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CELL THAWING MACHINE AND METHOD FOR OPERATING SAME

Abstract

A cell thawing machine is provided. The cell thawing machine comprises: a thawing unit that includes heating blocks including a first heating block and a second heating block forming a heating space for heating a container in which a predetermined amount of biological material including cells is stored, heaters installed in the heating blocks to provide heat to the heating blocks, and insulation blocks coupled to the heating blocks so as to surround the heaters; a driving unit that provides driving force for raising and lowering support pins so that the pins can support a lower portion of the container, and moving the first heating block and the second heating block in a straight line to the left and right; and a control unit that controls the thawing unit and the driving unit.

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Background/Summary

CROSS REFERENCE TO THE RELATED APPLICATIONS [0001] This application is the national phase entry of International Application No. PCT/KR2022/008719, filed on Jun. 20, 2022, which is based upon and claims priority to Korean Patent Application No. 10-2021-0082930 filed on Jun. 25, 2021, 10-2021-0098641 filed on Jul. 27, 2021, and 10-2021-0151329 filed on Nov. 5, 2021, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD
[0002] The present invention relates to a cell thawing machine and an operating method thereof.
BACKGROUND
[0003] In general, various biological materials are stored at low temperature after being stored in containers such as vials. For example, plasma and tissue cells are stored at a maximum of −100 degrees Celsius, and stem cells are stored at cryogenic temperatures of up to −165 degrees Celsius by using gaseous liquid nitrogen.
[0004] These biological materials are tested at a temperature higher than the storage temperature of the aforementioned low-temperature state. Accordingly, a thawing process is required to test the biological material.
[0005] To this end, a cell thawing machine has been proposed for thawing a biological material in a low-temperature state by heating a container such as a vial in which the biological material is stored.
[0006] However, conventional cell thawing machines adopt a method of transferring heat while a heating block and a container are in contact with each other. Accordingly, the conventional cell thawing machines have a problem in that it is difficult to uniformly heat the container as a whole, and since the high-temperature heating block directly contacts the container, there is a problem in that the container is cracked or deformed by the high temperature.
[0007] In addition, the conventional cell thawing machine was a method of simply displaying whether the heating block was operating normally through an indicator such as an LED.
[0008] Accordingly, the conventional cell thawing machines have a problem in that the operating temperature of the heating block cannot be easily measured during qualification evaluation to determine whether the heating block operates correctly.
SUMMARY
[0009] The present invention has been devised in view of the above points, and an object of the present invention is to provide a cell thawing machine which is capable of uniformly heating the container as a whole while securing the heat stability of the container including the biological

material during the heating process, and an operation method thereof.

[0010] In addition, another object of the present invention is to provide a cell thawing machine which is capable of increasing energy use efficiency and an operating method thereof.

[0011] Moreover, still another object of the present invention is to provide a cell thawing machine which is capable of conveniently measuring the operating temperature of a heating block during qualification evaluation.

[0012] In order to achieve the above-described objects, the present invention provides a cell thawing machine, including a thawing part including heating blocks which include a first heating block and a second heating block forming a heating space for heating a container in which a predetermined amount of biological material including cells is stored, heaters which are installed in the heating blocks to provide heat to the heating blocks, and heat insulating blocks which are coupled to the heating blocks so as to surround the heaters; a driving part for providing a driving force for raising and lowering support pins such that the support pins can support a lower portion of the container, and linearly moving each of the first heating block and the second heating block to the left and right directions; and a control part for controlling the thawing part and the driving part.

[0013] In addition, the present invention provides a method for operating a cell thawing machine including heating blocks which include a first heating block and a second heating block for forming a heating space for accommodating a container in which a predetermined amount of biological material including cells is stored through linear movement by a driving force of a motor, and heating the container accommodated in the heating space through heat provided from a heater; and support pins which are raised and lowered to support a lower portion of the container disposed in the heating space in connection with the linear movement of the heating block, the method including a first step of preheating the first heating block and the second heating block to a predetermined temperature by driving the heater while one surface of the first heating block and one surface of the second heating block facing each other are in contact with each other; a second step of heating the container disposed in the heating space to thaw the biological material while the first heating block and the second heating block are changed to a heating position forming the heating space; and a third step of changing the first heating block and the second heating block to a standby position by moving the same in a direction away from the heating position such that the container disposed in the heating space can be removed, wherein in the second step, the container disposed in the heating space is heated by heat transferred from the first heating block and the second heating block in a non-contact manner in a state where a lower portion of the container is supported through the support pins and the container is not in contact with the first heating block and the second heating block.

[0014] According to the present invention, the container can be uniformly heated by heating the container in a non-contact heating manner by using radiant heat, and it is possible to prevent cracks or thermal deformation of the container that may occur during heating by conductive heat in advance.

[0015] In addition, according to the present invention, since the temperature of the heating block can be maintained constant, a plurality of containers can be sequentially thawed. Through this, the present invention can improve energy consumption efficiency because it is possible to thaw a plurality of containers while reducing the reuse waiting time for thawing containers.

[0016] Furthermore, according to the present invention, when the upper cover is separated, the sensor insertion hole for qualification evaluation is exposed to the outside such that it is possible to easily perform qualification evaluation.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** is a view showing a cell thawing machine according to one embodiment of the present invention;

[0018] FIG. **2** is a view of FIG. **1** viewed from another direction;

[0019] FIG. **3** is a view in which the housing is separated from FIG. **1**:

[0020] FIG. **4** is a view showing the cell thawing machine according to the first embodiment of the present invention, showing a state in which the housing and circuit board are removed from FIG. **3**;

[0021] FIG. **5** is a view of FIG. **4** viewed from another direction;

[0022] FIG. **6** is a view in which the thawing part is separated from FIG. **4**;

[0023] FIG. **7** is a view in which the thawing part is extracted and separated from FIG. **6**:

[0024] FIG. **8** is a view in which the driving part is extracted from FIG. **6**;

[0025] FIG. **9** is an enlarged view of a part of FIG. **5**, in which portions of the first heating block and the second heating block are cut in a standby position;

[0026] FIG. **10** is a view showing a part of the cell thawing machine according to the first embodiment of the present invention in a state where the heating block is disposed at a heating position;

[0027] FIG. **11** is a view of FIG. **10** viewed from above;

[0028] FIG. **12** is a view showing the arrangement relationship of sensors and heating blocks corresponding to the state of FIG. **10**, showing a state in which the first heating block, the first heat insulating block and the first guide block are removed;

[0029] FIG. **13** is an operating state diagram of the cell thawing machine according to the first embodiment of the present invention, and is a partial cross-sectional view of the standby position when initially driven, as viewed from the A-A direction in FIG. **10**;

[0030] FIG. **14** is an operating state diagram showing a state in which the heating block is preheated in the cell thawing machine according to the first embodiment of the present invention, and is a partial cross-sectional view as viewed from the A-A direction of FIG. **10**.

[0031] FIG. **15** is an operating state diagram showing the process of introducing a container into the cell thawing machine according to the first embodiment of the present invention, and is a partial cross-sectional view as viewed from the direction A-A of FIG. **10**;

[0032] FIG. **16** is an operating state diagram of the cell thawing machine according to the first embodiment of the present invention, and is a partial cross-sectional view of the state in which the container is heated in the heating position, as viewed from the A-A direction in FIG. **10**;

[0033] FIG. **17** is an operating state diagram of the cell thawing machine according to the first embodiment of the present invention, and is a partial cross-sectional view of the process of removing the container from the standby position, as viewed from the A-A direction in FIG. **10**;

[0034] FIG. **18** is a view showing a cell thawing machine according to the second embodiment of the present invention, showing a state in which the top cover is separated from the state in which the cover is removed in FIG. **1**;

[0035] FIG. **19** is a cross-sectional view in the B-B direction of FIG. **18**, in which the thawing part is extracted;

[0036] FIG. **20** is a view showing a cell thawing machine according to the second embodiment of the present invention, showing a state in which the housing and circuit board are removed from FIG. **3**;

[0037] FIG. **21** is a view of FIG. **20** viewed from another direction;

[0038] FIG. **22** is a view in which the thawing part is separated from FIG. **20**;

[0039] FIG. **23** is a view in which the thawing part is extracted and separated in FIG. **22**;

[0040] FIG. **24** is a view in which the driving part is extracted from FIG. **22**;

[0041] FIG. **25** is an enlarged view of a part of FIG. **21**, in which portions of the first heating block and the second heating block are cut in a standby position;

