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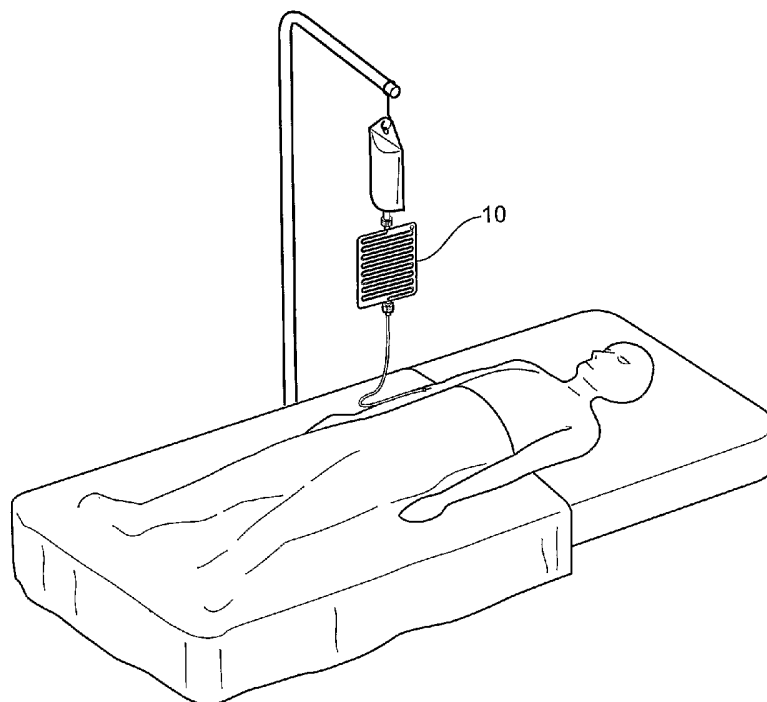
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(54) Title: FLUID WARMER



(57) Abstract: An apparatus for warming fluids (10) including a body, an inlet port and an outlet port, the inlet and outlet ports connected by a passageway allowing fluid communication between, the body containing at least one chemical therein capable of generating an increase in temperature upon activation, such that in use, when activated, the temperature of the biological fluid is raised on traveling from the inlet port to the outlet port.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

FLUID WARMER

FIELD OF THE INVENTION

The present invention is directed towards a self-contained fluid heating apparatus.

5 Blood is typically stored at approximately 4°C, and prior to infusion into a patient it is necessary that the blood be warmed to a temperature substantially the same as that of the living body, approximately 37°C. Failure to warm the blood prior to infusion into the patient may result in exposing the patient to thermal stress as the patient's body attempts to cope with the influx of cold blood.

10 Currently there exists a number of portable blood warming devices used in hospitals. These are typically large and cumbersome devices that draw power from a mains supply. In some devices the blood is fed into a spiral tube, which is immersed in a water bath whose temperature is maintained at a set temperature. Other known devices use a heated jacket, which is wrapped around a blood bag, and draws power from the mains supply.

15 These types of devices, whilst fine in hospital or clinical situations where a constant source of power is available, are not convenient to use in situations that are remote from reliable power sources or in remote locations where it is simply not practical to carry such large and cumbersome equipment, such as when a patient is moved from ward to ward.

20 Portable devices for blood warming are known, such as the Thermal Angel™ and the HOTIV™. Both of these particular devices rely on batteries to provide the heating energy, some disadvantages of batteries are that they are rather heavy and bulky. Given that heating equipment places substantial load on the batteries, it is not possible for these batteries to be small. Additionally, the maintenance issues
25 associated with batteries are such that, for example, if the portable blood warmer is used in an emergency vehicle then it is necessary that regular checks are made on the condition of the battery or indeed that spare batteries are available such that there is always a source of power at the ready.

Furthermore, the requirement of batteries in order to operate the blood warmer dramatically increases the overall weight of the apparatus and therefore if rescue workers are required to trek into a remote location this then places an additional burden on them and may complicate matters if the unit fails to operate due to problems
5 associated with the power source.

Accordingly, in emergency situations the health of the patient may be compromised.

OBJECT OF THE INVENTION

It is an object of the present invention to provide an apparatus for warming blood, or other fluids.

10 Another object of the invention is to provide an apparatus for warming blood that is lightweight and disposable.

It is a further object of the invention to provide an apparatus for warming blood that is economical in cost and manufacture.

15 It is yet a further object of the present invention to overcome, or at least substantially ameliorate, the disadvantages and shortcomings of the prior art.

Other objects and advantages of the present invention will become apparent from the following description, taken in connection with the accompanying drawings, wherein, by way of illustration and example, an embodiment of the present invention is disclosed.

SUMMARY OF THE INVENTION

20 According to the present invention, there is provided an apparatus for warming fluids including a body, an inlet port and an outlet port, the inlet and outlet ports connected by a passageway allowing fluid communication between, the body containing at least one chemical therein capable of generating an increase in temperature upon activation, such that in use, when activated, the temperature of the biological fluid is raised on
25 traveling from the inlet port to the outlet port:

In preference, the passageway is a tube of resilient material connecting the inlet port to the outlet port.

In preference, the inlet port projects from the body and is adapted to releasably engage an outlet of a bag of biological fluid.

- 5 In preference, the body defines the passageway between the inlet and outlet port such that a flexible tube can be inserted therein, the outer surface of the tube being in direct or close contact with the walls of the passageway.

In preference, the body further includes a back section and a front section hingedly connected for opening and closing the body to allow insertion of a tube therein.

- 10 In preference, the hinge is integral to the back and front sections.

The back and front sections each contain a portion of the passageway such that when in a closed configuration a tunnel is defined through the body.

In preference, a fastening means is provided to retain the back and front section in a closed position when in use.

- 15 In preference, there is at least one heat conductive material located within the body, shaped to at least partially conform to the shape of a section of the passageway.

In preference, the heat conductive material is selected from the group consisting of heat conductive metals or heat conductive polymers.

- 20 In preference, the heat conductive metal is selected from the group consisting of copper or aluminum alloys.

In preference the body contains one or more chemicals capable of undergoing an exothermic reaction between 30°C and 42°C.

In preference, the body contains a hydrated salt capable of releasing the latent heat of crystallization between 30° and 42°C.

In preference, a separate enclosure is provided substantially within or adjacent to the body substantially surrounded by the liquid chemical, the separate enclosure containing initiator material such that by rupturing this separate enclosure the initiator material is brought into direct contact with the liquid chemical in order to initiate a temperature increasing process.

In preference, an enclosure is provided containing the initiator material such that the initiator material can be injected into the liquid chemical in order to initiate a temperature increasing process.

In preference, the initiator material is material capable of initiating a reaction, such as a seed crystal.

In preference, at least one sheet of heat conductive material is wrapped around the tube.

In preference, the body has an outer insulating layer.

In preference, there is provided on the body at least one attachment point for attaching the body to a bag containing the fluid to be warmed.

In a further embodiment, the invention resides in an apparatus for warming fluids including a first and at least one second body, the first body having an inlet port and an outlet port, the inlet and outlet ports connected by a passageway allowing fluid communication between, the second bodies containing at least one chemical therein capable of producing a temperature increase upon activation, such that in use, the first body being in contact with the second bodies so that when activated, the temperature of the biological fluid is raised on traveling from the inlet port to the outlet port.

