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Crumlin et al.(10) **Pub. No.: US 2006/0196215 A1**(43) **Pub. Date: Sep. 7, 2006**(54) **ENVIRONMENTALLY ADAPTABLE
TRANSPORT DEVICE****Related U.S. Application Data**

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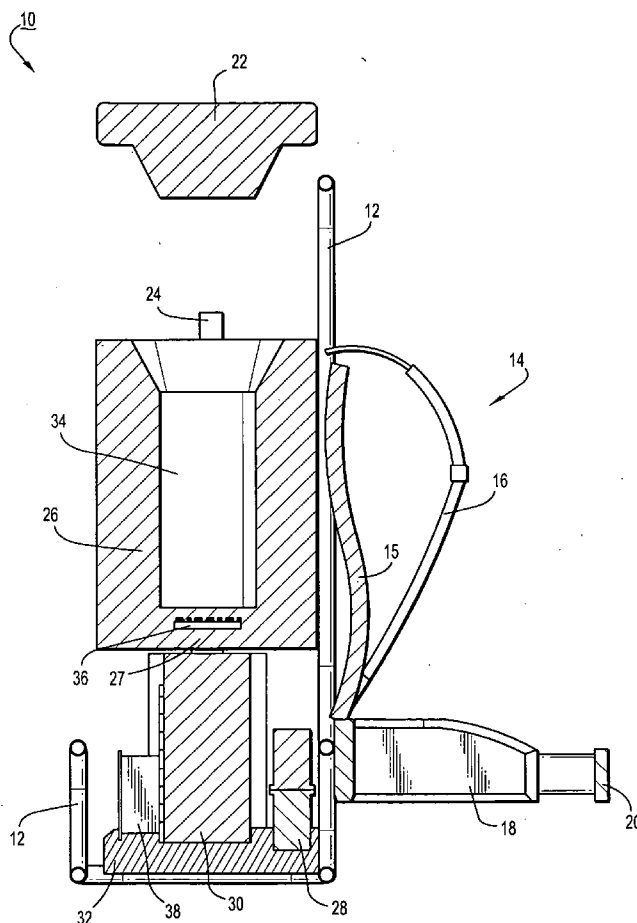
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(52) **U.S. Cl.** **62/371; 62/457.2**

(57) **ABSTRACT**

A temperature regulating device capable for environmentally adaptable transport of transporting temperature sensitive products is provided including an insulated casing having an interior portion and a temperature regulating device for maintaining the interior portion at a temperature range lower than ambient temperature exterior to the interior portion, wherein the temperature regulating device maintains the lower temperature without external power sources. The temperature device is personally portable and includes a backpack attachment for transporting by a single individual.

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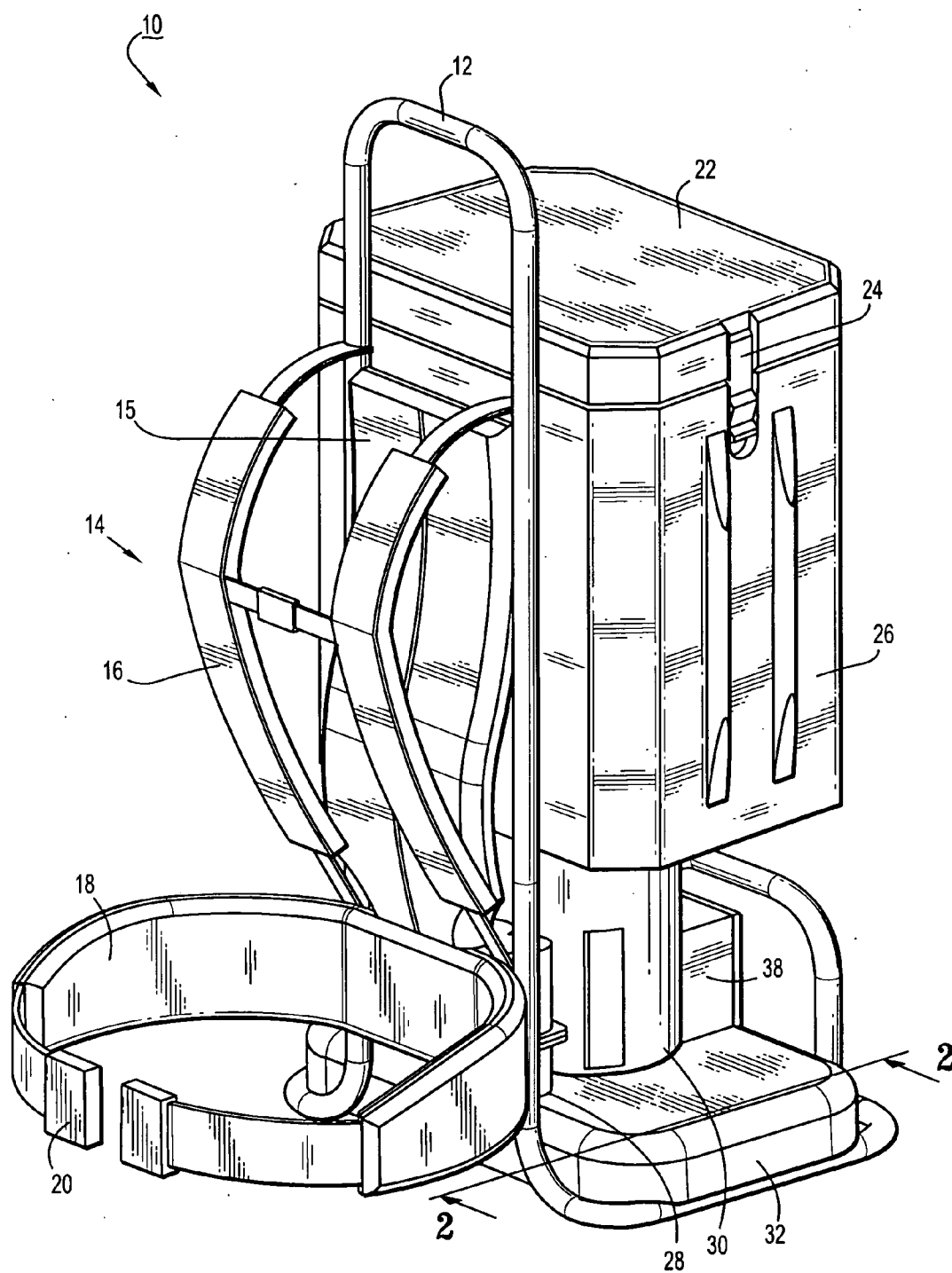


