IMPROVED MULTIFUNCTIONAL DEVICE FOR THORACIC SURGERY DRAINAGE

Field of the Invention

The invention relates to the field of medical devices, and specifically concerns an improved multifunctional device for thoracic surgery drainage.

Background to the Invention

In the medical field, particularly in thoracic surgery treatment activities, some patients' thoracic cavities usually require drainage of effusion. The current conventional drainage method is to connect a drainage bag with a drainage tube to perform thoracic effusion drainage, thereby achieving the purpose of discharging thoracic effusion and facilitating subsequent treatment.

Patent publication number CN116688255A discloses an improved multifunctional device for thoracic surgery drainage, comprising a base plate and a drainage bottle. Fixing mechanisms are arranged on both sides of the drainage bottle, a drainage tube is mounted at the upper end of the drainage bottle, a first connecting tube is mounted on the drainage tube, an adjusting mechanism is mounted on the surface of the first connecting tube, and a suction head is mounted at one end of the first connecting tube. A pressure-relief tube is mounted at the upper end of the drainage bottle on one side of the drainage tube, a second connecting tube is mounted on the pressure-relief tube, a negative pressure aspirator is mounted on the upper surface of the base plate on one side of the placing plate, and the second connecting tube is connected with the negative pressure aspirator. A placing platform is mounted on the upper surface of the base plate on one side of the placing plate, and a winding mechanism is mounted on the placing platform.

According to the above technical solution, after use, the mounting covers are removed from the drainage tube and the pressure-relief tube respectively, then one end of the first connecting tube is passed through the second notch, and one end of the first connecting tube is clamped inside the first notch. The adjusting mechanism is then moved to the other end of the first connecting tube, and by rotating the handle, the handle drives the winding wheel through the third rotating shaft to rotate, thereby winding the first connecting tube. When the effusion inside the drainage bottle needs to be treated, the drainage bottle is removed from the placing plate, the discharge tube is opened to remove the effusion from inside the drainage bottle, and disinfectant is added into the drainage bottle through the adding tube to disinfect the interior of the drainage bottle.

However, the above technical solution can only achieve storage of the first connecting tube after use by means of the winding wheel and rotating handle, while during use the first connecting tube is scattered on one side of the drainage bottle, easily knotting and tangling, which affects normal thoracic effusion drainage. In addition, the above technical solution merely disinfects the interior of the drainage bottle by adding disinfectant. However, patients' thoracic effusion generally contains a large amount of protein, and protein deposits adhering to the inner wall of the drainage bottle form flocculent matter, making subsequent disinfection of the drainage bottle difficult, which the above technical solution cannot resolve.

Statement of Invention

The purpose of the invention is to overcome the problems of existing thoracic surgery drainage devices in which the drainage tube easily knots and tangles during use and disinfection is difficult.

To achieve the above purpose, the technical concept adopted by the invention is: to provide an improved multifunctional device for thoracic surgery drainage, comprising a mobile base, a drainage tube, a collection bottle, a winding mechanism and an anti-adhesion mechanism arranged on the mobile base; the invention employs the winding mechanism to coil and organise the drainage tube, and the anti-adhesion mechanism to stir pleural effusion collected in the collection bottle, thereby preventing necrotic matter, proteins and other precipitates from adhering to the inner wall of the collection bottle, facilitating subsequent cleaning and disinfection.

Based on the above technical concept, the technical solution adopted by the invention is: An improved multifunctional device for thoracic surgery drainage, comprising a mobile base, and a collection bottle and a drainage tube arranged on the mobile base, wherein one end of the collection bottle and the drainage tube is connected, and the mobile base is further provided with: a winding mechanism, connected to the other end of the drainage tube; an anti-adhesion mechanism, connected to the collection bottle.

In order to facilitate stirring of pleural effusion collected in the collection bottle and to prevent precipitates in the pleural effusion from adhering to the inner wall of the collection bottle, in the above technical solution, preferably, the anti-adhesion mechanism comprises: a magnetic floating plate, horizontally arranged inside the collection bottle; a driver, arranged outside the collection bottle and magnetically connected with the magnetic floating plate.

