DEVICE FOR RAPID SEPARATION AND PREPARATION OF PLASMA

Field of the Invention

The invention relates to the technical field of plasma preparation equipment, and specifically to a device for rapid separation and preparation of plasma.

Background to the Invention

During plasma preparation, blood needs to be added into a test tube and subjected to centrifugation by a centrifuge, thereby enabling the blood in the test tube to be stratified by centrifugation, forming from bottom to top a red blood cell layer, a white blood cell and platelet layer, and a plasma layer, thus achieving plasma separation and preparation.

In coagulation function testing in laboratories, mixed plasma is used, and plasma is placed in blue trisodium citrate anticoagulant tubes. During separation, blood stability must be maintained to avoid mixing of separated plasma and blood cells. During the process, the air inside the device contains much dust and bacteria. After separation, plasma needs to be collected with a syringe, and dust and bacteria in the air may remain inside the device and at the top of the blue trisodium citrate anticoagulant tube, which may easily cause plasma contamination by air and bacteria.

Statement of Invention

The purpose of the invention is to provide a device for rapid separation and preparation of plasma, so as to solve the problem that, after separation, plasma needs to be collected with a syringe, while dust and bacteria in the air remain inside the device and at the top of the blue trisodium citrate anticoagulant tube, which may easily cause plasma contamination.

To solve the above technical problem, the invention is realised through the following technical solution:

The invention provides a device for rapid separation and preparation of plasma, comprising

a dust removal mechanism and a separation box, wherein the dust removal mechanism includes a box cover hinged to the top of the separation box, the bottom of the box cover being rotatably provided with two shafts, and several blades fixedly mounted on each shaft, characterised in that it further comprises: several ventilation holes formed on the bottom inner wall of the box cover, a top cover fixedly mounted on the top of the box cover, several air outlets respectively formed on the left and right sides of the top cover, several telescopic rods fixedly mounted on the bottom inner wall of the top cover, a T-shaped groove formed on the top of the box cover, several T-shaped plates fixedly mounted at the bottom ends of the telescopic rods, the T-shaped plates being adapted to the T-shaped groove, springs respectively wound around the telescopic rods, the tops of the springs being fixedly connected to the top cover, and the bottoms of the springs being fixedly connected to the T-shaped plates.

Further, a separation mechanism is provided on the bottom inner wall of the separation box, the separation mechanism comprising several separation rods rotatably mounted on the bottom inner wall of the separation box, the top ends of two corresponding separation rods being respectively fixedly provided with circular boxes, the tops of the two circular boxes being respectively provided with several through holes, and several rubber T-shaped cylinders being fixedly mounted inside each circular box.

Further, two supporting mechanisms are fixedly mounted on the bottom inner wall of the separation box, each supporting mechanism comprising several fixing rods fixedly mounted on the bottom inner wall of the separation box, several annular blocks fixedly mounted on the fixing rods, several sliding blocks fixedly mounted on the outer wall of the circular boxes, and the ends of the sliding blocks remote from each other extending into the annular blocks and being slidably connected thereto.

Further, compaction mechanisms are respectively provided at the bottom ends of the two shafts, each compaction mechanism comprising a circular disc fixedly mounted at the bottom end of the shaft, and a rubber disc fixedly mounted at the bottom of the circular disc, the rubber disc being adapted to the circular box.

Further, two opening and closing mechanisms are provided inside the separation box,

each opening and closing mechanism comprising a mounting plate fixedly mounted on the inner wall of the left side of the separation box, the rear surface of the mounting plate being fixedly provided with a hydraulic cylinder, strip-shaped grooves being respectively formed on the inner wall of the left side of the separation box and the inner wall of the left side of the box cover, the strip-shaped groove on the inner wall of the left side of the separation box being arranged at an inclined angle, two sliding rods being respectively fixedly mounted inside the two strip-shaped grooves, circular sliding blocks being slidably sleeved on the two sliding rods, the two circular sliding blocks respectively extending out of the two strip-shaped grooves, the left sides of the two circular sliding blocks being rotatably provided with connecting plates, the front surfaces of the connecting plates being provided with T-shaped sliding grooves, the ends of the hydraulic cylinders being fixedly provided with T-shaped sliding blocks, and the T-shaped sliding blocks extending into and slidably connected with the T-shaped sliding grooves.

