

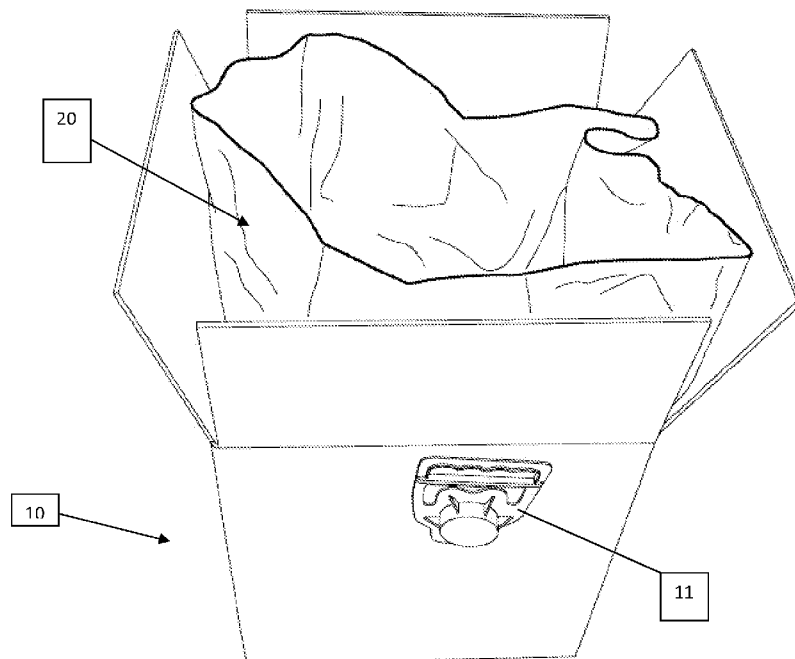


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(54) Title: PACKAGING AND METHODS OF PACKAGING PARTICULATE SOLIDS

Fig. 2



(57) Abstract: Packaging comprising an outer container, and at least a first inner container which is preferably gas impermeable disposed within the outer container and a second inner container which is gas permeable disposed within the first inner container and which contains the product being contained.



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PACKAGING AND METHODS OF PACKAGING PARTICULATE SOLIDS

CROSS REFERENCE TO RELATED APPLICATIONS

The present application claims priority to U.S. Provisional Application Serial No. 61/591,868, filed January 28, 2012, the contents of which are incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

This invention relates to articles, devices, systems and methods for the packaging of materials.

BACKGROUND

It is often necessary for particulate solid materials to be loaded into containers for shipment from a location of manufacture or pre- or post- manufacture to another location some distance away, or for simple storage until the time of use or other need for the particulate material. For example, such particulate solids may be in the form of a powder or other finely divided substance that is available for packaging in a free-flowing form. Such materials have heretofore been commonly packaged, whether for transportation or storage or both in simple, single compartment containers made from materials such as metal, plastic, cardboard or glass. The packaging that has been commonly used is generally effective in protecting people against unintended or unwanted contact with particulate solids, particularly if such materials are considered hazardous substances, and in protecting the contents against damage in transit.

Applicants have come to realize and appreciate that despite this level of effectiveness, the articles, devices, systems and methods which have heretofore been used for the packaging of many forms of such materials are inadequate and can be substantially improved. More specifically, applicants have come to appreciate and realize that many such particulate solid materials are subject to degradation by exposure to water vapor. For example, despite the use of current packaging techniques, applicants have come to appreciate that many particulate solid materials tend to undergo hygroscopic reactions even once sealed in current containers and packaging. These reactions normally result in agglomeration of the

solid particles in a non-uniform way, thereby creating in said packaging an unwanted heterogeneous distribution of the particulate material. This in turn frequently has the disadvantage of hindering the desired ability to achieve uniform processing of the heterogeneous solid substance upon unpackaging.

Applicants have come to recognize and appreciate that such unwanted reactions can originate as a result in moisture that might be present within the packaging when the package is closed and/or from outside the packaging after the package is closed. More specifically, applicants have come to appreciate that unwanted levels of hygroscopic reactions in particulate solids after packaging can be effectively eliminated by providing packaging according to the present invention which simultaneously protects against degradation from both sources of moisture while at the same time performing effectively and in a space-efficient manner.

