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(54) Title: HEATING AND COOLING DEVICE AND METHOD USING PELTIER EFFECT SEMICONDUCTOR

(57) Abstract: The present invention provides a Peltier effect semiconductor system 1000 including at least one semiconductor element pair 1100 arranged to produce Peltier effect. Further, a therapy device (100) for providing healing to injured body part of a user is provided. The therapy device includes an accessory (102). The accessory (102) includes a heat sink (112) having a plurality of fins, a first electrical insulator (114), at least one thermoelectric cooler (116). The device is configured to generate heat at a first side and to generate cool at a second side of the at least one thermoelectric cooler (116).

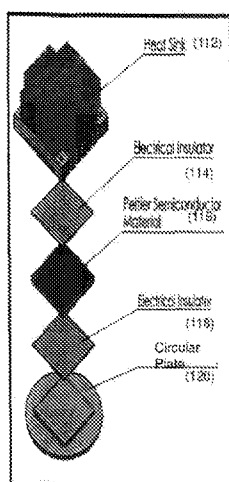


FIG. 3

HEATING AND COOLING DEVICE AND METHOD USING PELTIER EFFECT SEMICONDUCTOR

FIELD OF THE INVENTION

5 Embodiments of the present invention, generally relate to a semiconductor-based heating and cooling device and method, and more particularly to an device for thermal treatment of human injury or an animal injury, for providing cyclic heat treatment of hot therapy and cold therapy to the human injured part or the animal injured part.

BACKGROUND

10 Many injuries to the human body and animal body (for example, bruised muscles, aching joints, damaged ligaments, and post-surgery recoveries) are treated with the application of hot and or cold therapy. Such therapies require the application of heat or removal of heat to the affected area of the human body, and
15 help to reduce swelling, pain, and promote healing. In some injuries, cyclic heat treatment (i.e., hot-cold-hot-cold or similar patterns) is also recommended as it offers better recovery and health benefits over that of constant heat or constant cold treatments.

20 In the past, injuries requiring cold compresses have often been treated by a cloth, bandage or gel that has been cooled in a freezer and applied to the injured area. Ice packs have also been used to apply cooling therapy to a body surface. Injuries requiring heat treatment have often treated by a cloth or bandage that has

been heated, and then applied to the injured area.

However, these different past approaches have various shortcomings. For example, these conventional approaches require lot of preparation and hence are inconvenient. For example, ice packs need to be frozen and stored in a freezer prior
5 to application to an injury. Similarly, a hot water bottle requires it to be placed in boiling water to reach an effective hot temperature. Further, ice packs and heated cloths return to ambient temperature in a relatively short time. \

Further, there are some conventional devices also available, that uses heated or cooled water and circulates the water through tubes around the affected areas of
10 the body to provide cyclic relief. However, these conventional devices are bulky, expensive, and have slow cycling times due to requirement of fluid changeover. Further, the conventional devices provide poor control over the temperatures and durations that these devices operate.

The concept of Peltier effect has been in existence for many years. Peltier
15 coolers and the use of them to cool electronic elements and devices is also well known. However, typical arrangements of these include a plurality of thermal couples in contact with two planar elements. Thus, there is a 'hot' plane and a 'cold' plane spatially removed therefrom. This system is invariably used in all Peltier configurations. In addition, the Peltier cooler and the device to be cooled are typically
20 electrically isolated. That is, they are thermally coupled but are on different electronic circuits.

The semiconductors are known to be mounted on ceramic substrate for thermal conductivity and insulation. While the concept is known, the elements used to implement the concept has limitations which prevent their efficient use.

Therefore, there is a need for an improved system that utilizes the concept of Peltier effect more efficiently , and an improved device and a method for providing cold therapy and hot therapy to the user's injured part.

SUMMARY

According to an aspect of the present disclosure, a therapy device (100) for providing healing to injured body part of a user is provided. The therapy device includes an accessory (102). The accessory (102) includes a heat sink (112) having a plurality of fins. The accessory (102) further includes a first electrical insulator (114) located below the heat sink (112), and configured to insulate the heat sink (112). The accessory (102) further includes at least one thermoelectric cooler (116) located below the electrical insulator (114), and configured to generate heat at a first side and to generate cool at a second side of the at least one thermoelectric cooler (116). The accessory (102) further includes a second electrical insulator (118) located below the at least one thermoelectric cooler (116), and configured to insulate the at least one thermoelectric cooler (116). The accessory (102) further includes a metallic plate (120) located below the second electrical insulator (118), and configured to provide heat or cool to a body part of the user.

According to another aspect of the present disclosure, a method for providing therapy to a user is provided herein. The method includes receiving electrical power by a therapy device (100). Further, the method includes enabling a user to provide temperature value and duration of the temperature, utilizing a peltier effect to generate heat or cold at at least one thermoelectric cooler, and utilizing fins as a heat sink above the thermoelectric cooler. The method further includes providing hot therapy or cold therapy to a user's injured body part.

