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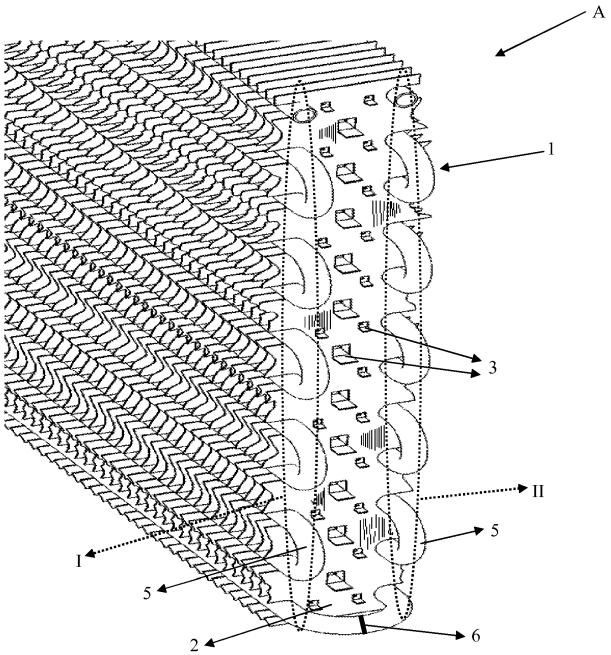
(54) **Evaporator unit**

(57) The evaporator unit (A) of the invention developed for cooler-type white goods comprises an evaporator tube (1) consisting of two lines (I, II) each of which continue with sequential bends (5); plate-shaped fins (2) that are arranged on the evaporator tube (1) in succession. The unit (A) is **characterized in that** each line (I, II) of the tube (1) is within itself while all the parts are sequentially on the same virtual plane (D); and in that there are protrusions (3) on each fin (2) which keep the fins (2) at parallel regular intervals with respect to each other and which are used for heat transfer; and in that there are a great number of slots (4) at the both sides of the each fin (2) plate into which tube lines can laterally enter.



Figure– 2

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Description

Technical Field

[0001] This invention relates to the evaporator units used in cooler-type white goods.

Prior Art

[0002] Evaporator units are the systems provided in cooler-type white goods and used during heat exchange thereof with the internal environment. Refrigerant gas is passed through the bent tubes of the evaporator units; the heat received from the cooling chamber of the white goods is transferred to the refrigerant gas by means of the fins that are in contact with the tube. For this reason, the cold gas entering into the evaporator unit gets warm after it leaves the unit. In order to increase the amount of heat transfer in evaporator units used particularly in such white goods as refrigerators, deep freezers and air conditioner internal units, a great number of fins (heat transfer plate) is used on the bent tubes.

[0003] The tube and fin material are made of aluminium and copper, the heat transmission coefficient of which are generally high. However, the high-cost of these materials is unfavorable for the manufacturers. Additionally, the bent tubes made of these materials are formed in cross (zigzag) sequential bends. For instance, in the published patent documents no US4580623 and US6591627, cross sequentially formed evaporator tubes are shown. However, bending the evaporator tubes into zigzag shape and attaching fins thereon require difficult and costly production methods.

Brief Description of the Invention

[0004] In the evaporator unit of the present invention however, it is ensured that the materials, such as steel, which have lower heat transmission coefficient in comparison with aluminium and copper are also used. However, by the use of steel-type materials, the desired cooling effectiveness must be ensured without any loss in the amount of heat transfer. Therefore, an evaporator unit (A) which is both structurally and in terms of the material used therein different from the prior art has been developed.

[0005] The evaporator unit of the invention developed for cooler-type white goods comprises an evaporator tube consisting of two lines each of which has continual sequential bends; plate-shaped fins on the evaporator tube that are arranged in succession. The unit is characterized in that each line of the tube is within itself while all the parts are sequentially on the same virtual plane; and in that there are protrusions on each fin which keep the fins at parallel regular intervals with respect to each other and which are used for heat transfer; and in that there are a great number of slots at the each side of the fin plate into which tube lines can laterally enter.

