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(54) ELECTRICAL HEAT STORAGE BOILER.

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Description

The invention relates to boilers in which water is heated by electricity, through the medium of a core of material capable of storing heat, the core being heated by electrically powered heating elements and heat from the core being transferred to a secondary circuit in which a fluid, commonly water, is circulated, as in the case of a domestic central heating or hot water system. It is envisaged that such electrically heated boilers be used in place of gas, oil or solid fuel boilers which also heat fluid secondary circuit in a way which is familiar.

Electric boilers exist which include a core and elements as referred to above, and in which transfer of heat from the core to the secondary circuit is achieved using air as the heat transfer medium. Thus air is heated by the core and the heated air passes over a heat exchanger through which water in the secondary circuit passes. A more recent approach to an electric storage boiler is to utilise steam as the medium for transferring heat from the store to the secondary circuit. The general arrangement which has been proposed has a core of material capable of storing heat, electrically heated element means in the core, a primary heating circuit, in which water is supplied to the base of boiling tubes which pass steam upwards through the core to a heat exchanger, from which condensed water is returned to the base of the boiling tubes, losses being made up from a header tank or similar arrangement, and a secondary heating circuit portion which passes through the heat exchanger and which is connected, in use, to a secondary heating circuit in a conventional way, the secondary heating circuit including radiators and/or a coil for heating water in a domestic hot water cylinder. Such an electric boiler will be referred to hereinafter as "an electric boiler of the kind described", and is envisaged as a substitute for a gas, oil or solid fuel boiler.

Electric boilers as defined in the pre-characterising part of claim 1 are known from DE-A-1812340 and FR-A-1434485.

A practical problem with electric boilers of the kind described is arranging for manageable installation and servicing, for example replacement of heating elements which may fail from time to time. In order to provide a satisfactorily large heat store, a substantial weight of heat storing bricks is necessary and it is desirable to be able to install and service the boiler from a single direction, preferably from the front so that the boiler can be placed, if desired, under a working surface.

According to the invention, there is provided an electric boiler in which a liquid is heated by means of a heat storing core, the core consisting of a multiplicity of first heat storing bricks and being heated by electrically powered heating elements, and heat from the core is transferred to a primary heating circuit in which the liquid is circulated, the primary heating circuit comprising a plurality of boiling tubes extending substantially vertically in an insulated casing surrounding the core, the casing having a front face, a rear face and two side faces, said boiling tubes being arranged in at least one row extending essentially parallel to said front face, said first bricks lying against the boiling tubes and having side face profiles formed to provide channels for accepting part of a boiling tube whereby a combination of such first bricks surrounds a length of boiling tubes, characterised in that

said front face is openable to allow installation of the core and access thereto, and

between the side faces of the casing and the first bricks as well as between the first bricks of two adjacent tubes of the same row are arranged second bricks which do not engage any parts of the boiling tubes.

The bricks in an assembled core preferably define channels extending from front to rear of the boiler, the heating elements being elongate and located in the core by sliding into the channels from the front of the core. Each element is preferably U-shaped. The cross-sectional profile of the element channels and the cross-section of the heating elements are preferably such that contact is achieved between a portion of the external surface of each element and the adjacent bricks.

The bricks which lie against the boiling tubes may be of a different profile from the second bricks. The second bricks preferably have planar faces, and each brick which lies against the boiling tubes preferably includes not only the boiling tube portion accepting channel but groove means extending, in use, in a direction from front to back of the core, which groove means defining with a planar face of a second brick at least one channel for accepting an element. Each groove means preferably has two parallel grooves such that each pair of bricks which includes a second brick defines two element channels.

The core preferably comprises a plurality of brick and boiling tube units, each unit comprising a length of boiling tube, a pair of bricks lying against and surrounding, between them, the length of boiling tube, and a pair of second bricks, each lying outside and against a respective one of the boiling tube contacting bricks to define at least one element channel on each side of the boiling tube.

The larger the boiler capacity, the larger the number of brick and boiler tube units, but a preferred embodiment envisages a boiler tube to be three brick courses high, and with four boiling tubes, a total of forty-eight bricks. With such a height, a boiler with two boiling tubes would have twenty-four bricks, and a boiler with six boiling tubes would have seventy-two bricks.

The insulated casing preferably has a front insulation layer including slots through which the elements pass whereby contacts for connecting each element to an electrical supply lie on the side of the insulation remote from the core, in use.

Metal sheets, for example of stainless steel, may be placed within and to cover the inner surfaces of the insulation on the side walls, base and top of the casing. A further metal sheet, again of stainless steel for example, may be placed in a vertical plane adjacent walls of the further bricks.

Preferably a header tank provided for the boiler has a capacity substantially larger than, and preferably at least double the capacity of the primary heating circuit.

Preferably the composition of bricks contacting a boiling tube is different from the composition of bricks not contacting a boiling tube, and the thermal conductivity of bricks contacting a boiling tube is greater than the thermal conductivity of bricks not contacting a boiling tube.

The composition of the bricks lying between elements may be magnetiteand the composition of bricks between an element and a boiling tube may be a mixture of magnetite and magnesite. The proportion of magnetite to magnesite may be varied from boiler to boiler to achieve particular storage and heat release characteristics.

Preferably the edge profiles of insulation layers around the core are such that there is a stepped edge profile on at least one of and preferably both insulation layers abutting at right angles.

By way of example, one embodiment of an electric boiler according to the invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a schematic illustration of the pipework layout of a boiler;

Figure 2 is a plan view of a course of core bricks in the boiler of Figure 1 having four boiling tubes;

Figure 3 is a sectional view along the lines X-X in Figure 2, and showing one element in position for the sake of example;

Figure 4 is an exploded view of the course of bricks of Figures 2 and 3;

Figure 5 is a side view of a heating element;

Figure 6 is a plan view of the heating element of Figure 5;

Figure 7 is a plan view of side, front and rear insulation of the casing;

Figure 8 is a front view of insulation of the casing, but without base and front insulation;

Figure 9 is a side view of top, front and rear insulation;

Figure 10 is a plan view of base insulation;

Figure 11 is an end view of the base insulation of Figure 10;

Figure 12 is a view of a header tank and condensing vent as incorporated in another boiler according to the invention; and

Figure 13 is a schematic illustration of an alternative pipework layout for a boiler according to the invention.

Figure 1 shows a schematic layout of pipework in an electric boiler 10 according to the invention. A primary heating circuit has four boiling tubes 11 surrounded in an assembled boiler by a core of heat storing bricks (not shown in Figure 1). Vaporizable liquid, preferably demineralised water, is fed to the base of the boiling tubes 11 via pipes 12 and water in the boiling tubes is turned to steam by heat in the core, the steam rising from the boiling tubes to a heat exchanger 13 through which liquid in a secondary heating circuit 14 flows. Steam from the boiling tubes condenses in the heat exchanger 13 while giving up its heat to the secondary circuit 14, condensed steam returning via pipe 15 and motorised valve 16 to the pipes 12. The motorised valve 16 is opened to allow the primary heating circuit to operate if there is a demand for heat from the secondary heating circuit 14. The motorised valve 16 can be controlled, for example, by a room thermostat or other suitable means to indicate a need for heat.

To insure an adequate level of fluid in the primary heating circuit, a header tank 17 having a capacity approximately twice that of the primary heating circuit is able to feed liquid via the motorised valve 16 to the pipes 12. Non-return valve 18 is provided to allow water to return to the header tank 17 when heat is not required from the boiler and the motorised valve 16 is therefore closed. A drain cock 20 is provided to allow the header tank 17 to be drained.

