Claims

1. An apparatus for removing media from a cell culture device comprising:

a gas delivery component that is capable of connecting to a filter that is connected to a gas permeable cell culture device, said gas delivery component capable of delivering gas into said gas permeable cell culture device by way of said filter,

a first fluid detection component that is capable of determining when the fluid moving within a media removal conduit that is connected to said gas permeable cell culture device changes from liquid to gas, said first fluid detection component capable of sending a signal to a first fluid flow control component that is capable of terminating fluid flow through said media removal conduit.

2. The device of claim 1 including a second fluid detection component that is capable of determining when fluid moving within a cell removal conduit that is connected to said gas permeable cell culture device changes from liquid to gas, said second fluid detection component capable of sending a signal to a second fluid flow control component capable of terminating fluid flow through said cell removal conduit.

3. A method of using the device of claim 1 comprising:

reducing the volume of liquid media in a gas permeable cell culture device that contains cells and media in order to increase the concentration of cells per milliliter of media by connecting said gas delivery component to a filter that is connected to said gas permeable cell culture device, said cell culture device including a media removal conduit, connecting said first fluid detection component to said media removal conduit, connecting said first fluid flow control

component to said media removal conduit, initiating gas delivery from said gas delivery component, whereby gas moves into said cell culture device, the gas displaces media from said cell culture device into a media collection vessel connected to said media removal conduit, said first fluid detection component determines when the fluid that is moving through said media removal conduit has changed from liquid to gas and upon making that determination said first fluid detection component sends a signal to said first fluid flow control component, and upon said first fluid flow control component receiving said signal said first flow control component terminates the flow of fluid through said media removal conduit.

4. The method of claim 3 including a step of collecting cells wherein after said first flow control component has terminated the flow of fluid through said media removal conduit, a cell collection vessel is connected to said media removal conduit, said media removal conduit having a media removal opening in contact with media, first flow control component opens the flow of fluid through said media removal conduit, gas delivered from said gas delivery component moves into said cell culture device, media and cells move through said media removal conduit into said cell collection vessel, said first fluid detection component determines when the fluid that is moving through said media removal conduit has changed from liquid to gas and sends a signal to said first fluid flow control component, and upon receiving said signal said first flow control component terminates the flow of fluid through said media removal conduit.

5. A method of using the device of claim 2 comprising:

Increasing the number of cells per milliliter of media in a gas permeable cell culture device by connecting said gas delivery component to a filter that is connected to a gas permeable

cell culture device containing liquid media and cells, at least a portion of said cells in contact with a growth surface within said cell culture device, said cell culture device including a media removal conduit and a cell removal conduit, connecting said first fluid detection component to said media removal conduit, connecting said first fluid flow control component to said media removal conduit, initiating gas delivery from said gas delivery component whereby gas moves into said cell culture device and the gas displaces media from said cell culture device into a media collection vessel connected to said media removal conduit, said first fluid detection component determining when the fluid that is moving through said media removal conduit has changed from liquid to gas and upon making that determination, said first fluid detection component sends a signal to said first fluid flow control component, and upon receiving said signal said first flow control component terminates the flow of fluid through said media removal conduit, and

removing cells from said gas permeable cell culture device by connecting said second fluid detection component to said cell removal conduit, connecting said second fluid flow control component to said cell removal conduit, initiating gas delivery from said gas delivery component, whereby gas moves into said cell culture device and displaces media and cells by way of said cell removal conduit from said cell culture device into a cell collection vessel connected to said cell removal conduit, said second fluid detection component determining when the fluid that is moving through said cell removal conduit has changed from liquid to gas and when that is determined said second fluid detection component sends a signal to said second fluid flow control component and upon receiving said signal, said second flow control component terminates the flow of fluid through said cell removal conduit.

