect to one another.

5. A heat exchanger core element according to any one of claims 1 to 4, wherein each side plate has one tube sidewall portion which comprises:

- a flat middle section which is recessed into the core element and with respect to the flat plate joining portions of each side plate; and
- a rounded corner section at both lengthwise ends of the flat middle section leading into the respectively

adjoining one of the flat plate joining portion of each side plate.

6. A heat exchanger core element according to any one of claims 1 to 4, wherein one of the side plates has a first tube sidewall portion which comprises:

- a flat middle section which is recessed into the element and with respect to flat plate joining portions on that side plate, and

- a first rounded corner section at both lengthwise ends of the flat middle section leading into the respectively adjoining one of the two flat plate joining portions on the side plate; and

wherein the other side plate has a second tube sidewall portion which comprises:

- a flat middle section which protrudes widthwise from the core element and with respect to the flat plate joining portions on that other side plate, and

- a second rounded corner section at both lengthwise ends of the flat middle section leading into the respectively adjoining one of the two flat plate joining portions on that other side plate.

7. A heat exchanger core element according to claim 6, wherein the first and second corners have substantially the same curvature radius.

8. A heat exchanger core element according to any one of claims 1 to 7, wherein the core element further comprises on each side plate a joining flap portion extending from a lower terminal end of the respective side plate substantially perpendicular thereto and parallel to the fin plate.

9. A heat exchanger core element according to claim 8, wherein the fin plate is provided on each of two lengthwise end portions thereof with flat joining surface portions adapted to support thereon the joining flap

portions of a core element arranged on a plane immediately thereabove.

10. A heat exchanger core element according to any one of claims 1 to 7, wherein the core element further comprises on each side plate a joining skirt portion extending from a lower terminal end of the side plate substantially parallel but offset thereto, thereby forming an integral step inbetween the lower end portion of the side plate and the upper end portion of the joint skirt portion, the joining skirt portions providing means for stacking one core element above another core element by plugging a core element with its joining skirt portion onto the upper end portions of the side plates of an immediately thereunder located core element.

11. A heat exchanger core element according to claim 10, wherein the joining skirt portions of the core element are offset in an outwardly widthwise direction by an amount corresponding to the thickness of the side plates.

12. A heat exchanger core element according to claim 10 or 11, wherein the tube sidewall portions have a flat middle section which is not parallel with regard to the flat joining portions of each sidewall but extends inclined thereto.

13. A heat exchanger core element according to any one of the preceding claims, wherein the flat middle section of the tube sidewall portion of the side plate(s) is provided with means for enhancing heat exchange with a heat exchange medium flowing along the tube sidewall portion.

14. A heat exchanger core element according to claim 13, wherein the heat exchange enhancing means comprise a plurality of dimples or ribs formed in the wall of the flat middle section.

15. A heat exchanger core element according to any one of the preceding claims, wherein at least one of the two side plates comprises two or more tube sidewall portions having interposed thereinbetween in the lengthwise direction of the core element, intermediate flat joining plate portions.

16. A heat exchanger core element according to any one of the preceding claims, wherein the core element is integrally made of a metallic sheet material which is drawn to have a substantially U-shaped cross-section.

17. A laminated heat exchanger core comprising a plurality of core elements in accordance with any one of claims 1 to 16, wherein two or more core elements are arranged and bonded together side by side such that corresponding flat joining plate portions of adjoining core elements abut against each other, the respective tube sidewall portions of adjoining core elements cooperate to form tube sections sealed along the lengthwise ends thereof, and the fin plates of adjoining core elements lie in substantially the same plane, thereby forming a core element sub-assembly extending in a first plane and providing flowpaths for a first heat exchanging medium in lengthwise direction of the core elements; and wherein two or more such core element sub-assemblies are laminated one above the other such that corresponding tube sections in each core element sub-assembly are arranged coaxially and cooperate to form leakage-free tubes providing flowpaths for a second heat exchanging medium, the core element sub-assemblies being joined by bonding or brazing together the joining flap potions of core elements in a first sub-assembly with the flat joining surface portions of corresponding core elements in a second sub-assembly located beneath the first sub-assembly, or by bonding or brazing the joining skirt portions of core elements in a first sub-assembly

to the upper portions of the side plates of corresponding core elements in a second sub-assembly located beneath the first sub-assembly, as the case may be.

18. A heat exchanger in form of a radiator, hot water heater, evaporator or condenser of a cooler, and the like comprising a core according to claim 16 arranged between an upper and a lower storing tank for the second heat exchange medium, the tubes formed in the heat exchanger core being in fluid tight communication with the inside of the upper and lower storing tanks, respectively.

19. A heat exchanger core formed by laminating a plurality of core elements and comprising:

(1) a first laminated core section formed by laminating a plurality of core elements one above another, each core element being substantially U-shaped in cross-section and comprising:

- (a) a fin plate disposed along the flowing direction of a first heat exchange medium and having a flat surface portion;
- (b) a side plate provided on each of two widthwise opposite side ends of the fin plate, the side plates extending lengthwise of the core element along the flowing direction of the first heat exchange medium and in a direction substantially perpendicular to the flat surface portion of the fin plate;
- (c) at least two flat joining portions provided on each one of the two side plates and extending substantially parallel to the flowing direction of the first heat medium, the two flat plate portions being spaced apart from each other in the longitudinal direction of the core element; and
- (d) a flowpath forming portion in one or both side plate(s) located between said flat joining portions, the flowpath forming portion being

recessed into the core element and with respect to the flat joining portions to extend across the height of the core element; and comprising

(2) a second laminated section formed in the same way as the first laminated core section,

the first laminated core section being joined sidewise to the first laminated core section in such a manner that the side plates of each core element of the first and second core sections facing one another are joined together by means of the at least two flat joining portions provided on the respective side plates of each core element and form with the respective flowpath forming portions leakage-free flowpath which extend in the laminating direction inbetween the first and second core sections, a second heat exchange medium being able to flow in said flowpath and exchange heat with the first heat exchange medium through the fin plates.

20. A core element for a laminated heat exchanger substantially as hereinbefore described with reference to Figs. 1 to 4, or Fig. 15, or Fig. 19, or Fig. 26, or Fig. 27, or Fig. 28.

21. A core for a laminated heat exchanger as hereinbefore described with reference to Fig. 7, or Fig. 15, or Fig. 16, or Fig. 17, or Fig. 22, or Fig. 25.