[0042] FIG. **26** is a view showing a part of the cell thawing machine according to the second embodiment of the present invention in a state where the heating block is disposed at a heating position;
[0043] FIG. **27** is a view of FIG. **26** as viewed from above;
[0044] FIG. **28** is a view showing the arrangement relationship of sensors and heating blocks corresponding to the state of FIG. **26**, showing a state in which the first heating block, the first heat insulating block and the first guide block are removed;
[0045] FIG. **29** is an operating state diagram of the cell thawing machine according to the second embodiment of the present invention, and is a partial cross-sectional view of the standby position when initially driven, as viewed from the C-C direction in FIG. **26**;
[0046] FIG. **30** is an operating state diagram showing a state in which the heating block is preheated in the cell thawing machine according to the second embodiment of the present invention, and is a partial cross-sectional view as viewed from the C-C direction of FIG. **26**;
[0047] FIG. **31** is an operating state diagram showing the process of introducing a container into the cell thawing machine according to the second embodiment of the present invention, and is a partial cross-sectional view as viewed from the C-C direction of FIG. **26**;
[0048] FIG. **32** is an operating state diagram of the cell thawing machine according to the second embodiment of the present invention, and is a partial cross-sectional view of the state in which the container is heated in the heating position, as viewed from the direction C-C in FIG. **26**;
[0049] FIG. **33** is an operating state diagram of the cell thawing machine according to the second embodiment of the present invention, and is a partial cross-sectional view of the process of removing a container from a standby position, as viewed from the C-C direction in FIG. **26**; and
[0050] FIG. **34** is a block diagram showing the method for operating a cell thawing machine according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0051] Hereinafter, with reference to the accompanying drawings, the exemplary embodiments of the present invention will be described in detail so that those skilled in the art can easily practice the present invention. The present invention may be embodied in many different forms and is not limited to the exemplary embodiments set forth herein. In order to clearly describe the present invention in the drawings, parts that are irrelevant to the description are omitted, and the same reference numerals are assigned to the same or similar components throughout the specification.

[0052] The cell thawing machines **100**, **200** according to one embodiment of the present invention may heat and thaw a biological material contained in a container **10** in a low-temperature state (e.g., frozen state).

[0053] Herein, the biological material may include cells, which are the structural basic unit of an organism, and the container **10** may be a known laboratory container or container for medical use such as a vial, a beaker or a test tube.

[0054] In addition, as illustrated in FIG. **1**, the container **10** may include a container main body **12** in which the biological material is accommodated and a cap part **14** for covering the open top of the container main body **12**, and approximately 6 mL or 10 mL of biological material may be contained in the container main body **12**. However, the shape of the container **10** and the capacity of the biological material contained in the container main body **12** are not limited thereto and may be changed into various shapes depending on design conditions.

[0055] In this case, the cell thawing machines **100**, **200** according to one embodiment of the present invention may heat the container **10** uniformly as a whole by heating the container **10** in a non-contact heating manner through radiant heat and/or convection heat, and it is possible to prevent cracks or thermal deformation of the container **10** that may occur during contact heating by conductive heat in advance.

[0056] To this end, as illustrated in FIGS. **1** to **6** and **18** to **22**, the cell thawing machines **100**, **200** according to one embodiment of the present invention includes a housing **110**, a thawing part **120**,

a driving part **130** and a control part **150**.
[0057] As illustrated in FIGS. **1** to **3**, the housing **110** may form an outer surface of the cell thawing machines **100**, **200**, and it may be formed in a box shape such that the thawing part **120**, the driving part **130** and the control part **150** may be disposed therein.
[0058] Such a housing **110** may be composed of one member or may be composed of a plurality of members, and the plurality of members may be detachably coupled.
[0059] For example, as illustrated in FIG. **3**, the housing **110** may include a box-shaped main body **111**, a lower cover **112** for covering an open lower portion of the main body **111**, a rear cover **113** for covering an open rear surface of the main body **111**, and an upper cover **114** for covering an upper portion of the main body **111**.
[0060] In this case, the thawing part **120**, the driving part **130**, and the control part **150** may be disposed inside the main body **111**.
[0061] In this case, the housing **110** may include an inlet **115** which is formed to penetrate a predetermined area such that the container **10** can be inserted into the main body **111**, and the inlet **115** may be covered through a cover **116**.
[0062] Herein, the inlet **115** may be formed through the housing **110** so as to be located at a position corresponding to a heating space **121** to be described below.
[0063] For example, the inlet **115** may be formed to pass through the upper cover **114** to communicate with a heating space **121** formed in the thawing part **120** at a heating position to be described below. Through this, when the container **10** is inserted into the inlet **115**, the cap part **14** of the container **10** may be exposed to the outside through the inlet **115**, the remaining portion except for the cap part **14** may be inserted into the heating space **121**.
[0064] In addition, as illustrated in FIG. **1**, a manipulation part **117** for manipulating the operation of the cell thawing machines **100**, **200** according to one embodiment of the present invention, and a display **118** for displaying the operating state of the cell thawing machines **100**, **200** may be provided on one side of the housing **110**.
[0065] Such a manipulation part **117** may be an interface for transmitting an input signal to the control part **150** through user manipulation.
[0066] Herein, the manipulation part **117** may be configured with a known press-type physical button or capacitive touch button.
[0067] In addition, the manipulation part **117** may be provided separately from the display **118**, or may be provided in an integrated form with the display **118**.
[0068] Moreover, the display **118** may output information on the overall operating state of the cell thawing machines **100**, **200** operated through the control part **150** (e.g., the operating status such as the temperature of the heating blocks **122***a*, **122***b*, the surface temperature of the container **10**, thawing or completion of thawing, or thawing progress time), date and time at the time of thawing, an error message such as sensor or heater failure, which will be described below, and the like.
[0069] Through this, the user may transmit input signals, such as operation and stop of the cell thawing machines **100**, **200**, thawing temperature adjustment and thawing time adjustment, to the control part **150** through manipulation of the manipulation part **117**, and the display **118** may output information on the overall state of the cell thawing machines **100**, **200** through the control part **150**.
[0070] Moreover, as illustrated in FIG. **2**, the cell thawing machines **100**, **200** may include at least one communication port **119** that is provided to be exposed to the outside from one side of the housing **110**, and the communication port **119** may be electrically connected to the control part **150**.
[0071] For example, the communication port **119** may include a LAN port **119***a* for communication with communication device such as an external network device or a PC, and a USB port **119***b* for inputting or outputting data, and the communication port **119** may be mounted on the rear cover **113** so as to be electrically connected to the control part **150**.
[0072] In this case, when the cell thawing machines **100**, **200** according to one embodiment of the present invention are connected to the external network device or communication device such as a

PC through the communication port **119**, the control part **150** may be time-synchronized with communication device such as the external network device or PC.

[0073] For example, when the cell thawing machines **100**, **200** are connected to a PC such as a laptop computer, the cell thawing machines **100**, **200** may be synchronized with the date and time of the PC by using a synchronization program installed in the PC.

[0074] Through this, the cell thawing machines **100**, **200** according to one embodiment of the present invention may be synchronized with the local time of the region where thawing is performed when in use, and the local time of the region may be output through the display **118**.

[0075] As a result, the cell thawing machines **100**, **200** according to one embodiment of the present invention may store history information about the exact time of thawing of the biological material contained in the container **10**, and the user may confirm the exact thawing time of the biological material contained in the container **10** through the history information.

[0076] Additionally, information related to thawing may be stored in the cell thawing machines **100**, **200** themselves or may be stored in a synchronization program of a communication device that is connected through the communication port **119**.

[0077] In this case, although the information related to thawing stored in the cell thawing machines **100**, **200** or the synchronization program may be stored by date, a thawing history may be stored for each thawing case, and the thawing history may include the local time of the region where the thawing is performed.

[0078] The thawing part **120** may heat the container **10** while the container **10** introduced into the housing **110** through the inlet **115** is accommodated in a heating space **121**.

[0079] To this end, as illustrated in FIGS. **4** to **7** and **20** to **23**, the thawing part **120** may include heating blocks **122***a*, **122***b* for forming a heating space **121** for accommodating and heating the container **10**, heaters **123***a*, **123***b* which are installed in the heating blocks **122***a*, **122***b* so as to provide heat to the heating blocks **122***a*, **122***b*, and heat insulating blocks **124***a*, **124***b* which are coupled to the heating blocks **122***a*, **122***b* so as to surround the heaters **123***a*, **123***b*.

[0080] Accordingly, when the container **10** is introduced into the housing **110** through the inlet **115**, the container **10** may be surrounded through the heating blocks **122***a*, **122***b* while being accommodated in the heating space **121** (refer to FIGS. **16** and **32**).

