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(71) Applicant: **Poliedra s.r.l.**
20833 Giussano (IT)

(72) Inventors:
- **Crescini, Damiano**
  25064 GUSSAGO (BS) (IT)
- **Vigano', Emanuele**
  20833 PAINA DI GIUSSANO (MB) (IT)

(74) Representative: **Mittler, Enrico et al**
Mittler & C. S.r.l.
Viale Lombardia, 20
20131 Milano (IT)

(54) Fluid heating apparatus

(57) A fluid heating apparatus is described comprising a body (1) provided with at least one heat generator (3) and heat exchanger means (4) adapted to allow the passage of said fluid within the body and to engage said at least one heat generator for heating the fluid, said heat generator producing combustion fumes. The apparatus comprises further means (110) provided with at least one first wall (113) substantially in contact with said combustion fumes and a second wall (114) in contact with said heat exchanger means; the further means (110) comprise at least one thermoelectric generator (20) supplied by the temperature difference between the first and the second wall. (Fig. 7)

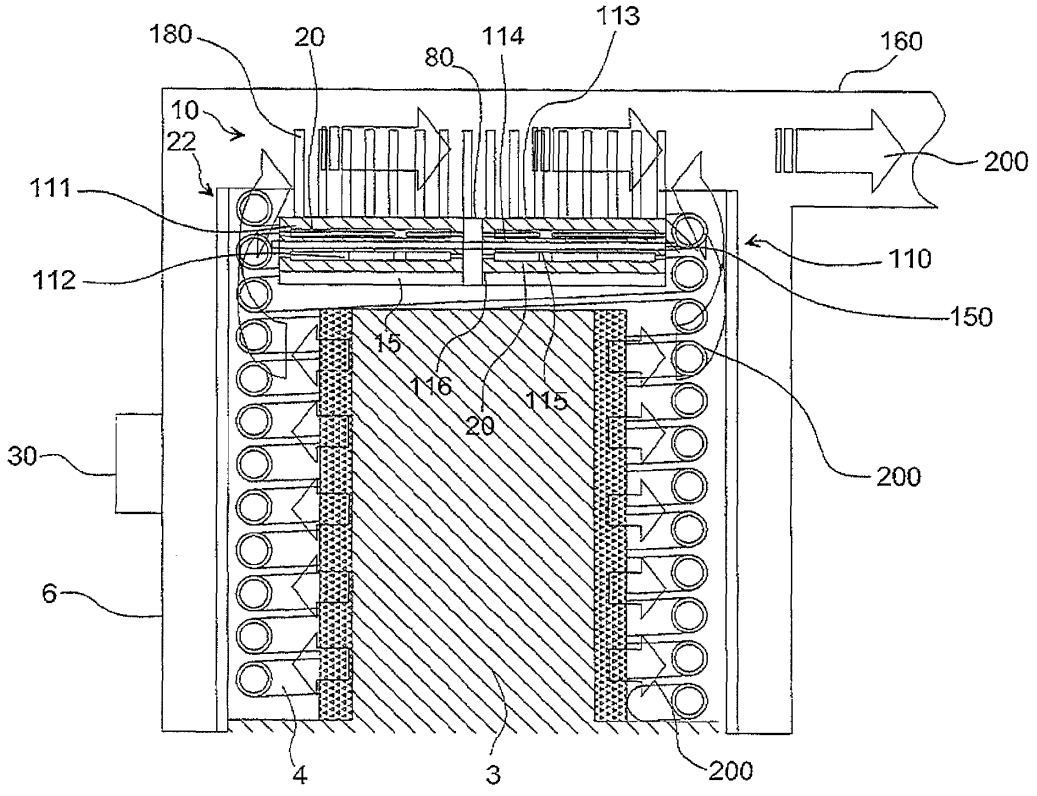

Fig.7

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Description

[0001] The present invention relates to a fluid heating apparatus, in particular a boiler.

[0002] Boilers for the production of hot water are known in the prior art. Said boilers comprise a heat generator, e.g. a gas burner or an element crossed by electrical current, fitted within a body for heating the cold water with which the boiler is fed. In the case of boilers with burner, the body comprises a serpentine tube arranged about the burner; the water coming from an external water network flows in the tube.

[0003] In view of the described prior art, it is the object of the present invention to provide a fluid heating apparatus which is different from those known.

[0004] In accordance with the present invention, said object is reached by a fluid heating apparatus comprising a body provided with at least one heat generator and heat exchanger means adapted to allow the passage of said fluid within the body and to engage said at least one heat generator for heating the fluid, said heat generator producing combustion fumes, **characterized in that** it comprises further means provided with at least one first wall substantially in contact with said combustion fumes and a second wall in contact with said heat exchanger means, said further means comprising at least one thermoelectric generator supplied by the temperature difference between said first and second wall,

[0005] The features and the advantages of the present invention will be apparent from the following detailed description of practical embodiments thereof, shown by way of non-limitative examples in the accompanying drawings, in which:

figure 1 shows a fluid heating apparatus, in particular a boiler, in accordance with a first embodiment of the present invention;
figure 2 is a vertical section taken along line II-II af the boiler in figure 1;
figure 3 shows part of the boiler in figure 1;
figure 4 is a vertical section of the boiler part in figure 3;
figure 5 is an exploded view of the part in figure 3;
figure 6 is a block diagram of the boiler in figure 1;
figure 7 shows a vertical section of a fluid heating apparatus, in particular a boiler, in accordance with a second embodiment of the present invention;
figures 8 and 9 show operating mode time diagrams of the heating apparatus in figure 7.