According to another aspect, the present invention provides a Peltier effect semiconductor system. The system including at least one semiconductor element pair arranged to produce Peltier effect wherein the semiconductor element pair includes one P-type doped semiconductor element and one N-type doped semiconductor element, each element having a cold end and a hot end, further said element pair being arranged to form a portion of a thermal circuit; a pair of non-ceramic substrate wherein the at least one semiconductor element pair is sandwiched between the non-ceramic substrate, wherein the non-ceramic substrate provides thermal conductivity and also act as electrical insulators

The preceding is a simplified summary to provide an understanding of some aspects of embodiments of the present invention. This summary is neither an extensive nor exhaustive overview of the present invention and its various embodiments. The summary presents selected concepts of the embodiments of the present invention in a simplified form as an introduction to the more detailed description presented below. As will be appreciated, other embodiments of the present invention are possible utilizing, alone or in combination, one or more of the

features set forth above or described in detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and still further features and advantages of embodiments of the present invention will become apparent upon consideration of the following detailed description of embodiments thereof, especially when taken in conjunction with the accompanying drawings, and wherein:

FIG. 1 illustrates a perspective view of accessories of a therapy device, according to an embodiment of the present invention;

FIG. 2 illustrates a schematic view of a control system the therapy device, according to an embodiment of the present invention;

FIG. 3 illustrates a schematic diagram of internal components of the accessory of therapy device, according to an embodiment of the present invention;

FIG. 4 illustrates a schematic diagram of internal components of the accessory of the therapy device, according to another embodiment of the present invention; and

FIG. 5 depicts an exemplary flowchart illustrating a method for providing therapy to a user's injured part, according to an embodiment of the present invention.

Fig. 6 illustrates a Peltier effect semiconductor system, according to an embodiment of the present invention.

Fig. 7 shows a unit test result for a 70X70 Peltier module applied to all industrial applications and functioning under the Peltier effect semiconductor system, according to an embodiment of the present invention.

5 DETAILED DESCRIPTION

As used throughout this application, the word "may" is used in a permissive sense (i.e., meaning having the potential to), rather than the mandatory sense (i.e., meaning must). Similarly, the words "include", "including", and "includes" mean including but not limited to.

10 The phrases "at least one", "one or more", and "and/or" are open-ended expressions that are both conjunctive and disjunctive in operation. For example, each of the expressions "at least one of A, B and C", "at least one of A, B, or C", "one or more of A, B, and C", "one or more of A, B, or C" and "A, B, and/or C" means A alone, B alone, C alone, A and B together, A and C together, B and C together, or
15 A, B and C together.

The term "a" or "an" entity refers to one or more of that entity. As such, the terms "a" (or "an"), "one or more" and "at least one" can be used interchangeably herein. It is also to be noted that the terms "comprising", "including", and "having" can be used interchangeably.

20 The term "automatic" and variations thereof, as used herein, refers to any process or operation done without material human input when the process or operation is performed. However, a process or operation can be automatic, even

though performance of the process or operation uses material or immaterial human input, if the input is received before performance of the process or operation. Human input is deemed to be material if such input influences how the process or operation will be performed. Human input that consents to the performance of the process or
5 operation is not deemed to be "material".

FIG. 1 illustrates a perspective view of a therapy device (100). The therapy device (100) includes an accessory (102) (shown in FIG. 1) and a control system (104) (shown in FIG. 2), and a cable (106). The accessory (102) is configured to receive electrical power through the cable (106). The control system (104) is
10 configured to be embedded in the accessory (102). In an embodiment, the control system (104) includes a display board (108) and an encoder (110) (as shown in FIG. 2). In an embodiment, the display board (108) is configured to display temperature value (for example, 30 degrees Celsius) that has been set by a user/operator using the encoder (110). According to an embodiment of the present invention, the
15 encoder (110) enables the user to set a desired temperature and duration for the desired therapy. The control system (104) further includes various circuitries to enable it to provide electrical power to the accessory (102) for a limited time period, as set by the user. Those skilled in the art will appreciate that the control system (104) makes the therapy device (100) easy to use by a user, as setting temperature
20 and duration becomes very easy and anyone can use the device.

The cable (106) includes a proximal end that is configured to mate with a receptor of the accessory (102). The cable (106) further includes a distal end that is configured to mate with a socket of an electrical power connection (not shown in

figure). The accessory (102) is configured to provide the desired therapy (for example, hot therapy, cold therapy or hot-cold-hot therapy or any other combination of hot and cold) to the user's injured part.

Those skilled in the art will appreciate that since each part of the user's body has different shape, different accessories (102A, 102B, 102C) are required to cover the user's injured part depending upon the site of the injury in the user's body. According to an embodiment of the present disclosure, the accessories (102) include various types of anatomic wraps which uses medical graded aluminium plates to deliver cold and heat therapy within minutes. In another embodiment, the therapy device (100) may include a manipole (not shown in figure) for areas that the wraps cannot reach effectively.

In an embodiment, the therapy device (100) is configured to provide cold as well as hot therapy (i.e., dual shock), as heating range of the therapy device (100) are from 0 degree Celsius to 42 degree Celsius. Further, in an embodiment, the therapy device (100) is configured to get cold within 2 minutes of setting, and is configured to get hot within 1 minute of setting on the control device (104). The therapy device (100) is configured to fluctuate from cold to hot within few minutes (for example, 2 minutes). Further, the therapy device (100) is configured to provide a display of the setting of temperature and timer value on the display board (108).

FIG. 3 illustrates internal components of the accessory (102) of the therapy device (100), according to an embodiment of the present invention. As shown in FIG. 3, the accessory (102) includes a plurality of components, which are positioned on

one another from top to bottom. At the top, the accessory (102) includes a heat sink (112). According to an embodiment of the present invention, the heat sink (112) includes a plurality of fins. In an embodiment, the plurality of fins are provided as straight and rectangular fins (as shown in the figure 3). According to another
5 embodiment of the present invention, the plurality of fins are provided as cylindrical fins (122) (as shown in the figure 4). The cylindrical fins (122) include air trapped inside the fins, and the air facilitates heat transfer due to convection process. Those skilled in the art will appreciate that due to larger surface area, the plurality of fins facilitates increasing the rate of heat transfer from the thermoelectric cooler (116)
10 below. Further, in an embodiment, the heat sink (112) includes a predetermined dimension (height, length, breadth, and diameter) of fins. Further, the heat sink (112) includes an embedded copper portion that acts as a heat reducer, and further facilitates increasing rate of heat transfer by conduction process.

