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(54) Heat exchanger with tap water duct, and heating device comprising such heat exchanger

(57) A heat exchanger comprising a burner, a flue duct, a heating chamber with heat exchanging elements and at least one duct for feeding therethrough a medium to be heated, abutting at least partly against the heating chamber, wherein the heating chamber is bounded by at least a base plate, with the base plate carrying at least a part of the heat exchanging elements and being in contact with the medium-conveying duct which is incorporable into a space heating circuit, while on the side of the medium-conveying duct remote from the base plate, a water duct is arranged which is incorporable into a sanitary water circuit, the arrangement being such that water flowing in the water duct is heatable by heat exchange with at least medium in the medium-conveying duct. The side of the combustion chamber remote from the base plate is preferably covered by a hood.

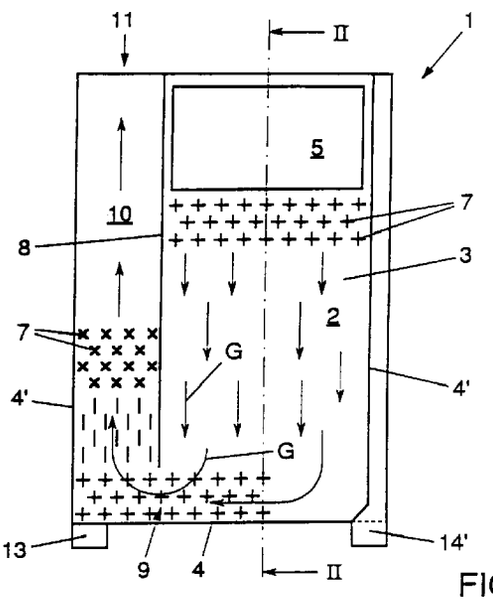

FIG. 1

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Description

This invention relates to a heat exchanger, comprising a burner, a flue duct, a heating chamber with heat exchanging elements and a duct for feeding therethrough a medium to be heated, abutting at least partly against the heating chamber, and a combined boiler comprising such heat exchanger. Such a heat exchanger and combined boiler are known from practice.

In such known combined CH/hot water facilities, in some manner or other a water tank (boiler) has been added to a central-heating boiler, the contents of which water tank are heated by a medium such as water that has been heated in the central-heating boiler and circulates in a closed circuit. In principle, there are two possible designs for the sanitary water heater, namely:

- as a tapping or through-flow boiler, which is filled completely with water from the closed circuit of the central-heating boiler and comprises a coil connected at one end to the water mains while at the other end hot water for domestic use can be tapped. This is a compact construction which can be supplied in a size of approximately 30x30x100 cm. Its operation is comparable to that of a (gas) water heater;
- as a storage boiler, in which a large quantity of water for domestic use is stored, which is heated by heated central-heating water directed through a coil. This design is comparable with an (electric) boiler. The dimensions of storage boilers are generally larger, for instance approximately 60x60x100 cm.

Both types can be arranged adjacent to the central-heating boiler and, in principle, in both cases, water is heated in the central-heating boiler for a specific purpose, namely space heating, with the heated water being passed through, for instance, radiators, which central-heating water also heats water that is supplied for a different purpose (domestic use).

Recent developments in the field of combined boilers of the first-mentioned type, that is, of the tapping or through-flow type, in which water from the closed central-heating circuit is directed to a heat exchanger comprising a tank in which extends a sanitary water tapping coil connected to the water mains, have led to compact wall installations. For the heat exchange between the central-heating water and the sanitary water, at least a separate boiler tank, connecting pipes between the boiler tank and the central-heating boiler, and a copper pipe coil for hot sanitary water to be tapped are necessary.

Another recent development comprises the use of a relatively small boiler tank, with a volume of, for instance, 3 liters, which is constantly maintained at a particular temperature and upon tapping is directly additionally heated.

In all of the above-mentioned known combined boiler designs, at least if they are to enable the tapping of water at the desired high temperature after only a short time (convenience time), a relatively large buffer stock of water in a vessel must be constantly maintained at a high temperature. This means that also during periods when the central heater is switched off for space heating purposes (for instance in the summer and during holidays) an amount of water corresponding with the contents of the buffer vessel must be maintained at a high temperature.