When the motorised valve 16 is first opened after a spell of the primary heating circuit being closed, air will be present in the chamber of the heat exchanger 13 and it is necessary to allow that air to be flushed out of the heat exchanger. To this end, a capillary bleed is provided from the heat exchanger 13 into the header tank 17, a non-return valve 22 being fitted to prevent return of fluid from the header tank 17 to the heat exchanger 13. Air present in the heat exchanger 13 can be flushed through the capillary 21, subsequent loss of steam from the heat exchanger due to the permanent presence of the capillary 21 being negligible when the system if fully operational. It will be appreciated that any steam passing through the capillary 21 will have condensed during passage through the capillary lying in liquid in the header tank 17.

A flow heater 23 is provided in the secondary heating circuit to provide direct heating in the secondary heating circuit if necessary. A control system provides apportionment of heat supplied to the secondary heating circuit from the flow heater 23 or the heat exchanger 13. The presence of the flow heater 23 and the control system therefore is the subject of a copending Patent application of today's date.

Figure 12 shows the header tank 17 in isolation.

In order to allow liquid to be drawn from the header tank 17 , venting to atmosphere must take place. Venting takes place via a tube coupling 130 to which is connected a small bore tube 131. A preferred bore for the tube 131 is 3mm but it will be appreciated that other small bore tubes may be used, typically in the range 1mm to 5mm although other bores may be appropriate in certain circumstances. The tube 131 runs horizontally in an upper portion and bends downwards at point 132. In an assembled boiler, the tube 131 would exit from the boiler casing on the header tank side of the bend 132. From the bend 132, the tube 131 extends downwards and into a larger bore tube 133, in this embodiment of 8mm bore. The larger bore tube could be of a different bore from 8mm, for example within the range 5mm to 10mm although other bores could be used. The tube 131 extends to the lowest point of the larger bore tube 133, the larger bore tube 133 then rising in a S configuration to an outlet 134. In this way, there is a long condensation path for vapour trying to leave the tube 133, condensed vapour forming a liquid pool rising from the lowest point of the tube 133.

When water is drawn from the header tank to feed the primary heating circuit, when the boiler is in use, liquid from the bottom of the larger bore tube 133 is drawn back to the header tank through the small bore tube 131. The smaller the volume within the small bore tube 131, the more liquid will be returned to the header tank for a given displacement of water from it.

Throughout this specification, it will be appreciated that water is not the only liquid which could be used in the primary heating circuit although it is the preferred vaporizable liquid.

The advantage of this embodiment of a header tank according to the invention is that evaporation losses from the header tank are minimised, thereby reducing the frequency at which the header tank must be refilled.

Figure 2 shows a plan view of a core of bricks surrounding the four boiling tubes 11. Figure 2 shows one course of heat storing bricks and, in the embodiment shown, there are sixteen bricks in each course, there being three courses of bricks in all making forty-eight bricks in the entire core.

As can be seen in Figures 2, 3 and 4, Figure 3 being a section along the lines X-X in Figure 2 and Figure 4 being an exploded view of the bricks, two different shapes of brick are used.

Around the boiling tubes are arranged bricks 30 of a first shape having semi-circular section, vertical channels 32 formed therein such that two bricks 30 are able to surround a single boiling tube 11. Additionally, the shaped bricks 30 includes horizontal channels 31 which define with plain, cuboidal bricks 35 heating element channels 36. Into which elongate sheathed heating elements 40 can be slid. One such element 40 is shown in a channel 36 in Figure 3.

A heating element 40 is shown in more detail in Figures 5 and 6, the element 40 being of the sheathed type and being of elongate U-shape. As can be seen in Figure 3, the dimensions of the element channel 36 are such that the sheath of the element makes physical contact with curves of the channel 36 to provide enhanced heat transfer from the element to adjacent bricks. Legs of the U-shape element 40 are held together remote from the base of the U-shape by a mounting plate 41. In assembling a boiler 10, each heating element 40 is slid into a respective heating element channel 36 in the core, having first passed through a front, slotted insulation slab against which the mounting plate 41 lies adjacent in its final position. This arrangement has the advantage that electrical connections 42 through which power is supplied to each heating element 40 are insulated from the main heat of the core. There is no view of the front insulation slab of the boiler 10 but it will be appreciated that the front insulation slab includes a number of elongate slots for engagement by the heating elements 40 corresponding to the number of heating elements 40 in the boiler 10 and at positions corresponding to the heating element channels 36 in the core. Wiring connections to the heating elements 40 are arranged conventionally and will therefore not be described in detail.

The material of the heat storing bricks 30 and 35 may be the same, for example magnetite or magnesite or a mixture of the two, magnesite having a higher thermal conductivity than magnetite which can be advantageous in transferring heat stored in the core more rapidly to the boiling tubes 11. It is also possible and can be advantageous for particular boiler demands to form the shaped bricks 30 of a material having higher thermal conductivity than the plain bricks 35. In the configuration described, it is the shaped bricks 30 which lie against the boiling tubes and an increase in thermal conductivity of the shaped bricks 30 results in easier passage of heat to the boiling tubes 11. Where the bricks are made of a mixture of magnetite and magnesite, an increase in thermal conductivity can be achieved by increasing the proportion of magnesite in the bricks. Forming the two sorts of bricks of different compositions is economically sensible since magnesite is significantly more expensive than magnetite, the materials having similar heat storing capacities but different thermal conductivities. A further advantage of having the shaped bricks 30 with a higher thermal conductivity is that it provides a better direct conduction path from the elements 40 to the boiling tubes 11 should it be necessary to boost the core temperature while heat is actually being drawn from the core in order to provide steam for the heat exchanger 13 to heat the secondary circuit 14. Efficiency of such an operation is thus increased.

The number and type of bricks 30 and 35 employed allows filling of a boiler casing to be achieved from the front of the casing. The core is assembled by first placing the shaped bricks 30 of a particular course around the boiling tubes 11, thereby leaving a space the width of two plain bricks 35 between the shaped bricks and a space the width of one plain brick 35 between respective shaped bricks 30 and the casing side walls. This means that the respective course of bricks can be completed simply by sliding in plain bricks 35 from the front. In the particular embodiment shown, there are three courses of bricks and each course can be built up in exactly the same way, placing of the shaped bricks in position being straightforward in view of the amount of space on either side and positioning of the plain bricks requiring no turning, simply sliding in a front to rear direction.

Once the core has been assembled, the front insulation slab is placed in front of the core and the elements 40 are simply slid through the front insulation slab and between the bricks in respective element channels 36. Thus, assembly is achieved entirely from the front and servicing of elements, should there be a failure, is likewise achieved through the front of the casing. This enables the boiler to be fitted under a work surface and yet be serviceable.

Equipment above the core such as the header tank, heat exchanger and flow heater are also arranged to be accessible from the front.

It will be appreciated that with a core of bricks heated to temperatures of 750°C or higher, for example 850°C, and with it being desirable to minimise heat loss from the casing since the boiler is designed to supply a secondary heating circuit, care must be taken to maximise the efficiency of the casing insulation. Calcium silicate is preferably used for the base insulation, and microporous insulation is preferably used for the other areas. This material has, however, to be treated carefully, and without protection, there is a risk of damage from abrasion when sliding in bricks during assembly of the core. Accordingly, thin sheets of metal, preferably stainless steel, are used to protect the base, side and top insulation in the casing. These protective sheets, particularly against the side insulations, have an additional advantage that, at high temperatures the sheets tend to bow and thus force inwardly the bricks of the core with which they are in contact. This has an effect of improving physical contact between the shaped bricks and the boiling tubes and also the bricks surrounding the heating elements 40. An additional possibility is to provide a thin sheet of metal, for example stainless steel, extending vertically from front to rear of the core. This sheet acts initially as a shim and also bows at high temperatures to enhance the effect described above with the protective side sheets.