Further, at the bottom, the accessory (102) includes a metallic plate (120). In
15 an embodiment, the metallic plate (120) is circular. In another embodiment, the metallic plate (120) may be rectangular. Further, in an embodiment, the metallic plate (120) is custom built thermal conductor plates, and is safe for the end user to utilise it as a medical piece. Those skilled in the art will appreciate that the metallic plate (120) includes no sharp edges as it is configured to come in direct contact with
20 human skin.

At middle section, the accessory (102) includes at least one thermoelectric cooler (116). According to an embodiment of the present invention, the thermoelectric cooler (116) is configured to act as heat pump which generates heat

at first side and extreme cool at second side. According to another embodiment, there are a plurality of thermoelectric coolers acting as heat pumps, the use of which will be apparent to a person skilled in the art.

Heat generated/cool generated by the thermoelectric cooler (116) heats or
5 cool down the temperature of the metallic plate (120), which provides desired therapy to the user's injured part. According to an embodiment of the present invention, Peltier effect is used to generate the cold or heat at the thermoelectric cooler (116). In an embodiment, the thermoelectric cooler (116) is made up of a semiconductor material including p-type and n-type.

10 In an embodiment, when the cool therapy is desired to be given to the user's injured part, the thermoelectric cooler (116) is used for cooling its below surface, which will cool the metallic plate (120) at bottom of the accessory (102). In an embodiment, as heat is absorbed at the cold side by electrons as they pass from a low energy level in a p-type semiconductor material to a higher energy level in an n-
15 type semiconductor material. A supplied voltage between the p-type semiconductor material and the n-type semiconductor material provides electrical potential to move the electrons through the thermoelectric cooler (116). At the upper surface of the thermoelectric cooler, which is hot side, energy is expelled to a heat sink (i.e., fins (112)) as electrons move from the higher energy level n-type semiconductor
20 material to the low energy level p-type semiconductor material.

Further, when the hot therapy is desired to be given to the user's injured part, the thermoelectric cooler (116) is used for heating its below surface, which will heat

the metallic plate (120) at bottom of the accessory (102). At the upper surface of the thermoelectric cooler, which is cool side, energy is expelled to a heat sink (i.e., fins 112) as electrons move from the lower energy level p-type semiconductor material to the higher energy level n-type semiconductor material.

5 The accessory (102) further includes an electrical insulator (114) that acts as a thin layer of wall between the semiconductor material of the thermoelectric cooler (116) and metal walls of the heat sink (112). The accessory (102) further includes another electrical insulator (118) that acts as a thin layer of wall between the semiconductor material of the thermoelectric cooler (116) and metal walls of the
10 metallic plate (120). In an embodiment, both the electrical insulator (114) and the electrical insulator (118) are configured to play a dual-role as an insulator and adhesive, which merge both the Peltier and metal material together.

 In an embodiment, the therapy device (100) is configured to provide cold therapy, hot therapy, cyclic hot and cold therapy as well as any combination of the
15 hot therapy and cold therapy depending upon requirement. For example, cold therapy can be given for acute injuries and post-surgical conditions to reduce muscle spasm and provide pain relief, to reduce swelling. Further, the hot therapy can be given for chronic injuries and tissue healing, and to increase elasticity of ligaments, and increase blood pressure to the area.

20 Further, according to an embodiment of the present invention, the therapy device (100) may be used as a thermo-electric device (100). The thermo-electric device (100) may provide cooling and heating to an outside environment or enclosed

environment or surface, for example room or any enclosure. In an embodiment, the thermo-electric device (100) includes similar components and structure as the therapy device. In another embodiment, the thermo-electric device (100) may include different components and structure depending upon requirement.

5 In an embodiment, the thermo-electric device (100) includes the accessory (102), as shown in FIG. 1. In another embodiment, the thermo-electric device (100) may include different shaped accessory depending upon requirement. As shown in Fig. 3 and 4, the accessory (102) includes a heat sink (112) having a plurality of fins, a first electrical insulator (114) that is configured to insulate the heat sink (112), a
10 thermoelectric cooler (116) that is configured to generate heat at a first side and to generate cool at a second side of the thermoelectric cooler (116), a second electrical insulator (118) that is configured to insulate the thermoelectric cooler (116), and a metallic plate (120) that is configured to provide heat or cool to the outside environment. As explained above in Fig. 3, the thermoelectric cooler (116) is made
15 up of a semiconductor material on a non-ceramic substrate, and is configured to utilize a peltier effect to generate heat and cold at the first side and the second side. The non-ceramic substrate is a polypropylene material.

Further, in an embodiment, the pluralities of fins are cylindrical fins. In another embodiment, the pluralities of fins are rectangular fins. The thermo-electric device
20 (100) further includes a cable (106) having wires to supply the electrical power to the accessory (102), as shown in FIG. 1. Furthermore, the thermo-electric device (100) includes a control system (104), as shown in FIG. 2. In an embodiment, a control system (104) is embedded in the accessory (102), and includes a display board

(108) to display temperature and duration of the temperature. The control system (104) further includes an encoder (110) to enable a user to set a temperature value and duration of the temperature.

FIG. 5 illustrates an exemplary flowchart 500 for a method of providing
5 therapy to a user, according to an embodiment of the present disclosure.

