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Min et al.

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(54) **FLUID MICRO-INJECTION DEVICE**

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B05B 1/30 (2006.01)
B05C 5/02 (2006.01)

(52) **U.S. Cl.**
CPC ***B05B 1/30*** (2013.01); ***B05C 5/0225*** (2013.01)

(58) **Field of Classification Search**
CPC .. B05B 1/3046; B05C 5/0225; B05C 11/1034
(Continued)

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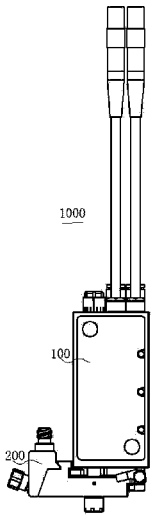
(57) **ABSTRACT**

A fluid micro-injection device including an execution system, a fluid channel assembly and a movable unit. The execution system includes: a base body defining an executor mounting chamber and an adjustor mounting chamber; an executor; an adjusting seat, at least a portion of the adjusting seat extending through the positioning hole and into the adjustor mounting chamber, and the adjusting seat being provided with a channel; and an adjustor, at least a portion of the adjustor being connected with the adjusting seat to adjust the distance between the adjusting seat and the executor. The fluid channel assembly includes: a fluid seat detachably connected with the base body. At least a portion of the movable unit is provided on the adjusting seat.

19 Claims, 11 Drawing Sheets



(58) **Field of Classification Search**
USPC 239/569
See application file for complete search history.

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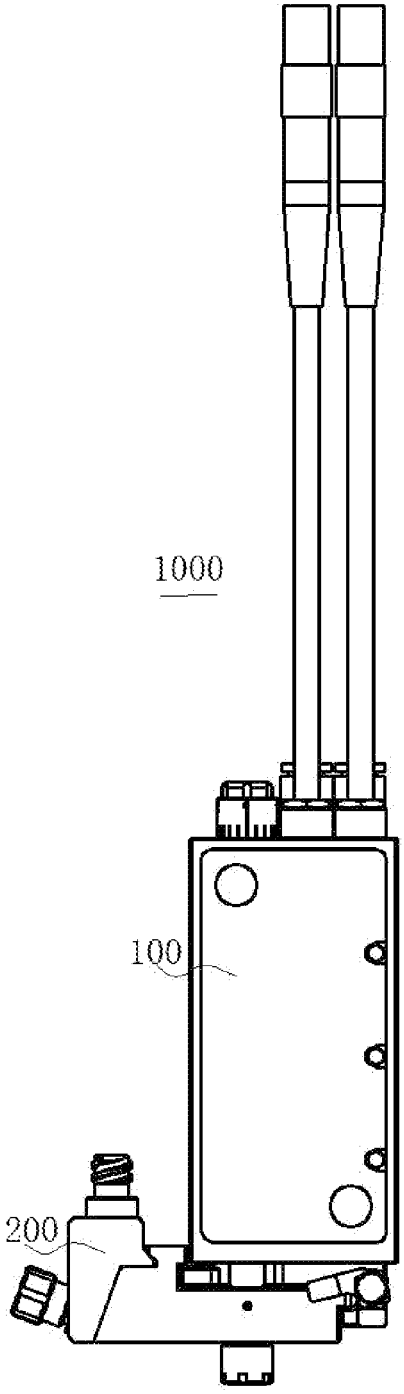

