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(54) **DEVICES AND METHODS FOR THAWING BIOLOGICAL MATERIAL**

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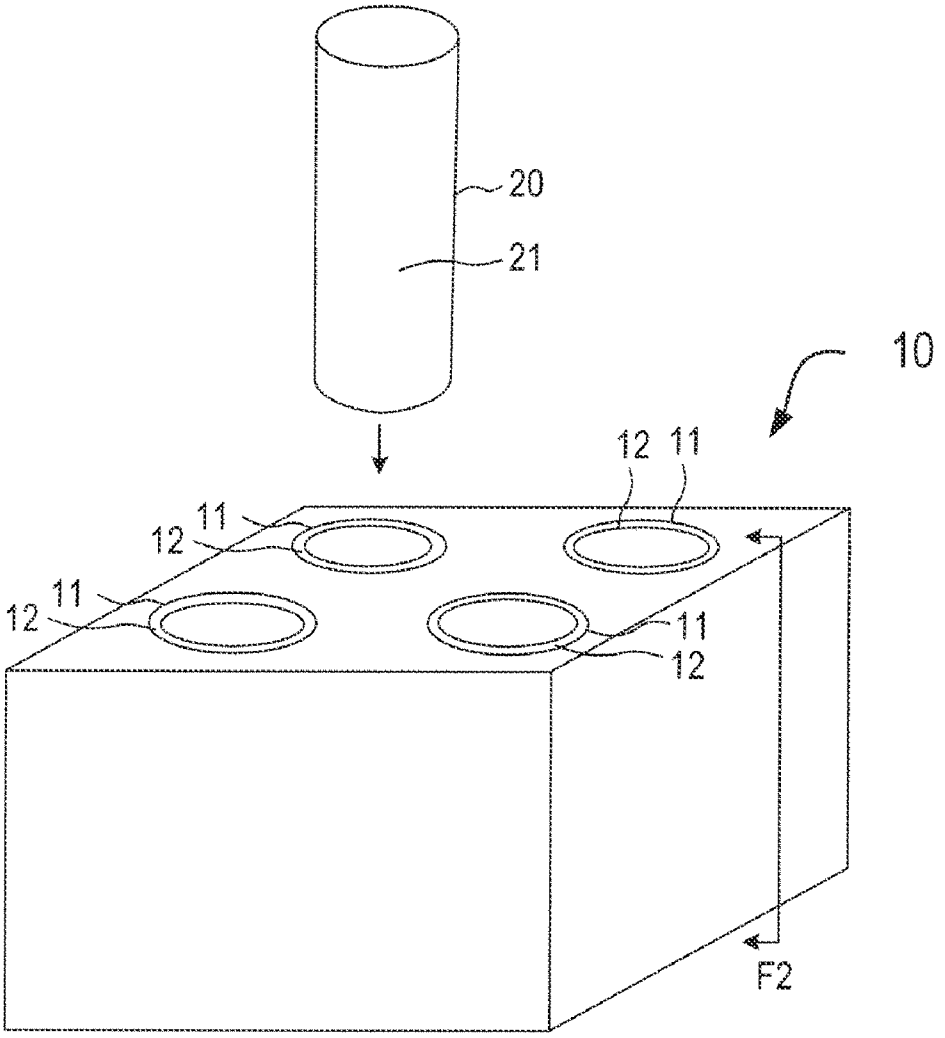
CPC ***B65D 81/18*** (2013.01); ***B65D 25/04*** (2013.01); ***F24J 1/00*** (2013.01)

USPC **126/263.02**; 220/500; 432/207

(57) **ABSTRACT**

Provided herein are devices and methods for thawing frozen biological material.



