

REGENERATIVE CELL EXTRACTION SYSTEM

TECHNICAL FIELD

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The present invention relates to a regenerative cell extraction system, and more particularly, to a regenerative cell extraction system in which all processes from collecting fat tissues to separating regenerative cells from the fat tissues can be automatically performed in a sealed state by executing a program, pure fat tissues, pure
10 matured fat cells, oil, and fat-derived stem cells can be selectively obtained in each of all processes and the amount of the collected regenerative cells can be easily adjusted.

BACKGROUND ART

Stem cells are defined as cells that have clonogenic and self-renewing
15 capabilities and that differentiate into multiple cell lineages. Whereas embryonic stem cells are derived from mammalian embryos in the blastocyst stage and have the ability to generate any terminally differentiated cell in the body, adult stem cells are part of tissue-specific cells of the postnatal organism into which they are committed to differentiate. Adult stem cells offer practical advantages over embryonic stem cells.
20 Unlike the latter, they do not raise any ethical issue, and can be extracted from the patient himself. They are in abundant supply and are intrinsic to various tissues of the human body. The most accessible sources of adult stem cells are the bone marrow, peripheral blood, umbilical cord blood and possibly adipose tissues, as indicated by recent studies. These cells are capable of maintaining, generating and replacing
25 terminally differentiated cells within their own specific tissue as a consequence of physiologic cell turnover or tissue damage due to injury.

Such capability, known as cell plasticity, has led to the development of therapeutic applications targeting the regeneration of defected tissues, with the goal to restore the physiology and functionality of the affected organ. Adult stem cells can give rise to
30 hematopoietic cells as known since many decades, but as found in recent years can also give rise to blood vessels, muscles, bone, cartilage, skin, neurons etc. Such cells are known as mesenchymal stem cells. In addition, platelets prepared as platelets concentrate can be used to accelerate wound healing, and consequently can play a role in regenerative medicine to help in the reconstruction of tissues like bone, skin or other

tissues.

Fat tissue has recently been found to be a source of stem cells, progenitor cells and matrix suitable for therapeutic applications. Also, fat tissue is a rich source of endothelial cells that promote the growth of new blood vessels and stimulate the growth of stem and progenitor cells, thereby contributing to tissue regeneration and tissue engineering.

While many devices have been developed to collect cells from fat tissue, they are not efficient in adopting a suction device for removing fat tissue in an optimum state or are not partially or fully automated of all processes from collecting fat tissue to processing the fat tissue. In addition, they do not include a system in which all processes from collecting fat tissue to processing the fat tissue can be automatically performed in a partially or fully sealed state, and thus, contamination occurs due to a lack of the sealing system.

Accordingly, there is a need for the development of a method and a device which can automatically perform all processes from collecting fat tissue to processing the fat tissue in a sealed state and can increase the purity of regenerative cells extracted from the fat tissue, i.e., stem cells, to reduce the amount of the regenerative cells by an amount at which the regenerative cells are finally put in a syringe and can be immediately used and which can reduce the necessity of manipulation after the regenerative cells have been extracted.

DETAILED DESCRIPTION OF THE INVENTION

TECHNICAL PROBLEM

The present invention provides a regenerative cell extraction system which can automatically perform all processes from collecting fat tissues to processing the fat tissues in a sealed state by executing a program, which can reduce the amount of the regenerative cells by an amount at which the regenerative cells are finally put in a syringe and can be immediately used, by improving the purity of the regenerative cells extracted from the fat tissues and which reduces the necessity of additional manipulation after the regenerative cells have been extracted.

TECHNICAL SOLUTION

According to an aspect of the present invention, there is provided a regenerative cell extraction system including a first unit, a second unit, and a transfer unit.

The first unit may collect tissues by vacuum suction, may separate blood contaminants from the collected tissues by agitation and centrifugation, and may
5 separate cells from the tissues from which blood contaminants have been separated to discharge the cells suspended in liquid.

The cells suspended in liquid may be inputted from the first unit into the second unit, and the second unit may separate regenerative cells by centrifugation, and a capacity of the second unit may be smaller than a capacity of the first unit.

10 The transfer unit may be connected between the first unit and the second unit, may inject washing water into the first unit and the second unit, may deliver extracts from the first unit and the second unit to corresponding bags, and may input the cells suspended in liquid extracted in the first unit into the second unit or may transfer tissues and cell contaminants.

15 ADVANTAGEOUS EFFECTS

As described above, in a regenerative cell extraction system according to an embodiment of the present invention, all processes from collecting fat tissues to extracting regenerative cells can be automatically performed by using a program, and
20 the fat tissues are moved and separated in a sealed state, and when the regenerative cells are separated from the fat tissues, fat tissues, matured fat cells, oil (fat), and fat-derived stem cells can be selectively obtained in each of all processes, and even when a large capacity of fat tissues is required, as used in breast augmentation, a large amount of pure fat and fat-derived stem cells can be obtained with an one time operation
25 and thus it is very convenient. In addition, a structure of a lower plate inside a second chamber is modified in various shapes so that only components can be selectively separated from blood, and the like. In this case, a large amount of desired tissues can be continuously separated from blood, and the like regardless of the capacity of the second chamber.

30 Furthermore, rotation speeds and other operations of a first unit and a second unit are automated by a program so that all processes from extracting tissues to separating stem cells from the tissues and storing the stem cells can be automatically performed with a predetermined capacity for a predetermined amount of time. In addition, a filter

is mounted on a transfer unit so that various cells including stem cells can be separated from various tissues.

DESCRIPTION OF THE DRAWINGS

5 FIG. 1 is a conceptual view of a regenerative cell extraction system according to an exemplary embodiment of the present invention;

FIG. 2A is a cross-sectional view of a structure of a first unit;

FIG. 2B illustrates another structure of the first unit illustrated in FIG. 2A;

FIG. 3 is a cross-sectional view of a structure of a second unit;

10 FIG. 4 is a plan view of a structure of a lower plate illustrated in FIG. 3;

FIG. 5 is a plan view of another structure of the lower plate illustrated in FIG. 3;

FIG. 6A is a plan view of a selection discharge unit to be combined with the lower plate of FIG. 5;

15 FIG. 6B is a side cross-sectional view of the selection discharge unit illustrated in FIG. 6A;

FIG. 6C is a cross-sectional view of a second unit for explaining a structure in which the selection discharge unit of FIG. 6A is combined with the lower plate of FIG. 5;

FIG. 7 is a plan view of another structure of the lower plate of FIG. 3;

20 FIG. 8 is a cross-sectional view illustrating the case where the lower plate illustrated in FIG. 7 is mounted; and

FIG. 9 is a cross-sectional view illustrating the case where another structure of a lower plate is mounted on a second chamber.

BEST MODE

25 According to an aspect of the present invention, there is provided a regenerative cell extraction system including a first unit, a second unit, and a transfer unit.

The first unit may collect tissues by vacuum suction, may separate blood contaminants from the collected tissues by agitation and centrifugation, and may separate cells from the tissues from which blood contaminants have been separated to
30 discharge the cells suspended in liquid.

The cells suspended in liquid may be inputted from the first unit into the second unit, and the second unit may separate regenerative cells by centrifugation, and a capacity of the second unit may be smaller than a capacity of the first unit.

The transfer unit may be connected between the first unit and the second unit, may inject washing water into the first unit and the second unit, may deliver extracts from the first unit and the second unit to corresponding bags, and may input the cells suspended in liquid extracted in the first unit into the second unit or may transfer tissues and cell contaminants.

The tissues may be fat tissues, and the regenerative cells may be fat-derived stem cells.

The first unit may include: a first chamber including an upper body having a cylindrical shape, an intermediate body integrated with a lower portion of the upper body and inclined towards a center of the first chamber as the intermediate body gets closer to a lower portion of the first chamber, a lower body integrated with the intermediate body, having a diameter that is equal to or less than an inner diameter of the upper body, and extending in the lower portion of the first chamber, and a cover integrated with a top surface of the upper body and covering the top surface of the upper body; and a central pipe inserted in the bottom surface of the lower body via a guide hole formed in the center of the cover up to a position in which a lower end of the central pipe is spaced apart from the bottom surface of the lower body by a predetermined distance, wherein the fat tissues are inputted into the first chamber via an upper portion of the central pipe and the cells suspended in liquid are discharged from the first chamber, and wherein at least one first wing is formed on inner walls of the intermediate body of the first chamber in a direction of the central pipe in order to facilitate agitation of extracted tissues.

The first chamber may include: a negative pressure pipe inserted in the guide hole by surrounding the central pipe, integrated with the central pipe and making the first chamber in a vacuum negative pressure state; and retainers mounted between a wall that constitutes the guide hole and the negative pressure pipe and allowing the first chamber to rotate independently with the central pipe and the negative pressure pipe and to be maintained in a sealed state.

The position in which a lower end of the central pipe is spaced apart from the bottom surface of the lower body by a predetermined distance may be between 0.1 and 3 mm from the bottom surface of the lower body. The central pipe may include at least one secondary wing that protrudes from an outside of a portion in which the central pipe is inserted in an inside of the first chamber.

Bearings that facilitate rotation of the first chamber may be further mounted

between the wall that constitutes the guide hole and the negative pressure pipe, together with the retainers, and a filter that filters foreign substances that exist in tissues inputted via the central pipe may be disposed inside the lower body in the lower portion of the central pipe.