In order to facilitate passage of pleural effusion, the magnetic floating plate is further defined as comprising: a concave panel, the surface of which is provided with multiple through-holes; four stirring blades, circumferentially arranged around the concave panel, each stirring blade being embedded with a permanent magnet.

In order to drive the magnetic floating plate to rotate more smoothly, the driver is further defined as comprising: four driving units, circumferentially arranged around the concave panel, each driving unit being magnetically connected with the corresponding permanent magnet.

In order to store the drainage tube integrally and avoid blockage caused by bending of the drainage tube, the winding mechanism is further defined as comprising: a bracket, connected to the mobile base; a winding drum, connected to the bracket; a winding assembly, respectively connected to the mobile base and the bracket.

In order to wind the drainage tube neatly on the winding drum and make it less prone to knotting, the winding assembly is further defined as comprising: a guide drum, rotatably connected to the bracket, the surface of the guide drum being provided with a slideway; a first slider, the lower end of which is slidably connected with the slideway; a slide rail, arranged on the bracket and slidably connected with the upper end of the first slider; a transmission unit, respectively connected to the guide drum and the winding drum.

In order to ensure smooth organisation of the drainage tube, the transmission unit is further defined as comprising: a first rotating shaft, which passes through the bracket and is connected to the guide drum; a second rotating shaft, which passes through the bracket and is connected to the winding drum; a conveyor belt, respectively connected to the first rotating shaft and the second rotating shaft; a driver, connected to the first rotating shaft.

In order to improve the stability of the collection bottle, the mobile base is further provided with a self-locking mechanism for fixing the collection bottle.

The self-locking mechanism is further defined as comprising: four clamping plates, evenly distributed around the collection bottle, each clamping plate being internally provided with a second slider, the second slider being connected to the corresponding driving unit; four air bags, respectively arranged on the inner side of the corresponding clamping plates, each air bag being in communication with the interior of the corresponding clamping plate; four V-shaped rods, arranged on the bottom surface of the mobile base, each V-shaped rod being rotatably connected to the bottom of the collection bottle and the corresponding clamping plate; a supporting plate, arranged below the collection bottle; a supporting spring, arranged on the bottom surface of the mobile base and connected to the supporting plate.

In order to ensure smooth drainage of pleural effusion out of the patient's body, the mobile base is further provided with: a gas disinfection bottle, connected to the collection bottle through a first diversion tube, and connected to an external negative pressure suction device through a second diversion tube.

Beneficial Effects

Firstly, through the combined design of the winding mechanism, drainage tube, collection bottle and anti-adhesion mechanism, the invention not only prevents the drainage tube from tangling, knotting or bending and thereby obstructing normal pleural effusion drainage during use, but also prevents precipitates from adhering to the inner wall of the collection bottle, facilitating subsequent cleaning and disinfection, thus improving the overall effectiveness of the thoracic surgery drainage device.

Secondly, through the combined design of the magnetic floating plate, clamping plates, air bags and driving units, the height of the magnetic floating plate varies with the liquid level of pleural effusion inside the collection bottle, while the weight of the collection bottle compresses the gas in the air bags into the inner cavities of the clamping plates, thereby ensuring that the position of the driving units remains on the same plane as the magnetic floating plate, enabling normal operation of the anti-adhesion mechanism.

Thirdly, through the combined design of the V-shaped rods, collection bottle, supporting spring and clamping plates, the greater the amount of pleural effusion in the collection bottle, the greater the weight of the collection bottle, and the stronger the clamping force of the clamping plates on the collection bottle. The structure is simple, the fixing effect on the collection bottle is enhanced, and the device is convenient to use.

Fourthly, the invention provides a gas disinfection bottle, which can be connected to an external negative pressure suction device to ensure that pleural effusion inside the patient's body is normally drained out.