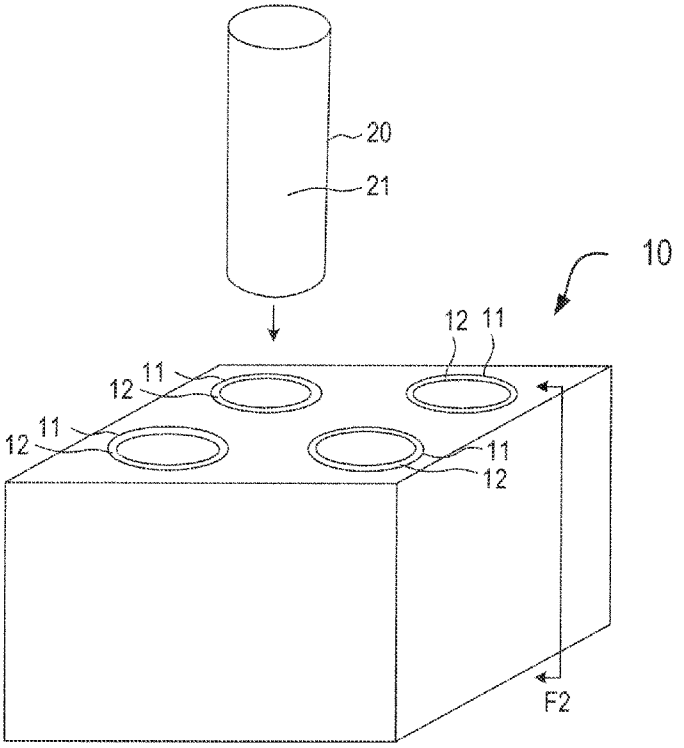


FIG. 1

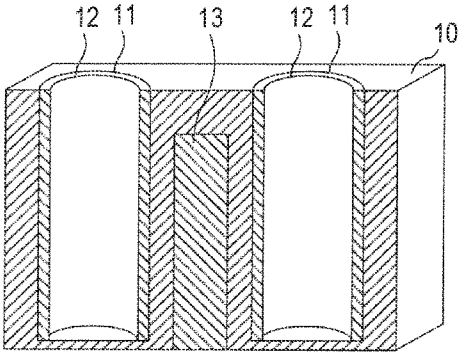


FIG. 2

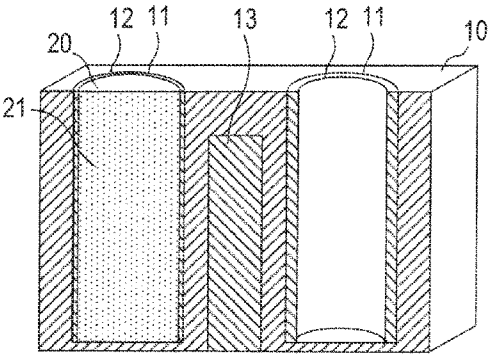


FIG. 3

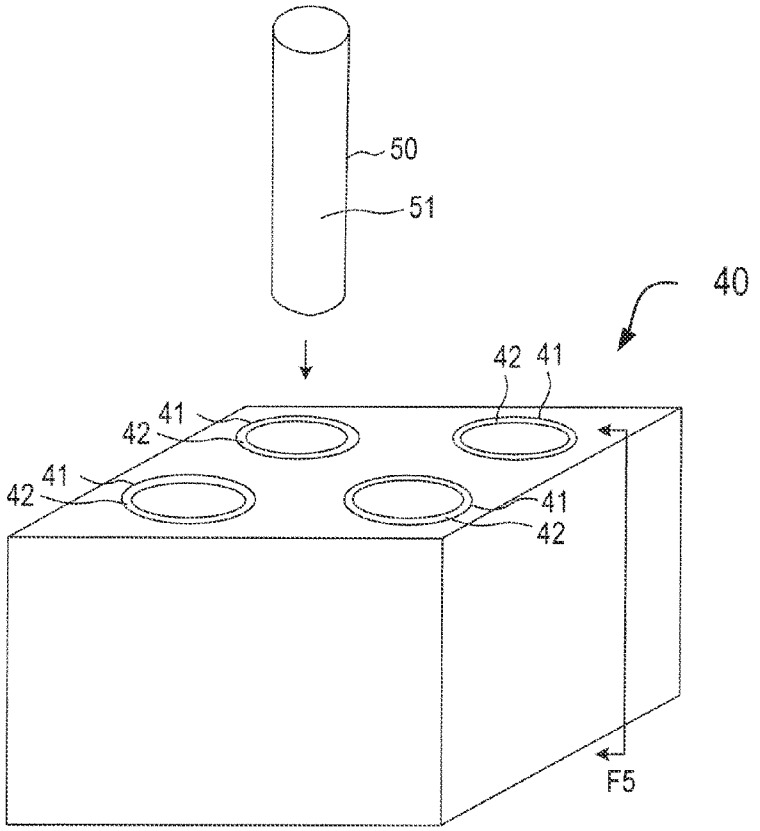


FIG. 4

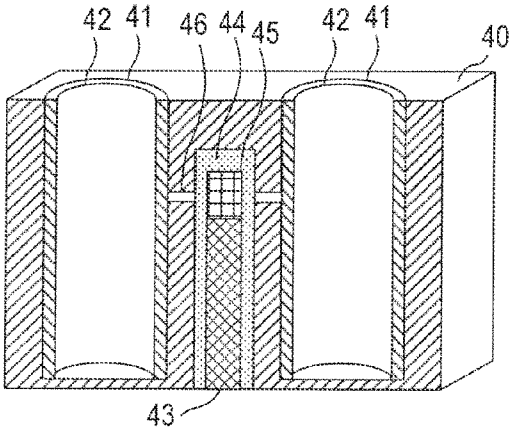


FIG. 5

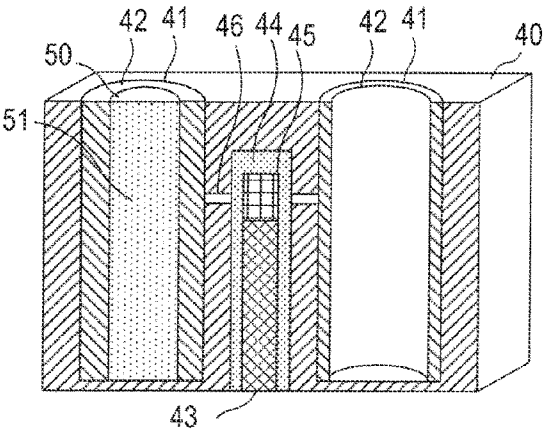


FIG. 6

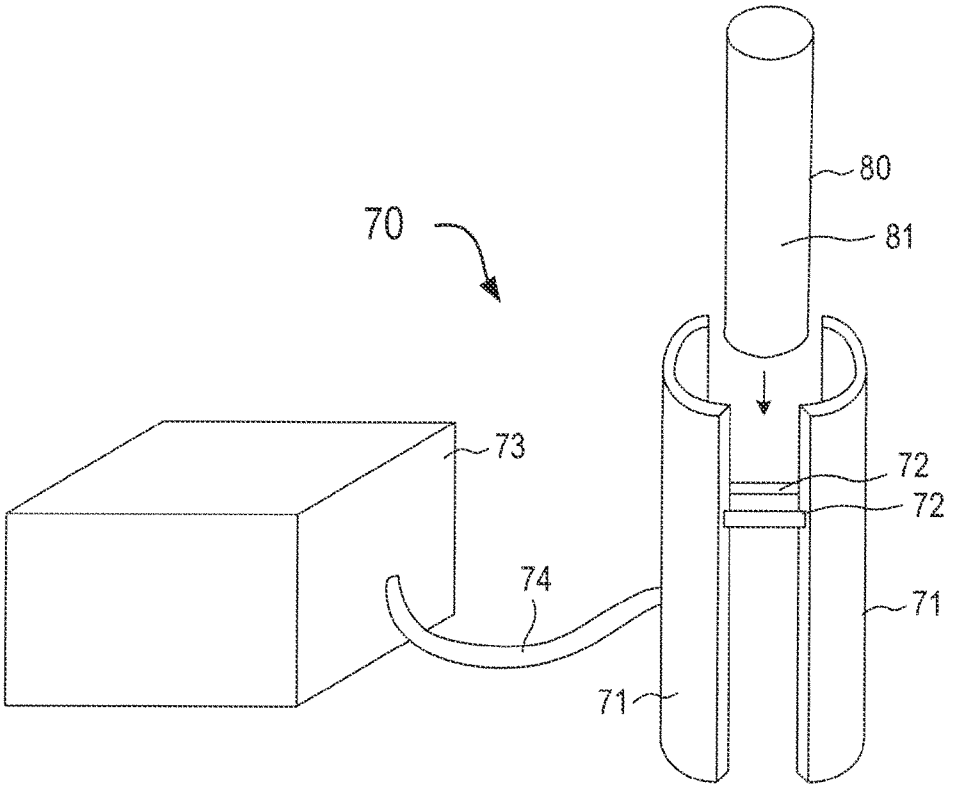


FIG. 7