Aim of the Invention

[0006] The aim of the invention is to form an easy-to-manufacture, cost-effective and reliable evaporator unit for cooler-type white goods.

[0007] Another aim of the invention is to ensure that straight bent evaporator tubes which are made of steel are used in the said unit.

[0008] A further aim of the invention is to form fins which can be easily attached onto the evaporator tubes of the said unit and which lead to an increase in heat transfer by means of the protrusions thereon.

[0009] Another aim of the invention is to ensure that the assembly of the evaporator tube to the fins on the unit is facilitated.

Description of Drawings

[0010] The exemplary evaporator units of the present invention are shown in the attached figures wherein;

Figure 1 is the perspective view of the evaporator unit of the prior art.
Figure 2 is the perspective view of the evaporator unit of the present invention.
Figure 3 is the perspective view of the cross section of the evaporator unit of the present invention.
Figure 4 is the front view of the evaporator unit of the present invention.
Figure 5 is the side view of the evaporator unit of the present invention.

[0011] The parts shown in the figures are individually numbered and the corresponding terms of these numbers are as follows:

Evaporator unit (A)
Evaporator tube (1)
Fin (2)
Protrusion (3)
Tube slot (4)
Bend (5)
Joining area (6)
Plane (D)
Air flow (F)
Pipe lines (I, II)
Evaporator unit (A') - (of the prior art)
Evaporator unit (1') - (of the prior art)
Fin (2') - (of the prior art)

Disclosure of the Invention

[0012] Figure 1 shows the perspective view of sample evaporator unit (A') of the prior art. The evaporator tube (1') used herein is formed cross (zigzag) sequence and the fins (2') (heat transfer plates) thereon are shown. The reason as to why the evaporator tube (1') is cross sequenced is to constitute certain barriers before the air

flow which rises from bottom to top due to convection. Therefore it is ensured that the air flow stays in contact with the cross sequenced tubes for longer time, resulting increase in the heat transfer. Nevertheless, such tube bending requires a difficult and costly process. It is also difficult and costly to assemble the cross sequenced tubes (1') with a fin (2') structure as shown in Figure 1. Moreover, as mentioned above, this structure is aimed for materials which have high heat transmission coefficients (i.e. copper, aluminium) and it does not allow the use of materials that have low heat transmission coefficients (such as steel).

[0013] The invention shown in Figures 2-5 allows the use of materials (i.e. steel), which have lower heat transmission coefficient with respect to copper and aluminium, in the evaporator unit (A). Low carbon steels are especially preferred for cost-effectiveness. Low carbon steels are more advantageous when compared to copper and aluminium with respect to raw materials and processing/shaping costs. Nonetheless, it is required that with the use of materials of steel-type or the materials which have lower heat transmission coefficients than copper and aluminium (the unit (A) can be used with any kind of material that has heat conductivity), the desired cooling effectiveness must be ensured without any loss in the amount of heat transfer. Therefore, an evaporator unit (A), which is both structurally and in terms of the material used therein different from the prior art, has been developed.

[0014] The evaporator tube (1) in this unit (A) consists of two lines (I, II) each of which continues with sequential bends. Both of the lines (I, II) are shaped with multiple bends (5) on the same virtual plane (D). In other words, it is ensured that each line (I, II) of the tube (1) remains within itself and all the parts of the tube are sequentially on the same plane (D) (shown in Figure 5) following the bending process. Preferably, the planes (D) on which the each line (I, II) of the tube (1) is placed are also parallel to each other.

[0015] As shown in Figure 2-3, there are protrusions (3) extending outwards on the plate-shaped fins (2). When the fins (2) are arranged on the evaporator tube (1) in succession, these protrusions (3) ensures that fins (2) are kept at certain intervals from each other in a parallel fashion with respect to each other. Moreover, these protrusions (3) constitute barriers to some extent before the air flow (F) which rises upward due to convection. This causes the air flow (F) to create turbulence while it passes through the evaporator unit (A); and turbulence leads to an increase in heat transmission coefficient. The increase in the heat transmission coefficient between air and the evaporator unit (A) naturally increases the amount of heat transfer. Additionally, the said protrusions (3) ensure that the air keeps in contact with the fins (2) for a longer time and they also ensure that the air is directed onto the tube (1). While the protrusions (3) can be formed with the fins (2) in an assembled manner; for the sake of simple production, they can also preferably be formed by bending certain areas in the interior part of the fin (2) plate laterally.

