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(54) Gas boiler with a main heat exchanger for producing hot water

(57) A gas boiler with a main heat exchanger (5) for producing hot water extends along a vertical axis (A1), and is provided with a burner (4) arranged transversely to the vertical axis (A1); and a combustion gas exhaust conduit (7) arranged above the burner (4); the main heat exchanger (5) extending transversely to the vertical axis (A1) and being arranged above the burner (4) and below the combustion gas exhaust conduit (7) so that the combustion gases flow from the burner (4) through the main heat exchanger (5) toward the combustion gas exhaust conduit (7) in a direction substantially parallel to the vertical axis (A1); the main heat exchanger (5) having a number of pipes (17) and a plurality of fins (18); each fin (18) being provided with a plate (24) transversal to the pipes (17) and parallel to the vertical axis (A1) at least an offset portion (34) protruding from the plate (34) and parallel to the vertical axis (A1) so as to define a flow passage parallel to the vertical axis (A1) between the offset portion (34) and the plate (24), from which the offset portion (34) protrudes.

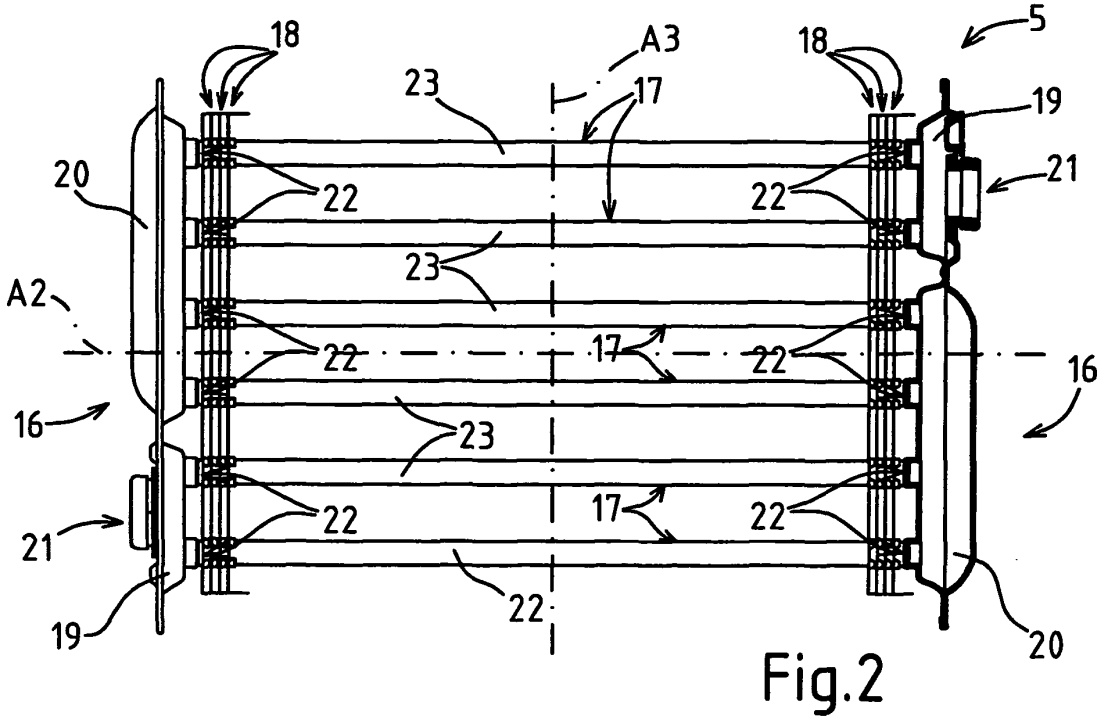

Fig.2

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Description

[0001] The present invention relates to a gas boiler with a main heat exchanger for producing hot water.

[0002] A gas boiler of the above-identified type extends along a vertical axis, and comprises a burner, which is arranged transversely to the vertical axis; and a combustion gas exhaust conduit arranged above the burner; the main heat exchanger extending transversely to the vertical axis and being arranged above the burner and below the combustion gas exhaust conduit so that the combustion gases flow from the burner through the main heat exchanger toward the combustion gas exhaust conduit in a direction substantially parallel to the vertical axis. The main heat exchanger comprises a number of pipes and a plurality of fins; each fin comprising a plate transversal to the pipes and parallel to the vertical axis.