In preference, the passageway is a tube of resilient material connecting the inlet port to the outlet port.

In preference, the inlet port projects from the first body and is adapted to releasably engage an outlet of a bag of biological fluid.

In preference, the first body defines the passageway between the inlet and outlet ports such that a flexible tube can be inserted therein, the outer surface of the tube being in direct or close contact with the walls of the passageway.

5 In preference, there is a means for controlling the temperature of the first body so that fluids passing there through do not exceed a predetermined temperature.

10 A further embodiment of the invention resides in a method for warming fluid to be administered to a patient, the method including: providing an apparatus for warming fluids including a body, an inlet port and an outlet port, the inlet and outlet ports connected by a passageway allowing fluid communication between, the body
15 containing a chemical therein capable of producing a temperature increase upon activation, such that in use, when activated, the temperature of the biological fluid is raised on traveling from the inlet port to the outlet port, connecting a supply of fluid to be warmed to the inlet port, connecting the outlet port to a fluid line inserted into a patient, activating the chemical to produce a temperature increase and allowing the fluid
15 to flow from the inlet to the outlet.

20 In yet a further form of the invention, there is a method of warming fluids to be administered that includes the steps of providing an apparatus for warming fluids including a body, wherein the body includes a front and back section hingedly connected along a portion of their edges for opening and closing the body, each
20 section containing a portion of a passageway such that when in a closed configuration a tunnel is defined through the body, inserting a flexible tube containing fluids to be warmed into either the front or back section of the passageway, then closing the front and back sections together so that the body is brought into thermal contact with a portion of the tube.

25 In order that the invention may be better understood and put into practical effect, reference will now be made to the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a first embodiment of the invention in use;

Figure 2 is a front view of the apparatus;

Figure 3 is a front view of a further embodiment of the invention showing a sectional view through B-B;

5 Figure 4 is an exploded view of section E from figure 3 showing the components of the apparatus;

Figure 5 is a front view of the apparatus according to a further embodiment of the invention showing the heat conductive material;

Figure 6 is an exploded view of section G of figure 5;

10 Figure 7 is a further embodiment showing the fluid-warming device in an open position;

Figure 8 shows a further embodiment in an open position;

Figure 9 shows a partial cross-sectional view of the fluid-warming device of Figure 8 in a closed position;

15 Figure 10a shows an alternative arrangement of the cross-sectional view of Figure 9 in an open position;

Figure 10b shows the arrangement of Figure 10a in the closed position;

Figure 11 shows an alternative insert that resides in the device of figure 8

Figure 12 is a partial cross-sectional view of the insert of Figure 11;

Figure 13 is a perspective view of yet a further embodiment of the invention.

20 Figure 14 is a graph showing performance parameters of the invention.

DETAILED DESCRIPTION OF THE INVENTION

With reference to figures 1 and 2 there is a blood warming apparatus 10 having a body 20 with an inlet port 30 and an outlet port 40. The body 20 contains a chemical 50 that is capable of producing a temperature increase upon activation. Such chemicals are known in the industry and may include a form of hydrated salt such as sodium acetate trihydrate, sodium borate decahydrate and sodium thiophosphate pentahydrate. Various other chemicals may well be used, the suitability of such being determined by the maximum output of heat and temperature, which must be close to that of physiologically accepted temperatures. Such chemicals are known and commercially available.

10 The body 20 has a passageway 60 that is serpentine, traveling from the inlet port 30 to the outlet port 40. In the example shown in figure 2 the body 20 has a coupling 65 suitable to connect to an outlet 70 of a bag of fluid 75. Typically, the coupling 65 and outlet 70 are of the "leur lock" type, or other acceptable standard used with bags of fluid such as blood.

15 The body 20 further has a coupling 80 at the outlet port 40 adapted to securely connect to a fluid line 85. Again, this is typically achieved using a "leur lock" connection or other commonly used method.

The chemical 50 inside the body 20 surrounds the passageway 60 such that when the chemical 50 is activated, which may be by way of a seed crystal injector or an activator "button" 100, the chemical 50 crystallises and heat is given off and fluid traveling from the bag 110 through the inlet 30 is then warmed as it travels through passageway 60 to the outlet 40.

25 The activator "button" 100 may be of the "clicker" type, which upon activation begins the process of crystallisation. This method is preferred in that the actual initiation time of crystallisation can be controlled and further allows for the apparatus 10 to be reused if appropriate. Activation may also be achieved in a number of other forms known to those skilled in the art, such as by temperature activation.

30 The apparatus 10 may be additionally connected to the fluid bag 75 by way of attachment points 120 located on the upper edge 130 of the body 20, however, this would depend on the overall size and weight of the apparatus 10.

In use then, it may be preferable that the chemical 50 is activated prior to attachment to the bag of fluid 75 such that sufficient time elapses for the chemical 50 to begin increasing its temperature.

Shown at figure 3 and figure 4 is a further example of the apparatus 200 having a
5 body 210, an inlet port 220 and an outlet port 230. Connecting the inlet port 220 and the outlet port 230 is a passageway 240.

The body 210 contains a chemical 50 that is capable, upon activation, of producing a temperature increase, such as a chemical or chemicals that provide an exothermic reaction.

10 The passageway 240 is defined by tubing 250 that permits the flow of fluid 75 from bag 110 from the inlet port 220 through the outlet port 230.

One of the problems with the use of hydrated salts as the chemical 50 is that they have a relatively low thermal conductivity such that heat is not adequately transferred through the body 210. In order to circumvent this members 260 are provided which
15 are shaped to at least partially conform to the shape of the tube 250 and extend laterally outward from the tube 250 into the bulk of the chemical 50. The members 260 are constructed from a material of high thermal conductivity, such as copper or aluminum alloy and act to transport heat from the periphery of the body 210 towards the tube 250, thus delivering more thermal energy to the fluid passing through the
20 tube 250.

The members 260 can, in one form, be constructed from two pieces of heat conducting material that are substantially the same and each member 260 consists of a front portion 270 and a back portion 280. Each portion has a section 290 that is
25 shaped or constructed so as to substantially conform to the outer shape of the tube 250. The lateral sections 295 of the front and back portions 270 and 280 respectively, are then brought into contact and secured together, preferably using a small amount of adhesive on the inner surface 300.

However, it is not absolutely necessary that the lateral sections 295 of the front and rear and back portions 270 and 280 respectfully, be secured together as long as the

section 290 has a snug nesting fit with the outer periphery of tube 250 such that any heat applied to the lateral sections 295 is then transferred to the section 290 to warm the fluid passing there through. In this way then it is possible to overcome the low thermal conductivity problems that arise from using hydrated salts to provide the
5 temperature increase.

In an alternative form, as shown in figure 5, the apparatus 400 has a body 410, an inlet port 420, an outlet port 430 and a passageway defined by tube 440 connecting the two ports.

The tube 440 has laterally extending members 450 placed at regular intervals along
10 the tubing 440.

