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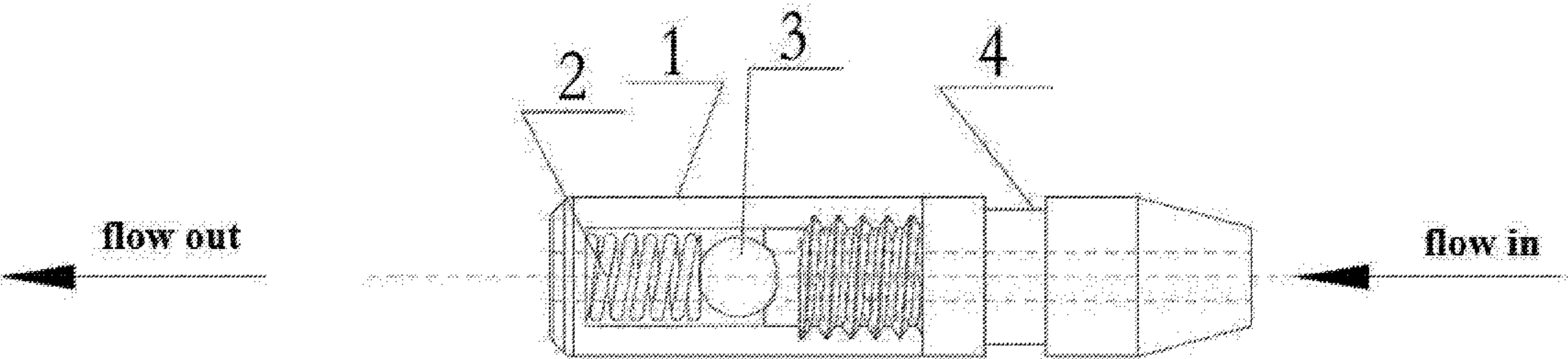


Fig. 1

(57) **Abrégé/Abstract:**
A split micro-valve comprises a valve plug (3) and a valve body (1, 4). The valve body (1, 4) is a split structure and comprises a front valve body (1) and a rear valve body (4). The front valve body (1) has a valve chamber (10) which comprises a liquid outlet (5) at one end and an interior thread (6) at the other end. The rear valve body (4) comprises a liquid inlet (9) at one end and an exterior thread (8) at the other end. The interior thread (6) of the front valve body (1) is connected to the exterior thread (8) of the rear valve body (4) in a threaded manner. The rear valve body (4) comprises a valve seat (7) at its threaded end. A valve plug (3) is located inside the valve chamber (10), and is cooperated with the valve seat (7) of the rear valve body (4). The valve body (1, 4) can be assembled easily and the size of the valve chamber (10) can be changed by replacing the front valve body (1).

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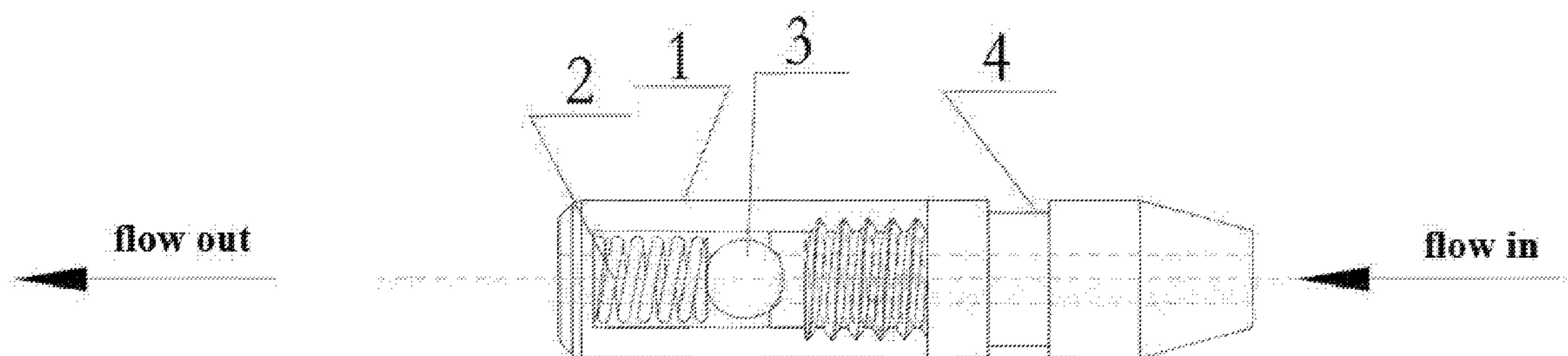