[0081] In this case, as illustrated in FIGS. **7** and **23**, the heating blocks **122***a*, **122***b* may include arrangement grooves **126***a*, **126***b* which are formed to be drawn inwardly on one surface, and the heaters **123***a*, **123***b* may be inserted into the arrangement grooves **126***a*, **126***b*. In addition, while the heaters **123***a*, **123***b* are inserted into the arrangement grooves **126***a*, **126***b*, the heat insulating blocks **124***a*, **124***b* may be coupled to the heating blocks **122***a*, **122***b* so as to completely cover the arrangement grooves **126***a*, **126***b*.

[0082] In addition, the cell thawing machines **100**, **200** according to one embodiment of the present invention may include auxiliary heat insulating blocks **124***c*, **124***d* to block heat transferred from the heaters **123***a*, **124***b* from being discharged to the outside, and the auxiliary heat insulating blocks **124***c*, **124***d* may be coupled to the heating blocks **122***a*, **122***b* to cover the upper surfaces of the heating blocks **122***a*, **122***b*.

[0083] Herein, the heating blocks **122***a*, **122***b* may be made of a material having thermal conductivity such as metal, and the heat insulating blocks **124***a*, **124***b* and the auxiliary heat insulating blocks **124***c*, **124***d* may be made of a material having heat insulating properties.

[0084] Accordingly, when the heaters **123***a*, **123***b* generate heat, the heating blocks **122***a*, **122***b* may be heated by the heat generated from the heaters **123***a*, **123***b*, and the heat generated from the heaters **123***a*, **123***b* may be concentrated toward the heating blocks **122***a*, **122***b* by limiting the direction of heat movement through the heat insulating blocks **124***a*, **124***b* and the auxiliary heat insulating blocks **124***c*, **124***d*, and the heat transferred from the heaters **123***a*, **123***b* to the heating blocks **122***a*, **122***b* may be transferred to the heating space **121**.

[0085] As a result, the container **10** may be heated by the heat provided from the heating blocks

122*a*, **122***b*, and the biological material stored in the container **10** may be thawed by the heat.

[0086] Moreover, since the heat generated from the heaters **123***a*, **123***b* may be concentrated toward the heating blocks **122***a*, **122***b* by limiting the direction of heat movement through the heat insulating blocks **124***a*, **124***b* and the auxiliary heat insulating blocks **124***c*, **124***d*, it is possible to improve the energy consumption efficiency of the cell thawing machines **100**, **200** according to one embodiment of the present invention.

[0087] In addition, since the container **10** accommodated in the heating space **121** may be heated by using the heat of the heating blocks **122***a*, **122***b* which is heated to a constant temperature by the heat transferred from the heaters **123***a*, **123***b*, the circumferential surface of the container **10** may be heated to a uniform temperature. Herein, the circumferential surface of the container **10** may be a circumferential surface including a side surface and a bottom surface of the container main body **12** excluding the cap part **14**.

[0088] In this case, as illustrated in FIGS. **7** and **23**, the thawing part **120** may include temperature sensors **128***a*, **128***b* which are installed on the heating blocks **122***a*, **122***b* to measure the temperatures of the heating blocks **122***a*, **122***b*. Herein, the temperature sensors **128***a*, **128***b* may be known contact-type temperature sensors such as thermocouples, resistance thermometers (RTDs) and thermistors, and the temperatures of the heating blocks **122***a*, **122***b* measured through the temperature sensors **128***a*, **128***b* may be transmitted to the control part **150**.

[0089] Accordingly, the control part **150** controls the driving of the heaters **123***a*, **123***b* based on the temperature information measured by the temperature sensors **128***a*, **128***b*, it is possible to maintain the temperatures of the heating blocks **122***a*, **122***b* to a constant temperature. For example, the control part **150** may maintain the temperatures of the heating blocks **122***a*, **122***b* to be constant by controlling the driving of the heaters **123***a*, **123***b* through PID control.

[0090] Moreover, the control part **150** may prevent overheating of the heating blocks **122***a*, **122***b* by controlling the driving of the heaters **123***a*, **123***b* based on the temperature information measured by the temperature sensors **128***a*, **128***b*.

[0091] In the present invention, the heaters **123***a*, **123***b* may be ceramic heaters to secure reliability and improve the lifespan cycle of products even under operating conditions in which heating and cooling are repeatedly performed, but the present invention is not limited thereto, various known heaters may all be applied.

[0092] Meanwhile, the heating space **121** may be provided in a shape corresponding to the shape of the container **10**, and the heating space **121** may be formed through at least two heating blocks **122***a*, **122***b*.

[0093] As a specific example, as illustrated in FIGS. **7** and **23**, the heating blocks **122***a*, **122***b* may include a first heating block **122***a* and a second heating block **122***b* which are disposed such that surfaces thereof face each other, and the heating space **121** may be formed through a pair of opposing surfaces **127***a*, **127***b* which are formed to be drawn on surfaces facing each other in the first heating block **122***a* and the second heating block **122***b*.

[0094] Herein, the pair of opposing surfaces **127***a*, **127***b* may be formed to be drawn inward to have a shape corresponding to the circumferential surface of the container main body **12**, and may be formed to have a shape corresponding to a side surface and lower surface of the container main body **12**.

[0095] For example, when the container **10** is formed in a cylindrical shape, the pair of opposing surfaces **127***a*, **127***b* may include an arc-shaped curved surface and an arc-shaped horizontal surface connected to a lower edge of the curved surface, and when the container **10** is formed in the shape of a square pillar, the pair of opposing surfaces **127***a*, **127***b* may include a horizontal surface of a rectangular cross-section for connecting a bent surface having a substantially ‘c’ cross-sectional shape and a lower edge of the curved surface.

[0096] Accordingly, when the container **10** is introduced into the heating space **121** through the inlet **115**, the circumferential surface including a side surface and a bottom surface of the container

10 may be completely surrounded by a pair of opposing surfaces **127***a*, **127***b* defining the heating space **121**.
[0097] As a result, the container **10** accommodated in the heating space **121** may be uniformly heated on the circumferential surface including a lower surface along with a side surface by the heat provided from the first heating block **122***a* and the second heating block **122***b*.
[0098] In this case, each of the first heating block **122***a* and the second heating block **122***b* may include arrangement grooves **126***a*, **126***b* which are formed to be drawn inward on one surface thereof, respectively, and the heaters **123***a*, **123***b* may include a first heater **123***a* and a second heater **123***b* that are disposed to be inserted into the arrangement groove **126***a* formed in the first heating block **122***a* and the arrangement groove **126***b* formed in the second heating block **122***b*, respectively.
[0099] In addition, the heat insulating blocks **124***a*, **124***b* may include a first heat insulating block **124***a* and a second heat insulating block **124***b*, and the first heat insulating block **124***a* may be coupled to the first heating block **122***a* so as to completely cover the arrangement groove **126***a* while the first heater **123***a* is inserted into the arrangement groove **126***a* of the first heating block **122***a*, and the second heat insulating block **124***b* may be coupled to the second heating block **122***b* so as to completely cover the arrangement groove **126***b* while the second heater **123***b* is inserted into the arrangement groove **126***b* of the second heating block **122***b*.
[0100] Moreover, the auxiliary heat insulating blocks **124***c*, **124***d* may include a first auxiliary heat insulating block **124***c* which is fastened to an upper surface of the first heating block **122***a*, and a second auxiliary heat insulating block **124***d* which is fastened to an upper surface of the second heating block **122***b*.
[0101] In addition, the temperature sensors **128***a*, **128***b* may include a first temperature sensor **128***a* which is installed in the first heating block **122***a* to measure the temperature of the first heating block **122***a*, and a second temperature sensor **128***b* which is installed in the second heating block **122***b* to measure the temperature of the second heating block **122***b*.
[0102] Accordingly, the heat generated from the first heater **123***a* may heat the first heating block **122***a*, and the heat generated from the second heater **123***b* may heat the second heating block **122***b*, and the control part **150** may control the driving of the first heater **123***a* and the second heater **123***b* based on the temperature information measured by the first temperature sensor **128***a* and the second temperature sensor **128***b* such that it is possible to maintain the temperatures of the first heating block **122***a* and the second heating block **122***b* to be constant.
[0103] In this case, the control part **150** may control the operations of the first heater **123***a* and the second heater **123***b* together based on the temperature information measured through the first temperature sensor **128***a* and the second temperature sensor **128***b*, or the control part **150** may individually control the operations of the first heater **123***a* and the second heater **123***b* based on the temperature information measured through the first temperature sensor **128***a* and the second temperature sensor **128***b*.
[0104] Through this, even if the heating blocks **122***a*, **122***b* include the first heating block **122***a* and the second heating block **122***b* in the cell thawing machines **100**, **200** according to one embodiment of the present invention, the temperatures of the first heating block **122***a* and the second heating block **122***b* may be precisely controlled through the control of the control part **150**.
[0105] Accordingly, since the first heating block **122***a* and the second heating block **122***b* may be maintained at the same temperature without temperature deviation through the control part **150**, the circumferential surface of the container **10** including a side surface and lower surface in the heating space **121** may be uniformly heated.
[0106] Moreover, when the control part **150** individually controls the driving of the first heater **123***a* and the second heater **123***b*, the user may immediately check an abnormality of the corresponding part based on the information output through the display **118**, and take appropriate action on the corresponding part in which the abnormality has occurred.