As shown in figure 6 the members 450 are at least partially coiled around the tube 440 such that the lateral sections 460 extend outwardly from the coiled section 490. In this way then heat is transferred from the periphery of the body 410 towards the tube 440 and warms fluid passing there through. By simply coiling the members 450 this then
15 provides a relatively inexpensive manufacturing procedure.

The temperature increasing process can again be initiated by the use of the "clicker" 495. However, this is not the only means for initiating the process. One possible way includes adding gas bubbles, such as air bubbles, into the liquid chemical. Another possible way of starting the process would be to add initiator material, such as seed
20 crystals into the liquid chemical. The seed crystals could be contained in a separate container within the body, the container being made from a frangible material so that the container can rupture to release the seed crystals to start the process.

Alternatively, the initiator material could be held in a separate integrated chamber and injected or forced into the liquid chemical through a membrane or valve when activation
25 of the chemical is required. The initiator material could pass through the valve or membrane, or rupture the membrane depending upon requirements. The integrated chamber can be positioned either substantially within or adjacent to the body 210.

The device shown in Figure 7 is a further form of the invention shown in an open position in which the passageway is in the form of a tube 500 that nests within the

device 510 by way of the channels 520 and 530 that accommodate the tube 500 when the sides 540 and 550 joined by a hinged section 555, are brought into touching engagement to substantially encase a length of the tube 500. Fasteners 560 are then used to hold the device 510 in a closed position and are of the hook and loop type.

- 5 The lateral members 570 are made of a heat conductive material to draw heat from the side of the device in towards the tubing 500.

In this way the device may be readily removed from the tubing so that when the temperature subsides the warmer can be removed from the tube without the need to change the tubing.

- 10 Figure 8 shows a similar arrangement in which the tube 600 is sandwiched between sides 610 and 620 of the device 605 containing chemical capable of producing a temperature increase. The serpentine pathway or channels 630 and 640 on the inner sides 635 and 645 respectively are semi circular in shape to nestingly hold a portion of tube 600. Figure 9 shows the tube 600 sandwiched between the sides 610 and 620,
15 such that the tube 600 is in close contact with the channels 630 and 640 with little or no gaps present.

- In the alternative arrangement shown in 10a and 10b, only one side of the device has the serpentine pathway or channel 655 on only one surface 649 of side 647, the opposite side 646 having a flat inner surface 648. The channel 655 is shaped so that
20 more than half of the tube 600 is received therein.

- Figures 11 and 12 show an alternative to the insertion of the tube 600 into the device 605 by having the tube 600 integrally constructed with a web or support 655 in a serpentine formation to form the insert 660. At each end of the tube 600 there are couplings 665, 645 of the leur lock type for attaching the tube 600 to a bag of fluid and
25 a patient.

In order to effect more efficient heating of the fluid as it flows from an inlet port to an outlet port, the arrangement of the passageway or tubing should be in a stacked serpentine arrangement 700 as shown in Figure 13. The tubing 725 is held in position

by a stabilizing means such as a plastic support frame and a chemical 720 capable of producing a temperature increase upon activation surrounds tubing 725.

5 The use of the serpentine pathway as shown herein is not necessarily the only way in which the fluid may pass through the body of the apparatus and other configurations may be employed without departing from the scope of the invention.

10 A further arrangement involves placing at least a portion of a first section of the tubing, from the inlet, inside the periphery of the body of the apparatus, with a second section of the tubing being substantially surrounded by the body, leading to the outlet. In this way the incoming fluid is slowly warmed as it travels towards the centre of the body, which is effectively insulated from the cold fluid flowing closer to the periphery of the body. The fluid then flows out through the outlet port. It would be advantageous to insulate a section of the tubing leading up to the outlet port if it is required to travel close to any cooler fluid so as to minimize any temperature loss as a result of being too close to tubing containing fluid at a lower temperature.

15 In order to demonstrate the efficiency of the device, a test system was set up in which water at 4°C was feed into the device and the parameters of flow rate and temperature of fluid exiting the device were measured.

20 The experimental data, see figure 14, shows that the unit, in a configuration containing 1.7 kg of chemical, was capable of warming 1220 mL of water from a starting temperature of 4°C to an average of 31°C, at an average flow rate of 50 mL/min. This clearly demonstrates that it is capable of providing a patient with fluid at a temperature that minimises the thermal stress on the patient.

25 In practice, a single 1 kg unit could be used to warm 600mL of fluid from 4°C. When the unit has expired it could be, if additional fluid was required to be warmed, removed and a new unit activated and attached to the fluid delivery system.

Accordingly, the above descriptions provide for the use of a fluid warming apparatus that employs relatively inexpensive chemicals that provide for a temperature increase in order to heat the desired fluid. The low cost and the simplicity of the apparatus makes it very suitable for use in emergency situations or in situations where the unit

may be stored for a substantial amount of time without having to worry about problems associated with power supply. Due to its lightweight, several of the apparatus may be carried in a field emergency medical kit often used by rescuers traveling to remote locations.

- 5 Although the above example is directed to an application of warming a fluid, another obvious alteration to the invention would be to use a chemical that is capable of providing a cooling effect (endothermic reaction) using appropriate chemicals known to those in the trade.

- 10 Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognised that departures can be made within the scope of the invention, which is not to be limited to the details described herein but is to be accorded the full scope of the appended claims so as to embrace any and all equivalent devices and apparatus

CLAIMS

1. An apparatus for warming fluids, the apparatus including a body, an inlet port and an outlet port, the inlet and outlet ports connected by a passageway allowing fluid communication between, the body containing at least one chemical therein capable of generating an increase in temperature upon activation, such that in use, when activated, the temperature of a fluid is raised on traveling from the inlet port to the outlet port.
2. The apparatus of claim 1, wherein the chemical is selected from the group of one or more chemicals capable of providing an exothermic reaction between 30°C and 42°C when activated.
3. The apparatus of claim 2, wherein the selected chemical is a hydrated salt capable of releasing the latent heat of crystallization between 30° and 42°C.
4. The apparatus of claim 3, wherein the body defines the passageway between the inlet and outlet port such that a flexible tube can be inserted therein, the outer surface of the tube being in direct or close contact with the walls of the passageway.
5. The apparatus of claim 4, wherein the inlet port projects from the body and is adapted to releasably engage an outlet of a bag of biological fluid.
6. The apparatus of claim 5, wherein the body further includes a back section and a front section hingedly connected for opening and closing the body to allow insertion of a tube therein.
7. The apparatus of claim 6, wherein the hinge is integral to the back and front sections such that the back and front sections each contain a portion of the passageway such that when in a closed configuration a tunnel is defined through the body.