Further, transmission mechanisms are respectively provided on the rear surfaces of the two connecting plates, each transmission mechanism comprising a nail-shaped square plate fixedly mounted on the rear surface of the connecting plate, an air box fixedly mounted on the bottom inner wall of the separation box, an airbag provided inside the air box, a through groove formed on the front surface of the air box, the nail-shaped square plate being adapted to the through groove on the front surface of the air box, an air pipe fixedly mounted on the front surface of the airbag, and the front end of the air pipe extending out of the air box.

Further, a disinfection mechanism is provided on the bottom inner wall of the separation box, the disinfection mechanism comprising a disinfection box fixedly mounted on the bottom inner wall of the separation box, a rectangular plate fixedly mounted inside the disinfection box, and a cylinder fixedly mounted inside the disinfection box, a piston being slidably mounted inside the cylinder, the right side of the piston being fixedly provided with a return spring, the right end of the return spring being fixedly connected to the cylinder, the bottom of the rectangular plate being fixedly provided with a liquid leakage pipe, the end of the liquid leakage pipe extending into the cylinder, the right end of the cylinder being fixedly provided with an infusion pipe, the right end of the infusion pipe extending out of the

disinfection box, a liquid spraying cover being fixedly mounted on the inner wall of the front side of the separation box, and the end of the infusion pipe being fixedly connected to the liquid spraying cover.

Further, a driving mechanism is provided on the inner wall of the front side of the separation box, the driving mechanism comprising a driving motor fixedly mounted on the inner wall of the front side of the separation box, the output shaft of the driving motor being fixedly connected to the corresponding separation rod, several pulleys being respectively fixedly sleeved on the separation rods, and synchronous belts being wound around the pulleys.

The invention has the following beneficial effects:

(1) In the device for rapid separation and preparation of plasma, during separation, when the box cover is closed, two rubber discs contact the blue trisodium citrate anticoagulant tubes placed in the through holes, the rubber discs deform and increase friction with the tubes, and during separation the rubber discs drive the circular discs to rotate, the circular discs drive the shafts to rotate, and the shafts drive several blades to rotate. The blades generate suction force during rotation, blowing air containing dust and bacteria out of the separation box. The air passes through the ventilation holes to push the T-shaped plate, and when the air pressure inside the separation box reaches a certain level, the T-shaped plate is lifted, allowing air containing dust and bacteria to be expelled through the air outlets on the top cover. After separation, the T-shaped plate is pushed into the T-shaped groove by the telescopic rods and springs, blocking the ventilation holes on the box cover and preventing dust and bacteria from re-entering the separation box.

(2) In the device for rapid separation and preparation of plasma, during separation the driving motor drives the corresponding separation rods to rotate, and under the action of the pulleys and synchronous belts, multiple separation rods rotate synchronously. The separation rods drive two circular boxes to rotate, and the circular boxes drive the blue trisodium citrate anticoagulant tubes containing blood to undergo rotational separation. During rotation of the circular boxes, several sliding blocks on the circular boxes synchronously rotate within the annular blocks, thereby avoiding instability caused by

excessive size and long-term wear of the circular boxes, and effectively improving the stability of separation.

(3) In the device for rapid separation and preparation of plasma, after placing the blue trisodium citrate anticoagulant tubes containing blood into the corresponding through holes on the circular boxes, the hydraulic cylinder is started, the hydraulic cylinder pulls the T-shaped sliding block to move, the T-shaped sliding block pulls the connecting plate to move, and during the movement of the connecting plate the T-shaped sliding block slides upward within the T-shaped sliding groove on the connecting plate until the box cover is completely closed, thereby preventing external dust from entering the separation box and causing cross infection. After the box cover is closed, the rubber discs on the box cover contact the blue trisodium citrate anticoagulant tubes in the through holes and press them more tightly, causing the tubes to enter the bottom ends of the rubber T-shaped cylinders, thereby improving the stability of the tubes during separation and avoiding shaking.