5 The second unit may include: an inlet portion having a predetermined diameter and extending in a vertical, downward direction, an upper body having a cylindrical shape in which an inner diameter of the upper body increases from a lower end of the inlet portion to a lower portion of the upper body and decreases from a cell separator having a maximum inner diameter to the lower portion of the upper body, and a lower
10 body integrated with the lower portion of the upper body, having a predetermined inner diameter and extending in a downward direction; a lower plate installed to correspond to an inside of the upper plate when the upper plate is defined from a unit, of which an inner diameter increases from a lower end of the inlet portion to a lower portion of the unit, to the cell separator, wherein a physiological buffer solution other than regenerative cells
15 that exist in the second chamber is discharged along a passage between the upper plate and the lower plate, the lower plate including a first inner inlet integrated with an upper end of the lower plate and having a cylindrical shape with a first inner diameter, and a second inner inlet surrounding the first inner inlet, having a larger second inner diameter than the first inner diameter and extending in an inside of the inlet portion; an input pipe
20 inserted in the second chamber via the first inner inlet in order to input the cells suspended in liquid discharged from the first unit into the second chamber; a first discharge pipe perforating an inside of the input pipe, inserted in the second chamber to be longer than the input pipe and being a passage which is formed on a bottom surface of the second body of the second chamber and through which regenerative cells are
25 discharged; and a second discharge pipe inserted between an outer wall of the second inner inlet and an inner wall of the inlet portion and discharging a physiological buffer solution other than the regenerative cells discharged via the passage between the upper plate and the lower plate to an outside, wherein the second chamber rotates by retainers independently with the input pipe, the first discharge pipe, and the second discharge
30 pipe and is maintained in a sealed state.

The input pipe may include a first support wing that surrounds the outer wall of the first inner inlet and the second discharge pipe includes a second support wing that surrounds the inlet portion, and the retainers may be mounted between inner walls of the

first support wing and the second inner inlet and between an outer wall of the inlet portion and the second support wing in order to rotate the second chamber independently and to maintain the second chamber in a sealed state.

Bearings that facilitate rotation of the second chamber may be further mounted
5 between inner walls of the first support wing and the second inner inlet and between an outer wall of the inlet portion and the second support wing, together with the retainers.

The input pipe may be inserted in a lower end of the upper body, and the first discharge pipe may be inserted from the bottom surface of the lower body to a height of 0.1 to 2 mm.

10 The second chamber may include at least one second wing that facilitates agitation of material inputted in the second chamber in a direction of the input pipe when the second chamber on an inner wall from the cell separator to the lower end of the upper body rotates.

The lower plate may include the first inner inlet and the second inner inlet; and a
15 circular plate integrated with lower ends of the first inner inlet and the second inner inlet, having the same gradient as a gradient of the upper plate, being unfolded in the form of a bamboo hat, and constituting the passage together with the upper plate, wherein at least one passage is formed between the upper plate and the lower plate, and predetermined portions of the circular plate between passages are attached to the upper plate.

20 Rotation speed of the second chamber and a length of the circular plate may be adjusted so that blood can be extracted from a blood component layer disposed in the second chamber due to a centrifugal force of the second chamber and an amount of the physiological buffer solution other than the regenerative cells in the second chamber to be discharged through the passage can be adjusted.

25 The lower plate may include: the first inner inlet and the second inner inlet; a circular plate integrated with lower ends of the first inner inlet and the second inner inlet, having the same gradient as a gradient of an upper plat, being unfolded in the form of a bamboo hat, and forming a passage together with the upper plate; and a selection discharge unit surrounding an outside of the second inner inlet of the lower plate,
30 connecting at least one passage from among passages selectively to the second discharge pipe and having a hollow, flat disc shape, wherein at least one passage is formed between the upper plate and the lower plate, and portions of the circular plate between the passages are attached to the upper plate, and when the circular plate is

separated from the lower plate in a direction of a diameter of the circular plate, weights of half separated portions are the same, and lengths of passages formed in one half portion are different from each other, and opposite passages formed in each of half separated portions have the same lengths, and a through hole through which the second inner inlet is formed, and a top surface discharge hole connected to the second discharge pipe at both sides of the through hole are formed on a top surface of the selection discharge unit, and a side discharge hole connected to the selected passage is formed in a side surface of the selection discharge unit, and a lower end of the side surface of the selection discharge unit is combined with a combination groove formed in a top surface of the circular plate, and the selection discharge unit selects the corresponding passage when the selection discharge unit rotates in the state where the side lower end of the selection discharge unit is closely combined with the combination groove.

A filtering net that filters the remainder of undigested tissues including a lump of enzymes or material, such as collagenase, from liquid cells inputted via the input pipe may be installed inside the lower body disposed in the lower portion of the input pipe.

The lower plate may include: the first inner inlet and the second inner inlet; a circular plate unit including a circular plate integrated with lower ends of the first inner inlet and the second inner inlet, having the same gradient as a gradient of the upper plate and being unfolded in the form of a bamboo hat, and a plurality of cylindrical wings integrated with an end of the circular plate and each having a passage formed in an inside of the plurality of cylindrical wings; and a selection discharge unit surrounding an outside of the second inner inlet of the lower plate, selecting at least one cylindrical wing from among the cylindrical wings, and has a hollow, flat disc shape in which the passage in the selected cylindrical wing is connected to the second discharge pipe, and top surfaces of the cylindrical wings are attached to the upper plate, and the cylindrical wings have different lengths, and component blood can be extracted by differentiating a blood component layer formed in the second chamber due to a centrifugal force of the second chamber, and a through hole through which the second inner inlet is formed, and a top surface discharge hole connected to the second discharge pipe at both sides of the through hole are formed in the top surface of the selection discharge unit, and a side discharge hole connected to the selected passage is formed in a side surface of the selection discharge unit, and a lower end of the side surface of the selection discharge unit is combined with a combination groove formed in a top surface of the circular plate,

and. when the selection discharge unit is closely combined with the combination groove and rotates, the selection discharge unit selects the cylindrical wing.

The lower plate may include: the first inner inlet and the second inner inlet; a circular plate unit includsing a circular plate integrated with lower ends of the first inner inlet and the second inner inlet, having the same gradient as that of the upper plate and being unfolded in the form of a bamboo hat, and a plurality of cylindrical wings, of which one ends are combined with an end of the circular plate and an inner wall of the second chamber, each of which has a passage formed therein, and each having the other ends on which weight pendulums with different or the same weights in order to make balance of the cylindrical wings are mounted, and when the second chamber rotates, the cylindrical wings are unfolded in a direction of an inner wall of the second chamber based on a centrifugal force generated by rotation of the second chamber, and component blood can be extracted from a blood component layer.

The circular plate unit may include two symmetrical cylindrical wings, and the weight pendulums mounted on the cylindrical wings have the same weights.

The transfer unit may include a first multi-way valve connected to the plurality of bags, a second multi-way valve connected to the first unit and the second unit, and pumps that connect the first multi-way valve and the second multi-way valve.

The transfer unit may include a plurality of solenoid valves connected to the plurality of bags, respectively, instead of the first multi-way valve and the second multi-way valve, and the transfer pipes controlled by the plurality of solenoid valves may be connected to the pumps.

A transfer filter that filter foreign substances, such as a lump of undigested collagenase included in liquid cells transferred from the first unit to the second unit may be inserted in the transfer unit. The transfer filter may include a double filter.

The regenerative cell extraction system may further include jigs on which the first unit and the second unit are mounted and which rotate while maintaining a constant temperature, the jigs controlling temperatures of the first unit and the second unit and rotation speeds of the first unit and the second unit.

MODE OF THE INVENTION

The attached drawings for illustrating preferred embodiments of the present invention are referred to in order to gain a sufficient understanding of the present

invention, the merits thereof, and the objectives accomplished by the implementation of the present invention.

Hereinafter, the present invention will be described in detail by explaining preferred embodiments of the invention with reference to the attached drawings. Like reference numerals in the drawings denote like elements.

FIG. 1 is a conceptual view of a regenerative cell extraction system 10 according to an exemplary embodiment of the present invention.

Referring to FIG. 1, the regenerative cell extraction system 10 according to the current embodiment of the present invention includes a first unit 100, a second unit 200, and a transfer unit 700.

The first unit 100 collects tissues by vacuum suction, separates blood contaminants from the collected tissues by agitation and centrifugation, and separates cells from the tissues from which the blood contaminants have been separated to discharge the cells suspended in liquid.

The cells suspended in liquid are inputted from the first unit 100 into the second unit 200, and the second unit 200 separates regenerative cells by centrifugation, and the capacity of the second unit 200 is smaller than that of the first unit 100.

That is, the capacity of the first unit 100 is larger than that of the second unit 200. When fat having a small capacity of, for example, about 100 cc or less, as used in facial plastic surgery, is processed, necessary stem cells may be extracted from fat by using only the second unit 200. However, the first unit 100 is required to process a large amount of fat that cannot be processed using only the second unit 200. For example, when tissue of about 1 liter is processed, the tissue is concentrated by the first unit 100 to have a small amount and then is delivered to the second unit 200, and stem cells are extracted from the tissue by using the second unit 200.

That is, the first unit 100 concentrates cells from a large amount of fat cells and delivers the concentrated cells to the second unit 200.