While heat losses directly through the wall insulation can be minimised, a consistent problem arises where slabs of insulation meet at a right angled corner. To minimise corner losses, the insulation slabs have been designed as shown in Figures 7, 8, 9 and 10 to provide at every corner at least one step contact so that there is no direct heat leakage path from the core to outside the insulation. This is achieved by stepping the insulation slabs at their periphery, the slabs being formed either in one piece with a step or in two pieces, one piece being of smaller dimensions than the other. With reference to Figure 7 (a plan view), rear insulation 50 has stepped side edge profiles 51 which mate with stepped side edge profiles 52 of side insulation panel 53, 54. Front insulation slab 55 has plain edges and locates in a recess formed by steps 56 in the side insulation slabs 53 and 54.

Figure 8 shows the stepped profiles 56 of the side insulation slabs 53 and 54 and that the stepped arrangement continues to the top of the side insulation slabs 53, 54 to mate with stepped profile in top insulation 57.

Figure 9 shows stepped mating of top and rear insulations 57 and 50 respectively and the mating of front insulation 55 with the top insulation 57.

Figures 10 and 11 show the base insulation slab 60 having a peripherally stepped profile shown in Figure 11. Four holes 61 are provided for allowing the base insulation slab 60 to slide over the boiling tubes 11 during assembly.

An advantage of this embodiment of the invention is that installation and maintenance of the boiler can be achieved from the front of the boiler. Installation can be effected by plumbing in the boiler to the secondary circuit, which may be in existence already or may be a new system, before the core is built in the casing and then building the core around the boiling tubes and in the remainder of the casing space from the front of the casing. The elements are then inserted from the front, after the front insulation is in place, and the casing is then closed for the front cover. Should an element need to be replaced, the front cover is removed, the non-functioning element disconnected and slid out and a replacement element slid in and connected. The flow heater is arranged so that its element can be replaced from the front also. The insulation profiles minimise heat losses at corners. The capillary bleed from the heat exchanger to the header tank allows convenient flushing of air when use of the boiler is started in a simple fashion and with negligible subsequent steam loss. Providing the header tank with a capacity substantially larger than the capacity of the primary heating circuit means that topping up of the header tank can be infrequent, it being desirable to provide for topping up during an annual maintenance inspection of the boiler.

With specific reference to Fig. 13 which shows an alternative pipework layout for a boiler, the pipework includes boiling tubes (64), a heat exchanger (66) and an auxiliary flow heater (68). A return pipe (70) extends from the primary heating circuit to the header tank (72). The top of the return pipe is above the water level in the header tank at all times so that water cannot pass from the header tank down the return pipe (70).

When the secondary heating circuit is switched off, it is advantageous if there is no water or steam left in the primary heating circuit since if there were, this would consume energy from the core due to continual evaporation and condensation of the water/steam. Accordingly, in order to remove the water and steam from the primary heating circuit the motor valve (74) is closed to prevent water entering the primary heating circuit from the header tank (72) and the solenoid valve (76) between the heat exchanger and the header tank (72) is also closed. Pressure within the primary heating circuit then forces the water/steam in the primary circuit up the return pipe (70) and into the header tank (72). No water from the header tank can pass down the return pipe (70) since the upper end of the pipe is above the water level in the header tank (72).

The header tank (72) includes a sensor (78) to determine the water level in the tank (72) and hence when additional water should be added via the inlet (80). When the water level in the header tank (72) has fallen below a predetermined level, the sensor (78) is triggered and a light illuminates on the control panel of the boiler appliance.

In a preferred embodiment of the invention the header tank is made of plastics material which enables it to withstand changes in internal pressure and temperature by virtue of its suitable properties. Further, the heat exchanger is more efficient if it is made from copper rather than steel, and water can be drained from the heat exchanger more easily if the exchanger is angled slightly with the drain pipe (82) extending from its lower end.

Claims

1. An electric boiler in which a liquid is heated by means of a heat storing core, the core consisting of a multiplicity of first heat storing bricks (30) and being heated by electrically powered heating elements (40), and heat from the core is transferred to a primary heating circuit in which the liquid is circulated, the primary heating circuit comprising a plurality of boiling tubes (11) extending substantially vertically in an insulated casing surrounding the core, the casing having a front face, a rear face and two side faces, said boiling tubes being arranged in at least one row extending essentially parallel to said front face, said first bricks (30) lying against the boiling tubes (11) and having side face profiles formed to provide channels (31) for accepting part of a boiling tube (11) whereby a combination of such first bricks (30) surrounds a length of boiling tubes (11), characterised in that

   said front face is openable to allow installation of the core and access thereto, and

   between the side faces of the casing and the first bricks (30) as well as between the first bricks (30) of two adjacent tubes of the same row are arranged second bricks (35) which do not engage any parts of the boiling tubes (11).

2. A boiler as claimed in claim 1, wherein the bricks (30,35) in an assembled core define channels (36) extending from front to rear of the boiler for receiving the heating elements (40), the heating elements (40) being elongate and located in the core by sliding into the channels (36) from the front of the core.

3. A boiler as claimed in claim 2, wherein the cross-sectional profile of the element channels (36) and the cross-section of the heating elements (40) are such that contact is achieved between a portion of the external surface of each element (40) and the adjacent bricks (30, 35).

4. A boiler as claimed in any preceding claim, wherein the first bricks (30) which lie against the boiling tubes (11) are of a different profile to that of the second bricks (35).

5. A boiler as claimed in claim 4, wherein the second bricks (35) have planar faces, and each brick (30) which lies against the boiling tubes (11) includes not only the boiling tube portion accepting channel (31) but groove means (32) extending, in use, in a direction from front to back of the core, which groove means defining with a planar face of a second brick (35) at least one channel (36) for accepting an element (40).

6. A boiler as claimed in claim 5, wherein each groove means (32) has two parallel grooves such that each pair of bricks (30,35) which includes a second brick (35) defines two element channels (36).

7. A boiler as claimed in any preceding claim, wherein the core comprises a plurality of brick and boiling tube units, each unit comprising a length of boiling tube (11), a pair of bricks (30) lying against and surrounding, between them, the length of boiling tube (11), and a pair of second bricks (35), each lying outside and against a respective one of the boiling tube contacting bricks (30) to define at least one element channel (36) on each side of the boiling tube (11).

8. A boiler as claimed in any preceding claim, wherein the boiler includes two boiling tubes (11) and twenty four bricks (30,35), or four boiling tubes (11) and forty eight bricks (30,35) or six boiling tubes (11) and seventy two bricks (30,35).

9. A boiler as claimed in any preceding claim, wherein metal sheets are placed within and cover the inner surfaces of the insulation on the side walls, base and top of the casing.

10. A boiler as claimed in any preceding claim, wherein a header tank (17) provided for the boiler has a capacity at least double the capacity of the primary heating circuit.

11. A boiler as claimed in any preceding claim, wherein the thermal conductivity of bricks (30) contacting a boiling tube (11) is greater than the thermal conductivity of bricks (35) not contacting a boiling tube (11).

12. A boiler as claimed in claim 11, wherein the composition of bricks (35) lying between elements (40) is magnetite and the composition of bricks (30) between an element (40) and a boiling tube (11) is a mixture of magnetite and magnesite.

