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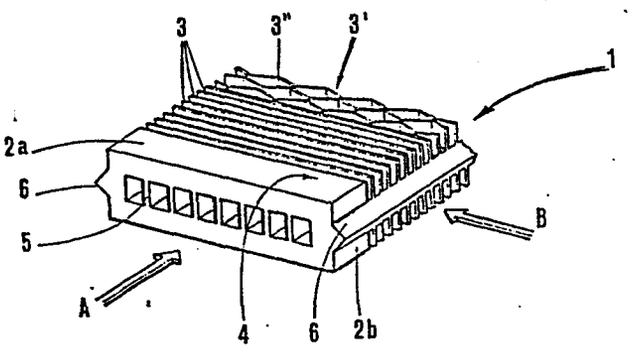
(54) Element for exchanging heat between fluids, and radiator constructed with the said heat exchange element.

(57) The invention belongs to the technical field of heat exchangers and relates, in particular, to an element for exchanging heat between two fluids of the same or of a different nature, and to a process for constructing the said heat exchange element.

The element according to the invention comprises a flat tubular element 1 and fins 3, the latter placed at least on the major sides 2a of the the former, directed crosswise to the direction in which the said element extends.

In the region of the extremities thereof, the said tubular element has parts 4 devoid of fins, the depth of which corresponds to the maximum height of the said fins 3.

FIG1



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Element for exchanging heat between fluids, and radiator constructed with the said heat exchange element

The invention relates to an element for exchanging heat between two fluids, and to a process for constructing the said heat exchange element.

Various types of exchangers are, as is known, marketed for exchanging heat between fluids, be they both liquids or mixed, for example oil and air. Many of these are constituted by simple tubular elements faced with fins and placed in rows.

The first fluid (liquid) flows through passages inside the said tubular elements, while the second (gas) hits the fins from the outside, the directions being on each occasion those most appropriate.

The said heat exchangers are neither relatively cheap nor simple to construct and are of a thermal efficiency that is not particularly high.

Heat exchangers exist that are formed by a number of blade elements side-by-side, in between which there are hollow spaces through which the various fluids can flow. In particular, blade elements can be provided that define narrow passages for the liquid and wider passages for the gas. The said blade elements are supported by internal raised parts fashioned in the form of frets which, apart from a mechanical action of resistance to pressure, have the task of increasing the contact or exchange surfaces.

The thermal efficiency of heat exchangers of this type is particularly high but the costs are considerable, mainly on account of the need to couple a plurality of semi-finished parts or elements. The said semi-finished parts, in fact, have to be assembled and then welded together.

In other cases still, such as for example in U.S. Patent 3,746,086, the heat exchange element is constituted by an extruded section on which the fins are made with the aid of special tools movable parallel to the axis of the section.

With all these solutions there is, however, difficulty of a practical nature in constructing radiators and this is because of the technical problems involved in joining together a number of exchange elements : the rendering integral of these is, in fact, accomplished with difficulty in the region of extremity manifolds due to the particular way in which the said unitary basic elements are designed and made.

One important object of the invention that falls within the framework of the technical task it is wished to fulfil, is to devise both an exchange element of a universal type, such, that is to say, as to allow radiators, however dimensioned, to be constructed without difficulty, and a process for constructing the said exchange element.

Another object of the invention is to devise an exchange element by means of which a complete radiator can be formed simply and economically.

The aforementioned objects and fulfilment of the said technical task are achieved with the element according to the invention for exchanging heat between fluids, comprising a tubular element in which a said first fluid is made to flow, and a plurality of fins integral with the said tubular element, and characterized by the fact that the said tubular element is flat, that the said fins are placed at least on the major sides thereof, turned crosswise to the direction in which the said element extends, and that in the region of the extremities thereof, the said tubular element has parts devoid of fins, the depth of which corresponds to the maximum height of the said fins.

Further characteristics and advantages will emerge more amply from the description of a preferred but not sole embodiment for the invention, illustrated purely as an unlimited example on the accompanying drawing, in which :

- Figure 1 shows, in a perspective view, one extremity of an exchange element according to the invention;
- Figure 2 shows, in a lateral view, the said exchange element;
- Figure 3 shows, in an upright projection, a radiator formed by a plurality of exchange elements of the type depicted in Figures 1 and 2.

With reference to the above listed figures, shown globally at 1 is an exchange element according to the invention, defined virtually, in a way in itself known, by a tubular element provided externally with fins integral there with.

The invention advantageously envisages the tubular element

being flat in such a way as to define two major sides 2a and two minor sides 2b, the former provided with the said fins 3 turned, advantageously, crosswise to the main direction of extension of the exchange element 1. Furthermore, the fins 3 are made in one piece with the tubular element.

