MAGNETIC BEAD REMOVAL METHOD, DEVICE, AND STORAGE MEDIUM

[0001] The present application is a Continuation Application of PCT Application No. PCT/CN2023/120445, titled “Magnetic Bead Removal Method, Device, And Storage Medium”, filed on September 1, 2023, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to the field of cell separation technology, and more particularly, to a magnetic bead removal method, device, and storage medium.

BACKGROUND

[0003] In the field of biotechnology, magnetic beads are often used to sort specific cells and bacteria, and then sorted cells or bacteria are cultured for experimental or medical purposes. At present, after micrometer sized magnetic beads are used to sort immunomagnetic cells and non-magnetic immune cells are cultured through the immunomagnetic cells, the immunomagnetic cells may still remain in the culture medium. Sometimes, the magnetic beads need to be removed by magnetic field adsorption to avoid adverse effects on experiments or medical treatment in the next step. The inventor realized that in the current technology, during the removal process of the immunomagnetic cells, due to the shear resistance of the fluid, when the area of the liquid bag containing the culture medium is too large (with the development of the cell processing industry, the volume of the sample in the liquid bag containing the culture medium is increasing, such

WHAT IS CLAIMED IS:

1. A magnetic bead removal method, comprising:

placing a liquid bag with a curved flow channel on a magnetic platform, wherein a plane where the curved flow channel is located is above the magnetic platform and parallel to the magnetic platform;

controlling a first flow control assembly to communicate the liquid bag with a sample container, thereby inputting a liquid containing immunomagnetic cells and non-magnetic immune cells into the curved flow channel from the sample container;

performing a flattening operation on the liquid bag to increase a contact surface between a bottom surface of the curved flow channel and the magnetic platform, thereby adsorbing the immunomagnetic cells in the curved flow channel onto the contact surface through the magnetic platform; and

performing a collection operation to collect the non-magnetic immune cells in the curved flow channel into a collection container.

2. The magnetic bead removal method according to claim 1, wherein the liquid bag comprises a liquid inlet communicating with the sample container through the first flow control assembly and a liquid outlet communicating with the collection container; and the curved flow channel is connected between the liquid inlet and the liquid outlet of the liquid bag.

3. The magnetic bead removal method according to claim 2, wherein the curved flow channel comprises multiple straight pipe sections arranged in parallel, and a connecting pipe section connected between two adjacent

straight pipe sections; the connecting pipe section is a bent pipe or a straight pipe arranged at a predetermined inclination angle with the straight pipe section; and/or

the curved flow channel comprises a spiral pipe section.

4. The magnetic bead removal method according to claim 3, wherein a maximum width of the curved flow channel is less than or equal to 50 mm; and/or

the liquid bag further comprises a buffering space, and the curved flow channel communicates with the liquid outlet of the liquid bag through the buffering space.

5. The magnetic bead removal method according to claim 1, wherein the performing a flattening operation on the liquid bag comprises:

determining whether a covering mechanism of a pressing device is capable of being closed, wherein the pressing device comprises the covering mechanism arranged on the magnetic platform and a pressing mechanism connected to the covering mechanism; when the covering mechanism is closed, the liquid bag is located in an accommodating space between the covering mechanism and the magnetic platform; and

when the covering mechanism is capable of being closed, controlling the pressing device to drive the closed covering mechanism to move downwards, thereby flattening the liquid bag placed in the accommodating space between the magnetic platform and the covering mechanism.

6. The magnetic bead removal method according to claim 5, wherein the

pressing device further comprises a lifting mechanism connected to the covering mechanism;

after the determining whether a covering mechanism of a pressing device is capable of being closed, the magnetic bead removal method further comprises:

when the covering mechanism is pushed up by the expanded liquid bag and incapable of being closed, controlling the lifting mechanism to drive the covering mechanism to ascend, thereby increasing the accommodating space between the magnetic platform and the covering mechanism;

after the covering mechanism ascends to a preset height at which the covering mechanism is capable of being closed, closing the covering mechanism; and

controlling the pressing device to drive the closed covering mechanism to move downwards to flatten the liquid bag placed in the accommodating space.