FIG. 1

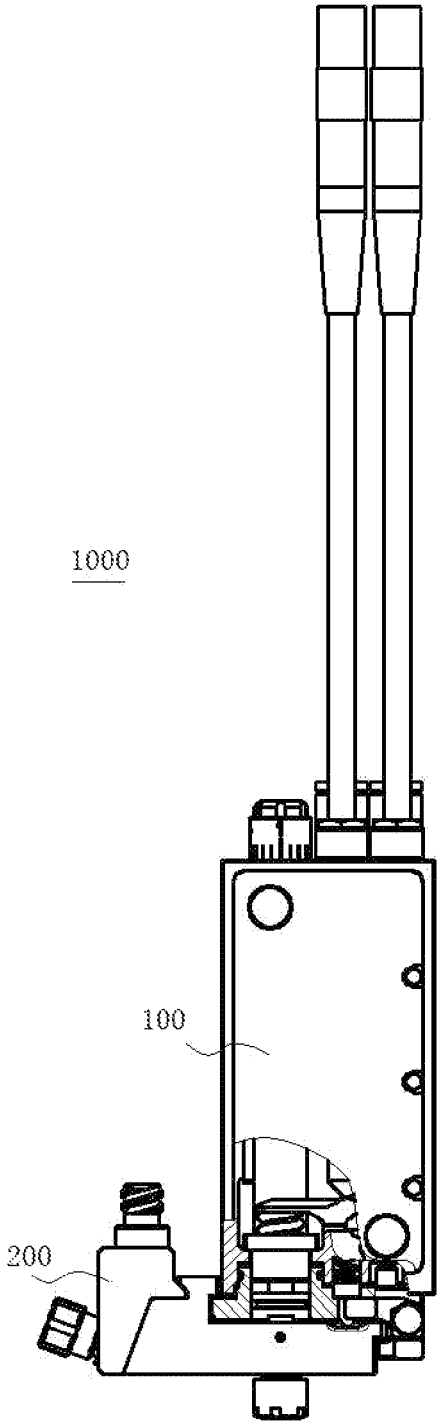

FIG. 2

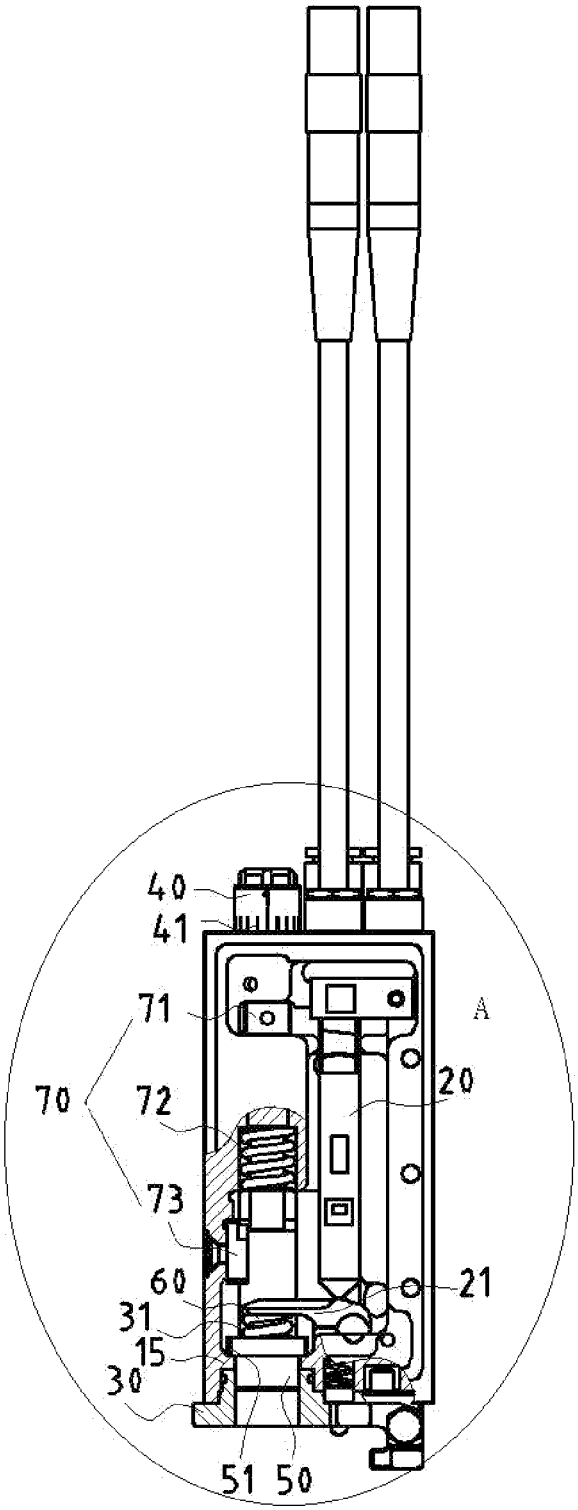

FIG. 3

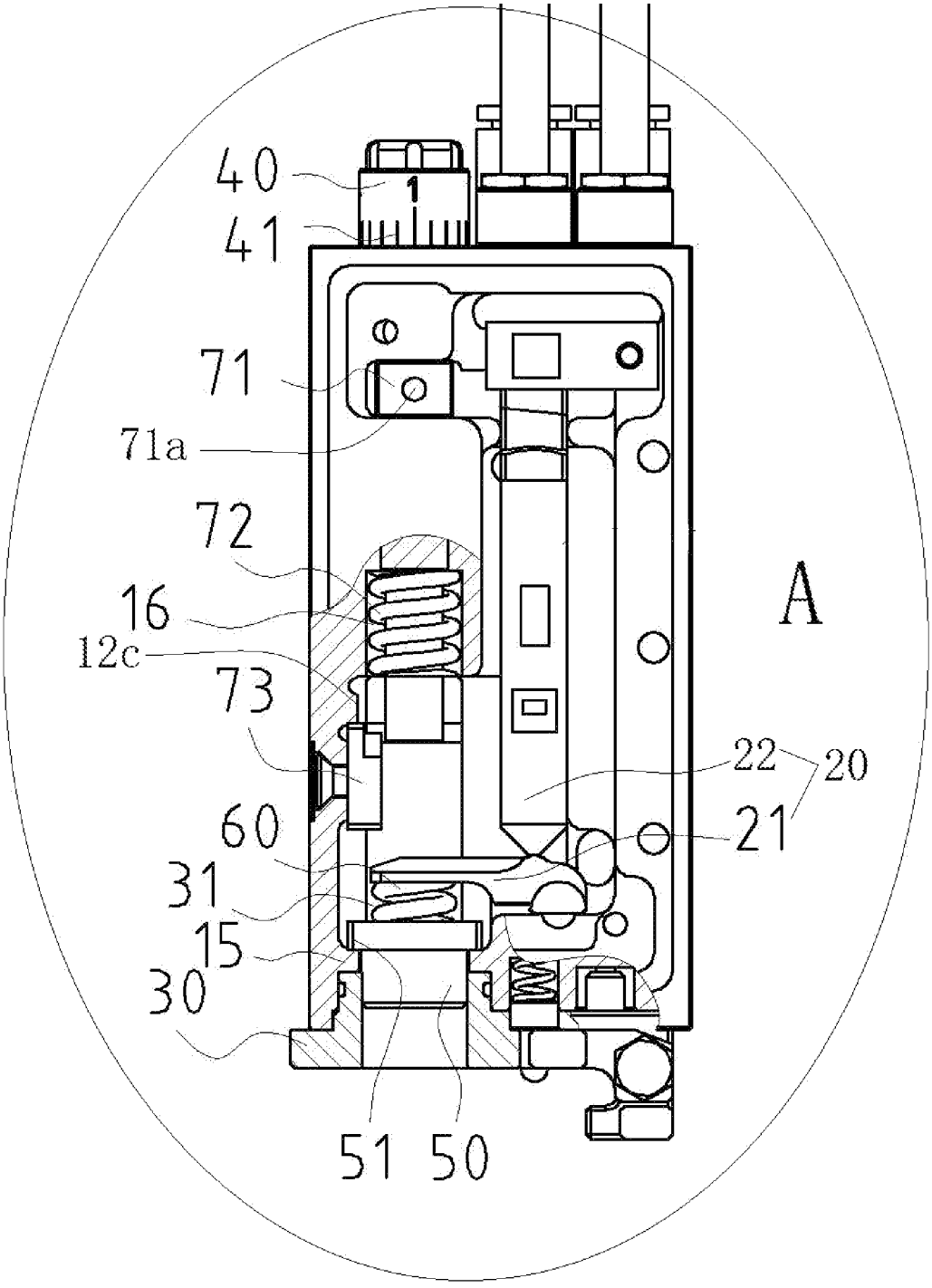

FIG. 4

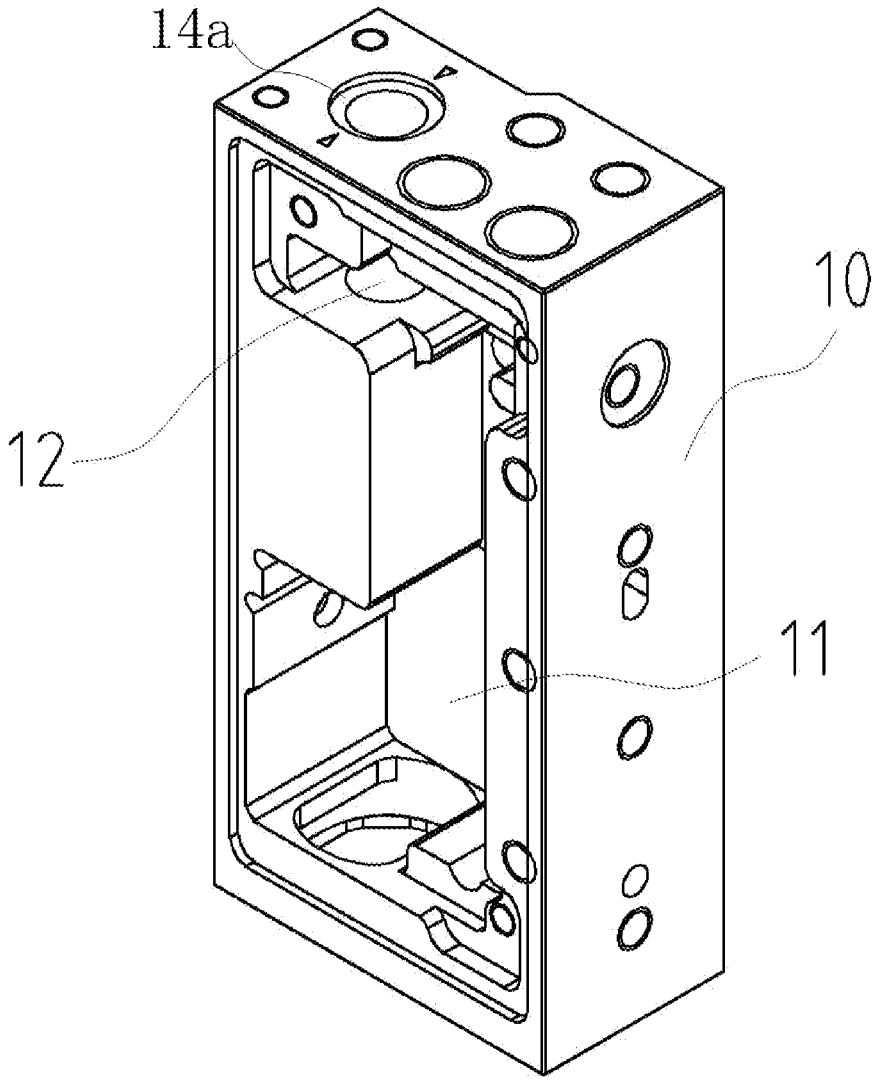

FIG. 5

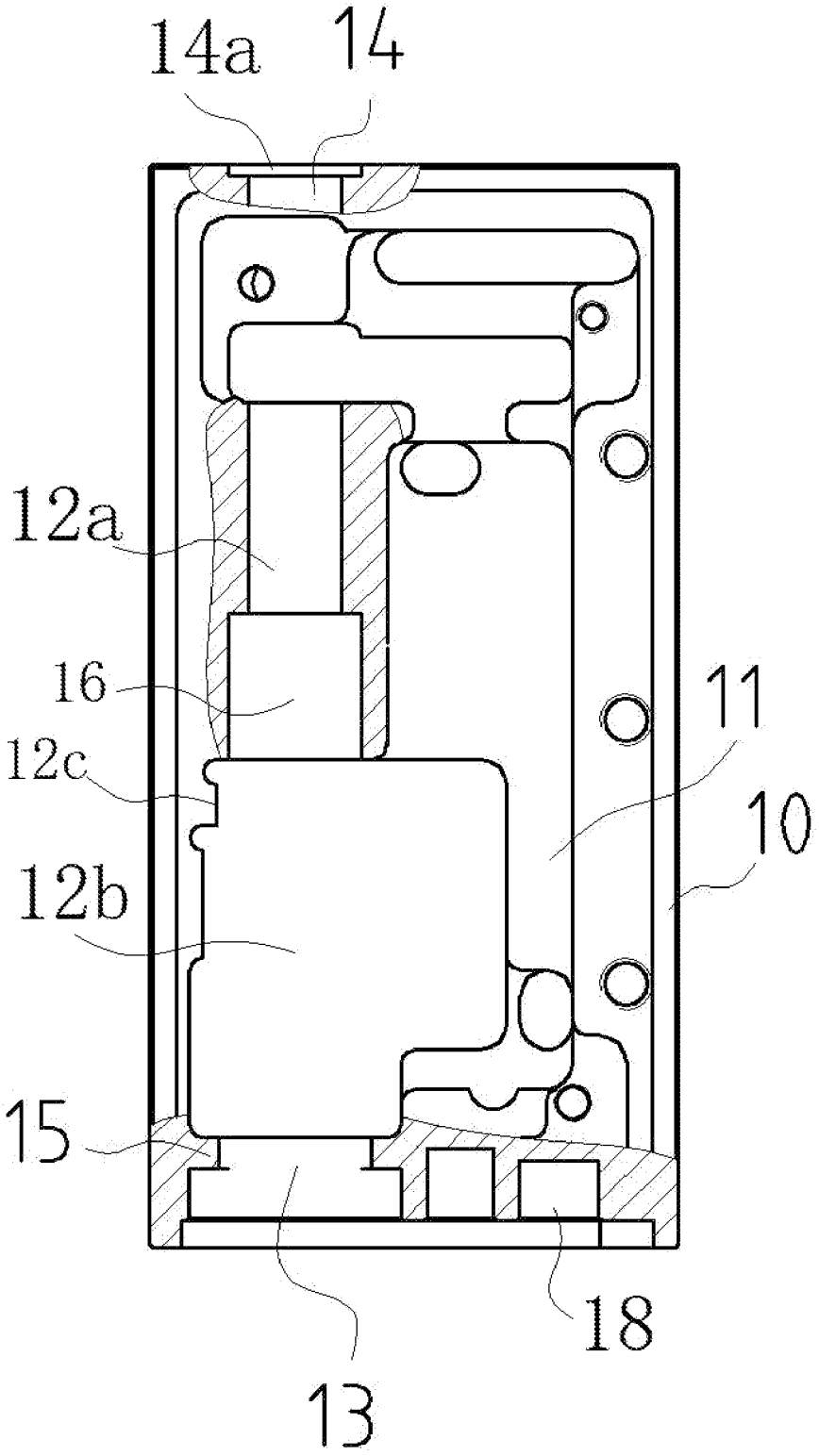

FIG. 6

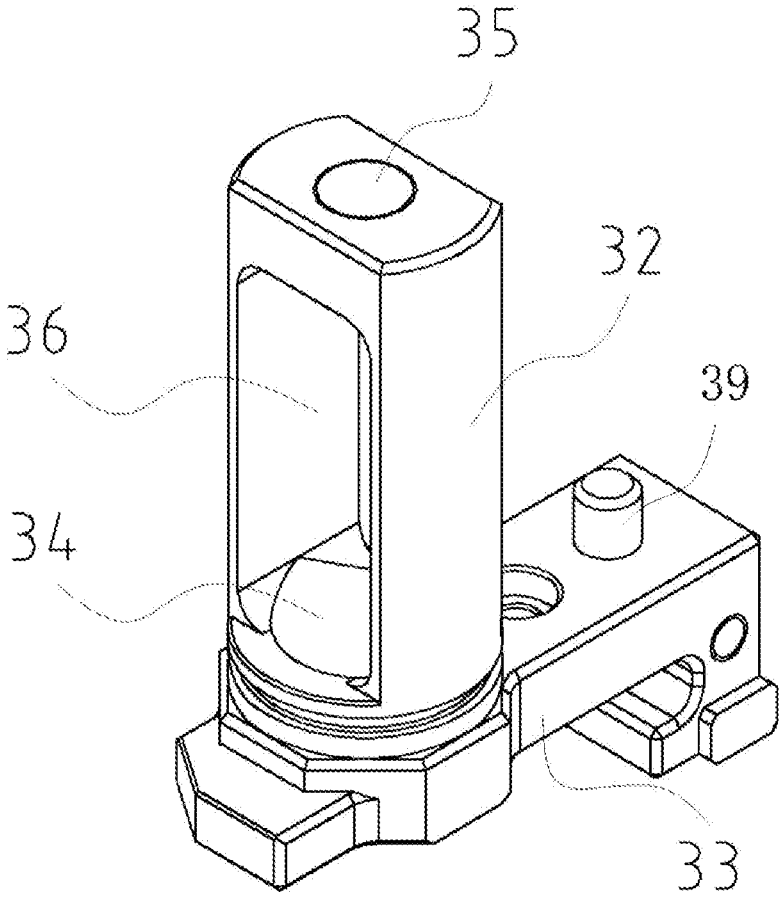

FIG. 7

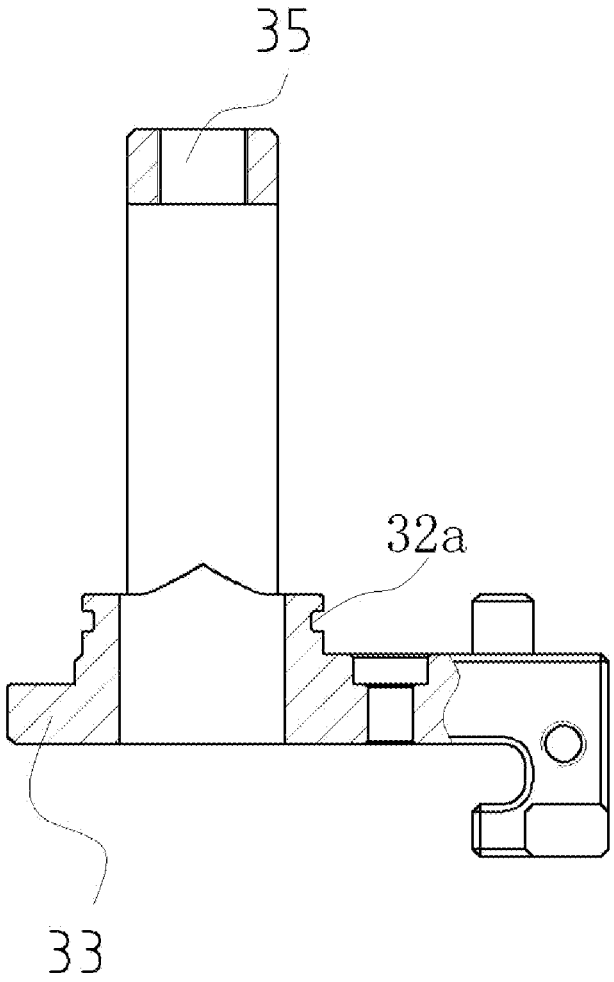

FIG. 8

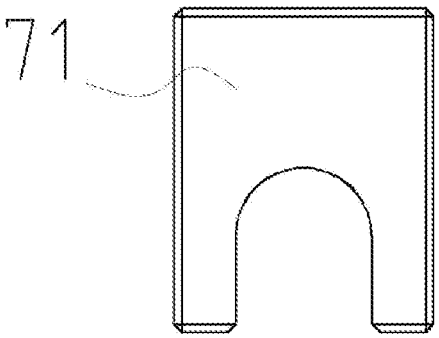

FIG. 9

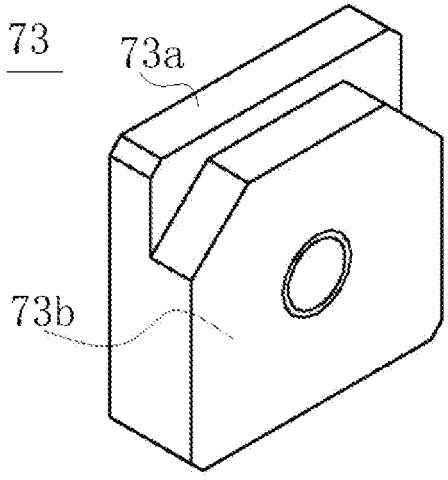

FIG. 10

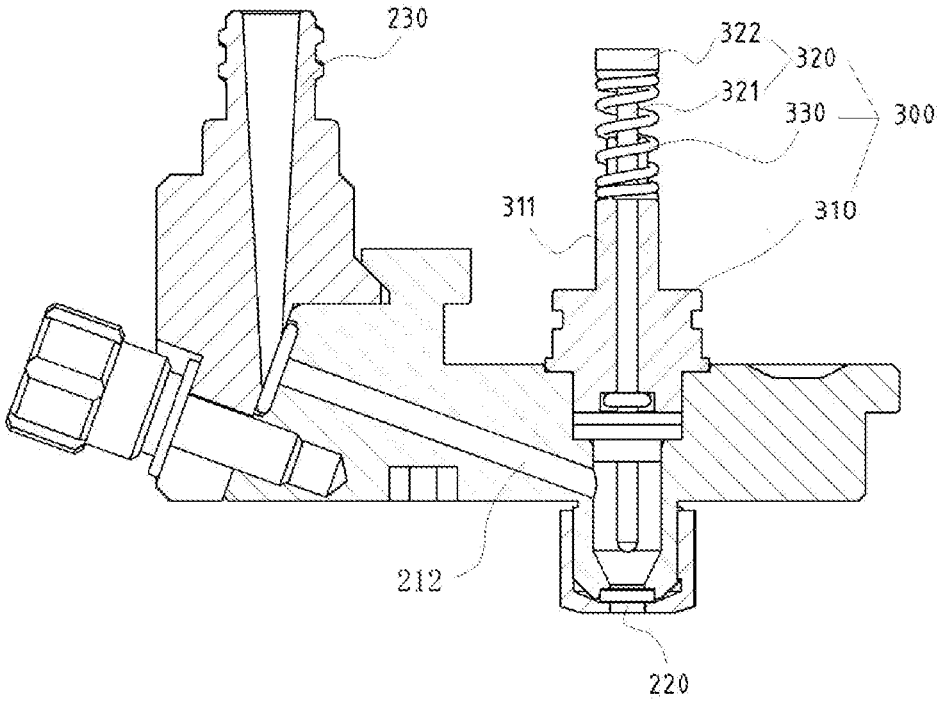

FIG. 11

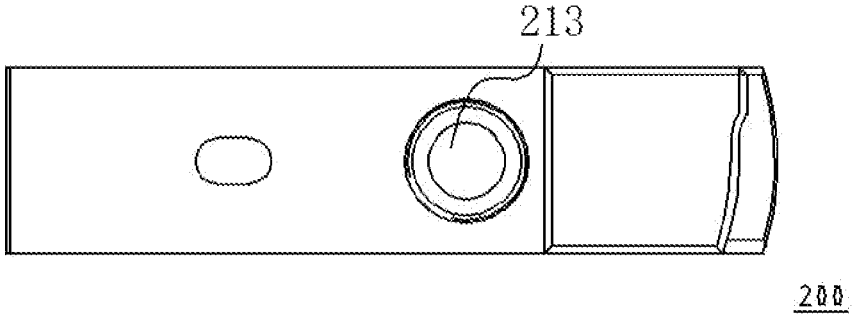

FIG. 12

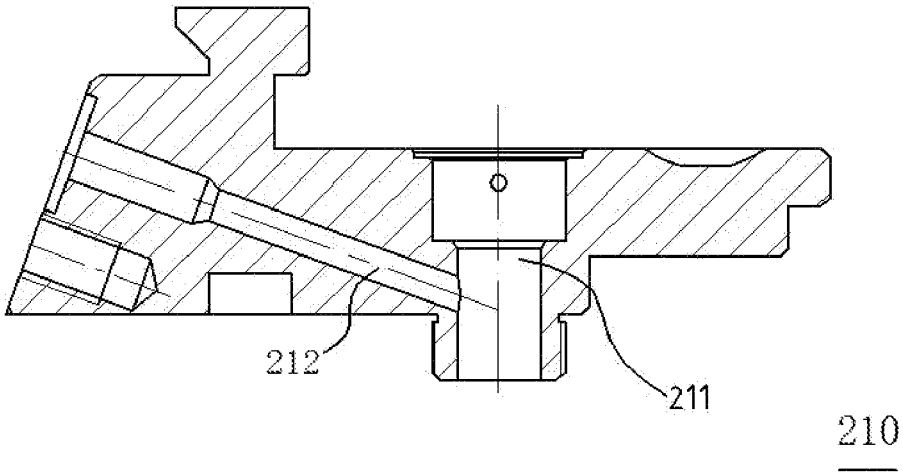

FIG. 13

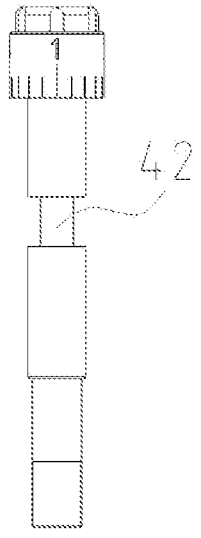

FIG. 14

FLUID MICRO-INJECTION DEVICE

CROSS REFERENCE OF RELATED APPLICATION

The present disclosure is a continuation of the International Application No. PCT/CN2020/112090 filed on Aug. 28, 2020 which claims the priority of the Chinese patent application No. 202010011477.5 entitled "FLUID MICRO-INJECTION DEVICE" and filed by CHANGZHOU MINGSEAL ROBOT TECHNOLOGY CO., LTD. on Jan. 6, 2020, both of which are hereby incorporated by reference in their entirety.

FIELD

The present disclosure relates to a fluid micro-injection device.

BACKGROUND

In a current fluid micro-injection device, a swivel nut is usually provided between the fluid micro-injection device and a member to be processed. By screwing the swivel nut, the positional relation and contact force between a nozzle and a closing element can be adjusted. Since the space for adjustment is quite limited and view of sight is often easily blocked, when using a specific tool for adjustment, a low efficiency for adjustment and operation inconvenience would occur.

SUMMARY

The present disclosure aims to solve at least one of the technical problems in the prior art.

To this end, the present disclosure provides a fluid micro-injection device, which has advantages such as easy to operate, high efficiency for assembly, disassembly and cleaning, and improvement in convenience for adjusting the distance and contact force between the movable element and the nozzle.

