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(71) Applicant: **KYOWA HAKKO KOGYO CO., LTD.**
**Chiyoda-ku, Tokyo 100-8185 (JP)**

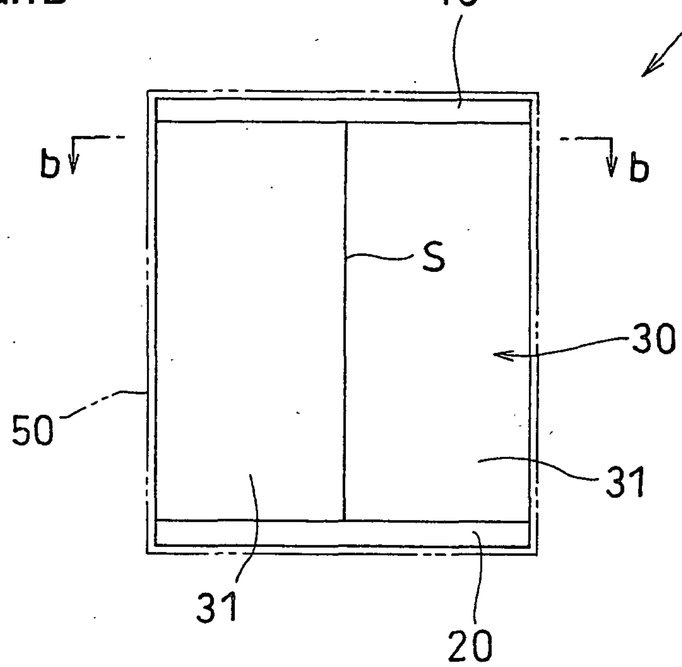
(72) Inventors:
- **Tanaka, Masahiko**
  **Sashima-gun, Ibaraki 306-0433 (JP)**
- **Sakai, Yasuo, Kyowa Hakko Kogyo Co., Ltd.**
  **Chiyoda-ku, Tokyo 100-8185 (JP)**

(74) Representative: **VOSSIUS & PARTNER**
**Siebertstrasse 4**
**81675 München (DE)**

# (54) Heat-insulating container

(57) A heat-insulating container (1) comprises a disc-shaped upper lid (10), a disc-shaped lower lid (20) and a cylindrical sidewall portion (30) which are all made of a synthetic resin foam. The cylindrical sidewall portion (30) is made up of two or more separate pieces (31) divided along the circumference. When necessary, the entire container is accommodated in a container protector (50) to ensure its strength. The heat-insulating container (1) allows the temperature of a heat-insulated item to be controlled below a preferable temperature for a long time. When not used as a heat-insulating container, its entire volume can be reduced, thereby allowing the space required for its distribution or storage to be reduced. Since the container is made up of a plurality of parts, molding costs can be reduced.

FIG.1B




EP 1 291 299 A1

## Description

**[0001]** The present invention relates to a heat-insulating container and more particularly to a heat-insulating container suitable for the storage or distribution of articles or substances such as, e.g., an enzyme, coenzyme or reagent whose temperature must be controlled below a predetermined temperature for a long time.

**[0002]** Heat-insulating containers made of synthetic resin foams are known. For example, Japanese Published Unexamined Patent Application No.159271/2000 discloses a heat-insulating container made of a synthetic resin foam, comprising a box-shaped container body, a cold insulator and a lid. The cold insulator can be accommodated in the internal peripheral walls of the lid and container body, such that the condensation formed on the cold insulator does not drop on a stored product. Registered Japanese Utility Model No. 3058267 discloses a heat-insulating container comprising a close-bottomed cylindrical container body made of a synthetic resin foam, and a synthetic resin foam lid rotatably attached to the opening portion of the container body.

**[0003]** Many of the heat-insulating containers made of a synthetic resin foam are generally box-shaped, as is the one disclosed in the above-mentioned Japanese Published Unexamined Patent Application No. 159271/2000. As a result, when, for example, an item to be cooled and/or a cool storage medium are stored in the container, the weight of the container may be so heavy that it cannot be transported manually. Further, the container body is in most cases made of an integral molding of a synthetic resin foam. Accordingly, the entire volume of the container covered by the lid is the same regardless of whether it is actually being used as a heat-insulating container or when being transported or stored merely as a container without any contents, thus securing a space for the container is a problem when it is not in use. Further, when the container is an integrally molded article, productivity of the container will be decreased and mold production cost will be increased sharply when a relatively large-sized article is to be manufactured. The container disclosed in Registered Japanese Utility Model No. 3058267 is cylindrically shaped, so that it can be rolled via its peripheral edge portion and thus can be transported by hand relatively easily when it is heavy. However, since, the container body is integrally molded, the container has the same problems as those of the box-shaped container with regard to the securing of storage space and manufacturing cost.

**[0004]** The containers made of a synthetic resin foam are not as strong as containers or drums made of non-expanded resin, metal or reinforced paper. Although the synthetic resin foam containers are superior in heat insulation properties, they are not hardy enough to withstand long-distance transportation by air, sea or land.

**[0005]** In view of these problems of the prior art, it is an object of the present invention to provide an improved heat-insulating container made of a synthetic resin foam which can perform its intended functions when actually used as a heat-insulating container regardless of the size of the internal volume and without manufacturing cost increasing, and which requires far less storage space when not in use.

**[0006]** It is another object of the present invention to provide a heat-insulating container made of a synthetic resin foam which can withstand external impacts so that it can be reliably used in distribution routes such as by air cargo.