The transfer unit 700 is connected between the first unit 100 and the second unit 200, injects washing water into the first unit 100 and the second unit 200, delivers extracts from the first unit 100 and the second unit 200 to corresponding bags B1, B2, ..., and Bn, and inputs cells suspended in liquid extracted in the first unit 100 into the second unit 200 or transfers tissues and cell contaminants. Here, the tissues are fat tissues, and the regenerative cells are fat-derived stem cells.

As described in the related art, although many regenerative cell extraction devices have been developed to collect cells from fat tissues, they are not efficient in adopting a suction device for removing fat tissues in an optimum state or are not fully automated of all processes from collecting fat tissues to processing the fat tissues, and they do not include a complete sealing system. In addition, a system used in a process of concentrating desired cells is different from the regenerative cell extraction system 10 according to the present invention.

The regenerative cell extraction system 10 illustrated in FIG. 1 solves the above problems. That is, full automation whereby all processes from collecting fat tissues to extracting regenerative cells are controlled by a program, can be implemented, and the fat tissues are moved and separated in a sealed state, and when the regenerative cells are separated from the fat tissues, fat tissues after being washed, pure matured fat cells, oil (that is derived from fat cells), and fat-derived stem cells can be selectively obtained in each of all processes.

That is, the regenerative cell extraction system 10 may perform extracting fat-derived stem cells, recovering pure fat tissues from which blood-derived contaminants have been removed, and extracting pure matured fat cells and oil (that is derived from fat cells). The capacity of the first unit 100 may be larger than that of the second unit 200, and the fat tissues may be extracted directly from the human body by vacuum suction and may be inputted into the second unit 200. This process may be performed by connecting a fat suction unit directly to the first unit 100.

Thus, the danger of contamination is relatively low, and working processes are relatively simple compared to the case that an existing device soaks tissues extracted from the human body in a separate bag and transfers the tissues to a regenerative cell extraction device.

The transfer unit 700 is connected between the first unit 100 and the second unit 200 by pumps and valves, and injects necessary materials, such as washing water, enzymes, and the like, into the first unit 100 and the second unit 200, extracts cells suspended in liquid from which blood contaminants have been removed, from the first unit 100 and stores the extracted cells in separate bags B1, B2, ..., and Bn, or transfers liquid in which fat-derived stem cells are included, to the second unit 200, extracts the fat-derived stem cells from the second unit 200 and stores the extracted fat-derived stem cells in separate bags B1, B2, ..., and Bn.

When the transfer unit 700 is configured using pumps and valves, multi-way valves may be used as valves. The multi-way valves are flat and circular disc-shaped. In the multi-way valves, a plurality of passages is formed along a circumferential side of a disc, and a rotator that can select one from the plurality of passages is formed in the center of the disc. The passages may be connected to a plurality of corresponding bags B1, B2, ..., and Bn, and material is moved to or stored in a bag connected to a passage selected by the rotator. A connection hole is formed in a top surface of the rotator and is connected to a rotator of another multi-way valve.

The transfer unit 700 may include a first multi-way valve (not shown) connected to the plurality of bags B1, B2, ..., and Bn, a second multi-way valve (not shown) connected to the first unit 100 and the second unit 200, and pumps (not shown) that connect the first multi-way valve and the second multi-way valve. The second multi-way valve is connected to a central pipe (see 160 of FIG. 2A – 160) of the first unit 100 and an input pipe (see 270 of FIG. 3) of the second unit 200.

The first multi-way valve may have the number of passages that corresponds to the number of bags B1, B2, ..., and Bn, and the number of passages of the second multi-way valve may be equal to or less than the number of passages of the first multi-way valve. Pumps are disposed between the first multi-way valve and the second multi-way valve and allow material to be moved between the first multi-way valve and the second multi-way valve. In this case, peristaltic pumps may be used.

In addition, the transfer unit 700 includes a plurality of transfer pipes (not shown) and a plurality of solenoid valves (not shown) connected to the plurality of bags B1, B2, ..., and Bn, respectively, instead of the first multi-way valve and the second multi-way valve. The transfer unit 700 may be configured in such a way that the plurality of solenoid valves (not shown) control the plurality of transfer pipes (not shown) connected to pumps (not shown). That is, the plurality of bags B1, B2, ..., and Bn may be connected to the first unit 100 or the second unit 200 via the transfer pipes, and when the transfer pipes are open or closed by the solenoid valves, material discharged from the first unit 100 may be stored in the bags B1, B2, ..., and Bn connected to the transfer pipes.

Since a structure and an operation of the transfer unit 700 will be understood by one of ordinary skill in the art, a detailed description thereof will be omitted.

FIG. 2A is a cross-sectional view of a structure of the first unit 100.

Referring to FIG. 2A, the first unit 100 includes a first chamber 110 and a central pipe 160.

The first unit 100 rotates to remove blood contaminants from the fat tissues inputted from the first unit 100 and to separate cells from the fat tissues. The first unit
5 100 has a cylindrical shape in which a lower portion of the first unit 100 is taped to be inclined.

The first chamber 110 performs processes of aspirating fat tissues, removing blood-derived contaminants from the fat tissues, dehydrating (separating) pure fat tissues, and dissolving the fat tissues by using enzymes (collagenase is usually used but
10 another enzymes only may be used or another enzymes may be used by mixing with another one).

In more detail, the first chamber 110 includes an upper body 120 having a cylindrical shape, an intermediate body 130 integrated with a lower portion of the upper body 120 and inclined towards a center of the first chamber 110 as the intermediate
15 body 130 gets closer to a lower portion of the first chamber 110, a lower body 140 integrated with the intermediate body 130, having a diameter that is equal to or less than an inner diameter of the upper body 120, and extending in the lower portion of the first chamber 110, and a cover 150 integrated with a top surface of the upper body 120 and covering the top surface of the upper body 120. The shape of a bottom surface of the
20 lower body 140 may be diverse, and the lower body 140 may have a U shape in which the lower body 140 protrudes from its bottom surface slightly, as illustrated in FIG. 2A.

The first chamber 110 may have a diameter of about 120 mm and a height of about 170 mm, and the size of the first chamber 110 may be larger than the size of a second chamber (see 210 of FIG. 3) of the second unit 200 and may be adjusted based
25 on the capacity of fat tissues to be processed.

That is, when the capacity of the desired fat tissues is smaller than 1,000 cc, the height of the first chamber 110 may be about 50 mm, and when the capacity of the desired fat tissues is between 1,000 and 2,000 cc, the height of the first chamber 110 may be about 150 mm, and when the capacity of the desired fat tissues is between 2,000
30 and 3,000 cc, the height of the first chamber 110 may be about 250 mm. However, aspects of the present invention are not limited thereto, and the size of the first chamber 110 may be diverse.

The central pipe 160 is inserted in the bottom surface of the lower body 140 via a

guide hole 151 formed in the center of the cover 150 up to a position in which a lower end of the central pipe 160 is spaced apart from the bottom surface of the lower body 140 by a predetermined distance. The position in which the lower end of the central pipe 160 is spaced apart from the bottom surface of the lower body 140 by a predetermined distance, may be between 0.1 and 3 mm from the bottom surface of the lower body 140.

The fat tissues are inputted into the first chamber 110 via an upper portion of the central pipe 160, and the cells are discharged from the first chamber 110. A stopper is disposed in the uppermost portion of the central pipe 160. The stopper has the same structure (Luer-Lok structure) as that of a safety syringe, is connected directly to a fat suction unit, and allows fat sucked by a vacuum negative pressure applied to a negative pressure pipe 190 that will be described later to be inputted directly into the first chamber 110. The stopper is sealed until the stopper is mounted on a fat cell separator after fat has been sucked.

Even when the fat tissues are not sucked directly into the first chamber 110 but are put in another transfer bag and are conveyed, the transfer bag is connected to the uppermost portion of the central pipe 160, and the fat tissues may be transferred to the first chamber 100 by a negative pressure induced by a separate vacuum pump (that is usually attached to a fat extractor) connected to the negative pressure pipe 190 or may be transferred into the first chamber 100 by using pumps embedded in the regenerative cell extraction system 10 according to the present invention.

The negative pressure pipe 190 is disposed on the first chamber 110. The negative pressure pipe 190 is inserted in a guide hole 151 by surrounding the central pipe 160, is integrated with the central pipe 160 and makes the first chamber 110 in a vacuum negative pressure state. Retainers 180 are mounted between a wall 153 that constitutes the guide hole 151 and the negative pressure pipe 190. The retainers 180 allow the first chamber 110 to rotate independently with the central pipe 160 and the negative pressure pipe 190 and to be maintained in a sealed state.

Elements having a sealing function with assisting rotation, such as bearings, may also be used, instead of the retainers 180.

Bearings (not shown) that facilitate rotation of the first chamber 110 may be further mounted between the wall 153 that constitutes the guide hole 151 and the negative pressure pipe 190, together with the retainers 180. In addition, a filter (not

shown) that filters foreign substances that exist in tissue inputted via the central pipe 160, i.e., material other than fat tissues, for example, a lump of collagenase, or the like and facilitates processing of fat cells may be disposed inside the lower body 140 in the lower portion of the central pipe 160.