SUMMARY

Applicants have found that the above-noted disadvantages can be substantially reduced or eliminated according to one aspect of the invention by providing packaging comprising an outer container, and at least a first inner container disposed within the outer container and a second inner container disposed within the first inner container. As used herein, the term "inner container" is intended to refer to both a container that is separate from the outer container and to compartments or layers within or formed from an inner portion of the outer container. As will be explained hereinafter, applicants have found that such an arrangement is capable of overcoming the one or more of disadvantages noted above, provided such inner containers are formed such that the first inner container is formed or otherwise is made to substantially restrict the flow of water, including water vapor, into the first inner container and further provided that the second inner container is formed from or otherwise made to substantially permit the flow of water, including water vapor, from the inside to the outside of the second inner container while at the same time effectively preventing escape of the particulate material from the second inner container. In certain highly preferred embodiments, a space is present between the first inner container and the second inner container and a moisture absorbent material is contained in the space. In such embodiments, it is generally preferred that the moisture absorbent material is distributed substantially

symmetrically within the space.

Although applicant does not intend to bound by or to any particular theory of operation, applicants have observed that detrimental water reactions occurred in prior products and techniques despite the use of measures to prevent such reactions from occurring. For example, hygroscopic products or reaction-sensitive products are typically dried and then transferred into containers with the aid of inert gases as a protective measure against such deleterious reactions. Despite these previously used protective measures, agglomerations caused by moisture reaction are repeatedly found to occur after periods of storage. Applicants have come to believe and appreciate that such detrimental agglomeration occurs as the result of two mechanisms. First, in some prior art containers, moisture was able to diffuse in gaseous form from outside through the packaging material and into the particulate solids. The diffused moisture forms a moisture film on the product surface, which in turn allows crystals of the solids to agglomerate. Notwithstanding that this mode of agglomeration is avoided by, for example, metal packaging which is 100% moisture-diffusion-proof, applicants have observed that even in such a case agglomeration was found to frequently occur. This is because applicants have come to appreciate believe that a second mode of agglomeration is possible and must be protected against, namely the presence of residual moisture contained within the product. Applicants have found that such moisture is able to diffuse over time to the surface of the product, which can frequently cause problems, such as the production of glutinous surfaces which can then agglomerate.

Accordingly, at least in part as a result of applicants' discovery of and understanding of the problem and the modes of operation of the agglomeration phenomena, applicants provide according to the present invention packages, packaging systems and packaging methods which are capable of substantially reducing and preferably substantially preventing diffusion of moisture from outside the packaging and to the product while at the same time allowing residual water contained within the product to become separated from the product and/or to otherwise not allow the residual water to detrimentally effect the product during transportation and/or storage.

DESCRIPTION OF THE FIGURES

Figure 1 is a plan view of an embodiment of the packaging according to one embodiment of the present invention with the outer container and first inner container opened to reveal the second inner container.

Figure 2 is a perspective view according to the embodiment of Figure 1 showing outer container and the first inner container in the open position.

Figure 3 is a plan view an embodiment of the packaging showing the second inner container within the first inner container and desiccant packages located in the space between a first and second inner container according to an embodiment of the present invention as shown in Figure 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

THE PACKAGING

A. The Outer Container

It is contemplated that the shape and size of the outer container can vary widely within broad aspects of the present invention. In general, the preferred packaging of the present invention comprises an outer container which contributes primarily to the desired external shape of the container and further helps to provide a macroscopic two way security such that the persons who handle the package are afforded basic protection from gross escape of the product from the package while at the same time providing basic protection of the product from gross ingress of macroscopic contaminants. Although it is contemplated that in certain embodiments the outer container may provide these features in a relatively flexible form, it is generally preferred that the outer container is a relatively rigid container formed from relatively low-cost materials such as corrugated cardboard and the like. In certain preferred embodiments, as shown in Figure 2, the outer container 10 comprises a corrugated cardboard box or the like, which in preferred embodiments includes appropriately placed handles or grips 11 fitted as a carrying aid.

B. The First Inner Container

Contained substantially within and protected by the outer container is a first

inner container 20, the top which is shown with its top end opened.. As with the outer container, it is contemplated that the shape and size of the first inner container can vary widely within broad aspects of the present invention. It will be appreciated, however, that in many preferred embodiments the size and shape of the first inner container will be such that it will fit conveniently and effectively within the outer container.