[0006] Figures 1 and 2 show a fluid heating apparatus, in particular a boiler, in accordance with a first embodiment of the present invention. The apparatus comprises a body 1 provided with at least one heat generator 3, e.g. a burner, and heat exchanger means 4 adapted to allow the passage of said fluid within the body and to exchange heat with the heat generator 3 for heating the fluid, e.g. water. The apparatus comprises further means 11, shown in more detail in figures 3-5, provided with a first wall 13 substantially in contact with said heat generator and a second wall 14 in contact with said heat exchanger means 4; the further means 11 comprise at least one thermoelectric generator 20 supplied by the temperature difference between the first 13 and the second 14 wall.

[0007] The apparatus preferably comprises other means 30 electrically supplied by said at least one thermoelectric generator 20.

[0008] The body 1 is preferably of the cylindrical type and comprises a hollow part 2 in which the burner 3 is accommodated and heat exchanger means 4, preferably a tube bundle which envelops the burner 3; the tube bundle 4 is arranged on the cylindrical wall of the boiler body 1 at a given distance from the burner 3. An insulation 5 covers the tube bundle 4 and a plate 6 covers the insulation 5.

[0009] A wall 22 closes the hollow part 2 on one end 10 of the boiler body 1; said end comprises the further means 11 comprising at least one thermoelectric generator 20 for the production of electricity, as shown in greater detail in figures 3-5. The further means 11 are in contact with the wall 22 of the hollow part 2 and are a removable structure from the end 10 of the body 1; the means 11 are indeed provided with a central hole 80 for coupling to the end 10 of the body 1, by means of screw or other, for separation therefrom. The wall 22 is adjacent to another wall 23 which separates it from the insulation 5.

[0010] The further means 11 may comprise one or more thermoelectric generators 20, e.g. Peltier cells, used as energy recovery means converting the thermal head generated by the heat generator 3 and the heat exchanger means, i.e. the tube bundle 4, into electricity capable of being either accumulated or used to supply electronic systems of any type.

[0011] The further means 11 have an appropriate geometry and size (e.g. a disc) capable of being able to be incorporated in the boiler. Preferably, the heat generator 3 has a cylindrical development, the tube bundle 4 is coaxial with the burner 3, preferably a tube bundle wound as a cylindrical spiral about the burner 3, and capable of either cooling or maintaining the wall 22 on which the means 11 are in contact at a temperature considerably lower than that of the burner. The wall 22 is in either direct or indirect contact with the tube bundle 4 thus constituting the low-temperature surface where the heat generator 3 constitutes the high-temperature source. The wall 22 is placed in contact with the wall 14 of the means 11 while the opposite wall 13 is placed at a close distance (a few centimeters) from the burner 3, substantially in contact with the burner 3. The wall 13 may be insulated from the burner or not (by means of a layer of appropriately dimensioned insulation 15) according to the resistance of the element in direct contact with the heat generated in that point by the burner.

[0012] Such a configuration generates a thermal head between the two walls 13 and 14 of the means 11 which may be exploited by the thermoelectric generators 20 for

the production of electricity. The thermoelectric generators 20 themselves have two opposite, separate metal walls which are placed in contact with the walls 13 and 14 of the means 11. When the two walls of the thermoelectric generator 20 are subject to a considerable temperature difference (and such a difference is maintained over time) an electrical potential difference is generated as a consequence on the surfaces themselves, the intensity of which depends on the thermal gradient. Such an electrical potential difference (voltage) is either used to supply the means 30 or is accumulated in a battery 40.

[0013] The means 11 preferably comprise four thermoelectric generators 20; the electrical power extracted therefrom must be appropriately managed by the means 30 to obtain, for example, the voltage and current needed to operate the devices connected thereto. If such energy is higher than needed or in excess with respect to the instantaneous consumption, batteries 40 are used as accumulation means.

[0014] The means 30 comprise an electrical signal management and conditioning unit 31 capable of appropriately exploiting the action of the thermoelectric generators as source of energy.

[0015] The unit 31 must manage possible monitoring 41, display 42 and alarm 43 devices of the boiler. The monitoring devices 41 are sensors which may be one or more for monitoring the characteristic magnitudes of the boiler, such as temperature, pressure, vibration, concentration of harmful substances in the environment (e.g. carbon monoxide) and other characteristics of the fumes generated by the burner (e.g. humidity or pH), The alarm devices 42 are activated when the temperature exceeds a predetermined temperature Tp, when the humidity exceeds a predetermined humidity Up and when the concentration of harmful substances exceeds a predetermined concentration Cp, respectively.

[0016] Use of a step-up converter 25 may be included, adapted to increase the voltage coming from thermoelectric generators 20 (which may vary from approximately 20-30 mV to 300-400 mV) to the reference voltage of the standard electronics available in commerce (typically 2.35V, 3.3V, 4.1V and 5V) for supplying the various devices of the means 30.

[0017] The unit 31 autonomously manages the possible surplus of energy addressing it to the battery 40 and loading it. The unit 31 preferably comprises a microcontroller 32 and a memory 33 but may comprise only analogue type devices.

[0018] The microcontroller 32 is programmed with a firmware, installed in memory 33, for managing the devices 41-43, a data acquisition device 44, the charge accumulator 40 and a wireless interface 45, as shown in figure 6. The firmware preferably works by either simultaneously or sequentially activating the various devices supplied by the thermoelectric generators 20, i.e. the devices 40-45; thus energy consumption peaks are not generated. For example, devices 41-43 are activated in subsequent instances T1, T2 and T3, the data acquisition unit 44 of the various sensors is activated at an instant of time T4 subsequent to the instances of time T1-T3, the visual or acoustic alarm devices 47 are activated in a subsequent instant of time T5 and the wireless interface 45 is activated in a subsequent instant of time T8. The firmware determines, in given conditions, the accumulation of the surplus of energy in the accumulator 40. The energy stored herein may be used, for example, to guarantee remote communication of the system state by means of wireless transmission, preferably of GSM type, also in adverse conditions.