Finally, through the combined design of the guide drum, slider, drainage tube and winding drum, the drainage tube can be wound in an orderly manner, with the drainage tube arranged neatly on the winding drum, avoiding disorderly winding and bending of the drainage tube, thereby ensuring normal drainage operation.

Brief Description of the Drawings

In order to more clearly illustrate the technical solutions of the embodiments of the invention or of the prior art, the drawings required for the description of the embodiments or the prior art are briefly introduced below. It is evident 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 on the basis of these drawings without creative effort.

Figure 1 is a structural schematic diagram of an improved multifunctional device for thoracic surgery drainage provided in an embodiment of the invention;

Figure 2 is a partial sectional view of the mobile base of the device shown in Figure 1;

Figure 3 is an enlarged view of portion A in Figure 2;

Figure 4 is a top view of the device shown in Figure 2;

Figure 5 is a front view of the device shown in Figure 2;

Figure 6 is an enlarged view of portion B in Figure 5;

Figure 7 is a half-sectional view of the collection bottle of the device shown in Figure 5;

Figure 8 is an enlarged view of portion C in Figure 7;

Figure 9 is a structural schematic diagram of the device shown in Figure 2 from another perspective;

Figure 10 is a structural schematic diagram of the self-locking mechanism;

Figure 11 is a structural schematic diagram of the magnetic floating plate;

Figure 12 is a structural schematic diagram of the device shown in Figure 11 from another perspective;

Figure 13 is a schematic diagram showing the positional relationship between the magnetic floating plate and the driving units;

Figure 14 is a structural schematic diagram of the magnetic unit;

Figure 15 is a structural schematic diagram of the winding mechanism.

In the drawings: 1 - Winding mechanism; 11 - Bracket; 12 - Winding drum; 13 - Guide drum; 14 - First slider; 15 - Slide rail; 16 - Transmission unit; 16a - First rotating shaft; 16b - Second rotating shaft; 16c - Conveyor belt; 16d - Driver; 2 - Anti-adhesion mechanism; 21 - Magnetic floating plate; 21a - Concave panel; 21b - Stirring blade; 21c - Permanent magnet; 22 - Driver; 22a - Limiting circular plate; 3 - Collection bottle; 4 - Drainage tube; 41 - Fixing tube; 42 - Flexible tube; 5 - Mobile base; 6 - Self-locking mechanism; 61 - Clamping plate; 62 - Air bag; 63 - V-shaped rod; 64 - Supporting plate; 65 - Supporting spring; 66 - Second slider; 66a - Reset spring; 67 - Connecting ring; 7 - Gas disinfection bottle; 8 - Negative pressure suction device.

Detailed Description

In order to make the objectives, technical solutions and advantages of the embodiments of the invention clearer, the embodiments of the invention are described below in detail and completely with reference to the accompanying drawings.

In the description of the invention, it should be understood that terms such as "longitudinal direction", "upper", "lower", "front", "rear", "left", "right", "top", "bottom", "inner", "outer", "axial", "radial" and "circumferential" indicate orientation or positional relationships based on the orientation or positional relationships shown in the drawings, and are merely for the purpose of facilitating description of the invention and simplifying the description, rather than indicating or implying that the device or element referred to must have a specific orientation, be constructed in a specific orientation or operate in a specific orientation, and therefore should not be construed as limiting the invention. In addition, features defined as "first" and "second" may explicitly or implicitly include one or more such features. In the description of the invention, unless otherwise specified, the term "plurality" means two or more.

In the description of the invention, it should be noted that unless otherwise expressly stipulated and defined, the terms "mounted", "connected" and "linked" should be understood in a broad sense, for example, they may be fixed connections, detachable connections or integrally connected; they may be mechanical connections or electrical connections; they may be directly connected or indirectly connected through an intermediate medium; they may also be communication between the interiors of two elements. For those skilled in the art, the specific meaning of the above terms in the invention can be understood according to the specific circumstances.

The inventors have found that current thoracic surgery drainage devices can only achieve storage of the first connecting tube after use by means of a winding wheel and rotating handle, while during use the first connecting tube is scattered on one side of the drainage bottle, easily knotting and tangling, which affects normal pleural effusion drainage.