FIG. 1

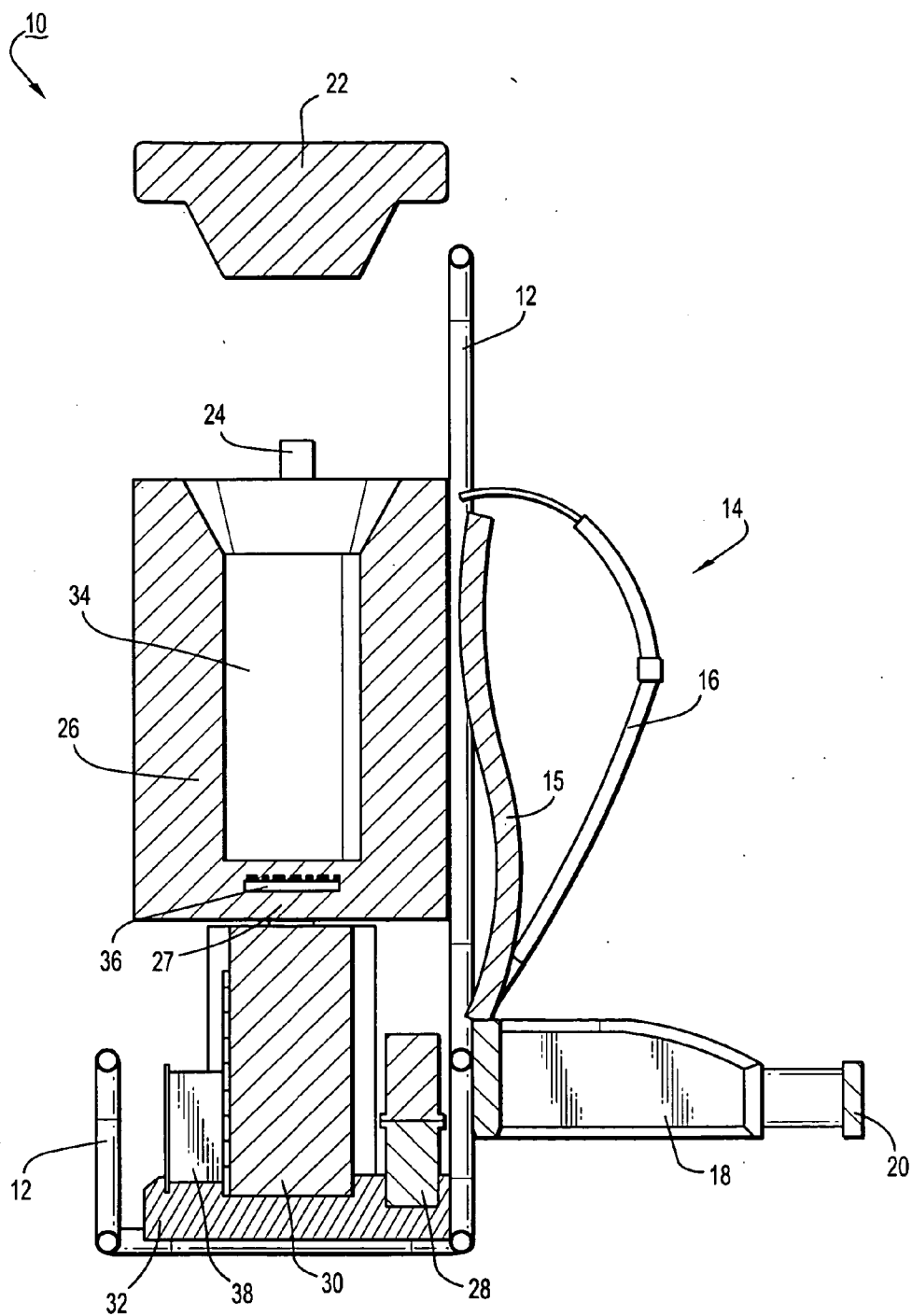


FIG. 2

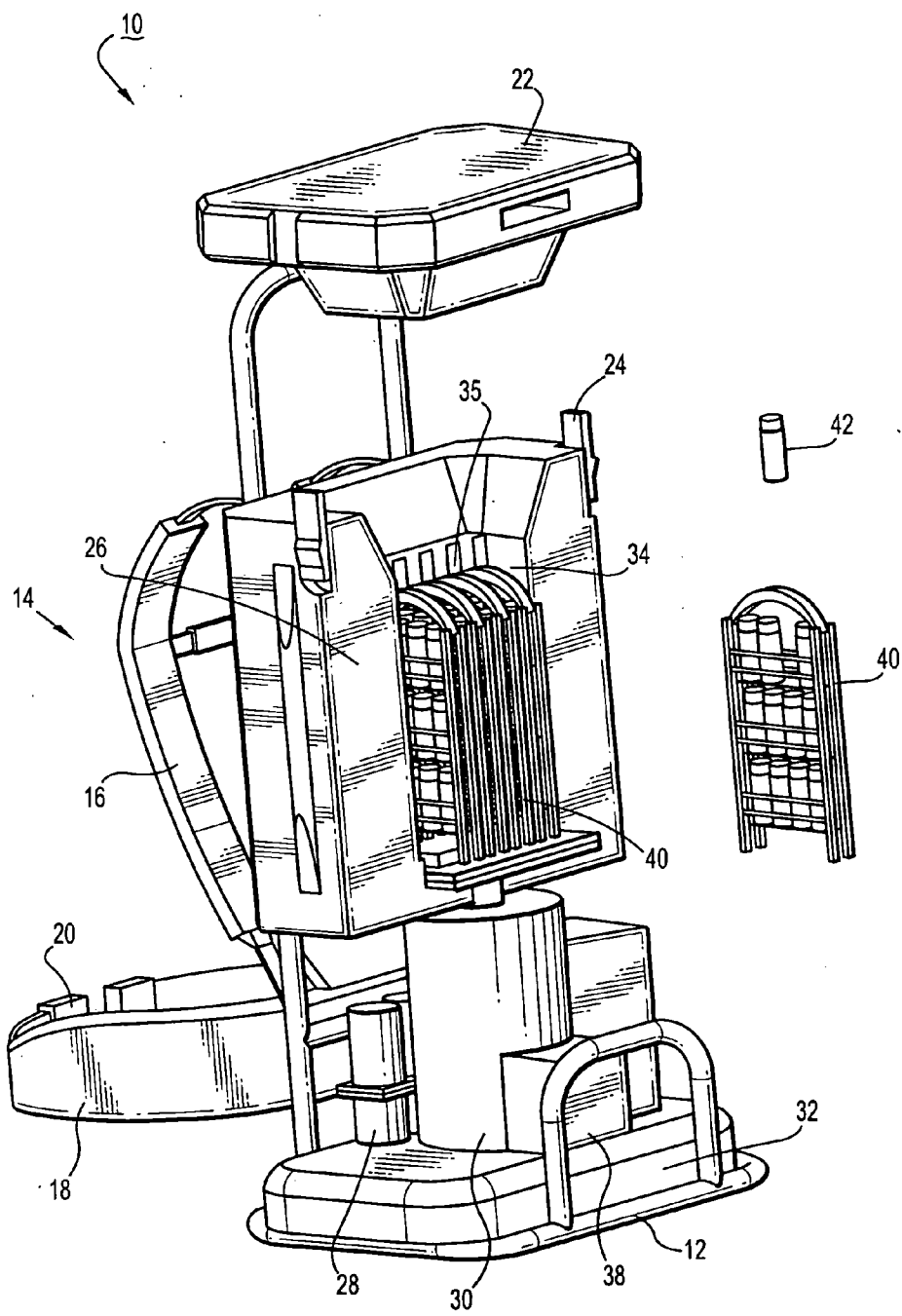


FIG. 3

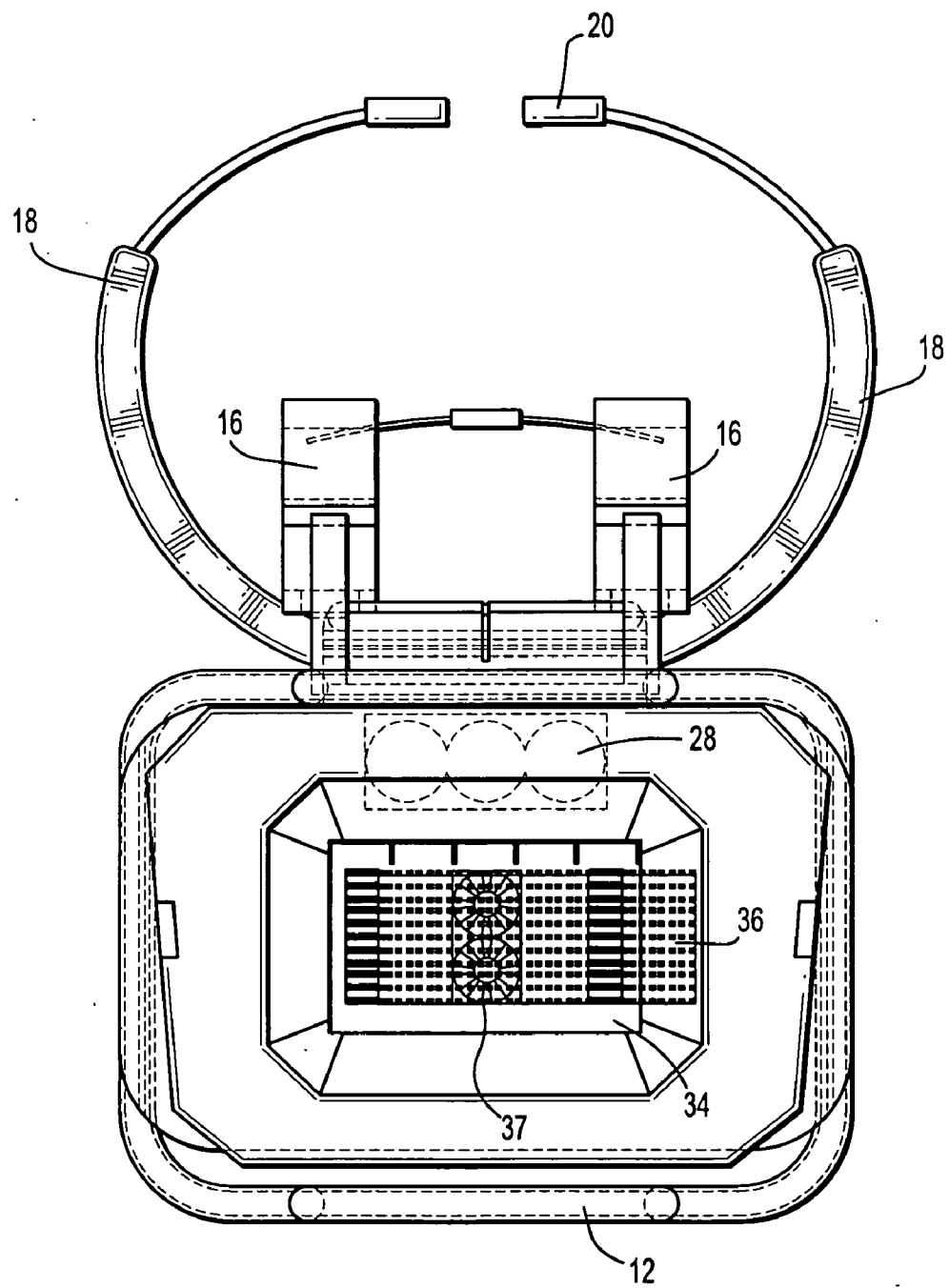


FIG. 4

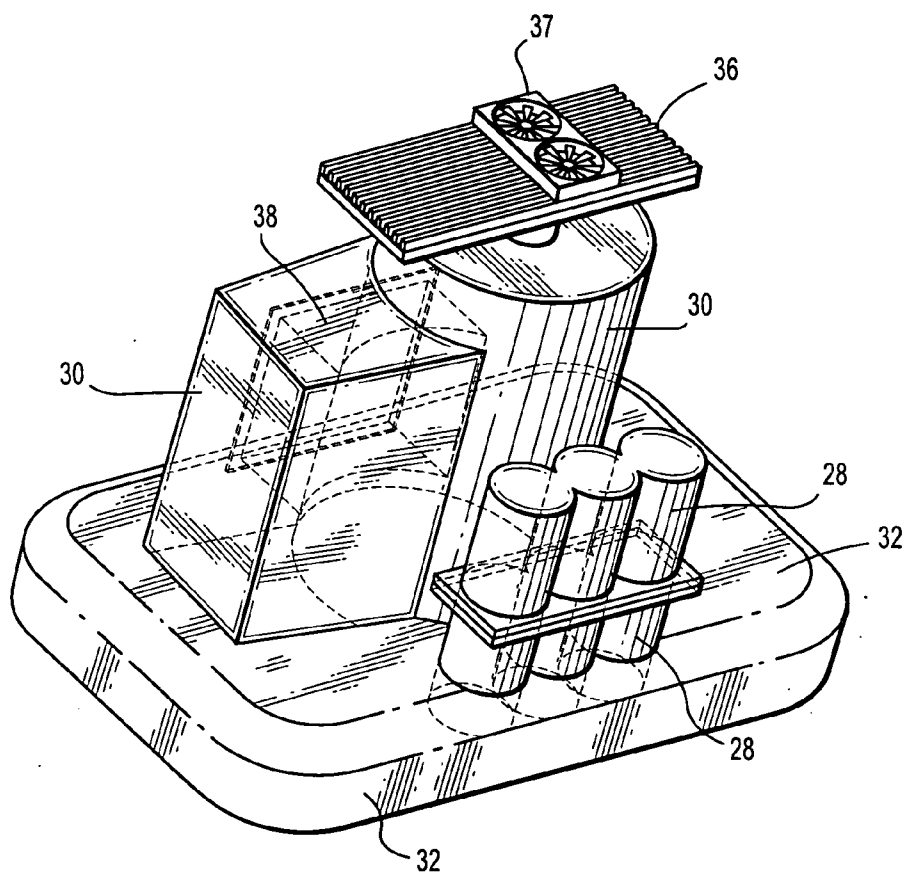


FIG. 5

ENVIRONMENTALLY ADAPTABLE TRANSPORT DEVICE

RELATED APPLICATION INFORMATION

[0001] This patent application claims the benefit of U.S. Provisional Application No. 60/634,419 filed by Crumlin et al. on Dec. 8, 2004, the entire contents of which is incorporated herein by reference.

BACKGROUND

[0002] 1. Technical Field

[0003] The present disclosure generally relates to a temperature regulating device and, more particularly, to a portable, environmentally adaptable temperature transport device for transporting temperature sensitive products.

[0004] 2. Description of the Related Art

[0005] There are many often life dependent situations in which a product or substance must be kept under a strict temperature range for a given amount of time, yet may need to travel to areas that do not have an established power grid or availability of a large, consistent power supply. In many areas of society, be it organ transport, vaccine transport to developing nations medical/biological products, animal transport, or the preservation of foodstuffs, etc., there is a pressing need for such a method of transporting various objects or substances over long distances and time spans, while maintaining the substances at constant temperature or within various temperature ranges. For instance, the World Health Organization states that 4.3 million deaths occur each year due to vaccine preventable diseases and that many of these deaths could be averted if cold chain (i.e., the intricate system for vaccine transport, delivery, and administration) technologies for keeping vaccines above their freeze-sensitive range and below their heat-sensitive range were more efficient.