The fluid micro-injection device according to an embodiment of the present disclosure may include: an execution system, an fluid channel assembly and a movable unit. The execution system includes: a base body defining therein an executor mounting chamber and an adjustor mounting chamber, the base body being provided with a positioning hole in communication with the executor mounting chamber; an executor movably provided in the executor mounting chamber, at least a portion of the executor extending into the adjustor mounting chamber; an adjusting seat, at least a portion of the adjusting seat extending through the positioning hole and into the adjustor mounting chamber, and the adjusting seat being provided with a channel in communication with the executor mounting chamber; and an adjustor movably provided in the adjustor mounting chamber, at least a portion of the adjustor being connected with the adjusting seat to adjust the distance between the adjusting seat and the executor. The fluid channel assembly includes: a fluid seat defining therein a fluid chamber and a fluid channel in communication with the fluid chamber, the base body being detachably connected with the fluid seat; a nozzle provided on the fluid seat and in communication with the fluid chamber; and a fluid supply joint in communication with the fluid channel to supply fluid to the nozzle through the fluid channel and the fluid chamber. The movable unit is provided between the base body and the fluid seat, at least a portion of the movable unit is inserted into the positioning hole to be connected with the executor and to be driven by the executor to move along an axis of the positioning hole to open and close the nozzle, and at least a portion of the movable unit is provided on the adjusting seat to be adjusted by the adjusting seat.

In the fluid micro-injection device according to embodiments of the present disclosure, the execution system, the fluid channel assembly and the movable unit operate cooperatively, the base body, the executor, the adjusting seat and the adjustor operate cooperatively in the execution system, the adjusting seat for the adjustor is connected with the movable unit, and by the upward or downward adjustment of the position of the adjusting seat, the movable unit is driven to move along the axis of the positioning hole, to enable adjustment of the distance and contact force between the nozzle and the lower end of the movable unit.

According to an embodiment of the present disclosure, the base body is provided with an adjusting hole in communication with the adjustor mounting chamber, an upper end of the adjustor extends out of the adjusting hole, and a lower end of the adjustor is connected with the adjusting seat.

According to an embodiment of the present disclosure, the adjustor mounting chamber is formed as a chamber which extends in a vertical direction and which is open at both upper and lower ends thereof, the adjustor mounting chamber is open at its upper end to form the adjusting hole, the adjustor mounting chamber is open at its lower end to form the positioning hole, and the adjustor is connected with the adjusting seat to drive the adjusting seat to move in the vertical direction.

According to an embodiment of the present disclosure, the adjustor is in a columnar shape extending along an axial direction of the adjustor mounting chamber, the lower end of the adjustor is provided with a screw pin, a part of the adjusting seat extending into the adjustor mounting chamber is provided with a screw hole corresponding to the screw pin, and the adjustor is rotatable along its axis to drive the adjusting seat to move in the vertical direction.

According to an embodiment of the present disclosure, the adjusting seat includes: an adjusting seat body which is in a columnar shape extending along the axial direction of the adjustor mounting chamber and which is inserted into the adjustor mounting chamber, the adjusting seat body being provided therein with a first pore channel extending along its axial direction, an upper end of the movable unit extending into the first pore channel, an upper end of the adjusting seat body being provided with a screw hole, a lateral part of the adjusting seat body being provided with an avoiding slot in communication with the first pore channel, and one end of the lever of the executor extends through the avoiding slot to be connected with the movable element; and a connection portion connected with the adjusting seat body and provided at a lower end of the base body, the connection portion being configured to be connected with the fluid channel assembly of the fluid micro-injection device, the connection portion is provided therein with a second pore channel which is coaxial with and in communication with the first pore channel, and the second pore channel cooperating with the first pore channel to form the channel

According to an embodiment of the present disclosure, the inner surface of the adjustor mounting chamber is provided with a restriction boss, the restriction boss extends along a circumferential direction of the inner surface and is located below the lever. The execution system further includes: a positioning seat provided in the executor mount-

ing chamber, the positioning seat being in a columnar shape extending along the axial direction of the executor mounting chamber, an upper end of the positioning seat being provided with a circular boss extending along its circumferential direction, the circular boss pressing against the restriction boss, the positioning seat being provided with a third pore channel extending therethrough along its axial direction, and the upper end of the movable unit extending through the third pore channel to be connected with the lever; and a first elastic element provided between the lever and the positioning seat, two ends of the first elastic element pressing against the lever and the positioning seat respectively.

According to an embodiment of the present disclosure, the fluid seat defines therein an installation chamber in communication with the fluid chamber. The movable unit includes: a guiding seat which is in a columnar shape, the guiding seat defining therein a guiding hole, the guiding hole extending through the guiding seat along the axial direction of the guiding seat, an lower end of the guiding seat being configured to be detachably installed into the installation chamber, and other parts of the guiding seat being configured to extend into the positioning hole when assembling the fluid channel assembly with the execution system; a movable element which is movable along an axial direction of the guiding seat, a lower end of the movable element extending through and out of the guiding hole along the axial direction of the guiding seat, an upper end of the movable element being located above the guiding seat, the upper end of the movable element being configured to extend through the channel and into the adjustor mounting chamber to be connected with at least a portion of the executor and to be controlled by the executor to move along the axial direction of the guiding hole when assembling the execution system with the fluid channel assembly, the lower end of the movable element cooperating with the nozzle to open and close the nozzle, and the adjustor being configured to adjust the movement of the adjusting seat along the axial direction of the movable element and to drive the movable element to move along its axial direction; and a second elastic element provided between the upper end of the guiding seat and the upper end of the movable element, two ends of the second elastic element pressing against the upper end of the guiding seat and the upper end of the movable element respectively.

According to an embodiment of the present disclosure, an upper part of the guiding seat is in a cylindrical shape, the upper end of the guiding seat is provided with a positioning pin which is coaxial with the guiding seat and has a radial size smaller than that of the guiding seat, the first elastic element is a spring sheathed on the positioning pin, the positioning hole is a cylindrical hole, and an outer circumferential surface of the upper part of the guiding seat is in close contact with the inner surface of the positioning hole when assembling the guiding seat with the base body.

According to an embodiment of the present disclosure, the movable element includes: a cylindrical shaft, provided in the guiding hole and movable along its axial direction, and an lower end of the cylindrical shaft being formed as a sphere head; and an upper end platform provided at an upper end of the cylindrical shaft, the upper end platform having a size greater than the radius of the cylindrical shaft, the second elastic element being provided between the upper end platform and the guiding seat.

According to an embodiment of the present disclosure, the execution system may further include a restrictor provided on the base body and connected with at least a portion of the adjustor and/or the adjusting seat. The restrictor is configured to at least restrict a position of the adjusting seat moving along the axial direction of the movable unit or a position of the adjustor.

According to an embodiment of the present disclosure, the adjustor is provided with a recess extending along a circumferential direction of the adjustor. The restrictor may include a first restriction portion provided on the base body and positioned in the adjustor mounting chamber. At least a portion of the first restriction portion is inserted into the recess to restrict the position of the adjustor.

According to an embodiment of the present disclosure, the number of the avoiding slots is two and the two avoiding slots are provided at opposite sides of the adjusting seat body. The restrictor includes a second restriction portion provided on the base body. At least a portion of the second restriction portion extends through the avoiding slot to restrict the position of the adjusting seat moving along the axial direction of the movable element.

According to an embodiment of the present disclosure, an inner surface of the adjustor mounting chamber is provided with a circular subsidence groove extending along a circumferential direction of the inner surface, a radial size of an opening at a lower end of the groove is smaller than a radial size of an upper end of the adjusting seat body. The execution system further includes a compressing spring provided in the subsidence groove. The compressing spring is an elastic element, and two ends of the compressing spring are compressed against a top surface of the subsidence groove and an upper end surface of the adjusting seat respectively.

Additional aspects and advantages of the present disclosure will be given at least in part in the following description, or become apparent at least in part from the following description, or can be learned from practicing of the present disclosure.

BRIEF DESCRIPTION OF DRAWINGS

The above and/or additional aspects and advantages of the present disclosure will become clear and easy to understand from the description of embodiments below in conjunction with the accompanying drawings, in which:

FIG. **1** is a schematic view illustrating a structure of a fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **2** is a sectional view illustrating a part of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **3** is a schematic view illustrating a structure of an execution system of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **4** is an enlarged view illustrating area A in FIG. **3**;

FIG. **5** is a schematic view illustrating a structure of a base body of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **6** is a sectional view illustrating a part of the base body of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **7** is a schematic view illustrating a structure of an adjusting seat of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **8** is a sectional view illustrating a part of the adjusting seat of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **9** is a schematic view illustrating a structure of a first restriction portion of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **10** is a schematic view illustrating a part of a second restriction portion of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **11** is a schematic view illustrating the assembly of the fluid channel assembly with the movable element of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **12** is a top view of the fluid channel assembly of the fluid micro-injection device according to an embodiment of the present disclosure;

FIG. **13** is a sectional view of the fluid channel assembly of the fluid micro-injection device according to an embodiment of the present disclosure; and

FIG. **14** is a schematic view illustrating a structure of the adjustor of the execution system of the fluid micro-injection device according to an embodiment of the present disclosure.

REFERENCE NUMERALS

Fluid micro-injection device **1000**;
Execution system **100**;
Base body **10**; Executor mounting chamber **11**;
Adjustor mounting chamber **12**; Adjusting hole **12***a*; Adjusting seat mounting chamber **12***b*;
Protruding part **12***c*;
Positioning hole **13**;
Adjusting hole **14**; Subsidence groove **14***a*;
Restriction boss **15**; Circular subsidence groove **16**; Positioning recess **18**;
Executor **20**; Lever **21**; Actuator **22**;
Adjusting seat **30**; Channel **31**;
Adjusting seat body **32**; Sealing recess **32***a*;
Connection portion **33**; First pore channel **34**; Screw hole **35**; Avoiding slot **36**; Positioning portion **39**;
Adjustor **40**; Scale mark **41**; Recess **42**;
Positioning seat **50**; Circular boss **51**;
First elastic element **60**;
Restrictor **70**;
First restriction portion **71**; Screw hole **71***a*;
Compressing spring **72**;
Second restriction portion **73**; Mounting plate **73***a*; Restriction plate **73***b*;
Fluid channel assembly **200**;
Fluid seat **210**; Fluid chamber **211**; Fluid channel **212**; Installation chamber **213**;
Nozzle **220**;
Fluid supply joint **230**;
Movable unit **300**;
Guiding seat **310**; Guiding hole **311**;
Movable element **320**; Cylindrical shaft **321**; Upper end platform **322**;
Second elastic element **330**.

DETAILED DESCRIPTION

Embodiments of the present disclosure will be described hereinafter in detail. Examples of the embodiments are illustrated in the drawings, throughout which the same or similar reference numerals refer to the same or similar elements or elements having the same or similar functions. The embodiments described below with reference to the accompanying drawings are illustrative to explain the present disclosure and should not be construed as being limited to the present disclosure.