Dated this 15th day of December 1993

NIPPONDENSO CO LTD

By their Patent Attorneys

GRIFFITH HACK & CO

82269/91

FIG.1

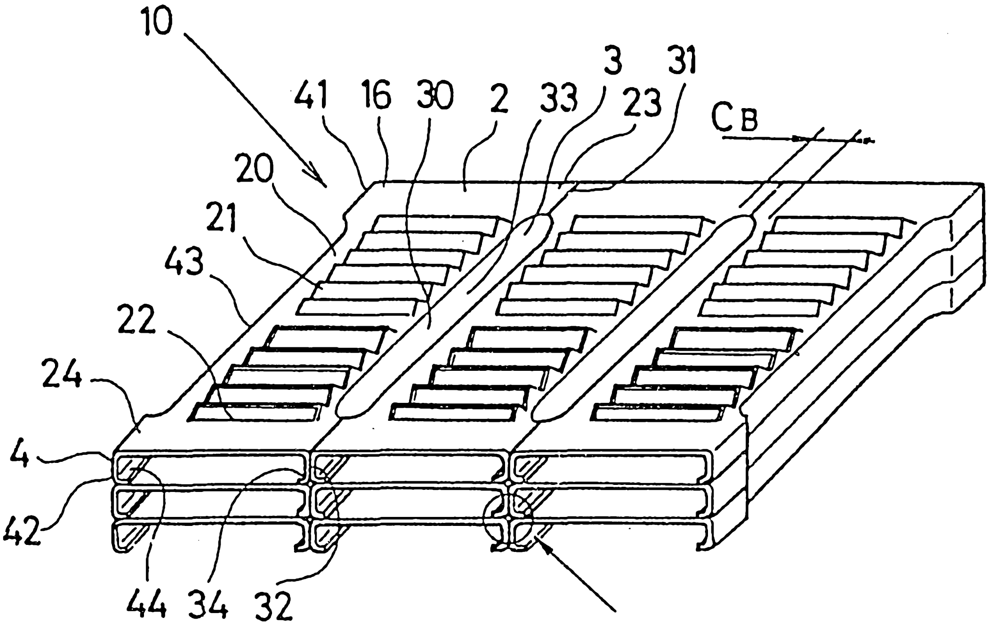

FIG.2

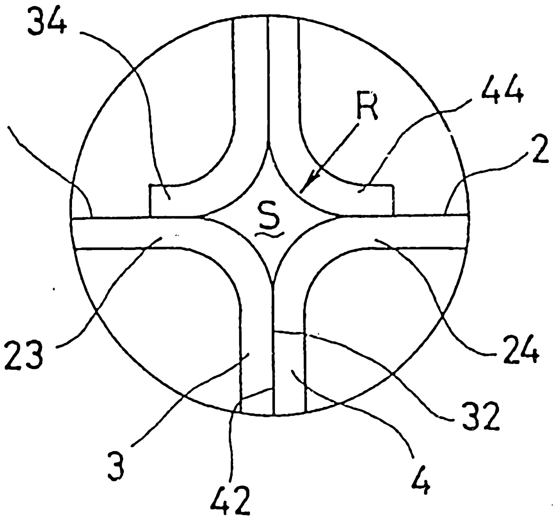

FIG.3

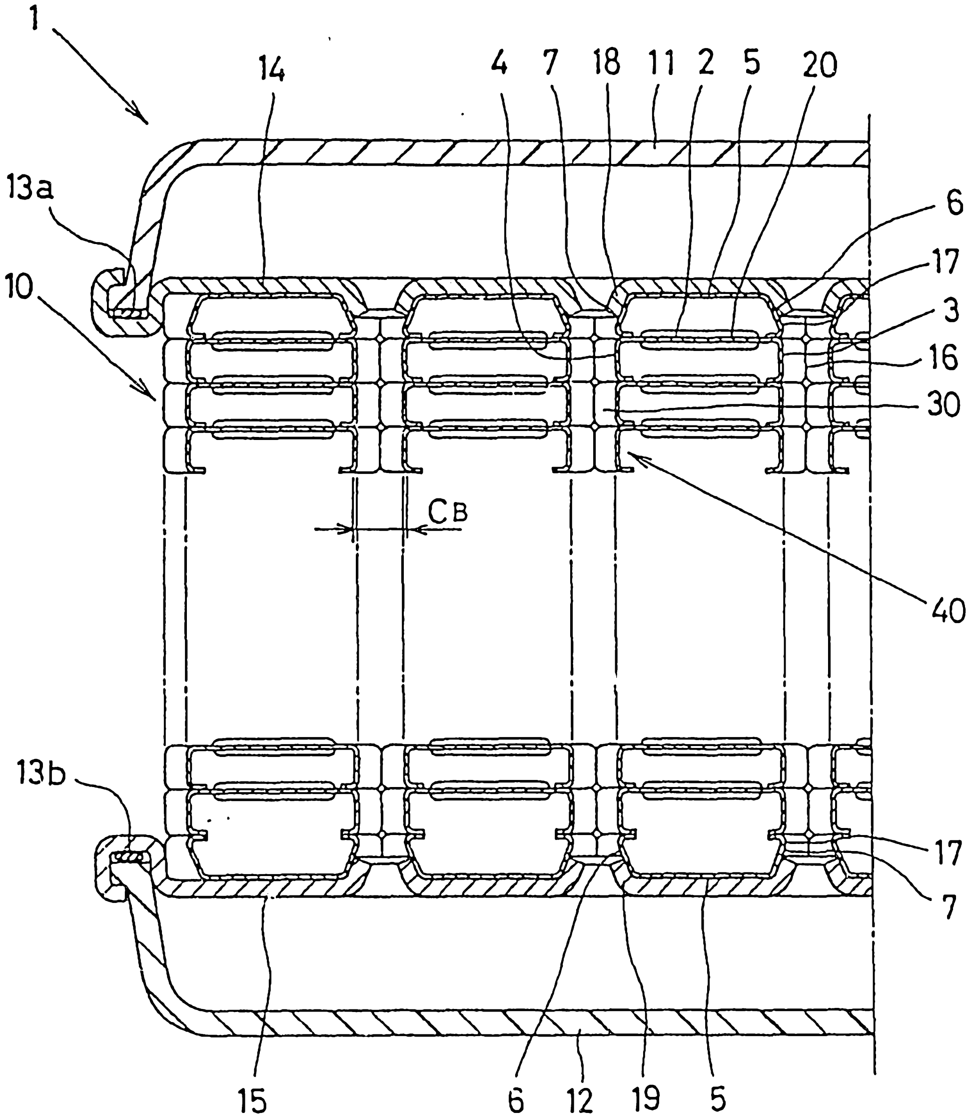

FIG.4