[0107] For example, when any one of the heaters **123***a*, **123***b* that are respectively installed in the first heating block **122***a* and the second heating block **122***b* or any one of the temperature sensors **128***a*, **128***b* that are respectively installed the first heating block **122***a* and the second heating block **122***b* does not operate normally, the user may immediately check an abnormality of the corresponding part based on the information output through the display **118**, and take appropriate action on the corresponding part in which the abnormality has occurred.
[0108] Meanwhile, in the cell thawing machines **100**, **200** according to one embodiment of the present invention, while the container **10** accommodated in the heating space **121** does not contact the heating block **122***a*, **122***b*, the container **10** may be heated by the heat transferred from the heating block **122***a*, **122***b* in a non-contact manner.
[0109] For example, while the container **10** is inserted into the heating space **121**, the circumferential surface of the container **10** may be spaced apart by a certain interval from the opposing surface **127***a* of the first heating block **122***a* and the opposing surface **127***b* of the second heating block **122***b* forming the heating space **121**.
[0110] In this case, the lower portion of the container **10** may be supported through support pins **133** whose ends protrude from a portion forming the bottom surface of the heating space **121** toward the heating space **121** at a predetermined height.
[0111] That is, as illustrated in FIGS. **16** and **32**, while the container **10** is inserted into the heating space **121** and the lower portion of the container **10** is supported through the support pins **133**, a gap (d) may be formed between the pair of opposing surfaces **127***a*, **127***b* and the outer surface of the container **10**.
[0112] Accordingly, the heat stored in the first heating block **122***a* and the second heating block **122***b* may be transferred to the relatively low-temperature container **10** through convection and/or radiation instead of conduction.
[0113] As a result, since the cell thawing machines **100**, **200** according to one embodiment of the present invention may heat the circumferential surface of the container **10** through heat transfer using convection and/or radiation, the circumferential surface of the container **10** may be uniformly heated through convective heat and/or radiant heat transmitted from the heating blocks **122***a*, **122***b*.
[0114] That is, compared to the case where the container **10** and the heating blocks **122***a*, **122***b* are in direct contact and the container **10** is heated through conduction heat, the cell thawing machines **100**, **200** according to one embodiment of the present invention may uniformly heat the circumferential surface of the container through convective heat and/or radiant heat, and thus, it is possible to prevent the concentration of heat in a local location of the container **10**.
[0115] Moreover, in the cell thawing machines **100**, **200** according to one embodiment of the present invention, even if the container **10** is made of a glass or plastic material that is vulnerable to high-temperature heat, the first heating block **122***a* and the second heating block **122***b* do not come into direct contact with the container **10**, and thus, it is possible to prevent cracks or thermal deformation of the container that may occur due to heat when in direct contact with a high-temperature object.
[0116] In the present invention, the gap (d) between the pair of opposing surfaces **127***a*, **127***b* forming the heating space **121** and the outer surface of the container **10** may be 0.2 mm to 0.3 mm, but the present invention is limited thereto, and the size of the gap (d) may be appropriately changed depending on the overall size of the container **10**.
[0117] In this case, at least any one of the first heating block **122***a* and the second heating block **122***b* may be linearly moved reciprocally in a straight line, and the heating space **121** may be formed when the first heating block **122***a* and the second heating block **122***b* are disposed to be located in nearby positions through the linear movement of at least any one of the first heating block **122***a* and the second heating block **122***b*.
[0118] That is, the driving part **130** may linearly move the heating blocks **122***a*, **122***b* in left and right directions. For example, as described above, when the heating blocks **122***a*, **122***b* include a

first heating block **122**_a_ and a second heating block **122**_b_, the driving part **130** may linearly move at least any one of the first heating block **122**_a_ reciprocally in the left and right directions.

[0119] As a non-limiting example, when the heating blocks **122**_a_, **122**_b_ include a first heating block **122**_a_ and a second heating block **122**_b_, the driving part **130** may linearly move the first heating block **122**_a_ and the second heating block **122**_b_ reciprocally in the left and right directions, respectively.

[0120] In addition, when the heating space **121** is formed between the first heating block **122**_a_ and the second heating block **122**_b_ through linear movement of at least one of the first heating block **122**_a_ and the second heating block **122**_b_, the driving part **130** may protrude an end of the support pin **133** at a predetermined height from a portion forming the bottom surface of the heating space **121**.

[0121] Accordingly, the end of the support pin **133** protruding at a predetermined height from the portion forming the bottom surface of the heating space **121** may support a lower portion of the container **10**.

[0122] Through this, as illustrated in FIGS. **16**, **30** and **32**, the cell thawing machines **100**, **200** according to one embodiment of the present invention may be changed to a heating position in which the first heating block **122**_a_ and the first heating block **122**_a_ are disposed to be close to each other through the driving of the driving part **130** and an end of the support pin **133** protrudes toward the heating space **121**, and a standby position in which the first heating block **122**_a_ and the second heating block **122**_b_ are disposed to be spaced apart from each other at a gap through the driving of the driving part **130** and the end of the support pin **133** is raised to a relatively higher position than the heating position as illustrated in FIGS. **13**, **15**, **17**, **29**, **31** and **33**.

[0123] Accordingly, as illustrated in FIGS. **16** and **32**, when the first heating block **122**_a_ and the second heating block **122**_b_ are located in the heating position, a heating space **121** may be formed between the opposing surface **127**_a_ of the first heating block **122**_a_ and the opposing surface **127**_b_ of the second heating block **122**_b_ to accommodate the container **10** and heat the container **10**, and the support pin **133** may descend to protrude a certain length from the portion forming the bottom surface of the heating space **121** inside the heating space **121**.

[0124] In addition, as illustrated in FIGS. **15**, **17**, **31** and **33**, when the first heating block **122**_a_ and the second heating block **122**_b_ are located in the standby position, the gap between the opposing surface **127**_a_ of the first heating block **122**_a_ and the opposing surface **127**_b_ of the second heating block **122**_b_ widens such that the support pin **133** may rise to a certain height. Through this, the user may place the container **10** at an end of the support pin **133** protruding at a certain height between the first heating block **122**_a_ and the second heating block **122**_b_ or remove the container **10** whose lower portion is supported by the support pins **133** between the first heating block **122**_a_ and the second heating block **122**_b_.

[0125] To this end, as illustrated in FIGS. **6**, **8**, **22** and **24**, the driving part **130** may include a motor for providing a driving force, a rotating member **132** which is axially coupled to a rotation shaft **131**_a_ of the motor **131**, and a moving member **136** which ascends and descends along the rotating member **132** when the rotating member **132** rotates.

[0126] In addition, the driving part **130** may include support pins **133** which are coupled to the moving member **136** so as to support a lower portion of the container **10** by moving up and down together with the moving member **136**, and a power transmission member for interconnecting the rotating member **132** and the thawing part **120** so as to linearly move the first heating block **122**_a_ and the second heating block **122**_b_ in left and right directions, respectively, through a driving force of the motor **131**.

[0127] Moreover, the power transmission member may include guide blocks **134**_a_, **134**_b_ which are fixedly coupled to the heat insulating blocks **124**_a_, **124**_b_, guide rails **135** for guiding linear movement of the guide blocks **134**_a_, **134**_b_, and link members **137**_a_, **137**_b_ for linking the guide blocks **134**_a_, **134**_b_ and the moving member **136** to each other.