(4) In the device for rapid separation and preparation of plasma, after separation is completed, the hydraulic cylinder is started again to move the connecting plate and open the box cover. The connecting plate drives the nail-shaped square plate to compress the airbag inside the air box, and the gas in the airbag passes through the air pipe into the cylinder and pushes the piston. The piston pushes the disinfectant inside the cylinder to be discharged through the infusion pipe and sprayed from the liquid spraying cover, thereby spraying disinfectant onto several blue trisodium citrate anticoagulant tubes for sterilisation, preventing bacteria from entering the syringe during plasma collection and causing cross infection. When the box cover is closed, the connecting plate drives the infusion pipe to move out of the air box, and under the action of gas reflux and the return spring, the piston returns to its initial position, while the disinfectant inside the disinfection box flows through the leakage pipe into the cylinder in preparation for the next disinfection.

Of course, any product implementing the invention does not necessarily need to achieve all of the above advantages simultaneously.

Brief Description of the Drawings

In order to more clearly illustrate the technical solutions of the embodiments of the invention, the drawings required for the description of the embodiments are briefly introduced below. It is obvious that the drawings described below are merely some embodiments of the invention, and for those skilled in the art, other drawings can also be obtained based on these drawings without creative effort.

Figure 1 is a schematic diagram of the overall structure of the invention;

Figure 2 is a schematic sectional diagram of the side portion of the invention;

Figure 3 is a schematic enlarged view of part A in Figure 2 of the invention;

Figure 4 is a schematic sectional diagram of the front portion of the invention;

Figure 5 is a schematic sectional diagram of the disinfection mechanism of the invention;

Figure 6 is a schematic enlarged view of part B in Figure 5 of the invention;

Figure 7 is a schematic enlarged view of part C in Figure 5 of the invention;

Figure 8 is a schematic bottom view of the internal structure of the invention.

In the drawings, the list of components represented by each reference numeral is as follows: 01 - Dust removal mechanism; 1 - Separation box; 2 - Box cover; 3 - Shaft; 4 - Blade; 5 - Ventilation hole; 6 - Top cover; 7 - Air outlet; 8 - Telescopic rod; 9 - T-shaped groove; 10 - T-shaped plate; 11 - Spring; 02 - Separation mechanism; 12 - Separation rod; 13 - Circular box; 14 - Through hole; 15 - Rubber T-shaped cylinder; 03 - Supporting mechanism; 16 - Fixing rod; 17 - Annular block; 18 - Sliding block; 04 - Compaction mechanism; 19 - Circular disc; 20 - Rubber disc; 05 - Opening and closing mechanism; 21 - Mounting plate; 22 - Hydraulic cylinder; 23 - Strip-shaped groove; 24 - Sliding rod; 25 - Sliding block; 26 - Connecting plate; 27 - T-shaped sliding groove; 28 - T-shaped sliding block; 06 - Transmission mechanism; 29 - Nail-shaped square plate; 30 - Air box; 31 - Airbag; 32 - Air pipe; 07 - Disinfection mechanism; 33 - Disinfection box; 34 - Rectangular plate; 35 - Cylinder; 36 - Piston; 37 - Spring; 38 - Leakage pipe; 39 - Infusion pipe; 40 - Liquid spraying cover; 08 - Driving mechanism; 41 - Driving motor; 42 - Pulley; 43 - Synchronous belt.

Detailed Description

The following will clearly and completely describe the technical solutions of the embodiments of the invention in conjunction with the accompanying drawings. It is evident that the described embodiments are merely part of the embodiments of the invention, and not all of the embodiments. Based on the embodiments of the invention, all other embodiments obtained by those skilled in the art without creative effort fall within the scope of protection of the invention.