8. The apparatus of claim 7, further including a fastening means to retain the back and front section in a closed position when in use.
9. The apparatus of claim 4, wherein there is at least one heat conductive material located within the body, shaped to at least partially conform to the shape of a section of the passageway.
5
10. The apparatus of claim 9, wherein the heat conductive material is selected from the group consisting of heat conductive metals or heat conductive polymers.
11. The apparatus of claim 10, wherein the heat conductive metal is selected from the group consisting of copper or aluminum alloys.
- 10 12. The apparatus of claim 11, wherein the inlet port projects from the body and is adapted to releasably engage an outlet of a bag of biological fluid.
13. The apparatus of claim 3, wherein there is at least one heat conductive material located within the body, shaped to at least partially conform to the shape of a section of the passageway.
- 15 14. The apparatus of claim 13, wherein the heat conductive material is selected from the group consisting of heat conductive metals or heat conductive polymers.
15. The apparatus of claim 14, wherein the heat conductive metal is selected from the group consisting of copper or aluminum alloys.
- 20 16. The apparatus of claim 15, wherein the passageway is a tube of resilient material connecting the inlet port to the outlet port.
17. The apparatus of claim 16, wherein the inlet port projects from the body and is adapted to releasably engage an outlet of a bag of biological fluid.
18. The apparatus of claim 3, further including a separate enclosure located either substantially within or adjacent to the body,

- 5 19. The apparatus of claim 18, wherein the separate enclosure is substantially surrounded by the chemical, the separate enclosure containing initiator material such that by rupturing the separate enclosure within the body the initiator material is brought into direct contact with the liquid chemical to initiate a temperature increasing process.
20. The apparatus of claim 19, wherein the initiator material is a seed crystal.
21. The apparatus of claim 20, wherein the passageway is a tube of resilient material connecting the inlet port to the outlet port.
22. The apparatus of claim 21, wherein the body has an outer insulating layer
- 10 23. The apparatus of claim 22, wherein there is provided on the body at least one attachment point for attaching the body to a bag containing the fluid to be warmed.
24. The apparatus of claim 23, wherein the inlet port projects from the body and is adapted to releasably engage an outlet of a bag of biological fluid.
- 15 25. The apparatus of claim 18, wherein the initiator material is brought into direct contact with the liquid chemical by injection of the initiator material into the liquid chemical to initiate a temperature increasing process.
26. The apparatus of claim 25, wherein the initiator material is a seed crystal.
27. The apparatus of claim 26, wherein the passageway is a tube of resilient material
20 connecting the inlet port to the outlet port.
28. The apparatus of claim 27, wherein the body has an outer insulating layer
29. The apparatus of claim 28, wherein there is provided on the body at least one attachment point for attaching the body to a bag containing the fluid to be warmed.

30. The apparatus of claim 29, wherein the inlet port projects from the body and is adapted to releasably engage an outlet of a bag of biological fluid.
31. The apparatus of claim 2, wherein the at least one chemical is contained within at least one secondary body, separate to a first body having an inlet port and an outlet port located thereon, such that when in use, the first body is brought into close contact with the at least one secondary body.
32. The apparatus of claim 31, wherein the selected chemical is a hydrated salt capable of releasing the latent heat of crystallization between 30° and 42°C.
33. The apparatus of claim 32, further including a separate enclosure located either substantially within or adjacent to each of the secondary bodies.
34. The apparatus of claim 33, wherein the at least one separate enclosure is substantially surrounded by the chemical, the separate enclosure containing initiator material such that by rupturing the at least one separate enclosure within the body the initiator material is brought into direct contact with the liquid chemical to initiate a temperature increasing process.
35. The apparatus of claim 34, wherein the body defines the passageway between the inlet and outlet port such that a flexible tube can be inserted therein, the outer surface of the tube being in direct or close contact with the walls of the passageway.
36. The apparatus of claim 35, wherein the inlet port projects from the body and is adapted to releasably engage an outlet of a bag of biological fluid.
37. The apparatus of claim 33, wherein the initiator material is brought into direct contact with the liquid chemical by injection of the initiator material into the liquid chemical to initiate a temperature increasing process.
38. The apparatus of claim 37, wherein the body defines the passageway between the inlet and outlet port such that a flexible tube can be inserted therein, the outer

surface of the tube being in direct or close contact with the walls of the passageway.

39. The apparatus of claim 38, wherein the inlet port projects from the body and is adapted to releasably engage an outlet of a bag of biological fluid.
- 5 40. A method for warming fluid to be administered to a patient, the method including: providing an apparatus for warming fluids including a body, an inlet port and an outlet port, the inlet and outlet ports connected by a passageway allowing fluid communication between, the body containing a chemical therein capable of producing a temperature increase upon activation, such that in use, when
10 activated, the temperature of the biological fluid is raised on traveling from the inlet port to the outlet port, connecting a supply of fluid to be warmed to the inlet port, connecting the outlet port to a fluid line inserted into a patient, activating the chemical to produce a temperature increase and allowing the fluid to flow from the inlet to the outlet.
- 15 41. An apparatus for warming or cooling fluids, substantially as hereinbefore described with reference to the accompanying drawings.