The object of the present invention is to provide a compact combined boiler, whereby these drawbacks are avoided. To that end, a combined boiler according to the invention is characterized by the features according to the characterizing clause of claim 1.

In the combined boiler according to the invention, a heat demand can be met substantially directly, both for space heating and for sanitary water heating. The convenience time is short, while no heat is lost if there is no heat demand. This is of importance in particular in the event of prolonged absence of any heat demand for the space heating circuit and/or for the sanitary water circuit. Because only a small amount of heat-transferring medium needs to be pumped round for circulation in the duct arranged closely against the heating chamber, and only a small mass needs to be heated, varying heat demands can be met fast.

In an advantageous embodiment, the or each water duct is internally lined with a plastic which does not affect the quality of the sanitary water. Instead of plastic, a metal lining can be used too, for instance copper or a copper alloy.

In further elaboration of the invention, the two water ducts are designed with a rectangular cross section, so that the available volume is utilised to a maximum. Both ducts are preferably pressure-resistant to, for instance, 4.5 bar for the central-heating water duct and 12 bar for the sanitary water duct, respectively.

When a heat exchanger according to the invention is used, in particular when the heat exchanger is used at relatively low temperatures, relatively much condensation will be formed in the combustion chamber. This is to be discharged from the combustion chamber and entails undesired pollution in the apparatus. With the known heat exchanger, this means that the combustion space should be provided with condensate discharge means and moreover that cleaning the combustion chamber and the burner is difficult to implement.

Accordingly, a further object of the invention is to provide a heat exchanger of the type described in the preamble, whereby the above-mentioned disadvantages are avoided, while the advantages thereof are maintained, and which heat exchanger is suitable over a relatively large temperature range, in particular also at relatively low temperatures. To that end, the heat exchanger according to the invention is characterized by the features according to claim 6.

Because in the heat exchanger according to the invention the cover, which co-defines the heating chamber, is simply removable, the heating chamber, at least the side of the base plate proximal to the combustion chamber and the heat exchanging elements, and the burner are readily accessible for inspection and maintenance. If during the use of the heat exchanger condensation and/or pollution occurs, the cover can be removed periodically and the different parts can be cleaned. Moreover, when damaged, parts can be simply repaired or replaced. Condensate can be simply collected, for instance in the cover, and be removed after removal of the cover. A further surprising advantage of the heat exchanger according to the invention is that it can be made of relatively shallow design, since a medium-conveying duct is arranged only on one side of the heating chamber. As a result, a compact heat exchanger can be obtained with a sufficient capacity and a low convenience time, that is, bringing the water to the required temperature by means of the heat exchanger takes only little time.

In an advantageous embodiment, the heat exchanger according to the invention is characterized by the features according to claim 7.

In the first (lower) part of a flue duct connecting to a heat exchanger, the flue gases have the highest temperature and moreover most condensate, and hence pollution, will concentrate there. Since in this embodiment of the heat exchanger this first part of the flue duct still extends within the heat exchanger and is covered by the detachable cover, the residual heat of the flue gases can still be utilized and this part of the flue duct can moreover be simply inspected and cleaned, while the condensate can be simply removed. In this connection, it is advantageous when the first part of the flue duct is at least partly provided with heat exchanging elements which preferably allow easier passage to the flue gases than do the heat exchanging elements in the heating chamber. Thus the residual heat of flue gases is utilized in optimum manner.

Further advantageous embodiments of a heat exchanger according to the invention are characterized by the measures according to the subclaims.

To clarify the invention, an exemplary embodiment of a heat exchanger and a heating apparatus will be described with reference to the drawings.

Fig. 1 shows a front view of a heating apparatus with heat exchanger according to the invention, with the cover removed;

Fig. 2 shows a side view of the heating apparatus with heat exchanger, partly sectioned along the line II-II in Fig. 1, with fitted cover; and

Fig. 3 shows a front view of an alternative embodiment of a heating apparatus according to the invention with detached cover and partly cutaway base plate and medium-conveying duct.

