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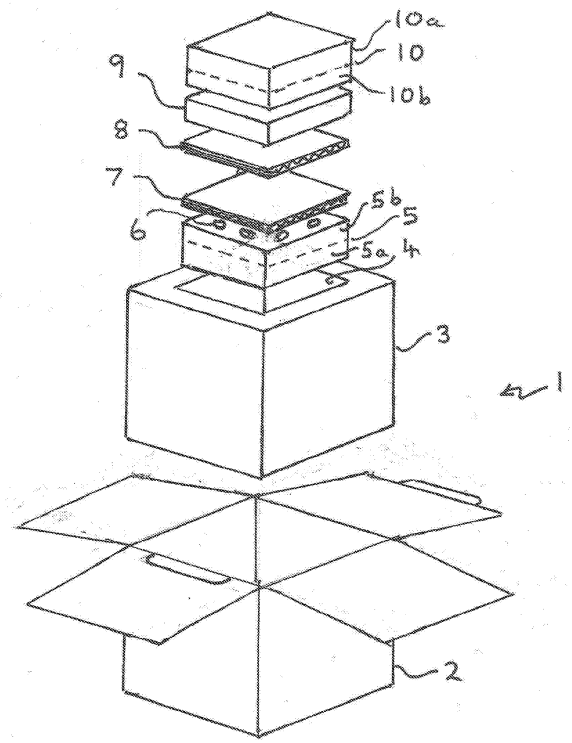
(56) Documents Cited:
GB 0449656 A **GB 0334939 A**
US 6482332 B1 **US 20100038369 A1**
US 20040079794 A1
KR2002/0072352
GB 191411378

(58) Field of Search:
INT CL **B65D, F25D**
Other: **EPODOC, WPI, Patent Fulltext**

(54) Title of the Invention: **Temperature controlled packaging and transportation method**
Abstract Title: **Thermally insulated container**

(57) A thermally insulated product delivery container 1 (PDC), including therewithin a rigid shell 3 defining a hollow tube containing wool, first 5 and second 10 tube-end closure boxes containing wool to thereby collectively define an inner void for receiving at least one phase change material container 9 for providing a temperature controlled condition within the void in the presence of a phase change material 6 (PCM), and at least one thermal baffle 8 positioned between the or each phase change material container and a product to be carried within the compartment. Preferably the PDC is insertable into a corrugated cardboard box 2. Also preferably, the end closures comprise an insulated compartment and a PCM compartment. The baffle(s) may have at least one layer of corrugated cardboard. In use, the PCM (gel pack or ice pack) cools down the product. The hygroscopic properties of the wool may act to absorb moisture from the condensation created by the PCM.