In addition, the above technical solution merely disinfects the interior of the drainage bottle by adding disinfectant. However, patients' pleural effusion generally contains a large amount of protein, and protein deposits adhering to the inner wall of the drainage bottle form fleshy matter, making subsequent disinfection of the drainage bottle difficult, which the above technical solution cannot resolve.

Based on the above findings, the present application provides an improved multifunctional device for thoracic surgery drainage, comprising a mobile base (5), and a winding mechanism (1), an anti-adhesion mechanism (2), a collection bottle (3), a drainage tube (4) and a self-locking mechanism (6) arranged on the mobile base (5). Through the following designs, the application achieves better storage of the drainage tube (4) and facilitates subsequent cleaning of the collection bottle (3), specifically as follows:

1. The winding mechanism (1) can neatly wind the drainage tube (4) onto its own winding drum (12), with the drainage tube (4) arranged in order, thereby avoiding disorderly winding on the winding drum, preventing bending of the drainage tube and ensuring normal drainage operation.

2. The anti-adhesion mechanism (2), during drainage, stirs the pleural effusion inside the collection bottle (3), keeping the pleural effusion in a flowing state, thereby preventing precipitates in the pleural effusion from adhering to the inner wall of the collection bottle (3), and thus reducing the difficulty of subsequent cleaning and disinfection of the collection bottle (3).

3. The self-locking mechanism (6), as the pleural effusion inside the collection bottle (3) continuously increases, can, with the weight of the collection bottle (3), cause the clamping plates (61) to press more tightly against the outer surface of the collection bottle (3), while simultaneously using the air bags (62) to adjust the height of the second slider (66), thereby achieving height adjustment of the driving unit, so that the driving unit is always maintained on the same horizontal plane as the magnetic floating plate (21) of the anti-adhesion mechanism (2).

Embodiment 1

This embodiment provides an improved multifunctional device for thoracic surgery drainage, as shown in Figures 1-15, comprising a winding mechanism (1), an anti-adhesion mechanism (2), a collection bottle (3), a drainage tube (4), a mobile base (5), a self-locking mechanism (6) and a gas disinfection bottle (7).

The mobile base (5) comprises a square frame, universal wheels fixed to the bottom surface of the square frame, and a handrail fixed to the side of the square frame. In actual use, medical staff can hold the handrail and push the mobile base (5) to one side of the patient's bed.

The self-locking mechanism (6) is fixed inside the square frame of the mobile base (5) so as to secure the collection bottle (3). Specifically, the self-locking mechanism (6) comprises four clamping plates (61), four air bags (62), four V-shaped rods (63), a supporting plate (64), a supporting spring (65), four second sliders (66), and a connecting ring (67) arranged on the bottom surface inside the square frame of the mobile base (5).

The four V-shaped rods (63) are circumferentially arranged around the connecting ring (67) as the centre, each V-shaped rod (63) having three ends; specifically, one end of each V-shaped rod (63) is rotatably connected to the connecting ring (67), another end is rotatably connected to the bottom surface of the supporting plate (64), and the final end is rotatably connected to the corresponding clamping plate (61).

The supporting plate (64) is of circular structure, and the bottom surface of the supporting plate (64) is provided with four circumferentially arranged T-shaped connecting blocks, each T-shaped connecting block being rotatably connected to one end of the corresponding V-shaped rod (63). In actual use, the collection bottle (3) is placed on the supporting plate (64) so that the clamping plates (61) clamp and secure the collection bottle (3).

The supporting spring (65) is located inside the connecting ring (67), the upper end of the supporting spring (65) being fixedly connected to the supporting plate (64), and the lower end being fixedly connected to the square frame of the mobile base (5).

Each clamping plate (61) is fixedly connected on its side to the corresponding air bag (62), and each clamping plate (61) is fixedly connected on its side to the outer surface of the corresponding air bag (62). Specifically, the interior of each clamping plate (61) is provided with a cavity with a downward-facing opening, and each clamping plate (61) is in communication with the interior of the corresponding air bag (62) through a connecting tube.