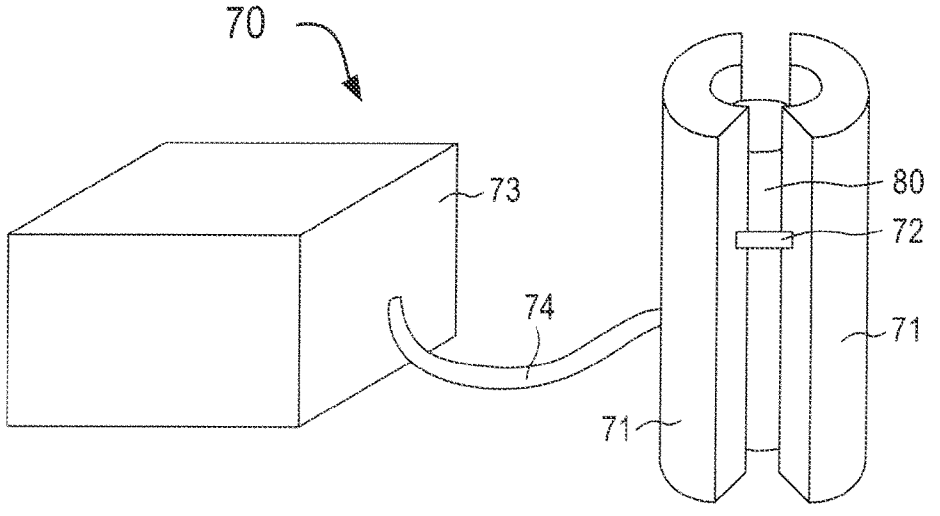


FIG. 8

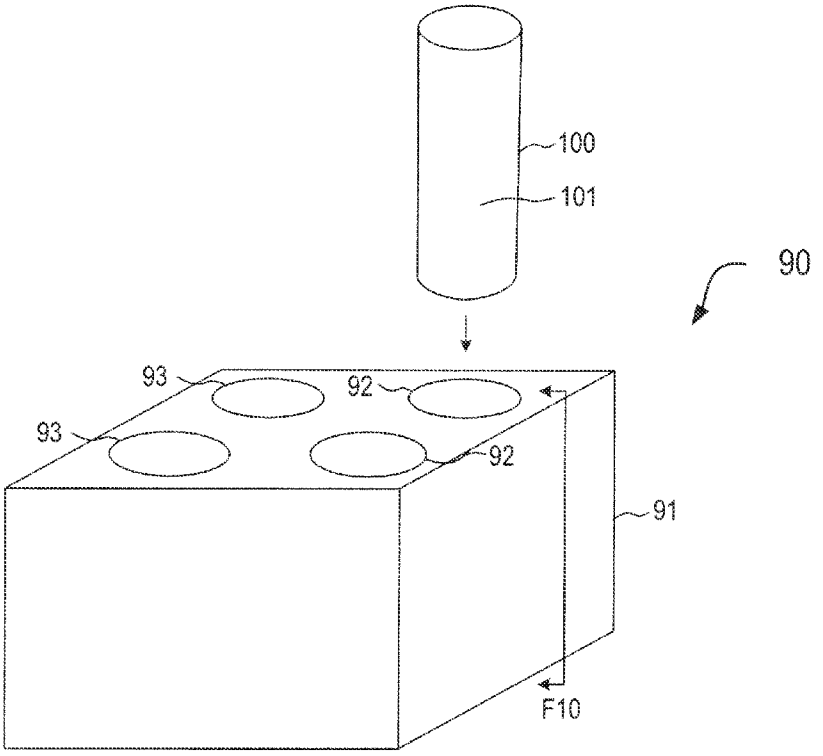


FIG. 9

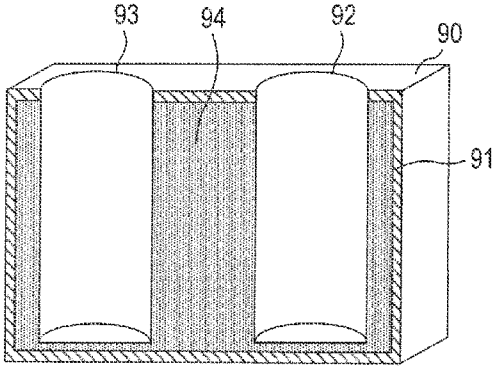


FIG. 10

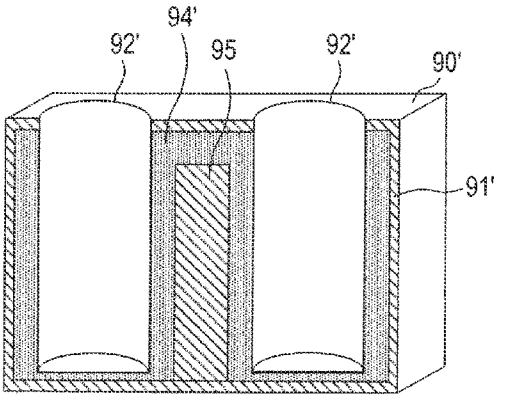


FIG. 11

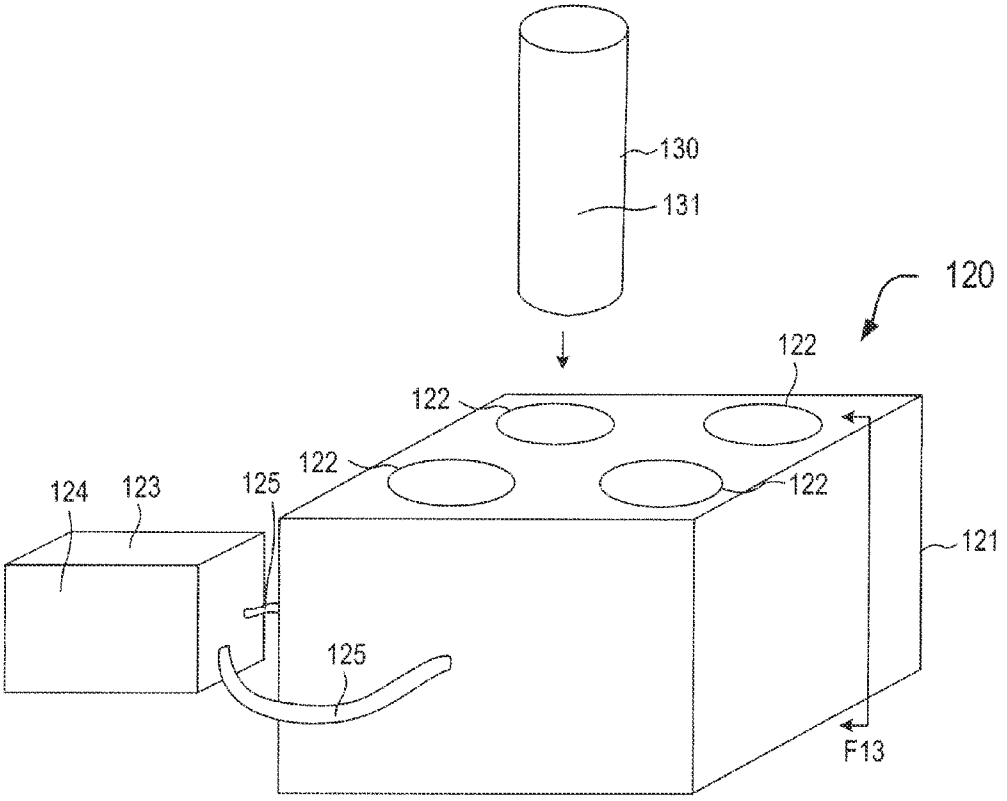

130
131
120
122
122
122
122
124
123
125
121
125
F13

FIG. 12

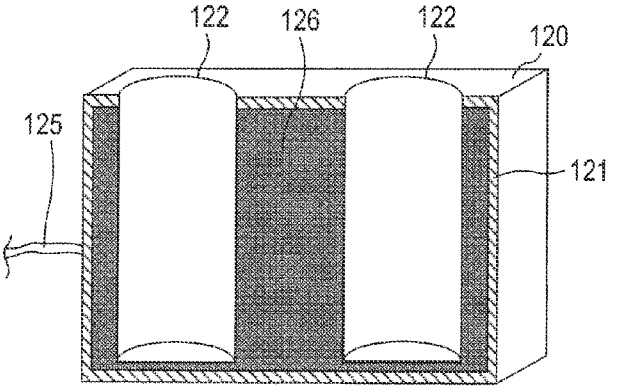

122
126
122
120
125
121

FIG. 13