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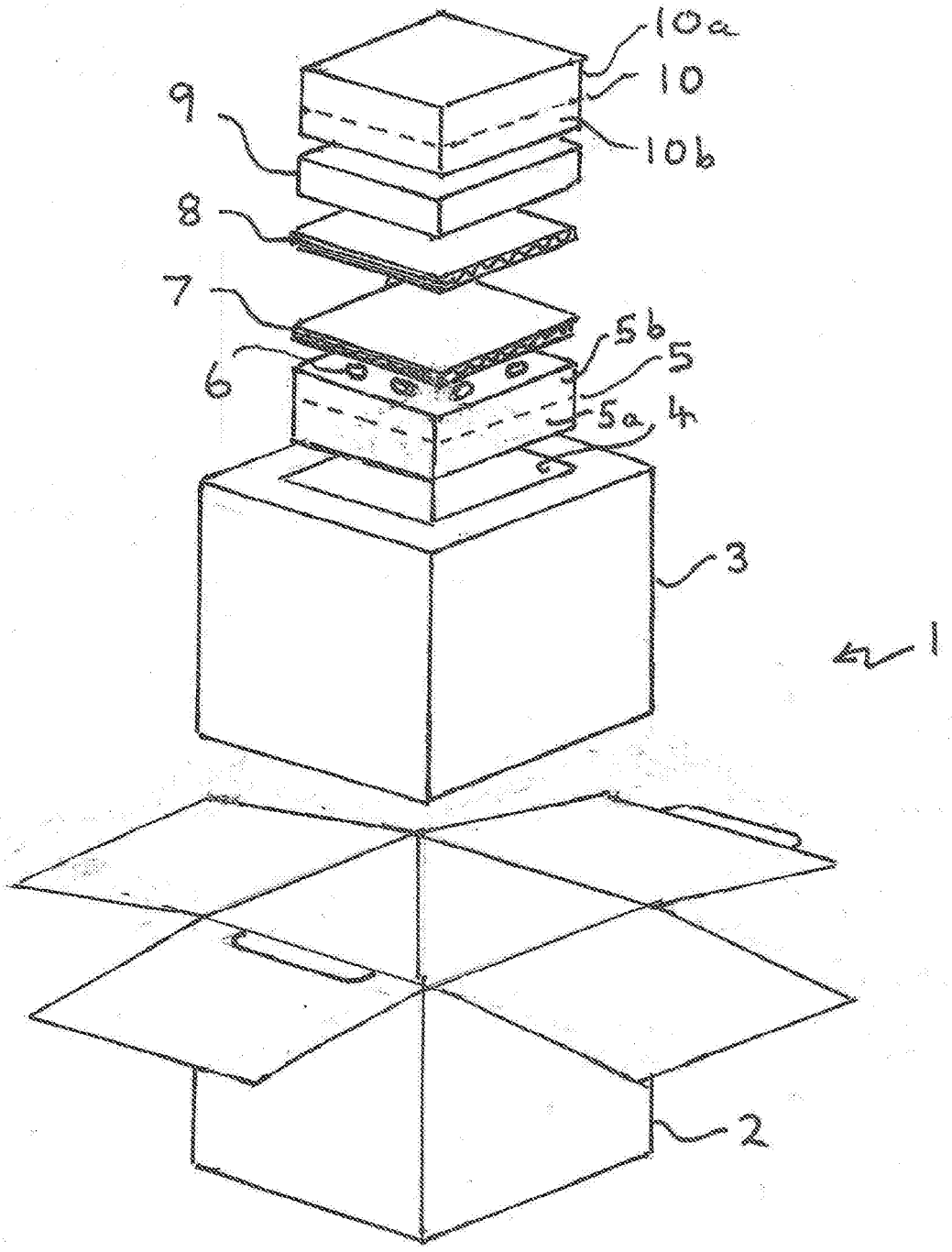
10a
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10b
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5b
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Temperature Controlled Packaging and Transportation Method

This invention relates to the transport of temperature-sensitive products, such as vaccines where it is desirable or even essential for the product to arrive at its destination without having experienced extremes of temperature.

It is well known that sheep's wool is a useful hygroscopic material that can be used within packaging such as corrugated cardboard boxes to provide a local temperature climate within the box by which products being transported, such as heat sensitive vaccines, can be kept within a required temperature range, such as between 2°c and 8°c, without any artificial means for controlling temperature within the box. This is particularly useful in circumstances whereby power is unavailable for artificially controlling the temperature of the box and it is now even possible to transport fragile items such as vaccines and donor organs to remote places over a period of at least 72 hours without any substantial degradation in the required temperature range. This concept can be assisted by the use of phase change materials (PCMs) such as ice, which gradually melt or otherwise change phase during transport, thereby absorbing heat without unduly increasing the temperature of the immediately surrounding environment. However, it is also known that live vaccines and living organs can be killed or irreparably damaged by the presence of PCMs in such containers and the present invention is derived from the realisation that there is a need to resolve this problem in a user-friendly manner without resorting to powered refrigeration techniques.

According to a first aspect of the invention there is provided a thermally insulated product delivery container (PDC), including therewithin a rigid shell

defining a hollow tube containing wool, first and second tube-end closure boxes containing wool to thereby collectively define an inner void for receiving at least one phase change material container for providing a temperature controlled condition within the void in the presence of a phase change material (PCM), and at least one thermal baffle positionable between the or each phase change material container and a product to be carried within the compartment.