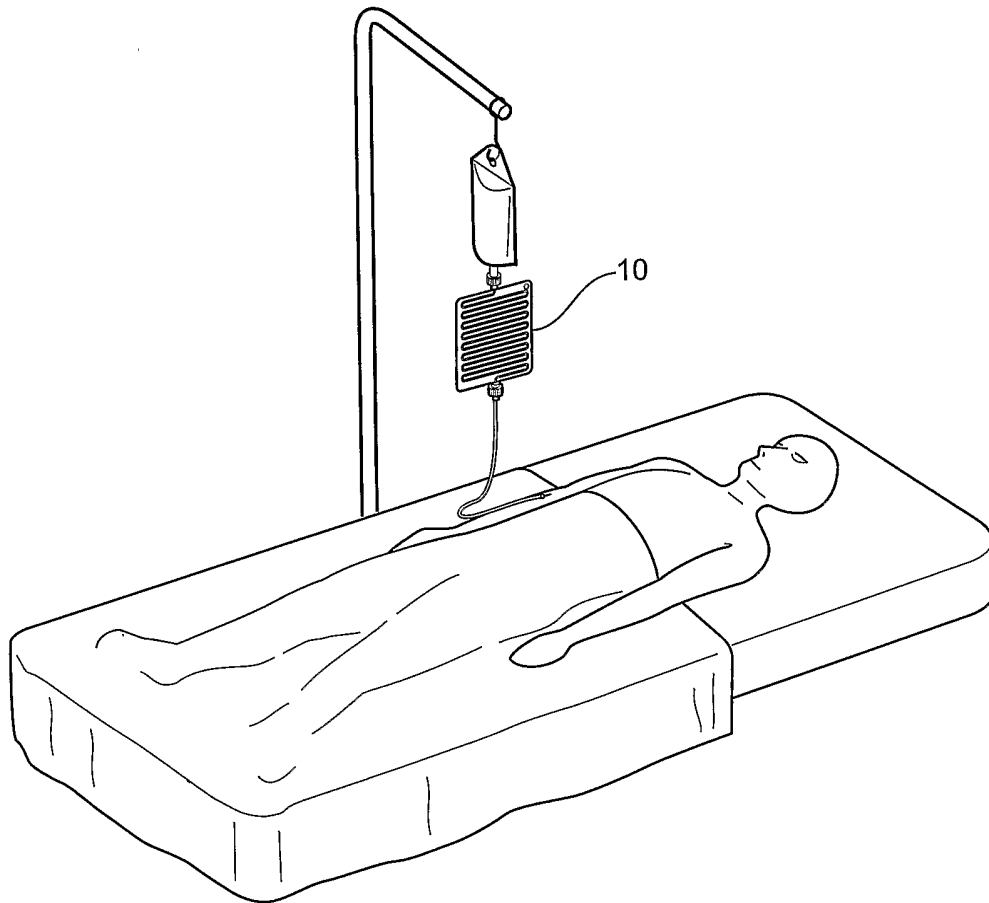
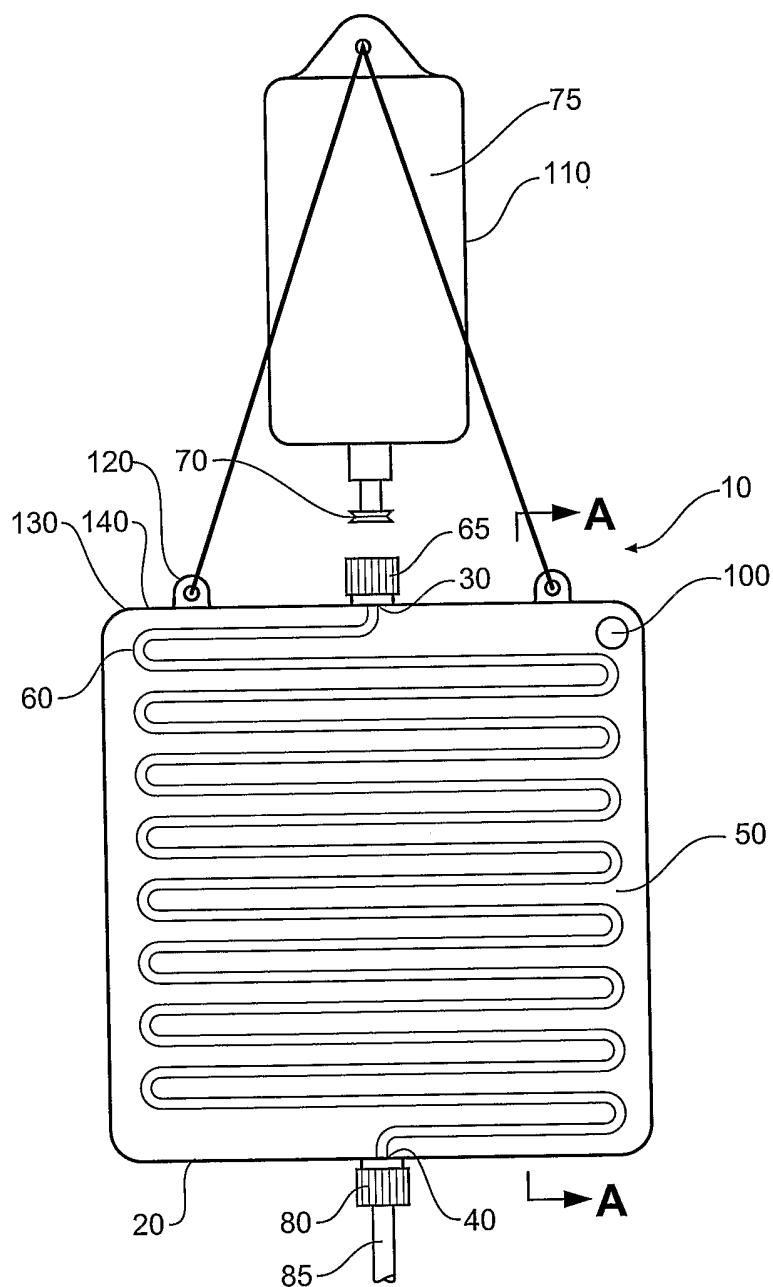
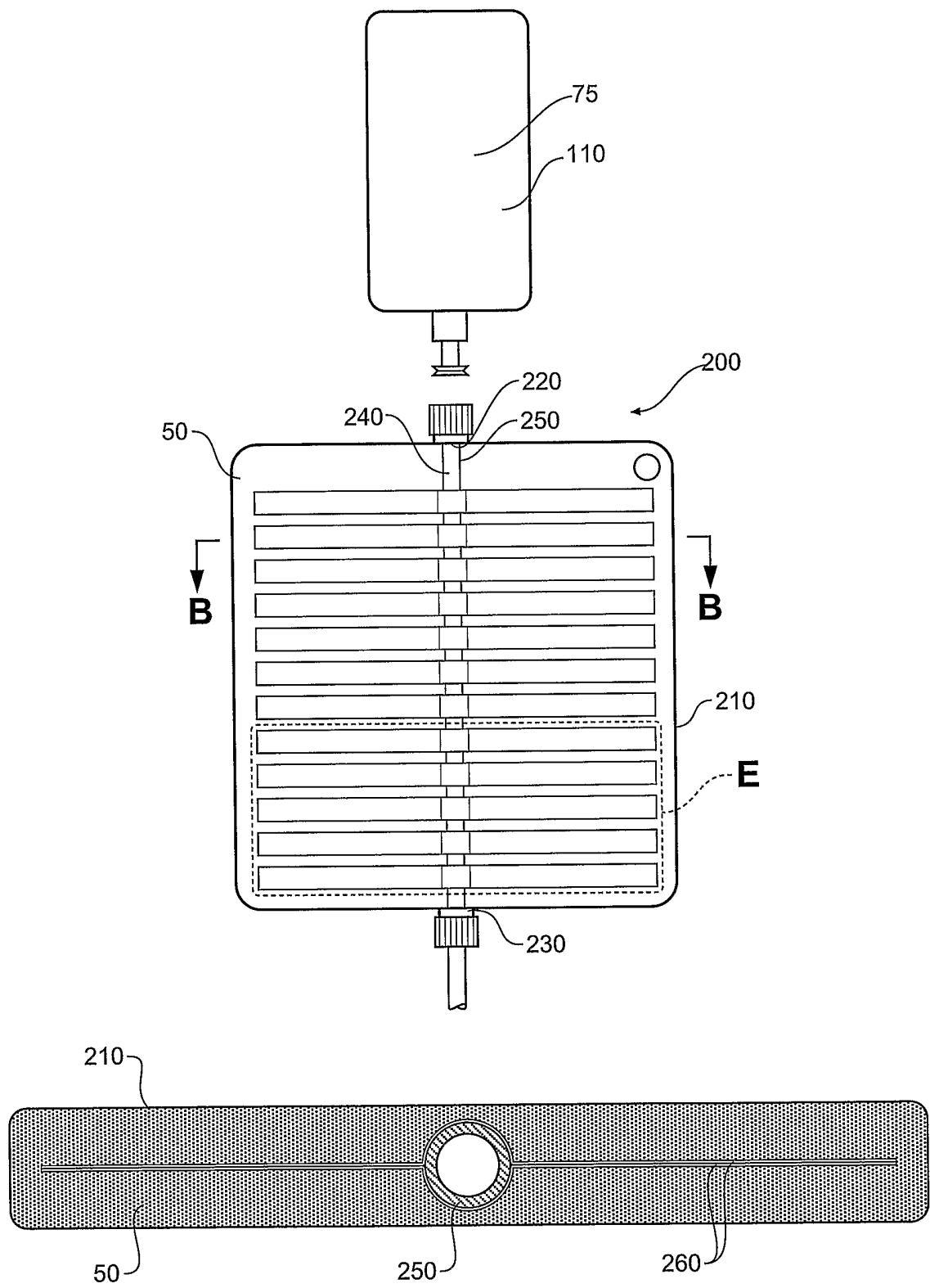