13. A boiler as claimed in any preceding claim, wherein the insulated casing includes a plurality of insulating layers (50-57).

14. A boiler as claimed in claim 13, wherein the edge profiles the insulation layers (50-57) are such that there is a stepped edge profile on at least one of the insulation layers abutting at right angles.

Patentansprüche

1. Elektrischer Boiler, in dem eine Flüssigkeit durch einen Wärmespeicherkern erwärmt wird, welcher Kern aus einer Vielzahl von ersten Wärmespeichersteinen (30) besteht und durch elektrisch betriebene Heizelemente (40) erhitzt wird, wobei Wärme von dem Kern zu einem primären Wärmekreislauf übertragen wird, in dem die Flüssigkeit umgewälzt wird, und der primäre Wärmekreislauf eine Vielzahl von Siederohren (11) aufweist, die sich im wesentlichen vertikal in einem isolierten Gehäuse erstrecken, das den Kern umgibt und eine Frontfläche, eine rückwärtige Fläche und zwei Seitenflächen besitzt, und die Siederohre in wenigstens einer Reihe angeordnet sind, die sich im wesentlichen parallel zu der Frontfläche erstreckt, und die ersten Steine (30) an den Siederohren (11) anliegen und Profile auf der Seitenfläche haben, die so ausgebildet sind, um Kanäle (31) zum Aufnehmen eines Teils eines Siederohres (11) vorzusehen, und eine Kombination von derartigen ersten Steinen (30) einen Abschnitt der Siederohre (11) umgibt, dadurch gekennzeichnet, daß die Frontfläche geöffnet werden kann, um eine Installation des Kerns und den Zugriff auf diesen zu ermöglichen, und daß sowohl zwischen den Seitenflächen des Gehäuses und den ersten Steinen (30) als auch zwischen den ersten Steinen (30) zweier benachbarter Rohre derselben Reihe zweite Steine (35) angeordnet sind, die mit keinem Teil der Siederohre (11) in Eingriff sind.

2. Boiler nach Anspruch 1, bei welchem die Steine (30, 35) in einem zusammengesetzten Kern Kanäle (36) begrenzen, die sich von der Vorder- bis zur Rückseite des Boilers erstrecken, um die Heizelemente (40) aufzunehmen, wobei die Heizelemente (40) länglich sind und in den Kern eingelegt werden, indem sie von der Vorderseite des Kerns in die Kanäle (36) eingeschoben werden.

3. Boiler nach Anspruch 2, bei welchem das Querschnittsprofil der Kanäle (36) für die Elemente und der Querschnitt der Heizelemente (40) so ausgebildet sind, daß ein Kontakt zwischen einem Bereich der äußeren Oberfläche von jedem Element (40) und den benachbarten Steinen (30, 35) erhalten wird.

4. Boiler nach einem der vorhergehenden Ansprüche, bei welchem die ersten Steine (30), die an den Siederohren (11) anliegen, ein zu den zweiten Steinen (35) unterschiedliches Profil aufweisen.

5. Boiler nach Anspruch 4, bei welchem die zweiten Steine (35) ebene Flächen aufweisen, und jeder Stein (30), der an den Siederohren (11) anliegt, nicht nur den Kanal (31) zur Aufnahme eines Abschnitts eines Siederohres sondern auch nutartige Mittel (32) beinhaltet, die sich während des Gebrauchs in einer Richtung von der Vorder- zur Rückseite des Kerns erstrecken, wobei die nutartigen Mittel mit einer ebenen Fläche eines zweiten Steins (35) wenigstens einen Kanal (36) zur Aufnahme eines Elementes (40) begrenzen.

6. Boiler nach Anspruch 5, bei welchem jedes nutartige Mittel (32) zwei parallele Nuten besitzt, so daß jedes Paar Steine (30, 35), das einen zweiten Stein (35) beinhaltet, zwei Kanäle (36) für die Elemente begrenzt.

7. Boiler nach einem der vorhergehenden Ansprüche, bei welchem der Kern eine Vielzahl von Einheiten aus Steinen und Siederohren aufweist, wobei jede Einheit einen Abschnitt eines Siederohres (11), ein Paar Steine (30), die an dem Abschnitt des Siederohres (11) anliegen und zwischen ihnen den Abschnitt des Siederohres (11) umgeben, und ein Paar von den zweiten Steinen (35) aufweist, die jeweils auf der Außenseite von und an den entsprechenden Steinen (30), die in Kontakt mit dem Siederohr stehen, liegen, um wenigstens einen Kanal (36) für ein Element auf jeder Seite des Siederohres (11) zu begrenzen.

8. Boiler nach einem der vorhergehenden Ansprüche, bei welchem der Boiler zwei Siederohre (11) und vierundzwanzig Steine (30, 35) oder vier Siederohre (11) und achtundvierzig Steine (30, 35) oder sechs Siederohre und zweiundsiebzig Steine (30, 35) aufweist.

9. Boiler nach einem der vorhergehenden Ansprüche, bei welchem innerhalb des Gehäuses Metallplatten angeordnet sind, die die inneren Oberflächen der Isolation an den Seitenwänden, der Unterseite und der Oberseite des Gehäuses bedecken.

10. Boiler nach einem der vorhergehenden Ansprüche, bei welchem ein Wasserkasten (17) für den Boiler vorgesehen ist, der ein Aufnahmevermögen besitzt, das mindestens doppelt so groß wie das Aufnahmevermögen des primären Wärmekreislaufs ist.

11. Boiler nach einem der vorhergehenden Ansprüche, bei welchem die Wärmeleitfähigkeit der Steine (30), die in Kontakt mit einem Siederohr (11) stehen, größer als die Wärmeleitfähigkeit der Steine (35) ist, die nicht in Kontakt mit einem Siederohr (11) stehen.

12. Boiler nach Anspruch 11, bei welchem die Zusammensetzung der Steine, die zwischen den Elementen (40) liegen, aus Magnetit ist, und die Zusammensetzung der Steine (30) zwischen einem Element (40) und einem Siederohr (11) eine Mischung aus Magnetit und Magnesit ist.

13. Boiler nach einem der vorhergehenden Ansprüche, bei welchem das isolierte Gehäuse eine Vielzahl von Isolierschichten (50 - 57) beinhaltet.

14. Boiler nach Anspruch 13, bei welchem die Kantenprofile der Isolierschichten (50 - 57) so ausgebildet sind, daß ein abgestuftes Eckprofil bei wenigstens einer der Isolierschichten vorhanden ist, die im rechten Winkel aneinander anstoßen.

Revendications

1. Chaudière électrique dans laquelle un liquide est chauffé au moyen d'un garnissage accumulateur de chaleur, le garnissage étant constitué d'une multiplicité de premières briques d'accumulation de chaleur (30) et étant chauffé par des éléments chauffants électriques (40), et la chaleur provenant du garnissage est transférée à un circuit de chauffage primaire dans lequel le liquide est mis en circulation, le circuit de chauffage primaire comprenant une pluralité de tubes bouilleurs (11) qui s'étendent en substance verticalement dans une enveloppe isolée entourant le garnissage, l'enveloppe comportant une face avant, une face arrière et deux faces latérales, les tubes bouilleurs étant disposés en au moins une rangée s'étendant en substance parallèlement à la face avant, les premières briques (30) étant disposées contre les tubes bouilleurs (11) et comportant des faces latérales profilées de manière à présenter des canaux (31) destinés à accepter une partie d'un tube bouilleur (11), de sorte qu'une combinaison de ces premières briques (30) entoure une longueur des tubes bouilleurs (11), caractérisée en ce que :

    la face avant peut être ouverte pour permettre l'installation du garnissage, et pour pouvoir accéder à celui-ci, et

    entre les faces latérales de l'enveloppe et les premières briques (30) ainsi qu'entre les premières briques (30) de deux tubes adjacents de la même rangée sont disposées des secondes briques (35) qui ne sont pas en contact avec des parties quelconques des tubes bouilleurs (11).