Referring to Figures 1-8, the invention relates to a device for rapid separation and preparation of plasma, comprising a dust removal mechanism 01 and a separation box 1. The dust removal mechanism 01 includes a box cover 2 hinged to the top of the separation box 1, the bottom of the box cover 2 being rotatably provided with two shafts 3, and several blades 4 being fixedly mounted on each of the two shafts 3, characterised in that it further comprises:

Several ventilation holes 5 formed on the bottom inner wall of the box cover 2, a top cover 6 fixedly mounted on the top of the box cover 2, several air outlets 7 respectively formed on the left and right sides of the top cover 6, several telescopic rods 8 fixedly mounted on the bottom inner wall of the top cover 6, a T-shaped groove 9 formed on the top of the box cover 2, several T-shaped plates 10 fixedly mounted at the bottom ends of the telescopic rods 8, the T-shaped plates 10 being adapted to the T-shaped groove 9, springs 11 respectively wound around the telescopic rods 8, the tops of the springs 11 being fixedly connected to the top cover 6, and the bottoms of the springs 11 being fixedly connected to the T-shaped plates 10.

As shown in Figure 4, a separation mechanism 02 is provided on the bottom inner wall of the separation box 1, the separation mechanism 02 comprising several separation rods 12 rotatably mounted on the bottom inner wall of the separation box 1, the top ends of two corresponding separation rods 12 being respectively fixedly provided with circular boxes 13, the tops of the two circular boxes 13 being respectively provided with several through holes 14, and several rubber T-shaped cylinders 15 being fixedly mounted inside each circular box 13.

By providing the separation mechanism 02, the separation rods 12 drive the circular boxes 13 to rotate, and the circular boxes 13 drive the blue trisodium citrate anticoagulant tubes containing blood to undergo rotational separation.

As shown in Figure 4, two supporting mechanisms 03 are fixedly mounted on the bottom inner wall of the separation box 1, each supporting mechanism 03 comprising several fixing rods 16 fixedly mounted on the bottom inner wall of the separation box 1, several annular blocks 17 fixedly mounted on the fixing rods 16, and several sliding blocks 18 fixedly mounted on the outer wall of the circular boxes 13, the ends of the sliding blocks 18 remote from each other extending into the annular blocks 17 and being slidably connected thereto.

By providing the supporting mechanisms 03, during rotation of the circular boxes 13, several sliding blocks 18 on the circular boxes 13 synchronously rotate within the annular blocks 17, thereby avoiding instability caused by excessive size and long-term wear of the circular boxes 13, and effectively improving the stability of separation.

As shown in Figure 4, compaction mechanisms 04 are respectively provided at the bottom ends of the two shafts 3, each compaction mechanism 04 comprising a circular disc 19 fixedly mounted at the bottom end of the shaft 3, and a rubber disc 20 fixedly mounted at the bottom of the circular disc 19, the rubber disc 20 being adapted to the circular box 13.

By providing the compaction mechanisms 04, after the box cover 2 is closed, the rubber discs 20 on the box cover 2 contact the blue trisodium citrate anticoagulant tubes in the through holes 14 and press them more tightly, causing the tubes to enter the bottom ends of the rubber T-shaped cylinders 15, thereby improving the stability of the tubes during separation and avoiding shaking.

As shown in Figure 6, two opening and closing mechanisms 05 are provided inside the separation box 1, each opening and closing mechanism 05 comprising a mounting plate 21 fixedly mounted on the inner wall of the left side of the separation box 1, the rear surface of the mounting plate 21 being fixedly provided with a hydraulic cylinder 22. Strip-shaped grooves 23 are respectively formed on the inner wall of the left side of the separation box 1 and the inner wall of the left side of the box cover 2, the strip-shaped groove 23 on the

inner wall of the left side of the separation box 1 being arranged at an inclined angle. Two sliding rods 24 are respectively fixedly mounted inside the two strip-shaped grooves 23, circular sliding blocks 25 being slidably sleeved on the two sliding rods 24, the two circular sliding blocks 25 respectively extending out of the two strip-shaped grooves 23, the left sides of the two circular sliding blocks 25 being rotatably provided with connecting plates 26. The front surfaces of the connecting plates 26 are provided with T-shaped sliding grooves 27, the ends of the hydraulic cylinders 22 being fixedly provided with T-shaped sliding blocks 28, and the T-shaped sliding blocks 28 extending into and slidably connected with the T-shaped sliding grooves 27.

