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(54) Title: HEAT EXCHANGER TUBE SET

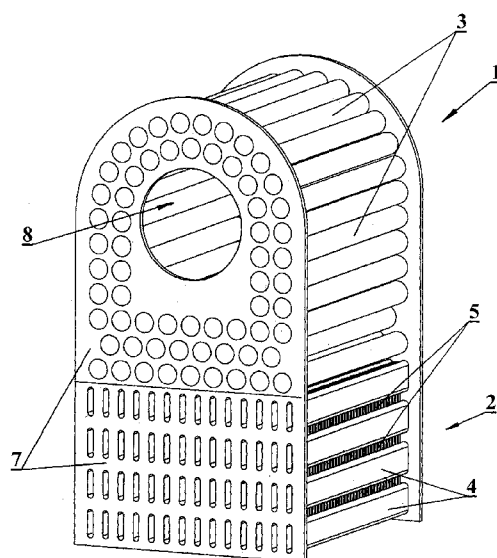


Fig. 1

(57) Abstract: The heat exchanger tube set is designed particularly for the fuel heat exchanger. The set comprises two heat exchange zones positioned one after another with respect to the combustion chamber (8), where zone one (1) is formed exclusively of tubes (3), and zone two (2) is composed of tubes (4) and finned elements (5) positioned in between the tubes (4). Preferably, the tubes (3) of zone one (1) are smooth, of any shape in cross-section, and the tubes (4) of zone two (2) are either flat or oval. Preferably, the finned element (5) consists of a band with profiled plates (6).



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Heat exchanger tube set

The invention concerns a heat exchanger tube set, designed particularly for the fuel heat exchanger.

Known are heat exchangers composed of tubes fixed to sieve bottoms, around which hot fumes flow.

Also known are heat exchangers composed of tubes fixed to sieve bottoms and fins arranged in between the tubes to increase the heat exchange surface area. Known from patent application WO 2011/055515 A1 is an element constituting heat exchange fins, fitted in between the tubes.

Also known from patent application EP 0860 674 A1 is a heat exchanger composed of a plurality of parallel tubes positioned at a distance from one another, and a plurality of ring fins around the tubes, touching on the tubes.

The purpose of this invention is to improve heat exchange parameters and increase the power of the heat exchanger while simultaneously economising on the material.

The purpose was achieved by designing a tube set consisting of heat exchange zones.

The heat exchanger tube set according to the invention, designed particularly for the fuel heat exchanger, containing heat exchange elements in the form of tubes fixed to sieve bottoms, and finned elements filling in the spaces in between the tubes is characterised in that it comprises two heat exchange zones positioned one after another with respect to the combustion chamber, where zone one is formed exclusively

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of tubes, and zone two is formed of tubes and finned elements positioned in between the tubes.

The purpose of zone one is to cool down the fumes initially so as to avoid over-heating and damaging the finned elements of zone two with high temperature, where the purpose of the finned elements is to increase the heat exchange surface area and agitate the agent flowing through them.

Preferably, the tubes of zone one are smooth, of any shape in cross-section, whereas the tubes of zone two may be either flat or oval.

Preferably, the finned element positioned in between the tubes of zone two is a band with profiled plates.

In one embodiment of the invention, a single band with profiled plates may run along the full height of zone two, in between the respective neighbouring tubes.

In another embodiment of the invention, two or more such bands may run the full height of zone two, in between the respective neighbouring tubes.

In this case the plates may all be inclined in the same direction or interchangeably inclined in the opposite directions.

The tubes of zone one and the tubes of zone two may be fixed to common appropriate sieve bottoms or to separate sieve bottoms.

The tubes of zone one and/or the tubes of zone two run parallel to one another or form a ring.

The combustion chamber may be installed above zone one or formed inside zone one.

The set may be of any shape.

The structure of the set composed of two zones according to the invention enables achieving high power of the heat exchanger while simultaneously economising on the material and increasing the exchanger's durability.

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The positioning of zone two behind zone one which separates zone two from the combustion chamber causes that the cooled fumes in zone one do not over-heat or destroy the plates of the finned elements of zone two, where the purpose of the latter is to increase the heat exchange surface area and agitate the agent flowing through them. Moreover, cooled in zone one, the fumes do not cause overheating of the working agent or bring it to the boiling point.

The invention is illustrated on the exemplary drawings, where:
Fig. 1 and Fig. 2 show the heat exchanger tube set in the axonometric projection,

Fig.3 shows the inside of the set,

Fig.4 shows a fragment of zone two,

Figures 5 to 10 show the set with different zone configurations in an orthographic projection,

Fig. 11 shows the set with separate sieve bottoms of the zones,

Fig. 12 shows the zones of the set,

Fig. 13 shows one finned element along the full height of zone two with plates profiled at the right angle to the tubes of zone two,

Fig. 14 shows two finned elements with the plates profiled at the right angle to the tubes of zone two,

Fig. 15 shows four finned elements with plates profiled at the right angle to the tubes of zone two,

Fig. 16 shows one finned element along the full height of zone two with plates profiled at the angle of $\neq 90^\circ$ to the tubes of zone two,

Fig. 17 shows two finned elements with plates profiled at the angle of $\neq 90^\circ$ to the tube axis, inclined in different directions,

Fig. 18 shows two finned elements with plates profiled at the angle of $\neq 90^\circ$ to the tube axis, all inclined in the same direction,

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Fig. 19 shows four finned elements with plates profiled at the angle of $\neq 90^\circ$ to the tube axis, interchangeably inclined in the opposite directions,

Fig.20 shows four finned elements with plates profiled at the angle of $\neq 90^\circ$ to the tube axis, all inclined in the same direction.