It is also contemplated that the material of construction can vary widely within the broad scope of the invention. In preferred embodiments, however, the first inner container is formed of a material that provides substantial resistance to the flow of water, including water vapor, therethrough, at least in the direction of from outside to inside of the first inner container. It is also preferred in certain embodiments that the walls of the first inner container are flexible. In certain highly preferred embodiments, the first inner container is formed from a substantially water-impermeable material, and even more preferably in certain embodiments of a substantially water-impermeable, layer or wall of plastic, and even more preferably a plastic film or aluminum laminated film having such features. In certain preferred embodiments the inner container is formed from a film and is preferably fitted in an interlocking manner to the internal wall of the outer container.

Although the outer container and first inner wall have been described and shown in the illustrated embodiments as separate discrete containers, it should be appreciated that the inner container could be formed integral with or otherwise connected to and/or as part of the outer container. For example, it may be desired in certain embodiments to form the first inner container by adhering, such as by lamination or gluing, a film or layer to the inner wall of the outer container. It may also be possible, but not generally preferred from the standpoint of cost considerations, to merger the outer container and the first inner container into a single structural unit by forming the outer container entirely from a material that is sufficiently resistant to the passage of vapor. However, in most embodiments this would likely greatly increase the cost of the package and therefore is not generally preferred.

C. The Second Inner Container

Contained substantially within the first inner container is a second inner

container 30, and the moisture sensitive product (not shown) is contained within the second inner container. The material from which the second inner container is formed in preferred embodiments comprises a synthetic fabric.

Once again it is contemplated that the shape and size of the second inner container can vary widely within broad aspects of the present invention. However, in certain preferred embodiments it is preferred that the second inner container is sized so as to provide a substantial space or gap between at least a portion of its outer walls and at least a portion of the inner walls of the first inner container. One aspect of such preferred embodiments is to provide space within which to locate material 31 that will be absorbent toward water, including water vapor, which enters such space or gap area. Further details concerning the relationship between the preferred amount of space or gap relative to the volume within the second inner container are described below.

The material of construction of the second inner container is important for many preferred embodiments of the present invention. More specifically, while in other aspects the material of construction can vary widely within the broad scope of the invention, it is required for such preferred embodiments that the material is of such a nature so as to permit water, including water vapor, to pass readily from the inside of the second inner container through at least portions, and preferably through substantial portions of the wall, that forms the second inner container. Although it is not generally preferred or necessary, it is contemplated that the wall of the container may also permit passage of water vapor from outside the second inner container to the inside of the inner container.

In one preferred aspect, the second inner container is in the form of a gas-permeable bag made of flexible material that substantially conforms to the volume of the product which it contains. In highly preferred embodiments, the volume within the second inner container, which in preferred embodiments is substantially equivalent to the volume of the product which it contains, is substantially greater than the volume of the gaps or spaces between the second inner container and the first inner container. Preferably, the packaging according to the present invention is configured such that the ratio of volume within the second inner container, and even more preferably the volume of the product within the second inner container, to the gap or space volume is at least about 1:0.2, and even more preferably 1:0.5. In

certain embodiments, the ratio of volume within the second inner container, and even more preferably the volume of the product within the second inner container, to the gap or space volume is from about 1:0.2 to about 1:1, and even more preferably from about 1:0.5 to about 1:0.8.

As mentioned above, a water absorbent material 31 is preferably contained in at least a portion of the space between the second inner container and the first inner container. Although such material may take many forms, shapes and sizes according to the scope of the present invention, in preferred embodiments a plurality of desiccant bag units, preferably in certain embodiments at least about four (4) bags 31, each with 8 units of desiccant, are used per about 25 kg product (with a volume of about 25 liters), which in preferred embodiments would utilize packaging according to the present invention having a gas space of from about 5 to about 50 liters in certain preferred embodiments, and even more preferably in certain embodiments of from about 5 to about 15 liters. Preferably the desiccant bags are substantially evenly distributed within the space between the first inner and the second inner containers, thus producing a product:space volume ratio of from about 1:0.2 to about 1:2, and even more preferably of from about 1:0.2 to about 1:0.75.

