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Automatic sample preparation device for sampling filter membranes of ambient air particulate matter

Abstract

Disclosed is an automatic sample preparation device for sampling filter membranes of ambient air particulate matter. The device includes an air particulate matter sampler and a cutter, where the cutter includes a second conical tube. The second conical tube is provided with an air inlet and a sliding groove, a mounting frame is arranged on the second conical tube, sliding rods are arranged on the mounting frame, a sliding block is arranged on either of the sliding rods, and an elliptical frame is arranged on the two sliding blocks. A traction plate is arranged on the elliptical frame, a traction rod is arranged on the traction plate, a screening box is arranged on the traction rod, and the screening box and the sliding groove are arranged. A drainage block is arranged on the screening box, a discharging block is arranged on the drainage block, and screening holes are formed.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

(1) This application claims priority of Chinese Patent Application No. 202410495375.3, filed on Apr. 24, 2024, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

(2) The present disclosure relates to the field of atmospheric particle samplers, and particularly relates to an automatic sample preparation device for sampling filter membranes of ambient air particulate matter.

BACKGROUND

(3) Atmospheric particle samplers are instruments or devices for collecting atmospheric pollutants or polluted atmosphere. Atmospheric samplers are various in types and can be divided into gas (including steam) samplers and particle samplers according to collection objects, and can be further divided into environmental samplers, indoor samplers (such as samplers used in factory workshops) and pollution source samplers (such as chimney samplers) according to application scenarios. In addition, there are special-purpose atmospheric samplers, such as samplers configured to simultaneously capture gaseous pollutants and particulate matter such as sulfur dioxide and particle matter in the atmosphere, or hydrogen fluoride and particle matter and the like, which facilitates study of the relationship between sulfur and fluorine in gaseous and solid substances.

There are also samplers for collecting bacteria in the air, and inertial cutters for atmospheric particle sampling are mainly used to separate particles of different sizes such that collected samples are representative. It is because particles in the atmosphere are very various in sizes, and particles of different sizes have different effects on health and environments. In order to better study compositions and sources of atmospheric particles, it is necessary to sample and analyze particles of different sizes. The inertial cutters function to separate atmospheric particles collected by the samplers according to particle sizes, which facilitates subsequent particle analysis and research.

(4) However, atmospheric particle samplers of the prior art still have the following defects in use:

(5) An atmospheric particulate sampler of the prior art is inconveniently cleaned because winged insects, flying catkins and the like in the air easily enter the sampler during outdoor sampling, and sampling accuracy is not high because the winged insects and flying catkins are larger than the air particulate matter and easily block a filter net of a sampling opening, and foreign matter on the filter net easily enters the sampling opening through the filter net, such that operation is time-consuming and labor-consuming, and the sampler needs to be shut down, thereby affecting normal collection of air particulate matter. Therefore, it is very necessary to provide an automatic sample preparation device for sampling filter membranes of ambient air particulate matter that can be applied to the field of atmospheric particle samplers of the prior art.

SUMMARY

(6) An atmospheric particulate sampler of the prior art is inconveniently cleaned because winged insects, flying catkins and the like in the air easily enter the sampler during outdoor sampling, and sampling accuracy is not high because the winged insects and flying catkins are larger than the air particulate matter and easily block a filter net of a sampling opening, and foreign matter on the filter net easily enters the sampling opening through the filter net, such that operation is time-consuming and labor-consuming, and the sampler needs to be shut down, thereby affecting normal collection of air particulate matter. In order to overcome the defects in the prior art, the present disclosure provides an automatic sample preparation device for sampling filter membranes of ambient air particulate matter.

(7) A technical solution adopted by the present disclosure to solve the above technical problems is as follows: An automatic sample preparation device for sampling filter membranes of ambient air particulate matter, including an air particulate matter sampler and a cutter, where the cutter includes a second conical tube; an upper surface of the second conical tube is provided with an air inlet, the air inlet is communicated with inside of the second conical tube, an inner top surface of the second conical tube is provided with a sliding groove, the sliding groove is located outside the air inlet, and a mounting frame is fixedly arranged on an arc-shaped surface of the second conical tube; sliding rods are symmetrically and fixedly arranged on an inner wall of the mounting frame, a sliding block is movably arranged on either of the sliding rods, an elliptical frame is fixedly arranged on tops of the two sliding blocks, and the elliptical frame is located above the mounting frame; a traction plate is fixedly arranged on the elliptical frame, and a traction rod is fixedly arranged on the traction plate, where one end of the traction rod movably penetrates inside of the second conical tube, a screening box is fixedly arranged at the other end of the traction rod, and the screening box and the sliding groove are movably arranged; and the air inlet is located above the screening box, a drainage block is fixedly arranged on a side surface of the screening box, and a discharging block is fixedly arranged at an end of the drainage block, where the drainage block is triangular, the drainage block is tilted downward in a direction of facing the discharging block, and screening holes are formed in the screening box.