Note should be taken of the fact that one characteristic of the invention envisages the fins 3 being provided solely in the region of a very spacious central area of the tubular element. At points corresponding to the extremities of the tubular element, there are finless parts 4 whose depth corresponds to the maximum height of the fins 3.

Each tubular element is provided internally with ribs 5 that extend parallel to the main extension direction thereof. The pattern of the fins 3 can be rectilineal, as shown in the front part of Figure 1 or, optionally, to suit the heat exchange and coolant requirements, rhomboidal 3' with vertices 3" in opposite contact with one another, or sinusoidal with all the fins parallel one with the other : the purpose being to increase the turbulence of the fluid that hits the fins 3.

In Figures 1 and 2 it can also be seen that the minor sides 2b of the tubular element are provided with wedge shaped projections 6 that are diametrically opposed one with respect to the other.

As regards the construction of the element, two fundamental phases are envisaged for the process according to the invention.

In a first phase, the flat tubular element is formed by extrusion in a way whereby walls of a relative or even considerable thickness are fashioned, especially in the region of the major sides 2a. Furthermore, directly with the extrusion are advantageously formed the ribs 5 that subdivide the passage inside the tubular element and whose task is that of strengthening the said passage and of increasing the heat exchange surface.

A further characteristic of the tubular element is shown in Figure 1, namely, the wedge shaped projections 6, the purpose of which is to act as baffle plates for the flow of, for example, air, are formed in the region of the minor sides 2b again directly at the time of extrusion.

In a second phase, shown in Figure 2, the flat tubular element is cut in the region of the walls that define the major sides 2a. The cutting operation is performed crosswise to the main extension direction of the tubular element by means of a tool 7 having multiple cutting edges 8. Thus fins 3 that are parallel one with the other and extend over a substantial part of the gauge of the walls of the tubular element, are formed. The whole tubular element is then cut into lengths corresponding to the size it is wished the heat exchangers to be and, furthermore, the extreme parts 4 are advantageously excluded from the cutting operation, so as to create terminal blocks that facilitate the connection of one heat exchanger to another.

By way of an alternative to the parallel fin method, the said second phase in the formation of the exchange element can be followed by a third phase in which the fins are al-

tered in shape, as shown with a broken line in Figure 2, through the use of a jig M provided with a plurality of deforming projections D, for example taper pins, which by penetrating between one fin and the adjoining one, cause the desired alteration in shape to take place. The said jig can be of the type that is flat and thus operates perpendicularly on a predetermined area occupied by the fins 3, or of the type that is cylindrical and thus operates tangentially to the exchange element, as shown diagrammatically in Figure 2 : in this case the alteration in shape solely in the top part of the fins 3' enables the fluid to have a certain turbulence, even when the rate of flow is high.

Figure 3 shows, in particular, a radiator 20 comprising a plurality of exchange elements 1 stacked in a direction perpendicular to the major sides 2a thereof. The various exchange elements 1 that form the radiator 20 are joined one to the other in the region of the contact surfaces constituted by the finless parts 4 : alternatively, a partition 25 can be interposed between one element and another. The bonding can be effected simply by means of a weld S, utilizing, for example, an arc welder.

To conclude, it is envisaged that the extremities of the exchange elements 1 be connected to end manifolds 12 provided, for example, with separation elements 9, an inlet 10 and an outlet 11.

The operation of the exchange element 1 described above in a prevalently structural sense, is quite obvious, as is also the operation and assembly of the radiator 20. The first fluid, for example liquid to be cooled, flows from A

through the passage inside the tubular element between the ribs 5.

On one hand, the latter augment the heat exchange surface of the exchange element; on the other, they strengthen the said element and prevent crushing or swelling.

The second fluid, commonly air, flows perpendicularly to the direction of the liquid, from B, and goes between the fins 3 causing, thanks to the overall dimension and to the conformation of these, an efficient heat exchange.

It is of fundamental importance to note that because of the finless parts 4 in the region of the extremities of the tubular element, the presence of the fins 3 in no way hampers the bonding of the said tubular element to other similar tubular elements. The parts 4 can be arranged directly in columns and be welded one to the other, as shown in Figure 3, to form a multi-element radiator.

Likewise the arrangement is immediate of end terminals 12 that guide the flow of the first fluid, for example oil, compressed air, or some other fluid, to where the passages inside the tubular elements 1 are located. Advantageously, the said end manifolds 12 increase the overall solidity of the radiator and can be fitted with a simple welding operation.