[0003] The performance of a gas boiler is determined by, among other parameters, the heat exchange rate of the main heat exchanger and the speed of the combustion gases downward of the main heat exchanger or the draft of the combustion gases along the combustion gas exhaust pipe. A kind of gas main heat exchangers for gas boilers of the above-identified type is designed to improve the heat exchange rate by embossing the plate of each fin, but it excessively slows down the speed of the combustion gases as they flow through of the embossed plates. Furthermore, the embossed plates may deviate the fumes from a direction substantially parallel to the vertical axis or create an excessive turbulence in the combustion gases.

[0004] Another kind of main heat exchangers for gas boilers comprises fins made of even plates so as to increase the speed of the combustion gases of the combustion gas exhaust draft. However, the combustion gases flow too fast through the main heat exchanger so that the heat exchange rate is too poor.

[0005] It is an object of the present invention to provide a gas boiler with a main heat exchanger that overcomes the drawbacks of the prior art, and, in particular suitable to improve the heat exchange rate and combustion gases draft.

[0006] According to the present invention, there is provided a gas boiler with a main heat exchanger for producing hot water extends along a vertical axis, and comprises a burner, which is arranged transversely to the vertical axis; and a combustion gas exhaust conduit arranged above the burner; the main heat exchanger extending transversely to the vertical axis and being arranged above the burner and below the combustion gas exhaust conduit so that the combustion gases flow from the burner through the main heat exchanger toward the combustion gas exhaust conduit in a direction substantially parallel to the vertical axis; the main heat exchanger comprising a number of pipes and a plurality of fins; each fin comprising a plate transversal to the pipes and parallel to the vertical axis; the gas boiler being characterised in that each fin is provided with at least an offset portion protruding from the plate and parallel to the vertical axis so as to define a flow passage parallel to the vertical axis between the offset portion and the corresponding plate.

[0007] According to the invention the offset portion protruding from the plate improves the heat exchange rate without excessively slowing down the speed of the combustion gases.

[0008] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic front view, with parts removed for clarity, of a gas boiler in accordance with the present invention;
Figure 2 shows a larger-scale top view of the main heat exchanger of the gas boiler of figure 1;
Figure 3 shows a perspective view of a fin of the main heat exchanger of figure 2;
Figure 4 shows a side view of the fin of figure 3;
Figure 5 shows a top view of the fin of figure 3; and
Figure 6 shows a perspective view, in an enlarged scale and with part removed for clarity, of the fin of figure 3.

[0009] Number 1 in Figure 1 indicates as a whole a gas boiler having an outer structure 2 that houses a combustion chamber 3; a burner 4; a main heat exchanger 5; a gas supply conduit 6; a combustion gas exhaust conduit 7 joined to the combustion chamber 3; a primary water circuit 8; a sanitary water circuit 9; and a secondary heat exchanger 10. The primary water circuit 8 comprises a circulation pump 11; an expansion tank 12, a valve 13; and re-circulation branches 14 and 15, which are connected to the secondary heat exchanger 10 and to valve 13.

[0010] The primary water circuit 8 is connected to the main heat exchanger 5 so as to circulate the water through the main heat exchanger 5 and heat the water.

[0011] The boiler 1 extends substantially along a vertical axis A1 ; and the burner 4 is arranged along the vertical axis, and oriented perpendicularly to the vertical axis A1. The main heat exchanger 5 is arranged along the vertical axis A1 above the burner 4 and below the combustion gas exhaust conduit 7, and is oriented perpendicularly to the vertical axis A1.

[0012] The burner 4 and the main heat exchanger 5 are arranged inside the combustion chamber 3 that converges toward and is joined to the combustion gas exhaust conduit 7. When the burner 4 is on, the combustion gases flow from the burner 4 through the main heat exchanger 5 and, then, are conveyed through the exhaust conduit 7.

[0013] The main heat exchanger 5 has substantially the shape of a rectangular prism of a longitudinal axis A2 perpendicular to vertical axis A1.