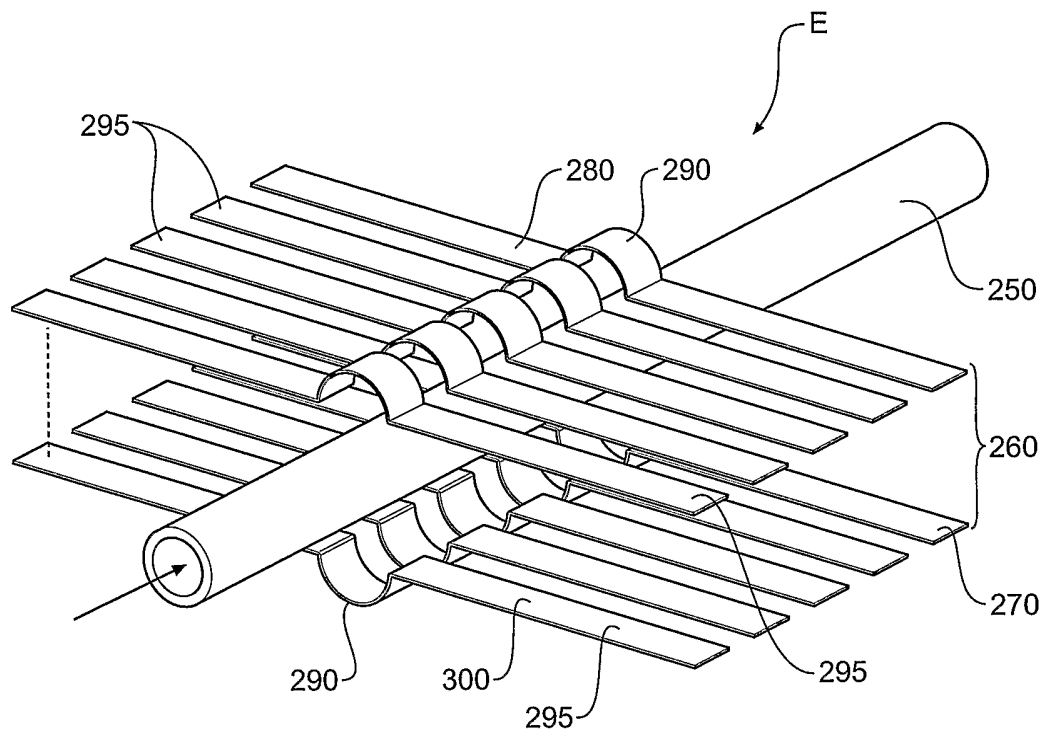
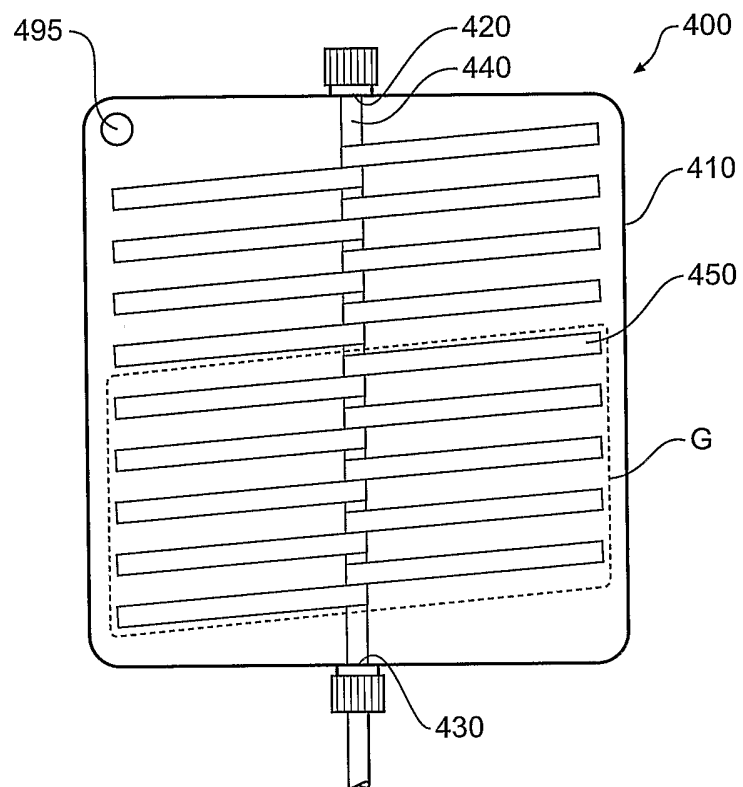
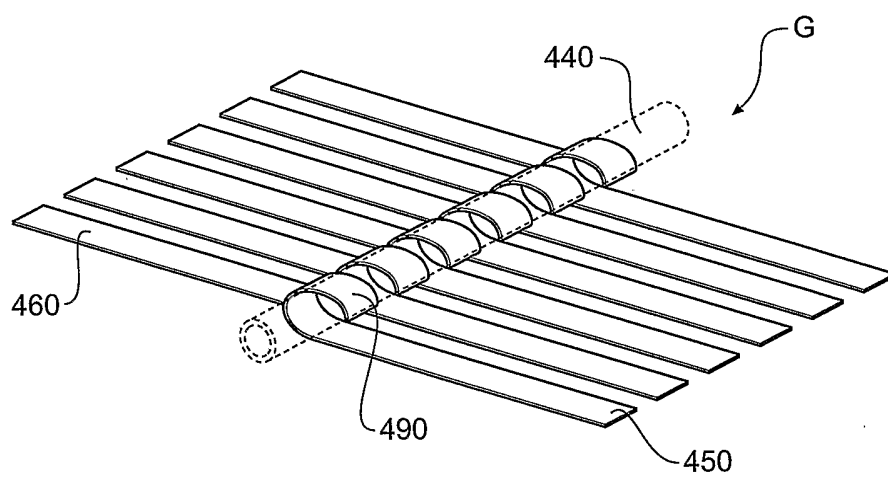