6. The method of claim 5 wherein after said second flow control component has terminated the flow of fluid through said cell removal conduit, said cell culture device is vented to atmosphere, said first flow control component is opened to allow the flow of fluid through said media removal conduit, media is moved through said media removal conduit into said cell culture device, said first flow control component is closed, said media is agitated to move cells into said media, and

said cell culture device is no longer vented to atmosphere and gas is delivered from said gas delivery component into said cell culture device and displaces media and cells from said cell culture device into a cell collection vessel connected to said cell removal conduit, said second fluid detection component determining when the fluid that is moving through said cell removal conduit has changed from liquid to gas and upon making that determination said second fluid detection component sends a signal to said second fluid flow control component and upon receiving said signal, said second flow control component terminates the flow of fluid through said cell removal conduit.

7. A method of reducing the volume of media in a gas permeable cell culture device that contains cells and media comprising:

A gas permeable cell culture device that contains a first volume of media and cells residing on a growth surface and reducing the volume of media in order to increase the concentration of cells per milliliter of media by connecting a gas delivery component to a filter that is connected to said cell culture device, said cell culture device including a media removal conduit, connecting a first fluid detection component to said media removal conduit, connecting a first fluid flow control component to a media removal conduit, initiating gas delivery from said

gas delivery component, whereby gas moves into said cell culture device, the gas displaces media from said cell culture device into a media collection vessel connected to said media removal conduit, said first fluid detection component determines when the fluid that is moving through said media removal conduit has changed from media to gas and upon making that determination said first fluid detection component sends a signal to said first fluid flow control component, and upon said first fluid flow control component receiving said signal said first flow control component terminates the flow of fluid through said media removal conduit leaving a residual volume of media and cells within said cell culture device, said residual volume of media being less than said first volume of media.

8. The method of claim 7 including a step of collecting cells wherein after said first flow control component has terminated the flow of fluid through said media removal conduit, a cell collection vessel is connected to said media removal conduit, and with media in contact with a media removal opening of said media removal conduit first flow control component is opened to allow the flow of fluid through said media removal conduit, gas delivered from said gas delivery component moves into said cell culture device displacing said residual media volume and cells through said media removal conduit and into said cell collection vessel, said first fluid detection component determines when the fluid that is moving through said media removal conduit has changed from media to gas and sends a signal to said first fluid flow control component, and upon receiving said signal said first flow control component terminates the flow of fluid through said media removal conduit.

9. A method of collecting cells from a gas permeable cell culture device comprising:

a first step of reducing a first volume of media within a gas permeable cell culture device that contains cells in order to increase the concentration of cells per milliliter by connecting a gas delivery component to a filter that is connected to a gas permeable cell culture device containing media and cells, said cell culture device including a media removal conduit and a cell removal conduit, connecting a first fluid detection component to said media removal conduit, connecting a first fluid flow control component to said media removal conduit, and with at least a portion of said cells residing on a growth surface initiating gas delivery from said gas delivery component whereby gas moves into said cell culture device and the gas displaces media from said cell culture device into a media collection vessel connected to said media removal conduit, said first fluid detection component determining when the fluid that is moving through said media removal conduit has changed from media to gas and upon making that determination said first fluid detection component sends a signal to a first fluid flow control component, and upon receiving said signal said first flow control component terminates the flow of fluid through said media removal conduit leaving a residual volume of media and cells within said cell culture device, said residual volume of media being less than said first volume of media, and

a second step of removing cells from said gas permeable cell culture device by connecting a second fluid detection component to said cell removal conduit, connecting a second fluid flow control component to said cell removal conduit, and with cells distributed throughout said residual volume of media initiating gas delivery from a gas delivery component, whereby gas moves into said cell culture device and displaces media and cells from said cell culture device into a cell collection vessel connected to said cell removal conduit, said second fluid detection component determining when the fluid that is moving through said cell removal conduit has changed from media to gas and when that determination is made said second fluid

detection component sends a signal to said second fluid flow control component and upon receiving said signal, said second flow control component terminates the flow of fluid through said cell removal conduit.

