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(54) Heat exchanger pack

(57) The heat exchanger pack with a tube fitted in the heat exchange zone, the tube composed of a number of horizontal pipe sections (2), the ends of which are anchored in the fixing cover plates (3), all pipes interconnected one after another from the inlet to the outlet of the heated agent flowing in the tube is characterised in that the pipe sections (2) are fitted inside profiled segments (1) with slots (4) in between them forming ducts for the flow of the heated agent.

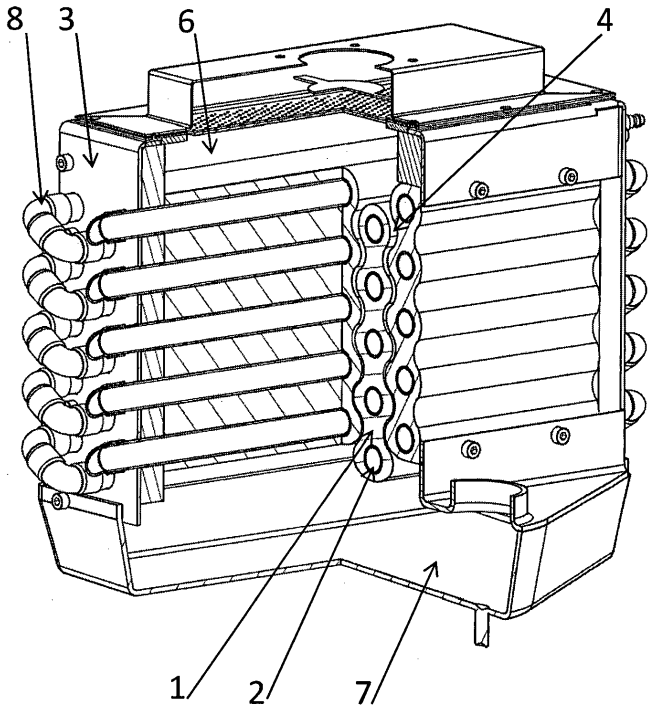

Fig. 1

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Description

[0001] The invention concerns a heat exchanger pack. It is intended for direct flame heat exchangers, particularly direct flame, continuous flow heat exchangers used to heat water.

[0002] Known are different structural solutions applied in continuous flow heat exchangers, in which the heated water flows in a tube from the inlet to the outlet, and the tube is washed by hot fumes generated in the combustion chamber fitted above. The tube may take different shapes, e.g. spiral or helical. Known are solutions where the tube consists of a number of interconnected straight pipe sections. The tubes may have different cross-sections, they may also be corrugated on the surface or have other additional elements improving heat exchange. Known too, are solutions where the elements in which the heated agent flows form a tube pack fitted in between the connecting elements. The pack can, in particular, be composed of straight, horizontal, mutually parallel pipe sections interconnected at the ends with elbows anchored in fixing cover plates from inlet to the outlet of the heated water. Hot gases flow around the pipe sections down from the combustion chamber installed above the pack.

[0003] Known from the European patent application published under No. EP 1983272 is a direct flame heat exchanger pack consisting of a number of parallel moulded profiles with inner partitions which form horizontal flow ducts inside the profiles. In between those parallel profiles there are vertical slots formed for the flow of another agent participating in heat exchange.

[0004] Also known from the European patent application published under No. EP 2080961 is a boiler with cast elements for the exchange of heat between hot fumes generated in the combustion chamber and the heated water. Inside the profiles, the boiler is fitted with a circular water conduit encircling the combustion chamber and vertical water conduits fitted between the circular conduit and the bottom hub. In between the vertical water conduits there are vertical ducts formed for the flow of hot gases.

[0005] The disadvantage of the known solutions, especially of the potable water heaters, is that the same pipe conduit in which the water flows is exposed to the impact of flame and combustion gasses on its other surface, which makes it difficult to select the material the pipe can be made of.

[0006] The purpose of this invention is to attain the best possible parameters of the heated water on the one hand, and extend failure-free life of the exchanger on the other hand.

[0007] The purpose has been attained through using profiled segments with water pipes fitted inside.