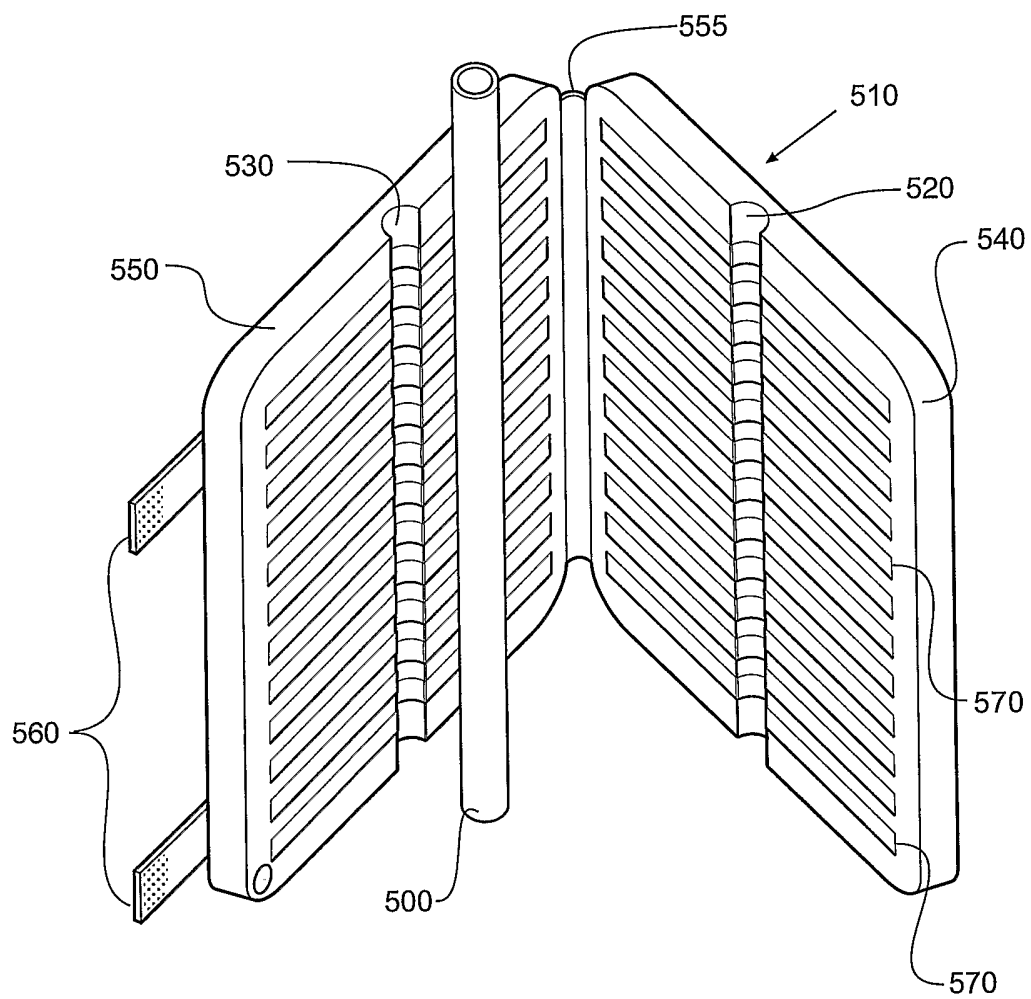
Fig 1

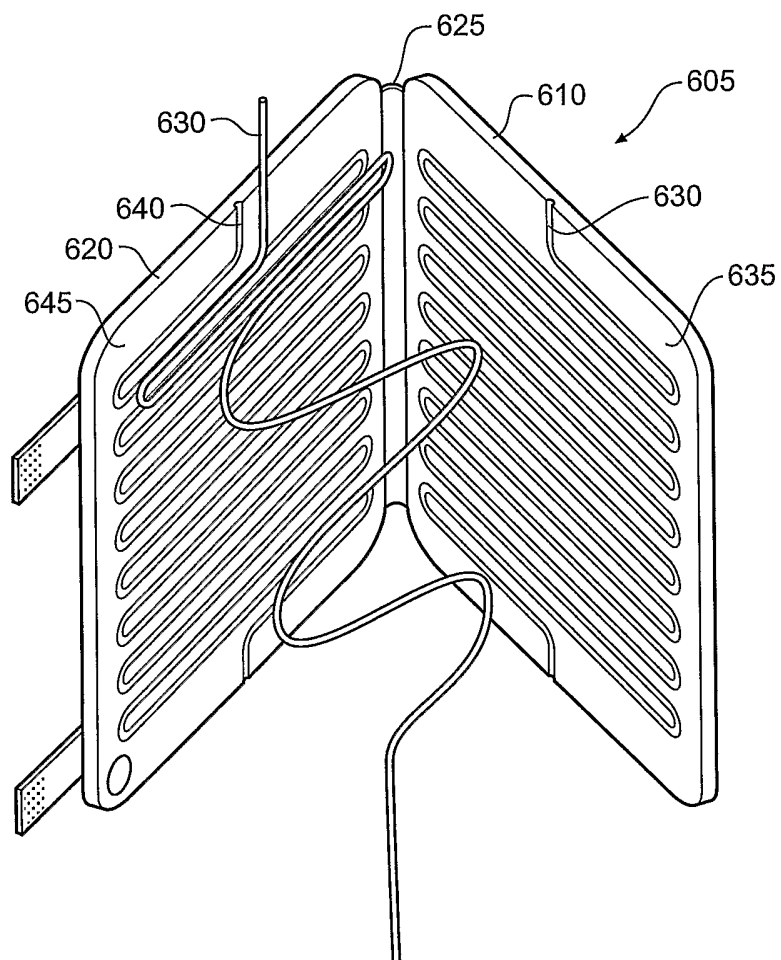
**Fig 2**

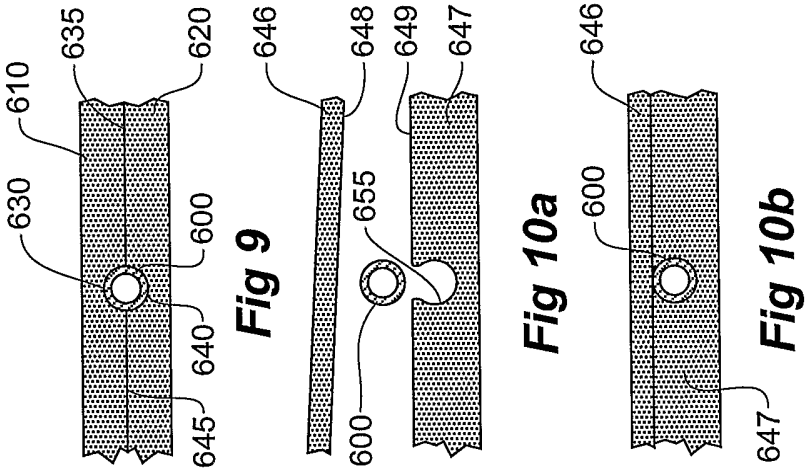
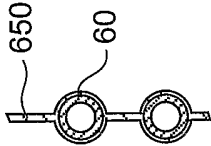
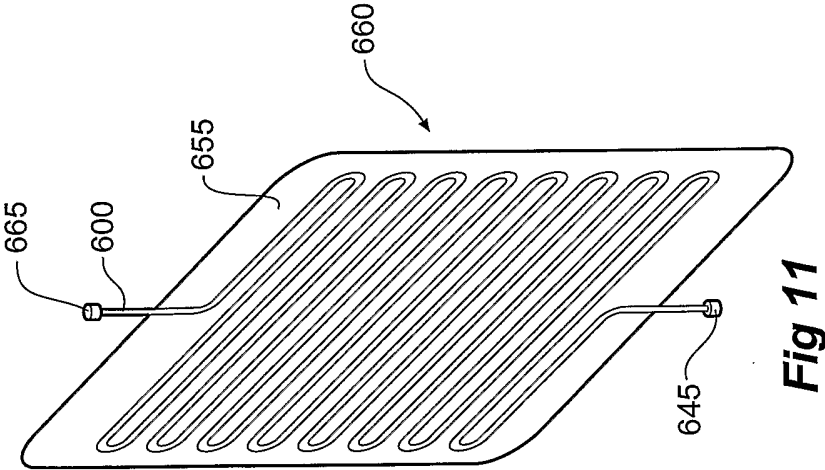
**Fig 3**