[0128] In this case, the heating blocks **122**_a_, **122**_b_ may include through-holes **125**_a_, **125**_b_ through which the support pins **133** pass such that the support pins **133** can smoothly ascend and descend when the moving member **136** moves up and down.
[0129] As a specific example, the guide blocks **134**_a_, **134**_b_ may include a first guide block **134**_a_ which is fixedly coupled to the first heat insulating block **124**_a_ and a second guide block which is fixedly coupled to the second heat insulating block **124**_b_, and the first guide block **134**_a_ and the second guide block **134**_b_ may be slidably coupled to the guide rail **135**.
[0130] In addition, the link members **137**_a_, **137**_b_ may include a first link member **137**_a_ for interconnecting the moving member **136** and the first guide block **134**_a_, and a second link member **137**_b_ for linking the moving member **136** and the second guide block **134**_b_ to each other.
[0131] Moreover, as illustrated in FIGS. **11** and **27**, the through-holes **125**_a_, **125**_b_ may include a first through-hole **125**_a_ which is formed to penetrate the first heating block **122**_a_, and a second through-hole **125**_b_ which is formed to penetrate the second heating block **122**_b_, and the first through-hole **125**_a_ and the second through-hole **125**_b_ may be joined together to form one through-hole.
[0132] In this case, the cell thawing machines **100**, **200** according to one embodiment of the present invention may further include a base **161**, a mounting table **162**, a support bar **163** and a support **164** that are disposed inside the housing **110**.
[0133] That is, as illustrated in FIGS. **6** and **22**, a mounting table **162** may be fixedly coupled to an upper surface of the base **161**, and the motor **131** may be fixedly coupled to one side of the mounting table **162** via a coupling table **165**, and the rotating member **132** which is axially coupled to a rotating shaft **131**_a_ of the motor **131** may be rotatably coupled to the mounting table **162**.
[0134] In addition, the plate-shaped support **164** having a predetermined area may be disposed at a certain interval from an upper portion from the base **161** through at least one support bar **163** having a predetermined length and one end of which is fixedly coupled to the base **161**, and the guide rail **135** may be fixedly coupled to one surface of the support **164**.
[0135] Moreover, the first guide block **134**_a_ and the second guide block **134**_b_ may be slidably coupled to the guide rail **135**, and the first heat insulating block **124**_a_ may be fixedly coupled to the first guide block **134**_a_, and the second heat insulating block **124**_b_ may be fixedly coupled to the second guide block **134**_b_.
[0136] Herein, the rotating member **132** may be a screw bar having a predetermined length and having one end axially coupled to a rotating shaft **131**_a_ of the motor **131**, and the moving member **136** may be screw-coupled to the rotating member **132** to be movable, and one end of the support pin **133** may be fixed to the moving member **136** such that the support pin **133** can be ascended and descended together when the moving member **136** moves up and down.
[0137] In addition, the support **164** may include a long first through-hole **164**_a_ which is formed to penetrate such that the first link member **137**_a_ and the second link member **127**_b_ can pass through, respectively, and a second through-hole **164**_b_ which is formed to penetrate such that the support pins **133** can pass through.
[0138] Moreover, both ends of the first link member **137**_a_ may be linked to the rotating member **132** and the first guide block **134**_a_, respectively, and both ends of the second link member **137**_b_ may be linked to the rotating member **132** and the second guide block **134**_b_, respectively.
[0139] Accordingly, when the rotating member **132** which is axially coupled to the rotating shaft **131**_a_ rotates when the motor **131** is driven, as illustrated in FIGS. **13** to **17** and **29** to **33**, the moving member **136** may be moved up and down by screw movement along the rotating member **132**, and the support pins **133** may be moved up and down together with the moving member **136**.
[0140] In addition, the first guide block **134**_a_ and the second guide block **134**_b_ which are each linked to the moving member **136** may be linearly moved in left and right directions along the guide rail **135** through ascending and descending of the moving member **136**.
[0141] As a result, the first heat insulating block **124**_a_ and the second heat insulating block **124**_b_,

which are fixedly coupled to the first guide block **134***a* and the second guide block **134***b*, respectively, may be linearly moved in left and right directions in the same manner as the first guide block **134***a* and the second guide block **134***b*, and the first heating block **122***a* and the second heating block **122***b*, which are fixedly coupled to the first heat insulating block **124***a* and the second heat insulating block **124***b*, respectively, may also be linearly moved in the left and right directions in the same way.

[0142] Through this, in the cell thawing machines **100**, **200** according to one embodiment of the present invention, the first heating block **122***a*, the second heating block **122***b* and the support pins **133** may be changed to a heating position in which the first heating block **122***a* and the second heating block **122***b* are disposed to be close to each other through the driving of the driving part **130** and an end of the support pin **133** protrudes at a certain height from a portion forming a bottom surface of the heating space **121**, and may be changed to a standby position in which the first heating block **122***a* and the second heating block **122***b* are disposed to be spaced apart from each other at an interval through the driving of the driving part **130** and an end of the support pin **133** rises to a relatively higher position than the heating position.

[0143] Moreover, when the cell thawing machines **100**, **200** according to one embodiment of the present invention are changed from the standby position to the heating position through the control of the control part **140**, a lower portion of the container **10**, which is supported through the support pins **133** in the heating space **121**, may be spaced apart by a certain interval from a portion forming a bottom surface of the heating space **121**.

[0144] Accordingly, the container **10** disposed in the heating space **121** may be disposed in the heating space **121** in a state where the circumferential surface does not come into contact with the heating blocks **122***a*, **122***b*.

[0145] The drawings and description illustrate and describe that the rotational movement of the motor **131** is changed to the linear movement of the first guide block **134***a* and the second guide block **134***b* through mutual coupling of the rotating member **132**, the moving member **136** and the link members **137***a*, **137***b*, but the present invention is not limited thereto, and various known structures such as a ball screw structure may all be applied as long as rotational movement can be converted into linear movement.

[0146] In this case, the cell thawing machines **100**, **200** according to one embodiment of the present invention may further include a position detecting means for detecting the positions of the heating blocks **122***a*, **122***b*.

[0147] For example, in the cell thawing machine **100** according to one embodiment of the present invention, the position detecting means may be a limit switch **170** for detecting the positions of the heating blocks **122***a*, **122***b* through contact with the heat insulating blocks **124***a*, **124***b*.

[0148] As illustrated in FIG. **6**, the limit switch **170** may be installed on one surface of the support **164**, and may detect the position of the second heating block **122***b* through contact with the second heat insulating block **124***b*, and the information detected through the limit switch **170** may be provided to the control part **150**.

[0149] As a specific example, as illustrated in FIGS. **9** and **10**, the limit switch **170** may include a switch box **171** which is fixedly installed on one surface of the support **164**, an operating lever **172** which performs a hinge operation on one side of the switch box **171**, and a roller **173** which is rotatably coupled to one end of the operating lever **172**.

[0150] Accordingly, in the limit switch **170**, when the roller **173** contacts the second heat insulating block **124***b* and the operating lever **172** operates, the switch box **171** may be operated, and information on whether the switch box **171** is operated may be transmitted to the control part **150**.

[0151] Specifically, as described above, when the first heating block **122***a* and the second heating block **122***b* are changed from the heating position to the standby position through the driving of the driving part **130**, the second heat insulating block **124***b* may move together with the second heating block **122***b*.

[0152] Through this, the second heat insulating block **124***b* may come into contact with the roller **173**, and as illustrated in FIG. **9**, when the second heating block **122***b* is completely moved to the standby position, the operating lever **172** may be operated such that the switch box **171** can be operated.
[0153] In this case, the control part **150** determines that the second heating block **122***b* is correctly positioned in the standby position and controls the driving of the motor **131** such that it is possible to prevent the second heating block **122***b* from moving excessively.
[0154] In addition, as illustrated in FIG. **10**, when the first heating block **122***a* and the second heating block **122***b* are changed from the standby position to the heating position through the driving of the driving part **130**, the second heat insulating block **124***b* is moved together with the second heating block **122***b* such that the contact state between the second heat insulating block **124***b* and the roller **173** can be released.
[0155] The drawings and description exemplify a hinge roller-type limit switch as a position detection means for detecting the position of the second heating block **122***b*, but the present invention is not limited thereto, and various known limit switches, such as lever-type limit switches and pin-type limit switches, may all be employed.
[0156] As another example, in the cell thawing machine **200** according to one embodiment of the present invention, the position detection means may further include a position detection sensor **270** for detecting the positions of the heating blocks **122***a*, **122***b* that linearly move in left and right directions through the driving of the driving part **130**.
[0157] Such a position detection sensor **270** may be a non-contact position detection sensor.
[0158] For example, the non-contact position detection sensor **270** may be a known photo-microsensor. As a non-limiting example, as illustrated in FIGS. **20** to **22**, the non-contact position detection sensor **270** may include a photosensor **272** which is installed on one surface of the support **164**, and a detection bar **274**, one end of which is fixedly installed in the second heat insulating block **124***b*.
[0159] Accordingly, when the detection bar **274** approaches the photosensor **272** through linear movement of the second heating block **122***b* and the second heat insulating block **124***b*, the photosensor **272** may detect the position of the second heating block **122***b* through the detection bar **274**, and the information detected through the position detection sensor **270** may be provided to the control part **150**.
[0160] As a result, the control part **150** may accurately detect the position of the second heating block **122***b* through the non-contact position detection sensor **270**, and may accurately check the origin of the motor **131**.
[0161] Specifically, as described above, when the first heating block **122***a* and the second heating block **122***b* are changed from the heating position to the standby position through the driving of the driving part **130**, the second heat insulating block **124***b* may move together with the second heating block **122***b*.
[0162] Through this, the detection bar **274**, which is fixed to the second heat insulating block **124***b*, may move toward the photosensor **272**, and as illustrated in FIG. **25**, when the second heating block **122***b* is completely moved to the standby position, a partial length of the detection bar **274** may enter a groove portion that is formed in the photosensor **272**.
[0163] In this case, the control part **150** determines that the second heating block **122***b* is correctly located in the standby position and controls the driving of the motor **131** such that it is possible to prevent the second heating block **122***b* from moving excessively.
[0164] In addition, as illustrated in FIG. **26**, when the first heating block **122***a* and the second heating block **122***b* are changed from the standby position to the heating position through the driving of the driving part **130**, the detection bar **274**, which is fixed to the second heat insulating block **124***b*, may move away from the photosensor **272**, as the second heat insulating block **124***b* moves together with the second heating block **122***b*.