In accordance with the examples of the invention, the heat exchanger tube set has two heat exchange zones. Zone one 1 is formed exclusively of smooth tubes 3 circular in cross-section, positioned parallel to one another. The combustion chamber 8 is positioned inside zone one 1, which is shown on Fig. 1, Fig. 5, and Fig.7, or partially encircled by the tubes 3 of zone one 1, which is shown on Fig. 9 and Fig. 10, or, in another embodiment of the invention as on Fig. 2, Fig. 6, and Fig. 8, the combustion chamber is positioned above zone one 1. Zone one 1 is immediately followed by zone two 2 formed of tubes 4 rectangular in cross-section, again running parallel to one another, in between which finned elements 5 are fitted formed of a band with profiled plates 6, which is presented on Fig. 4. There is one finned element running along the full height of zone two in between the respective neighbouring tubes, as shown on Fig. 13 and Fig. 16. In another embodiment there are two finned elements 5 fitted, which is presented on Fig. 14, Fig. 17, and Fig.18, and in yet another embodiment there is only one finned element 5 fitted in between two tubes 4, which is shown on Fig. 15, Fig. 19, and Fig. 20. In one embodiment of the invention the plates 6 of the finned element 5 are profiled perpendicular to the tubes 4, which is presented on Fig. 13 to Fig.

15, and in another embodiment at the angle of $\neq 90^\circ$, which is shown on Figures 16-20. In the case of two or several finned elements 5 fitted at the height of zone two 2, the plates 6 are all inclined in the same direction,

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which is shown on Fig. 18 and Fig. 20, or interchangeably inclined in the opposite directions, which is presented on Fig. 17 and Fig. 19. The tubes 3 of zone one and the tubes 4 of zone two are fixed to their respective common sieve bottoms 7, which is shown on Figures 5 to 10, or – in another embodiment of the invention– they are fixed to separate sieve bottoms 7, which is presented on Fig. 11.

Exemplary shapes of the set are shown on Figures 5 to 10.

The fumes formed in the combustion chamber 8 first flow around the tubes 3 of zone one 1, where they are cooled, and then penetrate into zone two 2, where they flow around the tubes 4 and finned elements 5, get agitated, and give up their heat. The agent circulating in the tubes 3 of zone one 1 and in the tubes 4 of zone two 2 takes over the heat.

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Claims

1. A heat exchanger tube set, designed particularly for the fuel heat exchanger, containing heat exchange elements in the form of tubes fixed to sieve bottoms, and finned elements filling in the spaces in between the tubes, characterised in that it comprises two heat exchange zones positioned one after another with respect to the combustion chamber (8), where zone one (1) is formed exclusively of tubes (3), and zone two (2) is formed of tubes (4) and finned elements (5) positioned in between the tubes (4).
2. The set according to Claim 1, characterised in that the tubes (3) of zone one (1) are smooth, of any shape in cross-section.
3. The set according to Claims 1 or 2, characterised in that the tubes (4) of zone two (2) are flat or oval.
4. The set according to Claims 1 or 3, characterised in that the finned element (5) is a band with profiled plates (6).
5. The set according to Claim 4, characterised in that a single finned element (5) runs along the full height of zone two (2), in between the respective neighbouring tubes (4).
6. The set according to Claim 4, characterised in that two or more finned elements (5) run along the full height of zone two (2), in between the respective neighbouring tubes (4).
7. The set according to Claim 4, characterised in that there is only one finned element (5) fitted in between two neighbouring tubes (4).
8. The set according to Claims 5 to 7, characterised in that the plates (6) of the finned element (5) are profiled perpendicular to the tubes (4) of zone two (2).

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9. The set according to Claims 5 to 7, characterised in that the plates (6) of the finned element (5) are profiled at the angle of $\neq 90^\circ$ to the tubes (4) of zone two (2).
10. The set according to Claim 9, characterised in that the plates (6) of the finned elements (5) grouped in zone two (2) are all inclined in the same direction or interchangeably inclined in the opposite directions.
11. The set according to Claims 1 to 10, characterised in that the tubes (3) of zone one (1) and the tubes (4) of zone two are fixed to their respective common sieve bottoms (7).
12. The set according to Claims 1 to 10, characterised in that the tubes (3) of zone one (1) and the tubes (4) of zone two are fixed to separate sieve bottoms (7).
13. The set according to Claims 1 to 12, characterised in that the tubes (3) of zone one 1 and/or the tubes (4) of zone two (2) run parallel to one another.
14. The set according to Claims 1 to 12, characterised in that the tubes (3) of zone one (1) and/or the tubes (4) of zone two (2) are form a ring.
15. The set according to Claims 1 to 14, characterised in that the combustion chamber (8) is formed inside zone one (1).
16. The set according to Claims 1 to 15, characterised in that it may be of any shape.