[0019] The various devices 40-45 may send signals on their state to the processor 32 by exploiting the analogue or digital inputs thereof. The microcontroller is programmed with a software appropriately compiled for managing the communication with the output devices 42, 43 according to the state of the sensors 41. The communication with the devices occurs by means of the analogue or digital outputs of the microcontroller and allows, for example, to turn on the indicating LEDs, to activate a display or a buzzer which emits an acoustic signal. Furthermore, the warning or monitoring signal may not be displayed or emitted only locally but may be transmitted to a more or less remote receiving station by means of wireless communication of GSM.

[0020] All analogue electronics are used in absence of a microprocessor. Such a configuration may be of considerable interest if one does not want to use a microprocessor (to reduce product and development costs or current consumption) and low-cost, low-current-consumption integrated circuits are available to develop a level comparator adapted for the purposes above (i.e. one or a set of integrated circuits capable of evaluating the signal level output from one or more sensors and comparing it with a reference threshold for the purpose of activating or deactivating the alarm signal).

[0021] The energy of the thermoelectric generators 20 may be intended for a generic external user (an electrical or electronic device). The heating apparatus according to the invention preferably comprises an electrical terminal 70 connectable to said external device to the apparatus so that the external device is electrically supplied by the thermoelectric generators 20. The electricity intended for the external device is preferably managed by the unit 31.

[0022] Figure 7 shows a fluid heating apparatus, in particular a boiler, in accordance with a second embodiment of the invention. The apparatus again comprises a body 1 provided within at least one heat generator 3, e.g. a burner, and heat exchangers 4 adapted to allow the passage of said fluid within the body and to exchange heat with the heat generator 3 for heating the fluid, e.g. water. The apparatus comprises further means 110 with at least one element 111 provided with a first wall 113 substantially in contact with the exhaust gases or fumes 200 generated by the heat generator and let out of the boiler by means of an opening 160 and a second wall 114 in contact with said heat exchangers 4; the element 111 com-

prises at least one thermoelectric generator 20 supplied by the temperature difference between the first 113 and the second 114 wall. Preferably, the further means 110 comprise at least one other element 112 with a wall 115 substantially in contact with said heat exchangers 4 and a second wall 116 in contact with the heat generator 3; the element 112 comprises at least one thermoelectric generator 20 supplied by the temperature difference between wall 115 and wall 116.

[0023] The elements 111 and 112 are interposed and supplied by an element 150 fixed to the structure of the boiler 1. The fumes 200 generated by the heat generator 3 are of the high-temperature type and cross the heat exchanger becoming low-temperature fumes; an element 180 provided with fins is arranged in the upper part of the boiler 1, over the element 111 and in contact therewith so as to intercept the fumes 200 before they escape from the boiler through the opening 160.

[0024] The apparatus preferably comprises other means 30 electrically supplied by said at least one thermoelectric generator 20.

[0025] The body 1 is preferably of the cylindrical type and comprises a hollow part 2 in which the burner 3 is accommodated and heat exchanger means 4, preferably a tube bundle which envelops the burner 3; the tube bundle 4 is arranged on the cylindrical wall of the boiler body 1 at a given distance from the burner 3. A plate 6 covers the boiler 1.

[0026] The elements 111, 150 and 112 are arranged to close the hollow part 2 of an end 10 of the boiler body 1; said end comprises the further means 110 comprising at least one thermoelectric generator 20 for the production of electricity. The further means 110 are a removable structure 10 of the body 1; the means 110, i.e. the elements 111 and 112, are indeed provided with a central hole 80 for coupling with the element 150 of the body 1, by means of screw or other, or for separation therefrom.

[0027] The further means 110 may comprise one or more thermoelectric generators 20, e.g. Peltier cells, used as energy recovery means converting the thermal head generated by the heat generator 3 and by the heat exchanging means, i.e. the tube bundle 4, and between the heat exchanger means and the fumes 200 into electricity capable of being either accumulated or used to supply electronic systems of any nature.

[0028] The further means 110, as the means 11 of the first embodiment of the invention, have an appropriate geometry and size (e.g. a disc) capable of being incorporated in the boiler. Preferably, the heat generator 3 has a cylindrical development, the tube bundle 4 is coaxial with the burner 3, preferably a tube bundle wound as a cylindrical spiral about the burner 3, and capable of either cooling or maintaining the element 150 in contract with the means 110, i.e. the walls 114 and 115, at a temperature considerably lower than that of the burner. The element 150 is in either direct or indirect contact with the tube bundle 4, thus constituting the low-temperature surface where the heat generator 3 constitutes the high-temperature source and the fumes 200 constitutes the low-temperature source. The element 150 is placed in contact with the walls 114 and 115 of the means 110, the wall 116 is placed at a close distance (a few centimeters) from the burner 3, substantially in contact with the burner 3 and the wall 113 is placed in contact with the element 180 and is adapted to intercept the fumes 200. The wall 116 may be insulated from the burner or not (by means of a layer of appropriately dimensioned insulation 15) according to the resistance of the element in direct contact with the heat generated in that point by the burner.

[0029] Such a configuration generates a thermal head between the two walls 113 and 114 of the element 111 and between the walls 115 and 116 of the element 112 of the means 110 which may be exploited by the thermoelectric generators 20 for the production of electricity. The thermoelectric generators 20 themselves have two opposite, separate metal walls which are placed in contact with the walls 113, 114 and 115, 116 of the means 110. When the two walls of the thermoelectric generator 20 are subject to a considerable temperature difference (and such a difference is maintained over time) an electrical potential difference is generated as a consequence on the surfaces themselves, the intensity of which depends on the thermal gradient. Such an electrical potential difference (voltage) is either used to supply the means 30 or is accumulated in a battery 40.