[0014] With reference to figure 2, the main heat exchanger 5 comprises two elongated opposite headers 16, which are parallel to a transversal axis A3 perpen-

dicular to the vertical axis A1 and to the longitudinal axis A2; six pipes 17 that are parallel to longitudinal axis A2 and connect the opposite headers 16; and a plurality of fins 18, which extends transversely to longitudinal axis A2 and are connected to the pipes 17.

[0015] Each header 16 comprises a first chamber 19 and a second chamber 20. The first chamber 19 is provided with a connection port 21 for the primary water circuit 7 and two connection ports 22 for the pipes 17. The second chamber 20 is provided with four connections port 22 for the pipes 17.

[0016] The water circulates into to main heat exchanger 5 and flows through a connection port 21 in the first chamber 19 of header 16 and, then, through a couple of pipes 17 reaches the second chamber 20 of the opposite header 16. Then, the water flows from the opposite header 16 into the second chamber 20 of the header 16 and, then, into the first chamber 19 of the opposite header 16. The water is expelled from the main heat exchanger 5 through the connection 21 of the first chamber 19 of the opposite header 16. Each second chamber 20 has the function of collecting the water from a couple of pipes 17 in a given direction and feeding the water to a couple of adjacent pipes 17 in the opposite direction.

[0017] Pipes 17 extend along longitudinal axis A2 and are equally spaced from each other in a direction parallel to the transversal axis A3.

[0018] With reference to figure 4, each pipe 17 has a wall 23 and an oblong cross section with a first axis X far longer than a second axis Y that is perpendicular to the first axis X. The first axis X is parallel to the vertical axis A1, whereas second axis Y is parallel to transversal axis A3.

[0019] With reference to figure 3, each fin 18 comprises a plate 24 having two opposite parallel faces 25 and 26 and is provided with a row of six evenly spaced holes 27, each suitable to host a pipe 17. Each hole 27 is wholly contoured by a rim 28, which is perpendicular to the plate 24, extends from face 25, and adheres to the wall 23 of the pipe 17 nearly for the entire perimeter of the pipe 17 except for a small section of the perimeter. In other words, each hole 27 comprises a portion 29 matching with the cross section of the pipe 17 and a portion 30, which remain free even after the insertion of the pipe 17 into hole 27.

[0020] Two large sides 31 and two small sides 32 delimit plate 24. Each large side 31 has a regularly waved contour, whereas each small side 32 has a straight contour and is provided with a rib 33 that is perpendicular to plate 24 and parallel to the vertical axis A1. The rib 33 extends from face 25 of a height H greater than the height of rim 28 and spaces the fin 18 from an adjacent fin 18 of a given distance equal to height H. In other words, the free end of each rib 33 is in contact with the plate 24 along face 26 of the adjacent fin 18.

[0021] Each fin 18 is provided with three offset portion 34, each of which is located along a plate 24 between two adjacent pipes 17, and extends from face 25.

[0022] As better shown in figures 5 and 6, the offset portion 34 is made of a deformed portion of the plate 24. In particular in figure 6, the offset portion 34 is attached to the plate 24 along two edges 35, and is separated from plate 24 along two edges 36 perpendicular to edges 35. Edges 35 are parallel to vertical axis A1, whereas edges 36 are parallel to transversal axis A3.

[0023] The offset portion 34 comprises a central panel 37, which is parallel to the corresponding plate 24; and two lateral panels 38 that join the central panel 37 to the plate 24 and are parallel to the vertical axis A1.

[0024] The central panel 37 is offset of substantially half the distance (height H) separating two adjacent fins from plate 24 so as to be equidistant from the corresponding plate 24 and the adjacent plate 24. A flow passage parallel to vertical axis A1 is defined between the offset portion 34 and the plate 24, from which the offset portion 34 protrudes.