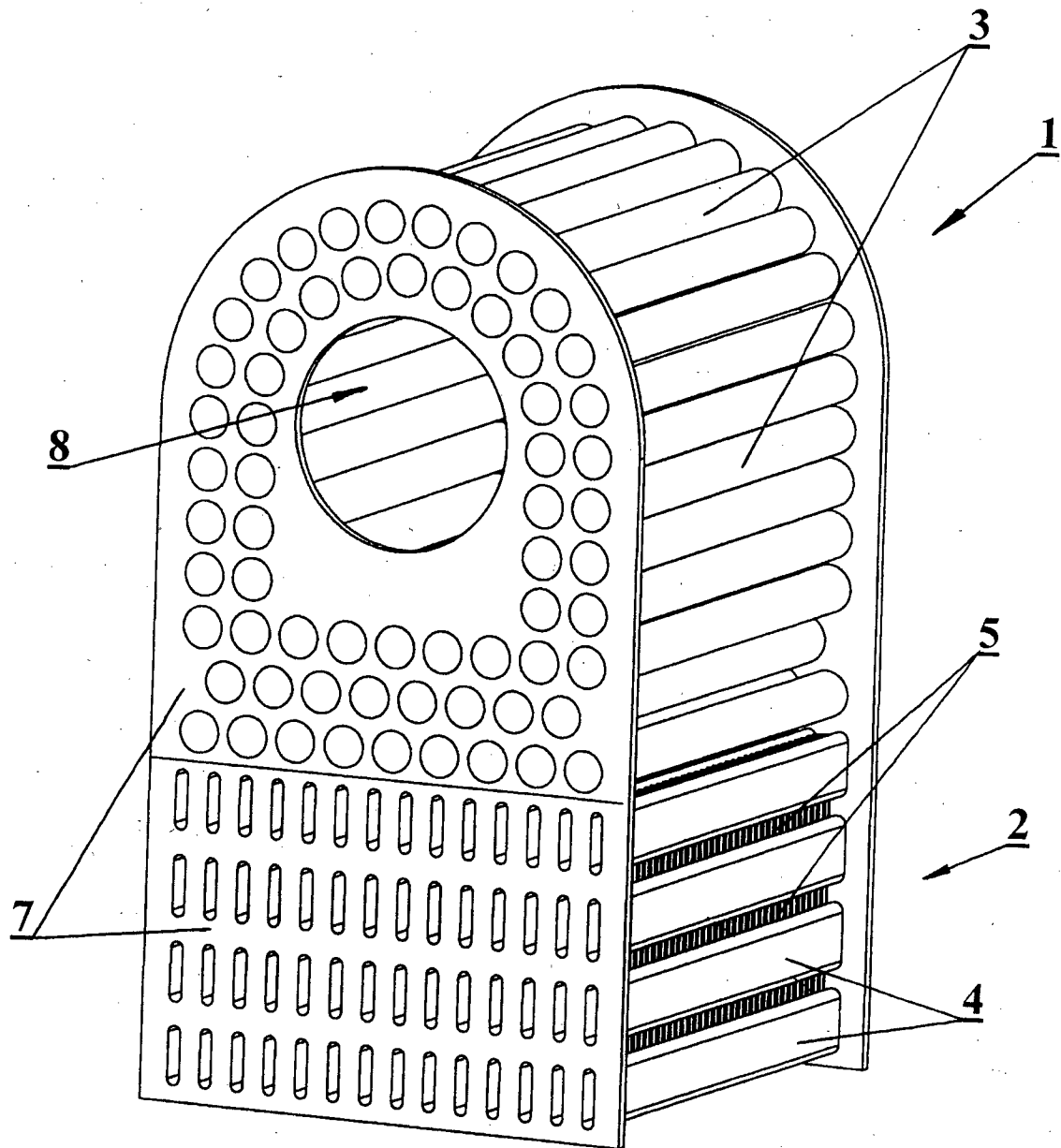


Fig. 1

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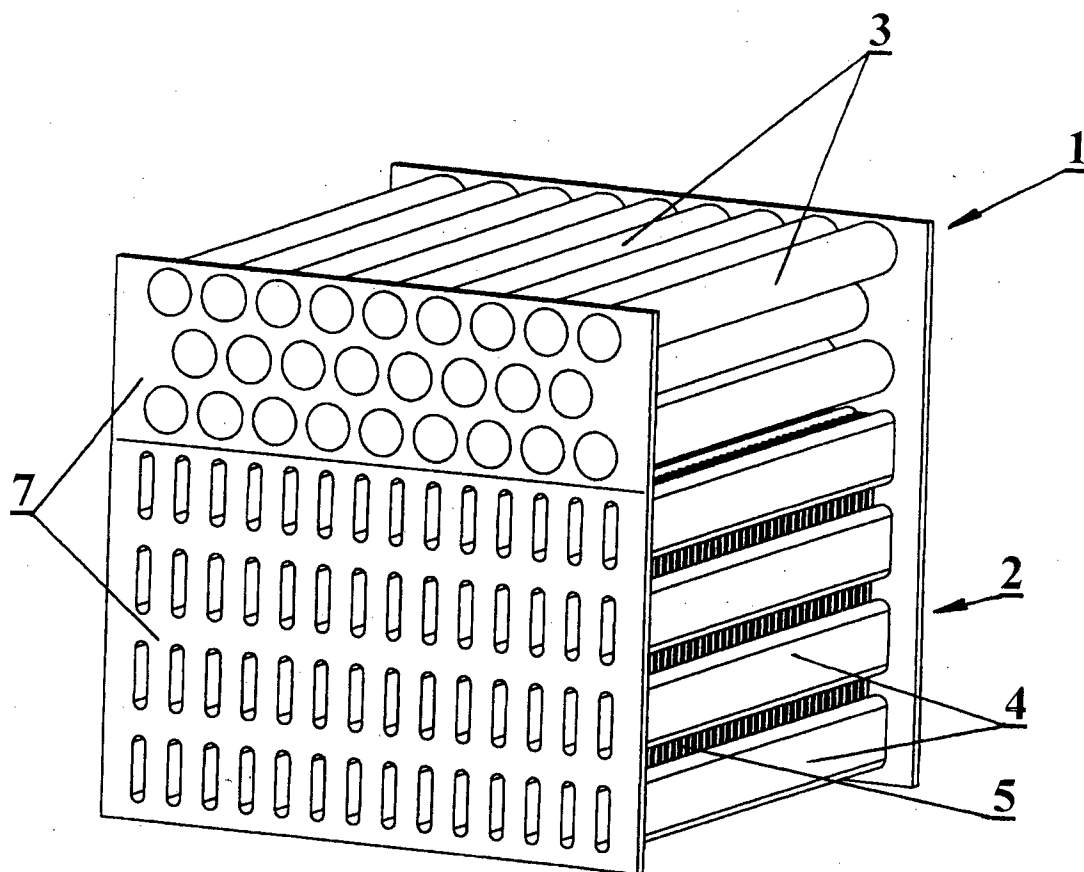