With this arrangement, the PDC may take the form of a corrugated cardboard container within which may be inserted a foldable corrugated tubular cardboard shell containing wool between its inner and outer walls, and a pair of tube closure boxes, one for each end of the tube, each also containing wool to therefore collectively define a product receiving void which acts to hygroscopically control the temperature gradient between the outside of the container and the inside of the container. One or more PCM containers may therefore be introduced into the interior of the container as a means of establishing a desired temperature range for the atmosphere within the container and, in order to ensure that a product to be transported within the container does not become too cold or too hot during transport a thermal baffle is provided between the product and the or each PCM container.

Conveniently, the thermal baffle comprises one or more layers of corrugated cardboard serving to control the flow of heat to or from the product, thereby to prevent or inhibit thermal shock to the product.

Preferably, the PDC is modular, being cuboid or cylindrical, in which the hollow wool-containing shell is a sliding fit within the container, the or each PCM container is a sliding fit within the wool-containing shell, a thermal baffle is a

sliding fit over the or each PCM container e.g. a medical product in its original primary packaging fitted over or between the or each thermal baffle so that when the container is closed it assumes a generally rigid structure whereby to minimise mechanical damage to the contents during transport. Conveniently, the or each PCM container includes apertures with which to exchange temperature differences within the PDC.

Conveniently, the first and second tube closure boxes are each separated into two compartments one for receiving wool and the other for receiving a PCM for controlling the temperature within the interior of the PCD.

The invention in a second aspect also provides a method of transporting temperature-sensitive products by the use of a container in accordance with the first aspect of the invention, the method including the steps of identifying for the product to be delivered a required minimum and maximum temperature range for the duration of transport, identifying a suitable PCM and identifying a suitable thickness or composition of thermal baffle acting between the PCM and the product being transported so as to prevent or inhibit thermal damage thereto.

The invention will now be described, by way of example only, with reference to the accompanying drawing which shows an exploded view of a product delivery container (PDC) 1 according to the first aspect of the invention. The PDC 1 comprises a cuboid corrugated cardboard box 2 insertable within which is a correspondingly shaped and sized hollow tubular shell 3 having therewithin a continuous batt of wool to, in use, act as a hygroscopic thermal insulant. The inner wall 4 of the hollow shell 3 is of shape and size corresponding to the external dimensions of, respectively, a first tube closure

box 5 having a lower chamber 5a containing wool (not shown) and an upper chamber 5b into which may be placed a PCM such as plastics-covered ice cubes which may thermally interact with the area of the interior of the PCD via a series of ventilation apertures 6. Above the apertures are a pair of thermal baffles 7, 8 between which may be placed a product to be transported (not shown) such as a pre-packaged temperature sensitive vaccine. Above the thermal baffle 8 is a dedicated PCM container 9 having various apertures (not shown) for permitting thermal interaction with a PCM and the inside of the container 1, above which is a second tube closure box 10 which, as with the first tube closure box 5 includes an outer compartment 10a containing wool and an inner compartment 10b for containing further PCM.

In use, the hollow wool-insulated tube 3 is placed within the cardboard box 2 and the first tube closure box 5 is pushed down to the lower end of tube 3 after a PCM has been inserted within the upper compartment 5b. The thermal baffle 7 is then placed on top immediately below a product to be carried (not shown) whereafter the second baffle 8 is placed thereover followed by PCM container 9 and finally the second tube closure box 10 after the PCM container 10b has been filled with a PCM.

As will be apparent, the size and shape of the PDC may vary to suit the type of product being transported but in each case the general principle in accordance with the invention is that the product is surrounded by an outer layer of hygroscopic thermal insulation in the form of wool and the product itself is protected from any adverse thermal shock from the PCM by the presence of thermal baffles 7, 8, the thickness of which may be adjusted to suit the

requirements of the product being transported. Thus, it has been found through trial and error that a thermal barrier containing folded layers of corrugated cardboard is sufficient to protect live and other vaccines from cold damage by the PCM.

