

DESCRIPTION

**FRAGILE OBJECT HOLDING DEVICE PROVIDED WITH PROTECTING
MECHANISM**

5

Technical Field

[0001]

The present invention relates to a fragile object holding device provided with a protecting mechanism.

10

Background Art

[0002]

In recent years, new regenerative medicine has developed as a solution for severe heart failure treatment. As an example thereof, a technique of applying a sheet-like cell culture that is produced using a temperature-responsive culture dish, to which tissue engineering is applied, to a heart surface has been attempted in severe myocardial infarction. The technique using the sheet-like cell culture enables safe transplant of a large number of cells in a wide range, and is particularly useful in treatment such as myocardial infarction (chronic heart failure associated with myocardial infarction), dilated cardiomyopathy, ischemic cardiomyopathy, and heart disease (for example, heart

failure, particularly chronic heart failure) associated with contractile dysfunction (for example, left ventricular systolic dysfunction).

[0003]

5 In order to use such a sheet-like cell culture in clinical application, for example, it is necessary to accommodate the produced sheet-like cell culture together with a preservation solution in a container and to transport the container to an intensive care unit where
10 transplant is performed. However, since the sheet-like cell culture has low absolute physical strength and the sheet-like cell culture wrinkles, cracks, and is damaged due to vibration generated when transporting the container, highly sophisticated technology is required in
15 this transporting operation, and it is necessary to take great care.

[0004]

Various methods and containers have been developed to meet such needs. For example, a package for
20 transporting a cultured cell sheet is disclosed in PTL 1 below. As liquid-tightness is caused by exhausting air together with a small amount of a liquid culture medium when sealing with a lid, bubbles do not move in the liquid culture medium during transportation. Thus, such

a package can prevent the shift and breakage of the cultured cell sheet.

[0005]

A preservation transport container for a membrane-
5 like tissue disclosed in PTL 2 below causes a
preservation solution not to ripple or flow by filling a
containing unit with the preservation solution to a
degree that a gas layer is not formed and causing liquid-
tightness, and consequently can prevent damage to the
10 membrane-like tissue without transmitting vibration to
the membrane-like tissue.

Citation List

Patent Literature

15 [0006]

PTL 1: JP-A-2009-89715

PTL 2: JP-A-2012-130311

Summary of Invention

20 Technical Problem

[0007]

As described above, a container for safely transporting a fragile cell sheet has been developed. In addition, research on such a container has been conducted

such that the inside of the container is made liquid-tight and movement of bubbles do not occur.

[0008]

However, highly sophisticated technology is required
5 in order to completely remove bubbles from the inside of
the container and achieve a liquid-tight state. In
addition, since a strong force is necessary to remove a
lid from the container in the liquid-tight state, a
liquid ripples when placing or removing the lid and the
10 cell sheet becomes damaged in some cases.

Solution to Problem

[0009]

The present invention is devised in view of such
15 points, and an object thereof is to provide a device that
can efficiently achieve a liquid-tight state with simple
operation and can prevent ripples of a liquid during
placing and removing operation of a lid.

[0010]

20 That is, the present invention relates to the
following.

[1] A device that includes a container for accommodating
a fragile object, a lid member for sealing the container,
and a protecting member, the device being capable of
25 forming a liquid-tight space by covering a liquid surface

in the container, which accommodates the fragile object and a liquid, with the protecting member and further covering the protecting member and an opening portion of the container with the lid member.

5 [2] The device according to [1], in which the protecting member and/or the lid member are subjected to a water-repellent treatment.

[3] The device according to [1] or [2], in which the protecting member has flexibility.

10 [4] The device according to any one of [1] to [3], in which the protecting member is fluid-impermeable.

[0011]

[5] The device according to any one of [1] to [4], in which the protecting member is able to be sandwiched
15 between the lid member and the container.

[6] The device according to any one of [1] to [5] further including a space that houses a pressed-out liquid.

[7] The device according to any one of [1] to [6], in which the fragile object is a sheet-like cell culture.

20 [8] The device according to [7], in which the sheet-like cell culture is a laminate.

[9] A clip that includes a cover member and a base member which are configured to press and sandwich the device according to any one of [1] to [8] from above and below.

Advantageous Effects of Invention

[0012]

In the device according to the present invention, since a liquid-tight state can be efficiently achieved with a simple mechanism and simple operation, the device is greatly advantageous in terms of operability and production costs. Since the inside of the container can be completely brought into the liquid-tight state, bubbles (gas) do not enter the container. Thus, the bubbles do not move in the container and the fragile object is not damaged due to shaking of the container during transportation. In particular, in a case where the fragile object is a laminate of sheet-like cell cultures, the bubbles do not move and thus the laminate does not shift or break. Therefore, the fragile object can be preserved in the long term while maintaining a shape of the fragile object in the liquid and preventing deformation.

[0013]

In the device according to the present invention, since a liquid-tight state can be easily released, vibration of the container and generation of flow of the liquid, which are caused, for example, by an operator forcibly removing the lid member, can be suppressed, and thus the fragile object is not damaged. In addition,

since operation can be performed without contaminating the surroundings, the device is appropriate to use at a place where cleanliness is strictly controlled, such as a bio-clean room used in producing a sheet-like cell culture and an intensive care unit where a sheet-like cell culture is used.

Brief Description of Drawings

[0014]

10 [Fig. 1] Fig. 1 is a cross-sectional view of a device 1 according to a first embodiment.

[Fig. 2] Fig. 2 is a cross-sectional view of a device 1A according to a second embodiment.

15 [Fig. 3] Fig. 3 is a cross-sectional view of a device 1B according to a third embodiment.

[Fig. 4] Fig. 4 is a perspective view of a clip 7 according to a fourth embodiment.

[Fig. 5] Fig. 5 is a perspective view of a clip 7A according to a fifth embodiment.

20 [Fig. 6] Fig. 6 is a perspective view of a clip 7B according to a sixth embodiment.

