SOIL SAMPLING DEVICE FOR ENVIRONMENTAL MONITORING

Field of the Invention

The present invention belongs to the technical field of environmental monitoring equipment and relates to a soil sampling device for environmental monitoring.

Background to the Invention

Environmental monitoring refers to the activity of monitoring and measuring the environmental quality status by environmental monitoring agencies. Environmental monitoring is the process of monitoring and measuring indicators that reflect environmental quality to determine the level of environmental pollution and quality. Soil testing is also a part of environmental testing, and when conducting soil testing, it is usually necessary to sample and test the soil.

At present, soil sampling devices are often used for soil sampling, including a sampling cylinder, a drill bit, and a rotating mechanism. The drill bit is set at the lower end of the sampling cylinder, and the rotating mechanism drives the sampling cylinder to rotate. The sampling cylinder drives the drill bit to drill into the soil for sampling. During the rotation of the sampling cylinder, soil enters from the sampling port on the side of the sampling cylinder, and sufficient soil is obtained to complete the sampling.

However, due to the direct entry of soil from different depths through the sampling port during sampling, it is easy to cause soil mixing at different depths, resulting in the masking of the unique chemical, physical, or biological characteristics of soil at different depths, which affects the accuracy of the detection results.

Statement of Invention

The purpose of the present invention is to provide a soil sampling device for environmental monitoring, which can maintain the independence of soil at different depths and avoid soil mixing at different depths that may affect the accuracy of detection results.

To achieve the above objectives, the specific technical solution of a soil sampling device for environmental monitoring provided by the present invention is as follows:

A soil sampling device for environmental monitoring, comprising a top plate and a bottom plate arranged horizontally from top to bottom, wherein the bottom plate is connected to the top plate through a supporting component, and a through hole is opened on the bottom plate, it further comprises:

The outer cylinder is vertically arranged between the bottom plate and the top plate, and its lower end is close to the through hole, at least one first sampling port is opened on the side of the outer cylinder, and two sliding grooves are symmetrically opened vertically above the first sampling port on the side of the outer cylinder;

An inner cylinder is set inside the outer cylinder and is slidably connected to the inner wall of the outer cylinder, a second sampling port is opened on the side of the inner cylinder near the position below the first sampling port;

A movable ring is fitted onto the outer cylinder and positioned near two sliding grooves, the outer diameter of the movable ring is larger than the diameter of the through hole;

The connecting component is set inside the outer cylinder and located close to the movable ring, the lower part of the connecting component is connected to the inner cylinder, and the two sides of the connecting component are connected to the movable ring through two sliding grooves;

The lifting components are respectively connected to the top plate and the outer cylinder, used to drive the outer cylinder to move up and down, so that the movable ring comes into contact with the bottom plate, and drives the inner cylinder to move up and down on the outer cylinder, so that the first sampling port and the second sampling port coincide and separate.

The characteristics of the present invention also lie in:

Wherein the connecting component comprises: a movable block set inside the outer cylinder and located near two sliding grooves; the transmission rod is vertically arranged between the movable block and the inner cylinder, and its two ends are respectively connected to the movable block and the inner cylinder; two connecting rods are horizontally arranged in two sliding grooves, and the two ends of each connecting rod are respectively connected to the inner surface of the movable block and the movable ring.

Wherein the lifting component comprises: an electric telescopic rod vertically arranged between the top plate and the outer cylinder, the upper end of the electric telescopic rod is connected to the top plate, and the lower end of the electric telescopic rod is connected to the outer cylinder through a box; the first elastic component is vertically arranged inside the outer cylinder and located at the upper part of the movable block, the two ends of the first elastic component are respectively connected to the top of the outer cylinder and the movable block.

Wherein a baffle is obliquely arranged inside the first sampling port, the lower end of the baffle is close to the inner cylinder and is rotatably connected to the first sampling port, the upper end of the baffle is close to the outside of the first sampling port, and the lower part of the baffle is connected to the inside of the first sampling port through a second elastic component obliquely arranged, the first sampling port is provided with an opening and closing component, which is respectively connected to the baffle and the movable block, the opening and closing component is used to drive the baffle through the up and down movement of the movable block, swing up and down to open and close the first sampling port.