At step 504, a temperature value and duration of the temperature is set by the user depending upon requirement. For example, if cold therapy is required, user may set the temperature to around 0 degree Celsius. If hot therapy is required, the user may set the temperature to around 35 degree Celsius. At step 506, Peltier effect is
10 used by the thermoelectric cooler (116) to generate heat or cold, and fins are utilized as heat sink above the thermoelectric cooler (116).

At step 508, the heat therapy or cold therapy, depending upon healing requirement is provided to the user's injured part. At step 510, it is determined by the
15 control system (104) if the user wants to change the temperature value or duration value. If yes, the method 500 returns to step 504. Otherwise, the method 500 proceeds to step 512, where the therapy is continued till the set time of therapy is over.

The therapy device (100) advantageously provides both hot as well as cold
20 therapy to a user's injured body part, and is capable of treating different types of injuries. Further, the therapy device advantageously provides delivering targeted

temperature management (TTM) and healing a user's injury, without any ice or water. Further, the therapy device advantageously provides delivering much better cold therapy and hot therapy to the user's injured body part as peltier module does not use any ceramic, thereby delivering better therapy results. Further, the therapy device advantageously provides plug and operate feature, and hence it is easy to use by any user. Further, the therapy device does not need any external heat sink to cool down the hot temperature generated by operating the device. The therapy device also provides a custom built metal plate which enables the user to apply cool/hot temperature to almost any surface. Further, the therapy device can be used in the indoors and outdoors environment. Further, the therapy device provides fast, accurate, consistent and efficient delivery of cold and hot therapy. The therapy device advantageously provides multiple applications (including medical as well as non-medical), for example, cryotherapy, CPU cooler, electrical device cooler, beverage cooler, and portable cooling device.

Further, the therapy device may be used as a thermo-electric device (100) also, and can provide cooling and heating to an outside environment, for example room or any enclosure. For example, if temperature of a small enclosure needs to be regulated (for example, required to be cooled or heated), the thermo-electric device may provide appropriate cooling or heating to the enclosure, as desired by the user. Since, the thermo-electric device (100) provides quick switching of temperature from cold to hot, the thermo-electric device (100) can be used for many applications.

In an embodiment the present invention provides a Peltier effect semiconductor system 1000 as shown in Fig. 6. The system 1000 includes at least one semiconductor element pair 1100 arranged to produce Peltier effect wherein the semiconductor element pair 1100 includes one P-type doped semiconductor element 1100a and one N-type doped semiconductor element 1100b, each element
5 1100 having a cold end 1120 and a hot end 1140, further said element pair 1100 being arranged to form a portion of a thermal circuit, a pair of non-ceramic substrate 1160 (1160a, 1160b) wherein the at least one semiconductor element pair 1100 is sandwiched between the non-ceramic substrate 1160a, 1160b, wherein the non-
10 ceramic substrate 1160 provides thermal conductivity and also act as electrical insulators.

In an embodiment, a pair of metal conductors 1180 (1180a, 1180b) are placed above and below the semiconductor element pair 1100.

In an embodiment, the non-ceramic substrate 1160 is a polypropylene
15 material for mounting the semiconductor element pair.

In an embodiment, the polypropylene material provides faster insulation and thermal conductivity.

In an exemplary embodiment, the system of the present invention has plurality of Peltier for being utilized in multiple applications.

20 In a related example embodiment, the system 1000 was tested for application to a human body by placing devices functioning on the present system 1000 over

parts of the human body to achieve faster and more effective results.

Table 1 below shows Experiment (Hot for End User wrap) Initial Temperature: 29.6°C; No. of Peltier Used: 2; Experiment Area: Thigh; Time Used: 20 Minutes.

Time	Voltage of Fans	Voltage of Temperature Controller	Voltage of 2 Peltiers	Current	Temperature
2:46 pm	12V	12V	4.7V	600mA	29.6°c
2:47 pm			4.7V	600mA	42.2°c
2:48 pm			4.4V	400mA (WS)	42.4°c
			4.4V	500mA (RUSH)	42.3°c
2:52pm			4.3V	400mA (WS)	42.1°c
2:56pm				500mA (RUSH)	42.2°c
2:58pm					42.3°c
2:59pm					42.4°c
3:02pm					42.2°c
3:06pm		42.2°c			

Table 1

Table 2 below shows Experiment (Cold for End User wrap) Initial Temperature: 27°C; No. of Peltier Used: 2; Experiment Area: Thigh; Time Used: 8 Minutes.

Time/pm	Voltage of Fans	Voltage of Temperature Controller	Voltage of 2 Peltiers	Current	Temperature
3:15:00	12V	12V	8V	1.3A (RUSH) 1.2A (WS)	27.0°C
3:15:30					15.4°C
3:16:30					14.1°C
3:16:45					13.5°C
3:17:00					13.0°C
3:20:00					12.6°C
3:22:00					11.8°C
3:23:00			7V	1.1A	12.8°C

Table 2

Table 3 below shows Experiment (Cold for End User wrap) Initial Temperature: 31°C; No. of Peltier Used: 2; Experiment Area: Tummy; Time Used: 8 Minutes.

5

Time/pm	Voltage of Fans	Voltage of Temperature Controller	Voltage of 2 Peltiers	Current	Temperature
3:30:00	12V	12V	7V	1.50A (RUSH) 1.35A (WS)	31.0°C
3:30:30			8V	1.41A (RUSH) 1.36A (WS)	19.0°C
3:31:00			9V	1.54A (RUSH)	15.8°C
3:33:28				1.49A (WS)	15.0°C
3:35:28					12.0°C
3:37:00					12.5°C
3:37:30					12.2°C
3:38:00					12.2°C

Table 3

Table 4 below shows Experiment (Cold for Professional wrap) Environment Temperature: 27°C; Initial Temperature: 27.5°C; No. of Peltier Used: 2; Experiment Area: Thigh; Time Used: 13 Minutes.