**Fig 4**

**Fig 5****Fig 6**

**Fig 7**

**Fig 8**



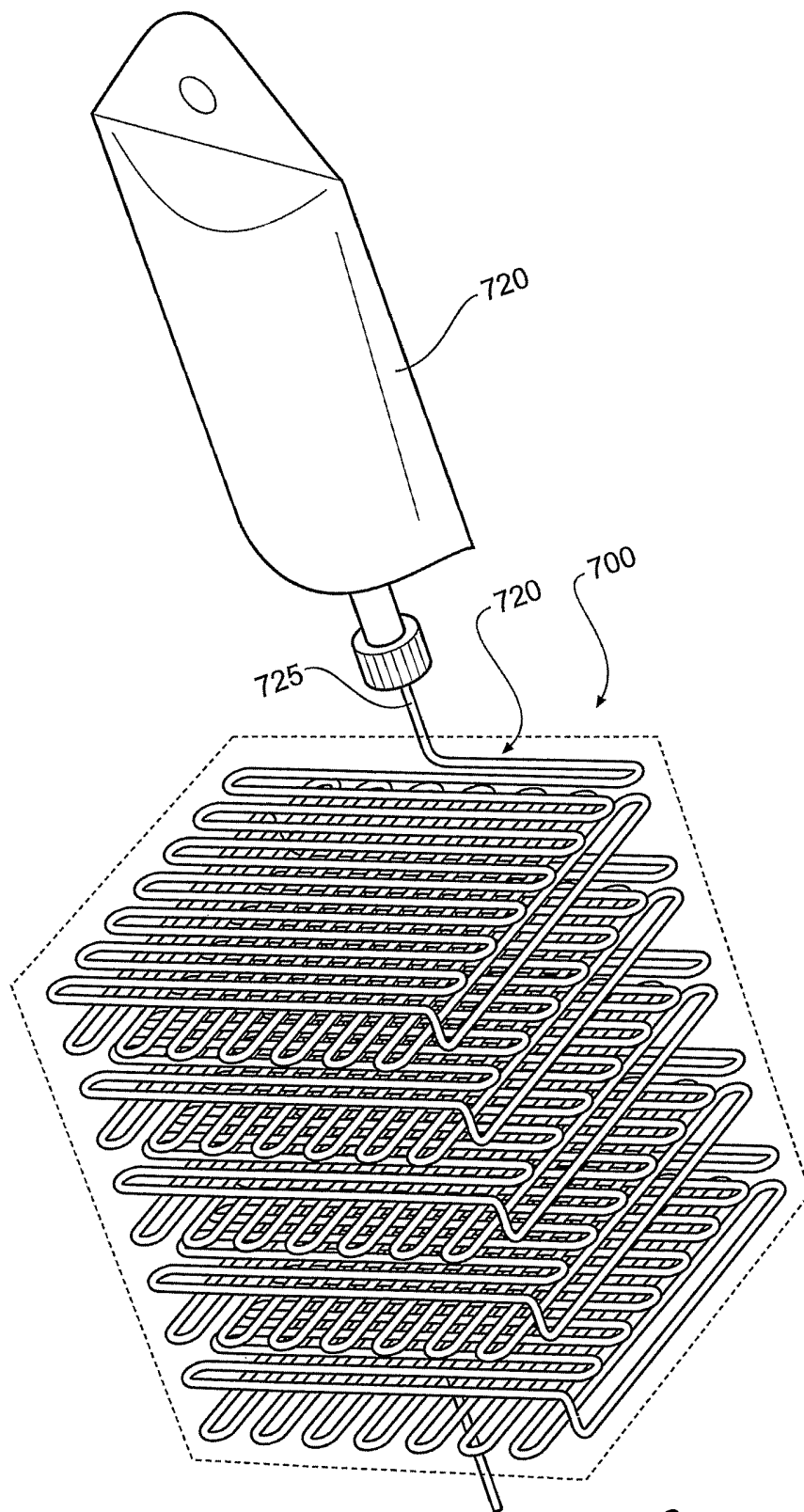
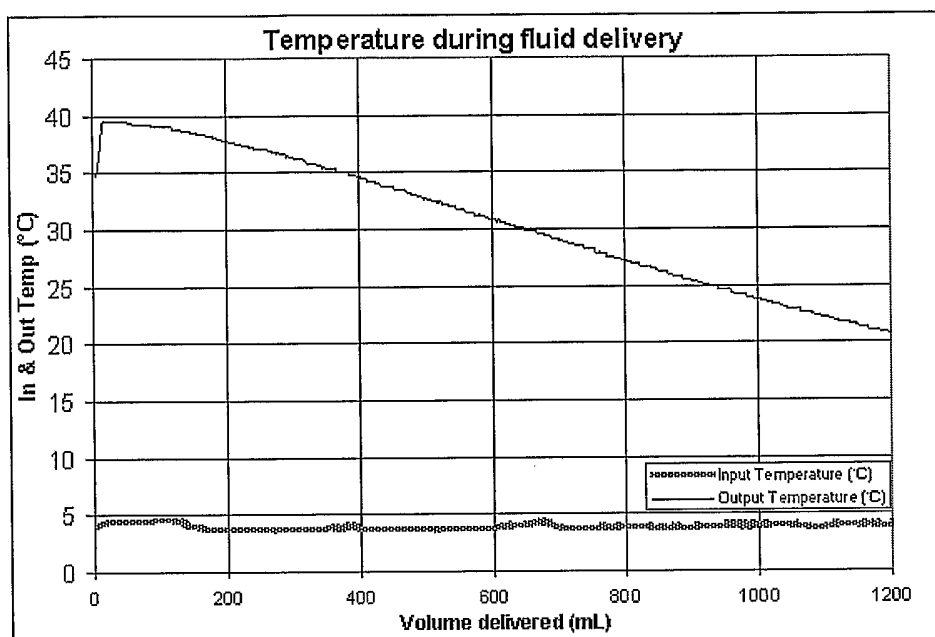


Fig 13

**Fig 14**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2005/001783

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

A61M 5/44 (2006.01) F24J 1/00 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

DWPI: IPC: A61M-005, F24J-001; Keywords: Warm, heat, temperature, chemical, exothermic, latent, react, fluid, blood, liquid, inlet, outlet, passage and similar words

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 042 455 A (YUE et al) 27 August 1991 See entire document	1-41
X	WO 2003/059414 A2 (HEAT FACTORY INC) 24 July 2003 See entire document	1-41
X	US 5 101 804 A (COHN) 7 April 1992 See abstract; col 2, lines 9-68; col 4, lines 58-63; col 8, lines 5-25; figure 7	1-41
X	EP 0 130 757 A2 (THE STATE OF ISRAEL MINISTRY OF DEFENCE MILITARY INDUSTRIES) 9 January 1985 See page 9, line 18-30; figure 2	1

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
08 February 2006

Date of mailing of the international search report
15 FEB 2006

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2005/001783

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	5042455				
WO	03059414	AU	2003207581	CA	2513377
				US	2003163087
US	5101804				
EP	0130757				
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.					
END OF ANNEX					