By providing the opening and closing mechanisms 05, during separation, when the box cover 2 is closed, the two rubber discs 20 contact the blue trisodium citrate anticoagulant tubes placed in the through holes 14, the rubber discs 20 deform and increase friction with the tubes, and during separation the rubber discs 20 drive the circular discs 19 to rotate, thereby providing a transmission effect while preventing external dust and bacteria from entering the separation box 1.

As shown in Figure 6, transmission mechanisms 06 are respectively provided on the rear surfaces of the two connecting plates 26, each transmission mechanism 06 comprising a nail-shaped square plate 29 fixedly mounted on the rear surface of the connecting plate 26, an air box 30 fixedly mounted on the bottom inner wall of the separation box 1, an airbag 31 provided inside the air box 30, and a through groove formed on the front surface of the air box 30. The nail-shaped square plate 29 is adapted to the through groove on the front surface of the air box 30, and an air pipe 32 is fixedly mounted on the front surface of the airbag 31, the front end of the air pipe 32 extending out of the air box 30.

By providing the transmission mechanisms 06, when the hydraulic cylinder 22 is started, the connecting plates 26 are moved to open the box cover 2, and the connecting plates 26 drive the nail-shaped square plates 29 to compress the airbags 31 inside the air box 30 to generate thrust.

As shown in Figures 5 and 7, a disinfection mechanism 07 is provided on the bottom inner wall of the separation box 1, the disinfection mechanism 07 comprising a disinfection box

33 fixedly mounted on the bottom inner wall of the separation box 1, a rectangular plate 34 fixedly mounted inside the disinfection box 33, and a cylinder 35 fixedly mounted inside the disinfection box 33. A piston 36 is slidably mounted inside the cylinder 35, the right side of the piston 36 being fixedly provided with a return spring 37, the right end of the return spring 37 being fixedly connected to the cylinder 35. The bottom of the rectangular plate 34 is fixedly provided with a leakage pipe 38, the end of the leakage pipe 38 extending into the cylinder 35. The right end of the cylinder 35 is fixedly provided with an infusion pipe 39, the right end of the infusion pipe 39 extending out of the disinfection box 33. A liquid spraying cover 40 is fixedly mounted on the inner wall of the front side of the separation box 1, and the end of the infusion pipe 39 is fixedly connected to the liquid spraying cover 40.

By providing the disinfection mechanism 07, the gas inside the airbag 31, when compressed by the nail-shaped square plate 29, passes through the air pipe 32 into the cylinder 35 and pushes the piston 36. The piston 36 drives the disinfectant inside the cylinder 35 to be discharged through the infusion pipe 39 and sprayed from the liquid spraying cover 40, thereby spraying disinfectant onto several blue trisodium citrate anticoagulant tubes for sterilisation, preventing bacteria from entering the syringe during plasma collection and causing cross infection.

As shown in Figures 2 and 4, a driving mechanism 08 is provided on the inner wall of the front side of the separation box 1, the driving mechanism 08 comprising a driving motor 41 fixedly mounted on the inner wall of the front side of the separation box 1, the output shaft of the driving motor 41 being fixedly connected to the corresponding separation rod 12. Several pulleys 42 are respectively fixedly sleeved on the separation rods 12, and synchronous belts 43 are wound around the pulleys 42.

By providing the driving mechanism 08, during separation the driving motor 41 drives the corresponding separation rods 12 to rotate, and under the action of the pulleys 42 and synchronous belts 43, multiple separation rods 12 rotate synchronously. The separation rods 12 drive two circular boxes 13 to rotate, and the circular boxes 13 drive the blue trisodium citrate anticoagulant tubes containing blood to undergo rotational separation.