[0016] As shown in Figure 3, at both sides of the each fin (2) plate there are a great number of slots (4) into which tube lines (I, II) can laterally enter. For instance, while a bent-formed line (I) of the evaporator tube (1) enters the slots (4) from one side of the fin (2) plate, the second line (II) of the tube (1) can enter the slots (4) from the other side of the fin (2) plate; then both tube lines (I, II) can be joined (e.g. by welding on the joining area (6) shown in Figure 2). This facilitates the mounting of the evaporator tubes (1) to the fin (2) plates in the unit (A) and ensures that the evaporator unit (A) is manufactured easily and rapidly.

[0017] Thanks to the evaporator unit (A) embodied with the invention, it is possible to use steel material in tubes (1) and/or fins (2). With this cost-effective use by increasing the amount of heat transfer by means of the protrusions on the fins (2), it is possible to deliver the same performance of the former evaporators made of copper and aluminium. Owing to the slots (4) on the fin (2) plate, engagement of tube (1) and fin (2) is facilitated as well. This is also an important factor in reducing the production cost.

Claims

1. An evaporator unit (A) for cooler type white goods comprising an evaporator tube (1) consisting of two lines (I, II) each of which continue with sequential bends (5); plate shaped fins (2) arranged in succession on the evaporator tube (1) **characterized in that**

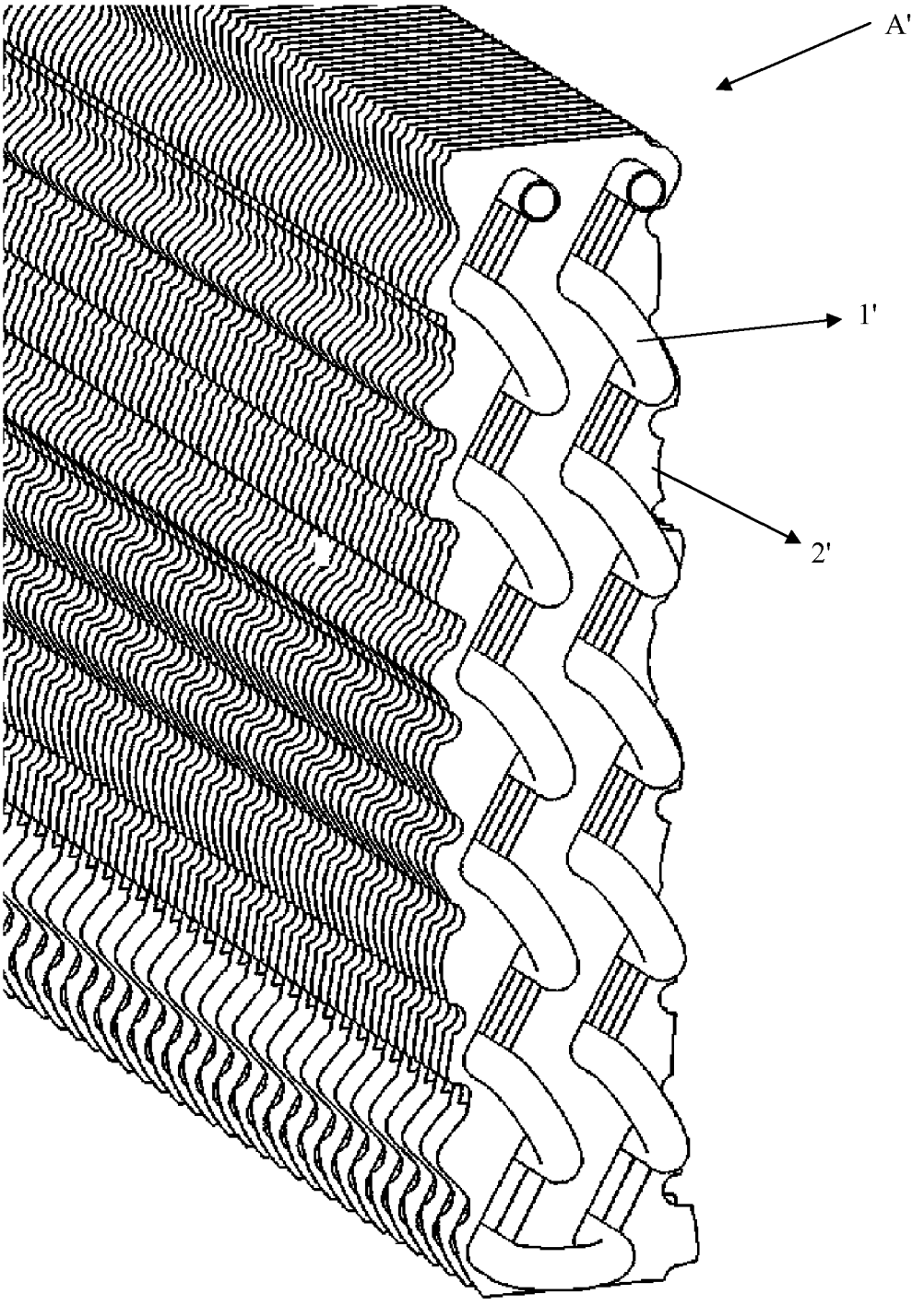
   - each line (I, II) of the tube (1) is within itself while all the parts are sequentially on the same virtual plane (D),
   - there are protrusions (3) on each fin (2)which keep fins (2) at parallel regular intervals with respect to each other and which are used for heat transfer
   - there are a great number of slots (4) at both sides of the each fin (2) plate into which the tube lines (I, II) can laterally enter.

