CLAIMS

[Claim 1] A cell culture system, comprising a culture tank that contains a liquid medium that cultures cells, and a cell separator, the cell separator comprising:

a hydrodynamic separation device having a curved flow channel having a rectangular cross-section, and separating relatively large cells from the cells contained in the liquid medium using a vortex flow generated by flow through the curved flow channel; and

a liquid feeding unit which flows the liquid medium through the hydrodynamic separation device in a pressure environment controlled so as to suppress decrease in cell viability caused by pressure fluctuation in the liquid medium during flowing through the hydrodynamic separation device, wherein

the liquid feeding unit has a pressure control mechanism that controls the pressure environment so that a pressure difference between the liquid medium introduced to the hydrodynamic separation device and the liquid medium derived from the hydrodynamic separation device is less than 0.6 MPa.

[Claim 2] The cell culture system according to claim 1, wherein the hydrodynamic separation device has a single inlet for taking in the liquid medium and at least two outlets for discharging the separated liquid medium, wherein a liquid medium containing the relatively large cells concentrated is discharged from one of the at least two outlets, and the rest of the liquid medium containing relatively small cells is discharged from the other of the at least two outlets.

[Claim 3] The cell culture system according to claim 1 or 2, wherein the liquid feeding unit has an urging device that urges the liquid medium with a flow pressure for supplying the liquid medium to the hydrodynamic separation device.

[Claim 4] The cell culture system according to any one of

claims 1 to 3, wherein the liquid feeding unit has a pressure control mechanism that controls the pressure environment so that a pressure difference between the liquid medium introduced to the hydrodynamic separation device and the liquid medium derived from the hydrodynamic separation device is equal to or less than 0.45 MPa.

[Claim 5] The cell culture system according to claim 4, wherein the pressure control mechanism comprises:

a pressure monitoring unit to monitor a pressure of the liquid medium supplied to the hydrodynamic separation device; and

a pressure adjusting member that adjusts the pressure of the liquid medium supplied to the hydrodynamic separation device, based on the pressure monitored by the pressure monitoring unit.

[Claim 6] The cell culture system according to any one of claims 1 to 5, wherein the liquid feeding unit further has a flow rate-controlling mechanism for controlling a flow rate of the liquid medium supplied to the hydrodynamic separation device.

[Claim 7] The cell culture system according to claim 6, wherein the flow rate-controlling mechanism comprises:

a flow meter to monitor the flow rate of the liquid medium supplied to the hydrodynamic separation device; and

a flow rate-adjusting member to adjust the flow rate of the liquid medium supplied to the hydrodynamic separation device, based on the flow rate monitored by the flow meter,

wherein the flow rate of the liquid medium supplied to the hydrodynamic separation device is adjusted according to a size of the cells to be separated.

[Claim 8] The cell culture system according to any one of claims 1 to 7, further comprising:

a circulation system which returns a liquid medium containing the relatively large cells separated by the hydrodynamic separation device of the cell separator to the

culture tank, to circulate the liquid medium between the culture tank and the cell separator.

[Claim 9] The cell culture system according to claim 8, further comprising:

a medium supplement unit which replenishes the culture tank with a new liquid medium corresponding to an amount of the rest of the liquid medium.

[Claim 10] The cell culture system according to claim 9, wherein the medium supplement unit comprises:

a monitor that monitors an amount of the new liquid medium replenished in the culture tank; and

a flow rate-adjusting member that adjusts a flow rate of the new liquid medium replenished to the culture tank, based on the amount monitored by the monitor.

[Claim 11] A cell culture method, comprising:

a cell culture for culturing cells in a liquid medium; and

a cell separation for separating, from the liquid medium, a liquid medium containing relatively large cells,

the cell separation comprising:

a separation process to separates the liquid medium containing the relatively large cells concentrated from the liquid medium containing the cells, by using a vortex flow generated by flow through a curved flow channel having a rectangular cross-section; and

a pressure control to control a pressure environment of the liquid medium that flows in the separation process, so as to suppress a decrease in cell viability caused by pressure fluctuation in the liquid medium while flowing through the curved flow channel, wherein

the pressure environment is controlled so that a pressure difference between the liquid medium introduced to the separation process and the liquid medium derived from the separation process is less than 0.6 MPa.