Thus the invention achieves the proposed objects. Practical tests have shown the exchange element formed to be highly functional and, in particular, to have excellent heat exchange ability. This ability is obtained with a structure

in itself particularly simple and, above all, easily utilizable for forming radiators of any capacity, depending on the dimensions and number of exchange elements used.

The invention as outlined above is liable to undergo numerous modifications and variants, all of which falling within the conceptual framework thereof.

Furthermore, all parts may be substituted with others technically equivalent.

In practice, the materials used and the shapes and sizes of these can be any according to the requirements.

Claims :

1. Element for exchanging heat between fluids, comprising a flat tubular element 1 in which a said first fluid is made to flow, and a plurality of fins 3 integral with the said tubular element, and characterized by the fact that the said fins 3 are placed on the major sides 2a of the said flat tubular element, turned crosswise to the direction in which the said element extends, over the full width of this, and that, in the region of the extremities thereof, the said tubular element has parts 4 devoid of fins, the depth of which corresponds to the maximum height of the said fins.

2. Exchange element according to Claim 1, characterized by the fact that the minor sides 2b of the said tubular element are provided with diametrically opposed wedge shaped projections 6 designed to serve as lips for a flow of a said second fluid.

3. Exchange element according to Claim 1, characterized by the fact that the said fins 3' extend crosswise in an undulated or sinusoidal arrangement.

4. Radiator characterized by the fact of comprising a plurality of exchange elements 1 formed in accordance with one or more of the preceding claims and arranged stacked in a direction perpendicular to the main finned sides 2a thereof.

5. Radiator according to Claim 3, characterized by the fact that the said exchange elements 1 are joined one to the other

in the region of the said finless parts 4.

6. Radiator according to Claim 5, characterized by the fact that the said finless parts 4 are externally connected to outside end manifolds 12.

7. Radiator according to Claim 4, characterized by the fact that a metal material partition is placed between two superposed exchange elements 1.

8. Process for constructing a heat exchanger defined by a finned tubular element, characterized by the fact of consisting in : forming a flat, thick wall, tubular element 1 that is cut into lengths corresponding to the size it is wished the heat exchangers to be, and fashioning, in the region of the main sides 2a of the said flat tubular element, fins 3 with the use of tools 7 having multiple cutting edges 8 parallel one with the other and movable in a direction crosswise to the maximum dimension thereof.

9. Process according to Claim 6, characterized by the fact that the said tubular element is cut in the region of the central part thereof, over the full width except for the extreme parts thereof.

10. Process according to Claim 8, characterized by the fact that after the crosswise cutting phase, a further phase is envisaged for discontinuously altering the shape of the peripheral part of the fins 3' through the penetration, at a number of points, of a jig M provided with a plurality of deforming projections D.

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FIG1

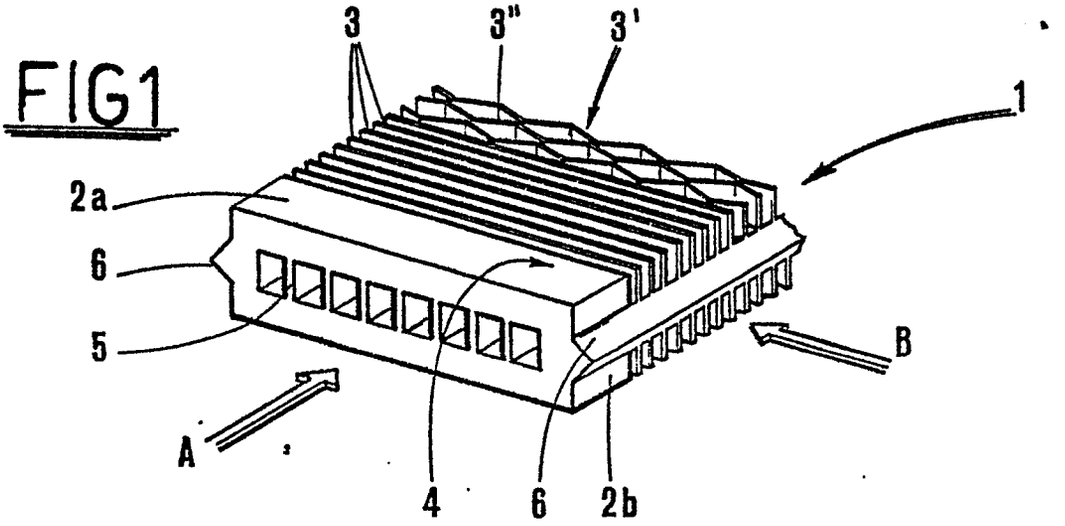
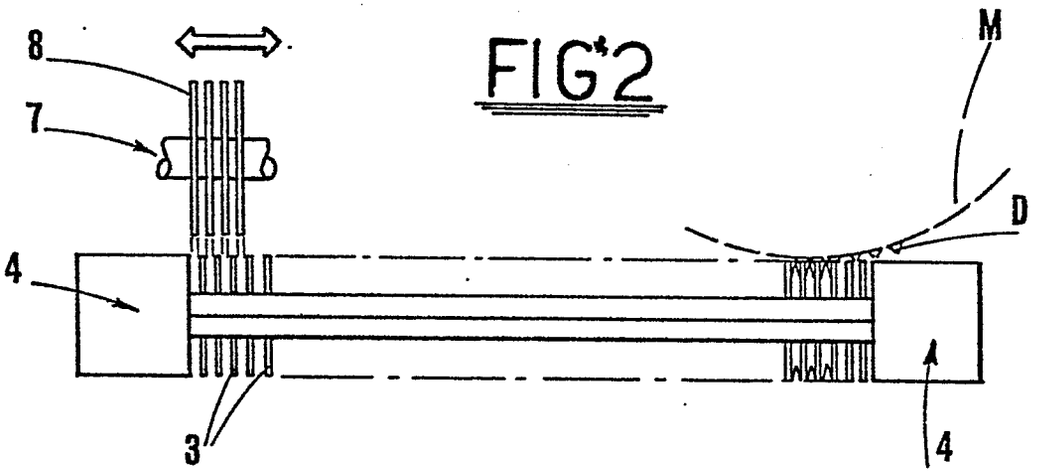