In preferred embodiments, the packaging configuration provided herein produces a moisture content in the space between the first inner container and the second inner container of not greater than about 10%, more preferably of not greater than 8%, and in certain preferred embodiments not greater than about 7% relative humidity. In certain preferred embodiments, the packaging configuration provided herein produces a moisture content in the space between the first inner container and the second inner container, measure at about 30 days, or more preferable in certain embodiments at about 60 days, and even more preferably at about 90 days after the product is packaged of not greater than about 10%, more preferably of not greater than 8%, and in certain preferred embodiments not greater than about 7% relative humidity.

THE METHODS

In general, the present invention provides methods of providing packaging and methods of packaging which utilize a package according to an embodiment described herein. In certain preferred embodiments, the present methods provide

packaging for a finely divided chemical product comprising: (a) providing an outer container; (b) providing at least a first inner container disposed within the outer container, said first inner container substantially restricting the flow of water into said first inner container from outside said first container; and (c) providing a second inner container for containing the finely divided chemical product, said second inner container being disposed within the first inner container and being formed to inhibit escape, and preferably substantially prevent the escape of the finely divided chemical product from within the second inner container when the container when the container is closes while permitting the flow of water from inside said second container to outside said second container when the container is closed. The other particular and preferred aspects of the present packaging product of the present invention can be used in connection with the present methods, and in particular in connection with the method steps describe herein and in the appended claims.

While the present invention has been particularly shown and described with reference to preferred embodiments, it will be readily appreciated by those of ordinary skill in the art that various changes and modifications may be made without departing from the spirit and scope of the invention. It is intended that the claims be interpreted to cover the disclosed embodiment, those alternatives which have been discussed above and all equivalents thereto.

CLAIMS

What is Claimed is:

1. Packaging for a finely divided chemical product comprising:
 - (a) an outer container;
 - (b) at least a first inner container disposed within the outer container, said first inner container substantially restricting the flow of water into said container from outside said container; and
 - (c) a second inner container disposed within the first inner container and inhibiting escape of the finely divided chemical product from the package, said second inner container permitting the flow of water from inside said second container to outside said second container.

2. A method of providing packaging for a finely divided chemical product comprising:
 - (a) providing an outer container;
 - (b) providing at least a first inner container disposed within the outer container, said first inner container substantially restricting the flow of water into said first inner container from outside said first container; and
 - (c) providing a second inner container for containing the finely divided chemical product, said second inner container being disposed within the first inner container and being formed to inhibit escape of the finely divided chemical product while permitting the flow of water from inside said second container to outside said second container.

3. A method of packaging a finely divided chemical product comprising:
 - (a) providing an outer container;
 - (b) providing at least a first inner container disposed within the outer container, said first inner container substantially restricting the flow of water into said first inner container from outside said first container;
 - (c) providing a second inner container for containing the finely divided chemical product, said second inner container being disposed within the first inner container and being formed to inhibit escape of the finely divided chemical product

while permitting the flow of water from inside said second container to outside said second container;

(d) placing said finely divided chemical product into said second inner container; and

(e) closing at least said first and second inner containers after said placing step.

4. The packaging of claim 1 wherein a space is present between said first and second inner containers, and a moisture absorbent material is disposed in said space.
5. The packaging of claim 2 wherein said moisture absorbent material is substantially symmetrically disposed in said space.
6. The packaging of claim 2 wherein said space has a moisture content of not greater than about 10% relative humidity.
7. The packaging of claim 2 wherein said space has a moisture content of not greater than about 8% relative humidity.
8. The packaging of claim 2 wherein volume of said space is from about 0.2 times the volume of said finely divided chemical product to about 0.8 times volume of said finely divided chemical product.
9. The packaging of claim 7 wherein said space has a moisture content of not greater than about 10% relative humidity.
10. The packaging of claim 7 wherein said space has a moisture content of not greater than about 8% relative humidity.