In the description of the present disclosure, it should be understood that terms "center", "longitudinal", "transverse", "length", "width", "thickness", "upper", "lower", "front", "back", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside", "clockwise", "counterclockwise", "axial", "radial", "circumferential" and the like refer to orientation or positional relationship based on the orientation or positional relationship shown in the drawings. Those merely intend to describe the present disclosure and simplify description, and do not indicate or imply that the indicated devices or components must be constructed and operated in a particular orientation. Therefore, the above cannot be construed as being limited to the present disclosure. Furthermore, features defining "first" and "second" may explicitly or implicitly include one or more features. In the description of the present disclosure, "plurality" means two or more, unless otherwise stated.

In the description of the present disclosure, it should be noted that the terms "installation", "attached", and "connected" should be understood widely, and for example, the terms may refer to be fixedly or detachable or integrally connected; mechanical or electrical connection; directly connected, or indirectly connected through an intermediate medium, or internal communication of two components, unless otherwise explicitly stated and defined. The specific meaning of the above terms in the present disclosure can be understood in a specific case by those skilled in the art.

According to an embodiment of the present disclosure, a fluid micro-injection device **1000** may be specifically described below with reference to drawings.

As illustrated in FIG. **1** to FIG. **14**, the fluid micro-injection device **1000** according to the embodiment of the present disclosure includes an execution system **100**, a fluid channel assembly **200** and a movable unit **300**. The execution system **100** includes a base body **10**, an executor **20**, an adjusting seat **30** and an adjustor **40**. The fluid channel assembly **200** includes a fluid seat **210**, a nozzle **220** and a fluid supply joint **230**.

In particular, the base body **10** defines therein an executor mounting chamber **11** and an adjustor mounting chamber **12**. The base body **10** is provided with a positioning hole **13** in communication with the executor mounting chamber **11**. The executor **20** is movably provided in the executor mounting chamber **11** and at least a portion of the executor **20** extends into the adjustor mounting chamber **12**. At least a portion of the adjusting seat **30** extends through the positioning hole **13** and into the adjustor mounting chamber **12**. The adjusting seat **30** is provided with a channel **31** in communication with the executor mounting chamber **11**. The adjustor **40** is movably provided in the adjustor mounting chamber **12**, and at least a portion of the adjustor **40** is connected with the adjusting seat **30** to adjust the distance between the adjusting seat **30** and the executor **20**. The fluid seat **210** defines therein a fluid chamber **211** and a fluid channel **212** in communication with the fluid chamber **211**. The base body **10** is detachably connected with the fluid seat **210**. The nozzle **220** is provided on the fluid seat **210** and in communication with the fluid chamber **211**. The fluid supply joint **230** is in communication with the fluid channel **212** to supply fluid to the nozzle **220** through the fluid channel **212** and the fluid chamber **211**. The movable unit **300** is provided between the base body **10** and the fluid seat **210**, at least a portion of the movable unit **300** is inserted into the positioning hole **13** to be connected with the executor **20** and driven by the executor **20** to move along an axis of the positioning hole to open and close the nozzle **220**, and at least a portion of the movable unit **300** is provided on the adjusting seat **30** to be adjusted by the adjusting seat **30**.

In other words, the fluid micro-injection device **1000** according to the embodiment of the present disclosure mainly consists of the execution system **100**, the fluid channel assembly **200** and the movable unit **300**. The execution system **100** mainly consists of the base body **10**, the executor **20**, the adjusting seat **30** and the adjustor **40**. The fluid channel assembly **200** mainly consists of the fluid seat **210**, the nozzle **220** and the fluid supply joint **230**. The fluid channel assembly **200** is provided below the execution system **100**, and the movable unit **300** is provided between the execution system **100** and fluid channel assembly **200**. In particular, the base body **10** defines therein the executor mounting chamber **11** and the adjustor mounting chamber **12**, the executor **20** is installed in the executor mounting chamber **11**, and at least a portion of the executor **20** extends into the adjustor mounting chamber **12**. The executor **20** cooperates with the movable unit **300** to perform flow control for the nozzle **220**. The adjustor **40** is installed in the adjustor mounting chamber **12** to adjust the position of the movable unit **300** along its axial direction. In particular, the base body **10** is provided with the positioning hole **13** in communication with the executor mounting chamber **11**, at least a portion of the adjusting seat **30** extends through the positioning hole **13** and into the adjustor mounting chamber **12**, and the movable unit **300** is able to extend through the channel **31** on the adjusting seat **30** and into the adjustor mounting chamber **12** to be connected with at least a portion of the executor **20**. When the adjustor **40** drives the adjusting seat **30** to move along the axial direction of the movable unit **300**, since the adjusting seat **30** is connected with the movable unit **300**, the position of the movable unit **300** along its axial direction can be adjusted to realize adjustment of distance between the movable unit **300** and the nozzle of the fluid micro-injection device.

Thus, the fluid micro-injection device **1000** according to the embodiment of the present disclosure includes the execution system **100**, the fluid channel assembly **200** and the movable unit **300**. In the execution system **100**, the base body **10**, the executor **20**, the adjusting seat **30** and the adjustor **40** cooperate with each other. Since the adjusting seat **30** of the adjustor **40** is connected with the movable unit **300**, by adjusting the position of the adjusting seat **30** in the vertical direction, the movable unit **300** is driven to move along the axis of the positioning hole **13** to adjust the distance and contact force between the lower end of the movable unit **300** and the nozzle **220**.

In some specific embodiments of the present disclosure, the execution system **100** of the fluid micro-injection device according to the embodiment of the present disclosure may further include a restrictor **70**. The restrictor **70** may be provided on the base body **10** and connected with at least a portion of the adjustor **40** and/or the adjusting seat **30**. The restrictor **70** can restrict at least the position of the adjusting seat **30** moving along the axial direction of the movable unit **300** or the position of the adjustor **40**. By restricting the position of the adjusting seat **30** moving along the axial direction of the movable unit **300**, the displacement range of the adjusting seat **30** can be restricted, preventing the adjusting seat **30** from going beyond the displacement strokemm By restricting the position of the adjustor **40**, the adjustor **40** can be prevented from shifting during the adjustment to improve the adjustment accuracy.

By the cooperation of the restrictor **70** with the adjustor **40** and/or the adjusting seat **30**, e.g., by cooperation of the restrictor **70** with the adjustor **40**, the position of the adjustor **40** can be restricted to prevent the adjustor **40** from deviating from a predetermined position so as to improve the adjustment accuracy, and to prevent the adjustor **40** from getting off the base body. When the restrictor **70** cooperates with the adjusting seat **30**, the moving position and moving distance of the adjusting seat **30** can be restricted to prevent the adjusting seat **30** from going beyond a predetermined movement strokemm By the cooperation of the restrictor **70** with the adjusting seat **30** and the adjustor **40** respectively, restriction function for the adjusting seat **30** and the adjustor **40** can be achieved. The execution system **100** of the fluid micro-injection device according to the embodiment of the present disclosure can thus have advantages such as a good positioning effect, high adjustment accuracy and ease in adjustment.

In the execution system **100** of the fluid micro-injection device according to the embodiment of the present disclosure, by the cooperation of the restrictor **70** with the adjustor **40** and/or the adjusting seat **30**, e.g., by the cooperation of the restrictor **70** with the adjustor **40**, the position of the adjustor **40** can be restricted to prevent the adjustor **40** from deviating from a predetermined position so as to improve the adjustment accuracy, and to prevent the adjustor **40** from getting off the base body. When the restrictor **70** cooperates with the adjusting seat **30**, the moving position and moving distance of the adjusting seat **30** can be restricted to prevent the adjusting seat **30** from going beyond a predetermined movement strokemm. By the cooperation of the restrictor **70** with the adjusting seat **30** and the adjustor **40** respectively, restriction function for the adjusting seat **30** and the adjustor **40** can be achieved. The execution system **100** of the fluid micro-injection device according to the embodiment of the present disclosure can thus have advantages such as a good positioning effect, high adjustment accuracy and ease in adjustment.

According to an embodiment of the present disclosure, the base body **10** is provided with an adjusting hole **14** in communication with the adjustor mounting chamber **12**, an upper end of the adjustor **40** extends out of the adjusting hole **14**, and a lower end of the adjustor **40** is connected with the adjusting seat **30**. That is, when in use, the position of the adjusting seat **30** can be adjusted directly by the adjustor **40** extending out of the adjusting hole **14**. The adjusting hole **14** may be provided at any of a plurality of positions on the base body **10**, e.g., at the upper part or lateral part. By configuring the adjustor **40** as a corresponding structure, the movable unit **300** can be adjusted in the axial direction, for example, by using a steering structure. An upper end of the adjusting hole **14** may be provided with a subsidence groove **14***a* extending along the inner surface of the adjusting hole **14**, a sealing ring may be provided in the subsidence groove **14***a* within the adjusting hole **14**, and the upper end of the adjustor **40** may extend through the sealing ring and into the adjustor mounting chamber **12**. The sealing ring can provide a sealing effect, and a bottom surface of the subsidence groove **14***a* may be in close contact with the sealing ring to effectively prevent the cooling gas in the valve from leaking from the adjusting hole **14**. Meanwhile, the adjustor **40** when adjusted to a predetermined position would not become loose by pressing the sealing ring to produce a counter elastic force.

The part of the upper end of the adjustor **40**, which extends out of the adjusting hole **14**, may be provided with notches which are in a flower typed configuration as a whole, facilitating using a matched tool to adjust the adjustor **40**. The notches may be distributed uniformly and circumferentially. The number of notches may be two or more, and may be an even number.

The upper end of the adjustor **40** may be provided with a step part. A lower end surface of the step part may cooperate with an upper end surface of the base body **10**. The lower end surface of the step part may be in close contact with the upper end surface of the base body **10** all the time. Through the close contact, the sealing ring in the subsidence groove **14***a* may be tightly pressed to produce a counter elastic force. Thus, the adjustor **40**, after adjusted to a predetermined position, will not become loose.

Preferably, the adjustor mounting chamber **12** is formed as a chamber which extends in a vertical direction and which is open at both upper and lower ends thereof. The adjustor mounting chamber **12** is open at its upper end to form the adjusting hole **14**, the adjustor mounting chamber **12** is open at its lower end to form the positioning hole **13**, and the adjusting seat **30** is movable in the vertical direction in the positioning hole **13**. The adjustor **40** is connected with the adjusting seat **30** to drive the adjusting seat **30** to move in the vertical direction. By providing the chamber which is open at both upper and lower ends thereof, the structure is greatly simplified and manufacture cost is reduced. The position of the adjusting seat **30** can be adjusted quickly and conveniently by the adjustor **40** without any transmission structure.