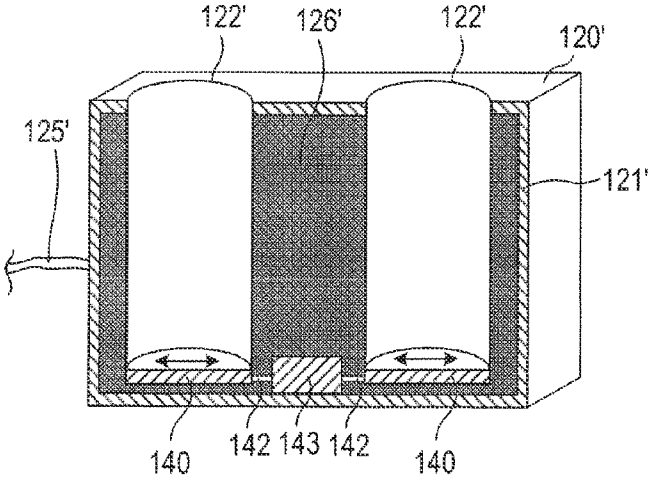

122'
126'
122'
120'
125'
121'
140
142
143
142
140

FIG. 14

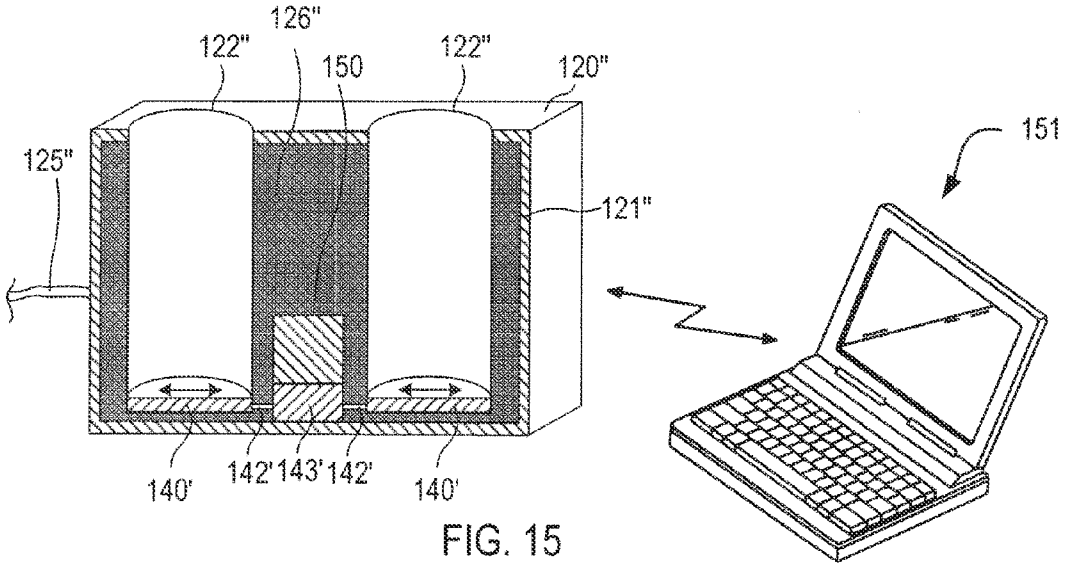

126"
122"
150
122"
120"
125"
121"
151
140'
142'
143'
142'
140'

FIG. 15

DEVICES AND METHODS FOR THAWING BIOLOGICAL MATERIAL

1. INTRODUCTION

[0001] Provided herein are devices and methods for thawing frozen biological material.