**[0007]** The heat-insulating container of the present invention basically comprises a disc-shaped upper lid, a disc-shaped lower lid, and a cylindrical sidewall portion which are all made of a synthetic resin foam, wherein the cylindrical sidewall portion is a structural member made up of two or more separate, circumferentially divided pieces. The main body portion of the container is assembled by attaching the disc-shaped lower lid to the cylindrical sidewall portion. If necessary, the joints are affixed with an adhesive tape. An item to be heat-insulated and a refrigerant such as dry ice are placed in the container, which is then covered by the disc-shaped upper lid and, if necessary, the circumferential surface of the container is attached with an adhesive tape, thereby producing a distribution or storage package utilizing the heat-insulating container of the present invention.

**[0008]** Since the heat-insulating container of the present invention is generally cylindrical in shape, it can be easily transported by rolling on its circular edge even if the contains is heavy. Further, the cylindrical sidewall portion, which forms the main body portion, can be divided into a plurality of separate pieces, so that the heat-insulating container, when not being used as such, requires less space for transportation or storage. Even if the cylindrical sidewall portion is large, the individual separate pieces can be relatively small, so that their molding requires less time than in the case of making the container as an integrally formed article. In addition, molded parts can be cut out of the molds more satisfactorily, and also the material can be poured into the mold cavities more satisfactorily. Thus, efficiency of molding can be improved while reducing costs, and the space required for storing the molds can also be reduced.

**[0009]** In the heat-insulating container of the present invention, the individual separate pieces which make up the cylindrical sidewall portion are combined via abutting surfaces formed on each separate piece such that a convex portion formed on one surface engages a concave portion formed on the other surface. The circumferential length of each separate piece is set such that no two abutting portions are located simultaneously in a vertical virtual plane slicing a center line of the cylinder.

**[0010]** In this embodiment, the possibility is minimized of a thermal shortcut being formed on the abutting surfaces of adjacent separate pieces, so that the heat-insulating properties can be improved. Further, even if a shock is applied to the container during transport on the edge on one side, the embodiment can reliably prevent the separation of the abutting surfaces of the separate pieces on the opposite side and the possible loss of airtightness.

**[0011]** In another embodiment of the heat-insulating container of the present invention, the cylindrical sidewall portion comprises a rib protruding radially inwardly, and a central bedding with such dimensions as to be locked by the rib. The central bedding is preferably formed with a number of holes for circulating cold air. In this embodiment, it is possible to store a heat-insulated item and a refrigerant such as dry ice separately, the former in a space below the central bedding and the latter in a space above the central bedding, so that a high cooling efficiency can be obtained for a long time. Advantageously, a bedding with legs may be placed on the disc-shaped lower lid, in which case a heat-insulated item can be placed on the bedding. This facilitates the circulation of cold air effectively, further improving the cooling efficiency. Alternatively, two central beddings may be provided in two stages, so that the refrigerant such as dry ice may be placed between them. In this case, different cooling environments can be created for spaces above and below the refrigerant.

**[0012]** In yet another embodiment, the cylindrical sidewall portion is further divided into two or more stages along the center line. In this embodiment, the height of the cylindrical sidewall portion can be selectively set according to the type or size of the heat-insulated item that is accommodated. Thus, a useless cooling space can be eliminated and the cooling efficiency can be improved. Also, multiple central beddings can be easily placed in multiple stages at intermediate positions.

**[0013]** In the present invention, the type of synthetic resin foam is not particularly limited. Examples include a polystyrene resin, a polypropylene resin, a polyethylene resin, a polyester resin, and a polyurethane resin. From the viewpoint of ease of molding, strength and impact resistance, the individual components are preferably internal mold foam articles produced by using prefoamed particles of a polystyrene resin. The expansion factor can be determined by taking into consideration the desired heat-insulating performance, container weight, etc, but it should be in the range of from 20 to 100, preferably from 30 to 60.

**[0014]** While a container made of a synthetic resin foam is superior in heat-insulating properties, its resistance to possible external shock might in some cases not be enough, depending on the kind of distribution environment. To cope with such possible situations, in another embodiment of the present invention, the heat-insulating container is equipped with a cylindrical container protector for protecting the heat-insulating container from external shock. The container protector may be made of any materials such as, e.g., reinforced paper, resin and metals, as long as they can provide a required strength. However, paper should preferably be used, for it can easily be disposed of.

**[0015]** Preferably, the container protector comprises an open-top container body and a lid. A heat-insulating container containing a heat-insulated item is then housed in the container body, the lid is placed, followed by sealing the joints by an adhesive tape, for example. The thus protected heat-insulating container is highly resistant to external shocks and can withstand a long-distance transportation by air, sea or land. Accordingly, the heat-insulating container in this embodiment of the present invention can be suitably used, e.g., for transporting abroad an item in a heat-insulated condition, such items including enzymes, coenzymes and reagents whose temperature must be controlled below a certain temperature for a long time during storage or distribution.

FIG. 1A is a plan view of an assembled heat-insulating container;
FIG. 1B is a side elevational view of the assembled heat-insulating container;
FIG. 2A is a sectional view taken on the line a-a of FIG. 1A;
FIG. 2B is a sectional view taken on the line b-b of FIG. 1B;
FIG. 3 is a perspective view of one of separate pieces which form a cylindrical sidewall portion;
FIG. 4A is a perspective view of a central bedding;
FIG. 4B is a perspective view of a bedding;
FIG. 5A is a schematic plan view of an example of the cylindrical sidewall portion;
FIG. 5B is a schematic plan view of another example of the cylindrical sidewall portion;
FIG. 5C is a schematic plan view of yet another example of the cylindrical sidewall portion;
FIG. 6A is a schematic plan view of a further example of the cylindrical sidewall portion;
FIG. 6B is a schematic plan view of a yet further example of the cylindrical sidewall portion;
FIG. 7 is a perspective view of an example of the container protector;
FIG. 8A is a sectional view of another example of the cylindrical sidewall portion;
FIG. 8B is a sectional view of yet another example of the cylindrical sidewall portion;
FIG. 8C is a sectional view of yet another example of the cylindrical sidewall portion;
FIG. 8D is a sectional view of a further example of the cylindrical sidewall portion;
FIG. 9 shows a graph showing the results of a heat-insulating test.