Wherein the opening and closing component comprises: a first plunger hydraulic cylinder vertically arranged at the upper part of the movable block and located inside the first elastic component, and the two ends of the first plunger hydraulic cylinder are respectively connected to the movable block and the top of the outer cylinder; the liquid storage chamber is located inside the top of the outer cylinder and is connected to the first plunger hydraulic cylinder; two installation chambers are symmetrically opened inside the outer cylinder and located below the storage chamber, the first sampling port is located between the two installation chambers, and each installation chamber is vertically equipped with a second plunger hydraulic cylinder, the upper end of each second plunger hydraulic cylinder is connected to the top of the installation chamber, and the second plunger hydraulic cylinder is connected to the storage chamber; the pressing component is connected to two second plunger hydraulic cylinders and a baffle respectively, and is used to drive the baffle to swing up and down through the expansion and contraction of the two second plunger hydraulic cylinders.

Wherein the pressing component comprises: a sliding chamber opened inside the side of the outer cylinder and located between two installation chambers and the first sampling port, and the sliding chamber is connected to each installation chamber through a vertically arranged guide hole; two guide rods are respectively set in two guide holes, and the upper end of each guide rod is connected to the lower end of the corresponding second plunger hydraulic cylinder; an arc-shaped plate is set inside the sliding chamber and is slidably connected to the inner wall of the sliding chamber, the lower end of each guide rod is connected to the arc-shaped plate; the pressure rod is vertically arranged at the lower part of the arc-shaped plate and located near the first sampling port, the upper end of the pressure rod is connected to the arc-shaped plate, and the lower end of the pressure rod passes through the bottom of the sliding chamber and is located inside the first sampling port and in contact with the upper surface of the baffle.

Wherein a third elastic component is sleeved on the pressure rod at a position inside the sliding chamber, and the two ends of the third elastic component are respectively slidably connected to the arc-shaped plate and the bottom of the sliding chamber.

Wherein the lower end of the pressure rod is provided with a first roller, and the first roller is in contact with the upper part of the baffle.

The soil sampling device for environmental monitoring of the present invention has the following advantages:

Firstly, through the coordination of the bottom plate, outer cylinder, inner cylinder, movable ring, connecting component, and lifting component, the lifting component can drive the outer cylinder to move up and down, so that the movable ring contacts the bottom plate and drives the inner cylinder to move up and down relative to the outer cylinder. This causes the first sampling port to overlap and separate from the second sampling port, thereby opening the second sampling port after the outer cylinder enters the soil, allowing the soil to enter the inner cylinder. After the sampling is completed, the second sampling port is closed and the outer cylinder is removed from the soil, so that soil of other depths will not enter the inner cylinder during the process of entering and removable the soil, avoiding soil mixing at different depths and ensuring the accuracy of the detection results.

Secondly, through the cooperation of the baffle, the second elastic component, the opening and closing component, and the movable block, the baffle is driven to swing up and down in the first sampling port, opening and closing the first sampling port to prevent soil from entering the first sampling port at other depths during the downward movement of the outer cylinder in the soil, and to prevent the first sampling port from mixing into the second sampling port after the second sampling port is opened, thereby further avoiding soil mixing at different depths.

Brief Description of the Drawings

FIG. 1 is a schematic diagram of the front view structure of the present invention.

FIG. 2 is an enlarged view of the partial structure of part A in Figure 1 of the present invention.

FIG. 3 is a schematic diagram of the internal side view structure of the outer cylinder in the present invention.

FIG. 4 is an enlarged view of the partial structure of part B in Figure 1 of the present invention.

FIG. 5 is a schematic top view of the internal structure of the sliding chamber in the present invention.

FIG. 6 is an enlarged view of the partial structure of part C in Figure 3 of the present invention.

Attached image label:

1. Top plate, 2. Support column, 3. Box body, 4. Outer cylinder, 5. Inner cylinder, 6. Bottom

plate, 7. Through hole, 8. Electric telescopic rod, 9. Partition plate, 10. Sampling chamber, 11. First sampling port, 12. Second sampling port, 13. Baffle, 14. Movable block, 15. Movable ring, 16. Sliding groove, 17. Connecting rod, 18. Transmission rod, 19. Limit plate, 20. First elastic component, 21. Second elastic component, 22. Third elastic component, 23. First plunger hydraulic cylinder, 24. Second plunger hydraulic cylinder, 25. Storage chamber, 26. First roller, 27. Installation chamber, 28. Sliding chamber, 29. Guide hole, 30. Guide rod, 31. Arc-shaped plate, 32. Second roller, 33. Pressure rod, 34. Motor, 35. Drill bit.