(8) Preferably, traction racks are fixedly arranged on symmetrical inner walls of the elliptical frame, a fixing frame is fixedly arranged at a bottom of the mounting frame, and an operating motor is fixedly arranged on the fixing frame, where a rotating rod is fixedly arranged at an output end of the operating motor, and the rotating rod movably penetrates the fixing frame; and a sector gear is fixedly arranged on a top of the fixing frame, the sector gear is located between the two

traction racks, and the sector gear is in toothed engagement with only one of the traction racks separately.

(9) Preferably, a traction tube is fixedly arranged on the second conical tube, a vertical block is fixedly arranged at one end of the traction tube, the vertical block is located inside the second conical tube, and a vertical tube is fixedly arranged at the other end of the traction tube, where the vertical tube is located on one side of the second conical tube, and the traction tube is tilted upward in a direction of facing the vertical block; and an internal threaded cap is fixedly arranged at a bottom of the vertical tube, and a collecting bottle is threadedly arranged on the internal threaded cap.

(10) Preferably, a placing opening is formed on a top of the vertical block, the placing opening is communicated with inside of the vertical block, and inner cavities are symmetrically arranged on the vertical block, where the inner cavities are located on both sides of the placing opening; a mounting tube is fixedly arranged on either of the inner cavities, an insertion rod is movably arranged at an end of either of the mounting tubes, and an end of the insertion rod moves inside the mounting tube; and a shielding block is fixedly arranged at an end of either of the insertion rods, the shielding block movably penetrates the placing opening, a telescopic spring is arranged on the mounting tube and the insertion rod, and both ends of the telescopic spring are fixedly arranged together with the inner cavity and the shielding block respectively.

(11) Preferably, the discharging block is located in the placing opening, and symmetrical side surfaces of the discharging block are respectively fitted with the shielding blocks.

(12) Preferably, an internal threaded tube is fixedly arranged on the air particulate matter sampler, a threaded operating tube is fixedly arranged at a bottom of an assembly tube, the threaded operating tube is threadedly engaged with the internal threaded tube, a connecting tube is fixedly arranged on a top of the assembly tube, a first conical tube is fixedly arranged on a top of the connecting tube, a threaded sleeve is fixedly arranged on the first conical tube, and a filter membrane sheet is arranged on an inner wall of the first conical tube.

(13) Preferably, a threaded cover is threadedly arranged on the threaded sleeve, and a filter membrane clamp is fixedly arranged on an inner wall of the threaded cover, where the threaded sleeve is located on an outer side of the filter membrane clamp, and a bottom of the filter membrane clamp is fitted with a surface of the filter membrane sheet; and a communicating pipe is fixedly arranged on a top of the threaded cover, a top of the communicating pipe is fixedly arranged together with a bottom of the second conical tube, a connecting rod is fixedly arranged on a top of the second conical tube, and a shielding plate is fixedly arranged on a top of the connecting rod.

(14) Preferably, guide plates are symmetrically and fixedly arranged on an inner wall of the second conical tube, one end of either of the two guide plates is fixedly arranged, and the other end of either the two guide plates is tilted downward outward; a mounting frame is fixedly arranged at a bottom of either of the two guide plates, a rotating rod is movably arranged on the mounting frame, and the rotating rod is located inside the communicating pipe and the threaded cover; and a plurality of push plates are fixedly arranged on the rotating rod, and the push plates are close to the filter membrane sheet.

(15) Preferably, a first equal-diameter bevel gear is fixedly arranged on a top of the rotating rod, and a movable rod is movably arranged on the second conical tube; a second equal-diameter bevel gear is fixedly arranged at one end of the movable rod, the second equal-diameter bevel gear is located below the guide plates, and the second equal-diameter bevel gear is in toothed engagement with the first equal-diameter bevel gear; and a third equal-diameter bevel gear is fixedly arranged at the other end of the movable rod, a fourth equal-diameter bevel gear is fixedly arranged on the rotating rod, and the fourth equal-diameter bevel gear is in toothed engagement with the third equal-diameter bevel gear.