**[0016]** The heat-insulating container of the present invention will be hereafter described by way of several embodiments with reference made to the drawings. FIGs. 1A and 1B show a plan view and a side elevational view, respectively, of an assembled heat-insulating container 1. FIGs. 2A and 2B show a sectional view taken along the line a-a of FIG. 1A and a sectional view taken along the line b-b of FIG. 1B, respectively. As shown, the heat-insulating container 1 comprises a disc-shaped upper lid 10, a disc-shaped lower lid 20, and a cylindrical sidewall portion 30, each made of a synthetic resin foam. In this example, the cylindrical sidewall portion 30 is made up of three identically shaped separate pieces 31 divided at 120° intervals along the circumference. As shown in detail in FIG. 3, each separate piece 31 comprises arched cut portions 32 and 33 formed on the inside of the upper and lower circumferential edges, respectively. Each separate piece 31 also comprises a rib 34 on the internal wall surface slightly above the middle section, protruding radially. One side edge of the internal surface of each separate piece 31 is provided with a rib 35. The other side edge of the internal surface of each separate piece 31 is provided with a groove 36 with which the rib 35 can engage in an air-tight manner. Thus, adjacent separate pieces can be assembled together in an air-tight manner.

**[0017]** The three separate pieces 31 are put together such that the rib 35 and groove 36 formed on the side edges can abut with each other, thereby forming the cylindrical sidewall portion 30 mentioned in the present invention. The cylindrical sidewall portion 30 is formed with circular recessed portions 32a and 33a on the inside of the upper and lower open ends, respectively, of the cylindrical sidewall portion 30. The cylindrical sidewall portion 30 is further formed with a circular rim 34a slightly above the middle of the internal wall. The separate pieces 31 are assembled via an abutting portion S where the concave portion formed on one surface abuts the convex portion formed on the other surface. As shown in FIG. 5A, no two abutting portions S are located simultaneously in a vertical virtual plane L slicing along a center line O of the cylinder. Thus, when an impact is applied to the edge on one side of the cylindrical sidewall portion 30, the abutting portions S of the separate pieces located on the opposite side do not easily separate and the loss of air-tightness can be prevented.

**[0018]** In this example, the disc-shaped upper lid 10 and the disc-shaped lower lid 20 are discs of substantially the same shape, and their diameter is substantially the same as the external diameter of the cylindrical sidewall portion 30. The disc-shaped upper lid 10 may be slightly smaller in diameter. This makes it easier to open the disc-shaped upper lid 10 when in use, as will be described later. One face of each disc forms a cylinder portion 11 or 21 with a reduced diameter which is substantially the same as the diameter of the circular recessed portions 32a and 33a formed at the upper and lower open ends of the cylindrical sidewall portion 30. Thus, the disc-shaped upper lid 10 and lower lid 20 are mounted on the cylindrical sidewall portion 30 such that their cylinder portions 11 and 21 with reduced diameter internally engages the upper and lower open ends of the cylinder sidewall portion 30 in an air-tight manner, as shown in FIG. 2A. Thus, in an assembled heat-insulating container 1, the internal space is isolated from the external space.

**[0019]** A plate-like central bedding 40 is placed as needed on the circular rim 34a formed on the internal wall surface of the cylindrical sidewall portion 30, as shown in FIG. 4A. The central bedding 40 is made of an expanded or non-expanded polystyrene resin, for example, and formed with a number of through holes 41. By placing the central bedding 40 inside the heat-insulating container 1, its internal space is divided into a lower space A and an upper space B, as shown in FIG. 2A, and the two spaces are communicated with each other via the through holes 41. FIG. 4B shows a bedding 45 which is used as needed. It has legs 46 on the back surface so that, when the bedding 45 is placed on the disc-shaped lower lid 20, a ventilating space is formed between the bedding and the disc-shaped lower lid 20.

**[0020]** Before use, the cylindrical sidewall portion 30 is assembled first, the bedding 45 is placed inside if needed (not shown in FIG. 2A), and then the disc-shaped lower lid 20 is attached to the bottom portion of the sidewall portion. When a high degree of stability is required, the joined surfaces or the seams are sealed by an adhesive tape (not shown). Then, an item to be heat-insulated, such as an enzyme, is put into the internal space (the lower space A in the illustrated example), the central bedding 40 is placed, and then a refrigerant such as dry ice is placed thereon (in the upper space B). Finally, the disc-shaped upper lid 10 is put on the cylindrical sidewall portion 30, to complete the heat-insulating container 1 in which the heat-insulated item is accommodated in an air-tight space. The through holes 41 in the central bedding 40 allow cool air to circulate effectively, so that the heat-insulated item can be stored in a temperature-controlled environment for long hours or days.

**[0021]** After a certain period of time, the disc-shaped upper lid 10 is removed and the accommodated item is retrieved. The heat-insulating container 1 after use is transported back or stored at a different site. The disc-shaped lower lid 20 and the central bedding 40 (and also the bedding 45) can be easily separated from one another. The cylindrical sidewall portion 30 can also be easily disassembled into the three separate pieces 31. Thus, the heat-insulating container 1 requires far less space when transported or stored without any contents than when used for its intended functions, so that the transportation or storage costs can be reduced. Further, since the heat-insulating container 1 is made up of a number of small parts, molding costs can be greatly reduced as compared with the case of integrally molding the entire container.

**[0022]** FIGs. 5A to 5C are plan views schematically showing only the cylindrical sidewall portion 30. FIG. 5A shows the above-described cylindrical sidewall portion 30. FIG. 5B shows a cylindrical sidewall portion 30 formed by not three but five separate pieces 31a. In this case, too, no two abutting portions S are simultaneously located in a vertical virtual plane L slicing along the center line O of the cylinder. FIG. 5C shows a further example which differs from the example of FIG. 5A in that the rib and groove at the side edges of each separate piece 31b are formed by a tongue 35a and a groove 36a, respectively, in the so-called tongue-and-groove joint. In this embodiment, better air-tightness can be obtained, and also the possibility of the individual separate pieces 31b being separated by an impact can be reduced.