Fig.2

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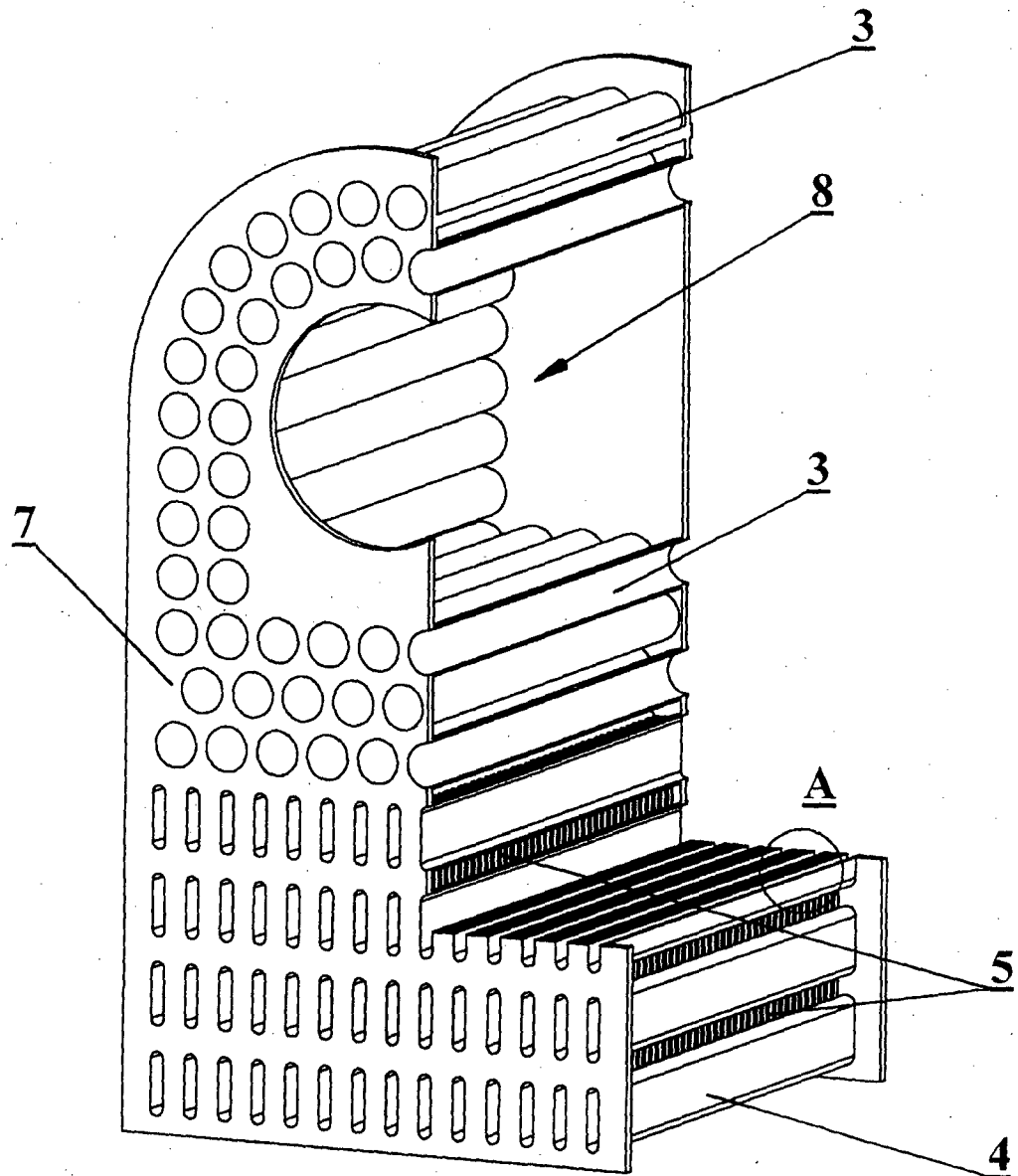


Fig. 3

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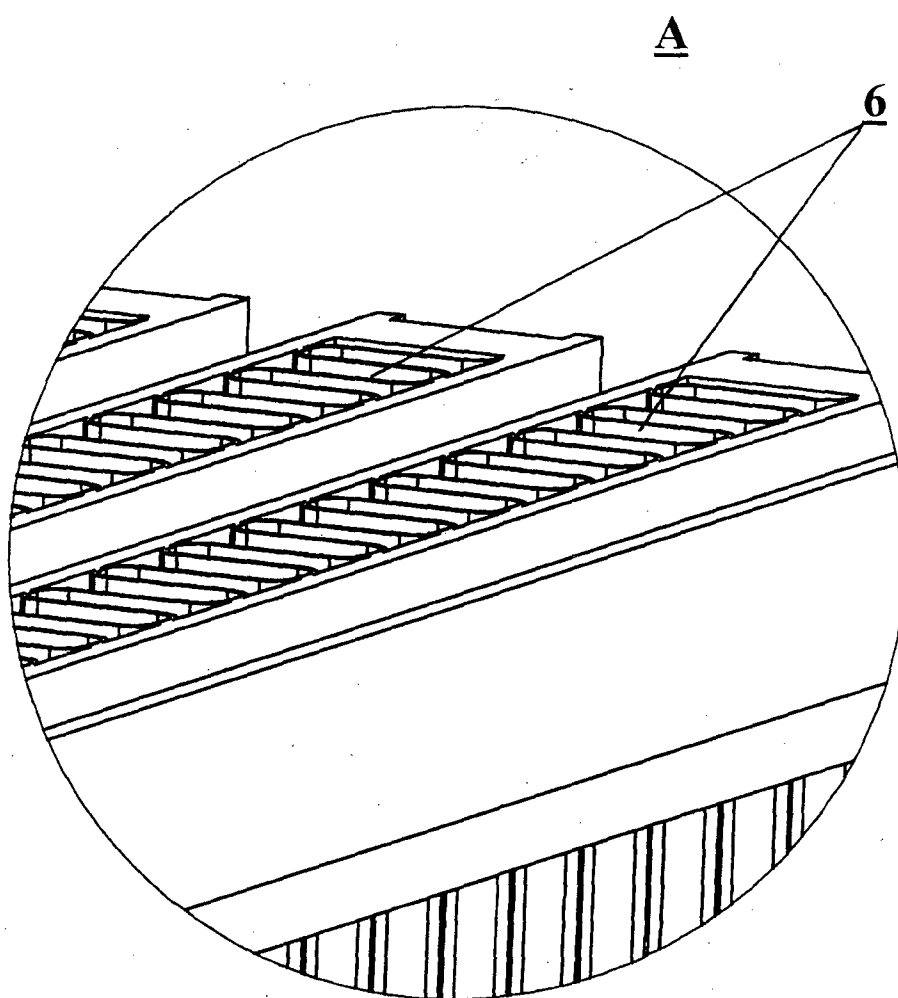