Fig. 1 shows a front view of a heating apparatus with heat exchanger 1 according to the invention, with open heating chamber 2. The heating chamber 2 is bounded at the back by a base plate 3, at the bottom and the two sides by an upright wall 4 and 4', respectively, and at the top by a burner 5. The burner 5 is preferably of the pre-mix type and can be inserted in the heating chamber or form an integral part thereof. During normal use, the heating chamber 2 is bounded at the front by a cover 6, removed in Fig. 1, but visible in Fig. 2.

A multiplicity of finger-shaped heat exchanging elements, designated fingers 7, extend from the base plate 3 into the heating chamber 2, as far as a point close to, and preferably substantially against, the cover 6 (when fitted; see Fig. 2). The fingers 7 are, for instance, arranged in rows, such that the fingers 7 in adjacent rows are mutually staggered. Thus the fingers 7 define a labyrinthine path through the heating chamber 2.

Arranged in the heating chamber 2 is a partition 8 which extends in vertical direction from the top, next to the burner 5, in the direction of the bottom wall 4, parallel to the sidewall 4'. The partition 8 terminates at a distance from the bottom wall 4, thereby defining a passage 9. The partition 8, the adjacent sidewall 4', the base plate 3 and the cover 6 define a flue duct 10 which at one end is in open communication with the rest of the heating chamber 2 via the passage 9 and, at the other end, can be joined to a chimney (not shown) via a chimney opening 11. In at least a part of the flue duct 10, as in the rest of the heating chamber 2, fingers 7 can be arranged, preferably at greater intervals.

Extending at the back of the base plate is a medium-conveying duct 12 having a zigzag course (Fig. 2). This medium-conveying duct 12 has an inlet side 13 adjacent the underside of the heat exchanger, at the lower end of the flue duct 10, and an outlet side 14 basically located adjacent the top of the heat exchanger 1, diametrically opposite the inlet side 13. A connecting tube 14' extends from the outlet side 14 along the sidewall 4' to a point adjacent the underside of the heat exchanger, such that the heat exchanger, at the underside thereof, is connectable to both the supply and the return pipe of a heating circuit (not shown). Viewed in the direction of flow, the medium-conveying duct 12 has, for instance, first a vertical loop at the back of the base plate adjacent (a part of) the flue duct 10 and then a number of horizontal loops arranged above each other on the back of the base plate adjacent the rest of the heating chamber 2 (Fig. 3).

As appears clearly from Fig. 2, on the side of the medium-conveying duct 12 remote from the base plate 3, a water duct 30 is arranged against the medium-conveying duct 12. This water duct 30 likewise has a meandering configuration, has an inlet 31 adjacent the underside of the heat exchanger 1, adjacent the inlet side 13 of the medium-conveying duct 3, and an outlet 32 adjacent the top of the heat exchanger, adjacent the outlet side 14 of the medium-conveying duct 12. The water duct 30 is incorporable into a sanitary water cir-

cuit, with mains water being supplied cold from a water mains pipe (not shown) via the inlet 31 and is passed out through the outlet 32 in heated condition. The operation of the heat exchanger will be further explained hereinafter.

The water duct 30 may be lined on the inside thereof with a relatively thin layer of plastic, which does not adversely affect the quality of sanitary water during its course through the water duct 30 and its heating therein. An advantage is that thus, legal regulations are satisfied in different countries without the water duct needing to be designed in, for instance, relatively expensive copper or brass. The water-conveying duct 30, like the rest of the heat exchanger, can be designed, for instance, in aluminum or an alloy thereof, so that the manufacture thereof is relatively cheap.

In an alternative embodiment, the or each water duct 30, rather than being lined with a thin layer of plastic, is lined with a thin layer of metal, in particular copper or a copper alloy, admitted as a drinking water conveying material. To that effect, a water duct can be formed, in particular bent, from a metal pipe or tube, which, prior to the formation of the base plate and the like, is thereafter placed in the die, whereafter the further heat exchanger is die-cast around the water duct. In this way an economically advantageous, safe heat exchanger is obtained.