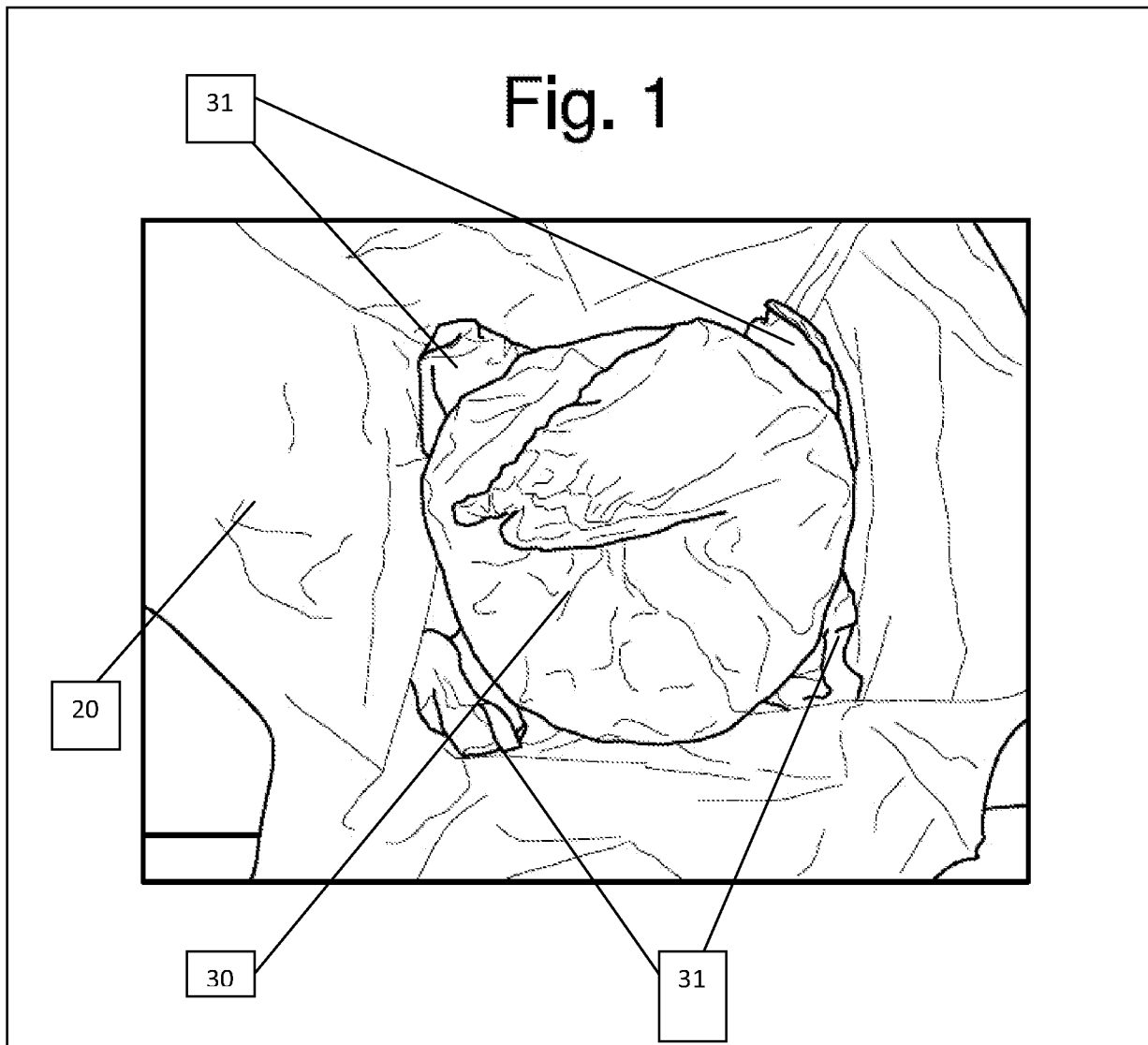


Fig. 2