**[0023]** FIGs. 6A and 6B are plan views schematically showing further examples of the cylindrical sidewall portion 30. In these examples, the cylindrical sidewall portion 30 is made up of two or four separate pieces 31. While in these cases two abutting portions S are simultaneously included in the vertical virtual plane L slicing the center line O of the cylinder, the cylindrical sidewall portion 30 can be prevented from easily separating by suitably arranging the manner of engagement in the abutting portions S, or by affixing an adhesive tape along the periphery of the cylindrical sidewall portion 30.

**[0024]** The above-described heat-insulating container 1 may be used as is for the distribution or storage of a heat-insulated item. However, since the container is made of a synthetic resin foam, it has problems for strength when used for distribution or storage purposes for a long time under an impact-prone environment. FIG. 7 shows a cylindrical container protector 50 which may be suitably used in such cases. As mentioned above, the container protector 50 may be made of any materials including, e.g., reinforced paper, resin, and metal, as long as they can provide a necessary strength. Paper is preferable, for it can be easily disposed of. In this example, the container protector 50 comprises a container body 51 with an open upper part and a lid 52. The heat-insulating container 1 accommodating a heat-insulated item is placed in the container body 51 and the lid 52 is closed, and, if necessary, the joints are sealed by an adhesive tape (not shown). In FIGS. 1 and 2, the container protector 50 is indicated by phantom lines. When thus placed in the protector, the heat-insulating container can be made highly resistant to external impacts or shocks and can therefore withstand a long transportation by air, sea or land.

**[0025]** It may be difficult to remove the disc-shaped upper lid 10 when the heat-insulating container 1 is accommodated in the container protector 50. This problem can be avoided by reducing the diameter of the disc-shaped upper lid 10 such that there is a gap between the container body 51 and the lid.

**[0026]** FIGs. 8A to 8D show other embodiments of the heat-insulating container 1. In these embodiments, the cylindrical sidewall portion 30 is further divided into two or more stages (stages 30a, 30b, and 30c in the illustrated example) along the central axis. The individual cylindrical sidewall portions 30a, 30b, and 30c are combined into one piece via a fitting engagement of a circular rib 38 and a circular groove 39 formed on the upper and lower peripheral edge faces of each sidewall portion. Thus, the cylindrical sidewall portion 30 can be assembled in a highly stabilized manner while ensuring a high degree of air-tightness. The air-tightness is further enhanced by the disc-shaped upper lid 10 and disc-shaped lower lid 20 being likewise joined with the cylindrical sidewall portions 30a and 30c, respectively, via a circular rib and a circular groove. The cylindrical sidewall portion 30a, 30b, or 30c in each stage is made up of a plurality of separate pieces, as in the above embodiments.

**[0027]** FIG. 8B differs from FIG. 8A in that the bedding 45 is placed inside. FIG. 8C differs from FIGs. 8A and 8B in that the thickness of the middle cylindrical sidewall portion 30b is different from that of the upper and lower cylindrical sidewall portions 30a and 30c (In the illustrated example, the middle cylindrical sidewall portion is wider, but it may be thinner.). This example is advantageous in that the temperature distribution inside the container can be controlled.

**[0028]** The example shown in FIG. 8D differs from the others in that two central beddings 40 are attached to the middle cylindrical sidewall portion 30b. In this case, different temperature environments can be obtained in a lower space A and an upper space B by placing a refrigerant between the central beddings 40. Further, by making the thickness of the middle cylindrical sidewall portion 30b greater than that of the upper and lower cylindrical sidewall portions 30a and 30c, the duration of time before melting or sublimation of the refrigerant occurs can be advantageously extended.

**[0029]** FIG. 9 shows the results of a heat-insulating test involving the heat-insulating container 1 according to the embodiment shown in FIGs. 1 and 2. The heat-insulating container 1 used had a diameter of 490 mm and a height of 620 mm externally. The thickness of the disc-shaped upper lid 10, disc-shaped lower lid 20 and cylindrical sidewall portion 30 was all 50 mm. The internal volume was about 60 L. The material was a polystyrene resin, with an expansion factor of 50. As a heat-insulated item, two packages each containing 5 kg of an enzyme (total of 10 kg) were stored in the lower space A. The central bedding 40 made of an expanded polystyrene resin was placed, and then four packages each containing 2.2 kg of dry ice (total of about 9 kg) were put into the upper space B. The container was sealed by putting the disc-shaped upper lid 10 thereon.

**[0030]** The heat-insulating container 1 was then placed in a reinforced paper drum (container protector 50) measuring, externally, 520 mm in diameter, 650 mm in height and 10 mm in thickness (with an internal volume of about 120 L), and the drum was covered by the lid 51 and sealed by an adhesive tape. The drum thus accommodating the heat-insulating container 1 was then left to stand outside for a long time at a temperature of about 40°C, and temperature changes in the enzyme were measured. FIG. 9 shows the results.

**[0031]** As shown in FIG. 9, the temperature of the enzyme was controlled at 0°C or below for about 75 hours, and it reached 25°C only after 110 hours. When an enzyme is manufactured in a production plant and exported, e.g., from Japan to Europe or the U.S., a typical transportation environment and time are 40°C and 100 hours, respectively. When it is an evaluation yardstick for temperature of the product to be maintained at 25°C (control temperature) or below, the above-described heat-insulating container is quite satisfactory.