[0008] The heat exchanger pack with a tube fitted in the heat exchange zone, the tube composed of a number of horizontal pipe sections, the ends of which are anchored in fixing cover plates, all pipes interconnected one after another from the inlet to the outlet of the heated agent flowing in the tube is, according to the invention, **characterised in that** the pipe sections are fitted inside the profiled segments with slots formed between them forming ducts for the flow of the heated agent.

[0009] The pipe sections of the pack are connected to the segments so as to ensure full contact along the entire surface.

[0010] Each segment takes the form of a solid vertical panel with pipe sections running in horizontal ducts fitted inside.

[0011] The segment side walls are profiled to any preferred shape enclosing the pipe segments.

[0012] Preferably, the profile of one of the segment side walls is a mirror reflection of the opposite side wall profile.

[0013] Preferably, the segments run parallel to one another in such a way that the bulging sections of their side walls lie opposite the concave sections of the adjacent segments.

[0014] In one of the variants the side walls are profiled in a sinusoid.

[0015] In another variant, the side walls are profiled in semicircles connected with straight sections.

[0016] In yet another variant, the side walls are shaped in a broken line profile of identical perpendicular sections.

[0017] In one embodiment, the outer segments of the pack are taller than the ones in between them, thus forming an integrated combustion chamber above the mid segments and within the outer segments.

[0018] In another embodiment all segments are of the same height.

[0019] Most preferably, the segments are made of aluminium, and the pipe sections of copper.

[0020] The advantage of the solution according to the invention is that the structure of the exchange pack where the flowing usable water contacts different material than the fume gases which heat the water, which extends the life of the exchanger while keeping the water parameters high.

[0021] Exemplary embodiments of the invention are presented on the drawing, where Fig. 1 shows the pack in the heat exchanger with a separate combustion chamber in axonometric projection and partial cross-section,

[0022] Fig. 2 shows the pack in the heat exchanger with an integrated combustion chamber in axonometric projection and partial cross-section, Fig. 3 - a variant of the shape of the profiled segments fit for the heat exchanger with a separate combustion chamber, Figures 4, 5, 6, and 7 present different exemplary shapes of profiled segments fit for the heat exchanger with an integrated combustion chamber.

[0023] In the exemplary embodiment, the pack is composed of a number of vertical segments 1, each segment containing horizontal pipe sections 2 circular in cross-section arranged one above another in horizontal ducts. Each segment 1 takes the form of a solid aluminium panel, while the pipe sections 2 are made of copper

and are mechanically connected to the segment so that full contact is ensured between the pipe surface and the surface of the ducts inside the segment. The segments 1 are arranged parallel to one another between the fixing cover plates 3. The profiles of the segment 1 side walls may have different shapes in different embodiments, for instance the shape of a sinusoid, as shown on Fig. 1, Fig. 2, Fig. 4, the shape of a broken line of identical perpendicular sections, as shown on Fig. 5, or a line formed of semicircles connected with straight sections, as shown on Fig. 7. Moreover, the profile of the segment side wall may not be the same along the entire height of the panel, as shown on Fig. 6. In the presented exemplary embodiments the shape of the profile of one side wall of the segment 1 is a mirror reflection of the profile of its opposite side wall, and the segments are arranged next to one another in such a way that the bulging sections of each segment profile lie opposite the concave profile sections of the adjacent segment, and the vertical slots 4 in between them form the flow ducts for the fume gases heating the water flowing in the pipe sections 2. In one of the variants of the pack embodiment all segments 1 are of equal height and are positioned so that they form a cuboid, as shown on Fig. 1 and Fig. 3. In other embodiment variants illustrated on Fig. 2, Fig. 4, Fig. 5, Fig. 6, and Fig. 7 the outer segments 1a extend higher than the mid segments 1b of the pack, and the space above the mid segments and in within the side segments forms an integrated combustion chamber 5. The segments 1 may be of equal height, as in Fig. 1, Fig. 3, Fig. 7, or different in height, as in Fig. 2, Fig. 4, Fig. 5, Fig. 6. In the embodiment shown on Fig. 1 the heat exchanger is composed of a pack of segments 1 closed on both sides with fixing cover plates 3, with a separate combustion chamber 6 installed above and a condensate bowl 7 installed below. Individual horizontal pipe sections 2 are interconnected with pipe elbows 8 on the outer side of the fixing cover plates 3, from the water inlet at the bottom of the pack to the water outlet at the pack top. In yet another embodiment, as shown on Fig. 2, the ends of the pipe sections 2 are interconnected with appropriate ducts inside the fixing cover plates, thus forming connections of the manifold type, and the heat exchanger the combustion chamber 5 integrated within the pack. In the embodiment shown on Fig. 1 the heat exchanger pack is composed of five segments 1 and is 166 mm high, 240 mm long, and 128 mm wide. In each segment 1 there are five identical pipe sections 2, 13 mm in diameter, fitted one above another, and the vertical slots 4 in between the segments 1 forming ducts for the flow of fumes are 1 mm - 4.5 mm wide. There may be any preferred number of pipe sections in the segment, depending on the assumed volume of heat exchange between the segment and the pipes, provided that the temperature of water at the exchanger outlet and the time it takes to obtain it depend on the number of pipes in the segment and the length of the segments containing the pipe sections.