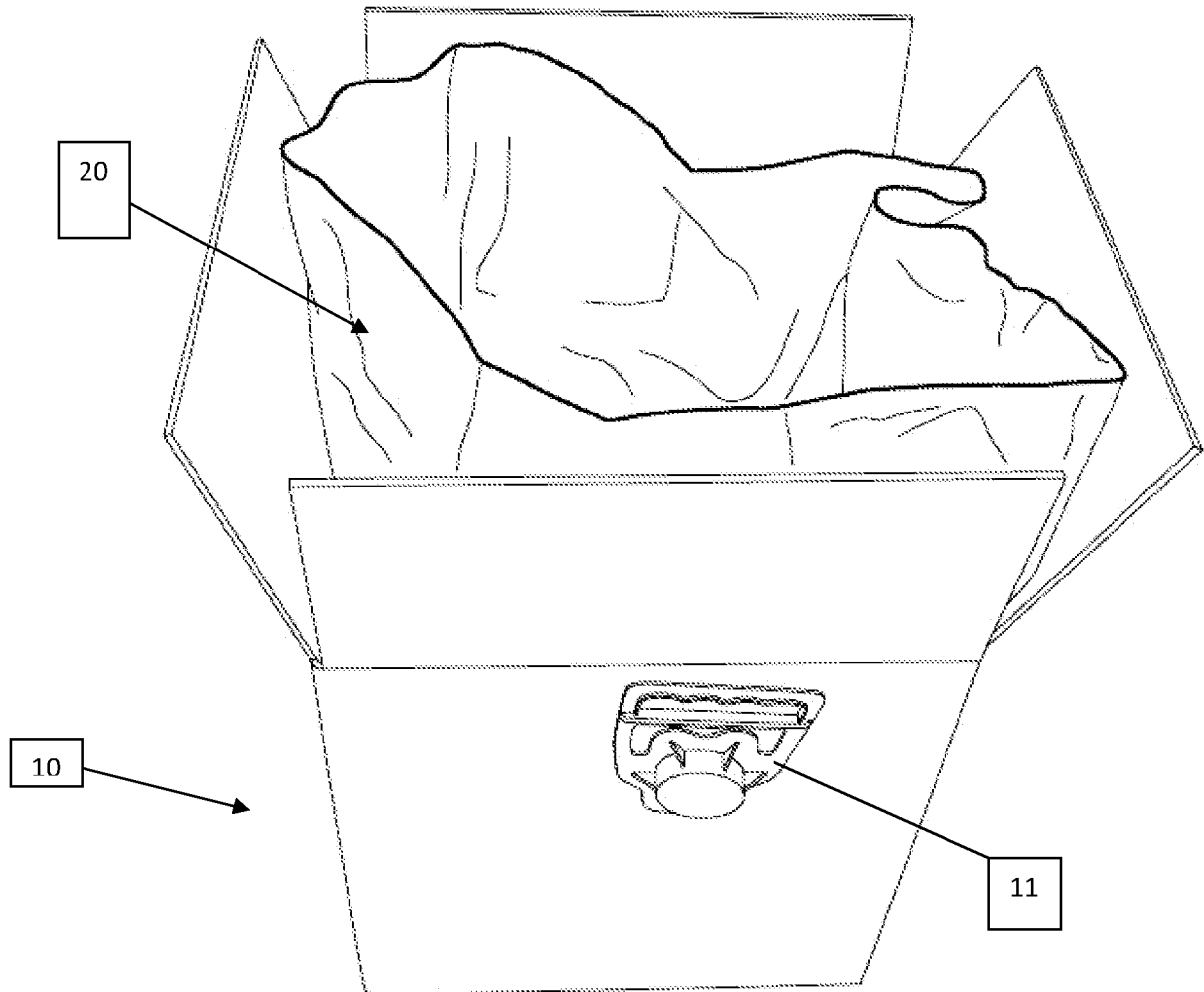
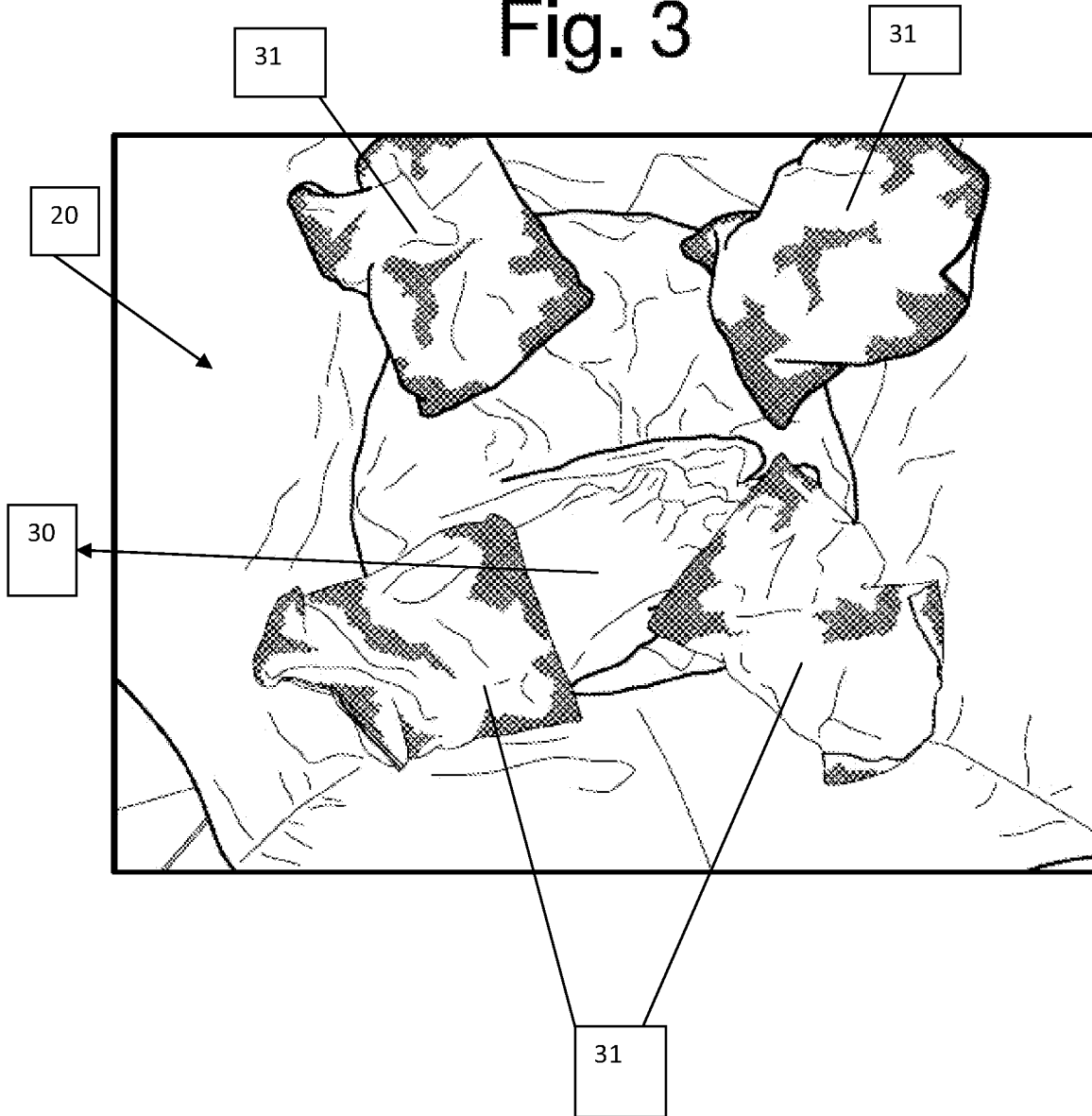