Description of Embodiments

[0015]

A fragile object in the present invention refers to an object that has low physical strength and can crack, be damaged, and be deformed due to shaking of a liquid. Examples of a shape of such an object include an object
5 having a thin portion, an object having a band shape, and an object having a sheet shape. Examples of such an object having a sheet shape include, but are not particularly limited to, sheet-like structures, for example, a flat membrane tissue made of a material
10 derived from a living body, such as a sheet-like cell culture, and films made of various materials, such as plastic, paper, a woven fabric, a nonwoven fabric, a metal, a polymer, and a lipid. Among the examples, it is preferable to use a structure which is hardly
15 decomposable in a liquid and a structure which is hardly disintegratable in a liquid. The sheet-like structure may be polygonal or circular, and may or may not be uniform in terms of a width, a thickness, and a diameter. One sheet-like structure of the present invention may be
20 used in a single-layer state, or the sheet-like structure may be used in a state of a laminate, in which two or more sheets overlap each other. In a case of the latter, layers of the laminate may be interlocked with each other, or may not be interlocked with each other. In an
25 interlocked case, all overlapping portions may be

interlocked with each other or may be partially interlocked with each other. In addition, the term "fragile" in the present invention means that, for example, it is difficult or practically impossible to perform evaluation of tensile properties with a tensile tester of the related art (for example, a tensile tester described in JIS K 7161), in which an object is fixed to a gripper outside a liquid, due to fragility thereof. An example of such a fragile object includes an object which has a small value of each of the tensile properties and is difficult to be accurately measured with the tensile tester of the related art. Examples of such a fragile object include objects that exhibit a fracturing load of less than 10 newtons (N), less than 5 N, less than 2 N, less than 1 N, less than 0.5 N, less than 0.1 N, and less than 0.05 N in a tensile test. In addition, since a measurement limit of a tensile test of the related art is generally approximately 1 N as a fracturing load, an object exhibiting a fracturing load that falls short of the measurement limit (for example, less than 0.5 N) is preferable as a fragile object in one form of the present invention.

[0016]

In the present invention, the term "graft" refers to a fragile object derived from a living body that has

relatively low physical strength. The graft includes a cultured cell (for example, a cell culture) and a harvested cell. The graft further includes a product produced by cells. In addition to the cells and/or the cell products, the graft can also include a material (a supplementary material or a support material) for supplementing and/or supporting a predetermined part of a living body (for example, a target lesion). The graft can take various shapes such as a sheet-like shape, a film-like shape, a block-like shape, and a columnar shape. The graft is used in transplant into a living body. Examples of the graft include a three-dimensional cell tissue (an organoid and a spheroid) and a two-dimensional cell tissue (a sheet-like cell culture). In the present invention, the sheet-like cell culture refers to a cell culture in which cells are interlocked with each other to form a sheet-like shape. The cells may be interlocked with each other directly (including going through a cell element such as an adhesion molecule) and/or via a mediator. The mediator is not particularly limited insofar as the mediator is a substance capable of at least physically (mechanically) interlocking cells with each other, and an example thereof includes an extracellular matrix. The mediator is preferably derived from cells, and is particularly derived from cells

configuring the sheet-like cell culture. Although cells are at least physically (mechanically) interlocked with each other, the cells may be functionally, including chemically and electrically, interlocked with each other.

5 The sheet-like cell culture may be configured by one cell layer (a single layer) or configured by two or more cell layers (a multi-layer body). In addition, the sheet-like cell culture may have a three-dimensional structure having a thickness exceeding a thickness of one cell
10 without cells showing a clear layer structure. For example, in a vertical cross-section of the sheet-like cell culture, cells may exist in a non-uniformly (for example, in a mosaic) disposed state instead of being uniformly arranged in a horizontal direction. The sheet-
15 like cell culture may exist as an independently formed single (one-sheet) sheet-like cell culture, or may exist as a laminate that is formed by laminating two or more layers of the independent single (one-sheet) sheet-like cell culture. The laminate may be, for example, a
20 laminate in which two layers (two sheets), three layers (three sheets), four layers (four sheets), five layers (five sheets), or six layers (six sheets) of the sheet-like cell cultures are laminated.

[0017]

The sheet-like cell culture in the present invention is configured by any cells capable of forming the structure. Examples of such cells include, but are not limited to, adherent cells (adhesive cells). Examples of
5 the adherent cells include adherent somatic cells (for example, cardiomyocytes, fibroblasts, epithelial cells, endothelial cells, hepatocytes, pancreatic cells, kidney cells, adrenal cells, periodontal ligament cells, gingival cells, periosteal cells, skin cells, synovial
10 cells, and chondrocytes) and stem cells (for example, myoblasts, tissue stem cells such as cardiac stem cells, pluripotent stem cells such as embryonic stem cells, induced pluripotent stem (iPS) cells, and mesenchymal stem cells). The somatic cells may be cells
15 differentiated from stem cells, particularly iPS cells. Non-limiting examples of cells capable of forming the sheet-like cell culture include myoblasts (for example, skeletal myoblasts), mesenchymal stem cells (for example, cells derived from bone marrow, adipose tissues,
20 peripheral blood, skin, hair roots, muscle tissues, endometrium, placenta, and cord blood), cardiomyocytes, fibroblasts, cardiac stem cells, embryonic stem cells, iPS cells, synovial cells, chondrocytes, epithelial cells (for example, oral mucosal epithelial cells, retinal
25 pigment epithelial cells, and nasal mucosal epithelial

cells), endothelial cells (for example, vascular endothelial cells), hepatocytes (for example, hepatic parenchymal cells), pancreatic cells (for example, pancreatic islet cells), kidney cells, adrenal cells, 5 periodontal ligament cells, gingival cells, periosteal cells, and skin cells. In the present specification, cells forming a single-layer cell culture, such as myoblasts and cardiomyocytes, are preferable, and skeletal myoblasts or iPS cell-derived cardiomyocytes are 10 particularly preferable.