2. BACKGROUND

[0002] Frozen biological material (e.g., cells) is regularly used in both laboratory and clinical settings. However, upon thawing such biological material, it is often difficult to obtain consistent results (e.g., in terms of cell viability, etc.) due to varying and non-ideal conditions under which the biological material is thawed. Therefore, there remains a need for devices which can safely and rapidly thaw biological material in a mariner that maintains the optimal condition of the biological material.

[0003] 3. SUMMARY

[0004] Provided herein are improved devices for thawing frozen biological material (e.g., cells). The devices described herein are designed to ensure that the container (e.g., a tube, vial, or bag) which holds the frozen biological material to be thawed is consistently and thoroughly in contact with the source of heat and thus promotes rapid thawing of the biological material. The devices described herein comprise controllable temperature settings, so that they may be utilized at any thawing temperature desired by the individual using the device (e.g., 1° C., 2° C., 3° C., 4° C., 5° C., 6° C., 7° C., 8° C., 9° C., 10° C., 11° C. 12° C. 13° C., 14° C., 15° C., 16° C., 17"C, 18° C., 19° C., 20° C., 21° C., 22° C., 23° C., 24° C., 25° C., 26° C., 27° C. 28° C., 29° C., 30° C., 31° C. 32° C., 33° C., 34° C., 35° C., 36° C., 37° C., 38° C., 39° C., 40° C., 41° C., 42° C., 43° C., 44° C., 45° C., 46° C., 47° C., 48° C. 49° C., 50° C., etc.), and also so that the temperature can be increased or decreased during the thawing process (e.g., the temperature can be increased or decreased in 1, 2, 3, 4, 5 or more degree intervals by, e.g., pressing a button). In certain embodiments, the devices described herein additionally comprise one or more components that enable agitation (e.g., gentle shaking or rotation) of the biological material to be thawed during the thawing process.

[0005] In one embodiment, provided herein is an improved thawing apparatus, wherein said apparatus comprises one or more compartments into which a container comprising frozen biological material may be thawed, wherein said one or more compartments comprise compressible material (e.g., compressible gasket material). Such thawing apparatuses are advantageous in that they can accommodate biological material containers (e.g., tubes or vials) of varying sizes, and also ensure that the containers (e.g., tubes or vials) that contain the biological material to be thawed are thoroughly in contact with the heat source. In certain embodiments, the improved thawing apparatuses comprising compressible material described herein are similar in design to dry block thawing apparatuses known in the art, but possess the advantage of comprising compressible material.

[0006] In another embodiment, provided herein is an improved thawing apparatus, wherein said apparatus comprises one or more compartments into which a container comprising frozen biological material may be thawed, wherein said one or more compartments comprises a cuff which can be placed around containers (e.g., tubes or vials) of varying size and manipulated so that it comes into thorough contact with the container. Such cuffs can be filled with a heated substance (e.g., heated fluid), the levels of which can be adjusted (e.g., filled with more or less fluid) to ensure accommodation of containers of varying size and to ensure that thorough contact between the container and the heating source. Alternatively, such cuffs may comprise a heated material which can be expanded by the application of pressure (e.g., air pressure; fluid pressure, e.g., oil pressure, water pressure, or the like) to ensure accommodation of containers of varying size and to ensure that thorough contact between the container and the heating source. In certain embodiments, the improved thawing apparatuses comprising cuffs described herein are similar in design to dry block thawing apparatuses known in the art, but possess the advantage of comprising cuffs, the size of which can be modified/adjusted.

[0007] In another embodiment, provided herein is an improved thawing apparatus, wherein said apparatus comprises (i) a sealed compartment comprising material that undergoes a phase change when heated to a certain temperature (e.g., paraffin or beeswax), (ii) a compartment into which a source of heat (e.g., boiling water) can be added, and (iii) at least one compartment into which a container (e.g., tube or vial) containing biological material can be placed. The improved thawing apparatus functions as follows: (i) the phase change of the phase change material is effected by addition of a heat source to the appropriate compartment of the apparatus, e.g., by adding boiling water to the compartment of the apparatus; (ii) once the phase change material has reached its melting point, the container(s) (e.g., tube or vial) containing the biological material to be thawed is then placed into the appropriate compartment of the apparatus; and (iii) as the frozen material cools the phase change material, the phase change material will remain at is melting point, which is suitable to result in the thawing of the biological material.

[0008] In another embodiment, provided herein is an improved thawing apparatus, wherein said apparatus comprises (i) a sealed compartment comprising a chemical material (e.g., iron) that heats to a certain temperature following exposure to a given condition (e.g., exposure to oxygen) and (ii) at least one compartment into which a container (e.g., tube or vial) containing biological material can be placed. The improved thawing apparatus functions as follows: (i) the apparatus is heated by exposing the chemical material to a given condition (e.g., oxygen); and (ii) once the apparatus is at its desired temperature, the container(s) (e.g., tube or vial) containing the biological material to be thawed is then placed into the appropriate compartment of the apparatus; resulting in the thawing of the biological material.

4. BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a perspective view of an exemplary thawing apparatus of the present invention having compressible material disposed in the compartments.

[0010] FIGS. **2** and **3** are perspective sectional views of the thawing apparatus of FIG. **1** taken along the view line F**2**, wherein the apparatus illustrated in FIG. **3** has a container inserted in a compartment.

[0011] FIG. **4** is a perspective view of an exemplary thawing apparatus of the present invention having cuffs disposed in the compartments.

[0012] FIGS. **5** and **6** are perspective sectional views of the thawing apparatus of FIG. **4**, taken along the view line F**5**, wherein the apparatus illustrated in FIG. **6** has a container inserted in a compartment.

[0013] FIGS. **7** and **8** are perspective views of an exemplary thawing apparatus of the present invention having cuffs, wherein the container is disposed outside the cuffs in a contracted or deflated condition in FIG. **7** and the container is disposed inside the cuffs in an expanded or inflated condition in FIG. **8**.

[0014] FIG. **9** is a perspective view of an exemplary thawing apparatus of the present invention having a phase change material.