Optionally, the adjustor **40** is in a columnar shape extending along an axial direction of the adjustor mounting chamber **12**. The lower end of the adjustor **40** is provided with a screw pin. A part of the adjusting seat **30** extending into the adjustor mounting chamber **12** is provided with a screw hole **35** corresponding to the screw pin. The adjustor **40** is rotatable around its axis to drive the adjusting seat **30** to move in the vertical direction. In other words, the position of the adjustor **40** relative to the base body **10** may be fixed. When the adjustor **40** is rotated, the adjusting seat **30** may move up or up relative to the adjustor **40** to adjust the adjusting seat **30** upward or downward, so as to drive the movable unit **300** to move in the vertical direction.

As illustrated in FIG. **14**, in some specific embodiments of the present disclosure, the adjustor **40** is provided with a recess **42** extending along a circumferential direction of the adjustor **40**. The restrictor **70** includes a first restriction portion **71**. The first restriction portion **71** is provided on the base body **10** and positioned in the adjustor mounting chamber **12**. At least a portion of the first restriction portion **71** is inserted into the recess **42** to restrict the position of the adjustor **40**.

The right side of the recess **42** may be in communication with the executor mounting chamber **11**. An upper end surface of the recess **42** may cooperate with an upper end surface of the first restriction portion **71** to restrict the displacement of the first restriction portion **71** in the axial direction. Through cooperation of the first restriction portion **71** with the recess **42**, the adjustor **40** can be prevented from being disengaged from the adjusting hole **14**. As illustrated in FIG. **9**, the first restriction portion **71** may be formed as a U-shaped element with an opening. An inner surface of the U-shaped element may cooperate with an inner surface of the recess **42**, thereby not only fixing the relative position between the first restriction portion **71** and the adjustor **40**, but also allowing the adjustor **40** to rotate around the axis. The first restriction portion **71** may be provided with a screw hole **71***a* at the side opposite to the opening of the first restriction portion **71**. When detached, the first restriction portion **71** may be detached or installed by screwing a screw into screw hole **71***a*.

According to an embodiment of the present disclosure, an inner surface of the adjustor mounting chamber **12** may be provided with a circular subsidence groove **16** extending along a circumferential direction of the inner surface. An opening at a lower end of the subsidence groove **16** may have a radial size smaller than that of an upper end of the adjusting seat body **32**, and the upward movement of the adjusting seat body **32** may be restricted by the outer edge of the subsidence groove **16**. The execution system **100** may further include a compressing spring **72** provided in the subsidence groove **16**. The compressing spring **72** is an elastic element, and two ends of the compressing spring **72** are compressed against a top surface of the subsidence groove **16** and an upper end surface of the adjusting seat **30** respectively. When the adjustor drives the adjusting seat **30** to move upwardly, the upper end of the adjusting seat body **32** presses against the outer edge of the subsidence groove **16**, preventing the upward adjustment from going beyond an adjustment range or preventing an over-adjustment. In addition, the adjusting seat body **32** is always under a downward acting force from the compressing spring **72**, thus increasing the stability of the downward movement of the adjusting seat **30**. The outer edge of the subsidence groove **16** may be formed as a flat surface cooperating with the upper end surface of the adjusting seat body **32**. When rotating the adjustor **40**, the compression extent of the compressing spring **72** can be determined according to easiness of rotating.

The adjustor mounting chamber **12** may have an adjusting hole **12***a* positioned between the recess **42** and the subsidence groove **16**. A lower end of the adjusting hole **12***a* may be in communication with the subsidence groove **16**. An upper end of the adjusting hole **12***a* may be in communication with the recess **42**. The adjusting hole **12***a* may cooperate with the corresponding portion of the adjustor **40**. The adjustor **40** may rotate in the adjusting hole **12***a* around its axial direction.

The compressing spring **72** has advantages such as having a broad resource and low cost. An upper end surface of the compressing spring **72** may be perpendicular to its axis, and may be in close contact with the top of the subsidence groove **16**, thus the position of the upper end surface of the compressing spring can be effectively fixed, and the compressing spring **72** can transfer a counter force to the adjusting seat **30** to guarantee a stable force. A lower end surface of the compressing spring **71** may be perpendicular to its axis and may be in close contact with the upper flat surface of the adjusting seat **30** to transfer the force acting on the adjusting seat **30** and to allow the adjusting seat **30** to reach a corresponding position in time. The outer diameter of the compressing spring **72** may fit with the inner radial dimension of the subsidence groove **16** to guarantee the positional stability of the compressing spring **72**.

Further, the upper end of the adjustor **40** may extend out of the adjusting hole **14** to be formed as an adjusting portion, and the adjusting portion is provided with scale marks **41** extending along the circumferential direction of the adjusting portion. By providing the scale marks **41**, the accurateness and convenience of adjustment of the adjustment mechanism **40** by a user can be improved, allowing the user to record, and clearly and quickly acquire the adjustment extent. The adjusting portion may be further provided with numerals in cooperation with the scale marks to determine a corresponding position of adjustment. Optionally, the base body **10** may be provided with mark(s), which can quickly determine an adjusted position of the adjustor **40**, allowing the adjustor to be quickly adjusted to the position in the subsequent operation to improve the adjustment efficiency. As illustrate in FIG. **5**, the marks may be located on the

upper end surface of the base body **10** and located on one side of the adjusting hole **14**. The cooperation of the marks with the scale mark **41**, the convenience for determining the adjusted position can be improved.

According to an embodiment of the present disclosure, the adjusting seat **30** includes an adjusting seat body **32** and a connection portion **33**. Particularly, the adjusting seat body **32** may be in a columnar shape which extends along the axial direction of the adjustor mounting chamber **12** and may be inserted into the adjustor mounting chamber **12**. The adjusting seat body **32** may be provided therein with a first pore channel **34**, the first pore channel **34** extends along the axial direction of the adjusting seat body **32**. The upper end of the movable unit **300** may extend into the first pore channel **34**. An upper end of the adjusting seat body **32** may be provided with a screw hole **35**. The lower end of the adjustor **40** may be in a threaded connection with the screw hole **35**. By rotation of the adjustor **40**, the position of the adjusting seat **30** may be adjusted in the vertical direction. A lateral part of the adjusting seat body **32** may be provided with an avoiding slot **36** in communication with the first pore channel **34**. One end of a lever **21** of the executor **20** may extend through the avoiding slot **36** to be connected with the movable unit **300**, preventing the adjusting seat body **32** from interfering with the lever **21** of the executor **20** during the vertical movement of the adjusting seat body **32**. The connection portion **33** may be connected with the adjusting seat body **32** and may be provided at a lower end of the base body **10**. The connection portion **33** may be configured to be connected with the fluid channel assembly of the fluid micro-injection device. The connection portion **33** may be provided therein with a second pore channel. The second pore channel is coaxial with and in communication with the first pore channel **34** in such a manner that the second pore channel cooperates with the first pore channel **34** to form a channel **31**. During assembly, the upper end of the movable unit **300** may sequentially extends through the second pore channel and the first pore channel **34** to be connected with the lever **21**.

Optionally, the upper end of the connection portion **33** may be provided with a positioning portion **39**. The base body **10** may be provided with a positioning recess **18** which cooperates with the positioning portion **39**. When assembling the connection portion **33** with the base body **10**, at least a portion of the positioning portion **39** may be able to be inserted into the positioning recess **18**, to improve the effect of positioning and stability for assembly.

The second pore channel may cooperate with an upper positioning cylindrical post of a guiding seat of the movable unit **300** (closing element) for the fluid channel assembly of the fluid micro-injection device. When the execution system **100** is in close connection with the fluid channel assembly, a lower end surface (a positioning surface) of the connection portion **33** may be in close contact and coincidence with a upper positioning surface of the guiding seat of the closing element (a striker), to restrict position of upward movement of the fluid channel assembly and the execution system **100**, guaranteeing the axis of the guiding seat to be completely coaxial with the axis of the positioning hole **13** and perpendicular to the positioning surface (the lower end surface of the connection portion **33**), and effectively restricting anterior and rear, left and right positions of the fluid channel assembly and the executor.

The adjustor mounting chamber **12** may be provided therein with an adjusting seat mounting chamber **12***b*. The adjusting seat mounting chamber **12***b* may be located below the subsidence groove **16** and above the positioning hole **13**. The upper end of the adjusting seat mounting chamber **12***b* may be in communication with the subsidence groove **16**. The lower end of the adjusting seat mounting chamber **12***b* may be in communication with the positioning hole **13**. The right side of the adjusting seat mounting chamber **12***b* nay be in communication with the executor mounting chamber **11**. The top surface of the adjusting seat mounting chamber **12***b* may cooperate with the upper end surface of the adjusting seat body **32**. When the adjusting seat **30** is adjusted to move upwardly, the upper end surface of the adjusting seat body **32** may be in contact with the upper end surface of the adjusting seat mounting chamber **12***b*, effectively preventing the position adjustment of the adjusting seat **30** from going beyond a range.

Optionally, the outer circumferential surface of the lower end of the adjusting seat body **32** close to the connection portion **33** may be provided with a sealing recess **32***a*. A sealing element may be provided within the sealing recess **32***a* to guarantee the internal sealing of the base body **10**.

Optionally, the adjusting seat body **32** may be integral with the connection portion **33**, having advantages such as easy to manufacture and process and lower manufacture cost.

Further, there are two avoiding slots **36** which are provided at opposite sides of the adjusting seat body **32**. The restrictor **70** includes a second restriction portion **73**. The second restriction portion **73** may be provided on the base body **10**. At least a portion of the second restriction portion **73** may extend through the avoiding slot **36** to restrict the position of the adjusting seat **30** moving along the axial direction of the movable unit **300**. The two avoiding slots **36** may be provided opposite to each other. One end of the lever **21** may extend through one avoiding slot **36** to be connected with the movable unit **300**. At least a portion of the second restriction portion **73** may extend through the other avoiding slot **36**. When the adjusting seat body **32** moves downward, at least a portion of the second restriction portion **73** may be located in the moving path of the adjusting seat body **32**. When the adjusting seat body **32** moves downward by a certain distance, the second restriction portion **73** may prevent the adjusting seat body **32** from keeping on moving downward. Optionally, the lower end of the adjustor **40** may extend through the screw hole **35**. The part of the adjustor **40** extending through the screw hole **35** may be arranged apart from the second restriction portion **73**, preventing the second restriction portion **73** from interfering with the movement of the lower end of the adjustor **40**.