[0018]

The cells can be derived from any organisms that can be treated with a cell culture. Examples of such organisms include, but are not limited to, humans, non- 15 human primates, dogs, cats, pigs, horses, goats, and sheep. In addition, although one type of cells may be used in forming the sheet-like cell culture, two or more types of cells can be used as well. In a preferable form of the present invention, in a case where there are two 20 or more types of cells forming a cell culture, for example, in a case of skeletal myoblasts, the proportion (purity) of the largest number of cells is 65% or more, preferably 70% or more, and more preferably 75% or more at the time of a cell culture production end.

25 [0019]

The sheet-like cell culture in the present invention may be a sheet-like cultured tissue obtained by disseminating and culturing cells in a scaffold (a scaffold at the time of cell culturing), but is
5 preferably formed only of substances derived from cells forming the cell culture and does not include substances other than the substances derived from cells.

The sheet-like cell culture may be produced through any known techniques.

10 [0020]

In one form of the present invention, the sheet-like cell culture is a sheet-like skeletal myoblast culture. Since the sheet-like skeletal myoblast culture is fragile to a point that the sheet-like skeletal myoblast culture
15 fractures due to its own weight when a part thereof is grasped, the sheet-like skeletal myoblast culture cannot be transported alone in the related art and it is extremely difficult to return to an original shape thereof once folded. Therefore, it is significant to
20 maintain a sheet shape in a liquid.

[0021]

In the present invention, a container is not particularly limited insofar as the container can accommodate a fragile object and a liquid and does not
25 leak the liquid, and any container including a

commercially available container can be used. Examples of a material for the container include, but are not limited to, polyethylene, polypropylene, Teflon (registered trademark), polyethylene terephthalate, polymethyl methacrylate, nylon 6,6, polyvinyl alcohol, cellulose, silicon, polystyrene, glass, polyacrylamide, polydimethylacrylamide, and metals (for example, iron, stainless steel, aluminum, copper, and brass). In addition, it is preferable that the container has at least one flat bottom surface for maintaining the shape of the fragile object, and examples thereof include, but are not limited to, a petri dish, a cell culture dish, and a cell culture bottle. Although not particularly limited, the area of the flat bottom surface is typically 1.13 to 78.5 cm², preferably 12.6 to 78.5 cm², and more preferably 9.1 to 60.8 cm².

[0022]

In the present invention, a liquid in the container is configured by at least one type of component, and the component is not particularly limited. For example, the liquid is configured by a liquid such as water, an aqueous solution, a non-aqueous solution, a suspension, and an emulsion.

In the present specification, a solution or a liquid may be a liquid having fluidity as a whole, or may

include solid substances such as cell scaffolds and other non-liquid components such as bubbles.

[0023]

The component configuring the liquid in the container is not particularly limited insofar as an effect on the fragile object is small. In a case where the fragile object is a membrane made of a material derived from a living body, it is preferable that the component configuring the liquid in the container is, from a perspective of biological stability and long-term preservability, a biocompatible component, that is, a component which does not cause undesired effects such as inflammatory reaction, immune reaction, and poisoning reaction or at least has a small effect on a biological tissue or a cell. Examples of the component include water, a physiological salt solution, physiological buffers (for example, HBSS, PBS, EBSS, Hepes, and bicarbonate sodium), culture media (for example, DMEM, MEM, F12, DMEM/F12, DME, RPMI1640, MCDB, L15, SkBM, RITC80-7, and IMDM), sugar solutions (a sucrose solution and Ficoll-paque (registered trademark) PLUS), seawater, a serum-containing solution, a Renografin (registered trademark) solution, a metrizamide solution, a meglumine solution, glycerin, ethylene glycol, ammonia, benzene, toluene, acetone, ethyl alcohol, benzol, an oil, a

mineral oil, animal fat, a vegetable oil, an olive oil, a colloid solution, liquid paraffin, a turpentine oil, a linseed oil, and a castor oil.

[0024]

5 In a case where the fragile object is a sheet-like cell culture, it is preferable that the component configuring the liquid in the container is a component which can stabilize and preserve cells, contains minimum oxygen and nutrients necessary for cell survival, and
10 does not destroy cells due to osmotic pressure. Examples of the component include, but are not limited to, a physiological salt solution, physiological buffers (for example, HBSS, PBS, EBSS, Hepes, and bicarbonate sodium), culture media (for example, DMEM, MEM, F12, DMEM/F12, DME,
15 RPMI1640, MCDB, L15, SkBM, RITC80-7, and IMDM), and sugar solutions (a sucrose solution and Ficoll-paque PLUS (registered trademark)).

[0025]

20 The amount of the liquid in the container has a degree that the fragile object can be maintained in a state where a lid member is attached to the container, and the amount is not particularly limited insofar as a liquid volume formed between a bottom portion of the container and a top of the lid member is approximately at
25 a height that the fragile object does not fluctuate

(shake) in the liquid. That is, when a space is generated between a liquid surface and the lid member, the liquid (liquid surface) shakes, and thereby the fragile object is likely to shake. Thus, it is preferable that the liquid volume is adjusted such that the space is not generated between the liquid surface and the lid member. In one form of the present invention, the sheet-like cell culture has a diameter of approximately 35 to 55 mm and an area of 6 cm² or more. The liquid volume is, for example, 1.0 mm to 20.0 mm regardless of the diameter of the sheet-like cell culture.

[0026]

In the present invention, the lid member is not particularly limited insofar as the container can be sealed. Examples of a material for the lid member include, but are not limited to, polyethylene, polypropylene, Teflon (registered trademark), polyethylene terephthalate, polymethyl methacrylate, nylon 6,6, polyvinyl alcohol, cellulose, silicon, polystyrene, glass, polyacrylamide, polydimethylacrylamide, and metals (for example, iron, stainless steel, aluminum, copper, and brass).

[0027]

In the present invention, shapes of the lid member and the container are not particularly limited insofar as

the lid member and the container can be engaged with each other and a sealed space can be formed due to such engagement.

For example, in a case where the container is a general-
5 purpose petri dish, it is preferable that the shape of the lid member is circular. In addition, a state of the fragile object accommodated in the container and the presence or absence of bubbles in the liquid may be checked by making the lid member and/or the container of
10 a light-transmitting material.