[0024] Thanks to the use of segments washed by gas fumes and pipe sections fitted inside the segments where the heated water flows it is possible to use different materials for the segments and pipes, each material appropriate for one of the heat exchange agents and at the same time none of the materials being directly exposed to the other agent, that is flame or water. The material selected as optimal for the pipes in which potable water flows is copper; however copper should not be exposed directly to contact with fume gases. The material selected for the segments is aluminium, which demonstrates very good heat transmission parameters but should not be in contact with potable water for any longer time because of fast oxidation.

[0025] The examples described above do not exhaust the list of possible embodiment variants of the solution sharing the features of the presented invention.

Claims

1. The heat exchanger pack with a tube fitted in the heat exchange zone, composed of a number of horizontal pipe sections (2), the ends of which are anchored in fixing cover plates (3), all pipes interconnected one after another from the inlet to the outlet of the heated agent flowing in the tube, **characterised in that** the pipe sections (2) are fitted inside the profiled segments (1) with slots (4) in between them forming ducts for the flow of the heated agent.

2. The pack according to Claim 1, **characterised in that** the pipe sections (2) are connected to the segments (1) so that full contact is ensured along the entire surface.

3. The pack according to Claim 2, **characterised in that** each segment (1) takes the form of a solid vertical panel with pipe sections (2) arranged in horizontal ducts inside.

4. The pack according to Claim 3, **characterised in that** the side walls of the segments (1) are profiled to any preferred shape enclosing the pipe sections (2).

5. The pack according to Claim 4, **characterised in that** the profile of one of the segment (1) side walls is a mirror reflection of the opposite side wall profile.

6. The pack according to Claim 5, **characterised in that** the segments (1) run parallel to one another so that the bulging sections of their side walls lie opposite the concave sections of the adjacent segments (1).

7. The pack according to Claim 6, **characterised in that** the side walls are profiled in a sinusoid.

8. The pack according to Claim 6, **characterised in that** the side walls are profiled in semicircles connected with straight sections.

9. The pack according to Claim 6, **characterised in that** the side walls are shaped in a broken line profile of identical perpendicular sections.

10. The pack according to Claims 1 to 9, **characterised in that** the outer segments (1a) of the pack are taller than the ones in between them (1b), thus forming an integrated combustion chamber (5) above the mid segments (1b) and within the outer segments (1a).

11. The pack according to Claims 1 to 9, **characterised in that** all segments (1) are of the same height.

12. The pack according to Claims 1 to 11, **characterised in that** the segments (1) are made of aluminium, and the pipe sections (2) are made of copper.