[0030] The elements 111 and 112 each preferably comprise four thermoelectric generators 20; the electrical power extracted therefrom must be appropriately managed by the means 30 to obtain, for example, the voltage and current needed to operate the devices connected thereto. If such energy is higher than needed or in excess with respect to the instantaneous consumption, batteries 40 are used as accumulation means.

[0031] As already described for the first embodiment of the invention, the means 30 comprise an electrical signal management and conditioning unit 31 capable of appropriately exploiting the action of the thermoelectric generators as source of energy.

[0032] The unit 31 must manage possible monitoring 41, display 42 and alarm 43 devices of the boiler. The monitoring devices 41 are sensors which may be one or more for monitoring the characteristic magnitudes of the boiler, such as temperature, pressure, vibration, concentration of harmful substances in the environment (e.g. carbon monoxide) and other characteristics of the fumes generated by the burner (e.g. humidity or pH). The alarm devices 42 are activated when the temperature exceeds a predetermined temperature Tp, when the humidity exceeds a predetermined humidity Up and when the concentration of harmful substances exceeds a predetermined concentration Cp, respectively.

[0033] The use of a step-up converter 25 may be included adapted to increase the voltage coming from the thermoelectric generators 20 (which may vary from approximately 20-30 mV to 300-400 mV) to the reference voltage of the standard electronics available in com-

merce (typically 2.35V, 3.3V, 4.1V and 5V) for supplying the various devices in the means 30, as shown in figure 6.

[0034] The unit 31 autonomously manages the possible surplus of energy addressing it to the battery 40 and loading it, The unit 31 preferably comprises a microcontroller 32 and a memory 33 but may comprise only analogue type devices.

[0035] The microcontroller 32 is programmed with a firmware, installed in memory 33, to manage the devices 41-43, a data acquisition device 44, the charge accumulator 40 and a wireless interface 45. The firmware preferably works by either simultaneously or sequentially activating the various devices supplied by the thermoelectric generators 20, i.e, the devices 40-45; energy consumption peaks are not generated in this manner. For example, devices 41-43 are activated in subsequent instances T1, T2 and T3, the data acquisition unit 44 of the various sensors is activated in an instant of time T4 subsequent to the instances of time T1-T3, the visual or acoustic alarm devices 47 are activated in a subsequent instant of time T5 and the wireless interface 45 is activated in a subsequent instant of time T8. The firmware determines, in given conditions, the accumulation of the surplus of energy in the accumulator 40. The energy stored herein may be used, for example, to guarantee remote communication of the system state by means of wireless transmission, preferably of GSM type, also in adverse conditions.

[0036] The various devices 40-45 may send signals on their state to the processor 32 by exploiting the analogue or digital inputs thereof. The microcontroller is programmed with a software appropriately compiled for managing the communication with the output devices 42, 43 according to the state of the sensors 41. The communication with the devices occurs by means of the analogue or digital outputs of the microcontroller and allows, for example, to turn on the indicating LEDs, to activate a display or a buzzer which emits an acoustic signal. Furthermore, the warning or monitoring signal may not be displayed or emitted only locally but may be transmitted to a more or less remote receiving station by means of wireless communication of GSM,

[0037] All analogue electronics are used in absence of a microprocessor. Such a configuration may be of considerable interest if one does not want to use a microprocessor (to reduce product and development costs or current consumption) and low-cost, low-current-consumption integrated circuits are available to develop a level comparator adapted for the purposes above (i.e. one or a set of integrated circuits capable of evaluating the signal level output from one or more sensors and comparing it with a reference threshold for the purpose of activating or deactivating the alarm signal).

[0038] The energy of the thermoelectric generators 20 may be intended for a generic external use (an electrical or electronic device). The heating apparatus according to the invention preferably comprises an electrical terminal 70 connectable to said external device of the apparatus so that the external device is electrically supplied by the thermoelectric generators 20. The electrical energy intended to the external device is preferably managed by the unit 31.

[0039] The walls 113 and 114 of the element 111 may constitute both the high-temperature wall and the low-temperature wall for the at least one thermoelectric generator 20 inserted in the element 111. Indeed, as visible in the diagrams in figures 8 and 9, when the boiler 1 is cold-started, the fluid in the heat exchanger 4 is cooler than the fumes 200, and consequently the wall 114 is at low temperature while the wall 113 is at high temperature; the energy produced by the thermoelectric generators 20 inside the element 111 is proportional to the area under the curves in figures 8-9.

[0040] At steady condition instead the fluid in the heat exchanger 4 is hotter than the fumes 200, thus the wall 114 is at high temperature while the wall 113 is at low temperature.

[0041] The diagram in figure 8 shows the voltage E generated by the thermoelectric generators of the boiler 1 according to the time if at steady condition there is an intermittent use of the boiler, e.g. the boiler is associated to a radiator which dissipates heat in approximately constant manner.

[0042] The diagram in figure 9 shows the voltage E generated by the thermoelectric generators of the boiler 1 according to the time if at steady condition there is an intermittent use of the boiler with punctual boiler loads, e.g. the boiler is associated to a radiator which dissipates heat in approximately constant manner and to episodic high dissipation loads related to high instantaneous heat consumption (sanitary hot water).

Claims

1. A fluid heating apparatus comprising a body (1) provided with at least one heat generator (3) and heat exchanger means (4) adapted to allow the passage of said fluid within the body and to engage said heat generator for heating the fluid, said heat generator producing combustion fumes, **characterized in that** it comprises further means (110) provided with at least one first wall (113) substantially in contact with said combustion fumes and a second wall (114) in contact with said heat exchanger means, said further means (110) comprising at least one thermoelectric generator (20) supplied by the temperature difference between said first and second wall.