[0028]

In the present invention, the fragile object is held in the liquid in the container where the liquid is accommodated. Although a position of the fragile object
15 in the liquid is not particularly limited, the fragile object is disposed at a position in which the lid member and the fragile object do not come into contact with each other (or may come into contact with each other) in a state where the lid member is attached to the container
20 to form the sealed space. Preferably, in the liquid of the container, the fragile object is disposed above a bottom of the container or near the bottom.

[0029]

In the present invention, a "water-repellent
25 treatment" refers to treating a solid surface such that a

contact angle, which is an angle formed between a liquid surface and a solid surface, is 90° or more at a boundary line where the solid surface and the liquid are in contact with each other. For example, on a water-repellent solid surface which is subjected to a Teflon (registered trademark) treatment, the contact angle is close to 180° and liquid droplets become almost spherical. Therefore, even when the liquid is interposed between individual surfaces which are subjected to the water-repellent treatment, the individual surfaces do not stick to each other. An example of a water-repellent treatment method includes a coating method of adhering a resin, such as Teflon (registered trademark), silicon, a fluorine-based water repellent, a waxy resin, an alumina soap, pyridinium salt, and ceratin, to the solid surface. In addition, a method of executing an unevenness treatment on the solid surface without using a coating agent, such as forming unevenness on the solid surface through a laser treatment just as a super-water-repellent treatment, may be adopted.

[0030]

[First Embodiment]

One aspect of the present invention relates to a device including a container for accommodating a fragile object, a lid member for sealing the container, and a

protecting member, the device being capable of forming a liquid-tight space by covering a liquid surface in the container which accommodates the fragile object and a liquid with the protecting member and further covering
5 the protecting member and an opening portion of the container with the lid member.

[0031]

Hereinafter, suitable embodiments of the present invention will be described in detail with reference to
10 the drawings.

First, a second embodiment of the present invention will be described.

Fig. 1 is a cross-sectional view of a device 1 according to the third embodiment of the present
15 invention. Fig. 2 is a cross-sectional view of a device 1A according to a first modification example of the first embodiment. Fig. 3 is a cross-sectional view of a device 1B according to a second modification example of the first embodiment. Note that in each of the drawings in
20 the present application, for ease of description, the size of each of members is enlarged as appropriate, and each of the illustrated members is not shown in the actual size.

[0032]

As illustrated in Fig. 1 (A), the device 1 according to the first embodiment of the present invention includes a container 2, a lid member 3 for sealing the container 2, and a protecting member 4. The container 2 has a shape of a general-purpose petri dish having a rim portion 21 that surrounds an opening portion and configures an accommodation space that can accommodate a fragile object S. The lid member 3 includes a top plate portion 32, a tubular skirt wall 36 hanging down from a rim of the top plate portion 32, and a female screw portion 35 provided on an inner peripheral surface of the tubular skirt wall 36. The female screw portion 35 is screwed with a male screw portion 25 provided on an outer peripheral surface of the container 2, and can cause the lid member 3 to be screwed with the container 2. A diameter of the protecting member 4 is larger than a diameter of the rim portion 21 of the container 2. The protecting member 4 is a fluid-impermeable plate-like member that can cover the opening portion of the container 2. The protecting member 4 and the lid member 3 are subjected to the water-repellent treatment.

[0033]

As illustrated in Figs. 1A and 1B, when using the device 1, the container 2 accommodates a liquid L and the fragile object S. At this time, by further adding the

liquid L in a state where the container 2 is full with the liquid L, a convex surface is formed on a liquid surface due to surface tension of the liquid L (Fig. 1 (A)). Next, the protecting member 4 in an inclined state is placed on the liquid surface, and comes into close contact with the rim portion 21 while pressing and leveling the convex surface. Since the container 2 is sealed with the protecting member 4 as described above, in a case where there are bubbles in the liquid surface, the inclined protecting member 4 applies a buoyant force to bubbles, and thereby the bubbles can be reliably pressed out. Then, by covering the protecting member 4 and the container 2 with the lid member 3, the protecting member 4 is sandwiched between the container and the lid member, and thereby a liquid-tight state in the container 2 is formed. In addition, even in a case where a gas has entered between the lid member 3 and the protecting member 4 at this time, the fluid-impermeable protecting member 4 blocks the gas. Thus, bubbles do not enter the container 2 and the fragile object S is not damaged.

[0034]

When using the fragile object S, the lid member 3 is removed from the container 2. At this time, since the protecting member 4 and the lid member 3 are subjected to the water-repellent treatment, the protecting member 4

does not stick to the lid member 3. Therefore, even when the lid member 3 is removed from the container 2, the protecting member 4 can keep a liquid-tight state in the container 2. Next, as the protecting member 4 is removed by sliding in a horizontal direction and releasing the liquid-tight state, the protecting member 4 can be easily removed from the container 2. That is, in a case where there is no protecting member 4 between the lid member 3 and the container 2, the lid member 3 and the liquid surface come into direct and close contact with each other, and the lid member 3 pulls the liquid due to surface tension when removing the lid member 3. At the same time, when removing the lid member 3 from the container 2 in the liquid-tight state, a sudden force is applied to the lid member 3. Thus, the liquid surface ripples and the fragile object becomes damaged in some cases. On the contrary, since such a problem can be prevented by protecting the liquid surface with the protecting member 4, the protecting member 4 functions as a protecting mechanism that protects the liquid surface. Dimensional errors of the device 1 in a vertical direction and the horizontal direction may be absorbed by having an elastic seal member (for example, a packing) interposed between the container 2, the lid member 3, and the protecting member 4.

[0035]

In the device 1 according to the first embodiment of the invention of the present application, since a liquid-tight state can be efficiently achieved with a simple mechanism and simple operation, the device is greatly advantageous in terms of operability and production costs. Since the inside of the container can be completely brought into the liquid-tight state, bubbles (gas) do not enter the container. Thus, the bubbles do not move in the container and the fragile object is not damaged due to shaking of the container during transportation. In particular, in a case where the fragile object is a laminate of sheet-like cell cultures, the bubbles do not move and thus the laminate does not shift or break. Therefore, the fragile object can be preserved in the long term while maintaining a shape of the fragile object in the liquid and preventing deformation.