A cover 6 is adapted to be clamped against the base plate 3 by means of four clamps 15, the cover 6 engaging the base plate and/or the walls 4, 4' in sealing gastight manner, optionally with interposition of a packing suitable therefor. The clamps 15 are designed as so-called quick acting clamps or comparable clamps. In a first position the cover 6 is pressed down against the base plate 3 by means of the clamps 15, in a second position the cover 6 can be removed. For instance by means of a lever, the clamps are simply movable between the first and the second position. It is noted that all kinds of other relatively simply detachable fastening means can be used, such as clamping springs, (wing) screws, sliding means and the like.

The heat exchanger 1 according to the invention can function as follows, assuming it is included in a suitable heating circuit and connected to a suitable fuel supply.

By means of the burner 5 heated flue gases are forced along the fingers 7 via the labyrinthine path in the direction of the passage 9 and thereafter via the passage 9 and the flue duct 10, along the fingers 7 arranged therein, towards the chimney. The flow of the flue gases is indicated schematically by the arrows G. While flowing through the heating chamber 2, including the flue duct 10, the heated flue gases give off their heat substantially to the fingers 7 and the base plate 3. Because the fingers 7, if any, in the flue duct 10 are spaced further apart and occupy only a part of the flue duct, an optimal exchange of heat between the relatively cold water and the strongly cooled flue gases is provided therein. The base plate 3 thereupon gives off the absorbed heat to medium, in particular water, which flows through the medium-conveying duct 12 and can be used for space heating.

Upon a demand for heat in a space heating circuit connected to the heating apparatus, water is brought to a suitable temperature and introduced into the space heating circuit via the outlet side 14, whereafter the water cooled to less than 50°C is returned via the inlet side 13 to the medium-conveying duct 12 again. Because the return temperature is relatively low, in the lower part of the heating apparatus condensation will occur, so that us can be made of heat of condensation. This means that the heating apparatus functions as a high-efficiency boiler.

Upon a demand for heated sanitary water, the burner will be set into operation, whereby water heated in the medium-conveying duct will be returned directly from the outlet side of the medium-conveying duct 12 to the inlet side and be reheated. During the passage of the medium-conveying duct 12, water in the water duct 30 is then heated to the desired temperature by heat exchange. Since only a relatively small amount of medium (water or, for instance, oil) needs to be heated in the medium-conveying duct 12, the stored heat in the heat exchanging element's own mass is large and the path to be covered is short, the convenience time, that is, the time elapsing between the registration of the heat demand and this demand being met, is particularly short.

In this connection, it is highly advantageous when a control is incorporated, which in each start-up situation provides for a fixed temperature difference between the mains water introduced and the heated medium in the medium-conveying duct 12. This difference can be, for instance, 45°C. When such a control is used, the convenience time is shortened, and moreover the convenience during use is appreciably improved as a result of a relatively constant temperature of the tap water.

After a certain lapse of time, the burner 5 can be switched off and the cover be removed upon release of the clamps 15. When the cover 6 has been removed, *inter alia* the heating chamber 2, the first part of the flue duct 10 and the burner 5 can be inspected and cleaned. Thus, water of condensation, if any, can be removed and so can other kinds of pollution. In addition, the operation of the burner 5 can be checked, for instance by checking the heat exchanger 1 for discolorations, since more strongly heated parts will discolor differently from less heated parts. After inspection and maintenance, the cover 6 can be simply re-placed, whereafter the heating apparatus can directly be set into operation again. The removal of the cover does not require that water be drained or otherwise precautions be taken other than switching off the burner.

In an advantageous embodiment, the base plate 3 is manufactured by die-casting or sand casting, preferably integrally with the sidewalls 4, 4', the fingers 7, the partition 8, the medium-conveying duct 12, the water duct 30 and/or the burner 5. As a result, no additional

assembly operations and sealing means are necesary and an optimum contact between the different parts is ensured. The cover 6, too, may be manufactured by casting. The parts referred to are preferably manufactured from aluminum or an aluminum alloy or like light metal. These have a favorable weight and favourable manufacturing and heat-technical characteristics.