(16) The present disclosure has the beneficial effects as follows:

(17) 1. In the present disclosure, the air particulate matter sampler generates a suction force to draw external air through the air inlet, and flying catkins and winged insects may enter the screening box. When the operating motor is activated, the rotating rod drives the sector gear to rotate, such that the sector gear is in toothed engagement with only one of the traction racks. The elliptical frame moves on the sliding rods through the sliding blocks in a reciprocating manner, such that the traction plate drives the traction rod to move on the second conical tube, and the screening box screens air particulate matter, flying catkins, winged insects and the like. Air particulate matter with small sizes is screened out, while the flying catkins, winged insects and the like with larger sizes enter the vertical block through the drainage block and the discharging block. The discharging block moves on the placing opening, such that one end of the insertion rod moves inside the mounting tube, and the telescopic spring is extended and retracted to prevent the flying catkins, winged insects and the like from re-entering the inside of the second conical tube. Finally, the flying catkins, winged insects and the like fall into the collecting bottle through the traction tube and the vertical tube for collection. The air particulate matter is adsorbed into the communicating pipe through the second conical tube, and then enters the first conical tube through the second conical tube, and the filter membrane sheet adsorbs the air particulate matter, which facilitates removal of the particulate matter on the filter membrane sheet for analysis and research, thereby improving an operating effect.
(18) 2. The present disclosure enables to dispose flying catkins, winged insects and the like without need to disassemble the cutter, and only the collecting bottle needs to be disassembled, thereby improving work efficiency.
(19) 3. In the present disclosure, air particulate matter falls into the communicating pipe through inclined surfaces of the guide plates, when the operating motor is activated, the rotating rod drives the fourth equal-diameter bevel gear to rotate, the fourth equal-diameter bevel gear drives the third equal-diameter bevel gear to rotate, the third equal-diameter bevel gear drives the second equal-diameter bevel gear to rotate through the movable rod, the second equal-diameter bevel gear drives the first equal-diameter bevel gear to rotate, such that the first equal-diameter bevel gear drives the push plates to rotate through the rotating rod, and the push plates push the unevenly distributed air particulate matter, such that the air particulate matter is evenly distributed on the filter membrane sheet, which facilitates delivery of an ideal sample for scanning electron microscopy.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) In order to more clearly illustrate technical solutions in the examples of the present disclosure or in the prior art, a brief introduction to the drawings required for the examples or the description of the prior art will be provided below. Obviously, the drawings in the following description are only some of the examples of the present disclosure, and those of ordinary skill in the art would also be able to derive other drawings from these drawings without making creative efforts.
(2) FIG. **1** is a schematic diagram of an assembly structure of an air particulate matter sampler and a cutter of the present disclosure.
(3) FIG. **2** is a schematic diagram of a breakdown structure of an air particulate matter sampler and a cutter of the present disclosure.
(4) FIG. **3** is a schematic diagram of a sectional structure of a cutter of the present disclosure.
(5) FIG. **4** is a sectional view of an adjustment mechanism of the present disclosure.
(6) FIG. **5** is a schematic diagram of a traction mechanism of the present disclosure.
(7) FIG. **6** is a sectional view of a traction mechanism of the present disclosure.
(8) Reference numerals in the figures: **10**—air particulate matter sampler, **11**—assembly tube, **12**—internal threaded tube, **13**—sector gear, **20**—threaded operating tube, **21**—connecting tube, **22**—

first conical tube, **23**—threaded cover, **30**—communicating pipe, **31**—second conical tube, **32**—mounting frame, **33**—traction plate, **40**—traction rod, **41**—connecting rod, **42**—shielding plate, **43**—traction tube, **50**—vertical tube, **51**—internal threaded cap, **52**—collecting bottle, **53**—air inlet, **60**—sliding groove, **61**—guide plate, **62**—mounting frame, **63**—rotating rod, **70**—first equal-diameter bevel gear, **71**—movable rod, **72**—second equal-diameter bevel gear, **73**—third equal-diameter bevel gear, **74**—rotating rod, **75**—fourth equal-diameter bevel gear, **76**—sliding rod, **80**—push plate, **81**—filter membrane clamp, **82**—filter membrane sheet, **83**—threaded sleeve, **84**—screening box, **85**—screening hole, **86**—drainage block, **87**—discharging block, **88**—fixing frame, **89**—operating motor, **90**—vertical block, **91**—placing opening, **92**—inner cavity, **93**—mounting tube, **94**—insertion rod, **95**—shielding block, **96**—telescopic spring, **97**—sliding block, **98**—elliptical frame, and **99**—traction rack.