10. The method of claim 9 including an additional step of rinsing said cell culture device to gather additional cells that may have been left in said cell culture device and/or said cell removal conduit after said second flow control component has terminated the flow of fluid through said cell removal conduit further comprising initiating the flow of liquid through said media removal conduit when said cell culture device is vented to atmosphere, said liquid moving through said media removal conduit into said cell culture device, agitating the liquid to move cells within said cell culture device into said liquid, and

initiating gas delivery from said gas delivery component into said cell culture device, said gas displacing liquid and cells from said cell culture device into said cell collection vessel via said cell removal conduit, said second fluid detection component determining when the fluid that is moving through said cell removal conduit has changed from liquid to gas and when that determination is made said second fluid detection component sends a signal to said second fluid flow control component and upon receiving said signal, said second flow control component terminates the flow of fluid through said cell removal conduit.

Claims

1. An apparatus for removing media from a cell culture device comprising:

a gas delivery component that is capable of connecting to a filter that is connected to a gas permeable cell culture device, said gas delivery component capable of delivering gas into said gas permeable cell culture device by way of said filter and serves to pressurize the internal volume of the cell culture device,

one fluid detection component that is capable of determining when the fluid moving within a media removal conduit that is connected to said gas permeable cell culture device changes from liquid to gas, said fluid detection component capable of sending a signal to a fluid flow control component that is capable of terminating fluid flow through said media removal conduit.

2. The device of claim 1 including a second fluid detection component that is capable of determining when fluid moving within a cell removal conduit that is connected to said gas permeable cell culture device changes from liquid to gas, said second fluid detection component capable of sending a signal to a second fluid flow control component capable of terminating fluid flow through said cell removal conduit.

3. A method of using the device of claim 1 comprising:

reducing the volume of liquid media in a gas permeable cell culture device that contains cells and media in order to increase the concentration of cells per milliliter of media by connecting said gas delivery component to a filter that is connected to said gas permeable cell culture device, said cell culture device including a media removal conduit, connecting said first fluid detection component to said media removal conduit, initiating gas delivery from said gas delivery component, whereby gas moves into said cell culture device, the gas pressurizes the cell culture device and displaces media from said cell culture device into a media collection vessel connected to said media removal conduit,

said first fluid detection component determines when the fluid that is moving through said media removal conduit has changed from liquid to gas and upon making that determination said first fluid detection component sends a signal to said first fluid flow control component, and upon said first fluid flow control component receiving said signal said first flow control component terminates the flow of fluid through said media removal conduit.

4. A method of using the device of claim 2 comprising:

Increasing the number of cells per milliliter of media in a gas permeable cell culture device cell culture device containing liquid media and cells, at least a portion of said cells in contact with a growth surface within said cell culture device, said cell culture device including a media removal conduit and a cell removal conduit, connecting said first fluid detection component to said media removal conduit, connecting said first fluid flow control component to said media removal conduit, initiating gas delivery from said gas delivery component whereby gas moves into said cell culture device and pressurizes the cell culture device and the gas displaces media from said cell culture device into a media collection vessel connected to said media removal conduit, said first fluid detection component determining when the fluid that is moving through said media removal conduit has changed from liquid to gas and upon making that determination, said first fluid detection component sends a signal to said first fluid flow control component, and upon receiving said signal said first flow control component terminates the flow of fluid through said media removal conduit, and

removing cells from said gas permeable cell culture device by connecting said second fluid detection component to said cell removal conduit, connecting said second fluid flow control component to said cell removal conduit, initiating gas delivery from said gas delivery component, whereby gas moves into said cell culture device and pressurizes the cell culture device and displaces media and cells by way of said cell removal conduit from said cell culture device into a cell collection

vessel connected to said cell removal conduit, said second fluid detection component determining when the fluid that is moving through said cell removal conduit has changed from liquid to gas and when that is determined said second fluid detection component sends a signal to said second fluid flow control component and upon receiving said signal, said second flow control component term.