Detailed Description

The following will provide a clear and detailed description of the technical solution in this application, in conjunction with the accompanying drawings. Among them, in the description of the embodiments of the present application, unless otherwise specified, "/" means "or", for example, A/B can represent A or B: "and/or" in the text is only a description of the association relationship of the associated object, indicating that there can be three types of relationships, such as A and/or B, which can represent: the existence of A alone, the existence of A and B at the same time, and the existence of B alone. In addition, in the description of the embodiments of the present application, "multiple" refers to two or more. The following terms "first" and "second" are only used for descriptive purposes and should not be understood as implying or implying relative importance or implying the number of technical features indicated. Therefore, the features that are limited to "first" and "second" can explicitly or implicitly include one or more of these features.

As shown in Figures 1 and 2, the present invention provides a soil sampling device for environmental monitoring, comprising a top plate 1, a bottom plate 6, an outer cylinder 4, an inner cylinder 5, a movable ring 15, a connecting component, and a lifting component. The top plate 1 and the bottom plate 6 are arranged horizontally relative to each other from top to bottom, that is, the bottom plate 6 is arranged below the top plate 1 and is used to contact the ground. The bottom plate 6 is connected to the top plate 1 through a supporting component, which facilitates the support of the top plate 1; The bottom plate 6 is provided with a through hole 7, and the outer cylinder 4 is vertically arranged between the bottom plate 6 and the top plate 1. The outer cylinder 4 has an upper end closed and a lower end open structure. The lower end of the outer cylinder 4 is close to the through hole 7, and at least one first sampling port 11 is opened on the side of the outer cylinder 4. The side of the outer cylinder 4 is symmetrically opened vertically above the first sampling port 11 with two sliding grooves 16, each of which is connected to the inside of the outer cylinder 4. The inner cylinder 5 is arranged inside the outer cylinder 4, and both ends of the inner cylinder 5 are closed structures. The inner cylinder 5 is slidably connected to the inner wall of the outer cylinder 4, making it easy for the inner cylinder 5 to slide up and down along the inner wall of the outer cylinder 4. A second sliding groove 16 is opened on the side of the inner cylinder 5 near the two sampling ports 12; The movable ring 15 is set on the outer cylinder 4, and is connected to the side of the outer cylinder 4 by sliding. The position of the movable ring 15 is close to two sliding grooves 16, and the outer diameter of the movable ring 15 is larger than the diameter of the through hole 7, avoiding the movable ring 15 from passing through the through hole 7. When the movable ring 15 contacts the bottom plate 6, it blocks the further downward movement of the movable ring 15, providing an upward force for the movable ring 15 to move relative to the outer cylinder 4. The connecting component is set inside the outer cylinder 4, and the position of the connecting component is close to the movable ring 15. The lower part of the connecting component is connected to the inner cylinder 5, and the two sides of the connecting component are connected to the movable ring 15 through two sliding grooves 16, making it easy to drive the inner cylinder 5 to move through the movement of the movable ring 15. The lifting components are respectively connected to the top plate 1 and the outer cylinder 4, used to drive the outer cylinder 4 to move up and down, so that the movable ring 15 comes into contact with the bottom plate 6, and drives the inner cylinder 5 to move up and down on the outer cylinder 4, so that the first sampling port 11 and the second sampling port 12 coincide and separate. Therefore, after the outer cylinder 4 enters the soil, the second sampling port 12 is opened to allow the soil to enter the inner cylinder 5, and after the sampling is completed, the second sampling port 12 is closed to remove the outer cylinder 4 from the soil, so that soil of other depths will not enter the inner cylinder 5 during the process of entering and removable the soil, avoiding soil mixing at different depths and ensuring the accuracy of the detection results.

As shown in Figures 1 and 2, the support component includes multiple support columns 2, which are vertically arranged between the top plate 1 and the bottom plate 6. Multiple support columns 2 are uniformly arranged along the edge of the bottom plate 6, and each support column 2 is connected to the top plate 1 and the bottom plate 6 at both ends.