DETAILED DESCRIPTIONS OF THE EMBODIMENTS

(9) The technical solutions in the examples of the present disclosure will be described clearly and completely with reference to the accompanying drawings in the examples of the present disclosure. It is obvious that the examples described are merely some examples rather than all examples of the present disclosure. All other examples acquired by those of ordinarily skilled in the art without making creative efforts based on the examples of the present disclosure fall within the scope of protection of the present disclosure.

Example 1

(10) FIGS. **1-6** are schematic structural diagrams of an automatic sample preparation device for sampling filter membranes of ambient air particulate matter in a preferred embodiment of the present disclosure. With reference to FIGS. **3-6**, the automatic sample preparation device for sampling filter membranes of ambient air particulate matter includes an air particulate matter sampler **10** and a cutter, where the cutter includes a second conical tube **31**. An upper surface of the second conical tube **31** is provided with an air inlet **53** that is communicated with inside of the second conical tube **31**, an inner top surface of the second conical tube **31** is provided with a sliding groove **60** located outside the air inlet **53**, and a mounting frame **32** is fixedly arranged on an arc-shaped surface of the second conical tube **31**. Sliding rods **76** are symmetrically and fixedly arranged on an inner wall of the mounting frame **32**, a sliding block **97** is movably arranged on either of the sliding rods **76**, and an elliptical frame **98** located above the mounting frame **32** is fixedly arranged on tops of the two sliding blocks **97**. Traction racks **99** are fixedly arranged on symmetrical inner walls of the elliptical frame **98**, a fixing frame **88** is fixedly arranged at a bottom of the mounting frame **32**, and an operating motor **89** is fixedly arranged on the fixing frame **88**, where a rotating rod **74** is fixedly arranged at an output end of the operating motor **89**, and the rotating rod **74** movably penetrates the fixing frame **88**. A sector gear **13** is fixedly arranged on a top of the fixing frame **88**, the sector gear **13** is located between the two traction racks **99**, and the sector gear **13** is in toothed engagement with only one of the traction racks **99** separately. A traction plate **33** is fixedly arranged on the elliptical frame **98**, and a traction rod **40** is fixedly arranged on the traction plate **33**, where one end of the traction rod **40** movably penetrates inside of the second conical tube **31**, and a screening box **84** that moves in the sliding groove **60** is fixedly arranged at the other end of the traction rod **40**. The air inlet **53** is located above the screening box **84**, a drainage block **86** is fixedly arranged on a side surface of the screening box **84**, and a discharging block **87** is fixedly arranged at an end of the drainage block **86**, where the drainage block **86** is triangular, and the drainage block **86** is tilted downward in a direction of facing the discharging block **87**. Screening holes **85** are formed in the screening box **84**, a traction tube **43** is fixedly arranged on the second conical tube **31**, a vertical block **90** located inside the second conical tube **31** is fixedly arranged at one end of the traction tube **43**, and a vertical tube **50** is fixedly arranged at the other end of the traction tube **43**, where the vertical tube **50** is located on one side of the second conical tube **31**, and the traction tube **43** is tilted upward in a direction of facing the vertical block **90**. An internal threaded cap **51** is fixedly arranged at a bottom of the vertical tube **50**, a