Fig. 3 shows an alternative embodiment of a heating apparatus according to the invention, in which a gas block 40 and a fan 41 with a burner and a circulation pump 42 are arranged adjacent the lower end of the base plate 3, with the combustion chamber 43 being box-shaped.

By way of illustration, a number of measurements of possible embodiments of a heating apparatus are given, which are not to be construed as limitative. The heat exchanger has, for instance, a width of between 200 and 450 mm and a height of between 300 and 600 mm. The depth of the heating chamber is, for instance, approximately 70-80 mm, the maximum depth of the cover approximately 120 mm, adjacent the connection for the chimney. The flue duct extends into the heating chamber for a length of, for instance, approximately 500 mm. The medium-conveying duct 12 has a shape and cross section such that per hour for instance 300 to 1000 liters of water or any other such medium can flow through it, the water duct is so dimensioned that per hour for instance 150 to 450 liters can flow through it. The medium-conveying duct 12 and the water duct 30 have a substantially rectangular, round or oval cross-section. The heating element's own mass is, for instance, 20 kg in a design of aluminum or an alloy thereof. As a result of the smaller cross-sectional dimensions in particular, the water duct 30 has relatively much surface of contact, so that heat exchange can occur rapidly and energetically favorably. A combined boiler according to the invention is very compact, has a high output and a high efficiency.

The medium-conveying duct 12 is preferably resistant to a pressure of more than 4.5 bar, the water duct 30 preferably up to a pressure of at least 12 bar.

The invention is not limited in any way to the embodiments represented in the specification and drawings. For instance, different heat exchanging elements can be used and different arrangements thereof. Moreover, they can be omitted in the flue duct. Also, the flue duct may extend entirely outside the heating chamber or be incorporated therein for a larger part, for instance by arranging one or more further partitions. The cover may be designed differently, optionally in several parts, and may render the heating chamber accessible from a different side. The cover can be secured with a different number of clamps and can otherwise be detachably mounted in any suitable manner. Further, the medium-conveying duct and the water duct may be designed differently, for instance traverse a different course, or be arranged at least partly on other sides of the heat exchanger. Additionally, the cover may be replaced by a different covering, for instance fixedly connected with the base plate. Although the heating apparatus is suitable in particular for use at low temperatures, the use thereof is naturally not limited thereto. These and many other modifications are understood to fall within the scope of the invention.

Claims

1. A heat exchanger, comprising a burner, a flue duct, a heating chamber with heat exchanging elements and at least one duct for feeding therethrough a medium to be heated, abutting at least partly against the heating chamber, characterized in that the heating chamber is bounded by at least a base plate, with the base plate carrying at least a part of the heat exchanging elements and being in contact with the medium-conveying duct which is incorporable into a space heating circuit, while on the side of the medium-conveying duct remote from the base plate, a water duct is arranged which is incorporable into a sanitary water circuit, the arrangement being such that water flowing in the water duct is heatable by heat exchange with at least medium in the medium-conveying duct and is tappable from the sanitary water circuit connecting to the water duct.

2. A heat exchanger according to claim 1, characterized in that on opposite sides of the heating chamber a medium-conveying duct and a water duct are arranged.

3. A heat exchanger according to claim 1 or 2, characterized in that the or each water duct is lined on the inside thereof with a layer of plastic which does not affect, at least not adversely so, the quality of the sanitary water.

4. A method according to claim 1 or 2, characterized in that the or each water duct is lined on the inside thereof with a metal which does not affect, at least not adversely so, the quality of sanitary water flowing therethrough, with the metal being preferably copper or a copper alloy.

5. A method according to claim 4, wherein the metal lining is formed by a tube cast in the heat exchanger.

6. A heat exchanger, optionally according to any one of the preceding claims, comprising a burner, a flue duct, a heating chamber with heat exchanging elements and a duct for feeding therethrough a medium to be heated, abutting at least partly against the heating chamber, characterized in that the heating chamber is bounded by at least a base plate and a cover, with the base plate carrying at least a part of the heat exchanging elements and being in contact with the medium-conveying duct,

and the cover being simply removable so as to clear at least the heat exchanging elements, the arrangement being such that after removal of the cover, in particular the base plate and the heat exchanging elements are clear for inspection and maintenance..