2. Chaudière suivant la revendication 1, dans laquelle les briques (30, 35) dans un garnissage assemblé définissent des canaux (36) qui vont de l'avant à l'arrière de la chaudière et qui sont destinés à recevoir des éléments chauffants (40), les éléments chauffants (40) étant oblongs et étant installés dans le garnissage par introduction dans les canaux (36) depuis l'avant du garnissage.

3. Chaudière suivant la revendication 2, dans laquelle le profil en coupe transversale des canaux à éléments (36) et la section transversale des éléments chauffants (40) sont tels qu'un contact est réalisé entre une partie de la surface externe de chaque élément (40) et les briques adjacentes (30, 35).

4. Chaudière suivant l'une quelconque des revendications précédentes dans laquelle les premières briques (30) qui sont disposées contre les tubes bouilleurs (11) sont d'un profil différent de celui

des secondes briques (35).

5. Chaudière suivant la revendication 4, dans laquelle les secondes briques (35) comportent des faces planes et chaque brique (30) qui est disposée contre les tubes bouilleurs (11) comprend non seulement le canal (31) recevant une partie de tube bouilleur, mais également des moyens à rainures (32) qui s'étendent, en pratique, dans une direction allant de l'avant vers l'arrière du garnissage, ces moyens à rainures définissant, avec une face plane d'une seconde brique (35), au moins un canal (36) destiné à recevoir un élément (40).

6. Chaudière suivant la revendication 5, dans laquelle chaque moyen à rainures (32) comporte deux rainures parallèles telles que chaque paire de briques (30, 35) qui comprend une seconde brique (35) définit deux canaux à éléments (36).

7. Chaudière suivant l'une quelconque des revendications précédentes dans laquelle le garnissage comprend une pluralité d'unités briques-tube bouilleur, chaque unité comprenant une longueur de tube bouilleur (11), une paire de briques (30) disposées contre la longueur de tube bouilleur (11) et l'enserrant entre elles, et une paire de secondes briques (35) disposées chacune à l'extérieur d'une brique respective (30) en contact avec le tube bouilleur et contre celle-ci pour définir au moins un canal à élément (36) de chaque côté du tube bouilleur (11).

8. Chaudière suivant l'une quelconque des revendications précédentes dans laquelle sont prévus deux tubes bouilleurs (11) et vingt-quatre briques (30, 35) ou quatre tubes bouilleurs (11) et quarante-huit briques (30, 35) ou six tubes bouilleurs (11) et septante-deux briques (30, 35).

9. Chaudière suivant l'une quelconque des revendications précédentes dans laquelle des tôles sont placées dans l'enveloppe et couvrent les surfaces internes de l'isolation prévue sur les parois latérales, la base et le dessus de l'enveloppe.

10. Chaudière suivant l'une quelconque des revendications précédentes dans laquelle un réservoir collecteur (17) prévu pour la chaudière a une capacité au moins double de celle du circuit de chauffage primaire.

11. Chaudière suivant l'une quelconque des revendications précédentes dans laquelle la conductivité thermique des briques (30) en contact avec un tube bouilleur (11) est supérieure à la conductivité thermique des briques (35) qui ne sont pas en contact avec un tube bouilleur (11).

12. Chaudière suivant la revendication 11, dans laquelle la composition des briques (35) disposées entre des éléments (40) est de la magnétite et la composition des briques (30) disposées entre un élément (40) et un tube bouilleur (11) est un mélange de magnétite et de magnésite.

13. Chaudière suivant l'une quelconque des revendications précédentes dans laquelle l'enveloppe isolée comprend plusieurs couches d'isolation (50-57).

14. Chaudière suivant la revendication 13, dans laquelle les profils marginaux des couches d'isolation (50-57) sont tels que l'on obtienne un profil marginal à gradin sur au moins une des couches d'isolation se touchant à angle droit.

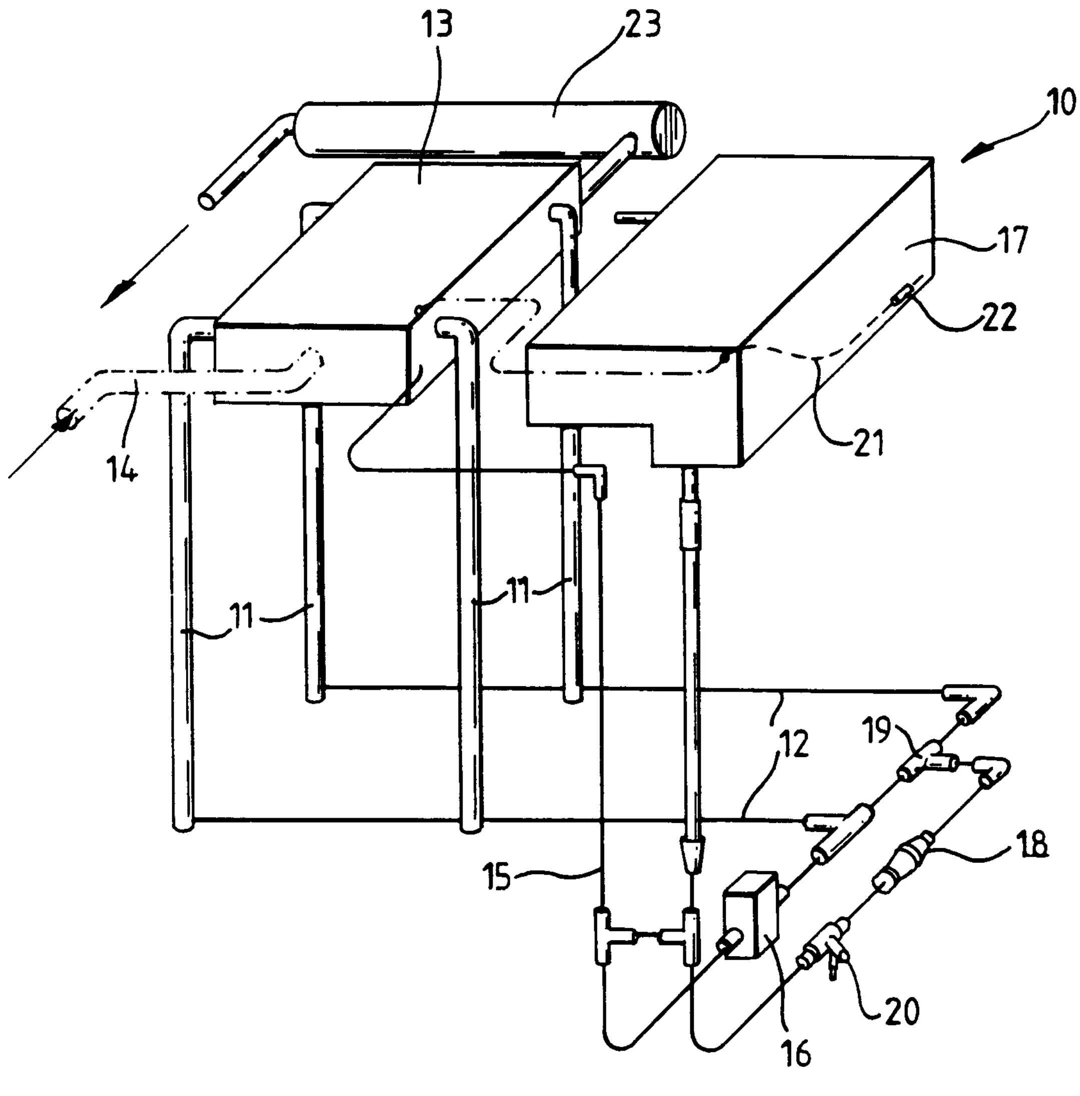
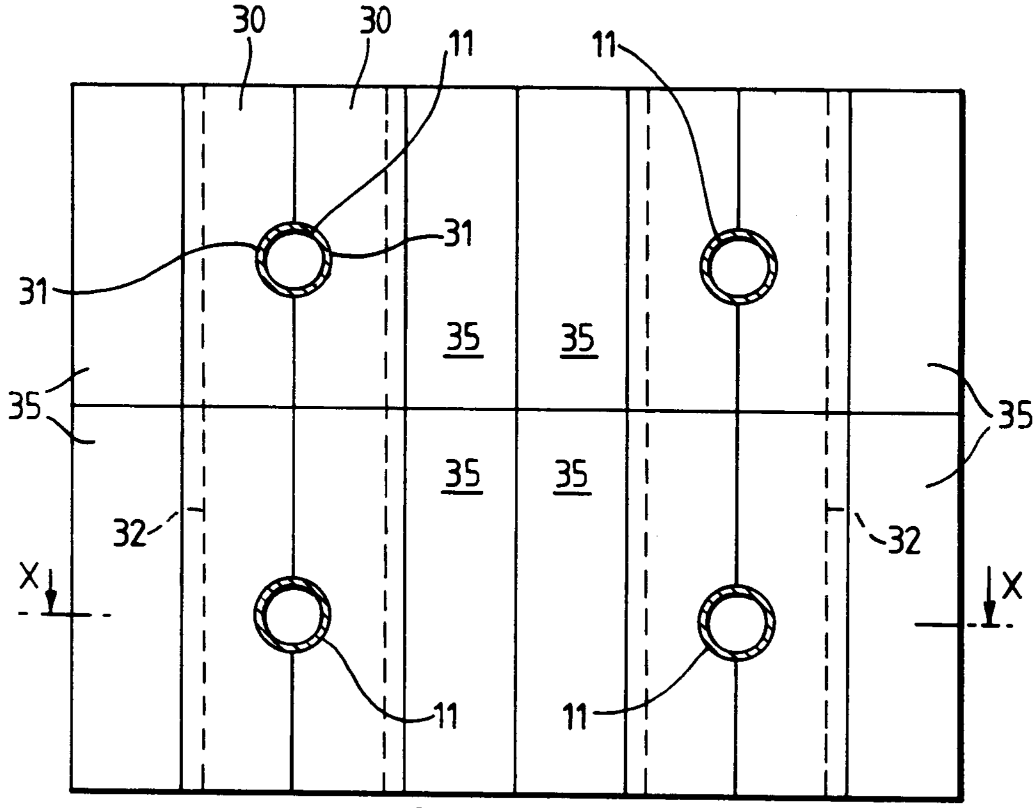