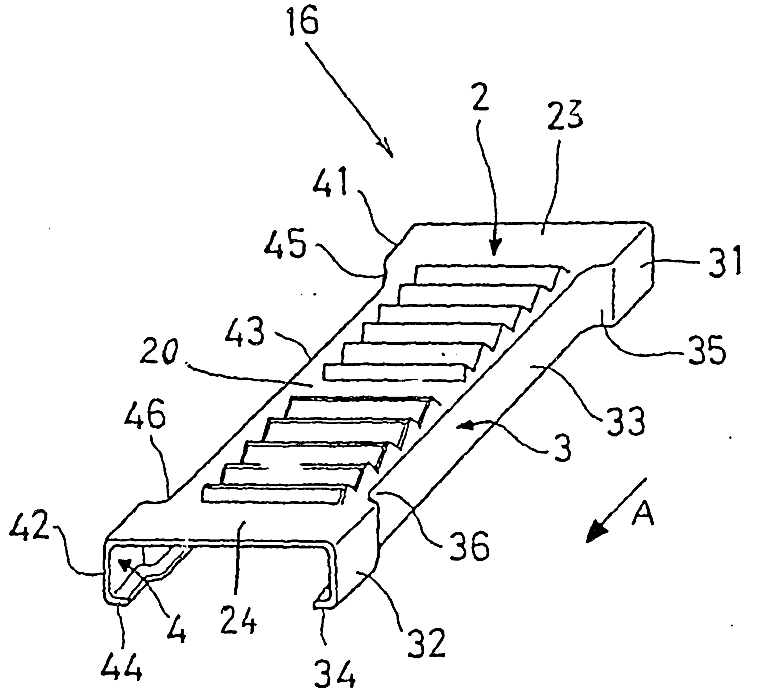

FIG.5

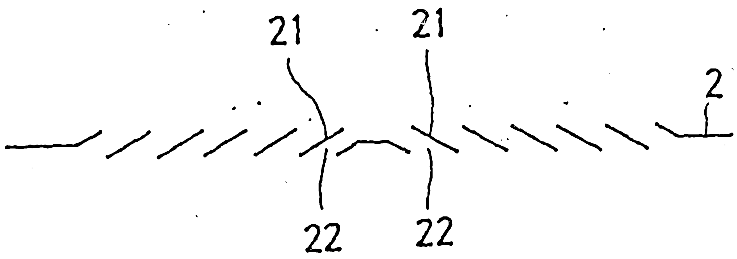

FIG.6

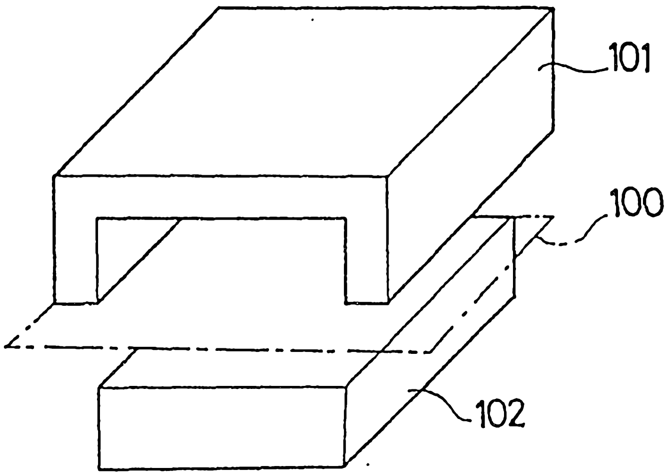

FIG.7

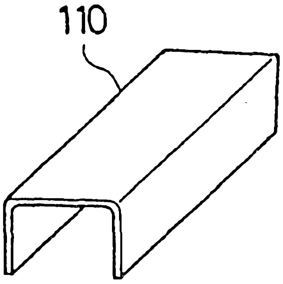

FIG.8

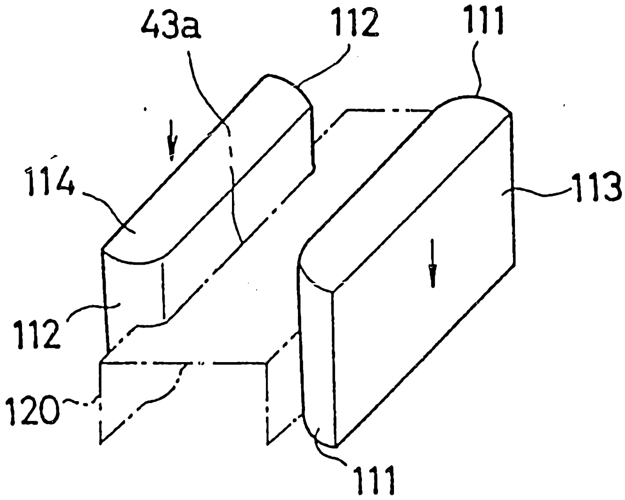

FIG.9

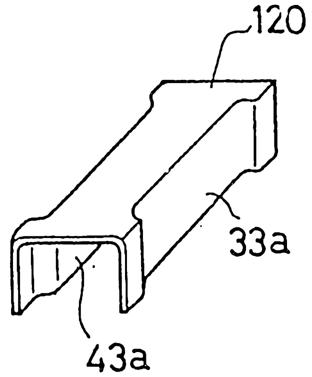

FIG.10