5 A filter 191 is mounted on the negative pressure pipe 190 in order to prevent a back flow of contaminated air. The negative pressure pipe 190 is a portion to which a negative pressure is applied in order to extract fat tissues in an operating room, i.e., a portion that can be connected to a vacuum suction unit. Thus, a stopper and a stopper combining portion of the negative pressure pipe 190 may have the same shape as that
10 of the safety syringe. The type of the filter 191 may be diverse, and the filter 191 may be an air filter having a thickness of 0.22 μm in order to prevent a back flow of air contaminated by the vacuum suction unit.

At least one first wing 170 is formed on inner walls of the intermediate body 130 of the first chamber 110 in a direction of the central pipe 160 in order to facilitate agitation of
15 extracted tissues. The first wing 170 may have a thickness of about 1 to 2 mm, and four first wings 170 are mounted in the first chamber 110 at an angle of 90 degrees. The first wing 170 facilitates mixture of the fat tissues and washing water when the first chamber 110 rotates or stops repeatedly.

In addition, the central pipe 160 may include at least one secondary wing 175 that
20 protrudes from an outside of a portion in which the central pipe 160 is inserted in an inside of the first chamber 110. The secondary wing 175 also facilitates mixture of the fat tissues and washing water when the first chamber 110 rotates or stops repeatedly.

The first unit 100 is mounted on a jig (not shown) and rotates while maintaining uniform speed and a predetermined temperature. The jig may adjust a temperature
25 and rotation speed of the first unit 100. A structure and an operation of the jig will be understood by one of ordinary skill in the art, and a detailed description thereof will be omitted.

In addition, the jig on which the first unit 100 is mounted, may allow the first unit 100 to have only a function of agitation when the first unit 100 does not rotate but
30 vibrates, by using an eccentric motor.

The operation of the first unit 100 will now be described.

First, the fat tissues are aspirated from the human body.

The stopper of the upper portion of the central pipe 160 is removed, and a string

with a fat suction needle of the fat suction unit is connected to the upper portion of the central pipe 160. Since the fat suction needle is generally used, the upper portion of the central pipe 160 is configured to be combined with the fat suction unit so that the string with the fat suction needle of the fat suction unit and the upper portion of the central pipe 160 can be easily connected to each other.

A cap of an upper portion of the negative pressure pipe 190 is open, and the vacuum suction unit is also connected to the negative pressure pipe 190. Next, the vacuum suction unit is operated to extract fat tissues from the human body. The extracted fat tissues contain blood, or the like. Compared to a general regenerative cell extraction system that inputs fat tissues into the regenerative cell extraction system after extracting the fat tissues from the human body and storing the extracted fat tissues separately, the regenerative cell extraction system 10 according to the present invention may extract fat tissues from the human body and may accommodate the extracted fat tissues in the first chamber 110 by connecting a fat suction unit and a vacuum suction unit to the first unit 100. Thus, problems relating to contamination or infection of the fat tissues, or a difficulty of storage of the fat tissues can be solved at one time.

After the fat tissues have been extracted, an extraction needle of the central pipe 160 and a connection pipe of the vacuum suction unit are removed. In this case, a cap of the connection pipe of the vacuum suction unit is not closed but is open for a while. That is, after the first chamber 110 is restored in an atmospheric pressure state by removing the connection pipe of the vacuum suction unit, a portion of the vacuum suction unit to which the extraction needle of the central pipe 160 is connected, is removed to prevent contaminated air from flowing into the central pipe 160.

Since the filter 191 is disposed in the negative pressure pipe 190 connected to the vacuum suction unit, even when the cap of the connection pipe of the vacuum suction unit is open, bacteriological contamination caused by external air may not occur.

A kit for fat-derived stem cells of the transfer unit 700 is connected to an upper portion of the central pipe 160 to which a fat tissue extraction needle is connected. A plurality of bags B1, B2, ..., and Bn is connected to the kit for fat-derived stem cells of the transfer unit 700, like in a umbilical cord blood processing kit. A solenoid valve is disposed in front of each of the plurality of bags B1, B2, ..., and Bn. The solenoid valve closes the transfer pipe connected to the solenoid valve at normal times, and a bag for storing a physiological salt solution, collagenase, and fat tissues from which blood has

been removed, a bag for collecting liquid discarded after processing, and a bag connected to the second unit 200, and the like are attached to the solenoid valves, and the solenoid valves may be configured in various shapes according to using purposes. In addition, as described above, the kit for fat-derived stem cells of the transfer unit 700 may be connected to the transfer unit 700 by using multi-way valves and pumps, instead of the solenoid valves, the transfer pipe, and pumps. In this regard, the solenoid valves may not need to be disposed in front of the bags B1, B2, ..., and Bn.

Second, blood contaminants are removed (pure fat tissue separation).

The first unit 100 is mounted on a jig that has the same inner diameter as an outer diameter of the first unit 100, rotates and is temperature-controlled. Obviously, an operation of absorbing fat tissues after the first unit 100 has been mounted on the jig from the beginning may be performed.

The first unit 100 and the second unit 200 may be mounted on jigs (not shown) that rotate while maintaining a constant temperature. The jigs (not shown) may control temperatures of the first unit 100 and the second unit 200 and their rotation speed.

By stopping the first unit 100 for about 1 minute, fat tissues and water are separated from the absorbed fat tissues. Then, the fat tissues are disposed in an upper position of the first chamber 110 than water. After pumps of the transfer unit 700 are connected to pipes of the kit, the pumps operate to suck water contaminated with blood soaked in a lower portion of the first chamber 110 via the central pipe 160 and to remove water. In this case, a sensor is disposed in a connection pipe between the pumps and the bag in which water contaminated with blood is stored, and if there is no defect in water including blood as a result of sensing, the pumps are automatically stopped. Since the color of water including blood is red due to blood unlike the fat tissues or is very dark compared to the fat tissues, the sensor may sense the color (brightness, density, or transmittance) of material passing through the connection pipe, thereby differentiating water including blood and water that does not include blood from each other and controlling an operation of the pumps.

Alternatively, since the specific gravity (weight) of material including blood and the specific gravity (weight) of the fat tissues are different from each other, a difference in specific gravities is sensed so that the operation of the pumps may be controlled. The operation of the sensor will be understood by one of ordinary skill in the art and thus, a detailed description thereof will be omitted.

By opening a washing water (salt solution) bag and operating the pumps, a similar amount of washing water to the amount of the fat tissues that remain in the first chamber 110 of the first unit 100 is injected into the first unit 100. The amount of washing water to be injected may be preset by a program based on the amount of extracted fat tissues. Then, the first chamber 110 rotates. The rotation speed or number of the first chamber 110 may be preset by a program based on the amount of extracted fat tissues. For example, the rotation speed or number of the first chamber 110 may be adjusted to repeatedly perform rotation for 10 seconds and stop for 10 seconds with 300 rpm per minute five times.

In this way, an operation of washing the fat tissues by injecting a salt solution into the first unit 100, removing the washed portion of water, and washing the fat tissues by adding the salt solution is repeatedly performed about three to five times. Finally, the salt solution is removed. Only the fat tissues of which the amount required to separate fat-derived stem cells from the fat tissue are left in the first chamber 110, and the remaining washed fat tissues are conveyed to a bag for storing pure fat by using pumps. That is, the regenerative cell extraction system 10 according to the present embodiment may separate only pure fat tissue that remains in the first chamber 110 after being washed, if necessary.

Third, cells are separated using enzymes.

Enzymes with a similar amount to the amount of fat cells that remain in the first chamber 110 and that are washed, (0.1% collagenase; however, it will be understood by one of ordinary skill in the art that another enzyme may be used and concentration of enzyme may vary.) are inputted into the first chamber 110 via the central pipe 160 by using pumps. In this case, since there is an estimated amount, the amount of enzymes may be preset by a program at an initial stage.

After enzymes have been inputted into the first chamber 110, rotation and stop of the first chamber 110 is repeatedly performed using a program. In this case, an outside of the first chamber 110 is heated to be maintained at a temperature of about 37°C. This operation is performed by heat transferred by the jigs in order to activate enzymes.

If rotation and stop of the first chamber 110 is repeatedly performed for a predetermined amount of time (for example, about 30 minutes), matured fat cells and fat-derived cells are dissolved by enzymes in the first chamber 110, and when rotation of the first chamber 110 is stopped for about 3 to 5 minutes, matured fat cells (upper layer)

and a fluid layer (lower layer) that contains fat-derived cells are separated from each other. Then, the fluid layer that contains fat-derived cells separated as a result of processing collagenase is moved to the second chamber 210 of the second unit 200 by using pumps. If matured fat cells and fat (oil) in a liquid state that is burst when the matured fat cells are extracted or processed is required, after enzymes (collagenase) are washed in the first chamber 110 three to five times by using the above-described washing operation, enzymes (collagenase) are transferred to a bag for storing matured fat cells by using the pumps. This operation may also be preset by a program at an initial stage and may be controlled by a sensor.

In this way, the first unit 100 may perform operations of directly extracting fat tissues, extracting pure fat tissues, extracting matured fat cells by using enzymes, and cell separation for separating stem cells from the fat tissues. The operations may be preset by a program, and the entire operations, or only a required operation may be separately performed.

FIG. 2B illustrates another structure of the first unit 100 illustrated in FIG. 2A.