[0036]

In addition, in the device 1 according to the first embodiment of the invention of the present application, since a liquid-tight state can be easily released, vibration of the container and generation of flow of the liquid, which are caused, for example, by an operator forcibly removing the lid member, can be suppressed, and thus the fragile object is not damaged.

[0037]

Next, a second embodiment of the present invention will be described. Hereinafter, differences from the first embodiment will be described in detail, and description of the same points will be omitted. Note that in each of the drawings in the present application, for ease of description, the size of each of members is enlarged as appropriate, and each of the illustrated members is not shown in the actual size.

10 [0038]

As illustrated in Fig. 2 (A), the device 1A according to the second embodiment of the present invention includes a container 2A, a lid member 3A for sealing the container 2A, and a protecting member 4A. 15 The container 2A has a shape of a general-purpose petri dish having the rim portion 21 that surrounds the opening portion, and has a tubular wall 26 that protrudes upward from a bottom portion. An accommodation space that can accommodate the fragile object S is formed inside the 20 tubular wall 26 of the container 2A. A height of the tubular wall 26 is the same as a height of the rim portion 21 of the container 2A. When the lid member 3A is attached to the container 2A, the lid member can come into close contact with both of the rim portion 21 of the 25 container 2A and a rim portion of the tubular wall 26. A

diameter of the protecting member 4A is smaller than a diameter of the rim portion 21 of the container 2A, and is larger than a diameter of a rim portion of a tubular wall 26. In the embodiment, the protecting member 4A has a film shape having flexibility, and an inner surface of the lid member 3A is subjected to the water-repellent treatment.

[0039]

As illustrated in Figs. 2A and 2B, when using the device 1A, the liquid L and the fragile object S are accommodated inside the tubular wall 26 of the container 2A. At this time, by further adding the liquid L in a state where the accommodation space is full with the liquid L, a convex surface is formed on a liquid surface due to surface tension of the liquid L (Fig. 2 (A)). Next, the protecting member 4A is placed on the liquid surface, and comes into close contact with the rim portion 21 while pressing and leveling the convex surface. Since the protecting member 4A has a film shape and can be slowly placed on the liquid surface, the liquid does not ripple. In addition, since a convex portion of the liquid L pressed out by the protecting member 4A is received by a space G outside the tubular wall 26 of the container 2A, the surroundings are not contaminated and the liquid L does not enter between the protecting member

4A and the lid member 3A. Therefore, when removing the lid member 3A, the protecting member 4A does not stick to the inside of the lid member 3A. Since the protecting member 4A can be sandwiched between the lid member 3A and the container 2A with a strong force by screwing the lid member 3A with the container 2A, liquid-tightness in the accommodation space can be maintained, and simultaneously the liquid L in the space G does not leak to the outside.

[0040]

10 When using the fragile object S, the lid member 3A is removed from the container 2A. Since unevenness is formed in a plurality of places on the inner surface of the lid member 3A at this time, the protecting member 4A does not stick to the inside of the lid member 3A.

15 Therefore, even when the lid member 3A is removed from the container 2A, the protecting member 4A can keep a liquid-tight state in the container 2A. Next, as the protecting member 4A is peeled off from the liquid surface so as to be wound up, a contact area with the

20 liquid surface gradually decreases. Thus, ripples in the liquid surface can be suppressed to a minimum. That is, in a case where the inner surface of the lid member 3A and the liquid surface are in contact with each other, the lid member 3A is pulled to the liquid surface when

25 removing, and a repulsive force is generated at a moment

when the lid member 3A comes off, thereby generating vibration in the liquid surface. On the other hand, in a case where the protecting member 4A is interposed between the container and the lid member, the vibration is not transmitted to the fragile object S since the protecting member 4A protects the liquid surface. Dimensional errors of the device 1A in the vertical direction and the horizontal direction may be absorbed by having an elastic seal member (for example, a packing) interposed between the container 2A, the lid member 3A, and the protecting member 4A.

[0041]

In the device 1A according to the second embodiment of the invention of the present application, since a liquid-tight state can be efficiently achieved with a simple mechanism and simple operation, the device is greatly advantageous in terms of operability and production costs. Since the inside of the container can be completely brought into the liquid-tight state, bubbles (gas) do not enter the container. Thus, the bubbles do not move in the container and the fragile object is not damaged due to shaking of the container during transportation. In particular, in a case where the fragile object is a laminate of sheet-like cell cultures, the bubbles do not move and thus the laminate

does not shift or break. Therefore, the fragile object can be preserved in the long term while maintaining a shape of the fragile object in the liquid and preventing deformation.

5 [0042]

In addition, in the device 1A according to the second embodiment of the invention of the present application, since a liquid-tight state can be easily released, vibration of the container and generation of
10 flow of the liquid, which are caused, for example, by an operator forcibly removing the lid member, can be suppressed, and thus the fragile object is not damaged.

[0043]

Next, a third embodiment of the present invention
15 will be described. Hereinafter, differences from the first embodiment and the second embodiment will be described in detail, and description of the same points will be omitted. Note that in each of the drawings in the present application, for ease of description, the
20 size of each of members is enlarged as appropriate, and each of the illustrated members is not shown in the actual size.

[0044]

As illustrated in Fig. 3 (A), the device 1B
25 according to the third embodiment of the present

invention includes a container 2B, a lid member 3B for sealing the container 2B, and a protecting member 4B. The container 2B is a bottomed tubular container including an upper portion 22 and a lower portion 23, and
5 the lower portion 23 configures a space that can accommodate the fragile object S. An inner diameter of the upper portion 22 is larger than an inner diameter of the lower portion 23, and a stepped portion 24 is provided at a boundary between the upper portion 22 and
10 the lower portion 23. The lid member 3B has a projection portion 31 that protrudes downward from the top plate portion 32. In the embodiment, the protecting member 4B is sandwiched between the projection portion 31 and the stepped portion 24, and a packing R for improving
15 adhesion is provided between the protecting member 4B and the stepped portion 24. The protecting member 4B has a plurality of small holes provided therein, and can cause the liquid L to permeate therethrough. In addition, a packing R' having a U-shaped cross-sectional shape is
20 provided between the rim portion 21 of the container 2B and the lid member 3B, and thus dimensional errors of the device 1B in the vertical direction and the horizontal direction can be absorbed.