[Claim 12] The cell culture method according to claim 11, further comprising:

a circulation process which returns the liquid medium containing the relatively large cells separated by the separation process to the cell culture, and circulates the liquid medium between the cell culture and the separation process.

[Claim 13] The cell culture method according to claim 12, further comprising:

a medium supplementation which replenishes the cell culture with a new liquid medium corresponding to an amount of the rest of the liquid medium containing relatively small cells separated in the separation process.

[Claim 14] The cell culture system according to claim 2, wherein the cell separator further comprises:

a temporary container for accommodating the rest of the liquid medium discharged from the other outlet of the hydrodynamic separation device;

an additional hydrodynamic separation device; and

an additional liquid feeding unit which flows the liquid medium contained in the temporary container through the additional hydrodynamic separation device in a pressure environment controlled so as to suppress decrease in cell viability caused by pressure fluctuation in the liquid medium during flowing through the additional hydrodynamic separation device.

[Claim 15] The cell culture system according to claim 14, wherein the additional liquid feeding unit has an urging device that urges the liquid medium with a flow pressure for supplying the liquid medium to the additional hydrodynamic separation device, and the urging device comprises:

a pump that urges the liquid medium at a connection path connecting the temporary container and the additional hydrodynamic separation device; or

a pressurizing device that pressurizes the inside of the temporary container and supplies the flow pressure to the contained liquid medium.

[Claim 16] The cell culture system according to claim 2, wherein the cell separator further comprises:

a temporary container for accommodating the rest of the liquid medium discharged from the other outlet of the hydrodynamic separation device;

a return path for resupplying the rest of the liquid medium contained in the temporary container to the hydrodynamic separation device; and

a switching mechanism for switching between supply of the liquid medium from the culture tank to the hydrodynamic separation device and supply of the rest of the liquid medium from the return path to the hydrodynamic separation device,

wherein, by switching of the switching mechanism, the liquid medium of the culture tank and the rest of the liquid medium of the temporary container are alternately supplied to the hydrodynamic separation device.

[Claim 17] The cell culture system according to claim 16, wherein the liquid feeding unit includes: a supply path connecting the culture tank and the hydrodynamic separation device; and an urging device that urges the liquid medium with a flow pressure for supplying the liquid medium to the hydrodynamic separation device, and the return path is connected to join the supply path,

wherein the urging device comprises:

a pump that urges the liquid medium at the supply path; or

a pressurizing container that temporarily stores the liquid medium in the supply path and pressurizes the stored liquid medium to apply the flow pressure.

[Claim 18] The cell culture system according to claim 2, wherein the liquid feeding unit includes: a supply path connecting the culture tank and the hydrodynamic separation device; and a pressurizing container that temporarily stores the liquid medium in the supply path and pressurizes the stored liquid medium to apply a flow pressure for supplying the liquid medium to the hydrodynamic separation device, and wherein the cell separator further comprises:

a temporary container for accommodating the rest of the liquid medium discharged from the other outlet of the hydrodynamic separation device;

a return path that connects the downstream side of the pressurizing container in the supply path with the temporary container and resupplies the rest of the liquid medium contained in the temporary container to the hydrodynamic separation device; and

a switching mechanism for switching between supply of the liquid medium from the culture tank to the hydrodynamic separation device and supply of the rest of the liquid medium from the return path to the hydrodynamic separation device,

wherein, by switching the switching mechanism, the liquid medium of the culture tank and the rest of the liquid medium of the temporary container are alternately supplied to the hydrodynamic separation device.

[Claim 19] The cell culture system according to claim 18, wherein the switching mechanism has an on-off valve or a check valve provided on each of the upstream and downstream sides of the pressurizing container in the supply path, and on the return path.