As shown in Figure 2, the connecting component includes a movable block 14, a transmission rod 18, and two connecting rods 17. The movable block 14 is set inside the outer cylinder 4, and its position is close to two sliding grooves 16. The movable block 14 is slidably connected to the inner wall of the outer cylinder 4, making it easy for the movable block 14 to move up and down inside the outer cylinder 4. The transmission rod 18 is vertically set between the movable block 14 and the inner cylinder 5, and its two ends are respectively connected to the movable block 14 and the inner cylinder 5, two connecting rods 17 are horizontally arranged in two sliding grooves 16, and the two ends of each connecting rod 17 are respectively connected to the movable block 14 and the inner side of the movable ring 15. When the movable ring 15 moves up and down along the outer cylinder 4, the two connecting rods 17 drive the movable block 14 to move up and down, and the movable block 14 drives the inner cylinder 5 to move up and down along the inner wall of the outer cylinder 4 through the transmission rod 18.

As shown in Figure 2, a limit plate is horizontally placed inside the outer cylinder 4 between the inner cylinder 5 and the movable block 14. A limit hole is opened near the transmission rod 18 on the limit plate, and the transmission rod 18 passes through the limit hole. The limit plate makes the up and down movement of the transmission rod 18 more stable.

As shown in Figure 1, Figure 2, and Figure 3, the lifting assembly includes an electric telescopic rod 8 and a first elastic component 20. The electric telescopic rod 8 is vertically arranged between the top plate 1 and the outer cylinder 4, and the upper end of the electric telescopic rod 8 is connected to the top plate 1. The lower end of the electric telescopic rod 8 is connected to the outer cylinder 4 through the box body 3, and the outer cylinder 4 is moved up and down by the extension and contraction of the electric telescopic rod 8. The first elastic component 20 is vertically arranged inside the outer cylinder 4 and located at the upper part of the movable block 14. The two ends of the first elastic component 20 are respectively connected to the top of the outer cylinder 4 and the movable block 14. The first elastic component 20 facilitates the upward movement of the inner cylinder 5 and its reset.

As shown in Figure 1, a motor 34 is installed inside the box 3. The output end of the motor 34 passes through the lower part of the box 3 and is connected to the top of the outer cylinder 4. The lower end of the outer cylinder 4 is equipped with a drill bit 35, which is detachably connected to the outer cylinder 4. The upper part of the inner cylinder 5 is detachably connected to the lower end of the transmission rod 18, making it easy to remove the drill bit 35 and take out the inner cylinder 5 from the outer cylinder 4. Start the motor 34 to drive the outer cylinder 4 to rotate. The outer cylinder 4 drives the drill bit 35 to rotate, and the ground is drilled through the drill bit 35, so that the outer cylinder 4 enters the soil.

As shown in Figure 1, each support column 2 is fitted with a sleeve at a position close to the box body 3. The sleeve is slidably connected to the corresponding support column 2, and is connected to the box body 3 through a horizontally set fixing rod, which facilitates the limit of the box body 3 and makes the up and down movement of the box body 3 more stable.

As shown in Figure 4, a baffle 13 is inclined inside the first sampling port 11. The lower end of the baffle 13 is close to the inner cylinder 5 and is rotatably connected to the first sampling port 11. The upper end of the baffle 13 is close to the outside of the first sampling port 11. The lower part of the baffle 13 is connected to the inside of the first sampling port

11 through a second elastic component 21 that is inclined. The first sampling port 11 is equipped with an opening and closing component, which is connected to the baffle 13 and the movable block 14 respectively. The opening and closing component is used to drive the baffle 13 to swing up and down through the up and down movement of the movable block 14, thereby opening and closing the first sampling port 11. Through the baffle 13, the outer cylinder 4 is prevented from movable downward in the soil, which will not allow soil of other depths to enter the first sampling port 11, thus avoiding the second sampling port 11. After opening the sampling port 12, the first sampling port 11 will not mix into the second sampling port 12, thereby affecting the accuracy of the detection results.