7. A heat exchanger according to claim 6, characterized in that at least a part of the flue duct extends through the heating chamber, which part is covered and clearable by the removable cover.

8. A heat exchanger according to any one of the preceding claims, characterized in that the base plate, at least during normal use, includes an angle with the horizontal and extends preferably in substantially vertical direction, with the burner connecting to the heating chamber adjacent the upper end of the base plate, and the flue duct connecting thereto adjacent the lower end of the base plate.

9. A heat exchanger according to any one of the preceding claims, characterized in that substantially all heat exchanging elements extend from the base plate into the heating chamber as far as close to the opposite side of the combustion chamber, in particular the cover.

10. A heat exchanger according to any one of the preceding claims, characterized in that the heat exchanger is substantially manufactured from aluminum or an aluminum alloy, preferably by casting, with the heat exchanging elements formed integrally with the base plate.

11. A heat exchanger according to any one of claims 6-10, characterized in that clamping means are provided for clamping the cover against the base plate.

12. A heat exchanger according to any one of the preceding claims, characterized in that a part of the heat exchanging elements extend in the flue duct.

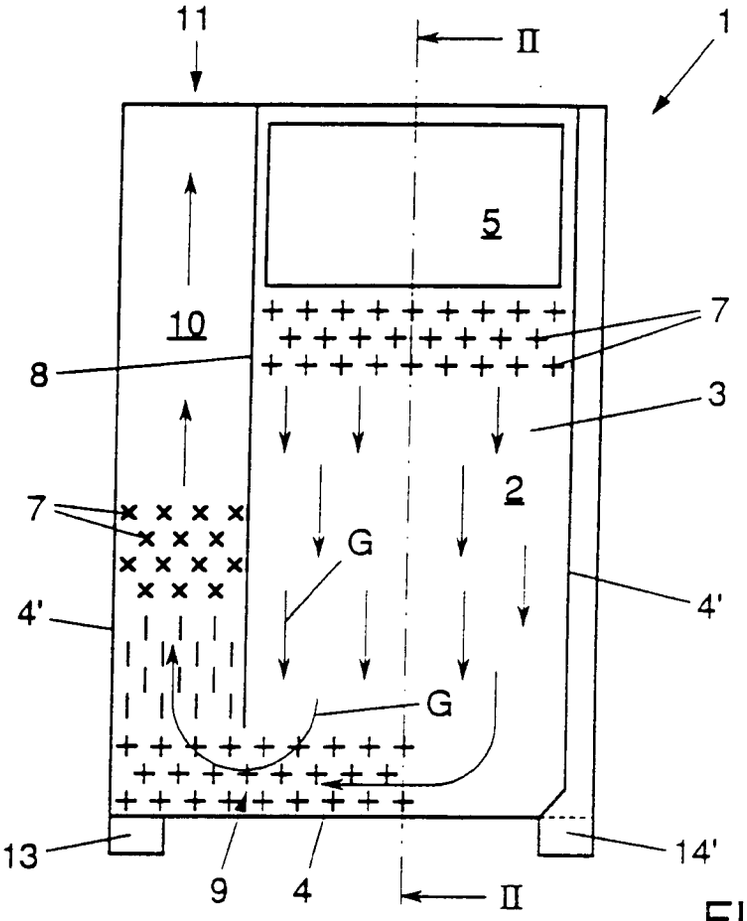

FIG. 1

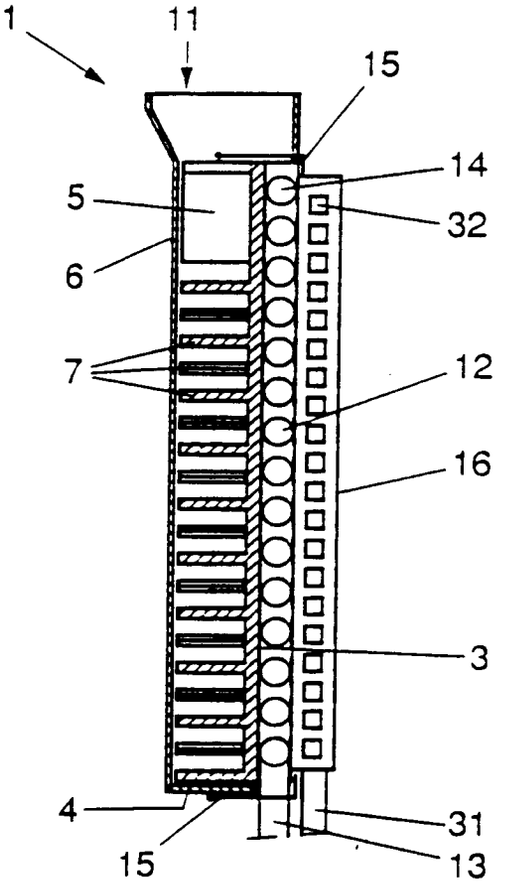

FIG. 2

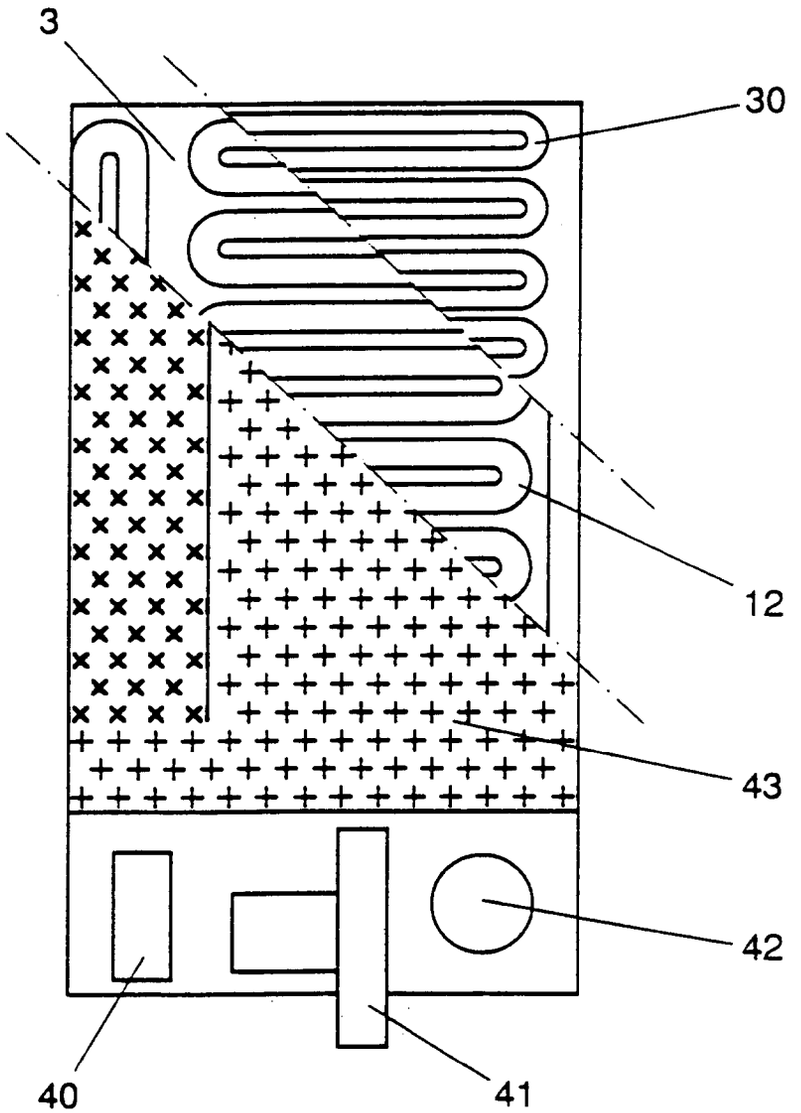

FIG. 3