[0006] The current mode of vaccine transport involves packing vaccines in phase-change materials such as conventional/dry ice, which are then carried by foot, horse, motor-bike, etc. from cities to rural medical outreach centers. Since vaccines must be kept within a strict temperature range of 2-8° C. (36-46° F.) and may no longer be viable if the temperature deviates outside this range, this presents a great problem as strict temperature control is extremely difficult to maintain during the final destination journeys from the cities to the rural areas and account for 75-80% of all vaccine wastage alone. Moreover, since the tendency is to bring more vaccines than are needed in an area, once the cooling source evaporates or expires, the excess vaccines also go to waste.

[0007] There are a number of transport systems in existence for maintaining consistent temperature controls. However, these known systems fail to meet the highly specific requirements for transporting sensitive substances, such as vaccines. Generally, two main issues present these failures. The first failure being sufficient temperature regulation of the environment in which these substances are transported. Most environmental control devices or "cold carriers" currently utilized are simply coolers using ice packs. The adaptability to varying environments and substances in terms of temperature regulation using these cold carriers is quite limited in flexibility of temperature. The second failure is transportability. The prior art includes refrigerated transport units, which can control the temperature of their internal environments. However, most of these are not designed for

single or multiple person portability. Rather, these known refrigerated transport units generally require a powerful consistent and accessible power supply, which is typically not available in many areas of the world.

[0008] Therefore, it would be desirable to overcome the disadvantages and drawbacks of the prior art with an environmentally adaptable device for transporting temperature sensitive products. It would be desirable if the transport device could adapt to varying environments and products requirements in terms of temperature regulation and temperature consistency over time. It would be highly desirable if the transport device offers adaptable transportability and power requirements for the control of internal temperature and environment, while being designed (e.g., both compact and ergonomically designed) for single or multiple person portability.

SUMMARY

[0009] The environmentally adaptable transport device according to the present disclosure uses a portable temperature regulating technology that may be used to carry any variety of products or substances that must be transported in a temperature controlled environment. The transport device may include a casing having an interior portion and a temperature regulating device for maintaining the interior portion at a temperature range lower than an ambient temperature exterior to the interior portion. The temperature regulating device is able to maintain the temperature range within the interior of the casing without the use of consistent, intermittent or variable external power sources.

[0010] The interior portion of the casing is designed to receive and hold a plurality of vials or other temperature sensitive products. The transport device is personally portable and may include a backpack attachment for transporting by a single individual.

[0011] Also disclosed is an environmentally adaptable transport device for storing temperature sensitive products within a storage container in fluid communication with a temperature regulating device, wherein the temperature regulating device generates a temperature within a specified temperature range or limit. The temperature regulating device may be powered by a rechargeable power source such as, for example, AC/DC outlets, an external generator, human mechanical power, solar power, fuel cell and vehicle power sources. Additionally, the power source may include sources such as batteries, hydrogen, methanol, thermal mass, phase change and hydrocarbons. The environmentally adaptable transport device may also include temperature control circuitry or feedback controls for controlling or monitoring the specified temperature range within the storage container and other temperature, power or related parameters of the device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The objects and features of the present disclosure, which are believed to be novel, are set forth with particularity in the appended claims. The present disclosure, both as to its organization and manner of operation, together with further objectives and advantages, may be best understood by reference to the following description, taken in connection with the accompanying drawings, as set forth below.