[0045]

As illustrated in Figs. 3A and 3B, when using the device 1B, the container 2B accommodates the liquid L and the fragile object S. At this time, the liquid L fills up to a height exceeding the stepped portion 24, and the protecting member 4B is placed on the stepped portion 24 while inclining the protecting member. Next, the protecting member 4B is sandwiched between the projection portion 31 and the stepped portion 24 of the container 2B by screwing the lid member 3B with the container 2B. Then, as the projection portion 31 presses the protecting unit 4B, the packing R interposed between the protecting unit 4B and the stepped portion 24 is pressed flat, thereby improving a liquid-tight state formed in the lower portion 23 of the container 2B. The liquid L pressed out by the projection portion 31 is housed in the space G between the upper portion 22 of the container 2B and the projection portion 31. When using the fragile object S, the lid member 3B is removed from the container 2B. Since surface tension is not generated between the protecting member 4B and the lid member 3B as the plurality of small holes are provided in the protecting member 4B, the protecting member 4B does not stick to the inside of the lid member 3B. In addition, when the lid member 3B is removed, spaces of the lower portion 23 and the upper portion 22 of the container 2B communicate with

each other via the plurality of small holes in the protecting member 4B, that is, a liquid-tight state is released. Thus, the protecting member 4B is easily removed, and thus the fragile object can be taken out.

5 [0046]

In the device 1B according to the third embodiment of the invention of the present application, since a liquid-tight state can be efficiently achieved with a simple mechanism and simple operation, the device is
10 greatly advantageous in terms of operability and production costs. Since the inside of the container can be completely brought into the liquid-tight state, bubbles (gas) do not enter the container. Thus, the bubbles do not move in the container and the fragile
15 object is not damaged due to shaking of the container during transportation. In particular, in a case where the fragile object is a laminate of sheet-like cell cultures, the bubbles do not move and thus the laminate does not shift or break. Therefore, the fragile object
20 can be preserved in the long term while maintaining a shape of the fragile object in the liquid and preventing deformation.

[0047]

In addition, in the device 1B according to the third
25 embodiment of the invention of the present application,

since a liquid-tight state can be easily released, vibration of the container and generation of flow of the liquid, which are caused, for example, by an operator forcibly removing the lid member, can be suppressed, and
5 thus the fragile object is not damaged.

[0048]

Although the illustrated embodiments of the present invention have been described hereinbefore, the present invention is not limited thereto. The lid members 3, 3A,
10 and 3B, the containers 2, 2A, and 2B, and the protecting members 4, 4A, and 4B according to the first to third embodiments can be freely combined with each other.

In the present invention, each configuration can be replaced with any configuration that can fulfill the same
15 function, or any configuration can be added.

[0049]

The use of the fragile object, in which the device of the present invention is used, can be performed, for example, through the following steps in turn.

20 (1) Accommodate the liquid and the fragile object in the container.

(2) Protect the liquid surface in the container with the protecting member.

(3) Cover the container with the lid member to form
25 a liquid-tight state.

(4) Transport the device.

(5) Remove the lid member to release the liquid-tight state.

(6) Remove the protecting member.

5 (7) Take out and use the fragile object.

[0050]

Hereinafter, an embodiment of a clip suitable for pressing and sandwiching the device (the container and the lid member) of the present invention will be
10 described in detail with reference to the drawings.

Fig. 4 is a perspective view of a clip 7 according to a fourth embodiment of the present invention. Fig. 5 is a perspective view of a clip 7A according to a fifth embodiment of the present invention. Fig. 6 is a
15 perspective view of a clip 7B according to a sixth embodiment of the present invention. Note that in each of the drawings in the present application, for ease of description, the size of each of members is enlarged as appropriate, and each of the illustrated members is not
20 shown in the actual size.

[0051]

[Fourth Embodiment]

The clip 7 can press and sandwich the device including the container (not illustrated) and the lid member (not

illustrated) for sealing the container such that the device is put therein from above and below.

[0052]

Both of the base member 8 and the cover member 9 have a circular shape, and can appropriately press the device from above and below. The base member 8 includes an opening portion 81, a bottom portion 82, a screwing portion (engagement portion) 83, a placement portion 84, and a ridge portion 85. Engagement means screwing in the embodiment. The placement portion 84 has a placement surface, on which the container can be placed, as an upper surface, and the opening portion 81 is provided in a center portion thereof. The placement portion 84 has the annular ridge portion 85 (elongated ridge) that surrounds a lower end of the container and can define a position where the container is provided with respect to the base member 8, when the container is placed on the placement surface. The placement portion 84 has a disk shape that protrudes upward from the bottom portion 82, and the screwing portion 83 is provided on a side peripheral surface thereof. The bottom portion 82 has an outer diameter larger than an outer diameter of the placement portion 84, and serves a role of a bottom portion when providing the base member 8 on a table.

[0053]

The cover member 9 includes an opening portion 91, a top portion 92, a screwing portion (engagement portion) 93, a tubular skirt wall 94, and a grip portion 95. The top portion 92 has a cover surface that can cover an upper surface of the lid member, and the opening portion 91 is provided in a center portion thereof. The top portion 92 includes the tubular skirt wall 94 hanging down from a rim of the top portion 92, and the device can be sandwiched by being surrounded with the top portion 92, the tubular skirt wall 94, and the placement portion 84. The screwing portion 93 (not illustrated) is provided on an inner peripheral surface of a lower end portion of the tubular skirt wall 94, and the cover member 9 can be screwed with the base member 8 by screwing such a screwing portion 93 with the screwing portion 83 of the base member 8. Optionally, a position where the lid member is provided with respect to the clip 7 can also be defined by matching an inner diameter of at least a part of the tubular skirt wall 94 (for example, an inner peripheral surface of an upper end portion of the tubular skirt wall 94) with an outer diameter of the lid member.