**[0032]** Thus, the heat-insulating container of the present invention allows the temperature of a heat-insulated item to be controlled below a preferable temperature for a long time. Further, since the heat-insulating container of the present invention is made up of a plurality of parts, the entire volume of the container can be minimized when not used as such, so that the space required for the distribution or storage of the container not in use can be reduced, and molding costs can be reduced as compared with the case of costs for integral molding.

**[0033]** All publications, patents and patent applications cited herein are incorporated herein by reference in their entirety.

**Claims**

**1.** A heat-insulating container comprising a disc-shaped upper lid, a disc-shaped lower lid, and a cylindrical sidewall portion which are all made of a synthetic resin foam, wherein the cylindrical sidewall portion comprises two or more separate pieces divided along the circumference.

**2.** A heat-insulating container according to claim 1, wherein the separate pieces are combined with one another via abutting surfaces formed on each separate piece, the abutting surfaces comprising a convex portion formed on one surface engaging a concave portion formed on the other surface, and the circumferential length of each separate piece is set such that no two abutting portions are located in a vertical virtual plane slicing along a center line of the cylinder.

**3.** A heat-insulating container according to claim 1 or 2, wherein the cylindrical sidewall portion has a rib protruding radially inwardly, the heat-insulating container further comprising a central bedding with such dimensions as to be locked by the rib.

**4.** A heat-insulating container according to claim 1, 2, or 3, wherein the cylindrical sidewall portion is also divided into two or more stages along the center line.

**5.** A heat-insulating container according to any one of claims 1 to 4, further comprising a bedding which can be accommodated in the cylindrical sidewall portion.

**6.** A heat-insulating container according to any one of claims 1 to 5, wherein the synthetic resin foam is selected from the group consisting of a polystyrene resin, a polypropylene resin, a polyethylene resin, a polyester resin, and a polyurethane resin, and the expansion factor is in the range of from 20 to 100.

**7.** A heat-insulating container according to any one of claims 1 to 6, further comprising a cylindrical container protector for protecting the heat-insulating container against external shocks.

**8.** A heat-insulating container according to any one of claims 1 to 7, wherein the container is used for heat-insulating an enzyme.