Fig. 1

(57) Abstract: A split micro-valve comprises a valve plug (3) and a valve body (1, 4). The valve body (1, 4) is a split structure and comprises a front valve body (1) and a rear valve body (4). The front valve body (1) has a valve chamber (10) which comprises a liquid outlet (5) at one end and an interior thread (6) at the other end. The rear valve body (4) comprises a liquid inlet (9) at one end and an exterior thread (8) at the other end. The interior thread (6) of the front valve body (1) is connected to the exterior thread (8) of the rear valve body (4) in a threaded manner. The rear valve body (4) comprises a valve seat (7) at its threaded end. A valve plug (3) is located inside the valve chamber (10), and is cooperated with the valve seat (7) of the rear valve body (4). The valve body (1, 4) can be assembled easily and the size of the valve chamber (10) can be changed by replacing the front valve body (1).

SPLIT MICRO-VALVE

TECHNICAL FIELD

[0001] The present disclosure relates to a fluid control device, and more particularly to a micro-valve structure for controlling dispensation of micro-fluid.

BACKGROUND

[0002] A micro-valve is suitable for dispensing very small amounts of liquid (e.g. in milliliter, microliter). For example, in a drug-delivery atomizer, certain amount of drug is extracted into a nozzle of the atomizer at first. The amount of drug being dispensed each time is typically 15 microliters to 2 milliliters, depending on the type of drug. For such drug-delivery atomizer, a micro-valve is desirably disposed at one end of a suction tube, for controlling the amount of fluid supplied to the drug-delivery atomizer. In clinical medicine, an intravenous injection amount per unit time for some drugs is more important than a total amount of the drugs being injected. In terms of pharmacokinetics, the shorter an interval of drug administration is, the smaller the blood concentration fluctuates. In clinical practice, constant-rate intravenous infusion is most effective. Table 1 below illustrates some commonly used drugs of intravenous general anesthesia, as well as their requirements of volume flow for the constant-rate intravenous infusion.

[0003] Table 1: Commonly used drugs of intravenous general anesthesia, and their requirements of volume flow for the constant-rate intravenous infusion

Name of drug	Flow rate of intravenous infusion (mg/min)	Form of drug liquid	Volume flow requirements (ml/min)
Thiopental Sodium	50	1.0 g of each power-injection being diluted into 10 ml	0.5
Methohexital	2-5	500mg/5ml of injection	0.02-0.05
Ketamin	0.5-1.5	100mg/10ml of injection	0.05-0.15
Propofol	2.5-5	200mg/ml of injective emulsion	0.25-0.5

[0004] If a precise syringe is not available, an intravenous drip can be used after the drug is diluted by a 5% glucose solution. The volume flow rate of intravenous drip is generally 2-4 ml/min.

[0005] If a precise syringe is manufactured using a glass needle tube and a stainless steel push rod, the requirements on the manufacturing are high, and the volume flow of injection might be significantly affected by the environment. Therefore, there is a need for a precise syringe with a micro-valve.

[0006] An existing micro-valve structure typically comprises a valve body, a valve plug, a spring and a positioner. The valve body, which is a tube-like shape, has at its one end a liquid inlet with a smaller diameter, and an inner side of the liquid inlet forms a valve seat. The valve plug is typically a valve ball, which is put into the valve seat along with the spring through the other end of the valve body. The valve ball is sealingly mated with the valve seat. The positioner is tightly mated with the other end of the valve body to position the spring and valve ball.

[0007] When the size of an exterior profile of the valve body is less than 3 mm, metallic materials e.g. stainless steel, may be used preferably. The reason for this is, for example, the difficulty of injection molding because of the small size of the parts, different situations of shrink of plastic parts for each batch of injection molding, or the difficulty in adjusting the parts from different batches. Furthermore, an existing small size metallic one-way valve is not detachable once assembled, which means that the parts cannot be detached for reuse as long as they are assembled together. Thus, the valve may not be used once any part thereof has defects. In practical production stage, each one-way valve being assembled can be put into use only after it passes a leak-checking test. An undetachable one-way valve is scrapped if it fails in the leak-checking test. In use stage, due to the corrosion and oxidation of metallic materials, materials and parts with better properties are desired for increasing service lifetime. However, liquid leakage is still inevitable for a valve after a period of time, and then the valve as a whole has to be scrapped.