As illustrated in FIG. 2B, the negative pressure pipe 190 may be integrated with the cover 150. The filter 191 may be disposed on the negative pressure pipe 190 in order to prevent a back flow of contaminated air.

FIG. 3 is a cross-sectional view of a structure of the second unit 200.

FIG. 4 is a plan view of a structure of a lower plate illustrated in FIG. 3.

Referring to FIGS. 3 and 4, the second unit 200 includes a second chamber 210, a lower plate 264, an input pipe 270, a first discharge pipe 275, and a second discharge pipe 280.

The second chamber 210 includes an inlet portion 220 having a predetermined diameter and extending in a vertical, downward direction, an upper body 230 having a cylindrical shape in which an inner diameter of the upper body 230 increases from a lower end of the inlet portion 220 to a lower portion of the upper body 230 and decreases from a cell separator 225 having a maximum inner diameter to the lower portion of the upper body 230, and a lower body 240 integrated with the lower portion of the upper body 230, having a predetermined inner diameter and extending in a downward direction. A bottom surface of the lower body 240 may be flat or a U-shaped protrusion shape.

The second chamber 210 is inclined towards its center from the cell separator 225 of the upper body 230 to a lower portion of the second chamber 210. This is because,

when the second chamber 210 rotates, a larger centrifugal force exerts on an outer side (wall) of the second chamber 210 than in a central portion of the second chamber 210 and when liquid including fat-derived stem cells is injected or separated, the separated fat-derived stem cells are collected on the cell separator 225.

5 In addition, since, when liquid including the fat-derived stem cells is continuously injected from the first unit 100, separation of the fat-derived stem cells starts from a wall distant from an inlet that is an end of a lower end of the input pipe 270, when liquid-state solutions from which the fat-derived stem cells have been removed, are removed via an outlet formed on an upper portion of the second chamber 210, cells cannot be easily
10 slipped out.

The lower plate 264 is installed to correspond to an inside of the upper plate 250 when the upper plate 250 is defined from a unit, of which an inner diameter increases from a lower end of the inlet portion 220 to a lower portion of the unit, to the cell separator 225. A physiological buffer solution other than regenerative cells that exist in
15 the second chamber 210 is discharged along a passage 265 between the upper plate 250 and the lower plate 264.

The lower plate 264 includes a first inner inlet 261 integrated with an upper end of the lower plate 264 and having a cylindrical shape with a first inner diameter, and a second inner inlet 263 surrounding the first inner inlet 261, having a larger second inner
20 diameter than the first inner diameter and extending in an inside of the inlet portion 220.

The input pipe 270 is inserted in the second chamber 210 via the first inner inlet 261 in order to input the cells discharged from the first unit 100 into the second chamber 210.

A first discharge pipe 275 perforates an inside of the input pipe 270, is inserted in
25 the second chamber 210 to be longer than the input pipe 270 and is a passage which is formed on a bottom surface of the second body 240 of the second chamber 210 and through which regenerative cells are discharged.

The input pipe 270 may be inserted in a lower end of the upper body 230, and the first discharge pipe 275 is inserted from the bottom surface of the lower body 240 to a
30 height of 0.1 to 2 mm.

A safety syringe may be mounted on an upper portion of the first discharge pipe 275 in order to discharge the recovered fat-derived stem cells to the outside. The upper portion of the first discharge pipe 275 is closed by a cap or is connected to a kit for

performing this process. Since an end of the first discharge pipe 275 descends from the bottom surface of the lower body 240 to a height of 0.1 to 2 mm, fat-derived stem cells gathered on the bottom surface of the lower body 240 are discharged to the outside via the first discharge pipe 275. The input pipe 270 is installed to surround the first
5 discharge pipe 275 and to transfer cells from the first unit 100 to the second unit 200.

The second discharge pipe 280 is inserted between an outer wall of the second inner inlet 263 and an inner wall of the inlet portion 220 and discharges a physiological buffer solution other than the regenerative cells discharged via the passage 265 between the upper plate 250 and the lower plate 264 to the outside.

10 The second chamber 210 rotates by retainers 281 and 283 independently with the input pipe 270, the first discharge pipe 275, and the second discharge pipe 280 and is maintained in a sealed state.

The second unit 200 performs operations of washing the fat-derived stem cells contained in a fluid including enzymes transferred from the first unit 100 and separating
15 the fat-derived stem cells.

The input pipe 270 includes a first support wing 271 that surrounds the outer wall of the first inner inlet 261, and the second discharge pipe 280 includes a second support wing 285 that surrounds the inlet portion 220. All of the first support wing 271 and the second support wing 285 facilitate rotation of the second chamber 210 independently
20 with the input pipe 270, the first discharge pipe 275, and the second discharge pipe 280 and to be sealed by the retainers 281 and 283.

That is, the retainers 281 and 283 are mounted between inner walls of the first support wing 271 and the second inner inlet 263 and between an outer wall of the inlet portion 220 and the second support wing 281 in order to rotate the second chamber 210
25 independently and to maintain the second chamber 210 in a sealed state.

Elements having a sealing function with assisting rotation, such as bearings, may also be used, instead of the retainers 281 and 283. Bearings that facilitate rotation of the second chamber 210 may be simultaneously mounted together with the retainers 281 and 283.

30 Like in the first chamber 110, the second chamber 210 includes at least one second wing 211 that facilitates agitation of material inputted in the second chamber 210 in a direction of at least one input pipe 270 when the second chamber 210 on an inner wall from the cell separator 225 to the lower end of the upper body 230 rotates. Like in

the first chamber 110, four second wings 211 may be disposed at an angle of 90 degrees, and a secondary wing (not shown), like 175 of the first chamber 110, may be mounted on an outside of the input pipe 270.

The lower plate 264 includes the first inner inlet 261, the second inner inlet 263, and a circular plate 260. The circular plate 260 is integrated with lower ends of the first inner inlet 261 and the second inner inlet 263, has the same gradient as that of the upper plate 250, is unfolded in the form of a bamboo hat, and constitutes the passage 265 together with the upper plate 250.

At least one passage is formed between the upper plate 250 and the lower plate 264, and predetermined portions 410 of the circular plate 260 between passages are attached to the upper plate 250.

That is, as illustrated in FIG. 4, the predetermined portions 410 of the circular plate 260 of the lower plate 264 are attached to the upper plate 250. A space between the portions 410 attached to the upper plate 250 is separated from the upper plate 250 and thus, the passage 265 is naturally formed. FIG. 3 illustrates the passage 265 for easy understanding. On the passage 265, as the second chamber 210 rotates, cells in the second chamber 210 and washing water are gathered on the cell separator 225 that is the outermost portion of the second chamber 210 due to a centrifugal force of the second chamber 210. In this case, stem cells are disposed close to a wall of the cell separator 225, and the washing water is farther away from the wall of the cell separator 225 than the stem cells. Thus, a negative pressure is applied to the second discharge pipe 280, or a positive pressure is applied to the second chamber 210, or the above, two operations are performed so that the washing water is extracted through the passage 265 and a small amount of liquid and stem cells remain in the second chamber 210.

The rotation speed of the second chamber 210 and the length of the circular plate 260 are adjusted so that blood can be extracted from a blood component layer disposed in the second chamber 210 due to a centrifugal force of the second chamber 210 and the amount or speed of the physiological buffer solution other than the regenerative cells in the second chamber 210 to be discharged through the passage 265 can be adjusted.

A filtering net 213 that filters the remainder of undigested tissues including a lump of enzymes or material, such as collagenase, from liquid cells inputted via the input pipe 270 may be installed inside the lower body 240 disposed in the lower portion of the input pipe 270. The filtering net 213 is a mesh net having a gap of about 0.5 to 2 mm. The

filtering net 213 is used in filtering a lump of collagenase or part of tissue (various materials that are not digested by enzymes used in the first unit 100) that is not fully digested when cells are inputted from the first unit 100 into the second unit 200 via the input pipe 27.

5 A prevention layer 215 may be disposed in a front of the passage 265 in order to discharge only washing water without discharging regenerative cells gathered on the cell separator 225 via the passage 265 when the second chamber 210 rotates. In addition, the prevention layer 215 may have a similar structure to that of the lower plate 264 and may be disposed on the passage 265 between inner walls of the circuit plate 260 and the
10 upper plate 250, as illustrated in FIG. 3. In this case, the prevention layer 215 may have a structure in which a hole 261 is formed in the center of the prevention layer 215, as illustrated in FIG. 4 and a portion of the prevention layer 215 is attached to the inner wall of the upper plate 250, as indicated by the portions 410 of FIG. 4.

Hereinafter, the operation of the second unit 200 will be described.

15 First, operations of washing enzymes contained in the fluid (physiological buffer solution including various cultivation fluids) including regenerative cells transferred from the first unit 100 and volume reduction for concentrating fat-derived cells by reducing the volume of the fluid.

A salt solution including collagenase and cells from the first unit 100 is gradually
20 filled in the second chamber 210 of the second unit 200 via the input pipe 270. When the second chamber 210 stops first and a predetermined amount of salt solution is filled in the second chamber 210, the second chamber 210 rotates. For example, when fat cells mixed with collagenase are filled in half of the entire volume of the second chamber 210, the second chamber 210 rotates at about 150G (where, a value of G may vary
25 between 75G to 1,000G or more, and if the value of G increases, a volume reduction time is reduced.). Since the amount of liquid transferred per rotation of pumps is constant, the amount of transferred liquid may be calculated by calculating time, and rotation of the second chamber 210 may start automatically when these conditions are programmed.