2. A unit (A) according to Claim 1 **characterized in that** the protrusions (3) are formed by bending certain areas in the interior part of the fin (2) plate laterally.

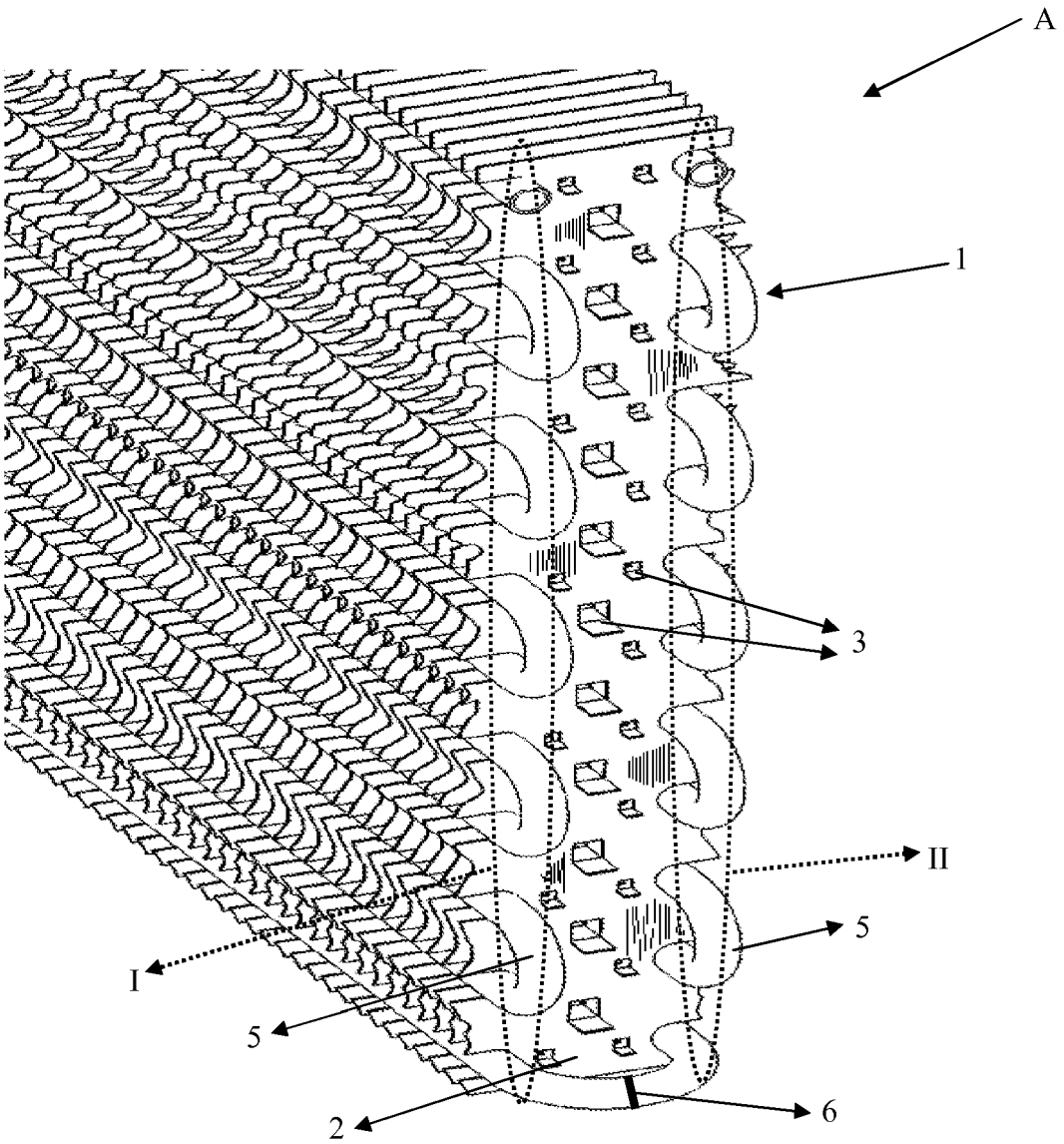
3. A unit (A) according to Claim 1 **characterized in that** the planes (D), on which each line (I, II) is placed, are parallel.