collecting bottle **52** is threadedly arranged on the internal threaded cap **51**, a placing opening **91** communicated with inside of the vertical block **90** is formed on a top of the vertical block **90**, and inner cavities **92** are symmetrically arranged on the vertical block **90**, where the inner cavities **92** are located on both sides of the placing opening **91**. A mounting tube **93** is fixedly arranged on either of the inner cavities **92**, an insertion rod **94** is movably arranged at an end of either of the mounting tubes **93**, and an end of the insertion rod **94** moves inside the mounting tube **93**. A shielding block **95** is fixedly arranged at an end of either of the insertion rods **94**, the shielding block **95** movably penetrates the placing opening **91**, and a telescopic spring **96** is fixedly arranged between the inner cavity **92** and the shielding block **95**, where the mounting tube **93** and the insertion rod **94** are arranged on an inner side of the telescopic spring **96**. The discharging block **87** is located in the placing opening **91**, and symmetrical side surfaces of the discharging block **87** are respectively fitted with the shielding blocks **95**. The air particulate matter sampler **10** generates a suction force to draw external air through the air inlet **53**, and flying catkins and winged insects may enter the screening box **84**. When the operating motor **89** is activated, the rotating rod **74** drives the sector gear **13** to rotate, such that the sector gear **13** is in toothed engagement with only one of the traction racks **99**. The elliptical frame **98** moves on the sliding rods **76** through the sliding blocks **97** in a reciprocating manner, such that the traction plate **33** drives the traction rod **40** to move on the second conical tube **31**, and the screening box **84** screens air particulate matter, flying catkins, winged insects and the like. Air particulate matter with small sizes is screened out, while the flying catkins, winged insects and the like with larger sizes enter the vertical block **90** through the drainage block **86** and the discharging block **87**. The discharging block **87** moves on the placing opening **91**, such that one end of the insertion rod **94** moves inside the mounting tube **93**, and the telescopic spring **96** is extended and retracted to prevent the flying catkins, winged insects and the like from re-entering the inside of the second conical tube **31**. Finally, the flying catkins, winged insects and the like fall into the collecting bottle **52** through the traction tube **43** and the vertical tube **50** for collection.

(11) With reference FIGS. **1-3**, an internal threaded tube **12** is fixedly arranged on the air particulate matter sampler **10**, a threaded operating tube **20** that is threadedly engaged with the internal threaded tube **12** is fixedly arranged at a bottom of an assembly tube **11**, a connecting tube **21** is fixedly arranged on a top of the assembly tube **11**, a first conical tube **22** is fixedly arranged on a top of the connecting tube **21**, a threaded sleeve **83** is fixedly arranged on the first conical tube **22**, a filter membrane sheet **82** is arranged on an inner wall of the first conical tube **22**, a threaded cover **23** is threadedly arranged on the threaded sleeve **83**, and a filter membrane clamp **81** is fixedly arranged on an inner wall of the threaded cover **23**, where the threaded sleeve **83** is located on an outer side of the filter membrane clamp **81**, and a bottom of the filter membrane clamp **81** is fitted with a surface of the filter membrane sheet **82**. A communicating pipe **30** is fixedly arranged on a top of the threaded cover **23**, a top of the communicating pipe **30** is fixedly arranged together with a bottom of the second conical tube **31**, a connecting rod **41** is fixedly arranged on a top of the second conical tube **31**, and a shielding plate **42** is fixedly arranged on a top of the connecting rod **41**. The air particulate matter is adsorbed into the communicating pipe **30** through the second conical tube **31**, and then enters the first conical tube **22** through the second conical tube **31**, and the filter membrane sheet **82** adsorbs the air particulate matter, which facilitates removal of the particulate matter on the filter membrane sheet **82** for analysis and research.

(12) Working principle: The air particulate matter sampler **10** generates a suction force to draw external air through the air inlet **53**, and flying catkins and winged insects may enter the screening box **84**. When the operating motor **89** is activated, the rotating rod **74** drives the sector gear **13** to rotate, such that the sector gear **13** is in toothed engagement with only one of the traction racks **99**. The elliptical frame **98** moves on the sliding rods **76** through the sliding blocks **97** in a reciprocating manner, such that the traction plate **33** drives the traction rod **40** to move on the second conical tube **31**, and the screening box **84** screens air particulate matter, flying catkins,

winged insects and the like. Air particulate matter with small sizes are screened out, while the flying catkins, winged insects and the like with larger sizes enter the vertical block **90** through the drainage block **86** and the discharging block **87**. The discharging block **87** moves on the placing opening **91**, such that one end of the insertion rod **94** moves inside the mounting tube **93**, and the telescopic spring **96** is extended and retracted to prevent the flying catkins, winged insects and the like from re-entering the inside of the second conical tube **31**. Finally, the flying catkins, winged insects and the like fall into the collecting bottle **52** through the traction tube **43** and the vertical tube **50** for collection. The air particulate matter is adsorbed into the communicating pipe **30** through the second conical tube **31**, and then enters the first conical tube **22** through the second conical tube **31**, and the filter membrane sheet **82** adsorbs the air particulate matter, which facilitates removal of the particulate matter on the filter membrane sheet **82** for analysis and research, thereby improving an operating effect.