30 The second chamber 210 is also mounted on a jig (not shown) and rotates while maintaining uniform speed and a predetermined temperature, like in the first chamber 110. A rotation time, temperature, rotation speed, and the like may be preset by a program, and the first unit 100 and the second unit 200 are controlled so that all

processes from extracting fat tissues to separating fat-derived stem cells may be automatically performed.

The program and automation will be understood by one of ordinary skill in the art, and thus, a detailed description thereof will be omitted.

5 Simultaneously with start of rotation of the second chamber 210, the physiological buffer solution including cells transferred from the first unit 100 is blocked for about 5 minutes, and loss of cells is prevented. If inputting of the physiological buffer solution including cells transferred from the first unit 100 simultaneously at an initial stage in which rotation of the second chamber 210 starts and discharging of the physiological
10 buffer solution from which regenerative cells are separated by rotation of the second chamber 210 are simultaneously performed, the regenerative cells included in the inputted physiological buffer solution are discharged immediately before being separated from the physiological buffer solution, and a recovery rate of the regenerative cells may be greatly reduced. Thus, the second chamber 210 is filled with a predetermined
15 amount of physiological buffer solution, rotates for about 5 minutes, and regenerative cells are fully separated from the physiological buffer solution, and then, inputting and separating and discharging of the physiological buffer solution including cells restarts from the first unit 100 gradually so that loss of the regenerative cells may be prevented.

After about 5 minutes have elapsed, the physiological buffer solution including
20 collagenase and cell components that remain in the first unit 100 is continuously transferred to the second chamber 210, and liquid components (washing water) are continuously removed from the second chamber 210 via the second discharge pipe 280. Since the liquid components are removed from the second chamber 210 simultaneously with rotation of the second chamber 210, fat-derived stem cells are gathered on the cell
25 separator 225 of the second chamber 210, and if the liquid components are continuously extracted from the second chamber 210, only a little amount of liquid remains in the second chamber 210 due to a centrifugal force. Even when inputting of the physiological buffer solution and separating and discharging of the fat-derived stem cells are simultaneously performed, harmony of rotation speed and inputting and discharging
30 speed is very significant for preventing loss of the regenerative cells.

In this way, the regenerative cells mixed with enzymes and a salt solution are inputted into the second chamber 210 from the first chamber 110 via the input pipe 270, and liquid components excluding stem cells are discharged via the second discharge

pipe 280 through the passage 265 by rotation of the second chamber 210 so that only the stem cells may be separated from the fat tissues.

Second, rotation of the second chamber 210 is stopped, and the salt solution is added to the second chamber 210. Then, rotation and stop of the second chamber 210 is repeatedly performed. For example, operations of rotating the second chamber 210 for about 10 seconds and stopping the second chamber 210 for 10 seconds are repeatedly performed three to five times. Subsequently, the second chamber 210 rotates again, and the salt solution is removed. The washing operation is repeatedly performed three to five times. After the last washing operation is performed, rotation of the second chamber 210 is stopped. If rotation of the second chamber 210 is stopped, fat-derived stem cells gathered on the wall of the cell separator 225 are discharged from the bottom surface of the lower body 240 along an inclined surface of the upper body 230.

Last, the cap in the uppermost portion of the first discharge pipe 275 is removed, and a syringe is inserted in upper portion of the first discharge pipe 275 in order to extract the salt solution including a desired amount or the whole amount of fat-derived stem cells from the syringe. Since the end of the first discharge pipe 275 descends to a height of 0.1 to 2 mm of the bottom surface of the lower body 240, the fat-derived stem cells gathered on the bottom surface of the lower body 240 may be easily extracted to the outside.

When the amount of the fat tissues extracted from the human body is not large, all processes may be performed using only the second unit 200 without the first unit 100, and the fat-derived stem cells may be separated from the fat tissues. That is, when the amount of the fat tissues is small, operations of washing the fat tissues, separating matured fat cells, separating regenerative cells by inputting enzymes, washing the fat-derived stem cells in order to improve the purity of the fat-derived stem cells, volume reduction of a washing solution, and discharging the fat-derived stem cells may be performed using only the second unit 200.

FIG. 5 is a plan view of another structure of the lower plate 264 illustrated in FIG.

3.

FIG. 6A is a plan view of a selection discharge unit to be combined with a lower plate 264-1 of FIG. 5.

FIG. 6B is a side cross-sectional view of the selection discharge unit illustrated in

FIG. 6A.

FIG. 6C is a cross-sectional view of a second unit for explaining a structure in which the selection discharge unit of FIG. 6A is combined with the lower plate 264 of FIG. 5.

Referring to FIGS. 5 and FIGS. 6A through 6C, a lower plate 264-1 according to another embodiment of the present invention includes a first inner inlet 261, a second inner inlet 263, a circular plate 260-1 integrated with lower ends of the first inner inlet 261 and the second inner inlet 263, having the same gradient as that of an upper plate 250, being unfolded in the form of a bamboo hat, and forming a passage 265 together with the upper plate 250, and a selection discharge unit 600 surrounding an outside of the second inner inlet 263 of the lower plate 264-1, connecting at least one passage from among passages 265-1 selectively to the second discharge pipe 280 and having a hollow, flat disc shape.

In more detail, at least one passage 265-1 is formed between the upper plate 250 and the lower plate 264-1, and portions 510 of the circular plate 260-1 between the passages 265-1 are attached to the upper plate 250.

When the circular plate 260-1 is separated from the lower plate 264-1 in a direction of a diameter of the circular plate 260-1, weights of half separated portions are the same, and lengths of passages formed in one half portion are different from each other, and opposite passages formed in each of half separated portions have the same lengths.

That is, as illustrated in FIG. 5, the circular plate 260-1 is configured in such a way that the passages 265-1 from short to long passages having different lengths are symmetrical with each other.

The lengths of the passages 265-1 are different from each other so that, when different materials need to be obtained from layers formed as a result of centrifugation of blood, or the like, by rotation of the second chamber 210, desired materials may be obtained in necessary positions of the layers.

In addition, the reason why the circular plate 260-1 has a symmetric structure is that, if the center of gravity is not fitted in the circular plate 260-1 during centrifugation, vibration may occur in the rotating second chamber 210. In this case, even though the circular plate 260-1 has a symmetric structure, if weights of the passages 265-1 of the circular plate 260-1 having different lengths are adjusted to be symmetrical with each

other, vibration may not occur in the second chamber 210 even when the second chamber 210 rotates. Adjusting the weights of the passages 265-1 of the circular plate 260-1 is a basic principle of a centrifugation device that can be understood by one of ordinary skill in the art, and thus, a detailed description thereof will be omitted.

5 A through hole 605 through which the second inner inlet 263 is formed, and a top surface discharge hole 610 connected to the second discharge pipe 280 at both sides of the through hole 605 are formed on a top surface 640 of the selection discharge unit 600 of FIGS. 6A and 6B. Portions of an inner sidewall 263-1 of the selection discharge unit 600 that forms the through hole 605 extend in a vertical direction by a
10 predetermined length so that they contact the second inner inlet 263 easily, as illustrated in FIG. 6B.

A side discharge hole 615 connected to the selected passage 265-1 is formed in a side surface of the selection discharge unit 600, and a lower end 620 of the side surface of the selection discharge unit 600 is combined with a combination groove 520 formed in
15 a top surface of the circular plate 260-1.

As illustrated in FIG. 6C, the lower end 620 of the selection discharge unit 600 is inserted in the combination groove 520 of the circular plate 260-1 and is closely combined therewith. The selection discharge unit 600 rotates in such a way that a side lower end 620 of the selection discharge unit 600 selects the corresponding passage
20 265-1. A portion in which the side lower end 620 of the selection discharge unit 600 and the combination groove 520 are closely combined with each other, may be sealed using a silicon ring, or the like, and the corresponding passage 265-1 may be selected when the selection discharge unit 600 rotates in the state where the side lower end 620 of the selection discharge unit 600 is combined with the combination groove 520. A
25 structure in which the selection discharge unit 600 is combined with the combination groove 520 and rotates, will be understood by one of ordinary skill in the art, and thus, a detailed description thereof will be omitted.

The first unit 100 and the second unit 200 having the above structure are mounted on rotative jigs (not shown) and rotate, and rotation speed of the first unit 100 and the
30 second unit 200 may be preset by a program and may be automatically adjusted. The rotation speed and operations from extracting fat tissues to separating fat-derived stem cells and storing the fat-derived stem cells in bags B1 to Bn may be automatically performed. The automatic operation will be understood by one of ordinary skill in the

field of software, and thus, a detailed description thereof will be omitted.

FIG. 7 is a plan view of another structure of the lower plate 264 of FIG. 3.

FIG. 8 is a cross-sectional view illustrating the case where the lower plate illustrated in FIG. 7 is mounted.

FIG. 7 illustrates a plan view of a lower plate 264-2 and a plan view and a side view of a selection discharge unit 700 combined with the lower plate 264-2.

Referring to FIGS. 7 and 8, another structure of the lower plate 264-2 according to the current embodiment of the present invention further includes cylindrical wings 750 that constitute passages, unlike in the structure of the lower plates 264 and 264-1 illustrated in FIGS. 4 and 5.