[0013] FIG. 1 is a perspective view of the environmentally adaptable transport device according to the present disclosure;

[0014] FIG. 2 is cross-sectional view along line 2-2 of the environmentally adaptable transport device shown in FIG. 1;

[0015] FIG. 3 is a partial exploded view of the environmentally adaptable transport device shown in FIG. 1;

[0016] FIG. 4 is a top plan view in partial cross-section of the environmentally adaptable transport device shown in FIG. 1; and

[0017] FIG. 5 is a partial exploded phantom view of a power supply and temperature regulating device of the environmentally adaptable transport device shown in FIG. 1.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0018] The exemplary embodiments of the environmentally adaptable transport device and methods of use disclosed are discussed in terms of temperature control and transport devices for accomplishing environmentally controlled transport of, for example, products and substances used in the medical field. The environmentally adaptable transport device may also employ the temperature controlled transport of foodstuffs and additional consumer based demands, such as, the storage of foodstuffs at desired temperatures for various time periods. Such a need is evidenced, for example, by fisherman in remote areas of the world that do not have a power grid, so a conventional refrigerator is not useful, but must often times keep their catches at similar temperatures to the temperature of the water the fish came from in order to keep the fish from premature spoiling. It is envisioned that the principles relating to refrigeration and temperature controls disclosed herein include employment with various methods and techniques for temperature control, such as, for example, gas expansion, thermal-electric, and mechanical refrigeration methods, as well as efficient temperature control methods, such as, for example, insulation materials that provide increased R-factors that allow higher and longer lasting temperature gradients.

[0019] In the discussion that follows, the term "temperature sensitive products" or "products" will refer to a variety of substances including, for example, vaccines, slides, organs, tissue and body parts, medicine, other medical/biological substances, animals, foodstuffs and the like, that require either a consistent temperature or temperature range for the preservation of such substances.

[0020] The environmentally adaptable transport device according to the present disclosure offers temperature regulation, portability and adaptability to varying and sometimes hostile environments. The transport device may utilize a variety of methods for obtaining power and can use that power to control the temperature within its structure. The control of temperature may be loosely or tightly controlled dependent upon requirements of the associated transport products. The transport device may utilize a variety of transport modes, such as, for example, carrying by a person (via backpack straps, a shoulder strap, etc.), being pulled on a handcart, sled or skis or transported on a vehicle.

[0021] The following discussion includes a description of the environmentally adaptable transport device in accordance with the principles of the present disclosure. Alternate embodiments are also disclosed. Reference will now be made in detail to the exemplary embodiments of the present disclosure, which are illustrated in the accompanying fig-

ures. Turning now to the figures wherein like components are designated by like reference numerals throughout the several views and initially to FIGS. 1-2, there is illustrated an environmentally adaptable transport device, such as, for example, a transport device 10, in accordance with the principles of the present disclosure.

[0022] The components of transport device 10 are fabricated from materials suitable for environmental transport applications, such as, for example, polymerics, carbon fiber or metals, such as titanium, stainless steel, depending on the particular application and intended use and environment of the transport device. Semi-rigid and rigid polymerics are contemplated for fabrication, as well as resilient materials, such as molded grade polyurethane, silicone, etc. The sealing components (e.g., gaskets, edges and interior components of the casing 26) of the transport device 10 may be fabricated from materials such as elastomers and the like. One skilled in the art, however, will realize that other materials and fabrication methods suitable for assembly and manufacture, in accordance with the present disclosure, also would be appropriate.

[0023] The environmentally adaptable transport device 10 is reusable in an environmentally controlled transport application such as, for example, the transport of vaccines to areas where temperatures and terrains are less than hospitable. The transport device is designed to be lightweight and designed to weigh less than 150 lbs., and preferably less than 50 lbs. and more preferably less than 35 lbs. Therefore, the transport device 10 can be employed for multiple uses and locations throughout the world.

[0024] The transport device 10 is a portable, self-contained, strict temperature controlled transport and storage unit that holds approximately 1,200 doses of standard liquid vaccines within vials 42 although more or less doses are contemplated herein. The transport device 10 maintains a 2-8° C. (36-46° F.) temperature range by implementing a technology (as described below) that creates efficient feedback-controlled cooling via an electrical, mechanical, thermal system powered by a rechargeable battery or other power source 28. For example, the cooling energy is provided by a commercially available Stirling cooler, such as, the Stirling cooler manufactured by Twinbird Corporation in Japan. See, for example, Stirling cooler specifications at http://www.twinbird.jp/sc/sc_top_en.html, which is incorporated herein by reference in its entirety. The cooling energy then passes or draws in heat through a heat exchanger 36 and convection fans 37 to maintain the temperature range within an insulated interior 34 by forced convection. Temperature information as well as other power or control parameters are monitored and displayed by an on-board temperature controller within control system electronics 38. Control system electronics 38 provide for a feedback means or information of current state of the transport device 10. The feedback means can include electronic components or a mechanical system, such as, for example, temperature gauges. The feedback means aids in the control and operation of the transport device 10 and may include one or more displays having visual and/or audible indicators.