[0054]

When using the clip 7, the container where the accommodation object S is accommodated is covered with the lid member. At this time, optionally, by covering

the container with the lid member in a state where the container is full with the liquid L, a liquid-tight space can also be formed. In addition, optionally, by having the seal member (not illustrated) interposed at a suitable position between the container and the lid member, sealability can also be improved. Next, the container is provided on the base member 8. At this time, the container can be positioned at the center of the placement portion 84 using the ridge portion 85. In addition, since the screwing portion 83 of the base member 8 is provided below the placement portion 84, that is, the screwing portion 83 is not a structure that surrounds a side surface of the container, vibration can be suppressed by sliding the container in a lateral direction, when providing/removing the container to/from the placement portion 84. Next, the cover member 9 is attached to the base member 8. At this time, the lid member can also be positioned at the center of the cover member 9 (and the base member 8) using the tubular skirt wall 94.

[0055]

As described above, the clip 7 can define relative positions of the container and the lid member using the ridge portion 85 of the base member 8 and the tubular skirt wall 94 of the cover member 9. When the device is

sandwiched between the base member and the cover member, the screwing portion 83 of the base member 8 and the screwing portion 93 of the cover member 9 are screwed with each other. At this time, by performing screwing operation by gripping the grip portion 95 provided on an outer peripheral surface of the tubular skirt wall 94 as a protruding portion (may be a groove portion), the container and the lid member can be fastened to each other from above and below with a strong force. This is appropriate for, for example, the use in a case where the container is a container that does not have a screwing portion such as a general-purpose petri dish, and has high versatility. In the devices 1, 1A, and 1B of Embodiments 1 to 3, a configuration where the female screw portion 35 and the male screw portion 25 are omitted and the lid member does not rotate (is not screwed) with respect to the container may be adopted. In this case, since torque of the lid member does not reach the protecting member interposed between the container and the lid member, the configuration is particularly advantageous. Then, in particular, in a case where the elastic seal member is interposed, the configuration is advantageous since the seal member is accurately compressed between the container and the lid member of which relative positions are accurately

determined, and thus sealability improves. A problem that the device is destroyed can be prevented since it is sufficient that the cover member 9 is screwed by a height of the screwing portion 83 of the base member 8, sandwiching operation is easy, and a sandwiching pressure can be easily adjusted.

[0056]

Since both of the base member 8 and the cover member 9 have the opening portion 81 and the opening portion 91, respectively, at the center portions, a position where the device is fixed and a state of the liquid L and the accommodation object S accommodated in the device can be observed at all times. This is particularly advantageous in a case where the container and the lid member are made of a light-transmitting material. This is advantageous even when the fragile object is an object having low visibility such as a sheet-like cell culture since light can be emitted from one opening portion and the sheet-like cell culture can be viewed from the other opening portion. In addition, in a case of forming a liquid-tight space as described above, the lid member can be pressed against the container while checking if bubbles or foreign substances are mixed in the container via the opening portion 91.

Next, the device is transported. Since the device is firmly sandwiched in the clip 7, a problem that the lid member comes off the container due to shaking during transportation can be prevented. Since the surroundings
5 are surrounded by the clip 7, the device is protected from outside shock. Finally, the clip 7 is removed from the device at a destination and is used.

[0057]

Although the illustrated embodiments of the present
10 invention have been described, the present invention is not limited thereto. For example, the screwing portion 83 and the screwing portion 93 can be replaced with other engagement means that has a function of pressing the device from above and below, such as slide engagement
15 (for example, refer to JP-A-2006-315757), flange fitting (for example, refer to JP-A-2006-001582), and ridge engagement (for example, refer to JP-A-2016-203985). The annular ridge portion 85 can be replaced with other means that can position the container on the placement surface,
20 such as a plurality of annularly disposed protrusions. As the accommodation object S, for example, the fragile object (for example, a laminate of sheet-like cell cultures) can also be accommodated. In this case, by making the inside of the container liquid-tight, the

fragile object can be transported while maintaining the shape of the fragile object.

[0058]

[Fifth Embodiment]

5 Next, the fifth embodiment of the present invention will be described. Hereinafter, differences from the fourth embodiment will be described in detail, and description of the same points will be omitted. Note that in each of the drawings in the present application,
10 for ease of description, the size of each of members is enlarged as appropriate, and each of the illustrated members is not shown in the actual size.

[0059]

As illustrated in Fig. 5, the clip 7A according to
15 the embodiment includes a base member 8A and a cover member 9A. In the embodiment, the base member 8A further includes protruding walls 86, a groove portion 87, and a notch portion 88. The plurality of protruding walls 86 are walls that are provided outside the ridge portion 85
20 and protrude to exceed a height of the container from the placement portion 84. The groove portion 87 is provided in a lower surface of the bottom portion 82 of the base member 8A. Thus, the base member 8A can be prevented from sticking to an operation surface when providing the
25 base member 8A on a table.

[0060]

When using the clip 7A, the container (not illustrated) is positioned at the center of the base member 8A using the ridge portion 85. Next, the lid member can be positioned at the center of the base member 8A by causing the lid member to follow the protruding walls 86 when covering the container with the lid member (not illustrated). That is, an operator can define relative positions of the container and the lid member using the ridge portion 85 and the protruding walls 86 of the base member 8A. This is particularly advantageous in that the seal member can be accurately pressed in a case where the annular seal member is interposed between the container and the lid member.

15 [0061]

Next, the device (not illustrated) is sandwiched. At this time, screwing operation can be easily performed by gripping the grip portion 95 configured as the protruding portion that radially protrudes from the cover member 9A and the notch portion 88 provided in a side surface of the bottom portion 82 of the base member 8A. When using the device, screwing of the cover member 9A is released to remove the device from the base member 8A. At this time, it is easy to grasp the device since the device is exposed from a gap between the plurality of

20

25

protruding walls 86. In addition, since the plurality of protruding walls 86 are disposed to surround the container, the lid member can be accurately positioned with respect to the container.