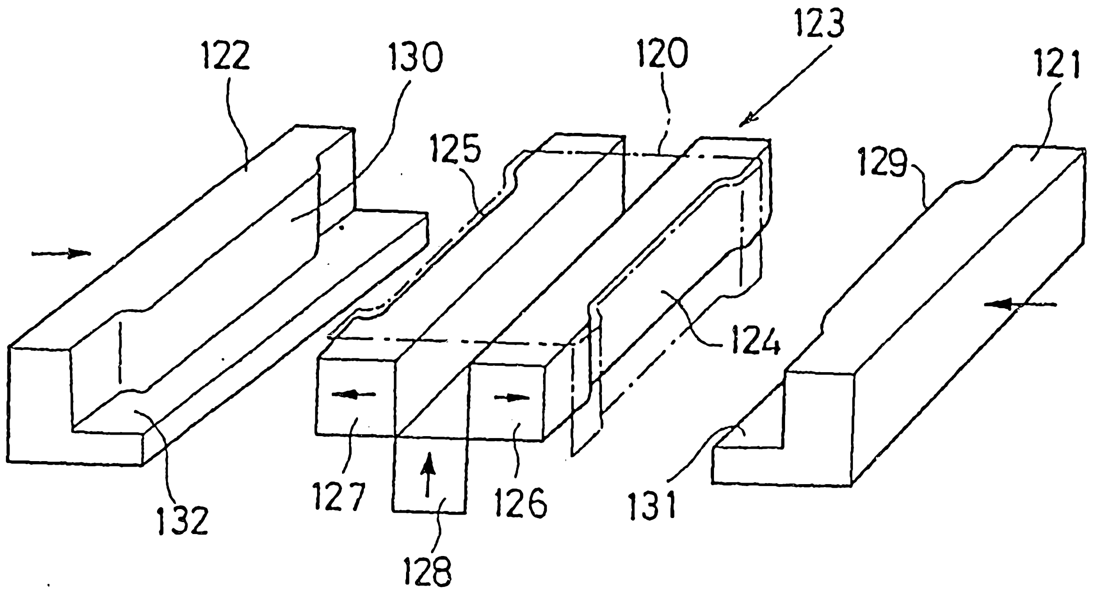

FIG.11

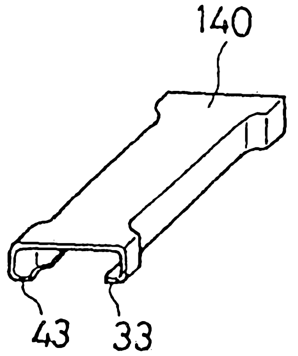

FIG.12

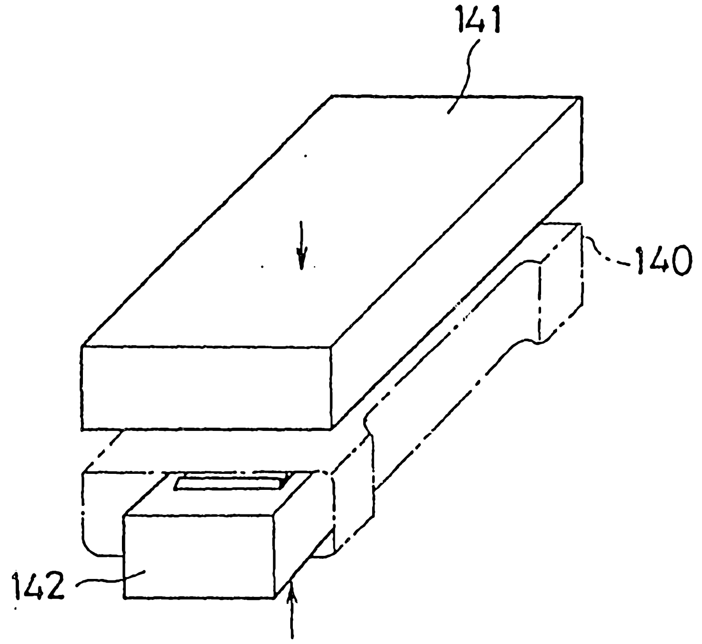

FIG.13

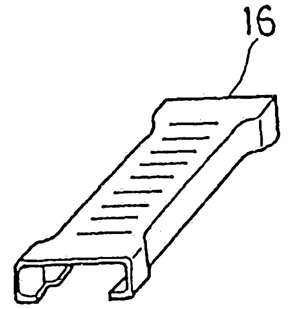

FIG.14

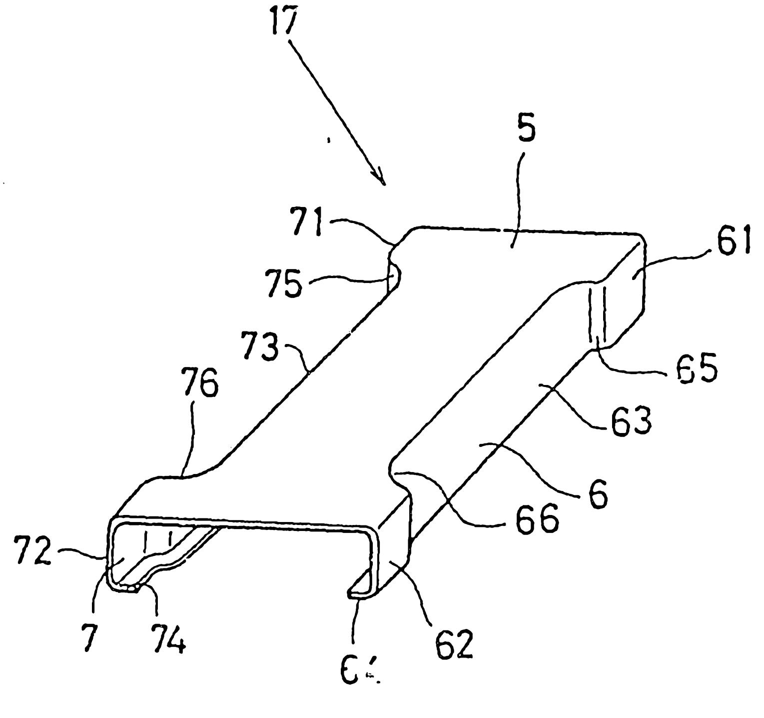

FIG.15

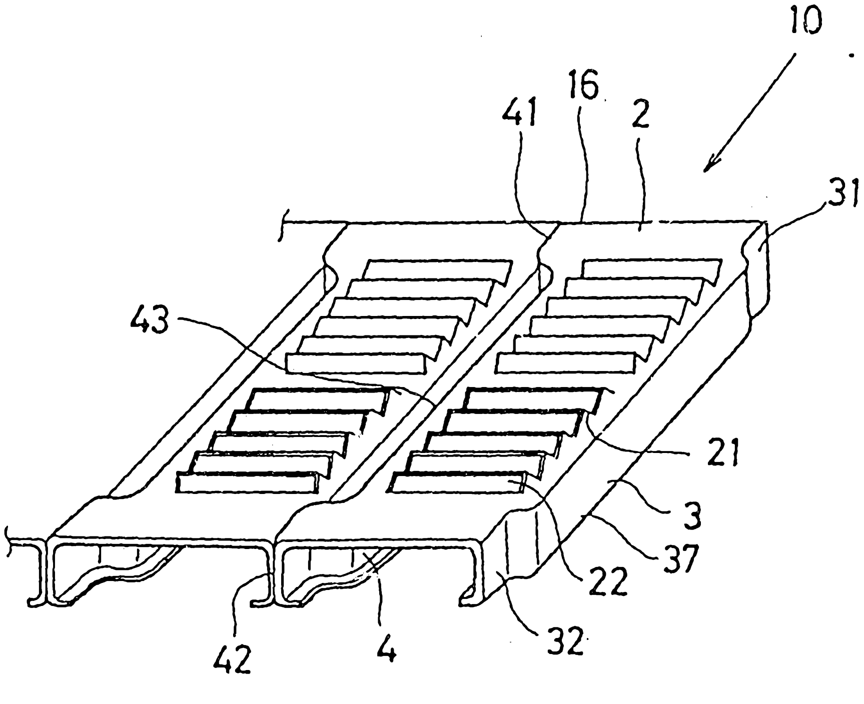