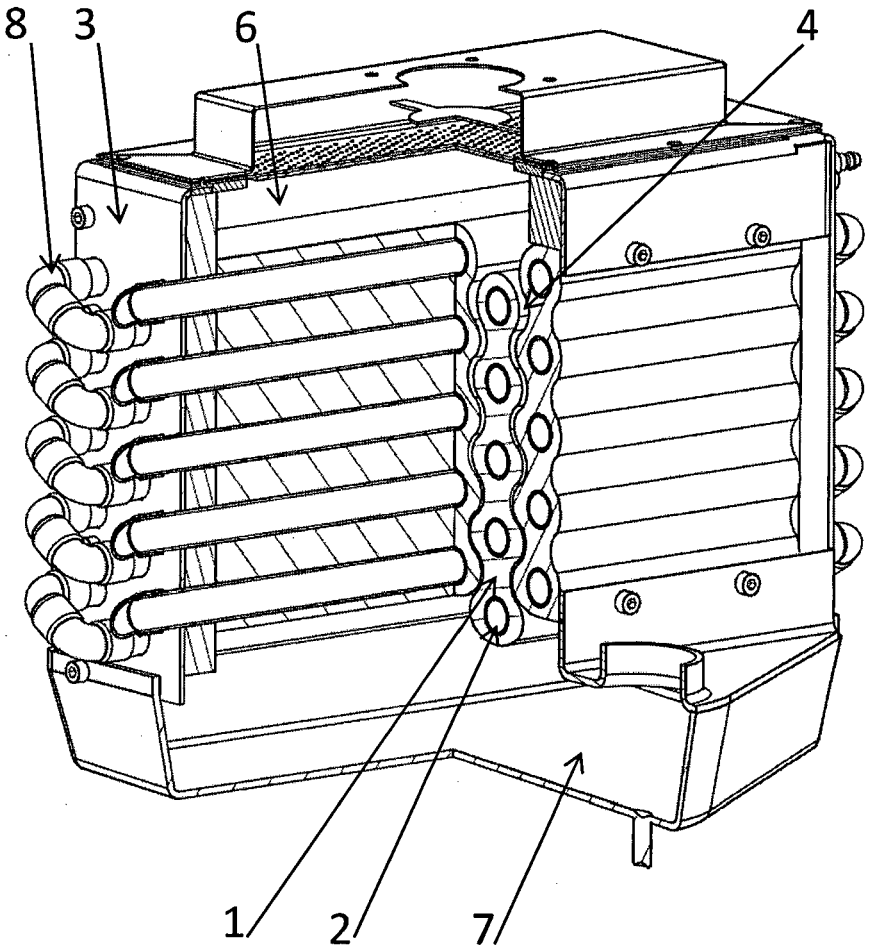

Fig. 1

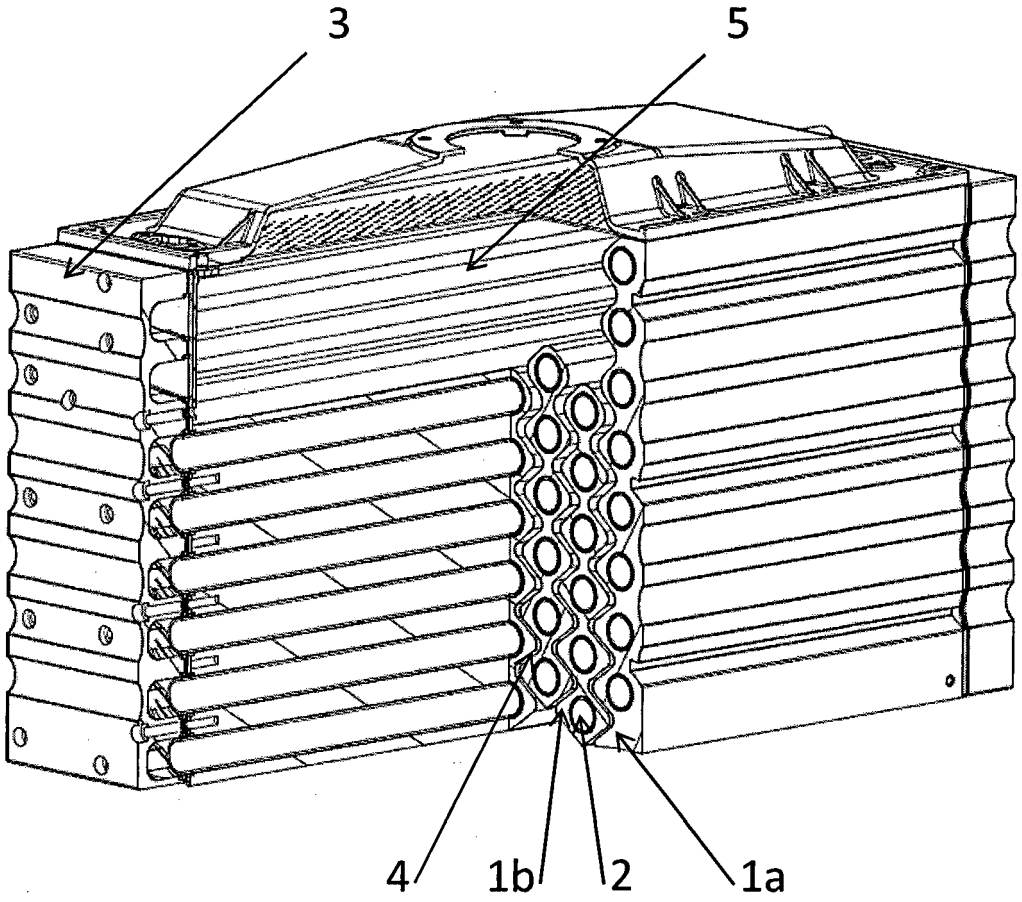

Fig. 2