[0015] FIG. **10** is a perspective sectional view of the thawing apparatus of FIG. **9** taken along the view line F**10**.

[0016] FIG. **11** is a perspective sectional view of alternative thawing apparatus taken along the view line F**10**.

[0017] FIG. **12** is a perspective view of an exemplary thawing apparatus of the present invention having a chemical material.

[0018] FIG. **13** is a perspective sectional view of the thawing apparatus of FIG. **12** taken along the view line F**13**.

[0019] FIG. **14** is a perspective sectional view of an alternative thawing apparatus taken along the view line F**13** and having controllable mechanisms.

[0020] FIG. **15** is a perspective sectional view of an alternative thawing apparatus taken along the view tine F**13** and having controllable mechanisms and a controller operatively coupled to an external computer.

5. DETAILED DESCRIPTION

[0021] Provided herein are improved devices for thawing frozen biological material (e.g., cells). The devices described herein are designed to ensure that the container (e.g., tube or vial) which holds the frozen biological material to be thawed is consistently and thoroughly in contact with the source of heat and thus promotes rapid thawing of the biological material. The devices described herein comprise controllable temperature settings, so that they may be utilized at any thawing temperature desired by the individual using the device (e.g., 23° C., 37° C., 50° C., 100° C., etc.), and also so that the temperature can be increased or decreased during the thawing process (e.g., the temperature can be increased or decreased in 1, 2, 3, 4, 5 or more degree intervals by, e.g., pressing a button). In certain embodiments, the devices described herein additionally comprise one or more components that enable agitation (e.g., gentle shaking or rotation) of the biological material to be thawed during the thawing process.

5.1 Improved Thawing Apparatuses

[0022] Dry block thawing apparatuses currently known in the art are problematic in that the compartments into which the biological material containers are placed are static, i.e., they are generally made of solid metal and are thus not able to accommodate containers (e.g., tubes or vials) of varying sizes. This design leads to various problems, including containers e.g., tubes or vials) becoming stuck in the compartments into which they are placed (due to the tubes being too large for the compartment) or containers (e.g., tubes or vials) loosely fitting into the compartments they are placed (due to the tubes being too small for the compartment). Moreover, dry block thawing apparatuses currently known in the art do not promote ideal contact of the biological material containers with the source of heat, and this issue is worsened in cases where the containers loosely fit in the compartments of the dry block thawing apparatus.

[0023] Water bath thawing apparatuses currently known in the art also are problematic for various reasons. First, water bath thawing apparatuses typically require that the container that contains the biological material to be thawed is often not exposed to an ideal amount of the heat source, similar to the situation with known dry block thawing apparatuses. Further, water bath thawing apparatuses known in the art are very likely to become contaminated, thus introducing the risk that the biological material to be thawed also will become contaminated.

[0024] The improved thawing apparatuses described herein overcome the issues that occur with known dry block thawing apparatuses and water bath thawing apparatuses, as well as other thawing apparatuses known in the art by, without limitation: (i) promoting significantly greater amount of contact between the container (e.g., tube or vial) that contains the biological material than that which occurs with thawing apparatuses currently known in the art; and (ii) being able to accommodate containers of various sizes.

[0025] Referring to FIGS. **1** to **3**, an exemplary thawing apparatus having compressible material, e.g., compressible material with a high heat transfer coefficient or high heat conduction, is provided in accordance with the principles of the present invention. Thawing apparatus **10** includes a plurality of compartments **11** having compressible material **12** disposed therein, and heating element **13**. Each compartment **11** may be configured to receive container **20** comprising frozen biological material **21**. Compressible material **12** (e.g., compressible gasket material) is configured to line compartment **11** as illustrated in FIGS. **1** and **2** and to compress when container **20** is inserted in compartment **11** as illustrated in FIG. **3**. Heating element **13** may be a conventional heating element and is configured to heat thawing apparatus **10** to a temperature suitable to thaw frozen biological material **21** disposed in container **20**. Thawing apparatus **10** may advantageously accommodate one or more biological material containers (e.g., tubes or vials) of varying sizes, and also ensure that the containers (e.g., tubes or vials) having the biological material to be thawed are thoroughly in contact with the heat from apparatus **10**. In certain embodiments, the improved thawing apparatuses comprising compressible material described herein are similar in design to dry block thawing apparatuses known in the art, but possess the advantage of comprising compressible material. In certain embodiments, the compressible material is a known compressible gasket material. In a specific embodiment, the compressible material is silicone, rubber, or sponge (or a combination thereof).

[0026] Referring now to FIGS. **4** to **6**, an alternative exemplary thawing apparatus having cuffs is provided in accordance with the principles of the present invention. Thawing apparatus **40** includes a plurality of compartments **41** each having cuff **42** disposed therein, heating element **43**, pump fluid **44**, pump **45**, and channels **46**. Each compartment **41** may be configured to receive container **50** comprising frozen biological material **51**. Cuff **42** is configured to line compartment **41** as illustrated in FIGS. **4** and **5** and to expand when container **50** is inserted in compartment **41** as illustrated in FIG. **6** by pumping pump fluid **44** using pump **45** into cuff **42** through respective channel **46**. Heating element **43** may be a conventional heating element disposed in or near pump fluid **44** and is configured to heat pump fluid **44** to a temperature suitable to thaw frozen biological material **51** disposed in container **50**. Alternatively, heating element **43** may be disposed outside of pump fluid **44** and configured to heat appa-

ratus **40** to thaw frozen biological material **51**. Pump **45** may be a conventional pump and is configured to pump pump fluid **44** to and from a respective cuff **42** using a respective channel **46** to cause the cuff to expand or contract. As will be apparent to one of ordinary skill in the art, pump **45** and/or channels **46** may include one or more valves suitable for controlling flow of pump fluid **44** to or from cuffs **42**. Containers (e.g., tubes or vials) of varying size may be placed in compartments **41** and cuffs **42** may be manipulated to come into contact with the container. In one embodiment, such cuffs may comprise a heated material which may be expanded by the application of pressure (e.g., air pressure; fluid pressure, e.g., oil pressure, water pressure, or the like) to ensure accommodation of containers of varying size and to ensure that thorough contact between the container and the heating source. In certain embodiments, the improved thawing apparatuses comprising cuffs described herein are similar in design to dry block heating/warming apparatuses known in the art, but possess the advantage of comprising cuffs, the size of which can be modified/adjusted.