Fig.1.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30
11
11
31
31
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32
X
X
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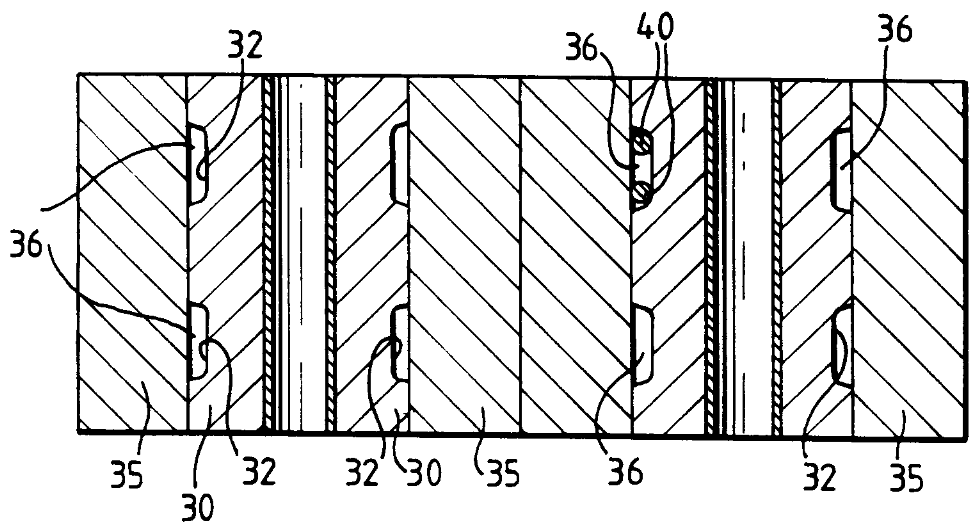
11

Fig.2.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35
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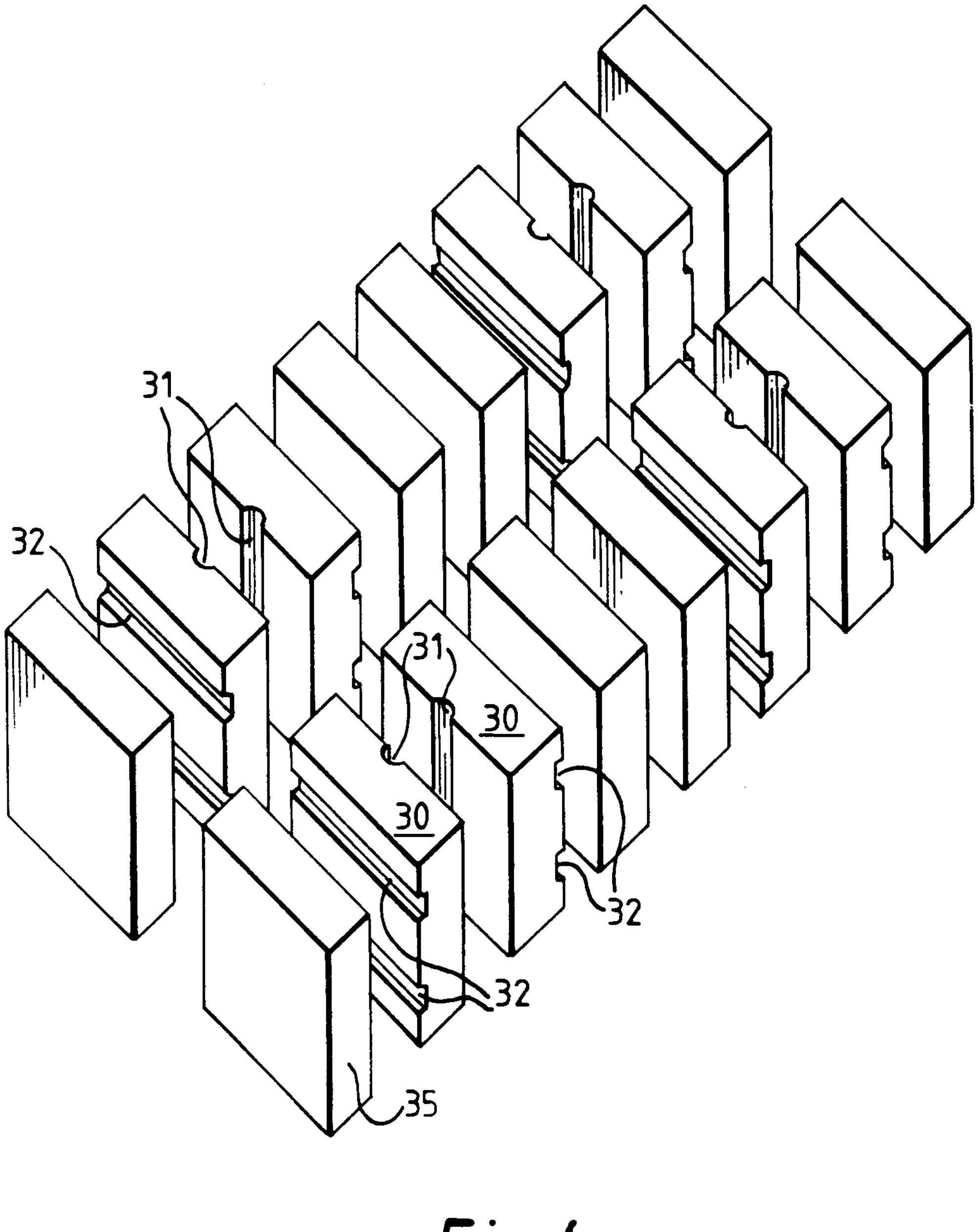
36
32
35