Time/am	Voltage of Fans	Voltage of Temperature Controller	Voltage of 2 Peltiers	Current	Temperature
8:30:00	12V	12V	14V	2.2A	27.5°C
8:30:30				(RUSH)	8.6°C
8:31:00				2.1A	6.0°C
8:31:30				(WS)	5.0°C
8:32:00					4.5°C
8:32:30					3.9°C
8:33:30					3.0°C
8:34:00					3.1°C
8:39:00					2.5°C
8:39:08			13V	1.9A	3.0°C
8:39:34				(RUSH)	3.1°C
8:40:16				1.8A	2.9°C
8:41:25				(WS)	2.7°C
8:41:37			12V	1.7A	3.4°C

Table 4

Table 5 below shows Experiment (Cold for Professional wrap) Environment Temperature: 27°C; Initial Temperature: 3.5°C; No. of Peltier Used: 2; Experiment Area: Thigh; Time Used: 11 Minutes.

Time/am	Voltage of Fans	Voltage of Temperature Controller	Voltage of 2 Peitiers	Current	Temperature
8:43:00	12V	12V	12V	2.3A	3.5°c
8:43:25					40.9°c
8:43:35					44.0°c
RESET (WAIT FOR THE TEMPERATURE DROPS TO 38°					
8:45:00	12V	12V	12V	2.2A (RUSH)	38.0°c
8:45:30				1.8A (WS)	18.1°c
8:46:00					11.0°c
8:46:30					8.0°c
8:47:00					6.6°c
8:47:30					5.6°c
8:48:00					5.4°c
8:48:30					5.0°c
8:49:00					4.5°c
8:49:30					4.2°c
8:50:00					3.9°c
8:50:30					3.7°c
8:51:00					3.5°c
8:51:30					3.3°c
8:52:00					3.2°c
8:52:30					3.2°c
8:53:00					3.2°c
8:53:30					3.2°c
8:54:00					3.2°c

Table 5

Table 6 below shows Experiment (Cold for Professional wrap) Environment Temperature: 27°C; Initial Temperature: 30°C; No. of Peltier Used: 2; Experiment Area: Thigh; Time Used: 9 Minutes.

Time/am	Voltage of Fans/V	Voltage of Temperature Controller/V	Voltage of 2 Peltiers /V	Current/A	Temperature/°c
9:00:00	12	12	12	2.0 (RUSH) 1.8 (WS)	30.0
9:00:30					16.0
9:01:00					11.0
9:01:30					9.0
9:02:00					7.8
9:02:30					6.7
9:03:00					6.1
9:03:30					5.6
9:04:00					5.2
9:04:30					5.0
9:05:00					4.7
9:05:30					4.6
9:06:00					4.3
9:06:30					4.3
9:07:00					4.2
9:07:30					4.5
9:08:00					4.5

Table 6

In an embodiment, the non-ceramic substrate 1160 is fashioned of thermally conductive material whereby heat easily passes from hot ends into the non-ceramic substrate.

In an embodiment, one substrate of the pair of non-ceramic substrate 1160 is thermally coupled to the cold ends 1120 of the at least one P-type doped semiconductor element 1100a and one N-type doped semiconductor element 1100b.

In an embodiment, one substrate of the pair of non-ceramic substrate 1160 is thermally coupled to the hot ends 1140 of said at least one P-type doped semiconductor element 1100a and one N-type doped semiconductor element

1100b.

In another embodiment, referring to Fig. 7 a unit test result 2000 for a 70X70 Peltier module applied to all industrial applications and functioning under the Peltier effect semiconductor system is shown. Fig. 7 shows a list of the Voltage and current
5 values along with a Graph plotting the same when a Peltier module is working on the Peltier effect system 1000 of the present invention.

The foregoing discussion of the present invention has been presented for purposes of illustration and description. It is not intended to limit the present invention to the form or forms disclosed herein. In the foregoing Detailed Description, for
10 example, various features of the present invention are grouped together in one or more embodiments, configurations, or aspects for the purpose of streamlining the disclosure. The features of the embodiments, configurations, or aspects may be combined in alternate embodiments, configurations, or aspects other than those discussed above. This method of disclosure is not to be interpreted as reflecting an
15 intention the present invention requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all features of a single foregoing disclosed embodiment, configuration, or aspect. Thus, the following claims are hereby incorporated into this Detailed Description, with each claim standing on its own as a separate embodiment of the present
20 invention.

Moreover, though the description of the present invention has included description of one or more embodiments, configurations, or aspects and certain

variations and modifications, other variations, combinations, and modifications are within the scope of the present invention, e.g., as may be within the skill and knowledge of those in the art, after understanding the present disclosure. It is intended to obtain rights which include alternative embodiments, configurations, or aspects to the extent permitted, including alternate, interchangeable and/or equivalent structures, functions, ranges or steps to those claimed, whether or not such alternate, interchangeable and/or equivalent structures, functions, ranges or steps are disclosed herein, and without intending to publicly dedicate any patentable subject matter.

CLAIMS

What is claimed is:

1. A therapy device (100) for providing healing to injured body part of a user, the

5 therapy device (100) comprising :

a heat sink (112) having a plurality of fins;

a first electrical insulator (114) located below the heat sink (112), and
configured to insulate the heat sink (112);

10 at least one thermoelectric cooler (116) located below the first electrical
insulator (114), and configured to generate heat at a first side and to generate
cool at a second side of the at least one thermoelectric cooler (116);

a second electrical insulator (118) located below the at least one
thermoelectric cooler (116), and configured to insulate the at least one
thermoelectric cooler (116); and

15 a metallic plate (120) located below the second electrical insulator
(118), and configured to provide heat or cool to a body part of the user.