As shown in Figures 2 and 3, the opening and closing assembly includes a first plunger hydraulic cylinder 23, a storage chamber 25, two installation chambers 27, and a lower pressure component. The first plunger hydraulic cylinder 23 is vertically arranged on the upper part of the movable block 14 and located inside the first elastic component 20, that is, the first elastic component 20 is set on the first plunger hydraulic cylinder 23. The two ends of the first plunger hydraulic cylinder 23 are respectively connected to the movable block 14 and the top of the outer cylinder 4. The storage chamber 25 is opened inside the top of the outer cylinder 4, and hydraulic oil is set inside the storage chamber 25. The storage chamber 25 is connected to the first plunger hydraulic cylinder 23, and a first connecting pipe is vertically arranged between the storage chamber 25 and the first plunger hydraulic cylinder 23. The two ends are respectively connected to the storage chamber 25 and the first plunger hydraulic cylinder 23, two installation chambers 27 are symmetrically opened inside the side of the outer cylinder 4 and located below the storage chamber 25. The first sampling port 11 is located between the two installation chambers 27, and each installation chamber 27 is vertically equipped with a second plunger hydraulic cylinder 24. The upper end of each second plunger hydraulic cylinder 24 is connected to the top of the installation chamber 27, and the second plunger hydraulic cylinder 24 is connected to the storage chamber 25, a second connecting pipe is vertically arranged between the second plunger hydraulic cylinder 24 and the storage chamber 25. The two ends of the second connecting pipe are respectively connected to the second plunger hydraulic cylinder 24 and the storage chamber 25. The hydraulic oil transmits the pressure inside the first plunger hydraulic cylinder 23 and the two second plunger hydraulic cylinders 24, so that the contraction of the first plunger hydraulic cylinder 23 can drive the extension of the two second plunger hydraulic cylinders 24. The lower pressure component is connected to the two second plunger hydraulic cylinders 24 and the baffle 13, and is used to drive the baffle 13 to swing up and down through the expansion and contraction of the two second plunger hydraulic cylinders 24, thereby opening and closing the first sampling port 11.

As shown in Figures 4, 5, and 6, the lower pressure component includes a sliding chamber

28, two guide rods 30, an arc-shaped plate 31, and a pressure rod 33. The sliding chamber 28 is located inside the side of the outer cylinder 4, between two installation chambers 27 and the first sampling port 11. The sliding chamber 28 is connected to each installation chamber 27 through vertically arranged guide holes 29, which are located inside the side of the outer cylinder 4. The two guide rods 30 are respectively arranged in the two guide holes 29, and each guide rod 30 can move up and down in the corresponding guide hole 29. The upper end of each guide rod 30 is connected to the lower end of the corresponding second plunger hydraulic cylinder 24, the arc-shaped plate 31 is set inside the sliding chamber 28, and is slidably connected to the inner wall of the sliding chamber 28. The arc-shaped plate 31 can freely slide up and down along the interior of the sliding chamber 28, and the sliding chamber 28 is set along the circumference of the outer cylinder 4, so that the sliding chamber 28 is also arc-shaped. The lower end of each guide rod 30 is connected to the arc-shaped plate 31, and the pressure rod 33 is vertically set at the lower part of the arc-shaped plate 31 and located near the first sampling port 11, that is, the pressure rod 33 is located between the two guide rods 30, and the upper end of the pressure rod 33 is connected to the arc-shaped plate 31. The lower end of the pressure rod 33 passes through the bottom of the sliding chamber 28 and is located inside the first sampling port 11 and in contact with the upper surface of the baffle 13, the pressure rod 33 is located between two guide rods 30, and its upper end is connected to the arc-shaped plate 31, the lower end of the pressure rod 33 passes through the bottom of the sliding chamber 28 and is located inside the first sampling port 11 and in contact with the upper surface of the baffle 13. That is, the sliding chamber 28 is connected to the first sampling port 11 through a connecting hole, and the pressure rod 33 is located inside the connecting hole. The pressure rod 33 can move up and down along the connecting hole. By movable downwards, the baffle 13 is driven to swing downwards, opening the first sampling port 11. When the pressure rod 33 moves upwards, the first elastic component 20 drives the baffle 13 to move upwards, closing the first sampling port 11.

As shown in Figure 4, a third elastic component 22 is fitted on the pressure rod 33 at a position inside the sliding chamber 28. The two ends of the third elastic component 22 are respectively connected to the arc-shaped plate 31 and the bottom of the sliding chamber 28 for sliding. The third elastic component 22 facilitates the downward movement and reset of the arc-shaped plate 31.

As shown in Figure 4, the lower end of the pressure rod 33 is equipped with a first roller 26, which contacts the upper part of the baffle 13. The first roller 26 reduces the friction between the lower end of the pressure rod 33 and the baffle 13, making the sliding of the lower end of the pressure rod 33 along the upper surface of the baffle 13 smoother and avoiding the influence of soil on the movement of the pressure rod 33 when the baffle 13 is stuck.