Fig.3.



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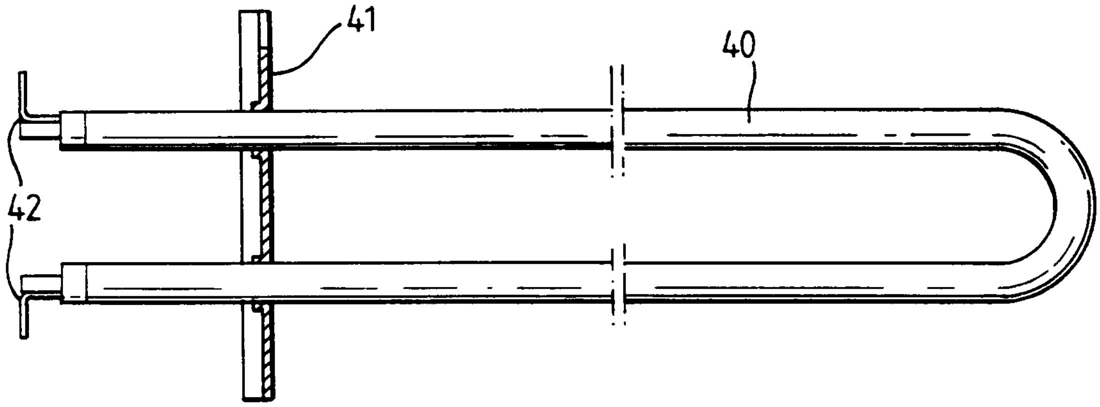

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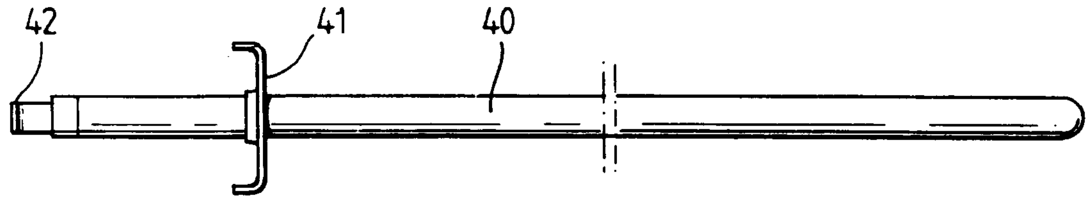

Fig.6.

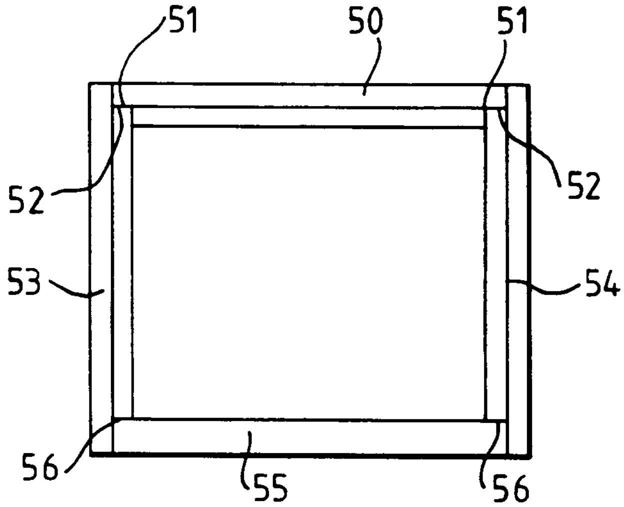

Fig.7.

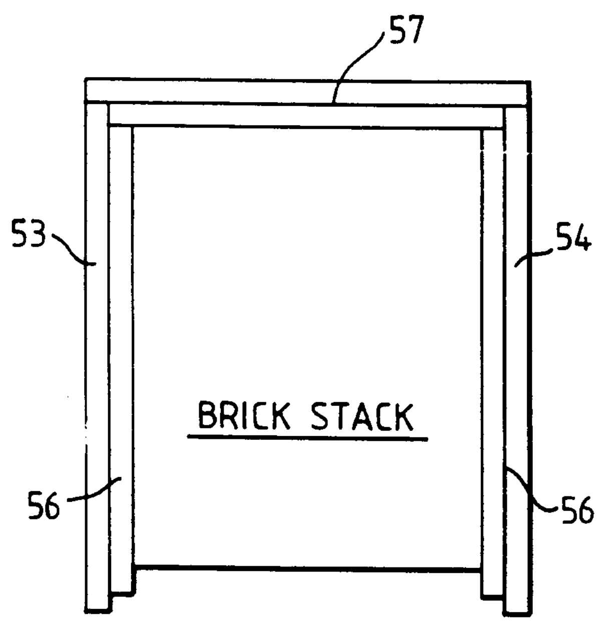

Fig.8.

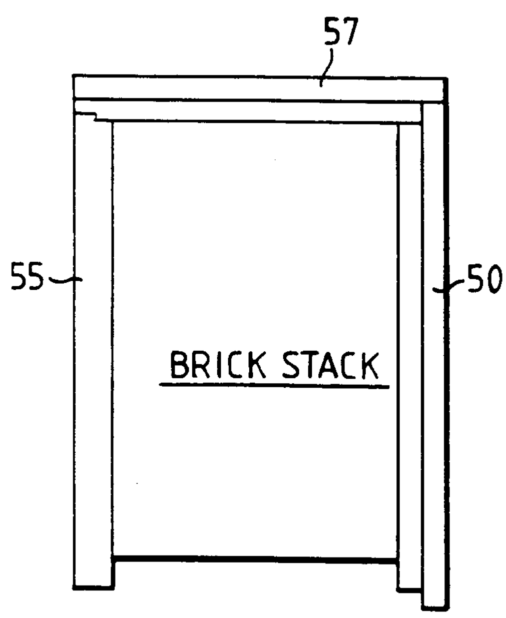

Fig.9.