Example 2

(13) FIGS. **3**, **5** and **6** are schematic structural diagrams of an automatic sample preparation device for sampling filter membranes of ambient air particulate matter in another preferred embodiment of the present disclosure. Active sampling aims to achieve rapid collection of particulate matter by air pumping. However, at present, there exist many problems including uneven distribution of particulate matter on the filter membrane sheet **82** during sampling, and difficulty to provide an ideal sample for scanning electron microscopy. Therefore, the device is improved on the basis of Example 1. Specifically, guide plates **61** are symmetrically and fixedly arranged on an inner wall of the second conical tube **31**, the guide plates **61** are located below the screening box **84**, one end of either of the two guide plates **61** is fixedly arranged, and the other end of either the two guide plates **61** is tilted downward outward. A mounting frame **62** is fixedly arranged at a bottom of either of the two guide plates **61**, a rotating rod **63** is movably arranged on the mounting frame **62**, and the rotating rod **63** is located inside the communicating pipe **30** and the threaded cover **23**. Further, a plurality of push plates **80** close to the filter membrane sheet **82** are fixedly arranged on the rotating rod **63**, a first equal-diameter bevel gear **70** is fixedly arranged on a top of the rotating rod **63**, and a movable rod **71** is movably arranged on the second conical tube **31**. A second equal-diameter bevel gear **72** that is in toothed engagement with the first equal-diameter bevel gear **70** is fixedly arranged at one end of the movable rod **71**, the second equal-diameter bevel gear **72** is located below the guide plates **61**, a third equal-diameter bevel gear **73** is fixedly arranged at the other end of the movable rod **71**, and a fourth equal-diameter bevel gear **75** that is in toothed engagement with the third equal-diameter bevel gear **73** is fixedly arranged on the rotating rod **74**.

(14) Working principle: air particulate matter falls into the communicating pipe **30** through inclined surfaces of the guide plates **61**, when the operating motor **89** is activated, the rotating rod **74** drives the fourth equal-diameter bevel gear **75** to rotate, the fourth equal-diameter bevel gear **75** drives the third equal-diameter bevel gear **73** to rotate, the third equal-diameter bevel gear **73** drives the second equal-diameter bevel gear **72** to rotate through the movable rod **71**, the second equal-diameter bevel gear **72** drives the first equal-diameter bevel gear **70** to rotate, such that the first equal-diameter bevel gear **70** drives the push plates **80** to rotate through the rotating rod **63**, and the push plates **80** push the unevenly distributed air particulate matter, such that the air particulate matter is evenly distributed on the filter membrane sheet **82**, which facilitates delivery of an ideal sample for scanning electron microscopy.

(15) The basic principles, main features and advantages of the present disclosure are shown and described above. It should be understood by those skilled in the art that the present disclosure is not limited by the foregoing examples, the descriptions in the foregoing examples and the specification are merely illustrative of the principles of the present disclosure, various changes and improvements will be made in the present disclosure without departing from the spirit and scope of the present disclosure, and all these changes and improvements fall within the scope of the present disclosure.