2. The therapy device (100) of claim 1, wherein the at least one thermoelectric
cooler (116) is made up of a semiconductor material on a non-ceramic
20 substrate, and is configured to utilize a peltier effect to generate heat and cold
at the first side and the second side.

3. The therapy device (100) of claim 1, wherein the metallic plate (120) is configured to transfer heat or cold generated at the at least one thermoelectric cooler (116) to the user's injured body part.

5 4. The therapy device (100) of claim 1, wherein the plurality of fins are cylindrical fins.

5. The therapy device (100) of claim 1, wherein the plurality of fins are rectangular fins.

10

6. The therapy device (100) of claim 1, further comprising a control system (104) embedded in the accessory (102), and having a display board (108) to display temperature and duration of the temperature.

15

7. The therapy device (100) of claim 6, wherein the control system (104) further comprising an encoder (110) to enable a user to set a temperature value for the therapy and duration of the therapy.

20

8. The therapy device (100) of claim 1, wherein the first electrical insulator (114) and the second electrical insulator (118) are configured to play a dual-role as an insulator and adhesive.

9. The therapy device (100) of claim 1, wherein the heat sink (112) further comprises an embedded copper portion that is configured to act as a heat reducer.

5 10. A thermo-electric device (100) for cooling and heating an outside or an enclosed environment or surface, the thermo-electric device (100) comprising an accessory (102), the accessory (102) comprising:

a heat sink (112) having a plurality of fins;

10 a first electrical insulator (114) located below the heat sink (112), and configured to insulate the heat sink (112);

at least one thermoelectric cooler (116) located below the first electrical insulator (114), and configured to generate heat at a first side and to generate cool at a second side of the at least one thermoelectric cooler (116);

15 a second electrical insulator (118) located below the at least one thermoelectric cooler (116), and configured to insulate the at least one thermoelectric cooler (116); and

a metallic plate (120) located below the second electrical insulator (118), and configured to provide heat or cool to the outside environment.

20 11. The thermo-electric device (100) of claim 10, wherein the at least one thermoelectric cooler (116) is made up of a semiconductor material, and is configured to utilize a peltier effect to generate heat and cold at the first side and the second side.

12. The thermo-electric device (100) of claim 10, wherein the plurality of fins are selected from cylindrical fins or rectangular fins.

5 13. The thermo-electric device (100) of claim 10, further comprising a control system (104) embedded in the accessory (102), and having a display board (108) to display temperature and duration of the temperature.

10 14. The thermo-electric device (100) of claim 13, wherein the control system (104) further comprising an encoder (110) to enable a user to set a temperature value and the duration of the temperature value.

15. A method for providing therapy to a user, the method comprising:

receiving electrical power by a therapy device (100);

15 enabling a user to provide temperature value and duration of the temperature;

utilizing a peltier effect to generate heat or cold at at least one thermoelectric cooler wherein the at least one thermoelectric cooler is made up of semiconductor material on a non-ceramic substrate;

20 utilizing fins as a heat sink above the at least one thermoelectric cooler; and

providing hot therapy or cold therapy to a user's injured body part.

16.A Peltier effect semiconductor system 1000 comprising:

at least one semiconductor element pair 1100 arranged to produce Peltier effect wherein the semiconductor element pair 1100 includes one P-type doped semiconductor element 1100a and one N-type doped semiconductor element 1100b, each element having a cold end 1120 and a hot end 1140, further said element pair 1100 being arranged to form a portion of a thermal circuit;

a pair of non-ceramic substrate 1160 (1160a, 1160b) wherein the at least one semiconductor element pair 1100 is sandwiched between the pair of non-ceramic substrate 1160 (1160a, 1160b);

wherein the pair of non-ceramic substrate 1160 provides thermal conductivity and also act as electrical insulators.

17. The system as claimed in claim 16 wherein the non-ceramic substrate 1160 is a polypropylene material for mounting the semiconductor element pair 1100.

18. The system as claimed in claim 17 wherein the polypropylene material provides faster insulation and thermal conductivity.

19. The system as claimed in claim 17, the non-ceramic substrate 1160 being fashioned of thermally conductive material whereby heat easily passes from hot ends into the non-ceramic substrate 1160.

20. The system as claimed in claim 17 wherein one substrate of the pair of non-ceramic substrate 1160 is thermally coupled to the cold ends 1120 of the at least one P-type doped semiconductor element 1100a and one N-type doped semiconductor element 1100b.

5

21. The system as claimed in claim 17 wherein one substrate of the pair of non-ceramic substrate is thermally coupled to the hot ends 1140 of said at least one P-type doped semiconductor element 1100a and one N-type doped semiconductor element 1100b.