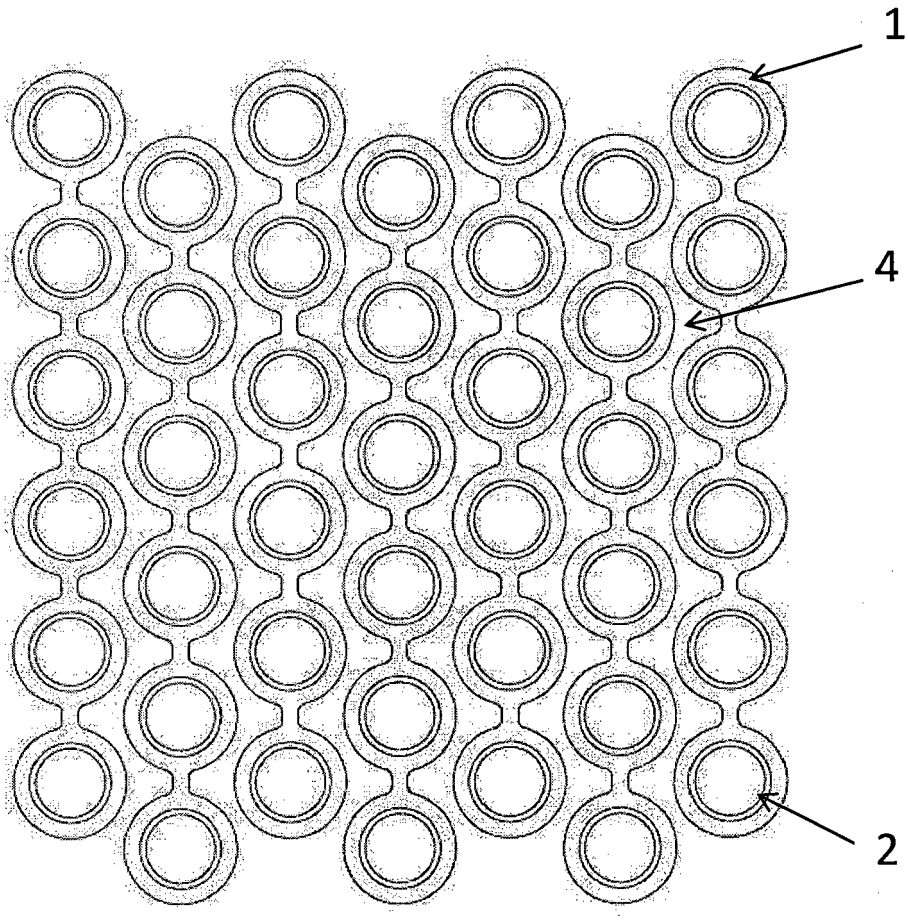

Fig.3

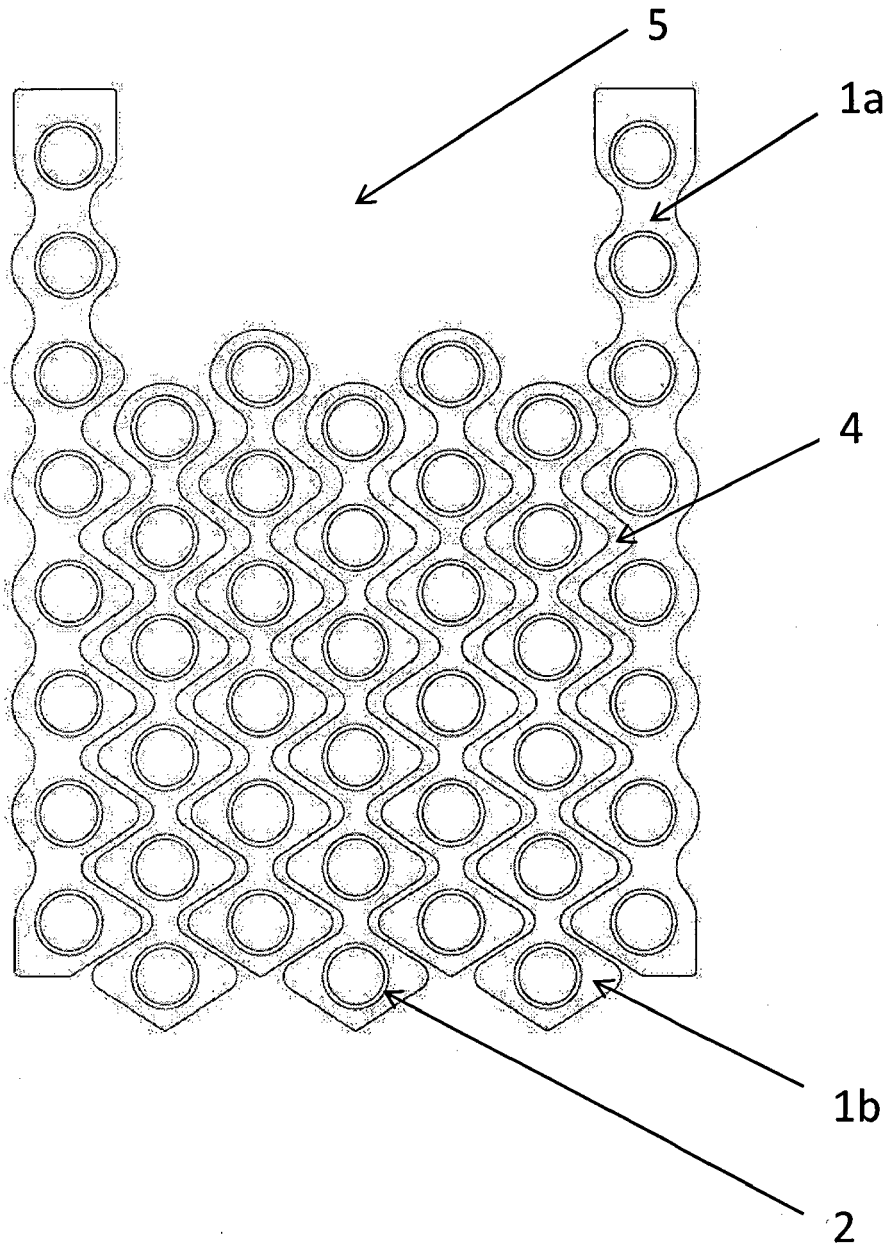