A further feature of the invention is that all of the components (other than the thermal insulation and PCM) can be made from sheet material such as corrugated cardboard, which lends itself to recycling along with the wool or even re-use of the product delivery container in the event that there has been little or no damage to it during transport. This has the added benefit in permitting PDC to be flat-packed for storage and transport to end-users for subsequent self-assembly.

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Claims

1. A thermally insulated product delivery container (PDC), including therewithin a rigid shell defining a hollow tube containing wool, first and second tube-end closure boxes containing wool to thereby collectively define an inner void for receiving at least one phase change material container for providing a temperature controlled condition within the void in the presence of a phase change material (PCM), and at least one thermal baffle positionable between the or each phase change material container and a product to be carried within the compartment.

2. The PDC of Claim 1 further including a corrugated cardboard container within which may be inserted a foldable corrugated tubular cardboard shell containing wool between its inner and outer walls, and a pair of tube closure boxes, one for each end of the tube, each also containing wool to therefore collectively define a product receiving void which acts to hygroscopically control the temperature gradient between the outside of the container and the inside of the container.

3. The PDC of Claim 1 or Claim 2 in which one or more PCM containers may therefore be introduced into the interior of the container as a means of establishing a desired temperature range for the atmosphere within the container

4. A PDC according to any preceding Claim further including a thermal baffle between the product and the or each PCM container in order to ensure that a product to be transported within the container does not become too cold

or too hot during transport.

5. The PDC of Claim 4 in which the thermal baffle comprises one or more layers of corrugated cardboard serving to control the flow of heat to or from the product, thereby to prevent or inhibit thermal shock to the product.

6. A PDC according to any preceding Claim of modular form, being cuboid or cylindrical, in which the hollow wool-containing shell is a sliding fit within the container, the or each PCM container is a sliding fit within the wool-containing shell, a thermal baffle is a sliding fit over the or each PCM container e.g. a medical product in its original primary packaging fitted over or between the or each thermal baffle so that when the container is closed it assumes a generally rigid structure whereby to minimise mechanical damage to the contents during transport.

7. A PDC according to any preceding Claim in which the or each PCM container includes apertures with which to exchange temperature differences within the PDC.

8. A PDC according to any preceding Claim in which the first and second tube closure boxes are each separated into two compartments one for receiving wool and the other for receiving a PCM for controlling the temperature within the interior of the PCD.

9. A PDC Substantially as hereinbefore described with reference to the drawing.

10. A method of transporting temperature-sensitive products by the use of a container in accordance with the first aspect of the invention, the method including the steps of identifying for the product to be delivered a required

minimum and maximum temperature range for the duration of transport, identifying a suitable PCM and identifying a suitable thickness or composition of thermal baffle acting between the PCM and the product being transported so as to prevent or inhibit thermal damage thereto.

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Application No:	GB1600308.9	**Examiner:**	Mr James Tagg
Claims searched:	1-8 & 10	**Date of search:**	9 May 2017

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
Y	1-4 & 10	US2010/038369 A1 (RIVAS) See Figure 1 and paragraphs [0011] & [0056]
Y	1, 3-6 & 10	US6482332 B1 (MALACH) See document and figures, In particularly Figure 4 and page 4 lines 49-52
Y	1-4 & 10	US2004/079794 A1 (MINNESOTA) See document and figures, in particularly paragraph [0049]
Y	1-7 & 10	GB449656 A (HECHT) See Figures, page 1 lines 59-67 and page 2 lines 8-28
Y	1-7 & 10	GB334939 A (DRYICE) See Document and Figures
Y	1-7 & 10	KR2002/0072352 A (GUEN) See WPI abstract Accession No. 2003-145637
Y	1-7 & 10	GB 191411378 A (CELSO) See EPODOC abstract

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

B65D; F25D

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI, Patent Fulltext

International Classification:

Subclass	Subgroup	Valid From
B65D	0081/18	01/01/2006
B65D	0081/26	01/01/2006
B65D	0081/38	01/01/2006
F25D	0003/08	01/01/2006
F25D	0003/14	01/01/2006