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100

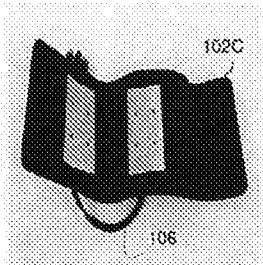
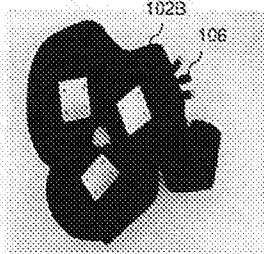
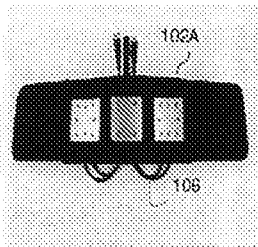


FIG. 1

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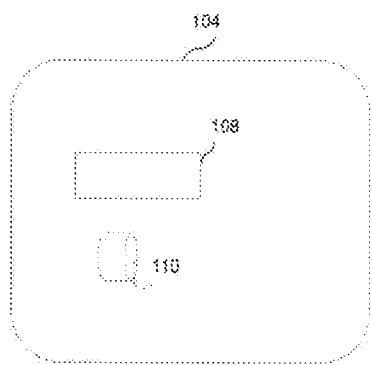


FIG. 2

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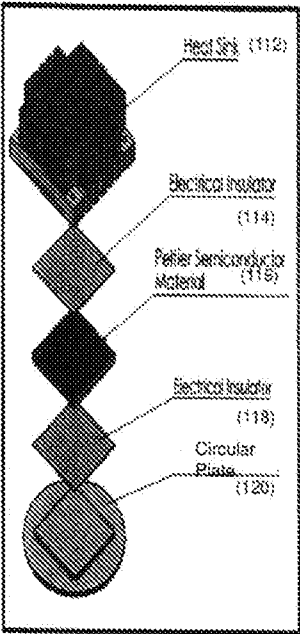


FIG. 3

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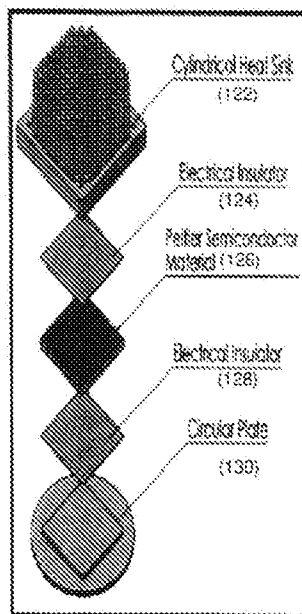


FIG. 4

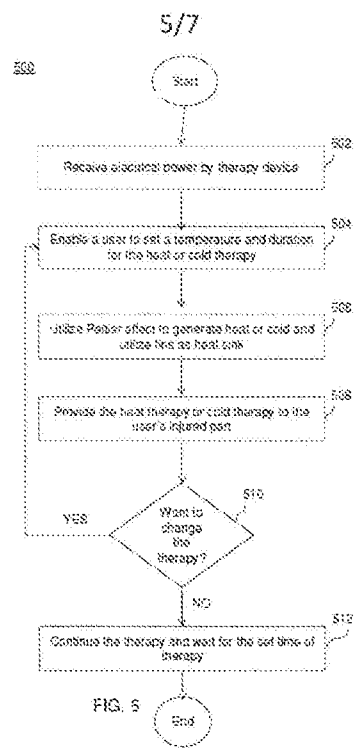


FIG. 5

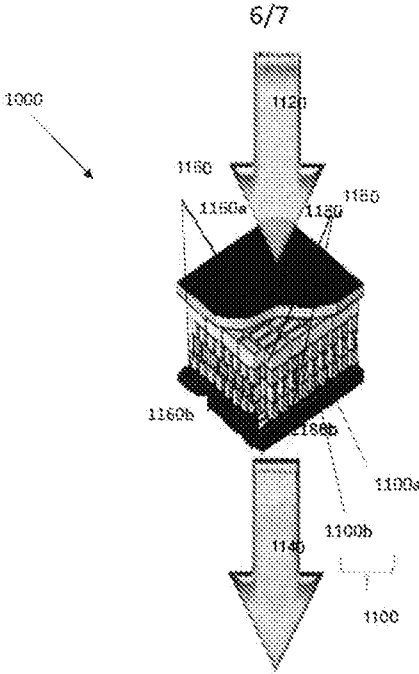


FIG. 6

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2000
↙

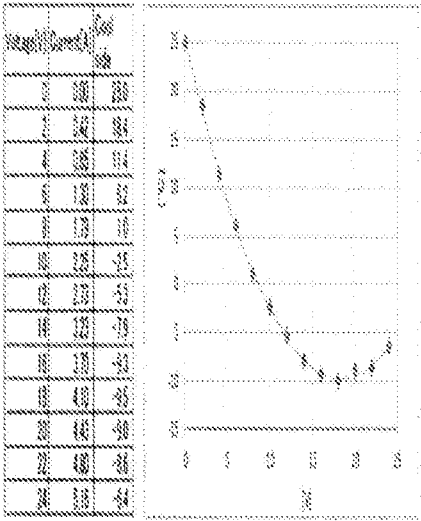


FIG. 7

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/MY2018/000016

A. CLASSIFICATION OF SUBJECT MATTER

A61F 7/02 (2006.01) H01L 27/16 (2006.01) H01L 35/04 (2006.01) H01L 35/30 (2006.01) H01L 35/32 (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)

PATENW: CPC/IPC: A61F2007/0075, A61F2007/0086, A61F2007/0088, A61F2007/0095/LOW, A61F2007/0228, A61F2007/0231, A61F2007/0233, A61F2007/0295/LOW, A61H2201/0285, A61H2201/5038, A61H2201/5043, H01L23/14/LOW, H01L23/34/LOW, H01L27/16, H01L35/04/LOW, H01L35/30, H01L35/32/LOW; and Keywords: heat, sink, fins, insulator, polymer, thermoelectric, p-type, n-type; and like terms.

GOOGLE PATENTS and ESPACENET: CPC: A61F2007/0075, A61F2007/0088, A61F2007/0295/LOW, A61H2201/0285, H01L35/30; and Keywords: thermoelectric, insulator, heating, cooling, polymer, massage; and like terms.