Claims

1. An automatic sample preparation device for sampling filter membranes of ambient air particulate matter, comprising an air particulate matter sampler and a cutter, wherein the cutter comprises a second conical tube; an upper surface of the second conical tube is provided with an air inlet, the air inlet is communicated with inside of the second conical tube, an inner top surface of the second conical tube is provided with a sliding groove, the sliding groove is located outside the air inlet, and a mounting frame is fixedly arranged on an arc-shaped surface of the second conical tube; sliding rods are symmetrically and fixedly arranged on an inner wall of the mounting frame, a sliding block is movably arranged on either of the sliding rods, an elliptical frame is fixedly arranged on tops of the two sliding blocks, and the elliptical frame is located above the mounting frame; a traction plate is fixedly arranged on the elliptical frame, and a traction rod is fixedly arranged on the traction plate, wherein one end of the traction rod movably penetrates inside of the second conical tube, a screening box is fixedly arranged at the other end of the traction rod, and the screening box and the sliding groove are movably arranged; the air inlet is located above the screening box, a drainage block is fixedly arranged on a side surface of the screening box, and a discharging block is fixedly arranged at an end of the drainage block, wherein the drainage block is triangular, the drainage block is tilted downward in a direction of facing the discharging block, and screening holes are formed in the screening box; two traction racks are fixedly arranged on symmetrical inner walls of the elliptical frame, a fixing frame is fixedly arranged at a bottom of the mounting frame, and an operating motor is fixedly arranged on the fixing frame, wherein a rotating rod is fixedly arranged at an output end of the operating motor, and the rotating rod movably penetrates the fixing frame; a sector gear is fixedly arranged on a top of the fixing frame, the sector gear is located between the two traction racks, and the sector gear is in toothed engagement with only one of the traction racks separately; a traction tube is fixedly arranged on the second conical tube, a vertical block is fixedly arranged at one end of the traction tube, the vertical block is located inside the second conical tube, and a vertical tube is fixedly arranged at the other end of the traction tube, wherein the vertical tube is located on one side of the second conical tube, and the traction tube is tilted upward in a direction of facing the vertical block; an internal threaded cap is fixedly arranged at a bottom of the vertical tube, and a collecting bottle is threadedly arranged on the internal threaded cap; a placing opening is formed on a top of the vertical block, the placing opening is communicated with inside of the vertical block, and inner cavities are symmetrically arranged on the vertical block, wherein the inner cavities are located on both sides of the placing opening; a mounting tube is fixedly arranged on each of the inner cavities, an insertion rod is movably arranged at an end of each of the mounting tubes, and an end of the insertion rod moves inside the mounting tube; a shielding block is fixedly arranged at an end of each of the insertion rods, the shielding block movably penetrates the placing opening, a telescopic spring is arranged on the mounting tube and the insertion rod, and both ends of the telescopic spring are fixedly arranged together with the inner cavity and the shielding block respectively; and the discharging block is located in the placing opening, and symmetrical side surfaces of the discharging block are respectively fitted with the shielding blocks.

2. The automatic sample preparation device for sampling filter membranes of ambient air particulate matter according to claim 1, wherein an internal threaded tube is fixedly arranged on the air particulate matter sampler, a threaded operating tube is fixedly arranged at a bottom of an assembly tube, the threaded operating tube is threadedly engaged with the internal threaded tube, a connecting tube is fixedly arranged on a top of the assembly tube, a first conical tube is fixedly arranged on a top of the connecting tube, a threaded sleeve is fixedly arranged on the first conical tube, and a filter membrane sheet is arranged on an inner wall of the first conical tube.

3. The automatic sample preparation device for sampling filter membranes of ambient air

particulate matter according to claim 2, wherein a threaded cover is threadedly arranged on the threaded sleeve, and a filter membrane clamp is fixedly arranged on an inner wall of the threaded cover, wherein the threaded sleeve is located on an outer side of the filter membrane clamp, and a bottom of the filter membrane clamp is fitted with a surface of the filter membrane sheet; and a communicating pipe is fixedly arranged on a top of the threaded cover, a top of the communicating pipe is fixedly arranged together with a bottom of the second conical tube, a connecting rod is fixedly arranged on a top of the second conical tube, and a shielding plate is fixedly arranged on a top of the connecting rod.

4. The automatic sample preparation device for sampling filter membranes of ambient air particulate matter according to claim 3, wherein two guide plates are symmetrically and fixedly arranged on an inner wall of the second conical tube, one end of either of the two guide plates is fixedly arranged, and the other end of either the two guide plates is tilted downward outward; a mounting frame is fixedly arranged at a bottom of either of the two guide plates, a rotating rod is movably arranged on the mounting frame, and the rotating rod is located inside the communicating pipe and the threaded cover; and a plurality of push plates are fixedly arranged on the rotating rod, and the push plates are close to the filter membrane sheet.

5. The automatic sample preparation device for sampling filter membranes of ambient air particulate matter according to claim 4, wherein a first equal-diameter bevel gear is fixedly arranged on a top of the rotating rod, and a movable rod is movably arranged on the second conical tube; a second equal-diameter bevel gear is fixedly arranged at one end of the movable rod, the second equal-diameter bevel gear is located below the guide plates, and the second equal-diameter bevel gear is in toothed engagement with the first equal-diameter bevel gear; and a third equal-diameter bevel gear is fixedly arranged at the other end of the movable rod, a fourth equal-diameter bevel gear is fixedly arranged on the rotating rod, and the fourth equal-diameter bevel gear is in toothed engagement with the third equal-diameter bevel gear.