FIG.16

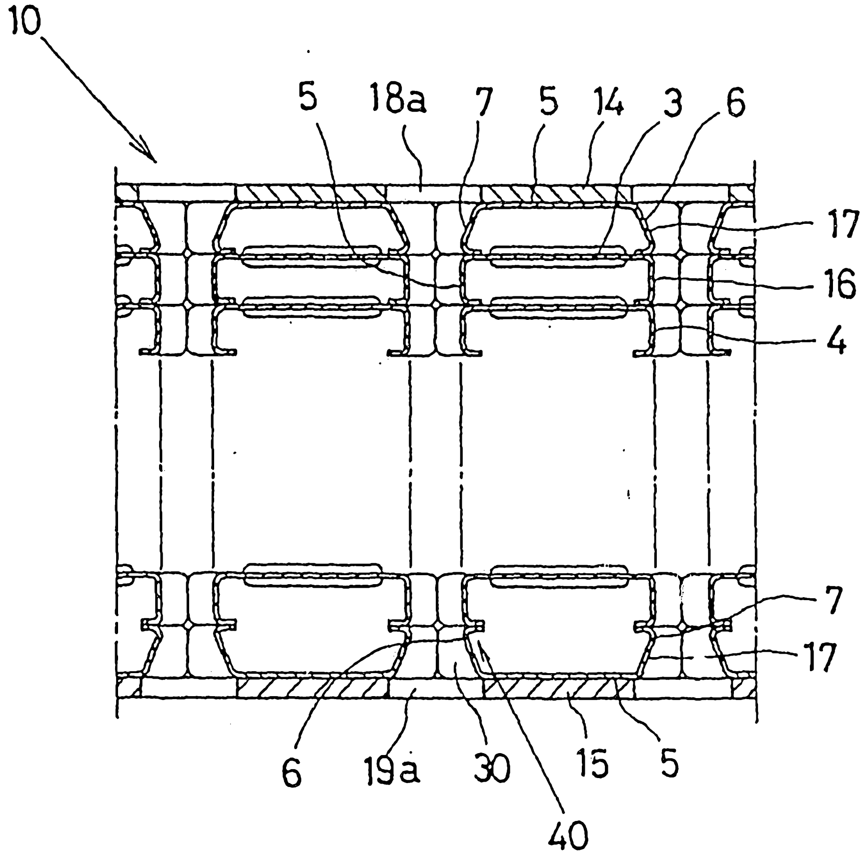

FIG.17

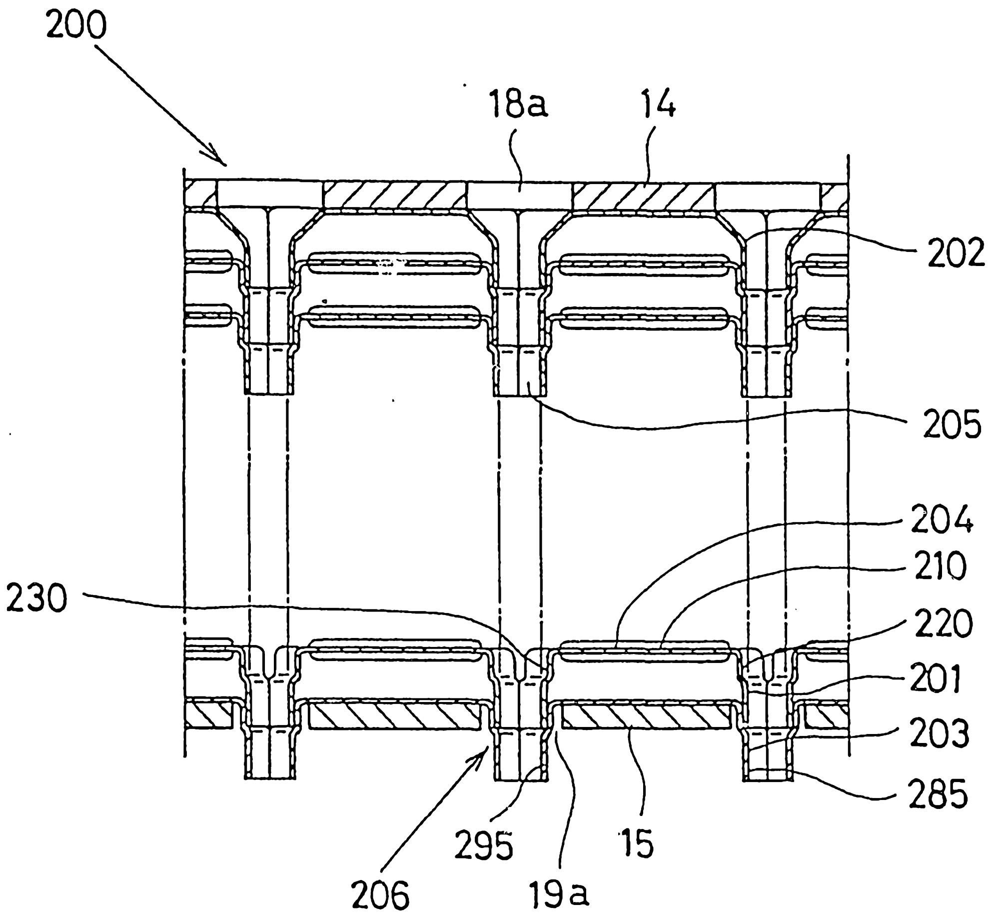

FIG.18

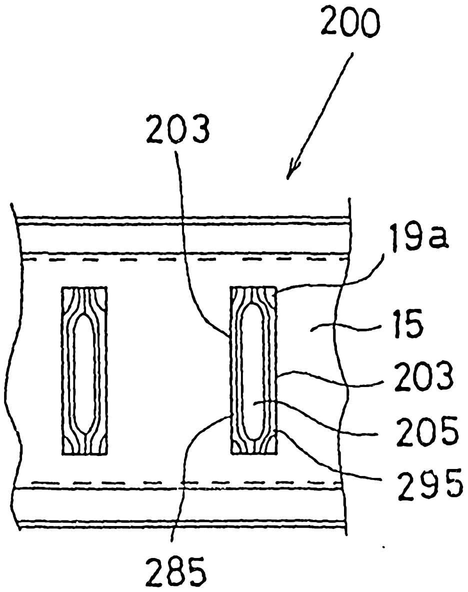

FIG.19

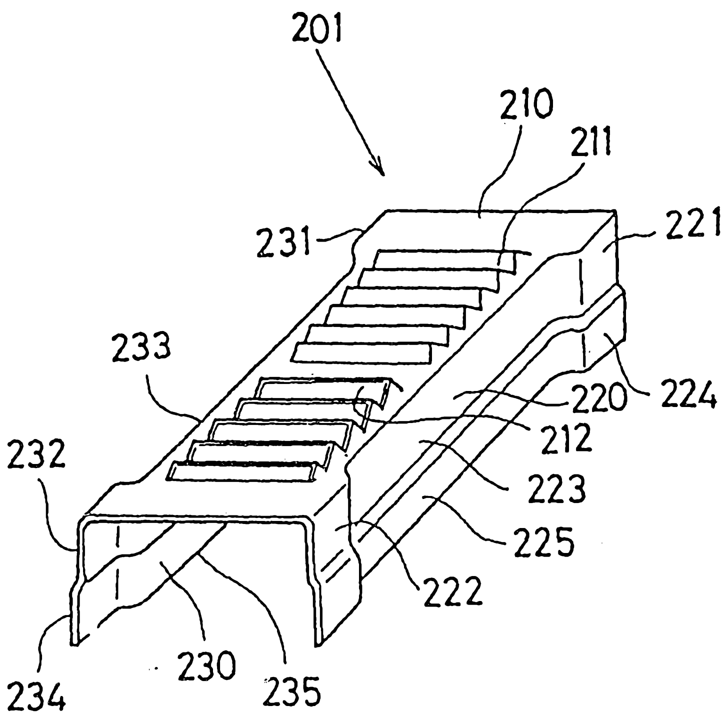

FIG.20

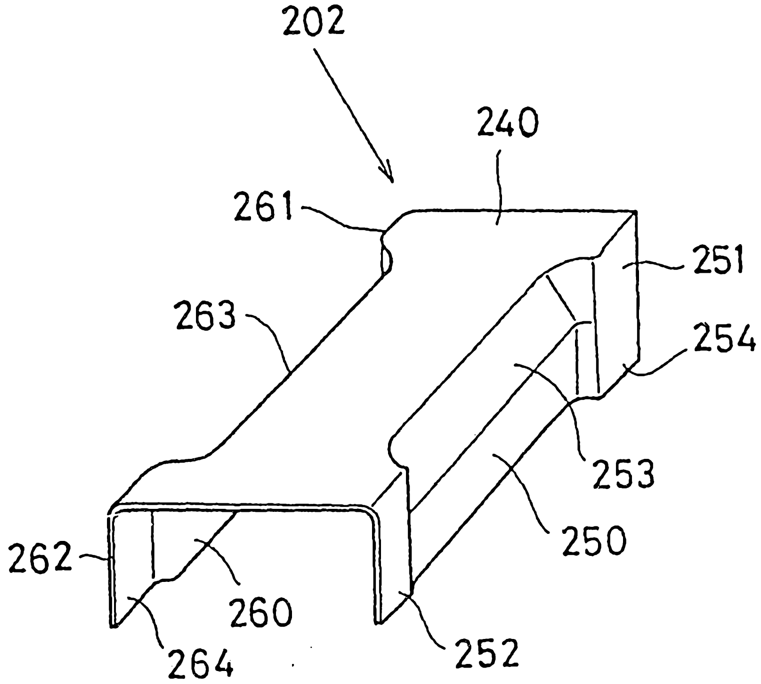

FIG.21