[0165] The drawings and description exemplify a non-contact sensor as a method for detecting the position of the second heating block **122***b*, but the present invention is not limited thereto, and various known position detection sensors may be employed as long as the position of the heating block **122** can be detected.
[0166] Meanwhile, the thawing part **120** may further include a sensor **141** for checking the state of the container **10** disposed in the heating space **121**. For example, the sensor **141** may detect the surface temperature of the container **10** disposed in the heating space **121** and provide the detected result to the control part **150**.
[0167] Herein, the sensor **141** may be an infrared temperature sensor so as to measure the surface temperature of the container **10** in a non-contact manner, and the sensor **141** may measure the surface temperature of the container **10** disposed in the heating space **121** while being fixed to the mounting member **142**.
[0168] Accordingly, the control part **150** may output information about the container **10** detected through the sensor **141** to the display **118**.
[0169] As a result, the user may check the thawing process of the biological material contained in the container **10** in real time through the information output from the display **118**, and may monitor whether the biological material is thawing within an appropriate temperature range.
[0170] To this end, as illustrated in FIGS. **9**, **12**, **25** and **28**, the sensor **141** may be coupled to the mounting member **142** so as to check the state of the container **10** disposed in the heating space **121**, and the mounting member **142** may be coupled to a fixing table **147** that is fixedly coupled to the support **164**.
[0171] In this case, the heating blocks **122***a*, **122***b* may include placement holes **129***a*, **129***b* which are formed in a shape corresponding to the sensor **141** such that the sensor **141** can enter the heating space **121** side.
[0172] That is, as illustrated in FIGS. **14** and **30**, the placement holes **129***a*, **129***b* may be formed to pass through the first heating block **122***a* and the second heating block **122***b*, respectively, and the placement holes **129***a*, **129***b* may be formed by joining a portion **129***a* that is formed in the first heating block **122***a* and a portion **129***b* that is formed in the second heating block **122***b*.
[0173] Accordingly, when the thawing part **120** is located at the heating position, the sensor **141** does not come into contact with the container **10** disposed in the heating space **121** through the placement holes **129***a*, **129***b*, and may measure the surface temperature of the container **10** at a location very close to the container **10**.
[0174] Moreover, the temperature information measured by the sensor **141** may be used as information for detecting whether the container **10** is disposed in the heating space **121**.
[0175] In the above description, an infrared temperature sensor is exemplified as the sensor **141**, but the present invention is not limited thereto, and various known sensors may all be employed, and depending on the type of sensor employed, the information of the container **10** measured may vary.
[0176] Moreover, the mounting member **142** to which the sensor **141** is fixed may be detachably coupled to the fixing table **147**. Accordingly, when the sensor **141** needs to be replaced, the sensor **141** may be easily replaced by separating the mounting member **142** from the fixing table **147**.
[0177] The control part **150** may control the overall driving of the cell thawing machines **100**, **200** according to one embodiment of the present invention.
[0178] As illustrated in FIG. **3**, the control part **150** may include a circuit board **151** and a chipset **152** such as an MCU that is mounted on the circuit board **151**, and the control part **150** may control all operations of the thawing part **120**, the driving part **130**, the sensing part **140**, the display **118**, the manipulation part **117** and the position detection means described above.
[0179] In this case, when heating the container **10** accommodated in the heating space **121** at the heating position, the control part **150** may control the driving of the driving part **130** so as to heat the container while the first heating block **122***a* and the second heating block **122***b* are in contact

with each other, but it may also control the driving of the driving part **130** so as to heat the container **10** while the first heating block **122***a* and the second heating block **122***b* do not come into contact with each other.

[0180] That is, the control part **150** may set the heating position such that a predetermined gap is formed in the remaining portion except for portions where the opposing surfaces **127***a*, **127***b* for forming the heating space **121** are formed among the surfaces of the first heating block **122***a* and the second heating block **122***b* facing each other.

[0181] Through this, the cell thawing machines **100**, **200** according to one embodiment of the present invention may prevent a load that may occur in the motor **131** in order to maintain contact between the first heating block **122***a* and the second heating block **122***b* at the heating position.

[0182] Additionally, in the process of thawing the biological material contained in the container **10** at the heating position, the cell thawing machines **100**, **200** according to one embodiment of the present invention may discharge water vapor or moisture generated from the surface of the container **10** to the outside through the gap. Through this, the biological material contained in the container **10** may be thawed more smoothly.

[0183] Moreover, after preheating the heating blocks **122***a*, **122***b* to a predetermined temperature through driving of the heaters **123***a*, **123***b*, the control part **150** may start thawing the biological material contained in the container **10**.

[0184] As described above, the control part **150** may maintain the temperatures of the heating blocks **122***a*, **122***b* to be constant through PID control, and when the heating blocks **122***a*, **122***b* are provided in plurality, the control part **150** may individually control each of the heating blocks **122***a*, **122***b*.

[0185] Herein, the preheating temperature of the heating blocks **122***a*, **122***b* may be the same as the thawing temperature for thawing the biological material contained in the container **10** or may be a relatively higher temperature than the thawing temperature.

[0186] In addition, the control part **150** may maintain the temperatures of the heating blocks **122***a*, **122***b* to be constant while the container **10** which is introduced into the heating space **121** is completely thawed and the heating blocks **122***a*, **122***b* are changed to the standby position.

[0187] Through this, the cell thawing machines **100**, **200** according to one embodiment of the present invention may be changed between a heating position and a standby position while the heating blocks **122***a*, **122***b* are continuously maintained at a constant temperature.

[0188] Accordingly, when the cell thawing machines **100**, **200** according to one embodiment of the present invention are used, the user may sequentially introduce and remove a plurality of containers **10** into the heating space **121** to perform thawing, thereby minimizing the waiting time increase work productivity.

[0189] Meanwhile, the cell thawing machine **200** according to one embodiment of the present invention may conveniently perform qualification evaluation in order to verify the operating temperature of the heating block.

[0190] To this end, the cell thawing machine **200** according to one embodiment of the present invention may further include a sensor insertion hole **180**, and the sensor insertion hole **180** may be formed to be drawn at a certain depth from one surface of the heating blocks **122***a*, **122***b*.

[0191] The sensor insertion hole **180** may be a space into which a calibration sensor is inserted during calibration in order to check whether the heating blocks **122***a*, **122***b* are normally operating.

[0192] For example, the calibration sensor (not illustrated) may be a bar-shaped temperature sensor having a predetermined length, and a partial length of the calibration sensor may be inserted into the sensor insertion hole **180**.

[0193] Accordingly, since the checker may easily measure the temperatures of the heating blocks **122***a*, **122***b* through the calibration sensor inserted into the sensor insertion hole **180**, it is possible to check whether the cell thawing machines **100**, **200** according to one embodiment of the present invention are normally operating.