[0025] With reference to figure 4, each offset portion 34 is equidistant from the adjacent pipes 17 and equidistant from the opposite large sides 31 of the plate 24. Each fin 18 comprises three offset portions 34 that are concentrated in the centre of the plate 24. In other words and with reference to the embodiments shown in the annexed figures, the pipes 17 are numbered from a small side 32 to the opposite small side 32 as the first, second, third, fourth, fifth and sixth pipe 17. The offset portions 34 are located only between the second and the third pipes 17; the third and the fourth pipes 17; and the fourth and the fifth pipes 17. The number of pipes 17 and offset portion 34 may change in accordance with the power, size and shape of the main heat exchanger 5 without departing from the scope of present invention.

[0026] A gas boiler embodying the features of the present invention has proven to provide high performances in particular in relation to the heat exchange rate and the draft. Tests carried out by the applicant have proven that such a gas boiler can be classified as a three stars boilers according to the European Standard defined in the in directive 92/42 EC.

Claims

1. A gas boiler with a main heat exchanger (5) for producing hot water extends along a vertical axis (A1), and comprises a burner (4), which is arranged transversely to the vertical axis (A1) ; and a combustion gas exhaust conduit (7) arranged above the burner (4); the main heat exchanger (5) extending transversely to the vertical axis (A1) and being arranged above the burner (4) and below the combustion gas exhaust conduit (7) so that the combustion gases flow from the burner (4) through the main heat exchanger (5) toward the combustion gas exhaust conduit (7) in a direction substantially parallel to the vertical axis (A1) ; the main heat exchanger (5) comprising a number of pipes (17) and a plurality of fins

(18); each fin (18) comprising a plate (24) transversal to the pipes (17) and parallel to the vertical axis (A1); the gas boiler being **characterised in that** each fin (18) is provided with at least an offset portion (34) protruding from the plate (34) and parallel to the vertical axis (A1) so as to define a flow passage parallel to the vertical axis (A1) between the offset portion (34) and the corresponding plate (24).

2. A gas boiler as claimed in Claim 1, **characterised in that** the offset portion (34) is located along a plate (24) between two adjacent pipes (17).

3. A gas boiler as claimed in Claim 1 or 2, **characterized in that** the offset portion (34) is made of a deformed portion of the plate (24); and is attached to the plate (24) along two first edges (35) parallel to the vertical axis (A1) and separated from the plate (24) along two second edges (26) perpendicular to the vertical axis (A1).

4. A gas boiler as claimed in any one of the foregoing Claims, **characterized in that** the offset portion (34) comprises a central panel (37) parallel to the corresponding plate (24).

5. A gas boiler as claimed in Claim 4, **characterized in that** said fins (18) are equally spaced from each other of a given distance along a second axis (A2) perpendicular to the vertical axis (A1); said central panel (37) being offset of half the given distance from the corresponding plate (24).

6. A gas boiler as claimed in Claim 5, **characterised in that** each fin (18) is delimited by two small opposite sides (32) and comprises two opposite ribs (33) protruding from the plate (24) at the small opposite sides (32); each rib (33) extending from the plate (24) of a height (H) along axis (A2) and equal to the given distance; said ribs (33) acting as a spacing member between adjacent fins (18).

7. A gas boiler as claimed in anyone of the Claims from 4 to 6, **characterized in that** each offset portion (34) comprises two lateral panels (38) joining the central panel (37) to the plate (24).