7. The magnetic bead removal method according to claim 6, wherein a lifting through-hole is formed in the magnetic platform, and the lifting mechanism comprises a lifting assembly arranged at a top of the magnetic platform, a lifting rod with a top thereof fixedly connected to the lifting assembly by passing through the lifting through-hole, and an ascending driving assembly arranged below the magnetic platform and connected to one end of the lifting rod away from the lifting assembly; the covering mechanism comprises a cover plate rotatably connected to the lifting assembly;

the controlling the lifting mechanism drives the covering mechanism to

ascend, thereby increasing the accommodating space between the magnetic platform and the covering mechanism, comprises:

turning on the ascending driving assembly to drive the lifting rod and thus to drive the lifting assembly and the cover plate to slide up along the lifting through-hole through the lifting rod, thereby increasing the accommodating space between the magnetic platform and the cover plate for placing the liquid bag.

8. The magnetic bead removal method according to claim 7, wherein the ascending driving assembly comprises a motor, a driving wheel, a driven wheel, a synchronous belt, a rotating shaft, a cam, a mounting bearing, and a bracket with an installation hole; the bracket is arranged at a bottom of the magnetic platform, the rotating shaft is arranged in the installation hole through the mounting bearing, the cam is fixedly arranged on the rotating shaft, the driving wheel is arranged on an output shaft of the motor, the synchronous belt is sleeved on the driving wheel and the driven wheel, the driven wheel is fixedly arranged on the rotating shaft, and a top of the cam abuts the lifting rod;

the driving the lifting assembly and the cover plate to slide up along the lifting through-hole comprises:

turning on the motor to drive the cam to sequentially rotate through the driving wheel, the synchronous belt, the driven wheel, and the rotating shaft, and driving the lifting assembly and the cover plate to slide up along the lifting through-hole through the lifting rod by a rotation of the cam.

9. The magnetic bead removal method according to claim 1, wherein the performing a collection operation to collect non-magnetic immune cells in the curved flow channel into a collection container comprises:

turning on a second flow control assembly arranged between the collection container and the liquid bag, such that the liquid bag communicates with the collection container, and transporting the non-magnetic immune cells in the curved flow channel to the collection container through the second flow control assembly.

10. A magnetic bead removal device comprising a pressing device and a controller for performing the magnetic bead removal method according to claim 1, wherein the controller is connected to the pressing device.

11. A magnetic bead removal device comprising a pressing device and a controller for performing the magnetic bead removal method according to claim 2, wherein the controller is connected to the pressing device.

12. A magnetic bead removal device comprising a pressing device and a controller for performing the magnetic bead removal method according to claim 3, wherein the controller is connected to the pressing device.

13. A magnetic bead removal device comprising a pressing device and a controller for performing the magnetic bead removal method according to claim 4, wherein the controller is connected to the pressing device.

14. A magnetic bead removal device comprising a pressing device and a controller for performing the magnetic bead removal method according to claim 5, wherein the controller is connected to the pressing device.

15. A non-volatile computer-readable storage medium storing computer-readable instructions, wherein the computer-readable instructions, when executed by a processor, implement the magnetic bead removal method according to claim 6.

16. A non-volatile computer-readable storage medium storing computer-readable instructions, wherein the computer-readable instructions, when executed by a processor, implement the magnetic bead removal method according to claim 1.

17. A non-volatile computer-readable storage medium storage computer-readable instructions, wherein the computer-readable instructions, when executed by a processor, implement the magnetic bead removal method according to claim 2.

18. A non-volatile computer-readable storage medium storing computer-readable instructions, wherein the computer-readable instructions, when executed by a processor, implement the magnetic bead removal method according to claim 3.

19. A non-volatile computer-readable storage medium storing computer-readable instructions, wherein the computer-readable instructions, when executed by a processor, implement the magnetic bead removal method according to claim 4.

20. A non-volatile computer-readable storage medium storing computer-readable instructions, wherein the computer-readable instructions, when executed by a processor, implement the magnetic bead removal method according to claim 5.