Applicant/Inventor search in EPODOC. Applicant and inventor names also search in internal databases provided by IP Australia.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: 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
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"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 19 June 2018	Date of mailing of the international search report 19 June 2018
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au	Authorised officer Kylie Pandika AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262832410

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/MY2018/000016
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6127619 A (XI et al.) 03 October 2000 Figure 1; and column 1 line 11 – 24, column 5 line 3 – 21, and column 6 line 66 – column 7 line 8	16 – 21
A	Figure 1; and column 1 line 11 – 24, column 5 line 3 – 21, and column 6 line 66 – column 7 line 8	2, 15
X	US 5040381 A (HAZEN) 20 August 1991 Figure 2; and column 3 line 62 – column 5 line 9	16 – 21
A	Figure 2; and column 3 line 62 – column 5 line 9	2, 15
X	US 9506675 B1 (CAMPBELL et al.) 29 November 2016 Figure 1 and 4A; and abstract, column 1 line 20 – 32, column 5 line 3 – 18, and column 5 line 60 – column 6 line 47	16 – 21
X	US 2013/0085552 A1 (MANDEL) 04 April 2013 Figure 2A, 4 and 6, and Table B; and paragraph [0033] and [0037 – 0043]	1 – 4, 6 – 15
X	US 4585002 A (KISSIN) 29 April 1986 Figure 2; and abstract, and column 3 line 5 – 68	1 – 5, 9
A	US 2009/0025774 A1 (PLISSONNIER et al.) 29 January 2009 paragraph [0085] and [0087]	1 – 16
A	US 2003/0097845 A1 (SAUNDERS et al.) 29 May 2003 Figure 1; and abstract, and paragraph [0027]	1 – 16
A	US 2004/0059400 A1 (LIN) 25 March 2004 Figure 1 – 5; and paragraph [0015]	1 – 16

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Supplemental Box**Continuation of: Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

(1) Claims 1 – 14 are directed to a thermo-electric device. The features of a first electrical insulator located below the heat sink, and configured to insulate the heat sink; a second electrical insulator located below the at least one thermoelectric cooler and configured to insulate the at least one thermoelectric cooler; and a metallic plate located below the second electrical insulator, and configured to provide heat or cooling to the outside environment are specific to this group of claims.

(2) Claims 15 and 16 – 21 are directed to a method and a system utilising a Peltier effect to generate heat or cooling. The feature of the Peltier effect system being made up of a semiconductor material on a non-ceramic substrate is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions and which provides a technical relationship among them is a thermoelectric cooler. However it is considered that this feature is generic in the art.

Therefore, this common feature cannot be a special technical feature. Hence there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied, *a priori*.

In addition, this Authority has found that the claims 15 and 16 – 21 are not so linked as to form a single general inventive concept and define different inventions based on the following features:

(2a) Claim 15 is directed to a method for providing therapy to a user. The features of receiving electrical power by a therapy device; enabling a user to provide temperature value and duration of the temperature; utilising fins as a heat sink above the at least one thermoelectric cooler and providing hot therapy or cold therapy to a user's injured body part are specific to this group of claims.

(2b) Claim 16 – 21 are directed to a Peltier effect semiconductor system. The features of at least one semiconductor element pair arranged to produce Peltier effect wherein the semiconductor element pair includes one P-type doped semiconductor element and one N-type doped semiconductor element, each element having a cold end and a hot end, further said element pair being arranged to form a portion of a thermal circuit; a pair of non-ceramic substrate wherein the at least one semiconductor element pair is sandwiched between the pair of non-ceramic substrate; and wherein the pair of non-ceramic substrate provides thermal conductivity and also act as electrical insulators are specific to this group of claims.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions and which provides a technical relationship among them is a semiconductor material on a non-ceramic substrate. However, this feature does not make a contribution over the prior art because it is disclosed in:

D1: US 6127619 (XI et al.) 3 October 2000 [see Figure 1 '11' and '17'; and column 5 line 3 - 18]

Therefore, in the light of D1, claims 15 and 16 lack unity, *a posteriori*.

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/MY2018/000016	
This Annex lists known 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/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
US 6127619 A	03 October 2000	US 6127619 A	03 Oct 2000
		AU 4551399 A	30 Dec 1999
		WO 9965086 A1	16 Dec 1999
US 5040381 A	20 August 1991	US 5040381 A	20 Aug 1991
US 9506675 B1	29 November 2016	US 9506675 B1	29 Nov 2016
		US 9869494 B1	16 Jan 2018
US 2013/0085552 A1	04 April 2013	US 2013085552 A1	04 Apr 2013
		US 9849024 B2	26 Dec 2017
		CN 103068346 A	24 Apr 2013
		CN 103068346 B	02 Mar 2016
		WO 2011156643 A1	15 Dec 2011
US 4585002 A	29 April 1986	US 4585002 A	29 Apr 1986
US 2009/0025774 A1	29 January 2009	US 2009025774 A1	29 Jan 2009
		CA 2637645 A1	23 Jan 2009
		EP 2019438 A2	28 Jan 2009
		FR 2919431 A1	30 Jan 2009
		FR 2919431 B1	27 Aug 2010
		JP 2009100643 A	07 May 2009
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		US 6739138 B2	25 May 2004
		AU 2002357015 A1	10 Jun 2003
		CA 2468024 A1	05 Jun 2003
		EP 1461574 A1	29 Sep 2004
		EP 1461574 B1	17 Apr 2013
		WO 03046448 A1	05 Jun 2003
US 2004/0059400 A1	25 March 2004	US 2004059400 A1	25 Mar 2004
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			