The cross section of the adjusting seat body **32** taken along the axial direction may be formed as square shape. The hollow part of the square-shaped section may correspond to the avoiding slot **36**. The upper end of the adjusting seat body **32** may be provided with a screw hole **35**. The upper end surface of the adjusting seat body **32** may be in close contact with the lower end surface of the compressing spring **72**, facilitating transferring the force acting on the adjusting seat **30** and allowing the adjusting seat **30** to reach a corresponding position in time. Further, when the adjusting seat **30** is adjusted to move upwardly, the upper end surface of the adjusting seat body **32** may be in contact with the top surface of the adjusting seat mounting chamber **12***b*, preventing the adjustment of the adjusting seat **30** from going beyond a range. The surface of the adjusting seat body **32**, which is located above the hollow part of the square shape, may cooperate with the second restriction portion **73**, which can restrict downward displacement of the adjusting seat **30** when being adjusted, guarantee the position of the adjusting seat **30** to be in the adjustment range, and prevent the

adjusting seat **30** from getting off the base body **10** due to over adjustment. The outer circumferential surface of the adjusting seat body **32** may cooperate with the adjusting seat mounting chamber **12***b*, which can guarantee the axis of the adjusting seat **30** to intersect with the axis of a small protruding part on the front end of the lever, so as to produce accurate transfer of force and displacement during adjustment of the adjusting seat **30**.

The left side of the adjusting seat mounting chamber **12***b* may be provided with a protruding part extending in a direction towards the channel. The upper end surface of the second restriction portion **73** may be in cooperation with the protruding part **12***c* to restrict the position of the second restriction portion **73** in the vertical direction. The inner sidewall of the adjusting seat mounting chamber **12***b* below the protruding part **12***c* may be installed with the second restriction portion **73**, and may be in close contact with the rear flat surface of the second restriction portion **73** to guarantee the installed position of the second restriction portion **73**. As illustrated in FIG. **10**, the second restriction portion **73** may include a rectangle-shaped mounting plate **73***a* and a restriction plate **73***b* provided on the mounting plate **73***a*. The mounting plate **73***a* and the restriction plate **73***b* may be integrally formed. The left lateral surface of the mounting plate **73***a* may be in cooperation with the inner sidewall of the adjusting seat mounting chamber **12***b* below the protruding part **12***c*. The left lateral surface of the mounting plate **73***a* may be fastened with a screw. The upper end surface of the mounting plate **73***a* may be in cooperation with the protruding part **12***c* on the adjusting seat mounting chamber **12***b* to determine the position of the second restriction portion **73** in the vertical direction. The left lateral surface of the restriction plate **73***b* may be connected with the right lateral surface of the mounting plate **73***a*. The upper end surface of the restriction plate **73***b* may be in cooperation with the upper end of the adjusting seat body **32**. Thereby, the downward displacement of the adjusting seat body **32** when being adjusted can be restricted, so as to guarantee the position of the adjusting seat **30** to be in a adjustment range and prevent the adjusting seat **30** from getting off the base body **10** due to over adjustment. The second restriction portion **73** may be provided with a screw hole extending horizontally. The second restriction portion **73** may be fixed to the inner lateral surface of the base body **10** through a screw bolt to accurately fix the restriction of position.

According to an embodiment of the present disclosure, the lever **21** is provided in the executor mounting chamber **11** and both ends of the lever **21** are movable. When assembling the base body **10** with the fluid seat **210**, the upper end of the movable element **320** may be connected with a first end of the lever **21** and is driven by the lever **21** to move in the axial direction of the guiding hole **311**. The executor **20** may further include an actuator **22** and a controller. The actuator **22** may be telescopically provided in the executor mounting chamber **11**. The actuator **22** may be connected with the second end of the lever **21** to control the movement of the lever **21**. The controller may be connected with the actuator **22** to control the retractable movement of the actuator **22**.

In some specific embodiments of the present disclosure, the inner surface of the adjustor mounting chamber **12** may be provided with a restriction boss **15** which extends along the circumferential direction of the inner surface and which is located below the lever **21**. The execution system **100** may further include a positioning seat **50** and a first elastic element **60**.

In particular, the positioning seat **50** may be provided in the executor mounting chamber **11**. The positioning seat **50** may be in a columnar shape extending along the axial direction of the executor mounting chamber **11**, and an upper end of the positioning seat **50** may be provided with a circular boss **51** extending along its circumferential direction. The circular boss **51** presses against the restriction boss **15**. The lower end surface of the circular boss **51** of the positioning base **50** may press against the upper end surface of the restriction boss **15** to restrict relative position between the elastic element **60** and the base body **10**. When the adjustor **40** drives the adjusting seat **30** to move vertically, the position of the restriction boss **15** relative to the base body **10** can be fixed to restrict the relative position between the positioning base **50** and the base body **10**. The positioning seat **50** may be provided with a third pore channel extending therethrough along its axial direction. The upper end of the movable unit **300** may extend through the third pore channel to be connected with the lever **21**. The first elastic element **60** may be provided between the lever **21** and the positioning seat **50**, and the two ends of the first elastic element **60** may press against the lever **21** and the positioning seat **50** respectively. The part below the circular boss **51** of the positioning seat **50** may be in cooperation with the second pore channel to restrict the axial position of the first elastic element **60**, and to allow the axis of the elastic element **60** to be coincident with the axis of the adjusting seat **30**. The third pore channel may be in cooperation with the lower end surface of the first elastic element **60** to transfer a counter force to the base body **10** via the positioning seat **50**, which guarantees a stable value of the force. The inner radial size of the third pore channel may be in cooperation with the outer radial size of the first elastic element **60** to guarantee a stable position of the first elastic element **60**.

Further, the first elastic element **60** may be a spring sheathed on the outer circumferential surface of the movable element, having advantages such as a broad resource and low cost.

As illustrated in FIG. **11** to FIG. **13**, according to an embodiment of the present disclosure, the fluid seat **210** may defines therein an installation chamber **213** in communication with the fluid chamber **211**. The movable unit **300** may include a guiding seat **310**, a movable element **320** and a second elastic element **330**.

In particular, the guiding seat **310** may be in a columnar shape. The guiding seat **310** defines therein a guiding hole **311** extending through the guiding seat along the axial direction of the guiding seat. The lower end of the guiding seat **310** may be detachably installed into the installation chamber **213**. Other parts of the guiding seat **310** may extend into the positioning hole **13** when the fluid channel assembly **200** is assembled with the execution system **100**. The movable element **320** is movable along an axial direction of the guiding seat **310**, and a lower end of the movable element **320** may extend through and out of the guiding hole **311** along the axial direction of the guiding seat **310**. An upper end of the movable element **320** may be located above the guiding seat **310**. When assembling the execution system **100** with the fluid channel assembly **200**, the upper end of the movable element **320** may extend through the channel **31** and into the adjustor mounting chamber **12** to be connected with at least a portion of the executor **20** and to be controlled by the executor **20** to move along the axial direction of the guiding hole **311**. The lower end of the movable element **320** may cooperate with the nozzle **220** to open and close the nozzle **220**. The adjustor **40** may adjust the movement of the

adjusting seat **30** along the axial direction of the movable element **320**, and drive the movable element **320** to move along its axial direction. The second elastic element **330** may be provided between the upper end of the guiding seat **310** and the upper end of the movable element **320**, and the two ends of the second elastic element **330** may press against the upper end of the guiding seat **310** and the upper end of the movable element **320** respectively.

Optionally, an upper part of the guiding seat **310** is in a cylindrical shape. The upper end of the guiding seat **310** may be provided with a positioning pin, the positioning pin is coaxial with the guiding seat **310** and has a radial size smaller than that of the guiding seat **310**. The first elastic element may be a spring sheathed on the positioning pin. The positioning hole **13** may be a cylindrical hole. When assembling the guiding seat **310** with the base body **10**, an outer circumferential surface of the upper part of the guiding seat **310** may be in close contact with the inner surface of the positioning hole **13**.

Further, the movable element **320** may include a cylindrical shaft **321** and an upper end platform **322**. The cylindrical shaft **321** may be provided in the guiding hole **311** and is movable along its axial direction. A lower end of the cylindrical shaft **321** may be formed as a sphere head. The upper end platform **322** may be provided at the upper end of the cylindrical shaft **321**. The upper end platform **322** may have a size greater than the radius of the cylindrical shaft **321**. The second elastic element **330** may be provided between the upper end platform **322** and the guiding seat **310**.

The assembling process and the assembling characteristics of the execution system **100** of the fluid micro-injection device according to embodiments of the present disclosure will be described in detail in the following.

At S**1**, the adjustor **40** is installed into the adjusting hole **14**, the compressing spring **72** is installed into the subsidence groove **16** from the positioning hole **13**, so as to make the compressing spring **72** to be in cooperation with the adjustor **40**.

At S**2**, the adjusting seat **30** is installed from the positioning hole **13**, and the screw thread at the lower end of the adjustor **40** is in a threaded connection with the screw hole **35** of the adjusting seat **30** to make the upper flat surface of the adjusting seat **30** to be in close contact with the top surface of the adjusting seat mounting chamber **12***b*.

At S**3**, the second restriction portion **73** is put into the adjusting seat mounting chamber **12***b*.

At S**4**, the positioning seat **50** is assembled with the adjusting seat **30**, to make the circular boss **51** of the positioning seat **50** to cooperate the restriction boss **15**, and the first elastic element is installed into the positioning seat **50**.

At S**5**, the executor **20** is installed into the executor mounting chamber **11**, the rear end of the lever is assembled with a swing axle pin, and the front end of the lever may be in close contact with the upper end surface of the first elastic element **60**.

At S**6**, the actuator **22** is installed into the executor mounting chamber **11**, and the lower part of the actuator **22** may be in cooperation with the rear end of the lever, and the adjustment range can be restricted to avoid damage to the piezoelectric actuator and to extend its use life.

At S**7**, the upper positioning cylinder of the guiding seat **310** is inserted into the second pore channel, and the fluid channel assembly **200** is rotated for assembly.

The fluid micro-injection device according to embodiments of the present disclosure includes the execution system **100** according to the above embodiments, Since the execution system **100** according to the above embodiments of the present disclosure has above-mentioned technical effects, the fluid micro-injection device according to the embodiments of the present disclosure also has the corresponding technical effects, and can overcome problems such as inconvenience and inefficiency in adjustment for contact force between the nozzle **220** and the movable element **320**, thereby improving the efficiency for adjustment of piezoelectric valve and the efficiency for manufacture and assembly.