Fig. 3



A. CLASSIFICATION OF SUBJECT MATTER***B65D 81/24(2006.01)i, B65D 77/04(2006.01)i, B65D 85/84(2006.01)i***

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)

IPC: B65D 81/24; A23L 1/00; A23L 1/48; B65D 85/00; B65D 81/02; F26B 5/06; F17C 11/00; B65D 85/34; B65D 81/26

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: packaging, particle, chemical, moisture, and space

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 5988050 A (FOSTER, JR., THOMAS E.) 23 November 1999 See column 3, lines 46-67, column 4, lines 1-52, and figure 1.	1-4 5-10
Y	US 2009-0136630 A1 (THIERY, SYLVAIN MARCEL ROGER) 28 May 2009 See paragraphs [0009]-[0012], claim 9, and figures 1,2,4.	1-4
A	US 2001-0050237 A1 (HACIKYAN, MICHAEL) 13 December 2001 See paragraphs [0026]-[0029] and figure 2.	1-10
A	US 2010-0236090 A1 (GRIMM, MICHAEL J.) 23 September 2010 See paragraphs [0010]-[0013] and figure 1.	1-10
A	US 2004-0118741 A1 (SULLIVAN JR., JOSEPH J.) 24 June 2004 See paragraphs [0015]-[0018] and figures 1,4.	1-10

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA/KR

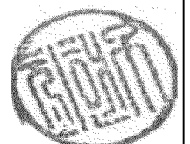
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CHOI, Hyun Goo

Telephone No. 82-42-481-8288



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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