Fig.4

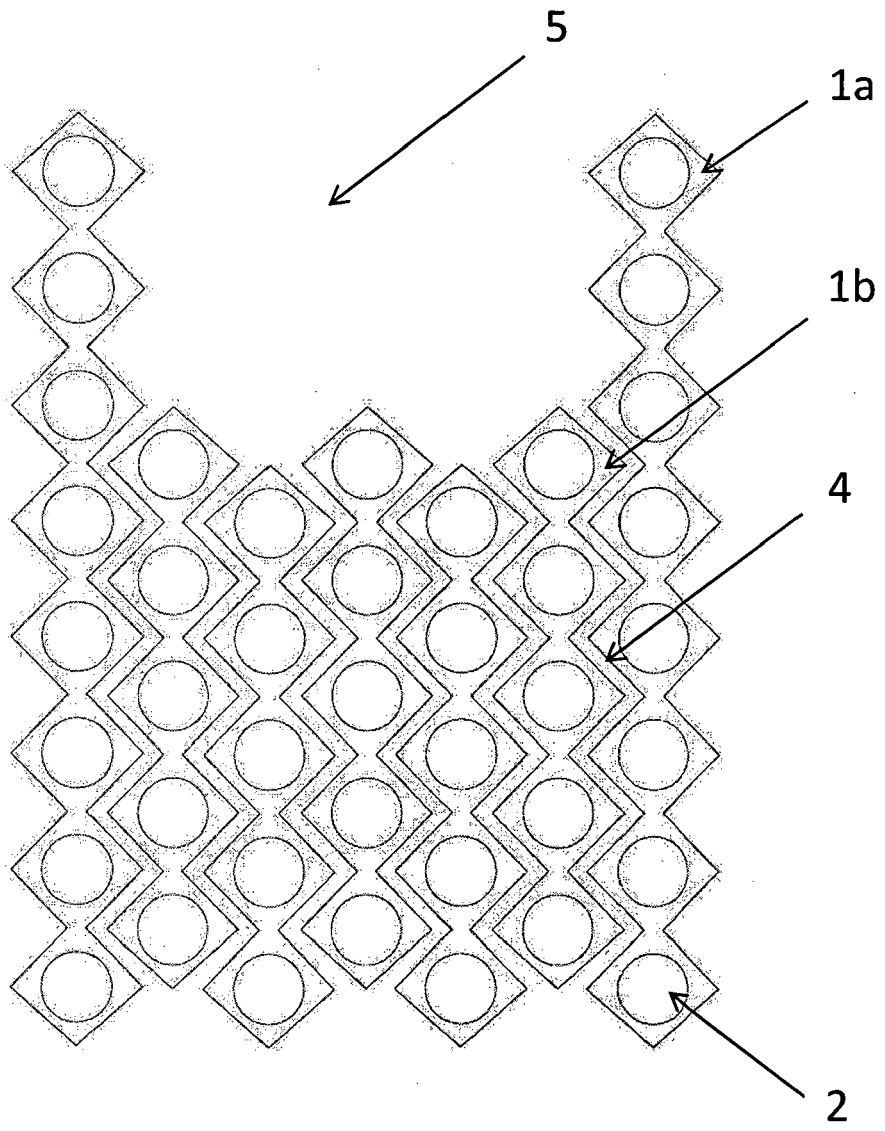

Fig.5

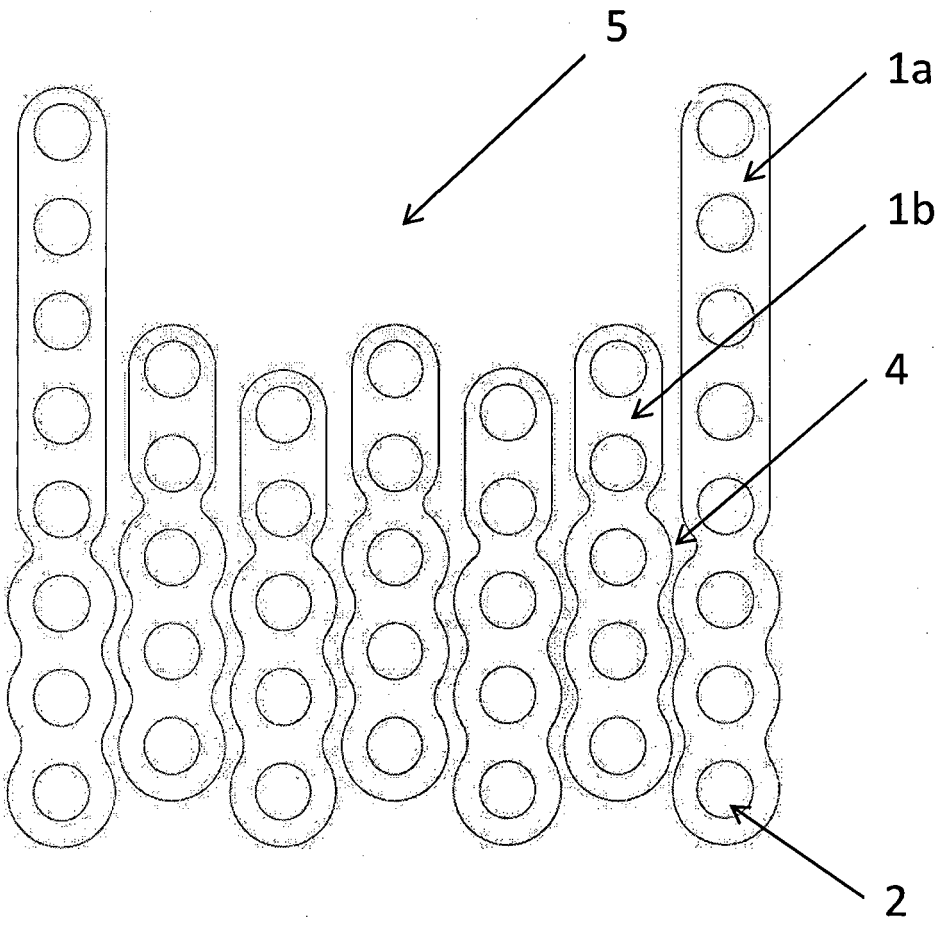