[0008] In addition, because the liquid being delivered is thick, the residual liquid is easily cured into crystal within the valve body, or the elongated tube is easily blocked, the valve is disposable or has to be cleaned carefully before and after each usage. In order to make sure that no rust stain or liquid remains within the tube, a cleaning process is added,

which adversely affects the service lifetime of the valve, and costs including manpower, time and resource.

[0009] Furthermore, the flow cannot be adjusted for the existing micro-valve by itself. If it is desired to adjust the flow, an additional rate control valve or other flow control valves are required mounted to the tube, or other type of one-way valve with a more complicated structure is required.

[0010] In order to solve at least one of the problems discussed above, there is a need for a new micro-valve structure.

SUMMARY

[0011] An objective of the present application is to provide a split micro-valve. The split micro-valve has an improved structure, which enables precise volume control of an inner valve chamber and ensures product uniformity.

[0012] In order to achieve the objective above, one of the technical solutions of the present application is as follows. A valve body has a first valve body section and a second valve body section which are formed separately. The first valve body section defines a valve chamber and has a first end and a second end opposite to the first end, and the first valve body section comprises a liquid outlet at the first end. The second valve body section having a first end and a second end opposite to the first end, and the second valve body section comprises a liquid inlet at the first end and defines a valve seat at the second end. The second valve body section is threadedly coupled to the first valve body through their respective second ends. The split micro-valve further comprises a valve plug received within the valve chamber, the valve plug being movable between a first position pressed against the valve seat and a second position away from the valve seat, so as to permit or prohibit a liquid flow from the liquid inlet to the liquid outlet.

[0013] In the technical solution above, the valve body is formed of the first valve body section and the second valve body section through threaded connection, and no positioner is required after the valve plug is mounted therein. As a result, it is convenient to mount and adjust the valve body, and the requirements on machining accuracy is reduced. The valve seat can be sealed by the valve plug when the valve plug is seated on the valve seat. In particular, during liquid supplying operation, the valve plug is separated from the valve seat due to the pressure from the liquid inlet, which enables the fluid communication between the liquid inlet

and the liquid outlet. When the liquid supplying operation is completed, the valve plug is restored into the valve seat by the pressure from the liquid outlet.

[0014] Further, in some embodiments, a spring is disposed within the valve chamber for pressing the valve plug against the valve seat. For example, the spring has a first end in contact with the valve plug, and a second end in contact with a sidewall of the liquid outlet. The resilience of the spring can be used to restore the valve plug, which is especially applicable to the situation where no restoration pressure is applied from the liquid outlet.

[0015] In some embodiments, the valve plug may have various shapes. For example, the valve plug is spherical. Alternatively, the valve plug is cylindrical. Further, the first end of the valve plug which contacts with the valve seat is semi-spherical, and the second end of the valve plug is cylindrical.

[0016] The micro-valve is applicable to different situations by adjusting the volume of the valve chamber.

[0017] Another technical solution of the present application is provided below.

[0018] In the embodiment, a split micro-valve comprises a valve body having a first valve body section and a second valve body section which are formed separately. The first valve body section has a first end and a second end opposite to the first end, and the first valve body section comprising a liquid outlet at the first end. The second valve body section defines a valve chamber and having a first end and a second end opposite to the first end, the second valve body section comprises a liquid inlet at the first end, and the valve chamber defines a valve seat towards the liquid inlet. The second valve body section is threadedly coupled to the first valve body through their respective second ends. The split micro-valve further comprises: a valve plug received within the valve chamber, the valve plug being movable between a first position pressed against the valve seat and a second position away from the valve seat, so as to permit or prohibit a liquid flow from the liquid inlet to the liquid outlet.

[0019] Further, in some embodiments, a spring is disposed inside the valve chamber. For example, the spring has a first end in contact with the valve plug and a second end in contact with the second end of the first valve body section.