5 [0062]

[Sixth Embodiment]

Next, the sixth embodiment of the present invention will be described. Hereinafter, differences from the fourth embodiment and the fifth embodiment will be described in detail, and description of the same points will be omitted. Note that in each of the drawings in the present application, for ease of description, the size of each of members is enlarged as appropriate, and each of the illustrated members is not shown in the
10
15 actual size.

[0063]

As illustrated in Fig. 6, the clip 7B according to the embodiment includes a cover member (not illustrated) and a base member 8B. The base member 8B includes a
20 placement portion 84B, a ridge portion 85B, and protruding walls 86B (description of other configurations will be omitted). The ridge portion 85B is semiannularly disposed on the placement portion 84B. The protruding walls 86B are semiannularly disposed outside the ridge
25 portion 85B, and a notch (gap) C is provided in a part

thereof (the two or more protruding walls 86B may be semiannularly disposed with a gap provided). That is, in the embodiment, one side half of a placement surface of the placement portion 84B (an opposite side half to the ridge portion 85B and the protruding walls 86B) is configured as a flat surface.

[0064]

When using the clip 7B, the container (not illustrated) is provided to slide from an opposite side to the ridge portion 85B and the protruding walls 86B in the lateral direction (a direction of the ridge portion 85B and the protruding walls 86B). At this time, by causing the container to slide on a flat surface of the placement portion 84B, unintended vibration of the container can be suppressed. Next, the lid member (not illustrated) is attached to the container. At this time, by pressing the lid member against the protruding walls 86B of the base member 8B, the lid member can be accurately positioned with respect to the container.

When using the device (not illustrated), the device is removed from the base member 8B. At this time, by pushing a side surface of the device (the container and/or the lid member) exposed from the notch C, the device is caused to slide on the flat surface and can be removed. A projection portion 89, which is a mark, may

be provided on a side facing the notch C on the placement portion 84B such that a sliding direction is easily noticed when sliding the device 1 on the base member 8B. Accordingly, the device 1 can be accurately positioned on
5 the placement portion 84B simply by sliding the device 1 between the projection portion 89 and the notch C. In addition, the device 1 can also be made not shifted by adopting a configuration where the projection portion 89 is disposed on an extension line of the ridge portion 85B
10 to face the notch C and the side surface of the device 1 is locked by the projection portion 89.

[0065]

In the clip according to the fourth to sixth embodiments of the invention of the present application,
15 since the container and a lid member can be efficiently brought into close contact with each other with a simple mechanism and simple operation, the device is greatly advantageous in terms of operability and production costs. In addition, since the accommodation object in the
20 container can be viewed from the outside, a state of the accommodation object and mixing of foreign substances can be easily checked. Further, since a relative positional relationship between the container and the lid member can be accurately adjusted, sealability improves. In
25 particular, since the seal member can be accurately

pressed in a case where the elastic seal member is interposed between the container and the lid member, sealablilty improves further.

[0066]

5 In addition, in the clip of the present invention, since the container and the lid member can be fixed by reliably bringing into close contact with each other, a problem that the lid member comes off the container during transportation can be prevented. In particular,
10 in a case where the accommodation object is a laminate of sheet-like cell cultures, it is possible to transport the device with the inside of the container reliably brought into a liquid-tight state, the laminate can be prevented from shifting or breaking as bubbles enter and move in
15 the container, and the laminate can be preserved in the long term while maintaining a shape thereof and preventing deformation.

[0067]

Without the present invention being limited to the
20 embodiments, those skilled in the art can realize clips that have different configurations and shapes by suitably combining each of configurations of the clips according to Embodiments 4 to 6 and a shape thereof. For example, the cover member 9 or the cover member 9A may be combined
25 with the base member 8, the base member 8A, or the base

member 8B. The ridge portion 85, the ridge portion 85B, the protruding wall 86, or the protruding wall 86B may be combined with the base member 8, the base member 8A, or the base member 8B.

5 In the present invention, each configuration can be replaced with any configuration that can fulfill the same function, or any configuration can be added.

Reference Signs List

10 [0068]

1, 1A, 1B device

2, 2A, 2B container

21 rim portion

22 upper portion

15 23 lower portion

24 stepped portion

25 male screw portion

3, 3A, 3B lid member

31 projection portion

20 32 top plate portion

35 female screw portion

36 tubular skirt wall

 [0069]

6 seal member

25 7, 7A, 7B clip

- 8, 8A, 8B base member
- 81 opening portion
- 82 bottom portion
- 83 engagement portion
- 5 84 placement portion
- 85, 85B ridge portion
- 86, 86B protruding wall
- 87 groove portion
- 88 notch portion
- 10 89 projection portion
- [0070]
- 9, 9A cover member
- 91 opening portion
- 92 top portion
- 15 93 engagement portion
- 94 tubular skirt wall
- 95 grip portion

CLAIMS

[Claim 1]

A device comprising:

- 5 a container for accommodating a fragile object;
 a lid member for sealing the container; and
 a protecting member,

 the device being capable of forming a liquid-tight
space by covering a liquid surface in the container,
10 which accommodates the fragile object and a liquid, with
 the protecting member and further covering the protecting
member and an opening portion of the container with the
lid member

[Claim 2]

- 15 The device according to Claim 1,
 wherein the protecting member and/or the lid member
are subjected to a water-repellent treatment

[Claim 3]

- The device according to Claim 1 or 2,
20 wherein the protecting member has flexibility

[Claim 4]

 The device according to any one of Claims 1 to 3,
 wherein the protecting member is fluid-impermeable

[Claim 5]

- 25 The device according to any one of Claims 1 to 4,

wherein the protecting member is able to be sandwiched between the lid member and the container

[Claim 6]

The device according to any one of Claims 1 to 5,
5 further comprising:

a space that houses a pressed-out liquid

[Claim 7]

The device according to any one of Claims 1 to 6,
wherein the fragile object is a sheet-like cell
10 culture

[Claim 8]

The device according to Claim 7,
wherein the sheet-like cell culture is a laminate

[Claim 9]

15 A clip comprising:

a cover member and a base member which are configured to press and sandwich the device according to any one of Claims 1 to 8 from above and below.