FIG.1A

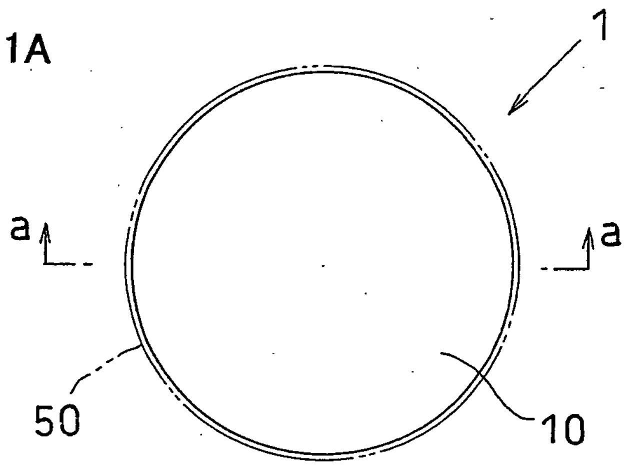



FIG.1B

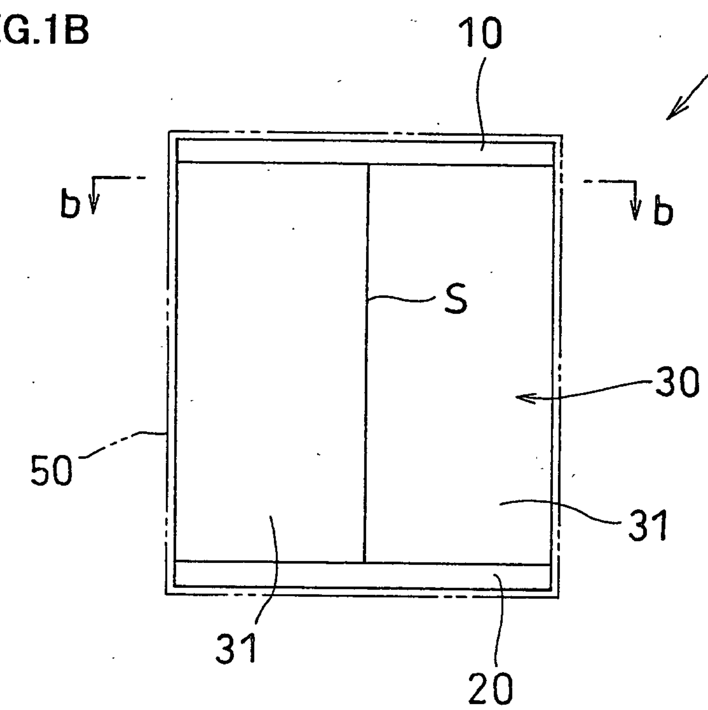


FIG.2A

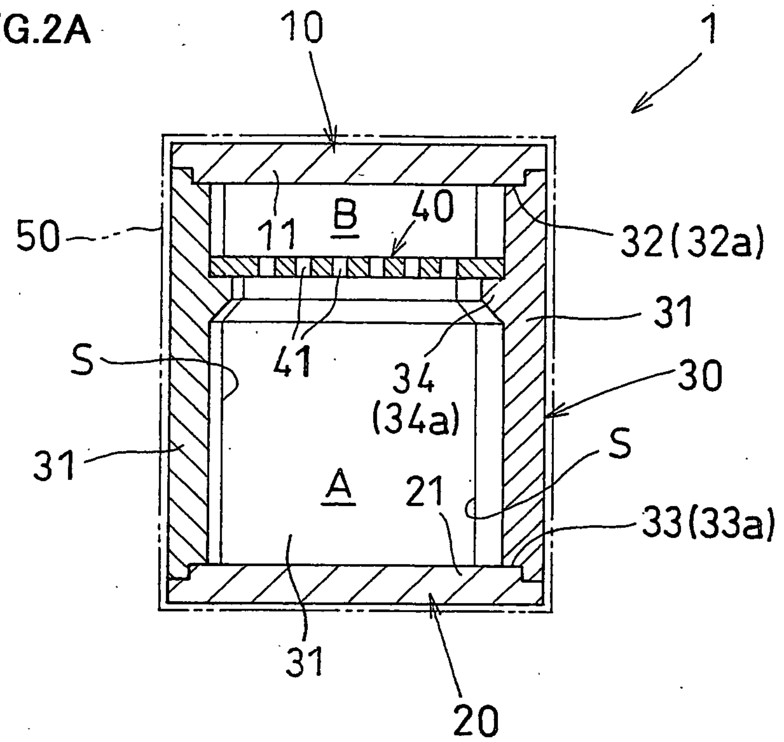
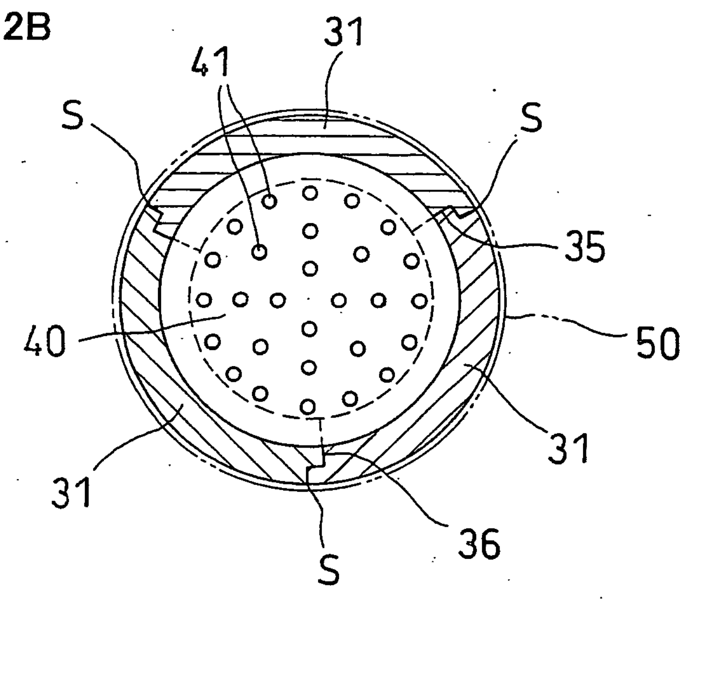