[0194] Although the sensor insertion hole **180** may be provided as one, when the heating blocks **122***a*, **122***b* include the above-described first heating block **122***a* and second heating block **122***b*, it may be provided in plurality so as to be respectively formed in the first heating block **122***a* and the second heating block **122***b*.
[0195] In this case, the sensor insertion hole **180** may be formed on a side surface of the heating blocks **122***a*, **122***b*, but as illustrated in FIG. **18**, the sensor insertion hole **180** may be formed on the heating blocks **122***a*, **122***b* to be drawn in at a certain depth from the upper surface to the lower portion of the heating block **122***a*, **122***b*.
[0196] In addition, when the cell thawing machines **100**, **200** according to one embodiment of the present invention include auxiliary heat insulating blocks **124***c*, **124***d* for covering the upper surfaces of the heating blocks **122***a*, **122***b*, the sensor insertion hole **180** may be formed on the heating blocks **122***a*, **122***b* so as to be inserted from the upper surface to the lower portion of the heating blocks **122***a*, **122***b* to a certain depth while penetrating the auxiliary heat insulating blocks **124***c*, **124***d*.
[0197] Accordingly, when the upper cover **114** on which the inlet **115** is formed is separated from the housing **110**, the sensor insertion holes **180** formed on the upper surfaces of the heating blocks **122***a*, **122***b* and auxiliary heat insulating blocks **124***c*, **124***d* may be exposed to the outside.
[0198] As a result, even if only the upper cover **114** is separated from the housing **110** without the need to separate the entire housing in the cell thawing machines **100**, **200** according to one embodiment of the present invention, the sensor insertion hole **180** for calibration may be exposed to the outside.
[0199] In addition, since the sensor insertion hole **180** is drawn at a certain depth from the upper surfaces to the lower portion of the heating block **122***a*, **122***b* in the cell thawing machines **100**, **200** according to one embodiment of the present invention, the calibration sensor inserted into the sensor insertion hole **180** may maintain a state of being inserted upright into the sensor insertion hole **180** even without a separate fixing means.
[0200] Through this, after separating the upper cover **114**, the checker may insert a partial length of the calibration sensor into the sensor insertion hole **180** formed on the upper surface of the heating block **122***a*. **122***b*, and then, it is possible to conveniently and accurately measure the operating temperatures of the heating block **122***a*, **122***b*.
[0201] In this case, the sensor insertion hole **180** may be formed to be located directly above the temperature sensors **128***a*, **128***b* that are embedded in the heating blocks **122***a*, **122***b*.
[0202] For example, as illustrated in FIG. **19**, the sensor insertion hole **180** may be formed in the heating blocks **122***a*, **122***b* such that a lower end, which is a sealed end, is located directly above the temperature sensors **128***a*, **128***b*, and the lower end of the sensor insertion hole **180** may be formed on the heating block **122***a*, **122***b* to have a gap of 1 mm to 5 mm from the temperature sensor **128***a*, **128***b*.
[0203] Accordingly, during calibration, the temperatures of the heating blocks **122***a*, **122***b* measured by the calibration sensor inserted into the sensor insertion hole **180** may be similar to the temperatures of the heating blocks **122***a*, **122***b* measured by the temperature sensors **128***a*, **128***b*, when the cell thawing machines **100**, **200** according to one embodiment of the present invention operate.
[0204] As a result, when calibration of the cell thawing machine **200** according to one embodiment of the present invention is performed by using the sensor insertion hole **180**, the temperatures of the heating blocks **122***a*, **122***b* measured through the calibration sensor are similar to the temperatures of the heating blocks **122***a*, **122***b* measured by the temperature sensors **128***a*, **128***b* during normal operation, and thus, the calibration result may secure high reliability.
[0205] Hereinafter, the method for operating the above-described cell thawing machines **100**, **200** will be described with reference to FIGS. **13** to **17** and FIGS. **29** to **34**.
[0206] First of all, as a preparation step, a cover **116** for covering the inlet **115** is removed, and

power is supplied to the cell thawing machines **100**, **200**.
[0207] When power is applied to the cell thawing machines **100**, **200**, the control part **150** may drive the driving part **130** to change the thawing part **120** to a standby position.
[0208] That is, as illustrated in FIGS. **13** and **29**, the control part **150** may drive the motor **131** to raise the moving member **136**. Accordingly, the first heating block **122***a* and the second heating block **122***b* may be slid and moved away from each other, and may be changed to a standby position of being spaced apart from each other at a predetermined interval.
[0209] If the first heating block **122***a* and the second heating block **122***b* are located in the standby position, the preparation step of changing the thawing part **120** to the standby position when power is applied may be omitted.
[0210] Next, as a first step (S**1**), the control part **150** may operate the first heater **123***a* and the second heater **123***b* to preheat the first heating block **122***a* and the second heating block **122***b* to a predetermined temperature.
[0211] For example, the preheating temperature of the first heating block **122***a* and the second heating block **122***b* may be equal to or relatively higher than the thawing temperature for thawing the biological material contained in the container **10**.
[0212] In this case, the preheating of the first heating block **122***a* and the second heating block **122***b* may be performed in a state where surfaces of the first heating block **122***a* and the second heating block **122***b* facing each other are in contact with each other.
[0213] That is, as illustrated in FIGS. **14** and **30**, the control part **150** may lower the moving member **136** by driving the motor **131**. Accordingly, the first heating block **122***a* and the second heating block **122***b* may slid and moved in a direction closer to each other in the standby position, respectively, and they may be changed to a state where surfaces of the first heating block **122***a* and the second heating block **122***b* facing each other are in contact with each other.
[0214] In this state, the control part **150** may control the driving of the motor **131** such that the contact state of the first heating block **122***a* and the second heating block **122***b* may be maintained until the preheating of the first heating block **122***a* and the second heating block **122***b* is finished.
[0215] Accordingly, while the first heating block **122***a* and the second heating block **122***b* are in contact with each other, the first heating block **122***a* and the second heating block **122***b* may be simultaneously heated through a first heater **123***a* and a second heater **123***b* that are respectively placed on both sides, and thus, the first heating block **122***a* and the second heating block **122***b* may be quickly heated to a predetermined temperature through heat transferred from the first heater **123***a* and the second heater **123***b*.
[0216] Thereafter, when the preheating of the first heating block **122***a* and the second heating block **122***b* is completed, the control part **150** may output a message indicating that the preheating is completed to the display **118**, and the control part **150** may slide and move the first heating block **122***a* and the second heating block **122***b* by driving the motor **131**.
[0217] Through this, as illustrated in FIGS. **15** and **31**, the first heating block **122***a* and the second heating block **122***b* may be changed to a standby position of being spaced apart from each other at a predetermined interval, and the support pins **133** may be raised upward to a predetermined height.
[0218] In this way, when the preheating of the first heating block **122***a* and the second heating block **122***b* is completed, the user may check the set thawing time through the display **118**, and if the set thawing time needs to be changed, the user may manipulate the manipulation part **117** to change the set thawing time to an appropriate time.
[0219] Next, as illustrated in FIGS. **15** and **31**, in a state where the first heating block **122***a* and the second heating block **122***b* are located in the standby position, the user may dispose a container **10** that needs to be thawed at the end of the support pins **133** that protrude upward at a certain height between the first heating block **122***a* and the second heating block **122***b* that are disposed in the standby position.
[0220] Thereafter, the user may input a thawing start signal through the manipulation part **117** in a

state where the container **10** that needs to be thawed is disposed at the end of the support pins **133**.

[0221] Accordingly, the control part **150** may heat the container **10** so as to thaw the biological material contained in the container **10** as a second step (S**2**).

[0222] That is, the control part **150** may lower the moving member **136** by driving the motor **131** such that the first heating block **122***a* and the second heating block **122***b* can be moved in a direction closer to each other.

[0223] Accordingly, as illustrated in FIGS. **16** and **31**, the first heating block **122***a* and the second heating block **122***b* may be changed from a standby position to a heating position for forming a heating space **121** for accommodating and heating the container **10**, and as described above, the support pins **133** may be lowered together with the moving member **136** such that one end protrudes from a portion forming the bottom surface of the heating space **121** at a certain height.

[0224] Accordingly, the container **10** may have a circumferential surface surrounded by the first heating block **122***a* and the second heating block **122***b* in a state of being disposed in the heating space **121**, and a lower portion of the container **10** disposed in the heating space **121** may be disposed in the heating space **121** while being spaced apart from the bottom surface of the heating space **121** by a predetermined interval through the support pins **133**, and the sensor **141** may measure the surface temperature of the container **10** in a very close position without contacting the container **10** that is disposed in the heating space **121** through the placement holes **129***a*, **129***b*.

[0225] Through this, the container **10** may be heated by the thawing time set by the user through the heat transferred from the first heating block **122***a* and the second heating block **122***b*, and through the sensor **141**, it is possible to measure the state of the container **10** in real time.

[0226] In this case, the control part **150** may output a message indicating that it is thawing to the display **118**, and based on the temperature information transmitted from the first temperature sensor **128***a* and the second temperature sensor **128***b*, the temperatures of the first heating block **122***a* and the second heating block **122***b* may be maintained to be constant by controlling the operation of the first heater **123***a* and the second heater **123***b*, and the state information about the container **10** detected through the sensor **141** may be output to the display **118** through driving of the control part **150**.

[0227] In this case, as described above, while the container **10** disposed in the heating space **121** is not in contact with the first heating block **122***a* and the second heating block **122***b*, it may be heated by the heat transferred from the first heating block **122***a* and the second heating block **122***b* in a non-contact manner.