Fig.6

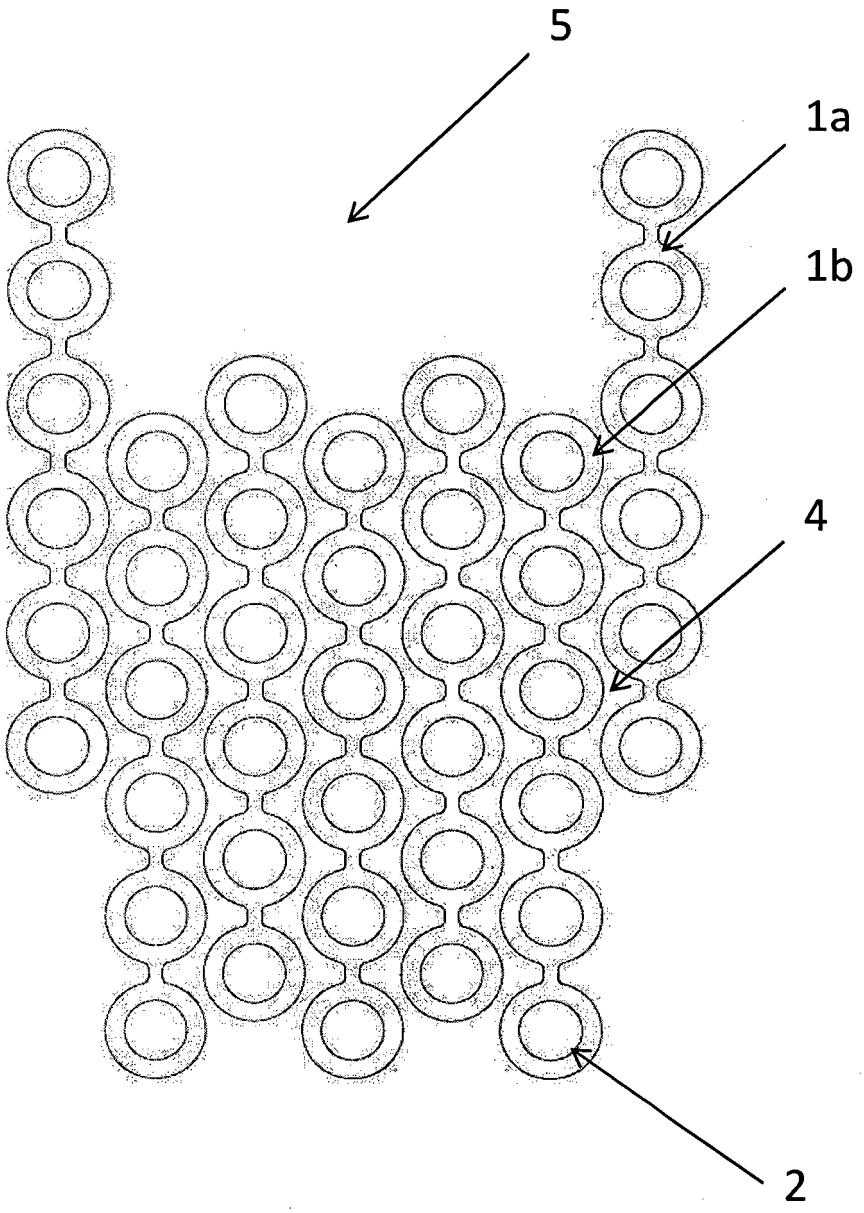

Fig.7

REFERENCES CITED IN THE DESCRIPTION

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- EP 1983272 A **[0003]**
- EP 2080961 A **[0004]**