In more detail, the lower plate 264-2 includes a first inner inlet 261, a second inner inlet 263, a circular plate unit 761, and a selection discharge unit 700.

The circular plate unit 761 includes a circular plate 760 integrated with lower ends of the first inner inlet 261 and the second inner inlet 263, having the same gradient as that of the upper plate 250 and being unfolded in the form of a bamboo hat, and a plurality of cylindrical wings 750 integrated with an end of the circular plate 760 and each having a passage 265-2 formed in an inside of the plurality of cylindrical wings 750.

The selection discharge unit 700 surrounds an outside of the second inner inlet 263 of the lower plate 264-2, selects at least one cylindrical wing from among the cylindrical wings 750, and has a hollow, flat disc shape in which the passage 265-2 in the selected cylindrical wing 750 is connected to the second discharge pipe 280.

As illustrated in FIG. 8, top surfaces of the cylindrical wings 750 are attached to the upper plate 250, and the cylindrical wings 750 have different lengths, and component blood may be extracted by differentiating a blood component layer formed in the second chamber 210 due to a centrifugal force of the second chamber 210.

That is, when the second chamber 210 rotates, materials included in the physiological buffer solution including fat-derived cells constitute layers according to their specific gravities due to a centrifugal force of the second chamber 210. Thus, materials may be separated from the blood component layer based on the lengths of the cylindrical wings 750 and may be discharged.

A through hole 710 through which the second inner inlet 263 is formed, and a top surface discharge hole 710 connected to the second discharge pipe 280 at both sides of the through hole 705 are formed in the top surface of the selection discharge unit 700

(see the middle drawing of FIG. 7)

A side discharge hole 715 connected to the selected passage 265-2 is formed in a side surface of the selection discharge unit 700, and a lower end 720 of the side surface of the selection discharge unit 700 is combined with a combination groove 722 formed in a top surface of the circular plate 760. When the selection discharge unit 700 is closely combined with the combination groove 722 and rotates, the selection discharge unit 700 selects the cylindrical wing 750.

As illustrated in FIG. 7, the selection discharge unit 700 has a flat disc shape having the through hole 705, and when the lower end 720 is inserted in the combination groove 722 of the circular plate 760 and the selection discharge unit 700 rotates at the combination groove 722, the side discharge hole 715 may select the passage 265-2. A device, such as a silicon ring, is installed in the combination groove 722 so that combination of the lower end 720 and the combination groove 722 may be sealed.

As illustrated in FIG. 8, the cylindrical wings 750 of the lower plate 264-2 are attached to the corresponding upper plate 250. In the circular plate 760 of the lower plate 264-2, the combination groove 722 is formed along a circumferential surface of the circular plate 760 in which the cylindrical wings 750 are formed, and the selection discharge unit 700 is combined with the combination groove 722.

Lengths of the cylindrical wings 750 are different from each other so that necessary materials may be separated from the blood component layer and may be stored.

Portions of an inner sidewall 263-2 of the selection discharge unit 700 that constitutes the through hole 705 extend in a vertical direction by a predetermined length so that they contact the second inner inlet 263 easily, as illustrated in FIG. 7.

FIG. 9 is a cross-sectional view illustrating the case where another structure of a lower plate is mounted on a second chamber.

The lower plate includes a first inner inlet 261, a second inner inlet 263, and a circular plate unit 961. The circular plate unit 961 includes a circular plate 960 integrated with lower ends of the first inner inlet 261 and the second inner inlet 263, having the same gradient as that of the upper plate 250 and being unfolded in the form of a bamboo hat, and a plurality of cylindrical wings 950, of which one ends are combined with an end of the circular plate 960 and an inner wall of the second chamber 210, each of which has a passage 265-3 formed therein, and each having the other ends on which

weight pendulums (not shown) with different or the same weights in order to make balance of the cylindrical wings 950 are mounted.

Although the lower plate 264-3 of FIG. 9 includes the cylindrical wings 950 on an end of the circular plate 960, like in the lower plate 264-2 of FIG. 7, a plurality of cylindrical wings 950 attached to the upper plate 250 and having different lengths are disposed on the lower plate 264-2 of FIG. 7. According to another embodiment, there may be only two cylindrical wings 950 of FIG. 9. The cylindrical wings 950 are formed of elastic materials, and weight pendulums (not shown) mounted on the cylindrical wings 950 may have different or the same weights in order to make balance of the cylindrical wings 950.

If there are two cylindrical wings, weight pendulums mounted on the cylindrical wings 950 have to have the same weights.

When the second chamber 210 is stopped, the cylindrical wings 950 are hung down in a downward direction by weight pendulums (not shown), as illustrated in FIG. 9. When the second chamber 210 rotates, the cylindrical wings 950 are unfolded in a direction of an inner wall of the second chamber 210 based on a centrifugal force generated by rotation of the second chamber 210, and component blood may be extracted from a blood component layer.

Since the centrifugal force exerts on the outside of the second chamber 210, the cylindrical wings 950 are unfolded in a direction of the inner wall of the second chamber 210 based on the rotation speed of the second chamber 210. If the rotation speed of the second chamber 210 is fast, the cylindrical wings 950 are very close to the inner wall of the second chamber 210, and if the rotation speed of the second chamber 210 is slow, the cylindrical wings 950 will be far away from the inner wall of the second chamber 210. Based on the principle, the cylindrical wings 950 may selectively discharge materials of necessary layers from the blood component layer formed in the second chamber 210.

The cylindrical wings 950 have to be connected to the end of the circular plate 960, and simultaneously have to be fixed on the inner wall of the second chamber 210. As indicated by a circle of FIG. 9, a portion opposite to a portion in which the cylindrical wings 950 are connected to the circular plate 960, is connected to the inner wall of the second chamber 210. In order to securely fix the cylindrical wings 950 on the inner wall of the second chamber 210, one end of each of the cylindrical wings 950 may be caught in a protrusion 970 formed in the inner wall of the second chamber 210 and may be fixed

thereto.

There may be several methods of fixing the cylindrical wings 950 on the inner wall of the second chamber 210, and it will be understood by one of ordinary skill in the art, and thus, a detailed description thereof will be omitted.

5 A transfer filter (not shown) that filter foreign substances, such as a lump of undigested collagenase included in liquid cells transferred from the first unit 100 to the second unit 200, may be inserted in the transfer unit 700. The transfer filter (not shown) may be a double filter. The double filter has a structure in which a filter having small-sized holes formed in a mesh net is disposed and an outside of the filter is
10 surrounded by a filter having relatively large holes formed in a mesh net. In detail, the double filter may have a structure in which a filter having holes with the size of 0.5 to 2 mm and a filter having holes with the size of 0.1 to 0.5 mm are sequentially mounted on the transfer unit 700. According to another embodiment, the transfer filter (not shown) may be a single filter.

15 In this way, various cells including stem cells may be separated from various tissues other than fat-derived stem cells by using the transfer filter mounted on the transfer unit 700.

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary
20 skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

CLAIMS

1. A regenerative cell extraction system comprising:

5 a first unit which collects tissues by vacuum suction, separates blood contaminants from the collected tissues by agitation and centrifugation, and separates cells from the tissues from which blood contaminants have been separated to discharge the cells suspended in liquid;

10 a second unit into which the cells suspended in liquid are inputted from the first unit, which separates regenerative cells by centrifugation, and of which a capacity is smaller than a capacity of the first unit; and

15 a transfer unit which is connected between the first unit and the second unit, injects washing water into the first unit and the second unit, delivers extracts from the first unit and the second unit to corresponding bags, and inputs the cells suspended in liquid extracted in the first unit into the second unit or transfers tissues and cell contaminants.

20 2. The regenerative cell extraction system of claim 1, wherein the tissues are fat tissues, and the regenerative cells are fat-derived stem cells.

3. The regenerative cell extraction system of claim 1, wherein the first unit comprises:

25 a first chamber comprising an upper body having a cylindrical shape, an intermediate body integrated with a lower portion of the upper body and inclined towards a center of the first chamber as the intermediate body gets closer to a lower portion of the first chamber, a lower body integrated with the intermediate body, having a diameter that is equal to or less than an inner diameter of the upper body, and extending in the lower portion of the first chamber, and a cover integrated with a top surface of the upper body and covering the top surface of the upper body; and

30 a central pipe inserted in the bottom surface of the lower body via a guide hole formed in the center of the cover up to a position in which a lower end of the central pipe is spaced apart from the bottom surface of the lower body by a predetermined distance, wherein the fat tissues are inputted into the first chamber via an upper portion of the

central pipe and the cells suspended in liquid are discharged from the first chamber, and wherein at least one first wing is formed on inner walls of the intermediate body of the first chamber in a direction of the central pipe in order to facilitate agitation of extracted tissues.

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4. The regenerative cell extraction system of claim 3, wherein the first chamber comprises:

10 a negative pressure pipe inserted in the guide hole by surrounding the central pipe, integrated with the central pipe and making the first chamber in a vacuum negative pressure state; and

retainers mounted between a wall that constitutes the guide hole and the negative pressure pipe and allowing the first chamber to rotate independently with the central pipe and the negative pressure pipe and to be maintained in a sealed state.