FIG2



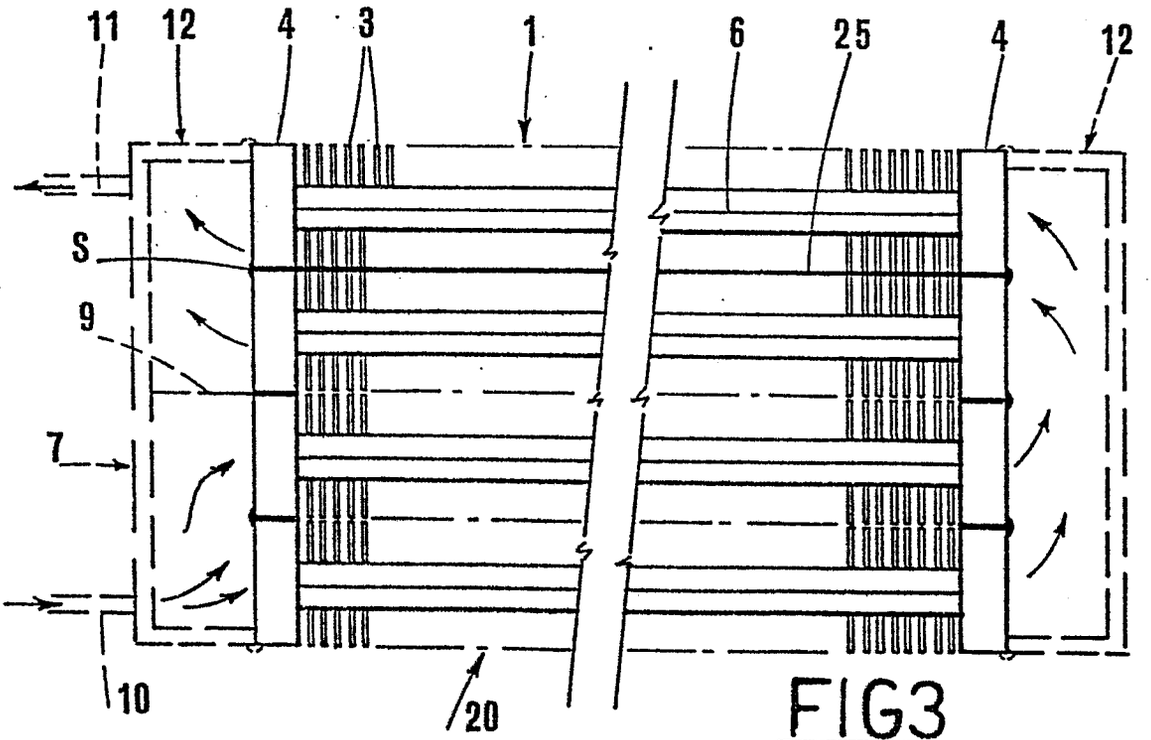


FIG3