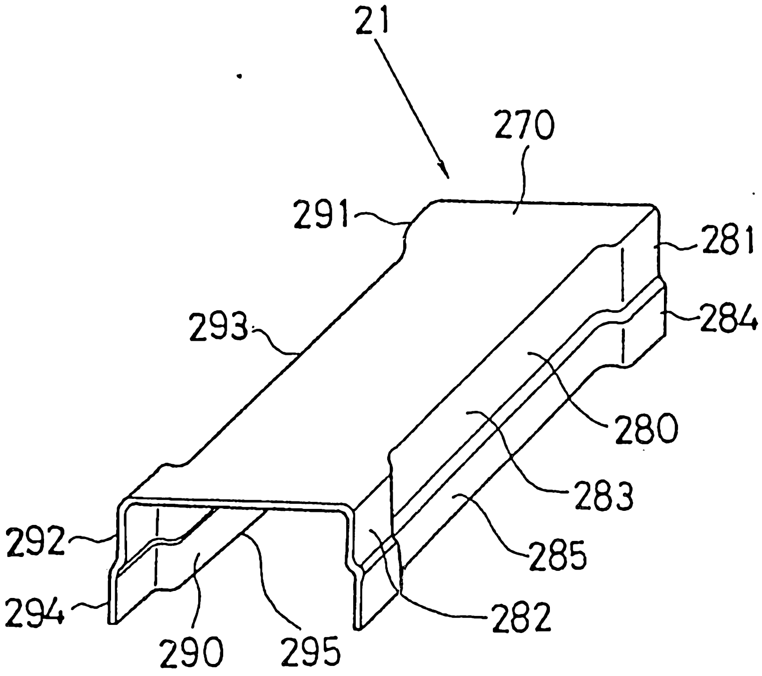

FIG.22

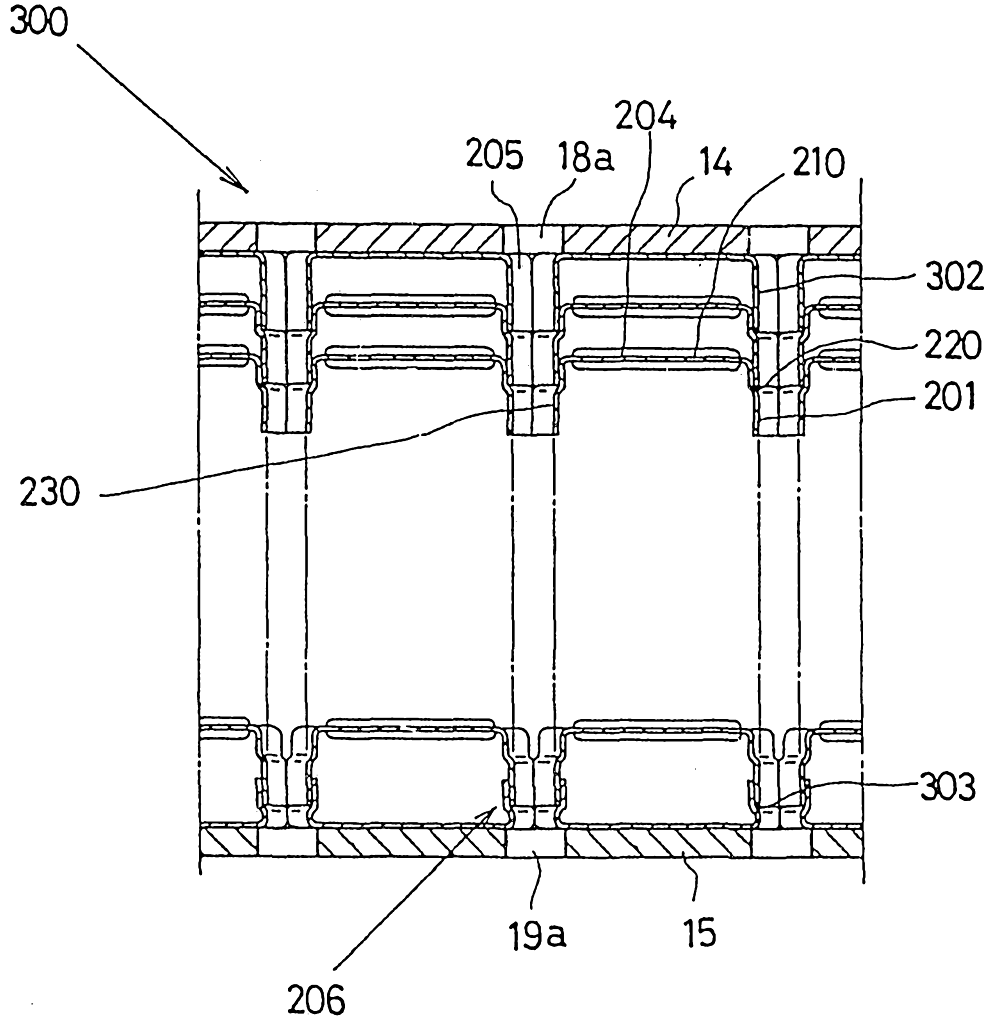

FIG.23

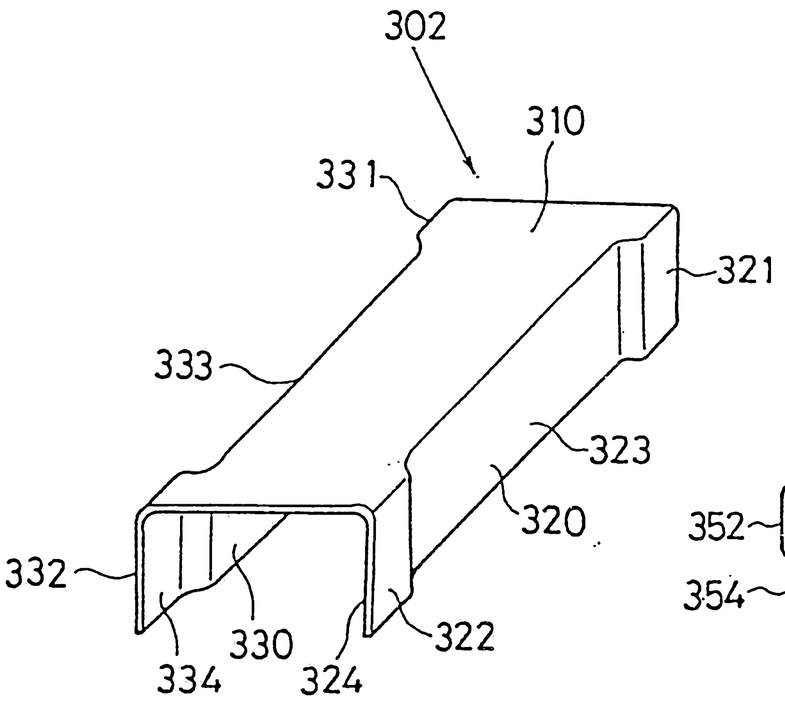
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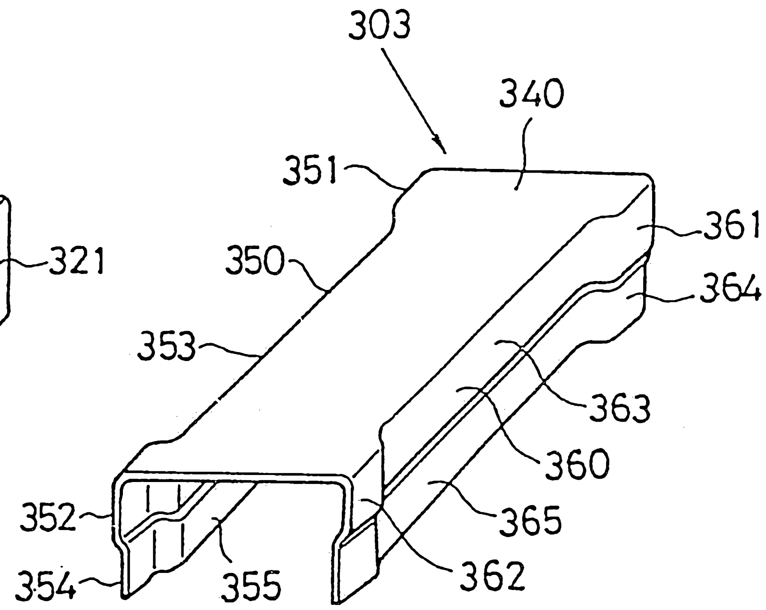
FIG.24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362