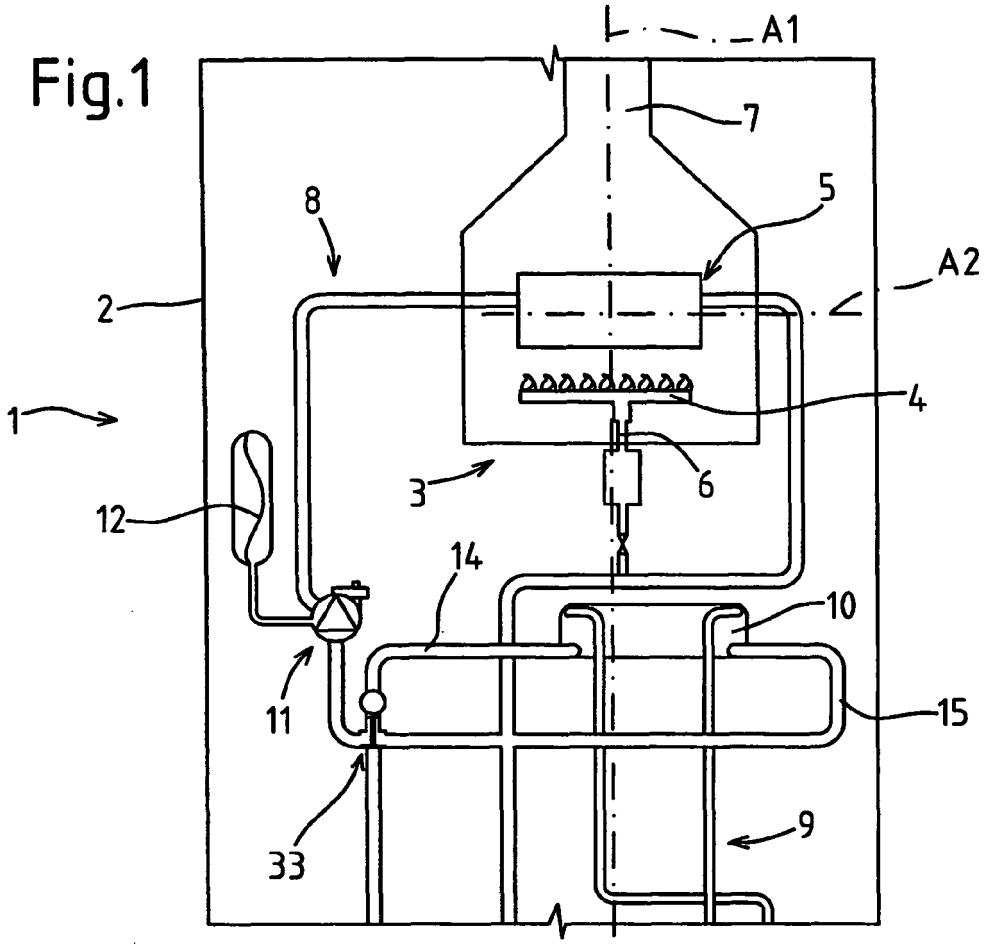
8. A gas boiler as claimed in Claim 7, **characterized in that** each lateral panel (38) is parallel to said vertical axis (A1).

9. A gas boiler as claimed in anyone of the foregoing Claims, **characterised in that** each fin (18) comprises a number of offset portions (34) lesser than the number of pipes (17); the portion of the fin (18) comprised between an outer pipe (17) and the adjacent pipe (17) being free of said offset portion (34).

10. A gas boiler as claimed in anyone of the foregoing Claims **characterised in that** each plate (24) is provided with a plurality of holes (27) for hosting the pipes (17), each hole (27) being provided with an outer rim (28) perpendicular to the plate (24).

11. A gas boiler as claimed in anyone of the foregoing Claims **characterized in that** each pipe (17) is provided with an oblong cross section with a main axis (X) longer than a second axis (Y); the first axis (X) being parallel to the vertical axis (A1).