2. An apparatus according to claim 1, **characterized in that** it comprises further means (30) electrically supplied by said at least one thermoelectric generator (20), said other means comprising at least one sensor (41) adapted to detect data on a characteristic magnitude of the apparatus.

3. An apparatus according to claim 1, **characterized in that** said other means (30) comprise a battery (40) for accumulating the unused electricity.

4. An apparatus according to claim 2, **characterized in that** said other means (30) comprise at least one device (44) adapted to acquire the data detected by said at least one sensor (40) and at least one alarm device (42) activated when said at least one data detected by the sensor exceeds a given threshold (Tp, Up, Cp).

5. An apparatus according to claim 3, **characterized in that** said other means (30) comprise an interface (45) for sending detected data to an external unit of the apparatus.

6. An apparatus according to one of the claims from 2 to 5, **characterized in that** said other means (30) comprise a unit (31) for the management of the electricity produced by the at least one thermoelectric generator (20), said unit (31) being adapted to distribute electricity to said at least one sensor (41), to said detected data acquisition device (44), to said alarm device (42) and to a battery (46) for accumulating the unused energy.

7. An apparatus according to claim 6, **characterized in that** said management unit (31) comprises a microprocessor (51) and a memory (52) in which an application software is installed and executed.

8. An apparatus according to claim 1, **characterized in that** it comprises a finned element (180) structured to intercept the combustion fumes (200) generated by the heat generator (3), said finned element being in contact with said first wall (113) and said boiler (1) being structured so that said combustion fumes (200) cross said heat exchanger (4) before being intercepted by said finned element.

9. An apparatus according to claim 1, **characterized in that** said further means (110) comprise a first element (111) with a first wall (113) in contact with the combustion fumes (200) and a second wall (114) in contact with said heat exchanger (4) and a second element (112) with a first wall (116) in contact with the heat generator (3) and a second wall (115) in contact with said heat exchanger (4), said first and second element each comprising at least one thermoelectric generator (20) supplied by the temperature difference between the first (113, 116) and the second (114, 115) wall of the respective first (111) and second (112) element.

10. An apparatus according to claim 1 or 9, **characterized in that** said apparatus is a boiler, said body (1) is of cylindrical type and comprises a hollow part (2), in which said heat generator (3) is accommodated, said heat exchanger means (4) being adapted to envelop said heat generator (3), said body (1) comprising an end closing element (150) of an end (10) of said hollow part (2) in contact with the heat exchanger means (4), the second wall (114, 115) of said further means (110) being in contact with said closing element (150) of an end (10) of said hollow part (2).

11. An apparatus according to claim 1, **characterized in that** said further means (110) are removable.

12. An apparatus according to claim 9, **characterized in that** said further means (110) comprise an insulating material wall (15) adjacent to the first wall (116) of the second element (112) of the further means (110) and interposed between the heat generator (3) and second first wall of the second element (112).

13. An apparatus according to claim 1, **characterized in that** is comprises at least one electrical terminal (70) connectable to an external device of the apparatus so that said external device is electrically supplied by said at least one thermoelectric generator (20).

14. An apparatus according to claim 1, **characterized in that** during a starting condition of said heating apparatus, said first wall (113) of said further means (110) is at a higher temperature than said second wall (114) and during a steady condition of said heating apparatus said first wall (113) of said further means (110) is at a lower temperature than said second wall (114).

15. An operating method of a fluid heating apparatus as disclosed in claim 1, **characterized by** comprising a startling step wherein said first wall (113) of said further means (110) is at a higher temperature than said second wall (114) and a steady step wherein said first wall (113) of said further means (110) is at a lower temperature than said second wall (114).