5. The method of claim 4 wherein after said second flow control component has terminated the flow of fluid through said cell removal conduit, said cell culture device is vented to atmosphere, said first flow control component is opened to allow the flow of fluid through said media removal conduit, media is moved through said media removal conduit into said cell culture device, said first flow control component is closed, said media is agitated to move cells into said media, and

said cell culture device is no longer vented to atmosphere and gas is delivered from said gas delivery component into said cell culture device and pressurizes the cell culture device and displaces media and cells from said cell culture device into a cell collection vessel connected to said cell removal conduit, said second fluid detection component determining when the fluid that is moving through said cell removal conduit has changed from liquid to gas and upon making that determination said second fluid detection component sends a signal to said second fluid flow control component and upon receiving said signal, said second flow control component terminates the flow of fluid through said cell removal conduit.

6. A method of reducing the volume of media in a gas permeable cell culture device that contains cells and media comprising:

reducing the volume of media in order to increase the concentration of cells per milliliter of media by connecting a gas delivery component that serves to pressurize the cell culture device to a filter that is connected to a gas permeable cell culture device that contains a first volume of media and cells residing on a growth surface, said cell culture device including a media removal conduit, and delivering gas from said gas delivery component, whereby gas moves into said cell culture device and

pressurizes the cell culture device, the gas displaces media from said cell culture device into a media collection vessel by way of said media removal conduit, and when the fluid that is moving through said media removal conduit has changed from media to gas the flow of fluid through said media removal conduit is terminated, leaving a residual volume of media and cells within said cell culture device, said residual volume of media being less than said first volume of media.

7. The method of claim 6 including a step of collecting cells wherein after the flow of fluid through said media removal conduit is terminated, and with media in contact with a media removal opening of said media removal conduit, gas delivered from said gas delivery component moves into said cell culture device and pressurizes the cell culture device, displacing said residual media volume and cells through said media removal conduit and a cell collection vessel, and when the fluid that is moving through said media removal conduit has changed from media to gas the flow of fluid through said media removal conduit is terminated.

8. The method of claim 6 including an additional step of rinsing said cell culture device to gather additional cells that may have been left in said cell culture device and/or said cell removal conduit after the flow of fluid through said cell removal conduit has been terminated, further comprising initiating the flow of liquid through said media removal conduit when said cell culture device is vented to atmosphere, said liquid moving through said media removal conduit into said cell culture device, agitating the liquid to move cells within said cell culture device into said liquid, and

initiating gas delivery from said gas delivery component into said cell culture device, said gas pressurizes the cell culture device, displacing liquid and cells from said cell culture device into a cell collection vessel via said cell removal conduit, and when the fluid that is moving through said cell removal conduit has changed from liquid to gas the flow of fluid through said cell removal conduit is terminated.

9. The method of Claim 3 and Claim 6 wherein the initial media height is in the range of 1.0 cm to 25 cm.

10. The method of Claim 3 and Claim 6 wherein the initial media height is in the range of 1.0 cm to 20 cm.

11. The method of Claim 3 and Claim 6 wherein the initial media height is in the range of 1.0 cm to 15 cm.

12. The method of Claim 3 and Claim 6 wherein the initial media height is in the range of 2.0 cm to 10 cm.

13. The method of Claim 4 and Claim 6 wherein the growth surface is hydrophobic.

14. The method of Claim 4 and Claim 6 wherein the growth surface is silicone.

15. The method of Claim 14 wherein the silicone has a thickness between 0.001 inches and 0.024 inches.

16. The method of Claim 3, Claim 4, and Claim 6 wherein the cells are non-adherent cells.

17. The method of Claim 16 wherein the cells include T cells.

18. The method of Claim 17 wherein the T cells include CAR T.

19. The device of Claim 1 wherein said gas delivery component is a diaphragm pump.

20. The method of Claim 3 and Claim 4 wherein when said first flow control component terminates the flow of fluid through said media removal conduit, the residual media height ranges from 0.20 cm and 1.0 cm.