CLAIMS

[Claim 1] A cell culture system, comprising:

a culture tank that contains a liquid medium containing cells to be cultured;

a hydrodynamic separation device having a curved flow channel having a rectangular cross-section, and separating the liquid medium supplied from the culture tank into a cell-rich fraction having a relatively high cell density and a cell-poor fraction having a relatively low cell density, using a vortex flow generated by flow through the curved flow channel; and

a filtration separator having a filter to remove cells from the cell-poor fraction separated by the hydrodynamic separation device and recover the liquid medium;

a first return path connecting the hydrodynamic separation device and the culture tank to supply the cell-rich fraction to the culture tank; and

a second return path connecting the hydrodynamic separation device and the culture tank to supply the cells removed from the cell-poor fraction to the culture tank.

[Claim 2] The cell culture system according to claim 1, further comprising:

a discharge path to discharge a part of the liquid medium containing the cells to the outside as a bleed.

[Claim 3] The cell culture system according to claim 2, wherein the discharge path is provided as a branch from the first return path, to discard a part or the entire of the cell-rich fraction.

[Claim 4] The cell culture system according to claim 1, wherein the filter of the filtration separator is a depth filter, and further comprising:

a discharge path to discard the cell-rich fraction to the outside as a bleed.

[Claim 5] The cell culture system according to claim 4,

further comprising:

a medium replenishment path for supplying a new liquid medium to the culture tank; and

an additional filtration separator having a filter for removing the cells from the liquid medium supplied from the culture tank and collecting the liquid medium.

[Claim 6] A cell culture system, comprising:

a culture tank that contains a liquid medium containing cells to be cultured;

a hydrodynamic separation device having a curved flow channel having a rectangular cross-section, and separating the liquid medium supplied from the culture tank into a cell-rich fraction having a relatively high cell density and a cell-poor fraction having a relatively low cell density, using a vortex flow generated by flow through the curved flow channel;

a medium return path that connects the hydrodynamic separation device and the culture tank and supplies the cell-poor fraction to the culture tank to reduce the cell density of the liquid medium in the culture tank; and

a filtration separator having a filter to remove the cells from the liquid medium supplied from the culture tank and recover the liquid medium.

[Claim 7] The cell culture system according to claim 6, further comprising:

a return path that connects the filtration separator and the culture tank and supplies a residual liquid medium containing the cells removed by the filtration separator, to the culture tank.

[Claim 8] The cell culture system according to any one of claims 1 to 7, wherein the hydrodynamic separation device has a single inlet for taking in the liquid medium and at least two outlets for discharging the liquid medium separated, wherein the cell-rich fraction is discharged from one of the at least two outlets, and the cell-poor fraction is discharged from the other outlet.

[Claim 9] The cell culture system according to any one of claim 1 to 8, further comprising:

an urging device that urges the liquid medium with a flow pressure for supplying the liquid medium to the hydrodynamic separation device; and

a pressure control mechanism that controls pressure environment so that the 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 a predetermined value.

[Claim 10] A cell culture method, comprising:

a cell culture for culturing cells in a liquid medium;

a hydrodynamic separation to separate the liquid medium supplied from the cell culture into a cell-rich fraction having a relatively high cell density and a cell-poor fraction having a relatively low cell density, using a vortex flow generated by flow through a curved flow channel having a rectangular cross-section; and

a filtration separation in which the cells are removed from the cell-poor fraction separated by the hydrodynamic separation with a filter, and the liquid medium is recovered;

wherein the cell-rich fraction obtained by the hydrodynamic separation is supplied to the cell culture,

and the cells removed from the cell-poor fraction are supplied to the cell culture.

[Claim 11] A cell culture method, comprising:

a cell culture for culturing cells in a liquid medium;

a hydrodynamic separation to separate the liquid medium supplied from the cell culture into a cell-rich fraction having a relatively high cell density and a cell-poor fraction having a relatively low cell density, using a vortex flow generated by flow through a curved flow channel having a rectangular cross-section;

a medium return in which the cell-poor faction is

supplied to the cell culture to reduce the cell density of the liquid medium in the cell culture; and

a filtration separation in which cells are removed from the liquid medium supplied from the cell culture with a filter and the liquid medium is recovered.