The four second sliders (66) are respectively located inside the cavities of the corresponding clamping plates (61), and the upper end of each second slider (66) is fixedly connected to a reset spring (66a) arranged in the inner cavity of the corresponding clamping plate (61). In actual use, each second slider (66) is connected to the anti-adhesion mechanism (2).

The working principle of the self-locking mechanism (6) provided by the invention is as follows: In the initial state, after the empty collection bottle (3) is placed on the supporting plate (64), each second slider (66) is located at the lowest position inside the cavity of the corresponding clamping plate (61).

During drainage of pleural effusion into the collection bottle (3), the weight of the collection bottle (3) increases, thereby compressing the supporting spring (65) downward. At this time, the supporting spring (65), through the supporting plate (64), drives each V-shaped rod (63) to rotate downward, so that each V-shaped rod (63) presses the corresponding clamping plate (61) against the side surface of the collection bottle (3), thereby achieving clamping and fixing of the collection bottle (3). Meanwhile, as the clamping plates (61) compress the air bags (62), the gas inside the air bags (62) enters the inner cavity of the corresponding clamping plates (61) through connecting tubes, thereby pushing the second sliders (66) upward.

After drainage of pleural effusion is completed, medical staff manually lift the supporting plate (64) with one hand, so that each V-shaped rod (63) rotates upward, driving the corresponding clamping plate (61) away from the outer surface of the collection bottle (3). At this time, the air bags (62) are no longer compressed, the gas inside the cavities of the clamping plates (61) flows back into the air bags (62), and both the air bags (62) and the reset springs (66a) return to their initial state. At this point, the reset springs (66a) provide a downward force on the second sliders (66), enabling the second sliders (66) to move downward to their initial positions, thereby facilitating removal of the collection bottle (3).

The anti-adhesion mechanism (2) comprises a magnetic floating plate (21) and a driver (22); the driver (22) comprises four driving units, each driving unit being embedded inside the corresponding second slider (66).

Specifically, each driving unit is a coil, each coil being connected to an external power supply. In order to maintain the shape of the coil, each coil is sleeved on a limiting circular plate (22a) located inside the corresponding second slider (66).

The magnetic floating plate (21) is located inside the collection bottle (3); specifically, the magnetic floating plate (21) comprises a concave panel (21a) and four stirring blades (21b) arranged on the bottom surface of the concave panel (21a).

Each stirring blade (21b) is embedded with a permanent magnet (21c) for magnetic connection with the corresponding driving unit; the concave panel (21a) is provided with multiple through-holes to facilitate passage of pleural effusion.

It should be noted that the embodiment of the invention does not limit the fixed connection method between the concave panel (21a) and the stirring blades (21b). By way of example, the fixed connection method may be integral moulding, snap-fit or bolt connection.

The working principle of the anti-adhesion mechanism (2) provided by the invention is as follows: Firstly, the magnetic floating plate (21) is placed inside the collection bottle (3); then each driving unit is energised. After energisation, each driving unit generates a magnetic field, and by utilising the principle of repulsion between like magnetic poles, each driving unit drives the permanent magnet (21c) located near it to rotate around the centre of the concave panel (21a). The permanent magnet (21c) in turn drives the corresponding stirring blade (21b) to rotate, thereby causing the magnetic floating plate (21) as a whole to rotate inside the collection bottle (3).

It should be noted that, in actual use, the size of the airflow generated by deformation of the air bags (62) under compression can be adjusted according to the change in liquid level height of pleural effusion inside the collection bottle (3) per unit time, so that the distance of liquid level change inside the collection bottle (3) per unit time corresponds to the distance moved by the second slider (66) under airflow. In this way, the permanent magnet (21c) embedded inside the second slider (66) and the driving unit are always maintained on the same horizontal plane, enabling the driving unit to drive the corresponding stirring blade (21b) through the permanent magnet (21c).