Fig. 4

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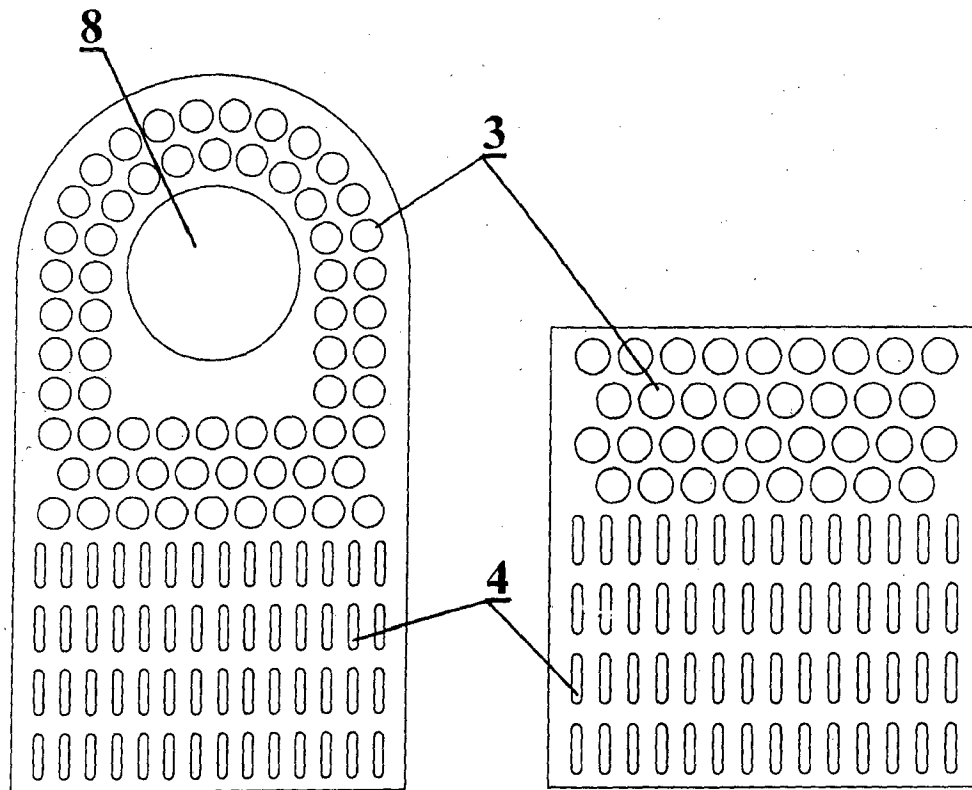


Fig. 5

Fig. 6

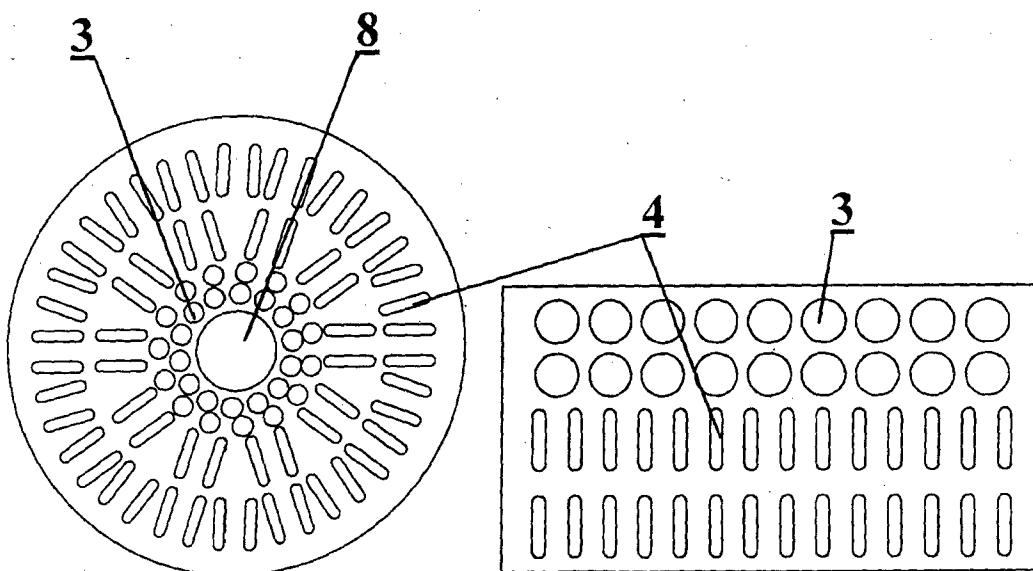


Fig. 7

Fig. 8

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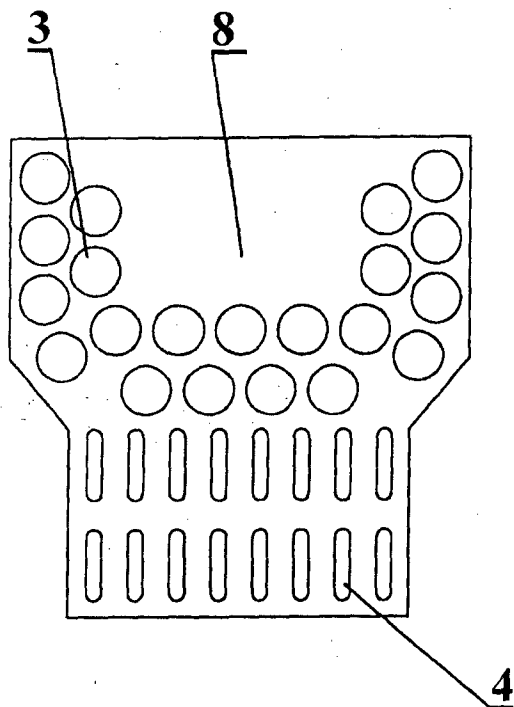