Fig.1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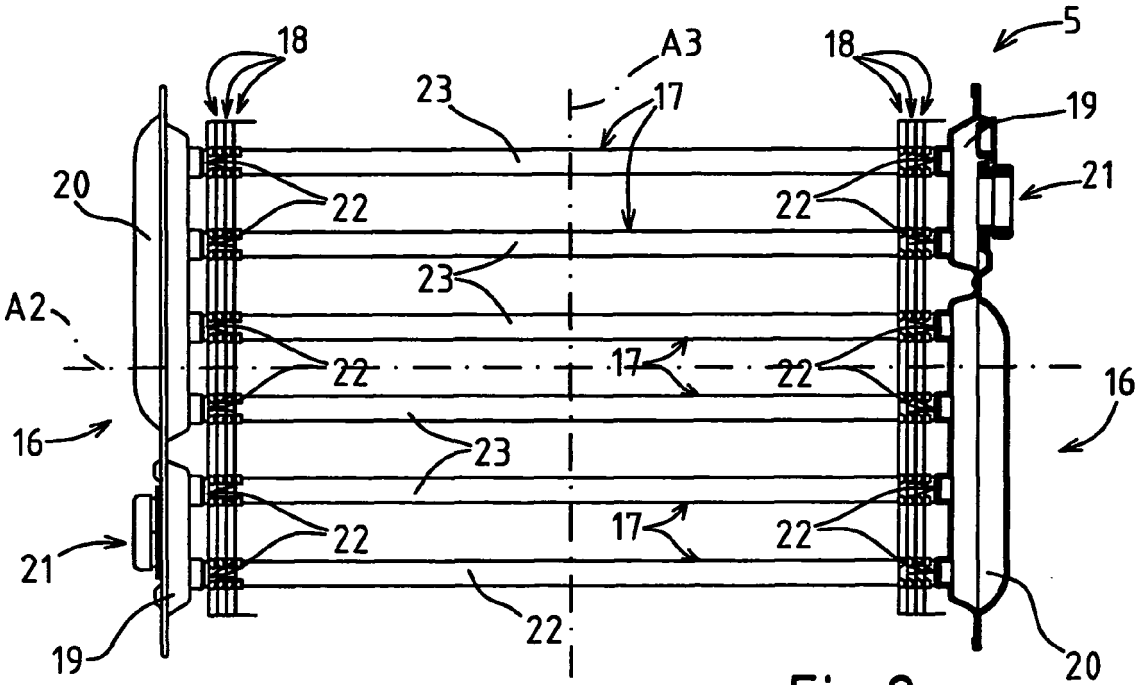
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Fig.2

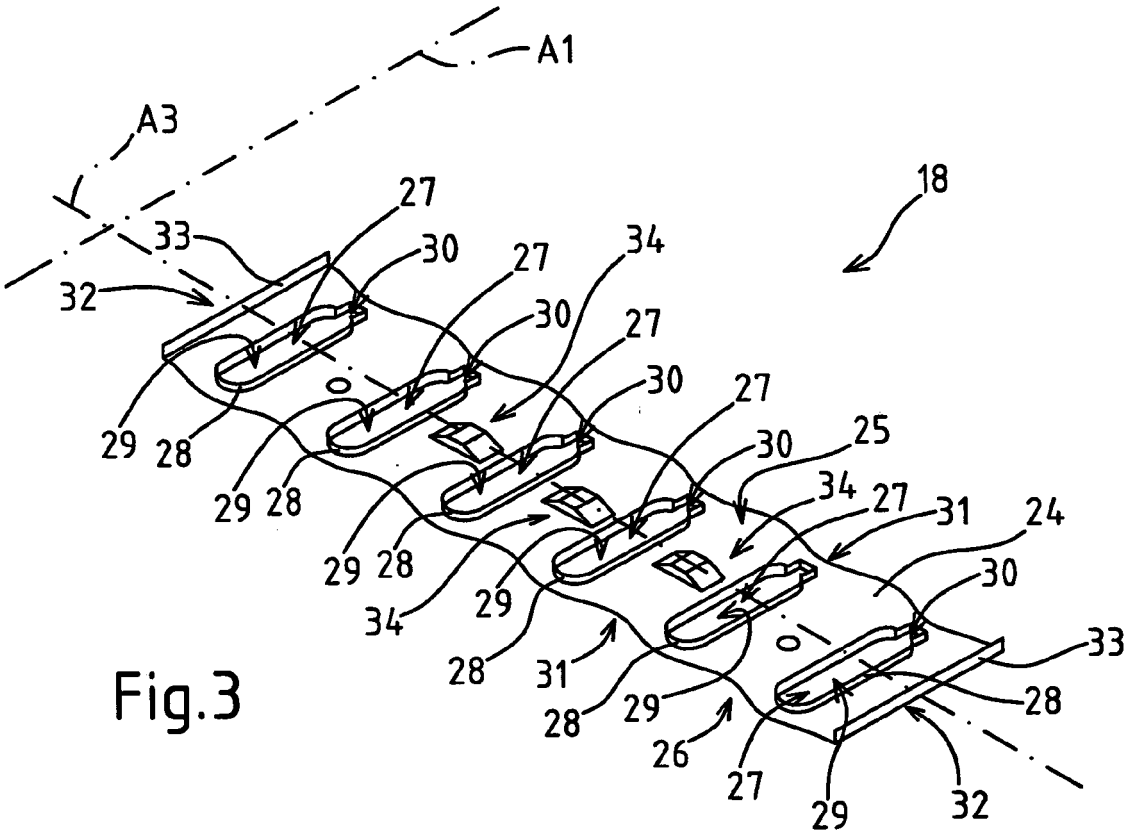
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Fig.3