In actual use, the collection bottle (3) may also be pre-filled with disinfectant to reduce the burden of subsequent disinfection of the collection bottle (3).

The winding mechanism (1) is arranged inside the square frame of the mobile base (5) so as to store the drainage tube (4) connected to the collection bottle (3), thereby keeping the drainage tube (4) neatly arranged and preventing tangling, knotting or bending of the drainage tube (4), which could otherwise obstruct smooth drainage of pleural effusion.

Specifically, the drainage tube (4) comprises a fixing tube (41) and a flexible tube (42); one end of the fixing tube (41) is in communication with the interior of the collection bottle (3), and the other end is connected to the flexible tube (42), which is connected to the winding mechanism (1).

The winding mechanism (1) comprises a bracket (11), a winding drum (12) and a winding assembly.

The bracket (11) comprises two mounting plates arranged in parallel, the two mounting plates being fixedly connected to the bottom surface of the mobile base (5). It should be noted that the embodiment of the invention does not limit the fixed connection method between the bracket (11) and the mobile base (5). By way of example, the fixed connection method may be bolt connection, welding or snap-fit connection.

The winding drum (12) is horizontally arranged between the two mounting plates of the bracket (11), and the two ends of the winding drum (12) are respectively rotatably connected to the mounting plates. In order to prevent the flexible tube (42) from slipping off the winding drum (12), circular baffles are respectively provided at both ends of the winding drum (12).

The winding assembly comprises a guide drum (13), a first slider (14), a slide rail (15) and a transmission unit (16). The guide drum (13) and the winding drum (12) are arranged horizontally in parallel, and the two ends of the guide drum (13) are respectively rotatably connected to the mounting plates of the bracket (11). Specifically, the guide drum (13) is provided with a wavy slideway, which serves to guide the first slider (14).

The slide rail (15) is arranged above the guide drum (13); specifically, the slide rail (15) comprises two horizontally arranged crossbars, and the two ends of each crossbar are fixedly connected to the two mounting plates of the bracket (11).

The first slider (14) is of T-shaped structure; specifically, the first slider (14) is sleeved on the two crossbars of the slide rail (15), and the side surface of the first slider (14) is provided with a circular through-hole, which is used for sleeving the drainage tube (4).

The transmission unit (16) comprises a first rotating shaft (16a), a second rotating shaft (16b), a conveyor belt (16c) and a driver (16d).

Specifically, the first rotating shaft (16a) is located outside the bracket (11), and one end of the first rotating shaft (16a) passes through the bracket (11) and is fixedly connected to the side surface of the guide drum (13). The second rotating shaft (16b) is located outside the bracket (11), and one end of the second rotating shaft (16b) passes through the bracket (11) and is fixedly connected to the side surface of the winding drum (12). The conveyor belt (16c) is sleeved on the first rotating shaft (16a) and the second rotating shaft (16b). The output end of the driver (16d) is fixedly connected to the side of the first rotating shaft (16a) away from the guide drum (13). In this way, the driver (16d) drives the first rotating shaft (16a) to rotate, the first rotating shaft (16a) drives the guide drum (13) to rotate, and at the same time the first rotating shaft (16a) drives the second rotating shaft (16b) to rotate through the conveyor belt (16c), so that the second rotating shaft (16b) drives the winding drum (12) to rotate, thereby realising synchronous rotation of the guide drum (13) and the winding drum (12).

It should be noted that the driver (16d) provided in this embodiment of the invention is prior art, and this embodiment of the invention does not improve upon it.

The working principle of the winding mechanism (1) provided by the invention is as follows: Firstly, the flexible tube (42) is pulled out from the circular through-hole of the first slider (14) so as to be connected to the thoracic puncture needle, and then the driver (16d) is started. The driver (16d), through the first rotating shaft (16a) and the second rotating shaft (16b), drives the guide drum (13) and the winding drum (12) to rotate in the same direction. At this time, the first slider (14), being guided by the wavy slideway on the outer surface of the guide drum (13), reciprocates left and right on the slide rail (15), while the winding drum (12) rotates so as to wind the flexible tube (42) evenly onto the winding drum (12), thereby avoiding overlapping winding of the flexible tube (42) at one position on the winding drum

(12), which could otherwise compress part of the internal passage of the wound flexible tube (42) and obstruct the flow of pleural effusion.