[0027] Referring now to FIGS. **7** to **8**, another alternative exemplary thawing apparatus having cuffs is provided in accordance with the principles of the present invention. Thawing apparatus **70** includes at least one cuff **71**, connectors **72**, fluid source pump **73**, and at least one tube **74**. Cuff **71** is configured to receive container **80** comprising frozen biological material **81**. As will be apparent to one of ordinary skill in the art, more than one cuff **71** may he used as illustrated and connected via connectors **72** or one cuff shaped and sized to receive container **80** may be used. Fluid source pump **73** is configured to store fluid and may include a conventional heating element for heating the fluid and a conventional pump for pumping the heated fluid to cuff(s) **71** through tube **74** and optionally to more than one cuff **71** through connectors **72**. Cuff **71** is configured to contract when fluid is pumped therefrom as illustrated in FIG. **7** and to expand when fluid is pumped therein as illustrated in FIG. **8**. Cuffs **71** may be placed around containers (e.g., tubes or vials) of varying size and manipulated to come into contact with the container. In one embodiment, such cuffs may comprise a heated material which may be expanded by the application of pressure (e.g., air pressure) to ensure accommodation of containers of varying size and to ensure that thorough contact between the container and the heating source.

[0028] Referring now to FIGS. **9** to **10**, yet another exemplary thawing apparatus is provided in accordance with the principles of the present invention. Thawing apparatus **90** includes housing **91**, a plurality of compartments **92**, a plurality of heating compartments **93**, and phase change material **94**. Each compartment **92** may be configured to receive container **100** comprising frozen biological material **101**. Housing **91** is configured to seal phase change material **94** therein. Each heating compartment **93** is configured to receive a heated material (e.g., boiling water) at a temperature suitable to cause phase change material **94** (e.g., paraffin or beeswax) to undergo a phase change. Thawing apparatus **90** may function as follows: (i) the phase change of phase change material **94** is effected by addition of a heat source to heating compartment **93** of apparatus **90**, e.g., by adding boiling water to the compartment of the apparatus; (ii) once phase change material **94** has reached its melting point, container(s) **100** (e.g., tube or vial) containing frozen biological material **101** to be thawed is then placed into compartment **92** of apparatus **90**; and (iii) as frozen biological material **101** cools phase change material **94**, phase change material **94** remains at is melting point, which is suitable to result in the thawing of the frozen biological material.

[0029] Referring to FIG. **11**, thawing apparatus **90'** is constructed substantially identically to thawing apparatus **90** of FIGS. **9** and **10**, wherein like components are identified by like-primed reference numbers. Thus, for example, housing **91'** in FIG. **11** corresponds to housing **91** of FIGS. **9** and **10**, etc. As will be observed by comparing FIGS. **10** and **11**, apparatus **90'** does not include heating compartment **93** and includes heating element **95**. Heating element **95** may be disposed in or near phase change material **94'** and may be a conventional heating element configured to heat phase change material **94'** to a suitable temperature to cause phase change material **94'** to undergo a phase change.

[0030] Referring now to FIGS. **12** to **13**, an alternative exemplary thawing apparatus having a chemical material is provided in accordance with the principles of the present invention. Thawing apparatus **120** includes housing **121**, a plurality of compartments **122**, reactant source pump **123** having reactant **124**, tube(s) **125** and chemical material **126**. Each compartment **122** may be configured to receive container **130** comprising frozen biological material **131**. Housing **121** is configured to seal chemical material **126** therein. Reactant source pump **123** is configured to store reactant **124** (e.g., oxygen) and may include a conventional pump for pumping reactant **124** to chemical material **126** (e.g., iron) through tube(s) **125**. Chemical material **126** is configured to heat to a suitable temperature to thaw frozen biological material **131** following exposure to a given condition (e.g., exposure to a reactant such as oxygen from reactant source pump). Thawing apparatus **120** may function as follows: (i) chemical material **126** is heated by exposing chemical material **126** to a given condition (e.g., reactant from reactant pump source); and (ii) once the apparatus is at its suitable temperature, container(s) **130** (e.g., tube or vial) containing biological material **131** to be thawed is then placed into the appropriate compartment **122** of apparatus **120**; resulting in the thawing of biological material **131**. In a specific embodiment, the chemical material is iron and the given condition is exposure to oxygen. In another specific embodiment, the chemical material is sodium acetate. In another specific embodiment, the chemical material is liquefied petroleum gas (lpg) and the given condition is exposure to platinum.

[0031] In certain embodiments, the improved thawing apparatuses described herein result in a 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, or greater than 50% increase in contact between the container (e.g., tube or vial) that contains the biological material than that which occurs with a thawing apparatus currently known in the art (e.g., a standard dry block thawing apparatus or a standard water bath thawing apparatus).

[0032] Referring to FIGS. **14** and **15**, thawing apparatuses **120'** and **120"** are constructed substantially identically to thawing apparatus **120** of FIGS. **12** and **13**, wherein like components are identified by like-primed reference numbers. Thus, for example, housing **121'** in FIG. **14** and housing **121"** in FIG. **15** correspond to housing **121** of FIGS. **12** and **13**, etc. As will be observed by comparing FIGS. **13** and **14**, apparatus **120'** further includes one or more controllable mechanisms **140** coupled by at least one shaft **142** to motor **143**. Controllable mechanisms **140** are configured to agitate container(s) **130** (e.g., tube or vial) containing biological material **131** to be thawed. Motor **143** may be a conventional motor config-

ured to agitate controllable mechanism **140** by moving shaft (s) **142**. In one embodiment, motor **143** is configured to agitate controllable mechanism **140** so as to shake container(s) **130** (e.g., tube or vial) containing biological material **131** to be thawed, e.g., shakes the container up and down or left to right as illustrated, or both. In another embodiment, motor **143** is configured to agitate controllable mechanism **140** to rotate container(s) **130** (e.g., tube or vial) containing biological material **131** to be thawed, e.g., the controllable mechanism rotates the container in a clockwise or counter-clockwise manner.