10
1
50
11
B
40
32(32a)
31
41
34
(34a)
S
30
31
A
21
S
33(33a)
31
20

FIG.2B


31
41
S
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35
40
50
31
31
36
S

FIG.3

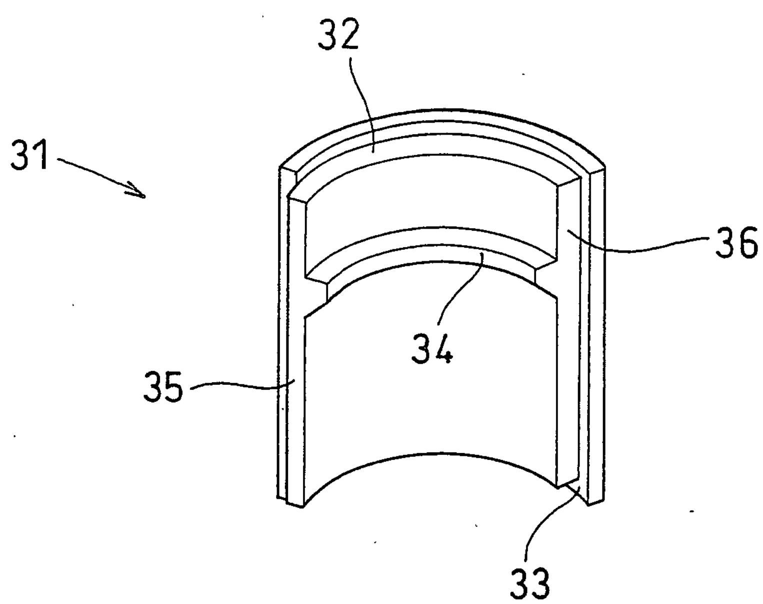



FIG.4A

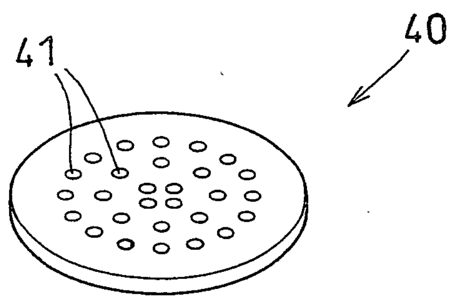



FIG.4B

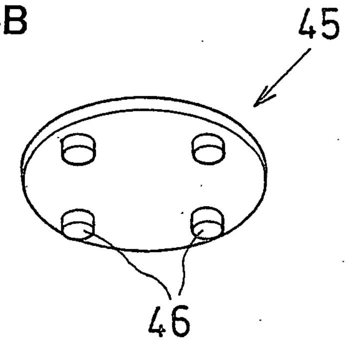


FIG.5A

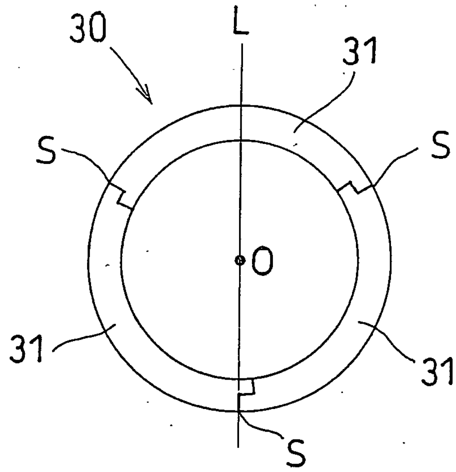



FIG.5B

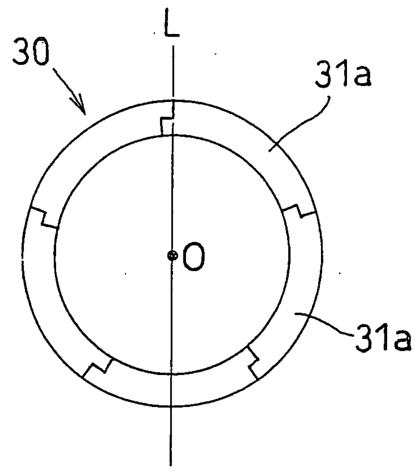



FIG.5C

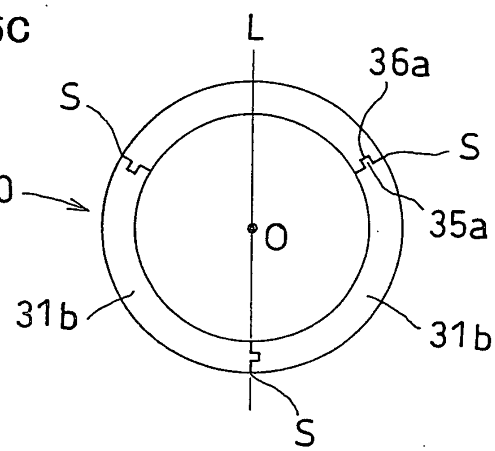



FIG.6A

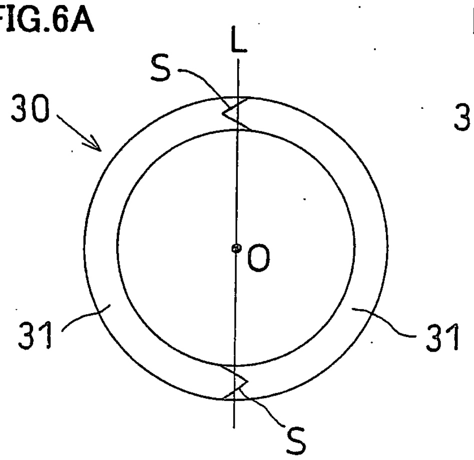



FIG.6B

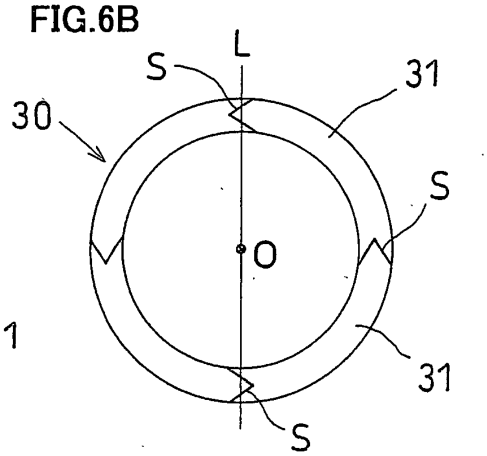


FIG.7

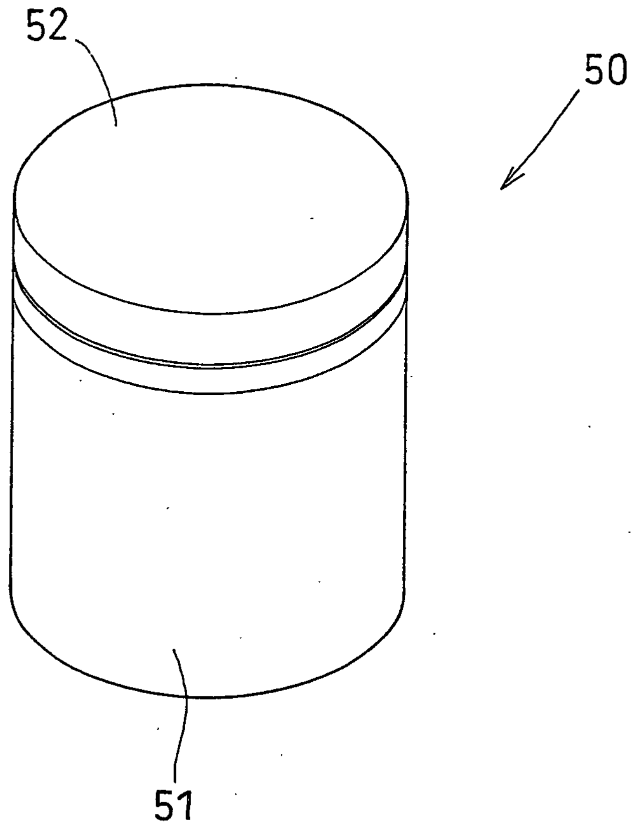


FIG.8A

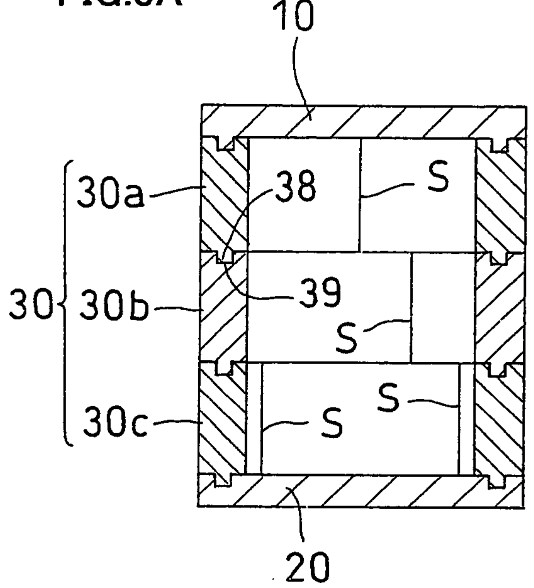



FIG.8B

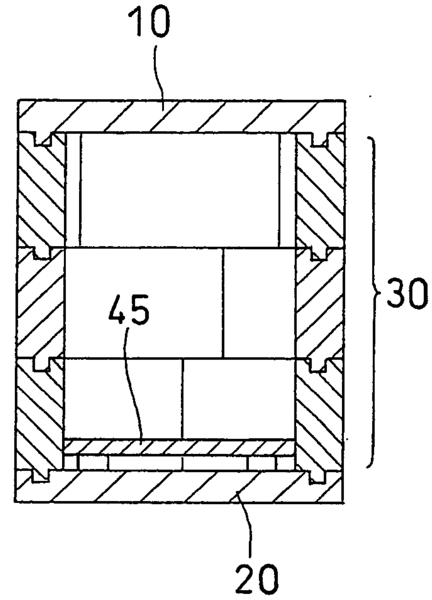



FIG.8C