FIG.25

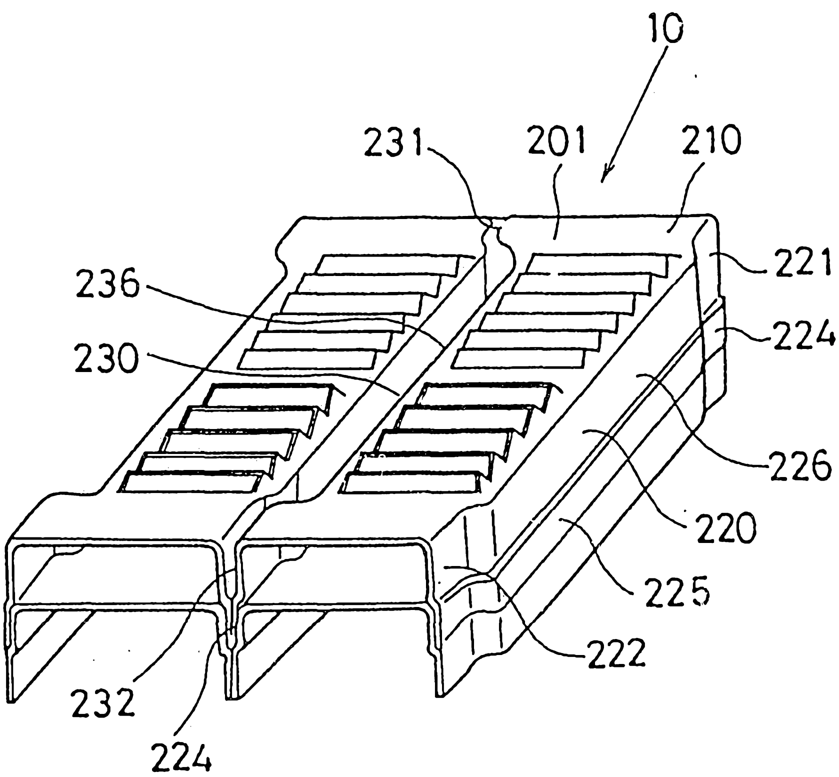


FIG.26

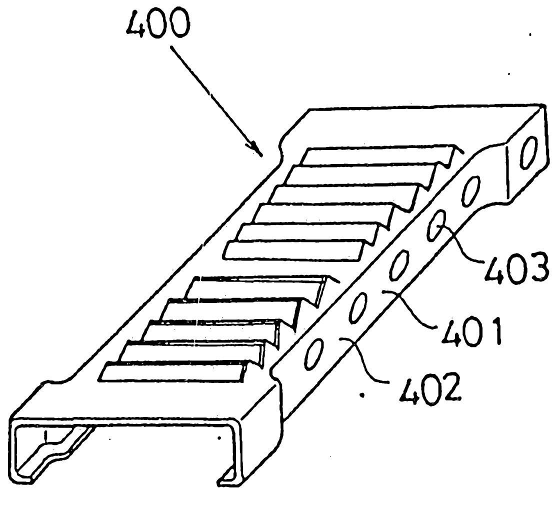


FIG.27

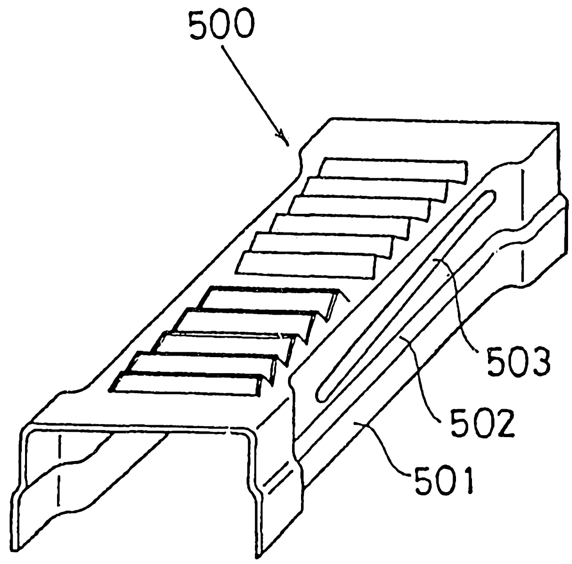


FIG.28

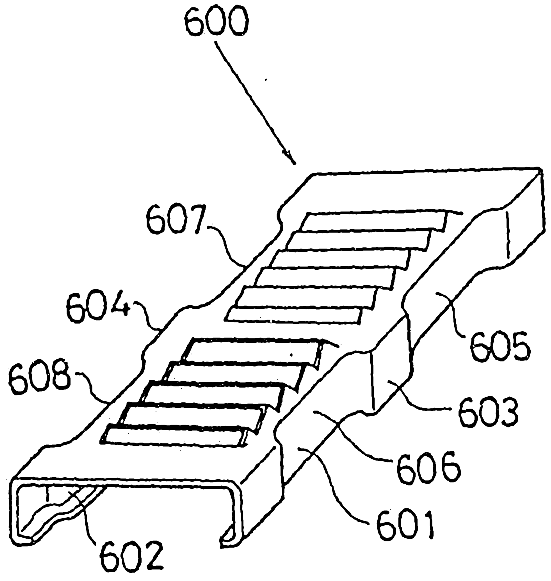


FIG.29

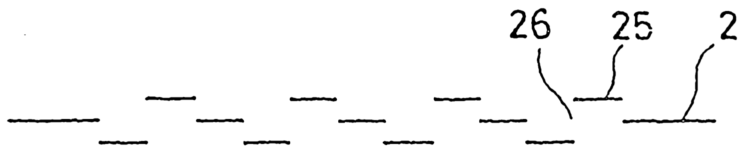


FIG.30

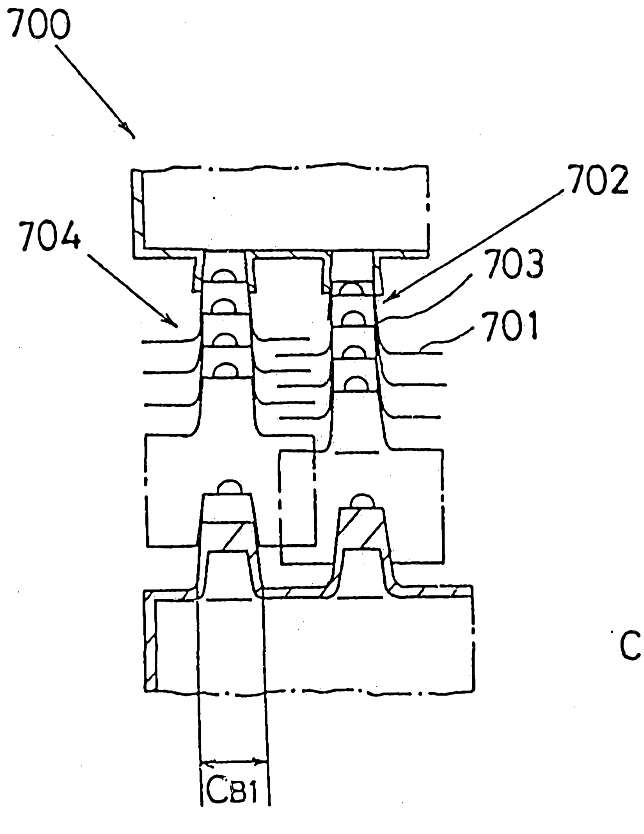
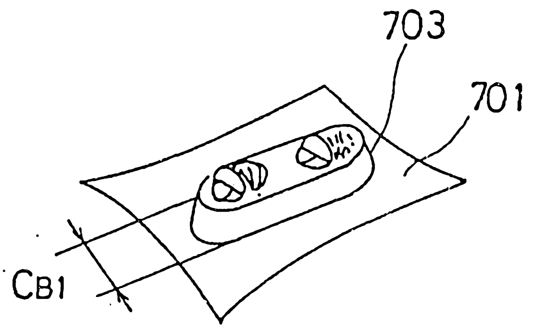


FIG.31



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP91/00985

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl[5] F28F3/08, F28D9/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	F28F3/00-3/10, F28D9/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho	1926 - 1990
Kokai Jitsuyo Shinan Koho	1971 - 1990

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [*]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	JP, U, 54-6664 (Nihon Radiator Co., Ltd.), January 17, 1979 (17. 01. 79), (Family: none)	3
A	JP, U, 63-159669 (Toyo Radiator Co., Ltd.), October 19, 1988 (19. 10. 88), (Family: none)	3
A	JP, A, 56-168093 (Hisaka Seisakusho, K.K.), December 24, 1981 (24. 12. 81), (Family: none)	4
A	JP, A, 56-121994 (Hitachi, Ltd.), September 25, 1981 (25. 09. 81), (Family: none)	1-6
A	JP, Y2, 56-150 (Matsushita Electric Ind. Co., Ltd.), January 6, 1981 (06. 01. 81), (Family: none)	1-6

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