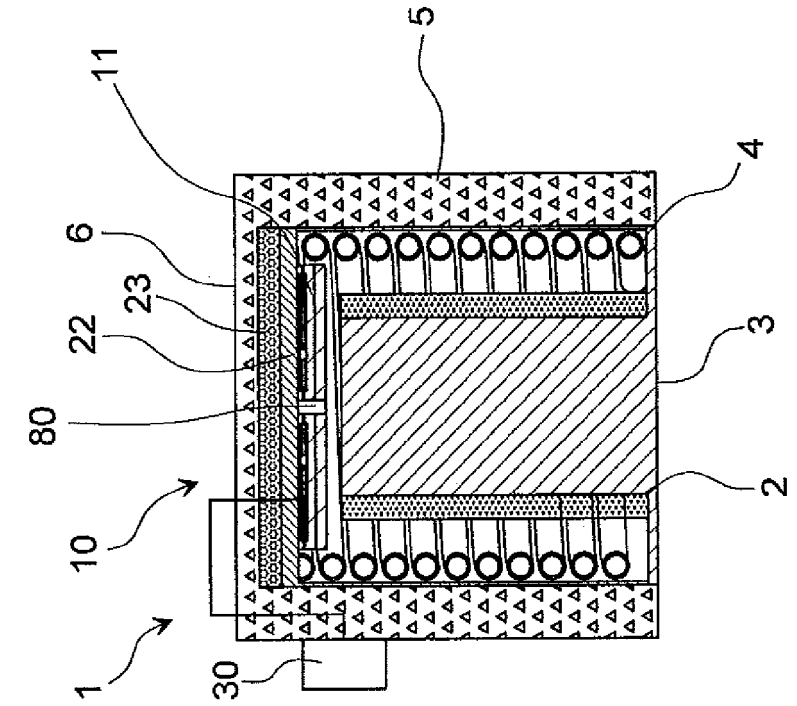


Fig.2

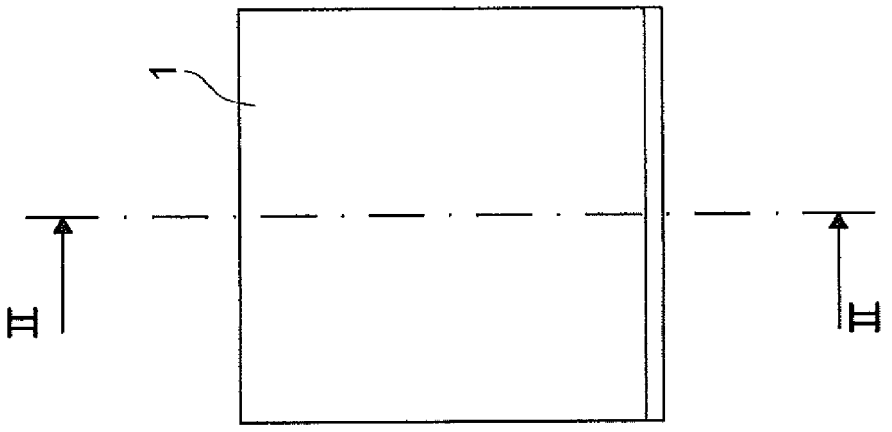


Fig.1

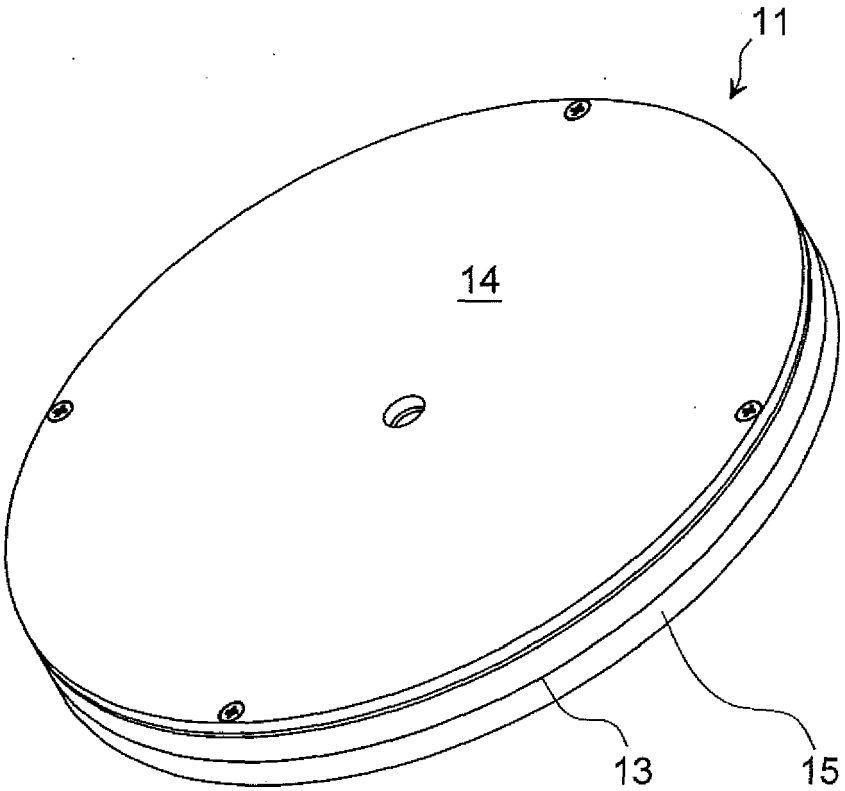


Fig.3