4. A unit (A) according to Claim 1 **characterized in that** the tube (1) and/or the fin (2) is made of steel-type material.

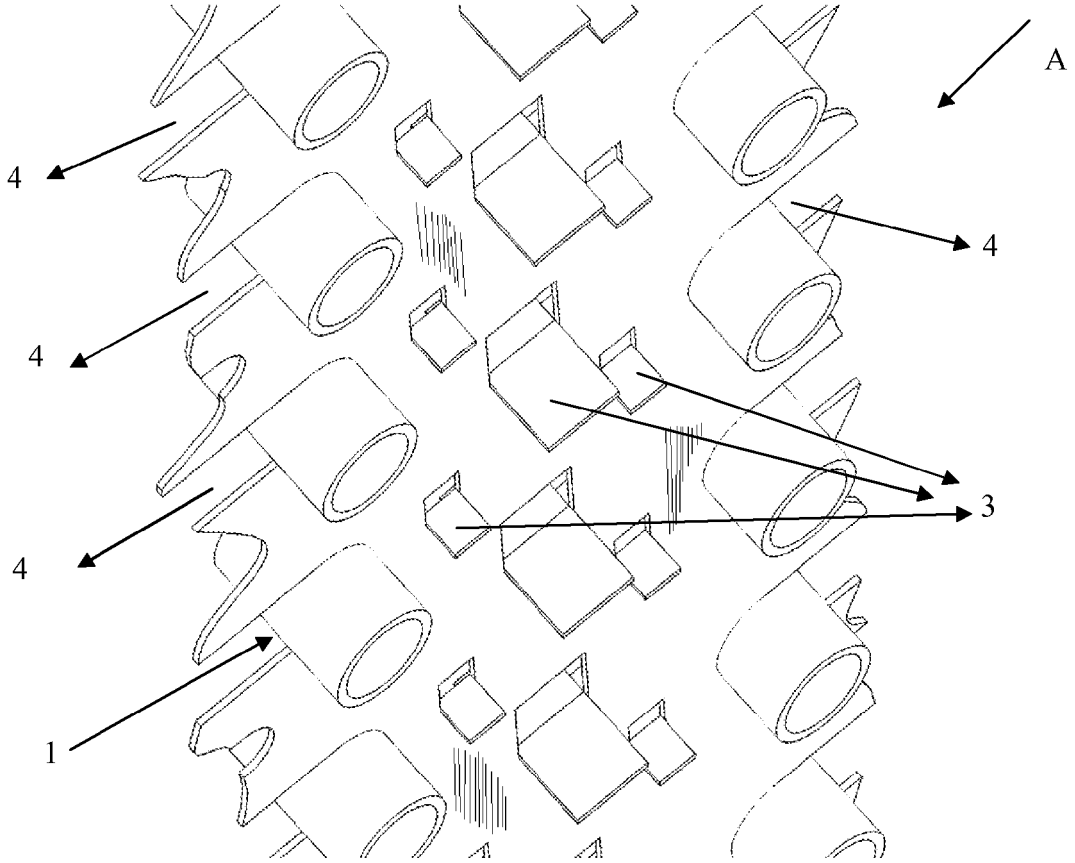
5. A unit (A) according to Claim 1 **characterized in that** the tube (1) and/or the fin (2) is made of low carbon steel.