September 26, 1991 (26. 09. 91)	October 14, 1991 (14. 10. 91)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	

国際調査報告

国際出願番号PCT/JP 91/00985

I．発明の属する分野の分類

国際特許分類（IPC）　Int. Cl⁵
F28F3/08, F28D9/00

II．国際調査を行った分野

調査を行った最小限資料	
分類体系	分類記号
IPC	F28F3/00－3/10，F28D9/00
最小限資料以外の資料で調査を行ったもの	
日本国実用新案公報	1926－1990年
日本国公開実用新案公報	1971－1990年

III．関連する技術に関する文献

引用文献のカテゴリー※	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	請求の範囲の番号
A	JP, U, 54－6664（日本ラヂエーター株式会社），17. 1月. 1979（17. 01. 79），（ファミリーなし）	3
A	JP, U, 63－159669（東洋ラジエーター株式会社），19. 10月. 1988（19. 10. 88），（ファミリーなし）	3
A	JP, A, 56－168093（株式会社　日阪製作所），24. 12月. 1981（24. 12. 81），（ファミリーなし）	4
A	JP, A, 56－121994（株式会社　日立製作所），25. 9月. 1981（25. 09. 81），（ファミリーなし）	1－6
A	JP, Y2, 56－150（松下電器産業株式会社），6. 1月. 1981（06. 01. 81），（ファミリーなし）	1－6

※引用文献のカテゴリー
「A」特に関連のある文献ではなく、一般的技術水準を示すもの
「E」先行文献ではあるが、国際出願日以後に公表されたもの
「L」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
「O」口頭による開示、使用、展示等に言及する文献
「P」国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
「T」国際出願日又は優先日の後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの
「X」特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの
「Y」特に関連のある文献であって、当該文献と他の1以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの
「&」同一パテントファミリーの文献

IV．認証

国際調査を完了した日　26. 09. 91	国際調査報告の発送日　14.10.91
国際調査機関　日本国特許庁（ISA/JP）	権限のある職員　3L 7153　特許庁審査官　細谷　繁