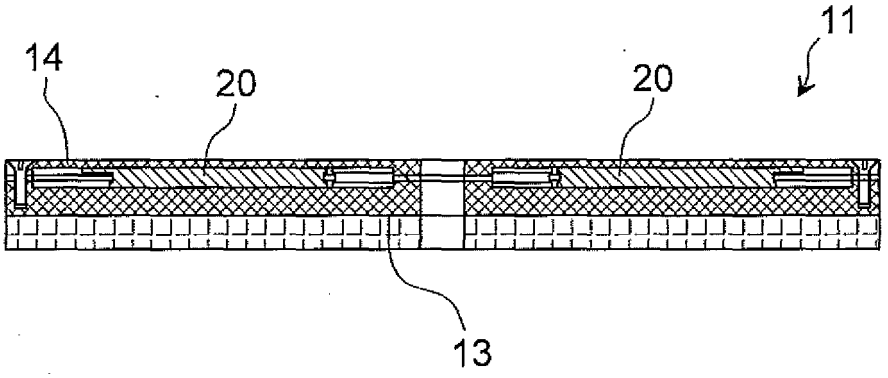


Fig.4

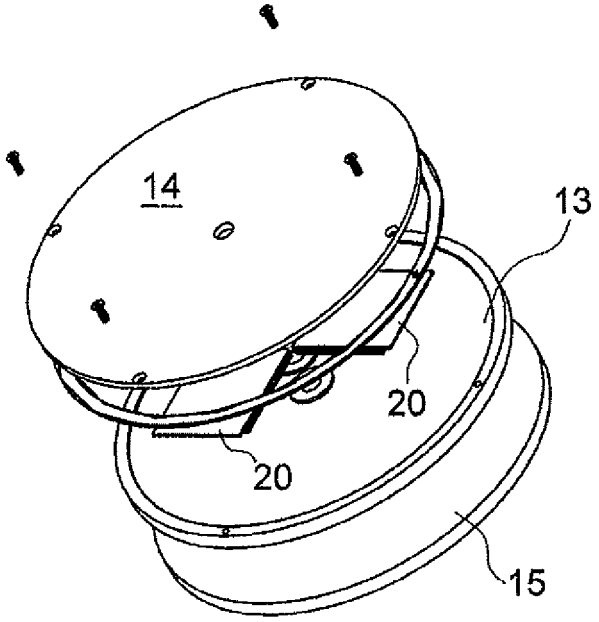


Fig.5

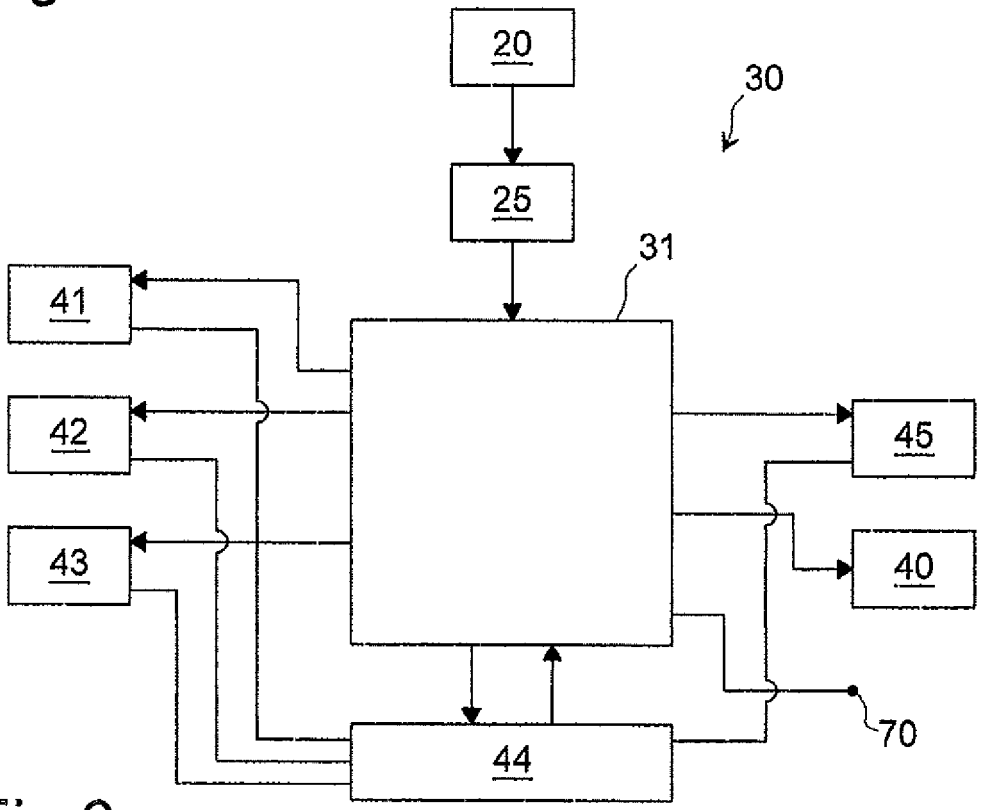
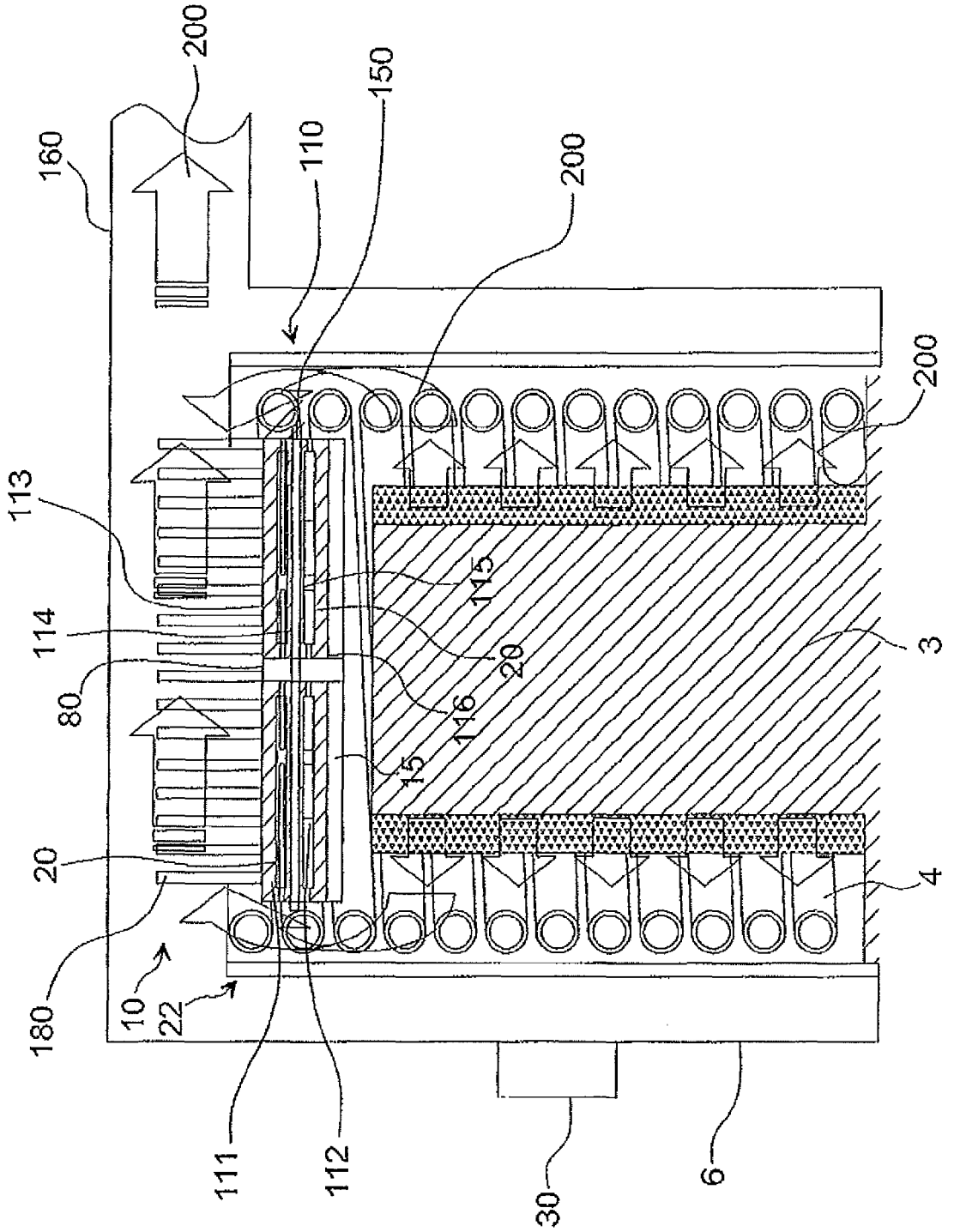