[0020] In some embodiments, the valve plug may have various shapes. For example, the valve plug is spherical. Alternatively, the valve plug is cylindrical. Further, the first end

of the valve plug which contacts with the valve seat is semi-spherical, and the second end of the valve plug is cylindrical.

[0021] The present application has some advantages below as compared with the prior art.

[0022] 1. In the prior art, a valve body of a micro-valve is typically form as an integral structure, and the design of the valve focuses more on how to position a valve plug and spring. The valve body of the present application is inventively constructed as a split structure, and the valve plug is disposed at a joint between the two valve body sections which are threadedly coupled with each other. As a result, the micro-valve can be assembled easily, and no complicated mold is required.

[0023] 2. Theoretically, a throttle controls its fluid flow by adjusting the throttling section or throttling length. Since the inner part of the micro-valve of the present application can be replaced, the fluid flow of the micro-valve of the present application can be adjusted by using valve plugs having different section sizes or lengths, changing the size of its housing or spring, or other adjustment means, which is similar to the adjusting of the throttle. For a situation where flow adjustment does not occurs frequently, only a portion of the parts is needed to be changed for a period of time, which reduces unnecessary storage, configuration and cost.

[0024] 3. The minimum outer diameter of the entire valve can be as small as 1.5 mm. Even if the one-way valve of the present application is mounted in a tube having a small diameter, the tube section mounted with the micro-valve would not protrude from the tube. As a result, the exterior can extend smoothly, and a tube can be matched easily. The outer diameter of the valve of the present application is even smaller than a known one-way valve or check valve having a diameter of 2.5 mm available from THE LEE COMPANY.

[0025] 4. The product structure can be detached easily, and thus every single part can be replaced independently. An undesirable part can be replaced in time once being found. Furthermore, the coupling between different parts of the valve can be adjusted easily, and thus the quality of the entire product can be improved. In addition, the cost of materials is reduced, and the cost for the entire product is thus reduced, which is beneficial for market competition.

[0026] 5. The product structure can be detached easily, and thus visible cleaning and disinfection can be used. As a result, the use cost and process loss can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0027] Figure 1 is a first embodiment according to the present disclosure.
- [0028] Figure 2 is an exploded view of Figure 1.
- [0029] Figure 3 is a partial section view of Figure 1.
- [0030] Figure 4 is a structure diagram of a second embodiment.
- [0031] Figure 5 is a structure diagram of a third embodiment.
- [0032] Figure 6 is a diagram of a fourth embodiment.
- [0033] Figure 7 is a section view of Figure 6.
- [0034] Figure 8 is a structure diagram illustrating an application scenario as a fifth embodiment.
- [0035] Figure 9 is a partial enlarged view of Figure 8.
- [0036] Figure 10 is a structure diagram of a sixth embodiment.
- [0037] Figure 11 is an exploded view of Figure 10.
- [0038] Figure 12 is a section view of Figure 11.
- [0039] Figures 13 and 14 are section views of other two structures in the sixth embodiment.

DETAILED DESCRIPTION

- [0040] The present disclosure will be more apparent in combination with drawings and embodiments.
- [0041] First Embodiment
- [0042] As illustrated in Figures 1-3, a split micro-valve is provided, which includes a first valve body section, i.e. a front valve body section 1, a second valve body section, i.e. a rear valve body section 4, a valve plug 3, and a spring 2. As shown in Figure 3, the front valve body section 1 has a valve chamber 10. At a first end of the front valve body section 1 there is a liquid outlet 5, and at a second end of the front valve body section 1 there is an interior thread 6. At a first end of the rear valve body section 4 there is a liquid inlet 9, at a second end of the rear body section 4 there is an exterior thread 8. The interior thread 6 of the front valve body section 1 is matably connected to the exterior thread 8 of the rear valve body

section to form a threaded connection. In addition, the rear valve body section 4 defines a valve seat 7 at its second end.

[0043] As illustrated in Figure 1, the spring 2 and the valve plug 3 are disposed inside the valve chamber 10. A first end of the spring 2 is in contact with the valve plug 3, and a second end of the spring 2 is in contact with a sidewall of the liquid outlet of the valve chamber 10. In some embodiments, the valve plug is a spherical valve ball, which can be seated within the valve seat of the rear valve body section.

[0044] In some embodiments, the one-way valve can be used inside of an analgesic pump, an insulin pump, a needleless syringe, or an atomizer. It's advantageous to reduce the volume of structure, and thus to develop a portable wearable administering device.