[0033] As will be observed by comparing FIGS. **14** and **15**, apparatus **120"** further includes controller **150** for controlling components of thawing apparatus **120"** including motor **143'**. Controller **150** may include any one or more microprocessors, controllers, digital signal processors (DSPs), application specific integrated circuits (ASICs), field-programmable gate arrays (FPGAs), or equivalent discrete or integrated digital or analog logic circuitry, and the functions attributed to controller **150** herein may be embodied as software, firmware, hardware, or any combination thereof. Controller **150** may include a memory for storing data related to use of thawing apparatus **120"**, such as a selected program for agitating container(s). The memory may store program instructions that, when executed by controller **150**, cause controller **150** and apparatus **120"** to provide the functionality ascribed to them herein. The memory of controller **150** also may store software downloaded thereon or implemented as a program product and stored on a tangible storage device such as machine-readable medium, e.g., tape, compact disk (CD), digital versatile disk (DVD), blu-ray disk (BD), flash drive, and so forth, external nonvolatile memory device, cloud storage, or other tangible storage medium. The software may include computer executable instructions for controlling apparatus **120"**. Optionally, controller **150** may include suitable components for wired and/or wireless communication with external computer **151**, illustratively a laptop computer. External computer **151** may have software downloaded thereon for controlling apparatus **120"**. In one embodiment, the software on external computer **151** allows a practitioner (e.g., a lap technician) to select a predefined program and/or create a program for agitating container(s). As will be readily apparent, thawing apparatus **120"** and external computer **151** are not to scale.

[0034] In certain embodiments the apparatuses described herein comprise controllable temperature settings, so that they may be utilized at any thawing temperature desired by the individual using the device (e.g., 23° C., 37° C., 50° C., 100° C., etc.), and also so that the temperature can be increased or decreased during the thawing process (e.g., the temperature can be increased or decreased in 1, 2, 3, 4, 5 or more degree intervals by, e.g., pressing a button). In certain embodiments, the apparatuses described herein can be programmed to thaw at a specific temperature (e.g., 42° C.) for a specific period of time, followed by a shift to a different temperature (e.g., 37° C.) for a specific period of time.

[0035] In certain embodiments, the apparatuses described herein comprise one or more methods for alerting the practitioner that the thawing cycle of a certain biological material has been completed, e.g., the apparatus may comprise a bell, a buzzer, a flashing light or any combination thereof, or any other similar alerting mechanism. In certain embodiments, the device may comprise instructions for thawing certain frozen biological materials that are frozen in a specific volume, and also may provide times for which said frozen biological materials that are frozen in a specific volume will be thawed using the apparatus.

[0036] The duration of time for thawing of a biological material using a thawing apparatus described herein will depend on a variety of factors including, without limitation, the volume of the frozen biological material, the thawing apparatus used, whether or not the practitioner wishes to agitate (e.g., rotate or shake) the container containing the biological material, and the temperature the practitioner desires to thaw at. Those of skill in the art will appreciate how the improved thawing apparatuses can be adjusted to accommodate the desired timing and degree of thawing.

[0037] As will be apparent to one of ordinary skill in the art, components of the thawing apparatuses described herein may be used separately or in combination with one another. For example, controllable mechanism(s) **140'**, shaft(s) **142'**, motor **143'**, and/or controller **150** of FIG. **15** may be incorporated in thawing apparatus **10**, thawing apparatus **40**, thawing apparatus **70**, and/or thawing apparatus **90**, etc. without departing from the principles of the present invention.

5.2 Containers

[0038] Any container suitable for freezing biological material can be used in the thawing apparatuses described herein. In certain embodiments, the containers comprise tubes. In certain embodiments, the containers comprise vials. In certain embodiments, the containers comprise bags. Such containers may be made of any material known in the art, e.g., glass, plastic, polystyrene, etc.

[0039] The containers be used in the thawing apparatuses described herein may be of any size known in the art. In certain embodiments, the containers have a volume of 100 μl to 500 μl, 500 μl to 1 ml, 1 ml to 2 ml, 1 ml to 5 ml, 5 ml to 10 ml, 10 ml to 25 ml, 25 ml to 50 ml, 50 ml to 100 ml, or 100 ml to 1 L. In certain embodiments the containers have a volume of more than 1 L.

5.3 Biological Material

[0040] Any biological material can be thawed in a container using the thawing apparatuses described herein. In a specific embodiment, the biological material comprises cells, e.g., cryopreserved cells. In another specific embodiment, the biological material comprises intact tissue or organ. In another specific embodiment, the biological material comprises blood, e.g., human or animal blood.

[0041] The devices and methods disclosed herein are not to he limited in scope h the specific embodiments described herein. Indeed, various modifications of the devices and methods in addition to those described will become apparent to those of skill in the art from the foregoing description and accompanying figures. Such modifications arc intended to fall within the scope of the appended claims.

1. A thawing apparatus comprising one or more compartments into which a container comprising frozen biological material may be thawed, wherein said one or more compartments comprise compressible material.

2. A thawing apparatus comprising one or more compartments into which a container comprising frozen biological material may be thawed, wherein said one or more compartments comprises a cuff which fits around the container.

3. A thawing apparatus comprising: (i) a sealed compartment comprising material that undergoes a phase change

when heated to a certain temperature, (ii) a compartment into which a source of heat can be added, and (iii) at least one compartment into which a container containing biological material can be placed.

4. A thawing apparatus comprising: (i) a sealed compartment comprising a chemical material that heats to a certain temperature following exposure to a given condition and (ii) at least one compartment into which a container containing biological material can be placed.

5. The thawing apparatus of claim **1**, wherein said compressible material comprises rubber, silicone, or sponge.

6. The thawing apparatus of claim **2**, wherein said cuff is filled with fluid.

7. The thawing apparatus of claim **3**, wherein said material is paraffin or beeswax.

8. The thawing apparatus of claim **3**, wherein said source of heat is heated water.

9. The thawing apparatus of claim **4**, wherein said chemical material is iron and wherein said given condition is exposure to oxygen.

10. The thawing apparatus of claim **4**, wherein said chemical material is sodium acetate.

11. The thawing apparatus of claim **4**, wherein said chemical material is liquefied petroleum gas (lpg) and wherein said given condition is exposure to platinum.

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