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5. The regenerative cell extraction system of claim 3, wherein the position in which a lower end of the central pipe is spaced apart from the bottom surface of the lower body by a predetermined distance is between 0.1 and 3 mm from the bottom surface of the lower body.

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6. The regenerative cell extraction system of claim 3, wherein the central pipe comprises at least one secondary wing that protrudes from an outside of a portion in which the central pipe is inserted in an inside of the first chamber.

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7. The regenerative cell extraction system of claim 3, wherein bearings that facilitate rotation of the first chamber are further mounted between the wall that constitutes the guide hole and the negative pressure pipe, together with the retainers, and

a filter that filters foreign substances that exist in tissues inputted via the central pipe is disposed inside the lower body in the lower portion of the central pipe.

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8. The regenerative cell extraction system of claim 1, wherein the second unit comprises:

an inlet portion having a predetermined diameter and extending in a vertical,

downward direction, an upper body having a cylindrical shape in which an inner diameter of the upper body increases from a lower end of the inlet portion to a lower portion of the upper body and decreases from a cell separator having a maximum inner diameter to the lower portion of the upper body, and a lower body integrated with the lower portion of the upper body, having a predetermined inner diameter and extending in a downward direction;

a lower plate installed to correspond to an inside of the upper plate when the upper plate is defined from a unit, of which an inner diameter increases from a lower end of the inlet portion to a lower portion of the unit, to the cell separator, wherein a physiological buffer solution other than regenerative cells that exist in the second chamber is discharged along a passage between the upper plate and the lower plate, the lower plate comprising a first inner inlet integrated with an upper end of the lower plate and having a cylindrical shape with a first inner diameter, and a second inner inlet surrounding the first inner inlet, having a larger second inner diameter than the first inner diameter and extending in an inside of the inlet portion;

an input pipe inserted in the second chamber via the first inner inlet in order to input the cells suspended in liquid discharged from the first unit into the second chamber;

a first discharge pipe perforating an inside of the input pipe, inserted in the second chamber to be longer than the input pipe and being a passage which is formed on a bottom surface of the second body of the second chamber and through which regenerative cells are discharged; and

a second discharge pipe inserted between an outer wall of the second inner inlet and an inner wall of the inlet portion and discharging a physiological buffer solution other than the regenerative cells discharged via the passage between the upper plate and the lower plate to an outside,

wherein the second chamber rotates by retainers independently with the input pipe, the first discharge pipe, and the second discharge pipe and is maintained in a sealed state.

9. The regenerative cell extraction system of claim 8, wherein the input pipe comprises a first support wing that surrounds the outer wall of the first inner inlet and the second discharge pipe comprises a second support wing that surrounds the inlet portion, and

the retainers are mounted between inner walls of the first support wing and the second inner inlet and between an outer wall of the inlet portion and the second support wing in order to rotate the second chamber independently and to maintain the second chamber in a sealed state.

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10. The regenerative cell extraction system of claim 9, wherein bearings that facilitate rotation of the second chamber are further mounted between inner walls of the first support wing and the second inner inlet and between an outer wall of the inlet portion and the second support wing, together with the retainers.

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11. The regenerative cell extraction system of claim 8, wherein the input pipe is inserted in a lower end of the upper body, and the first discharge pipe is inserted from the bottom surface of the lower body to a height of 0.1 to 2 mm.

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12. The regenerative cell extraction system of claim 8, wherein the second chamber comprises at least one second wing that facilitates agitation of material inputted in the second chamber in a direction of the input pipe when the second chamber on an inner wall from the cell separator to the lower end of the upper body rotates.

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13. The regenerative cell extraction system of claim 8, wherein the lower plate

the first inner inlet and the second inner inlet; and

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a circular plate integrated with lower ends of the first inner inlet and the second inner inlet, having the same gradient as a gradient of the upper plate, being unfolded in the form of a bamboo hat, and constituting the passage together with the upper plate,

wherein at least one passage is formed between the upper plate and the lower plate, and predetermined portions of the circular plate between passages are attached to the upper plate.

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14. The regenerative cell extraction system of claim 13, wherein rotation speed of the second chamber and a length of the circular plate are adjusted so that blood can be extracted from a blood component layer disposed in the second chamber due to a centrifugal force of the second chamber and an amount of the physiological

buffer solution other than the regenerative cells in the second chamber to be discharged through the passage can be adjusted.

15. The regenerative cell extraction system of claim 8, wherein the lower
5 plate comprises:

the first inner inlet and the second inner inlet;

a circular plate integrated with lower ends of the first inner inlet and the second inner inlet, having the same gradient as a gradient of an upper plate, being unfolded in the form of a bamboo hat, and forming a passage together with the upper plate; and

10 a selection discharge unit surrounding an outside of the second inner inlet of the lower plate, connecting at least one passage from among passages selectively to the second discharge pipe and having a hollow, flat disc shape,

wherein at least one passage is formed between the upper plate and the lower plate, and portions of the circular plate between the passages are attached to the upper
15 plate, and

when the circular plate is separated from the lower plate in a direction of a diameter of the circular plate, weights of half separated portions are the same, and lengths of passages formed in one half portion are different from each other, and opposite passages formed in each of half separated portions have the same lengths,
20 and

a through hole through which the second inner inlet is formed, and a top surface discharge hole connected to the second discharge pipe at both sides of the through hole are formed on a top surface of the selection discharge unit, and a side discharge hole connected to the selected passage is formed in a side surface of the selection discharge
25 unit, and a lower end of the side surface of the selection discharge unit is combined with a combination groove formed in a top surface of the circular plate, and

the selection discharge unit selects the corresponding passage when the selection discharge unit rotates in the state where the side lower end of the selection discharge unit is closely combined with the combination groove.

30 16. The regenerative cell extraction system of claim 8, wherein a filtering net that filters the remainder of undigested tissues comprising a lump of enzymes or material, such as collagenase, from liquid cells inputted via the input pipe is installed inside the

lower body disposed in the lower portion of the input pipe.

17. The regenerative cell extraction system of claim 8, wherein the lower plate comprises:

5 the first inner inlet and the second inner inlet;

a circular plate unit comprising a circular plate integrated with lower ends of the first inner inlet and the second inner inlet, having the same gradient as a gradient of the upper plate and being unfolded in the form of a bamboo hat, and a plurality of cylindrical wings integrated with an end of the circular plate and each having a passage formed in
10 an inside of the plurality of cylindrical wings; and

a selection discharge unit surrounding an outside of the second inner inlet of the lower plate, selecting at least one cylindrical wing from among the cylindrical wings, and has a hollow, flat disc shape in which the passage in the selected cylindrical wing is connected to the second discharge pipe, and

15 wherein top surfaces of the cylindrical wings are attached to the upper plate, and the cylindrical wings have different lengths, and component blood can be extracted by differentiating a blood component layer formed in the second chamber due to a centrifugal force of the second chamber, and

a through hole through which the second inner inlet is formed, and a top surface
20 discharge hole connected to the second discharge pipe at both sides of the through hole are formed in the top surface of the selection discharge unit, and

a side discharge hole connected to the selected passage is formed in a side surface of the selection discharge unit, and a lower end of the side surface of the selection discharge unit is combined with a combination groove formed in a top surface
25 of the circular plate, and

when the selection discharge unit is closely combined with the combination groove and rotates, the selection discharge unit selects the cylindrical wing.

18. The regenerative cell extraction system of claim 8, wherein the lower
30 plate comprises:

the first inner inlet and the second inner inlet;

a circular plate unit comprising a circular plate integrated with lower ends of the first inner inlet and the second inner inlet, having the same gradient as that of the upper

plate and being unfolded in the form of a bamboo hat, and a plurality of cylindrical wings, of which one ends are combined with an end of the circular plate and an inner wall of the second chamber, each of which has a passage formed therein, and each having the other ends on which weight pendulums with different or the same weights in order to make balance of the cylindrical wings are mounted, and when the second chamber rotates, the cylindrical wings are unfolded in a direction of an inner wall of the second chamber based on a centrifugal force generated by rotation of the second chamber, and component blood can be extracted from a blood component layer.

19. The regenerative cell extraction system of claim 18, wherein the circular plate unit comprises two symmetrical cylindrical wings, and the weight pendulums mounted on the cylindrical wings have the same weights.

20. The regenerative cell extraction system of claim 1, wherein the transfer unit comprises a first multi-way valve connected to the plurality of bags, a second multi-way valve connected to the first unit and the second unit, and pumps that connect the first multi-way valve and the second multi-way valve.

21. The regenerative cell extraction system of claim 1, wherein the transfer unit comprises a plurality of solenoid valves connected to the plurality of bags, respectively, instead of the first multi-way valve and the second multi-way valve, and the transfer pipes controlled by the plurality of solenoid valves are connected to the pumps.

22. The regenerative cell extraction system of claim 1, wherein a transfer filter that filter foreign substances, such as a lump of undigested collagenase included in liquid cells transferred from the first unit to the second unit 200 is inserted in the transfer unit.

23. The regenerative cell extraction system of claim 22, wherein the transfer filter comprises a double filter.

24. The regenerative cell extraction system of claim 1, further comprising jigs on which the first unit and the second unit are mounted and which rotate while

maintaining a constant temperature, the jigs controlling temperatures of the first unit and the second unit and rotation speeds of the first unit and the second unit.