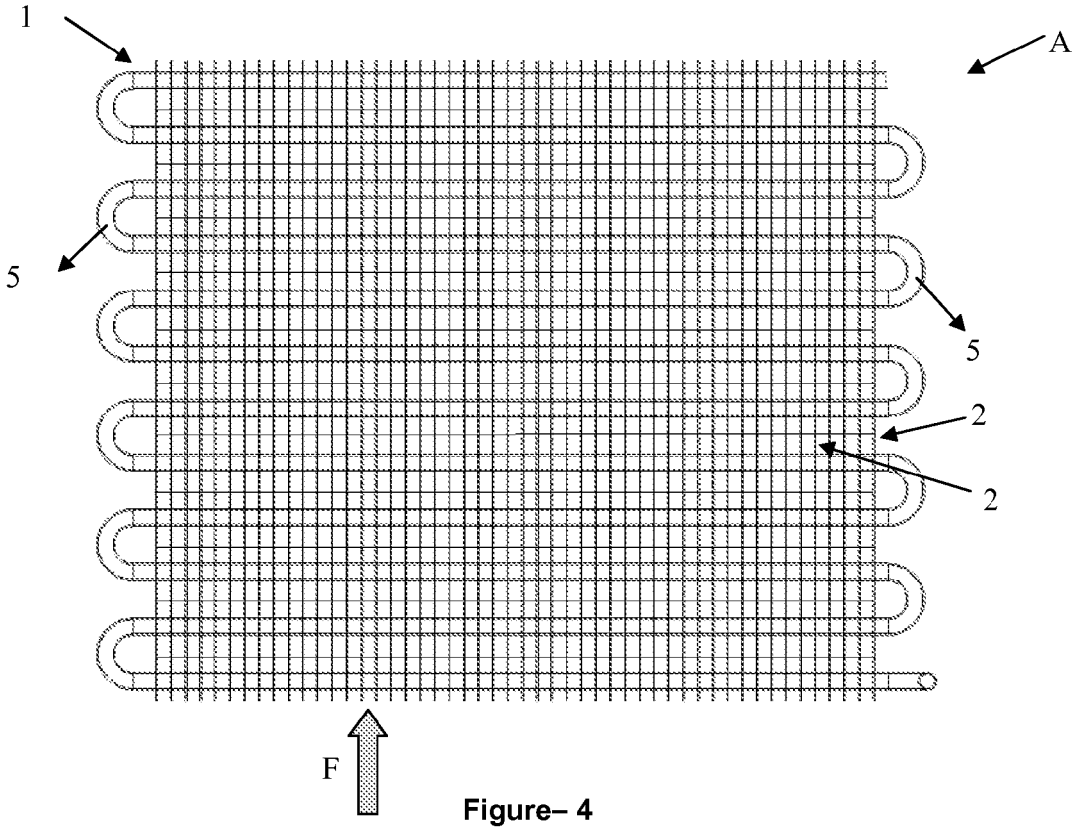
Figure– 1



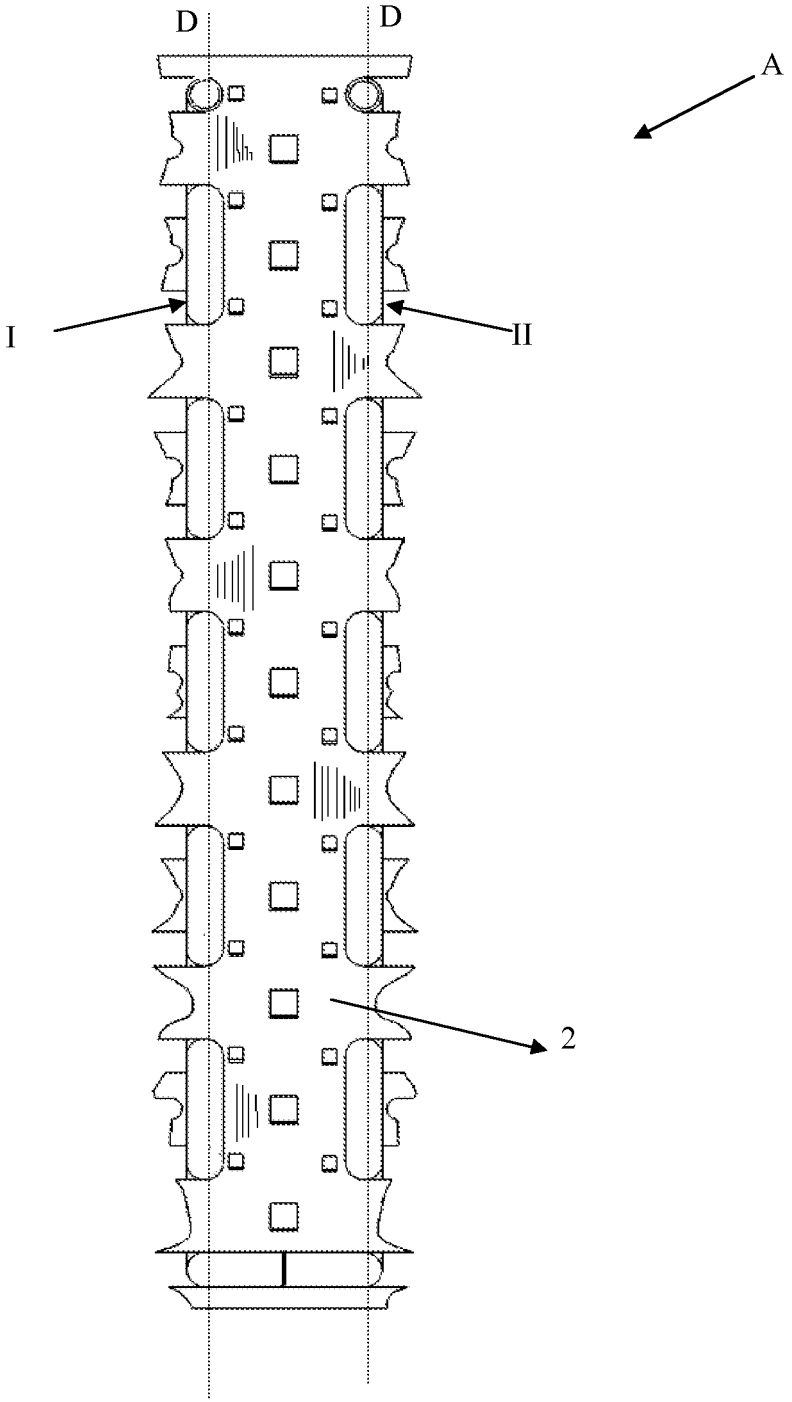
Figure– 2



Figure– 3



Figure– 4



Figure– 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4580623 A **[0003]**
- US 6591627 B **[0003]**