As shown in Figures 1 and 3, multiple second rollers 32 are uniformly arranged along the edge of the lower part of the movable ring 15 to reduce the friction between the movable ring 15 and the bottom plate 6, making the rotation of the movable ring 15 more stable.

As shown in Figures 1 and 3, multiple partition plates 9 are horizontally fixed inside the inner cylinder 5 from top to bottom. These partitions divide the interior of the inner cylinder 5 into multiple sampling chambers 10 from top to bottom, with each sampling chamber 10 corresponding to a second sampling port 12. This allows the outer cylinder 4 to have a first sampling port 11 located above each second sampling port 12, facilitating simultaneous sampling of soil at different depths; At the same time, each second sampling port 12 corresponds to a sliding chamber 28, and two guide rods 30 pass through the arc-shaped plate 31 and are fixedly connected to the arc-shaped plate 31. The adjacent two sliding chambers 28 are connected through sliding holes, and each guide rod 30 passes through the corresponding sliding hole, so that the two guide rods 30 can drive the baffle 13 inside each first sampling port 11 to move up and down, thereby opening and closing the first sampling port 11. When sampling soil at different depths, it can avoid mixing soil from other depths.

Working principle: When in use, move the device to the position where sampling is required, so that the bottom plate 6 comes into contact with the ground, and then start the motor 34. The motor 34 drives the outer cylinder 4 to rotate, and the outer cylinder 4 drives the drill bit 35 to rotate. At the same time, start the electric telescopic rod 8. The electric telescopic rod 8 moves downward through the outer cylinder 4 of the box body 3, and during the process of the outer cylinder 4 driving the drill bit 35 to rotate, it moves downward through the through hole 7 to drill holes on the ground, driving the outer cylinder 4 into the soil. The movable ring 15 moves downward with the outer cylinder 4 until it comes into contact with the bottom plate 6; When the movable ring 15 comes into contact with the bottom plate 6, it blocks further downward movement of the movable ring 15, providing upward force to the movable ring 15, causing it to move relative to the outer cylinder 4, causing the movable ring 15 to move upward relative to the outer cylinder 4. The movable ring 15 drives the movable block 14 to move upward through two connecting rods 17, and the movable block 14 drives the inner cylinder 5 to move upward along the inner wall of the outer cylinder 4 through the transmission rod 18, so that the second sampling port 12 on each sampling chamber 10 can move upward and coincide with the first sampling port 11. At this time, the electric telescopic rod 8 is stopped, so that the outer cylinder 4 does not move downward further.

At the same time, when the movable block 14 moves upward, it drives the first plunger hydraulic cylinder 23 to contract, and the internal pressure of the first plunger hydraulic cylinder 23 increases. The pressure is transmitted to the two second plunger hydraulic cylinders 24 through hydraulic oil. The extension of the two second plunger hydraulic cylinders 24 drives the two guide rods 30 to move downward. The two guide rods 30 drive each arc-shaped plate 31 to move downward along the corresponding sliding chamber 28, and each arc-shaped plate 31 drives the corresponding pressure rod 33 to move downward, the lower end of the pressure rod 33 squeezes the baffle 13, driving the baffle 13 to swing downwards, so that the baffle 13 extends out of the corresponding first sampling port 11. Each baffle 13 scrapes off the soil at the corresponding depth in the borehole with the rotation of the outer cylinder 4, so that the soil enters the first sampling port 11, the second sampling port 12 in sequence along the baffle 13, and then enters the corresponding sampling chamber 10. After the soil collected in each sampling chamber 10 meets the detection requirements, the motor 34 is turned off, the outer cylinder 4 stops rotating, and then the electric telescopic rod 8 is started. The electric telescopic rod 8 drives the outer cylinder 4 to move upwards, and the inner cylinder 5 moves relatively downwards under the action of the first elastic component 20, so that each second sampling port 12 is closed. At the same time, each baffle 13 resets under the action of the second elastic component 21, closes the first sampling port 11, and completes the sampling.

It can be understood that the present invention is described through some embodiments, and those skilled in the art are aware that various changes or equivalent substitutions can be made to these features and embodiments without departing from the spirit and scope of the present invention. Furthermore, under the guidance of the present invention, these features and embodiments can be modified to suit specific situations and materials without departing from the spirit and scope of the present invention. Therefore, the present invention is not limited by the specific embodiments disclosed herein, and all embodiments falling within the scope of the claims of the present application are within the scope protected by the present invention.