Fig. 9

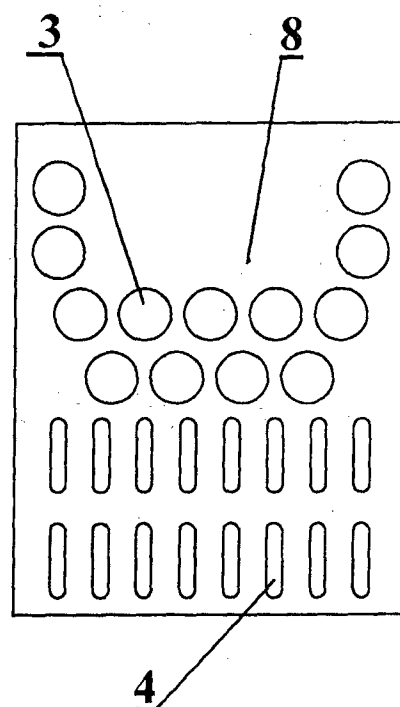


Fig. 10

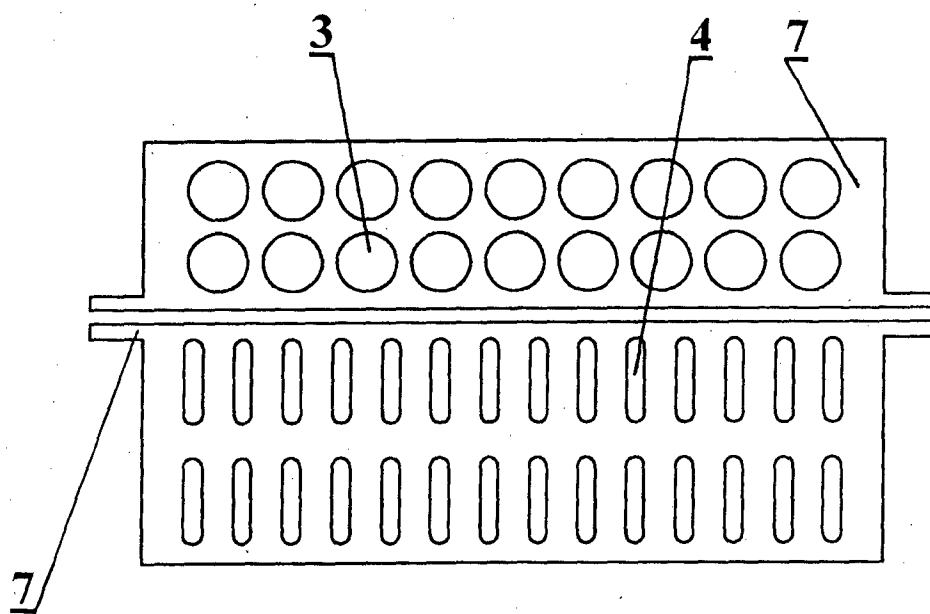


Fig. 11

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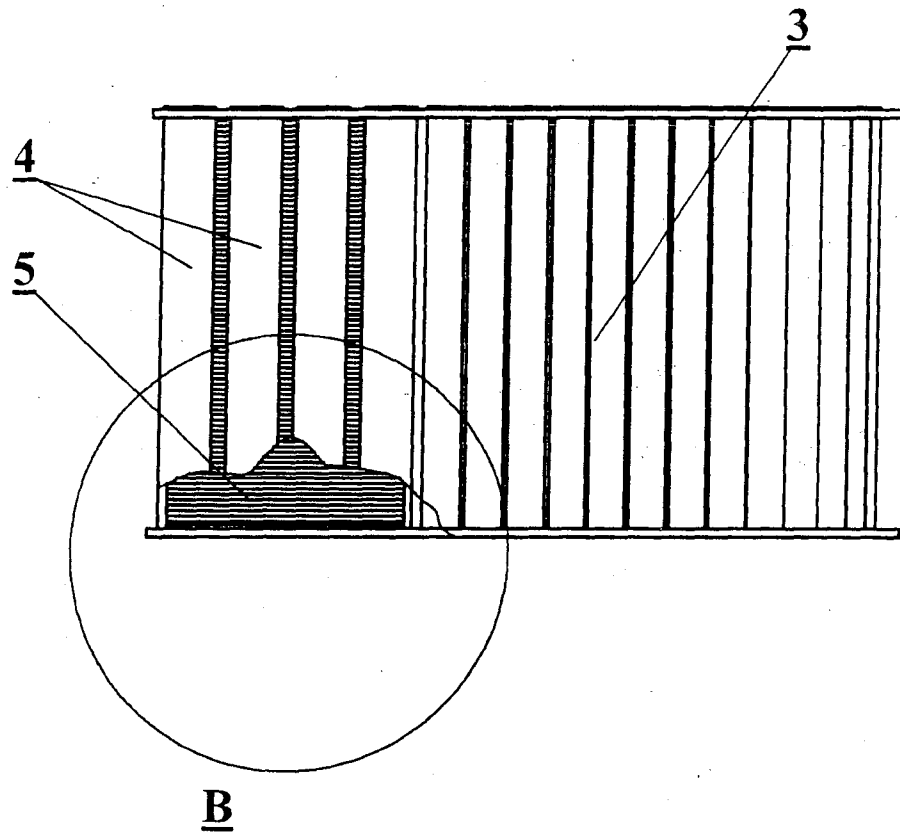