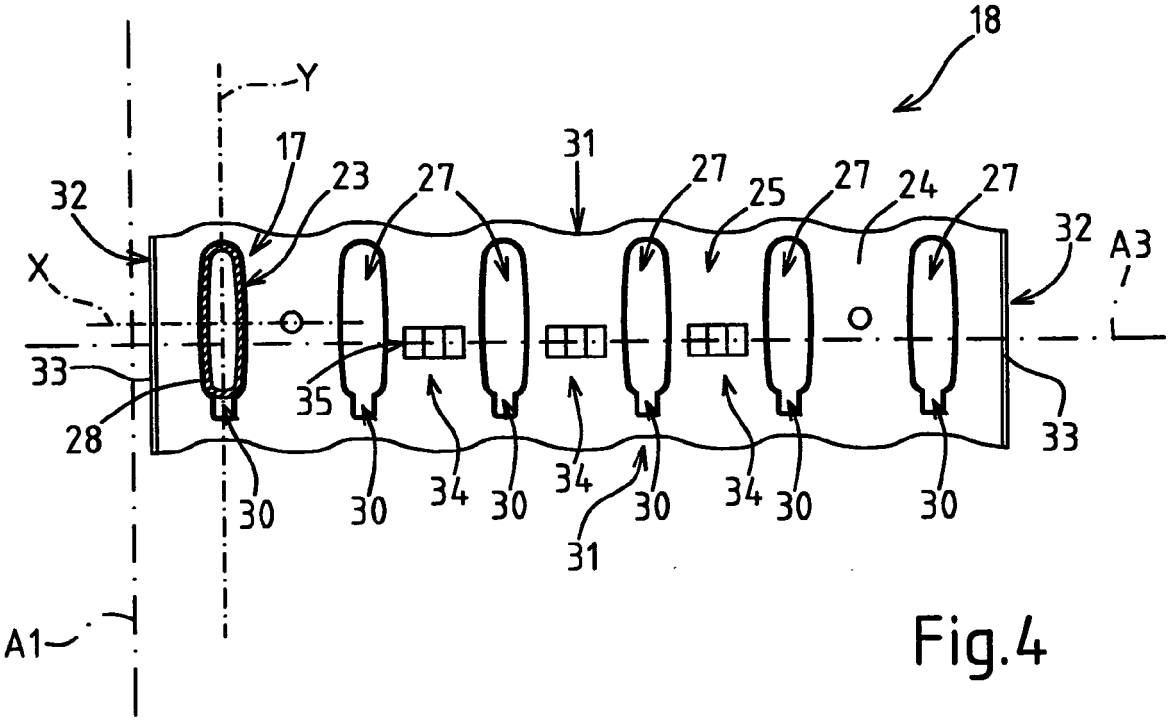
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Fig.4

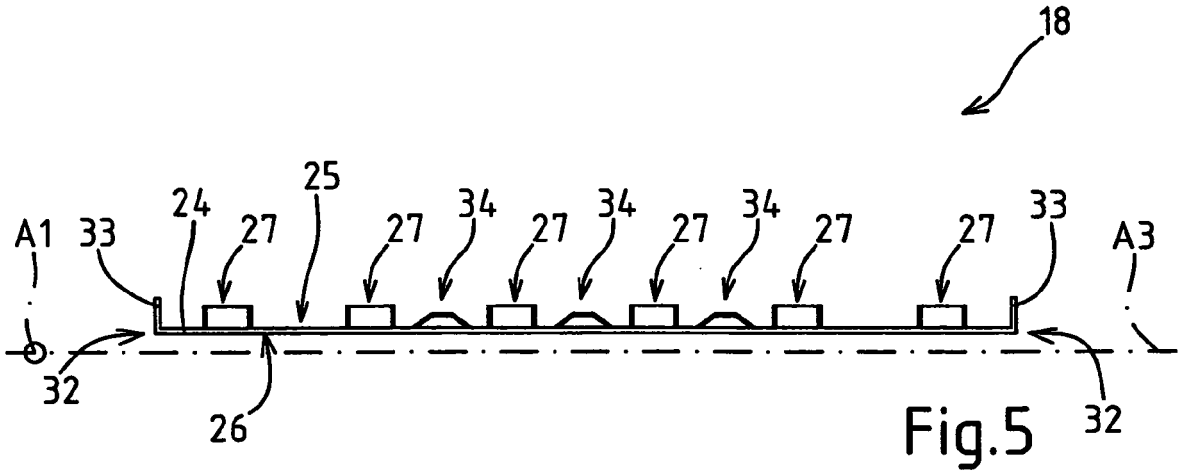
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Fig.5