[0228] That is, while the container **10** is inserted into the heating space **121**, the circumferential surface of the container **10** may be spaced apart by a predetermined interval with the opposing surface **127***a* of the first heating block **122***a* and the opposing surface **127***b* of the second heating block **122***b* forming the heating space **121**, and the lower surface of the container **10** may be spaced apart by a predetermined height from a portion forming the bottom surface of the heating space **121** through the support pins **133**.

[0229] Through this, a gap (d) may be formed between the pair of opposing surfaces **127***a*, **127***b* and the outer surface of the container **10** in a state where the container **10** is disposed in the heating space **121**.

[0230] Accordingly, the heat stored in the first heating block **122***a* and the second heating block **122***b* may be transferred to the relatively low-temperature container **10** through convection and/or radiation instead of conduction.

[0231] As a result, since the circumferential surface of the container **10** may be heated through convective heat and/or radiant heat, the circumferential surface of the container **10** may be uniformly heated by convective heat and/or radiant heat transferred from the heating block **122***a*, **122***b*.

[0232] Additionally, in the second step (S**2**), the control part **150** may control the driving of the motor **131** so as to heat the container **10** in a state where the first heating block **122***a* and the

second heating block **122***b* are in contact with each other, but it may control the driving of the motor **131** so as to heat the container **10** in a state where the first heating block **122***a* and the second heating block **122***b* do not contact each other.
[0233] That is, the control part **150** may set the heating position such that a predetermined gap is formed in the remaining portion except for portions where the opposing surfaces **127***a*, **127***b* for forming the heating space **121** are formed among the surfaces of the first heating block **122***a* and the second heating block **122***b* facing each other.
[0234] Through this, the cell thawing machines **100**, **200** according to one embodiment of the present invention may prevent a load that may occur in the motor in order to maintain the state where the first heating block **122***a* and the second heating block **122***b* are in contact with each other in the heating position, and in the process of thawing the biological material contained in the container **10** at the heating position, it is possible to discharge water vapor or moisture generated from the surface of the container **10** to the outside through the gap, and thus, it is possible to thaw the biological material more smoothly.
[0235] Next, when the thawing time set by the user elapses, the control part **150** may output a message indicating completion to the display **118**, and as a third step (S**3**), the control part **150** may drive the motor **131** to change the first heating block **122***a* and the second heating block **122***b* to a standby position.
[0236] Accordingly, as illustrated in FIGS. **17** and **33**, the user may remove the container **10** disposed between the first heating block **122***a* and the second heating block **122***b* while the first heating block **122***a* and the second heating block **122***a* are located in the standby position.
[0237] In this case, the control part **150** may control the driving of the first heater **123***a* and the second heater **123***b* such that the temperatures of the first heating block **122***a* and the second heating block **122***b* are continuously maintained to be constant.
[0238] Accordingly, the user may sequentially thaw a plurality of containers **10** by sequentially repeating the first step (S**1**) and the second step (S**2**).
[0239] Although one exemplary embodiment of the present invention has been described above, the spirit of the present invention is not limited to the exemplary embodiments presented herein, and those skilled in the art who understand the spirit of the present invention may easily suggest other exemplary embodiments by changing, modifying, deleting or adding components within the scope of the same spirit, but this will also fall within the scope of the present invention.

Claims

1. A cell thawing machine, comprising: a thawing part comprising heating blocks, wherein the heating blocks comprise a first heating block and a second heating block forming a heating space for heating a container in which a predetermined amount of biological material comprising cells is stored, heaters are installed in the heating blocks to provide heat to the heating blocks, and heat insulating blocks are coupled to the heating blocks so as to surround the heaters; a driving part for providing a driving force for raising and lowering support pins such that the support pins can support a lower portion of the container, and linearly moving the first heating block and the second heating block to the left and right directions; and a control part for controlling the thawing part and the driving part.
2. The cell thawing machine according to claim 1, wherein the container disposed in the heating space is heated by heat transferred from the heating blocks in a non-contact manner in a state where a lower portion of the container is supported through the support pins and the container is not in contact with the heating blocks.
3. The cell thawing machine according to claim 1, wherein the heating block is made of a thermally conductive material.
4. The cell thawing machine according to claim 1, wherein the heating block comprises an

arrangement groove, wherein the arrangement groove is formed to be drawn inward on one surface, the heater is inserted into the arrangement groove, and the heat insulating block is coupled to the heating block so to cover the arrangement groove.

5. The cell thawing machine according to claim 1, wherein the heating space is formed through opposing surfaces that are each drawn inward to have a shape corresponding to the circumferential surface of the container on surfaces facing each other in the first heating block and the second heating block.

6. The cell thawing machine according to claim 5, wherein the opposing surfaces are formed to surround a side portion and lower portion of the container.

7. The cell thawing machine according to claim 1, wherein the heating block comprises a through-hole, wherein the through-hole is formed to penetrate such that an end of the support pin can pass toward the heating space.

8. The cell thawing machine according to claim 1, wherein the thawing part further comprises an auxiliary heat insulating block, wherein the auxiliary heat insulating block covers an upper surface of the heating block.

9. The cell thawing machine according to claim 1, wherein the thawing part comprises a temperature sensor, wherein the temperature sensor is installed on the heating block to measure the temperature of the heating block.

10. The cell thawing machine according to claim 9, wherein the cell thawing machine further comprises a sensor insertion hole, wherein the sensor insertion hole is formed to be drawn at a certain depth from an upper surface of the heating block to a lower portion such that a calibration sensor for measuring the temperature of the heating block can be inserted therein, and wherein the sensor insertion hole is formed to be located directly above the temperature sensor.

11. The cell thawing machine according to claim 1, wherein the driving part comprises a motor for providing a driving force, a rotating member, wherein the rotating member is axially coupled to a rotating shaft of the motor, a moving member, wherein the moving member is raised and lowered along the rotating member when the rotating member rotates, the support pins are coupled to the moving member such that the support pins can support a lower portion of the container by moving up and down along with the moving member, and a power transmission member for interconnecting the moving member and the thawing part such that the first heating block and the second heating block can be moved linearly in the left and right directions, respectively, through a driving force of the motor.

12. The cell thawing machine according to claim 11, wherein the power transmission member comprises a guide block, wherein the guide block is fixedly coupled to the heat insulating block, a guide rail for guiding the linear movement of the guide block, and a link member for linking the guide block and the moving member to each other.

13. The cell thawing machine according to claim 1, wherein the cell thawing machine further comprises a sensor for detecting the state of the container disposed in the heating space.

14. The cell thawing machine according to claim 1, wherein the cell thawing machine further comprises a limit switch for detecting the position of the heating block through contact with the heat insulating block.

15. The cell thawing machine according to claim 1, wherein the cell thawing machine further comprises a non-contact position detection sensor for detecting the position of the heating block.

16. The cell thawing machine according to claim 1, wherein the cell thawing machine comprises a housing having an inlet, wherein the inlet is formed through a position corresponding to the heating space.

17. The cell thawing machine according to claim 16, wherein the cell thawing machine further comprises a sensor insertion hole, wherein the sensor insertion hole is formed to be drawn at a certain depth from an upper surface of the heating block to a lower portion such that a calibration sensor for measuring the temperature of the heating block can be inserted therein, wherein the housing comprises a box-shaped main body and an upper cover, wherein the upper cover is detachably coupled to the main body so as to cover an upper portion of the main body, wherein the inlet is formed on the upper cover to be located at a position corresponding to the heating space, and wherein the sensor insertion hole is exposed to the outside when the upper cover and the main body are separated.

18. The cell thawing machine according to claim 1, wherein when heating the container accommodated in the heating space, the control part controls the driving of the driving part to heat the container in a state where the first heating block and the second heating block are not in contact with each other.

19. The cell thawing machine according to claim 1, wherein the control part individually controls the temperatures of the first heating block and the second heating block.

20. A method for operating a cell thawing machine comprising heating blocks, wherein the heating blocks comprise a first heating block and a second heating block for forming a heating space for accommodating a container in which a predetermined amount of biological material comprising cells is stored through linear movement by a driving force of a motor, and heating the container accommodated in the heating space through heat provided from a heater; and support pins are raised and lowered to support a lower portion of the container disposed in the heating space in connection with the linear movement of the heating block, the method comprising: a first step of preheating the first heating block and the second heating block to a predetermined temperature by driving the heater while one surface of the first heating block and one surface of the second heating block facing each other are in contact with each other; a second step of heating the container disposed in the heating space to thaw the biological material while the first heating block and the second heating block are changed to a heating position forming the heating space; and a third step of changing the first heating block and the second heating block to a standby position by moving the same in a direction away from the heating position such that the container disposed in the heating space can be removed, wherein in the second step, the container disposed in the heating space is heated by heat transferred from the first heating block and the second heating block in a non-contact manner in a state where a lower portion of the container is supported through the support pins and the container is not in contact with the first heating block and the second heating block.