[0045] When manufacturing a precise syringe, flow requirements are illustrated below in Table 2.

[0046] Table 2: Flow rate requirements for a precise syringe

Total amount of injection (μ l)	Inner diameter of syringe (mm)	Minimum flow rate (ml/min)	Maximum flow rate (ml/min)
10	0.485	0.184	0.027
25	0.729	0.417	0.626
50	1.03	0.833	0.125
100	1.457	1.667	0.250
250	2.304	4.169	0.625
500	3.256	8.326	1.248

[0047] In the embodiment, a capillary stainless steel tube is used as a valve sleeve of the body for a micro-valve, which can fully satisfy the requirement on the size of inner diameter of the micro-valve in a precise syringe application. That is, corresponding valves that match with the required inner diameter sizes can be mounted with the same syringe needle based on the requirements on different flow rates.

[0048] Second Embodiment

[0049] As illustrated in Figure 4, a split micro-valve is provided, which includes a front valve body section 1, a rear valve body section 4, a valve plug 3, and a spring 2. The front valve body section 1 has a valve chamber 10. At a first end of the front valve body section 1 there is a liquid outlet 5, and at a second end of the front valve body section 1 there is an interior thread 6. At a first end of the rear valve body section 4 there is a liquid inlet 9, and at a second end of the rear body section 4 there is an exterior thread. The interior thread 6

of the front valve body section 1 is matably connected to the exterior thread 8 of the rear valve body section to form a threaded connection. In addition, the rear valve body section 4 defines a valve seat 7 at its second end. The spring 2 and the valve plug 3 are disposed inside the valve chamber 10. In the embodiment, the valve plug is cylindrical.

[0050] Third Embodiment

[0051] As illustrated in Figure 5, a split micro-valve is provided, which includes a front valve body 1, a rear valve body 4, a valve plug 3, and a spring 2. The front valve body section 1 has a valve chamber 10. At a first end of the front valve body section 1 there is a liquid outlet 5, and at a second end of the front valve body section 1 there is an interior thread 6. At a first end of the rear valve body section 4 there is a liquid inlet 9, and at a second end of the rear body section 4 there is an exterior thread. The interior thread 6 of the front valve body section 1 is matably connected to the exterior thread 8 of the rear valve body section to form a threaded connection. In addition, the rear valve body section 4 defines a valve seat 7 at its second end. The spring 2 and the valve plug 3 are disposed inside the valve chamber 10. In the embodiment, a first end of the valve plug that contacts with the valve seat is hemispherical, and a second end of the valve plug is cylindrical.

[0052] Fourth Embodiment

[0053] As illustrated in Figures 6 and 7, a split micro-valve is provided, which includes a front valve body 1, a rear valve body 4, and a valve plug 3. The front valve body section 1 has a valve chamber 10. At a first end of the front valve body section 1 there is a liquid outlet 5, and at a second end of the front valve body section 1 there is an interior thread 6. At a first end of the rear valve body section 4 there is a liquid inlet 9, and at a second end of the rear body section 4 there is an exterior thread. The interior thread 6 of the front valve body section 1 is matably connected to the exterior thread 8 of the rear valve body section to form a threaded connection. In addition, the rear valve body section 4 defines a valve seat 7 at its second end..

[0054] In the embodiment, the valve plug is spherical, and no spring is disposed. Since the volume of the valve chamber is small, the spherical valve plug is sealingly seated on the valve seat under the pressure from the outlet side when the micro-valve is in use.

[0055] Fifth Embodiment

[0056] Application of a Micro-Valve of the Present Application

[0057] The interventional injection of chemotherapeutic drugs in the treatment of cancer requires multiple points of dispersive microinjection. For an asthma patient in an acute attack, an aerosol inhalation of high concentration drug is required at a time to relieve the patient's acute symptom. The dosage of aerosol is generally 15-30 μ l each time. When using a compound drug having various substances mixed in proportion, it's desired to have a precise output control over the minimum flow. In order to reach a minimum controllable output amount (volume), two key problems are needed to be solved: (1) decreasing the area of a working section; and (2) achieving a small displacement.