[0025] The functions of the transport device 10 are battery 28 powered with multiple recharging and operating options including generators, solar panels, car cigarette lighter or any electrical power source. It is contemplated that the transport device 10 includes various electrical and power attachment means for communication with various power sources. The transport device 10 is mounted to a sturdy

carrying frame 12 with adapters and fixtures that can be attached to a wide variety of transport means.

[0026] More particularly and with continued reference to FIGS. 1-2, the environmentally adaptable transport device 10 includes an insulated casing 26 housing having an insulated interior portion 34. The insulated casing 26 includes an open portion, for example a top portion, that is sized to receive or mate with a top or cover portion 22. Cover portion 22 is sized to be received or mated with interior portion 34. The cover portion 22 forms an air tight seal with the insulated casing 26 by way of various locking handles 24. It is contemplated within the present disclosure that cover portion 22 may attach to insulated casing 26 by means of a screw top, screws, adhesive, buttons, clasps, hook and loop fasteners, friction, gravity, suction, cams, sliding, latches, etc. The cover portion 22 as well as all other components of the transport device 10 may be insulated to aid in the transport device's 10 ability to maintain its interior 34 temperature. The insulation and means for insulating used by the components of the transport device 10 may vary to accommodate desired functionality or aesthetics, such as, for example, varying wall thickness of the components, additional insulation thickness and the addition of gaskets and sealing materials to aid in the reduction of thermal leakage from within the insulated interior 34.

[0027] In an alternate embodiment, access to the insulated interior 34 may be accomplished by alternate means through the top, side or bottom portions of the insulated casing 26 including, for example, by way of a sliding door or flapped opening.

[0028] Insulated casing 26 further includes a portion, for example a bottom portion, 27 that is generally sealed off from the outer or ambient environment. Bottom portion 27 is in fluid communication with a heat exchanger element 36. As will be discussed herein, heat exchanger element 36 is part of the temperature regulating device 30 and may include convection fans 37 (FIG. 5) or fin members for the movement of heat across the boundary between the insulated interior space 34 and the ambient environment.

[0029] The target volume of the transport device 10 is the volume defined by the insulated casing 34 including any additional structural elements such as vial racks 40 (FIG. 3) and additional thermal control elements including, but not limited to, phase change materials or ice packs. The insulated casing 26 is generally formed from plastic or other PVC materials and can be blown, molded or formed as is known in the art. Formation of the insulated casing includes forming least one layer, and preferably two layers, although additional layers are contemplated herein. The layers are sealed together to form an initial hollow enclosed shell with space therebetween for the inclusion of insulating material, such as, for example, BLO-foam, Styrofoam, vacuum panels, etc.

[0030] A frame or chassis component 12 may be used to add rigidity and carrying means to the transport device 10. The carrying frame 12 can be used to attach the transport device 10 to a person or other carrier. As shown in FIG. 2, for greater support the carrying frame 12 generally surrounds the main body portion of the transport device 10. The carrying frame 12 can be formed with any suitable material, such as, for example, aluminum, carbon fiber, etc. and preferably will remain relatively light yet sturdy in order to facilitate the transportation of relatively large amounts of cargo (e.g., vaccines) over relatively far distances in a variety of environments. The carrying frame 12 may include

a backpack attachment 14 including backpack support 15, strap members 16, harness 18 and locking buckle 20. It is contemplated that other types of carrying frames 12 and backpack attachments 14 may be utilized as is known in the art. Also contemplated and within the present disclosure are alternate modalities of transport of the transport device 10, for example, the transport device 10 may include wheels, be positioned on a type of dolly, be attached to a sled or skis and include handles for carrying by one or more persons or even animals.

[0031] The transport device 10 further includes a bottom or base portion 32 that generally provides support for the temperature regulating device 30, power supply 28 and control system electronics 38. The base portion 12 may also provide shock protection to the transport device 10 and especially to the temperature regulating device 30. The shock protection component of the base portions 32 may be formed from known suitable materials that act to dampen impacts from being dropped, crushed and the like.

[0032] With reference to FIGS. 3-5, various exploded views of the transport device 10 are shown. Various optional vial racks 40 containing a plurality of vials 42 containing for example, vaccine or other medicine can be stored within the interior 34 of the insulated casing 26. The vial racks 40, internal structures or other receiving means may be made of a lightweight material such as, for example, aluminum or plastic, and may be built to slide within compartments, shelves or other vial 40 receptacles 35 formed within the interior 34. It is contemplated that other suitable means of securing various contents within the interior 34 may be formed, such as, for example, shelving, pouches, within fluid solutions, nesting of additional storage compartments and the like.