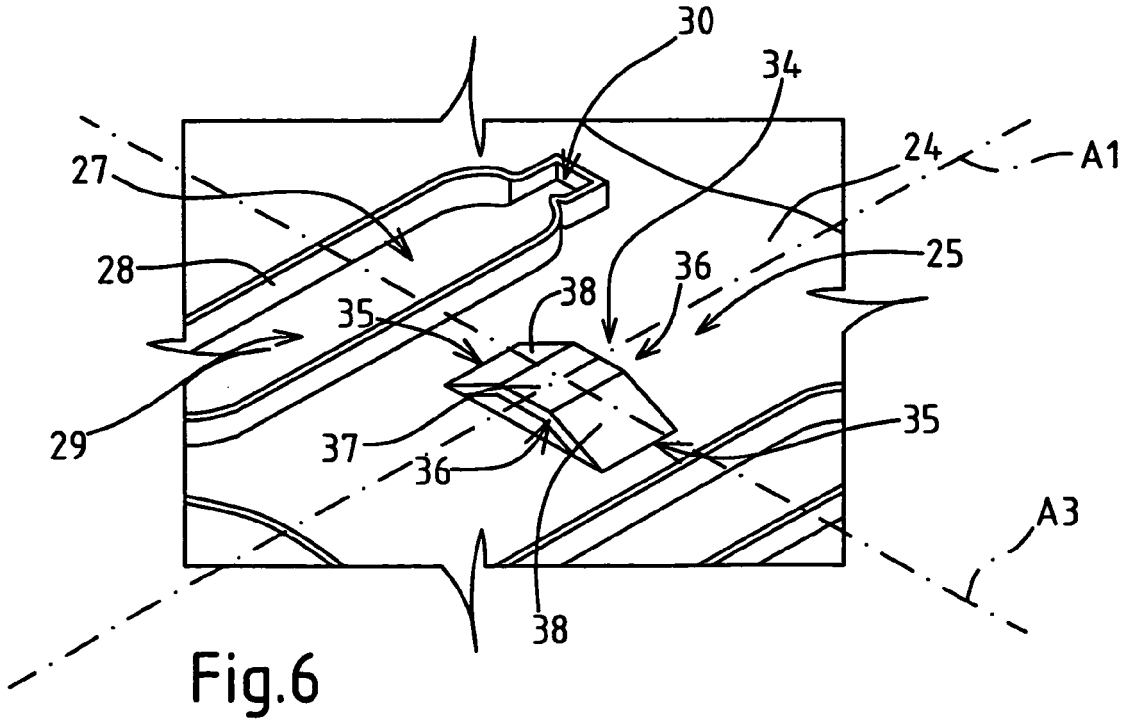
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Fig.6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 42 5725

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 315 577 A2 (VAILLANT JOH GMBH & CO [DE]) 10 May 1989 (1989-05-10) * the whole document * -----	1-8,10, 11	INV. F24H1/40 F24H9/00 F28F1/32
X	NL 98 349 C (DESSA WÄRMEGERÄTE GMBH) 15 June 1961 (1961-06-15) * the whole document * -----	1,2,10	F28F13/06

TECHNICAL FIELDS SEARCHED (IPC)

F24H
F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	11 April 2007	van Gestel, Harrie

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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11-04-2007

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