Fig. 12

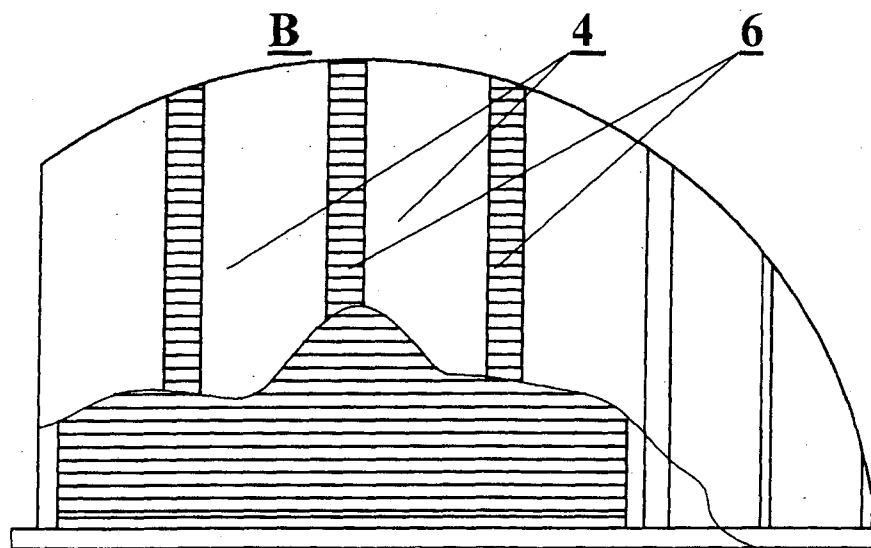


Fig. 13

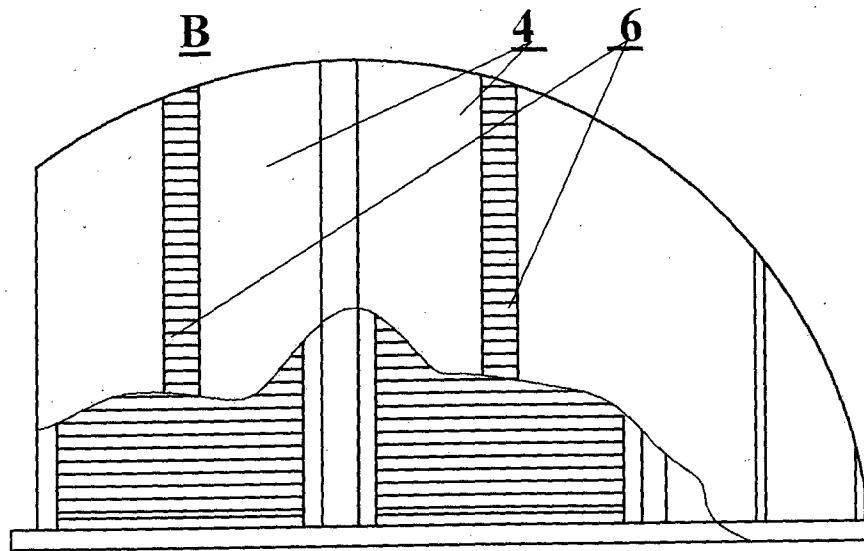


Fig. 14

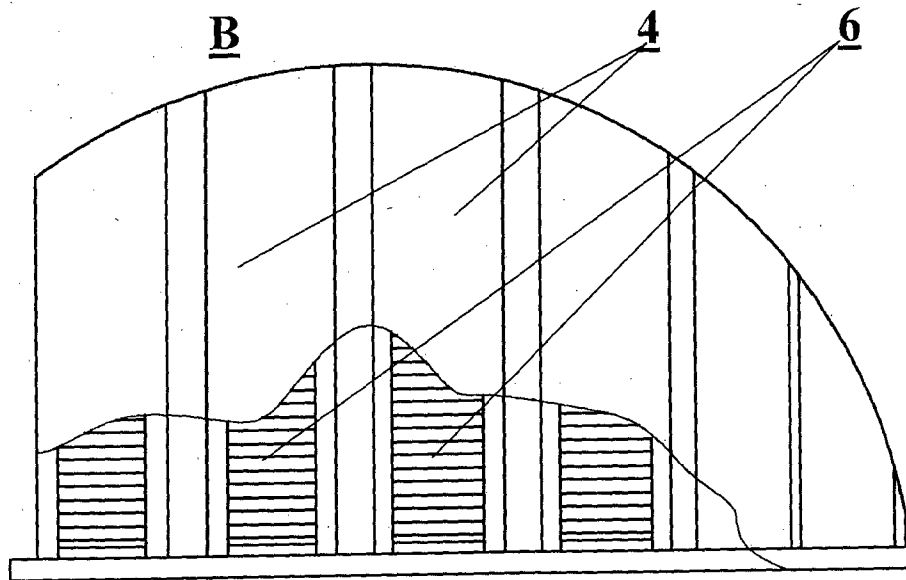


Fig. 15

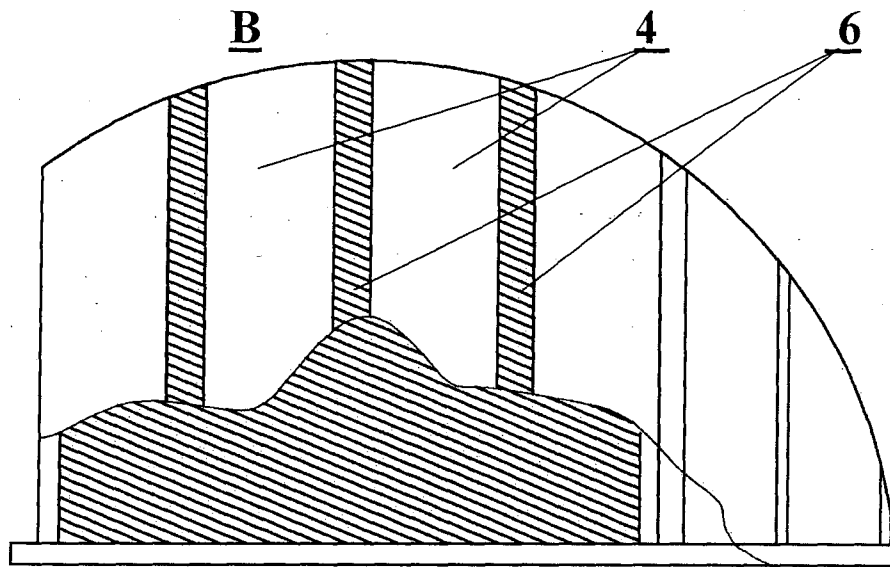


Fig. 16

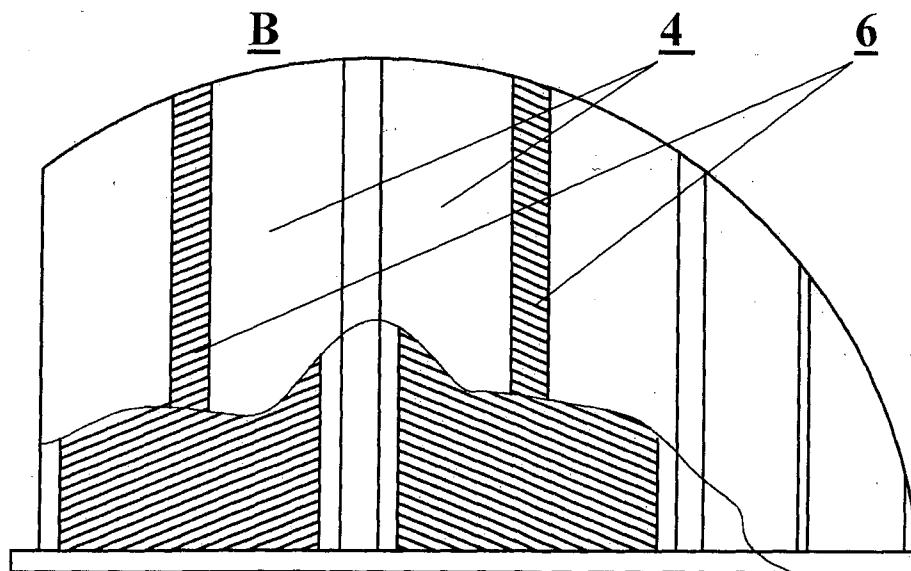


Fig. 17

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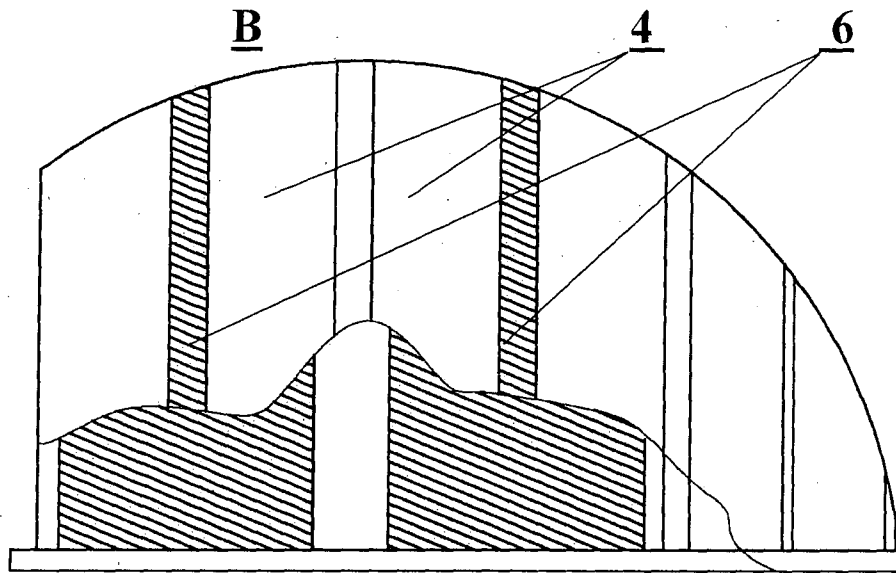


Fig. 18

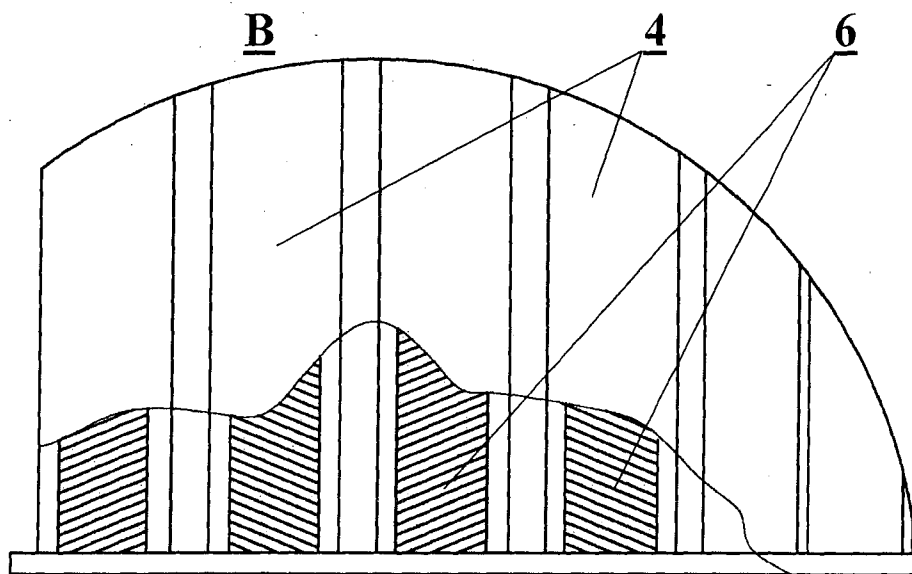


Fig. 19

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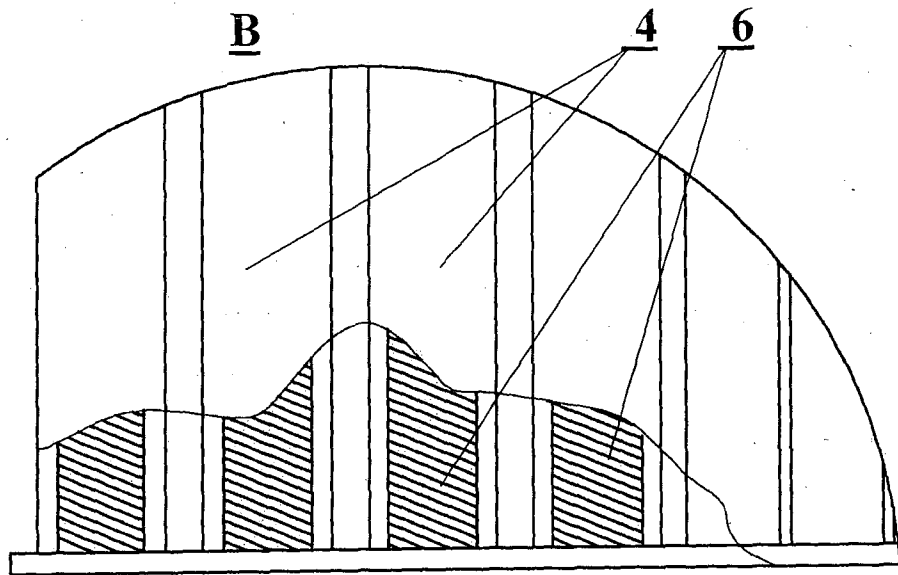


Fig. 20

INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2012/000045

A. CLASSIFICATION OF SUBJECT MATTER
INV. F28D7/16 F28F1/02 F28F1/12 F24H1/28 F24H1/40
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F28D F28F F24H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

30 October 2012

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No

PCT/PL2012/000045

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Information on patent family members

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