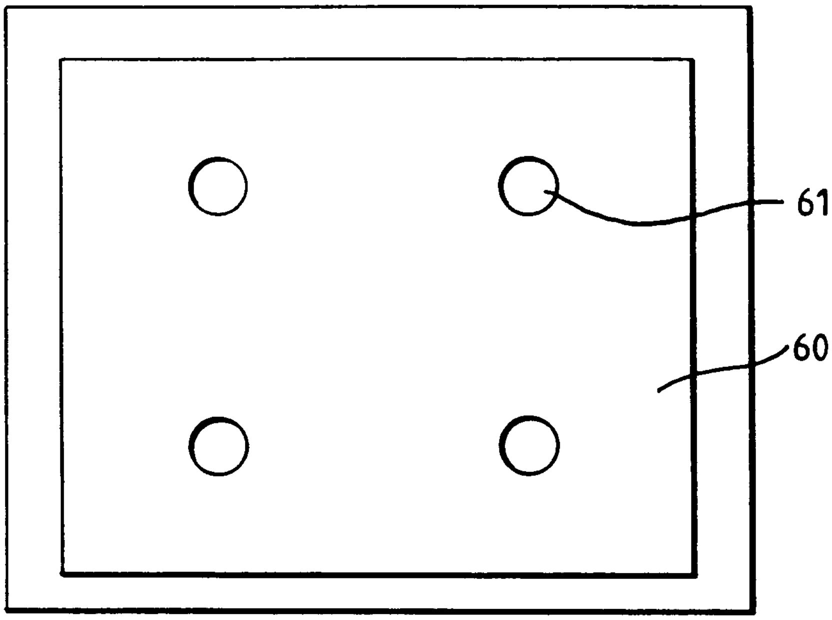

Fig.10.

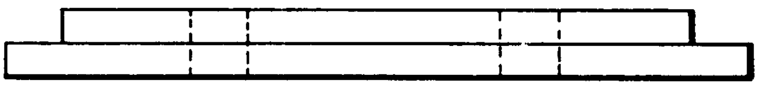

Fig.11.

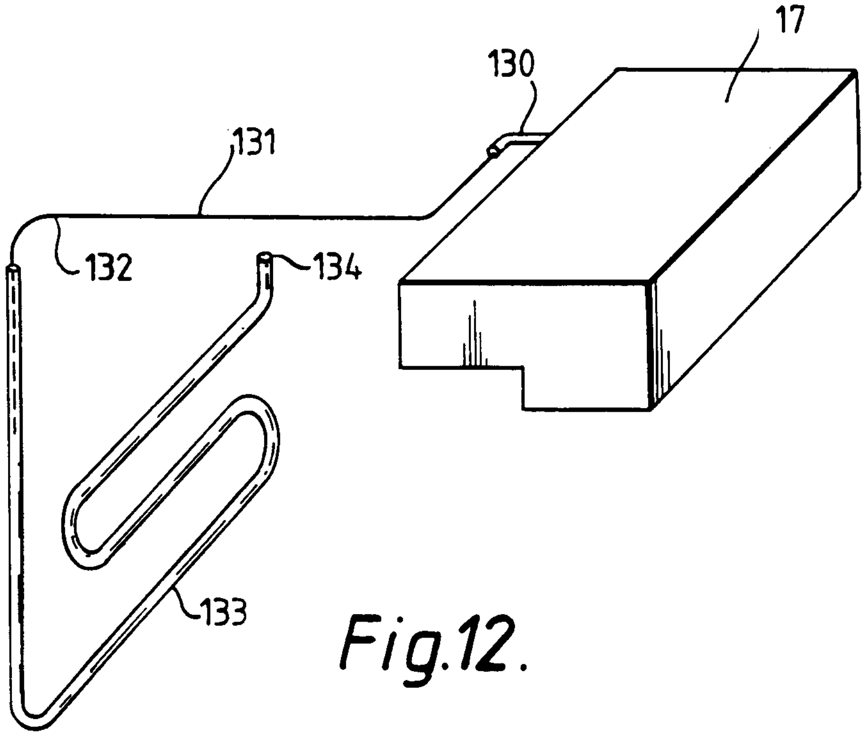

Fig.12.

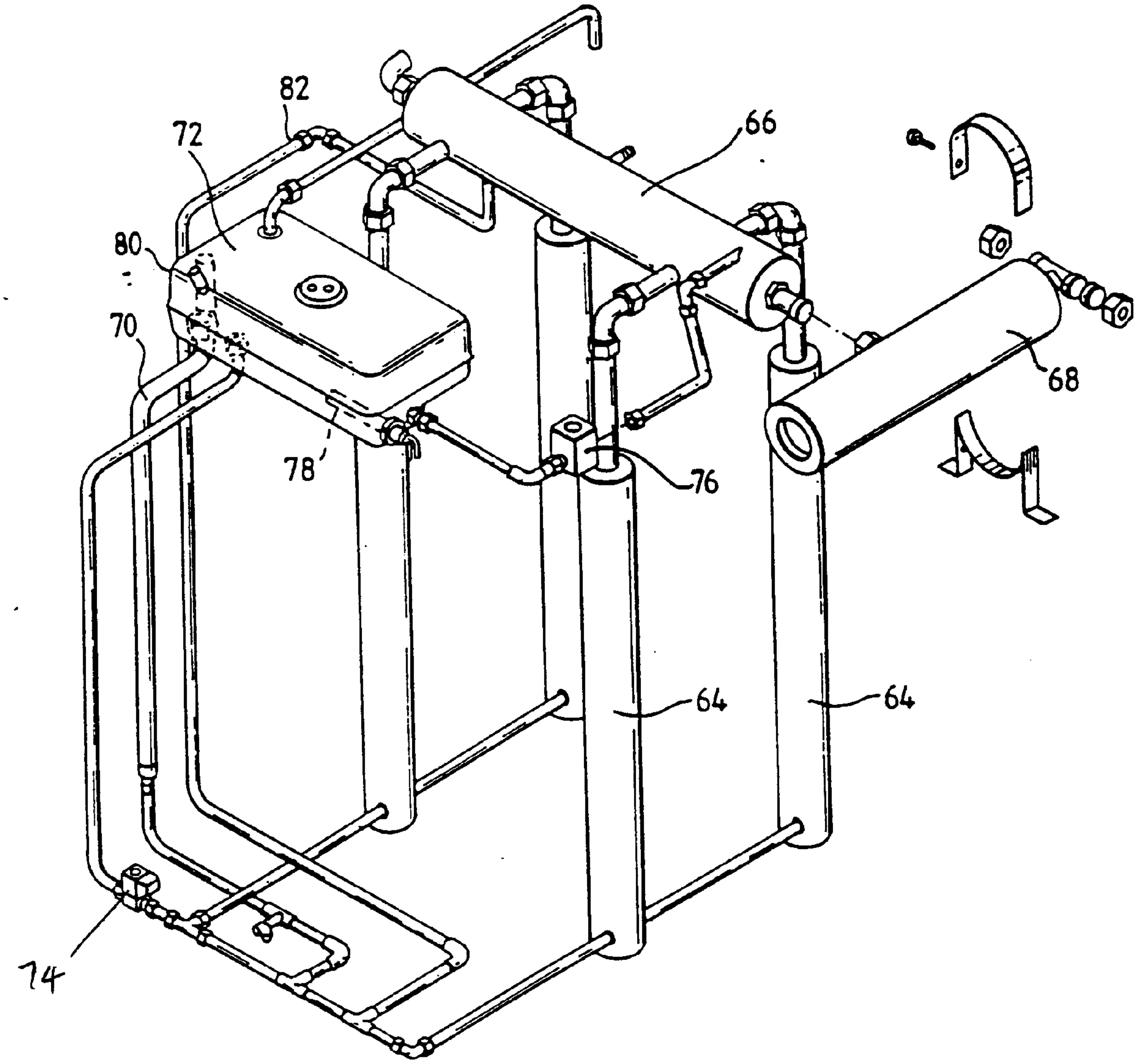

Fig.13.