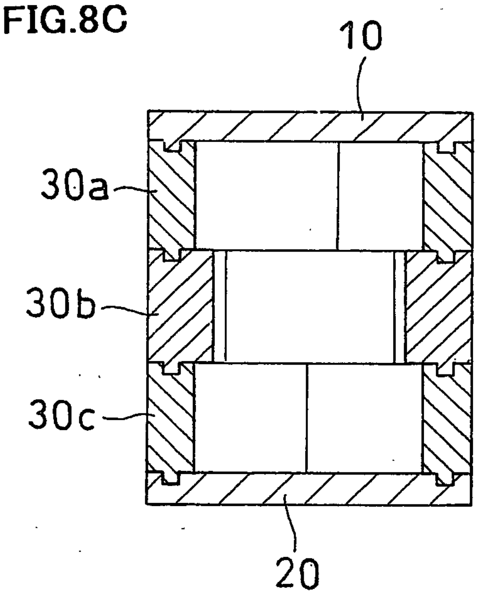



FIG.8D

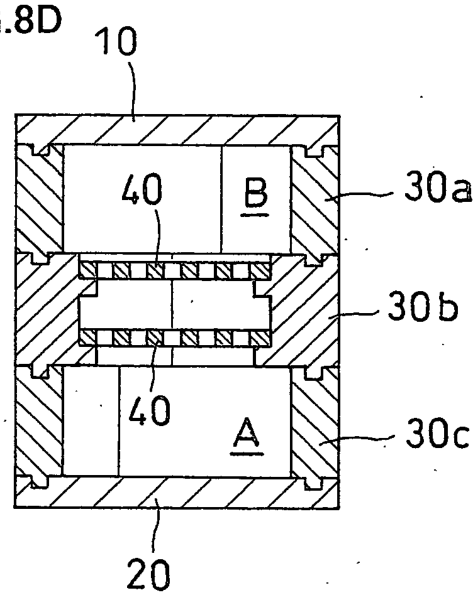
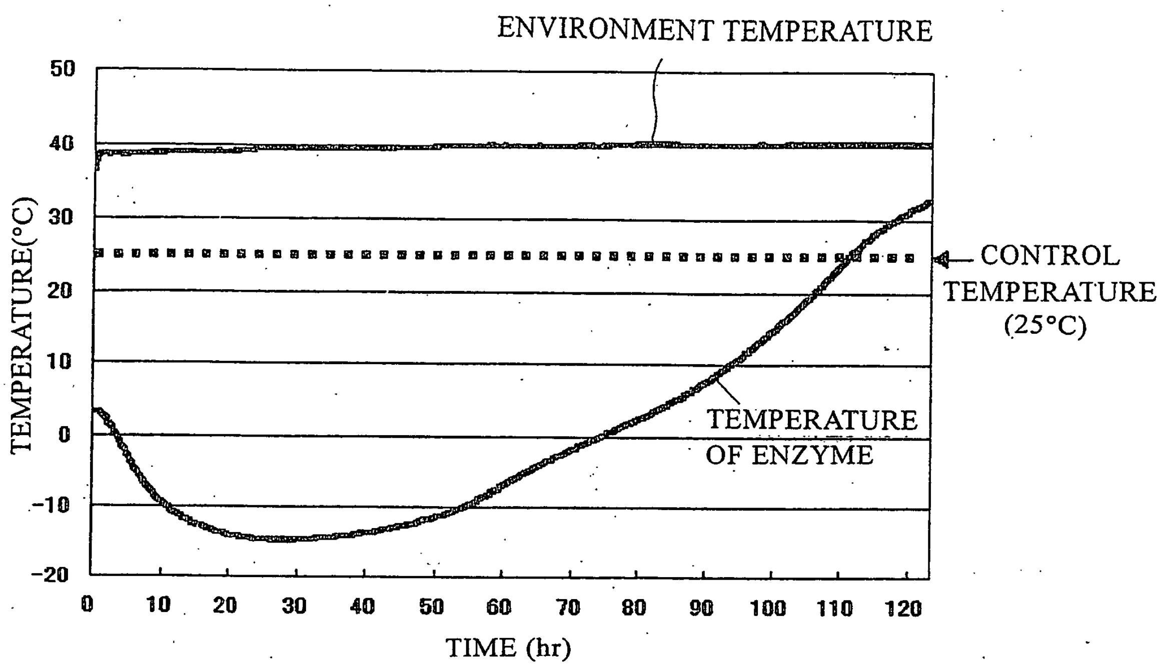


FIG.9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40
30
20
10
0
-10
-20
TEMPERATURE(°C)
CONTROL TEMPERATURE (25°C)
TEMPERATURE OF ENZYME
0
10
20
30
40
50
60
70
80
90
100
110
120
TIME (hr)

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 02 01 9187

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.7) |
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| | | | B65D |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 9 January 2003 | Martens, L |

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09-01-2003

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