Other structure and operation of the fluid micro-injection device according to embodiments of the present disclosure are easy to understand and implement for a person skilled in the art, the detailed description related thereto are omitted here.

In the description of the present specification, the description with reference to the terms "an embodiment", "some embodiments", "illustrative embodiment", "example", "specific example", or "some examples", etc. refer to particular features, structures, materials or characteristics described in the embodiments or examples included in at least an embodiment or example of the present disclosure. In the present specification, the schematic representation of the above terms does not necessarily mean the same embodiment or example. Furthermore, described particular features, structures, materials or characteristics may be combined in a suitable manner in any one or more embodiments or examples. Although the embodiments of the present disclosure have been shown and described above, it can be appreciated by those skilled in the art that various changes, modifications, replacements and variants can be made to the above embodiments without departing from the principle and spirit of the present disclosure. The scope of the present disclosure is defined by the claims and their equivalents.

What is claimed is:

1. A fluid micro-injection device, comprising:

an execution system, the execution system comprising:

a base body defining therein an executor mounting chamber and an adjustor mounting chamber, the base body being provided with a positioning hole in communication with the executor mounting chamber;

an executor movably provided in the executor mounting chamber, at least a portion of the executor extending into the adjustor mounting chamber;

an adjusting seat, at least a portion of the adjusting seat extending through the positioning hole and into the adjustor mounting chamber, and the adjusting seat being provided with a channel in communication with the executor mounting chamber; and

an adjustor movably provided in the adjustor mounting chamber, at least a portion of the adjustor being connected with the adjusting seat to adjust the distance between the adjusting seat and the executor;

a fluid channel assembly, the fluid channel assembly comprising:

a fluid seat, the fluid seat defining therein a fluid chamber and a fluid channel in communication with the fluid chamber, the base body being detachably connected with the fluid seat;

a nozzle provided on the fluid seat and in communication with the fluid chamber; and

a fluid supply joint in communication with the fluid channel to supply fluid to the nozzle through the fluid channel and the fluid chamber; and

a movable unit provided between the base body and the fluid seat, at least a first portion of the movable unit being inserted into the positioning hole to be connected with the executor and driven by the executor to move along an axis of the positioning hole to open and close the nozzle, and at least a second portion of the movable unit being provided on the adjusting seat to be adjusted by the adjusting seat,

wherein the adjusting seat comprises an adjusting seat body which is in a columnar shape extending along the axial direction of the adjustor mounting chamber and which is inserted into the adjustor mounting chamber,

wherein an inner surface of the adjustor mounting chamber is provided with a circular subsidence groove extending along a circumferential direction of the inner surface, a radial size of an opening at a lower end of the circular subsidence groove is smaller than a radial size of an upper end of the adjusting seat body, and the execution system further comprises:

a compressing spring provided in the circular subsidence groove, the compressing spring being an elastic element, and two ends of the compressing spring being compressed against a top surface of the circular subsidence groove and an upper end surface of the adjusting seat respectively.

2. The fluid micro-injection device of claim **1**, wherein the base body is provided with an adjusting hole in communication with the adjustor mounting chamber, an upper end of the adjustor extends out of the adjusting hole, and a lower end of the adjustor is connected with the adjusting seat.

3. The fluid micro-injection device of claim **2**, wherein the adjustor mounting chamber is formed as a chamber which extends in a vertical direction and which is open at both upper and lower ends thereof, the adjustor mounting chamber is open at its upper end to form the adjusting hole, the adjustor mounting chamber is open at its lower end to form the positioning hole, and the adjustor is connected with the adjusting seat to drive the adjusting seat to move in the vertical direction.

4. The fluid micro-injection device of claim **3**, wherein the adjustor is in a columnar shape extending along an axial direction of the adjustor mounting chamber, the lower end of the adjustor is provided with a screw pin, a part of the adjusting seat extending into the adjustor mounting chamber is provided with a screw hole corresponding to the screw pin, and the adjustor is rotatable along its axis to drive the adjusting seat to move in the vertical direction.

5. The fluid micro-injection device of claim **4**, wherein the adjusting seat body being provided therein with a first pore channel extending along its axial direction, an upper end of the movable unit extending into the first pore channel, an upper end of the adjusting seat body being provided with the screw hole, a lateral part of the adjusting seat body being provided with an avoiding slot in communication with the first pore channel, and one end of a lever of the executor extends through the avoiding slot to be connected with the movable element; and

a connection portion connected with the adjusting seat body and provided at a lower end of the base body, the connection portion being configured to be connected with the fluid channel assembly of the fluid micro-injection device, the connection portion is provided therein with a second pore channel which is coaxial with and in communication with the first pore channel, and the second pore channel cooperating with the first pore channel to form the channel.

6. The fluid micro-injection device of claim **5**, wherein the inner surface of the adjustor mounting chamber is provided with a restriction boss, the restriction boss extends along a circumferential direction of the inner surface and is located below the lever, and wherein the execution system further comprises:

a positioning seat provided in the executor mounting chamber, the positioning seat being in a columnar shape extending along the axial direction of the executor mounting chamber, an upper end of the positioning seat being provided with a circular boss extending along its circumferential direction, the circular boss pressing against the restriction boss, the positioning seat being provided with a third pore channel extending therethrough along its axial direction, and the upper end of the movable unit extending through the third pore channel to be connected with the lever; and

a first elastic element provided between the lever and the positioning seat, two ends of the first elastic element pressing against the lever and the positioning seat respectively.

7. The fluid micro-injection device of claim **6**, wherein the fluid seat defines therein an installation chamber in communication with the fluid chamber, and the movable unit comprises:

a guiding seat which is in a columnar shape, the guiding seat defining therein a guiding hole, the guiding hole extending through the guiding seat along the axial direction of the guiding seat, an lower end of the guiding seat being configured to be detachably installed into the installation chamber, and other parts of the guiding seat being configured to extend into the positioning hole when assembling the fluid channel assembly with the execution system;

a movable element which is movable along an axial direction of the guiding seat, a lower end of the movable element extending through and out of the guiding hole along the axial direction of the guiding seat, an upper end of the movable element being located above the guiding seat, the upper end of the movable element being configured to extend through the channel and into the adjustor mounting chamber to be connected with at least a portion of the executor and to be controlled by the executor to move along the axial direction of the guiding hole when assembling the execution system with the fluid channel assembly, the lower end of the movable element cooperating with the nozzle to open and close the nozzle, and the adjustor being configured to adjust the movement of the adjusting seat along the axial direction of the movable element and to drive the movable element to move along its axial direction; and

a second elastic element provided between a upper end of the guiding seat and the upper end of the movable element, two ends of the second elastic element pressing against the upper end of the guiding seat and the upper end of the movable element respectively.

8. The fluid micro-injection device of claim **7**, wherein an upper part of the guiding seat is in a cylindrical shape, the upper end of the guiding seat is provided with a positioning pin which is coaxial with the guiding seat and has a radial size smaller than that of the guiding seat, the first elastic element is a spring sheathed on the positioning pin, the positioning hole is a cylindrical hole, and an outer circumferential surface of the upper part of the guiding seat is in close contact with the inner surface of the positioning hole when assembling the guiding seat with the base body.

9. The fluid micro-injection device of claim 7, wherein the movable element comprises:

a cylindrical shaft, provided in the guiding hole and movable along its axial direction, and an lower end of the cylindrical shaft being formed as a sphere head; and

an upper end platform provided at an upper end of the cylindrical shaft, the upper end platform having a size greater than the radius of the cylindrical shaft, the second elastic element being provided between the upper end platform and the guiding seat.

10. The fluid micro-injection device of claim 5, wherein the execution system further comprises:

a restrictor provided on the base body and connected with at least a portion of the adjustor and/or the adjusting seat, the restrictor being configured to at least restrict a position of the adjusting seat moving along the axial direction of the movable unit or a position of the adjustor.

11. The fluid micro-injection device of claim 10, wherein the adjustor is provided with a recess extending along a circumferential direction of the adjustor, and the restrictor comprises:

a first restriction portion provided on the base body and positioned in the adjustor mounting chamber, at least a portion of the first restriction portion being inserted into the recess to restrict the position of the adjustor.

12. The fluid micro-injection device of claim 11, wherein a right side of the recess is in communication with the executor mounting chamber, an upper end surface of the recess is configured to cooperate with an upper end surface of the first restriction portion to restrict displacement of the first restriction portion in the axial direction.

13. The fluid micro-injection device of claim 11, wherein the first restriction portion is formed as a U-shaped element with an opening, an inner surface of the U-shaped element is configured to cooperate with an inner surface of the recess.

14. The fluid micro-injection device of claim 10, wherein the number of the avoiding slots is two and the two avoiding slots are provided at opposite sides of the adjusting seat body, and the restrictor comprises:

a second restriction portion provided on the base body, at least a portion of the second restriction portion extending through the avoiding slot to restrict the position of the adjusting seat moving along the axial direction of the movable element.

15. The fluid micro-injection device of claim 14, wherein one end of the lever extends through one avoiding slot to be connected with the movable unit, at least a portion of the second restriction portion extends through the other avoiding slot, and when the adjusting seat body moves downward, at least a portion of the second restriction portion is located in a moving path of the adjusting seat body.

16. The fluid micro-injection device of claim 5, wherein an upper end of the connection portion is provided with a positioning portion, the base body is provided with a positioning recess which is configured to cooperate with the positioning portion, at least a portion of the positioning portion is inserted into the positioning recess when the connection portion is assembled with the base body.

17. The fluid micro-injection device of claim 2, wherein an upper end of the adjusting hole is provided with a subsidence groove extending along an inner surface of the adjusting hole, a sealing ring is provided in the subsidence groove within the adjusting hole, and the upper end of the adjustor is configured to extend through the sealing ring and into the adjustor mounting chamber.

18. The fluid micro-injection device of claim 2, wherein the upper end of the adjustor is formed as an adjusting portion, and the adjusting portion is provided with scale marks extending along an circumferential direction of the adjusting portion.

19. The fluid micro-injection device of claim 1, wherein the adjustor mounting chamber is provided therein with an adjusting seat mounting chamber, the adjusting seat mounting chamber is located below the circular subsidence groove and above the positioning hole, an upper end of the adjusting seat mounting chamber is in communication with the circular subsidence groove, a lower end of the adjusting seat mounting chamber is in communication with the positioning hole, a right side of the adjusting seat mounting chamber is in communication with the executor mounting chamber, and a top surface of the adjusting seat mounting chamber is configured to cooperate with an upper end surface of the adjusting seat body.

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