In use, after placing the blue trisodium citrate anticoagulant tubes containing blood into the

corresponding through holes 14 on the circular boxes 13, the hydraulic cylinder 22 is started, the hydraulic cylinder 22 pulls the T-shaped sliding block 28 to move, the T-shaped sliding block 28 pulls the connecting plate 26 to move, and during the movement of the connecting plate 26 the T-shaped sliding block 28 slides upward within the T-shaped sliding groove 27 on the connecting plate 26 until the box cover 2 is completely closed, thereby preventing external dust from entering the separation box 1 and causing cross infection. After the box cover 2 is closed, the rubber discs 20 on the box cover 2 contact the blue trisodium citrate anticoagulant tubes in the through holes 14 and press them more tightly, causing the tubes to enter the bottom ends of the rubber T-shaped cylinders 15, thereby improving the stability of the tubes during separation and avoiding shaking. During separation, the driving motor 41 drives the corresponding separation rods 12 to rotate, and under the action of the pulleys 42 and synchronous belts 43, multiple separation rods 12 rotate synchronously. The separation rods 12 drive two circular boxes 13 to rotate, and the circular boxes 13 drive the blue trisodium citrate anticoagulant tubes containing blood to undergo rotational separation. During rotation of the circular boxes 13, several sliding blocks 18 on the circular boxes 13 synchronously rotate within the annular blocks 17, thereby avoiding instability caused by excessive size and long-term wear of the circular boxes 13, and effectively improving the stability of separation.

During separation, when the box cover 2 is closed, the two rubber discs 20 contact the blue trisodium citrate anticoagulant tubes placed in the through holes 14. The rubber discs 20 deform and increase friction with the tubes. During separation, the rubber discs 20 drive the circular discs 19 to rotate, the circular discs 19 drive the shafts 3 to rotate, and the shafts 3 drive several blades 4 to rotate. The blades 4 generate suction force during rotation, blowing air containing dust and bacteria out of the separation box 1. The air passes through the ventilation holes 5 to push the T-shaped plate 10. When the air pressure inside the separation box 1 reaches a certain level, the T-shaped plate 10 is lifted, and the air containing dust and bacteria inside the separation box 1 is expelled through the air outlets 7 on the top cover 6. After separation, the T-shaped plate 10 is pushed into the T-shaped groove 9 by the telescopic rods 8 and springs 11, thereby blocking the ventilation holes 5 on the box cover 2 and preventing dust and bacteria from re-entering the separation box 1.

After separation is completed, the hydraulic cylinder 22 is started again to move the connecting plate 26 and open the box cover 2. The connecting plate 26 drives the nail-shaped square plate 29 to compress the airbag 31 inside the air box 30. The gas inside the airbag 31 passes through the air pipe 32 into the cylinder 35 and pushes the piston 36. The piston 36 drives the disinfectant inside the cylinder 35 to be discharged through the infusion pipe 39 and sprayed from the liquid spraying cover 40, thereby spraying disinfectant onto several blue trisodium citrate anticoagulant tubes for sterilisation, preventing bacteria from entering the syringe during plasma collection and causing cross infection. When the box cover 2 is closed, the connecting plate 26 drives the infusion pipe 39 to move out of the air box 30. Under the action of gas reflux and the return spring 37, the piston 36 returns to its initial position, and the disinfectant inside the disinfection box 33 flows through the leakage pipe 38 into the cylinder 35 in preparation for the next disinfection.

The above disclosed preferred embodiments of the invention are merely provided to help explain the invention. The preferred embodiments do not describe all details exhaustively, nor do they limit the invention solely to the specific embodiments described. It is evident that, based on the content of this specification, many modifications and variations can be made. The embodiments selected and specifically described herein are intended to better explain the principles and practical applications of the invention, so that those skilled in the art can readily understand and utilise the invention. The invention is only limited by the claims and their full scope and equivalents.