In practical application, in order to ensure that pleural effusion is normally drained out of the patient's body, the mobile base (5) is further provided with a gas disinfection bottle (7). The gas disinfection bottle (7) is in communication with the interior of the collection bottle (3) through a first diversion tube, and is connected to an external negative pressure suction device (8) through a second diversion tube. The interior of the gas disinfection bottle (7) is pre-filled with disinfectant, and the end of the second diversion tube is immersed in the disinfectant.

It should be noted that the external negative pressure suction device (8) provided in this embodiment of the invention is prior art, and this embodiment of the invention does not improve upon it.

Application Case:

The infant presented with weak respiration, cyanosis of the whole body skin, poor response to stimulation, low muscle tone of the limbs, and weakened primitive reflexes. Transcutaneous oxygen saturation (without oxygen) was 30%; transcutaneous oxygen saturation (with oxygen) was 60%. The preliminary diagnosis was neonatal pleural effusion (bilateral), and ultrasound-guided thoracic catheter drainage was performed.

Step 1: Perform chest B-ultrasound localisation and relevant preoperative auxiliary examinations such as coagulation function.

Step 2: Insert one end of the drainage tube (4) into the central through-hole of the second slider (66), wind it once around the winding drum (12), and then connect it to the collection bottle (3).

Step 3: Start the driver (16d); the driver (16d), through the first rotating shaft (16a) and the second rotating shaft (16b), drives the winding drum (12) and the guide drum (13) to rotate, thereby the first slider (14) drives the drainage tube (4) to be evenly wound on the winding drum (12).

Step 4: Connect one end of the first diversion tube to the gas disinfection bottle (7) and the other end to the collection bottle (3), and connect one end of the second diversion tube to the gas disinfection bottle (7) and the other end to the external negative pressure suction device (8).

Step 5: Disinfect the puncture site and surrounding area within at least 15 cm, lay sterile drapes, and check that the puncture instruments are complete and intact.

Step 6: Perform chest wall infiltration anaesthesia with diluted lidocaine, ensuring successful anaesthesia of the pleural layer to reduce pleural reaction.

Step 7: Energise each driving unit.

Step 8: Insert the needle at the puncture site; after a breakthrough sensation is felt, open the external negative pressure suction device (8) to extract pleural effusion.

During this step, the amount of pleural effusion in the collection bottle (3) continuously increases, the weight of the collection bottle (3) continuously increases, and the collection bottle (3) compresses the supporting spring (65) downward, while the magnetic floating plate (21) rises as the level of pleural effusion inside the collection bottle (3) increases.

At this time, the supporting spring (65), through the supporting plate (64), drives each V-shaped rod (63) to rotate downward, so that each V-shaped rod (63) presses the corresponding clamping plate (61) against the side surface of the collection bottle (3), thereby achieving clamping and fixing of the collection bottle (3). Meanwhile, as the clamping plates (61) compress the air bags (62), the gas inside the air bags (62) enters the inner cavity of the corresponding clamping plates (61) through connecting tubes, thereby pushing the second sliders (66) upward, so that the driving units embedded inside the second sliders (66) and the permanent magnets (21c) are always maintained on the same plane.

According to the principle of repulsion between like magnetic poles, each driving unit drives the permanent magnet (21c) located near it to rotate around the centre of the concave panel (21a). The permanent magnet (21c) in turn drives the corresponding stirring blade (21b) to rotate, thereby causing the magnetic floating plate (21) as a whole to rotate inside the collection bottle (3), so as to stir the pleural effusion in the collection bottle (3) and prevent precipitates in the pleural effusion from adhering to the inner wall of the collection bottle (3).

The contents not described in detail in this specification belong to the prior art well known to those skilled in the art.