[0033] The temperature regulating device 30 is controlled by control electronics 38, which may control, for example, features such as transport device 10 current state and temperature, start and stop of heat exchange operations, and all other control functions such as, for example, GPS reading location data storage, temperature data storage, etc. Additionally, control electronics 38 controls various temperature parameters, such as, the temperature setting, temperature logging, and temperature alarms for alarming to preset maximum and minimum temperatures of the insulated interior 34 of casing 26.

[0034] The temperature regulating device 30 may include a typical refrigerant compression device that is known in the art. Preferably such devices are compact, lightweight and highly efficient. It is also contemplated that temperature regulating device 30 may utilize a variety of refrigerant gasses and fluids, peltier and/or thermo-electric devices, Stirling cooler technologies, resistors, forms of conduction, forms of natural/forced convection by convection fans 37, forms of radiation and the like.

[0035] With particular reference to FIG. 5, the temperature regulating device 30 of the present disclosure is placed on the base 32 of the transport device 10. Such placement provides for additional rigidity and a lower center of mass for ease in transporting. It is contemplated that the temperature regulating device may be situated in alternate locations with relation to the transport device 10. A temperature node is situated at the bottom of the insulated interior 34 and is in communication with heat exchanger 36 and convection fans 37 (FIG. 3). It is contemplated that alternative heat exchange and cooling configurations are part of the present disclosure, such as, for example, ducts, heatsinks, fins, conduction, radiation, mass transport, etc.

[0036] In the present disclosure, heat exchange between the ambient environment and the insulated interior **34** are accomplished through convection. It is contemplated that alternative configurations of thermal heat exchange between the ambient environment and the insulated interior **34** can be accomplished, such as, for example, thermal pipes, heat displacement via cooling fins, convection fans, thermal siphons, phase change, conduction, radiation, mass transport, etc.

[0037] The transport device **10** including the temperature regulating device **30** requires power input from any type of power generator such as onboard power supply **28**. Power supply **28** may include, for example, batteries (e.g., Lithium-ion, NiMH, NiCad, etc.), fuel cells, solar power cells and the like. External power supplies may include power from a vehicle engine or other type of motor, solar power, wind power, hydro-power, etc. As the only requirement for the power supply **28** is to generate the necessary power to sustain sufficient and consistent temperature within the insulated interior **34**, the transport device **10** may also include the ability to integrate with stored thermal energy directly with the use of phase change materials, thermal mass and the like. For example, vaccine racks **40** or vaccine vials **42** may be replaced with phase change material as is used in conventional cold carriers.

[0038] It will be understood that various modifications may be made to the embodiments disclosed herein. For example, the environmentally adaptable transport device **10** according to the present disclosure may be utilized as a recreational cooler for storing beverages and food. Therefore, the above description should not be construed as limiting, but merely as exemplification of the various embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

What is claimed is:

1. A transport device comprising:
 - a casing having an interior portion; and
 - a temperature regulating device for maintaining said interior portion at a temperature range lower than an ambient temperature exterior to the interior portion, wherein said temperature regulating device maintains said temperature range without external power sources.
2. The transport device according to claim 1, wherein said interior portion includes means for receiving a plurality of vials or other temperature sensitive products.
3. The transport device according to claim 1, wherein the transport device weighs less than 150 pounds.
4. The transport device according to claim 1, wherein the transport device is personally portable.
5. The transport device according to claim 1, wherein the transport device includes a backpack attachment for transporting by a single individual.
6. A storage device comprising:
 - a casing having an interior portion;
 - a temperature regulating device for generating a temperature within a specified temperature range; and
 - a feedback means for maintaining said temperature within said interior portion of the casing.
7. The storage device according to claim 6, wherein said interior portion includes means for receiving a plurality of vials.
8. The storage device according to claim 6, wherein the storage device weighs less than 150 pounds.
9. The storage device according to claim 6, wherein the storage device is personally portable.
10. The storage device according to claim 6, wherein the storage device includes a backpack attachment for transporting by a single individual.
11. An environmentally adaptable transport device for storing temperature sensitive products comprising:
 - a storage container in fluid communication with a temperature regulating device, wherein the temperature regulating device generates a temperature within a specified temperature range; and
 - a power source for powering the temperature regulating device, wherein the power source is rechargeable.
12. The environmentally adaptable transport device according to claim 11, wherein the rechargeable power source includes the sources of AC/DC outlets, external generator, human power, solar power, fuel cell and vehicle power source.
13. The environmentally adaptable transport device according to claim 11, wherein the power source includes batteries, hydrogen, methanol, thermal mass, phase change and hydrocarbons.
14. The environmentally adaptable transport device according to claim 11, wherein the transport device is personally portable.
15. The environmentally adaptable transport device according to claim 11, wherein the transport device includes a backpack attachment for transporting by a single individual.
16. The environmentally adaptable transport device according to claim 11, wherein said storage container includes means for receiving a plurality of vials.
17. The environmentally adaptable transport device according to claim 11, wherein the transport device weighs less than 150 pounds.
18. The environmentally adaptable transport device according to claim 11, further comprising temperature control circuitry for controlling said specified temperature range.
19. The environmentally adaptable transport device according to claim 18, wherein said temperature control circuitry controls or monitors specified temperature parameters of the device.