Fig.6


200
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110
200
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113
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Fig.7

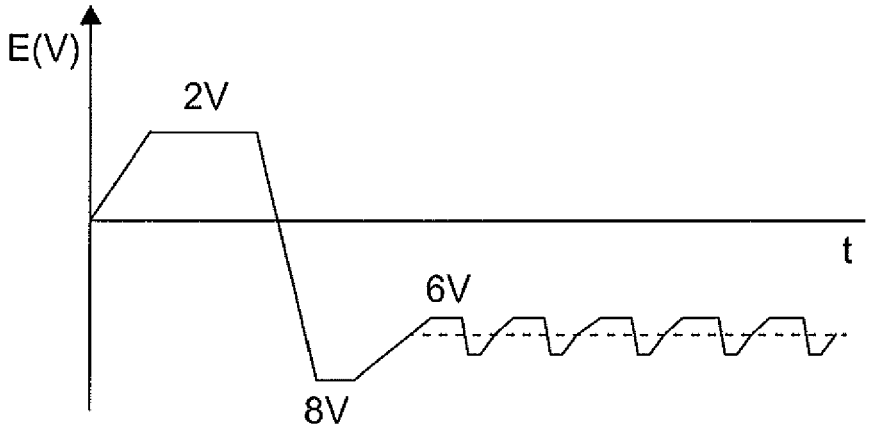

Fig.8

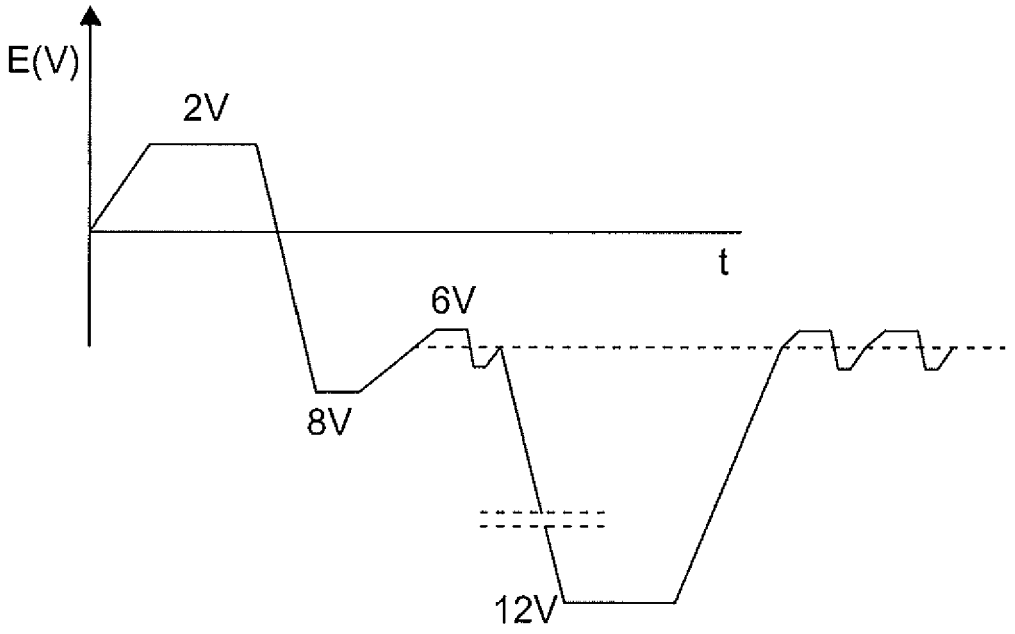

Fig.9

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 12 15 2510

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	GB 2 451 521 A (ALPINE ENERGY LTD [GB]) 4 February 2009 (2009-02-04) * page 3, line 5 - page 7, line 6; figure 1 *	1-15	INV. F24H1/43
X	US 5 427 086 A (BROWNELL DAVID L [US]) 27 June 1995 (1995-06-27) * column 2, line 44 - column 4, line 26; figures *	1-15	
X	DE 197 07 644 A1 (SCHULZE CURTIS [DE]) 27 August 1998 (1998-08-27) * the whole document *	1-15	
A	WO 2010/047572 A1 (FOO KWOK HSING [MY]) 29 April 2010 (2010-04-29) * abstract; figures *	1	
A	WO 2006/103613 A2 (KONINKL PHILIPS ELECTRONICS NV [NL]; VAN DER SLUIS PAUL [NL]) 5 October 2006 (2006-10-05) * abstract; figures *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F24H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 May 2012	Vedoato, Luca

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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04-05-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2451521 A	04-02-2009	NONE	
US 5427086 A	27-06-1995	NONE	
DE 19707644 A1	27-08-1998	NONE	
WO 2010047572 A1	29-04-2010	CN 101701745 A	05-05-2010
		CN 201517837 U	30-06-2010
		WO 2010047572 A1	29-04-2010
WO 2006103613 A2	05-10-2006	BR PI0609768 A2	18-10-2011
		CA 2614461 A1	05-10-2006
		CN 101151492 A	26-03-2008
		JP 2008534904 A	28-08-2008
		KR 20070116918 A	11-12-2007
		US 2009025703 A1	29-01-2009
		WO 2006103613 A2	05-10-2006

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82