[0058] The micro-valve of the present application can be applied in flow control during inhalation of drug liquid from an atomizer. A minimum inner diameter of the valve chamber 10 can be as small as 0.4 mm, which reduces an area of a working section significantly. Moreover, under a same liquid pressure, the displacement of a valve plug can be adjusted by changing the length of the valve plug, compression amount of a spring, or stiffness of a spring, thereby satisfying the design requirement on precision.

[0059] As illustrated in Figures 8 and 9, an atomizer has an upper housing 11 and a lower housing 12. A liquid pool 13, a spring and a spring-positioning shell 14 are disposed inside the lower housing 12. In the embodiment, a rear valve body section 4 is integrally formed with an inlet tube, which extends into the liquid pool 13. A front valve body section 1 is threadedly coupled with the rear valve body section 4. The front valve body section 1 and rear valve body section 4 form a valve body, which is inserted into a flow channel. A distal end of the flow channel adjacent to an atomizing outlet 15 is disposed with a positioning hole, which prevents the valve body from escaping out of the flow channel. Furthermore, the atomizer further include a first sealing 16, a second sealing 17, a first fastener 18, and a second fastener 19 to sustain the stability of the valve body in a movement direction. A micro-channel is disposed between the positioning hole and the atomizing outlet, such that a high liquid pressure can be generated from an instant decrease of diameter of the channel when the liquid flows from the positioning hole having a diameter of 0.4 mm to the atomizing outlet having a diameter of 0.005 mm. The high liquid pressure pushes the valve plug 3 back against a liquid inlet of the rear valve body section 4, thereby preventing the liquid from flowing back and forcing the liquid flow toward the atomizing outlet. The valve body is connected to the liquid pool 13 via a connecting member 20, so as to achieve a synchronous movement.

[0060] First state: initially, the micro-valve is connected to the liquid pool 13 via the connecting member 20, and the micro-valve is below the atomizing outlet 15. A peripheral spring is pre-compressed, with its upper portion pressed against the connecting member 20 and its lower portion fixed by the spring-positioning shell 14.

[0061] Second state: at the beginning of the liquid dispensing operation, the connecting member 20 is forced to move down to compress the peripheral spring further, and the micro-valve and liquid pool move down along with the connecting member. The movement of the micro-valve away from the atomizing outlet causes the valve plug to float upward, such that liquid is infused into the flow channel.

[0062] Third state: at the end of the liquid dispensing operation, the force exerted on the connecting member is released, such that the compression force on the peripheral spring rapidly decreases to move itself back to a position at the first state. The connecting member rapidly moves upward with the liquid pool and the micro-valve. The liquid in the flow channel is pushed by the micro-valve, and the valve plug is pressed by the liquid against the valve seat 7 of the rear valve body section 4, thereby preventing liquid from flowing back. Consequently, liquid in the flow channel is dispensed out from the atomizing outlet.

Size of valve chamber (mm)	Size of valve plug (mm)	Size of tube chamber (mm)	Size of outlet (mm)	Dosage atomized each time (g)
Φ 1.6*2.0	Φ 1.5*1.5	Φ 1.8*10	0.005	0.45g
Φ 1.4*1.8	Φ 1.3*1.3	Φ 1.6*10	0.005	0.30g

[0063] Sixth Embodiment:

[0064] As illustrated in Figures 10-12, a split micro-valve includes a valve body and a valve plug 3. The valve body includes a first valve body section, i.e. a front valve body section 1, and a second valve body section, i.e. a rear valve body section 4. At a first end of the front valve body section 1 there is a liquid outlet 5, and at a second end of the front valve body section 1 there is an exterior thread 8. The rear valve body 4 has a valve chamber 10. At a first end of the rear valve body section 4 there is a liquid inlet 9, and at a second end of the rear valve body section 4 there is an interior thread 6. The exterior thread 8 of the front valve body section 1 is threadedly coupled to the interior thread 6 of the rear valve body section 4. In addition, a joint between the valve chamber of the rear valve body section and the liquid inlet 9 form a valve seat 7. The valve plug 3 is disposed inside the valve chamber

10 of the rear valve body section, and is matable with the valve seat 7 at the rear valve body section.

[0065] A spring 2 is disposed inside the valve chamber 10. A first end of the spring 2 is in contact with the valve plug 3, and a second end of the spring 2 is in contact with the end of the rear valve body 1 having the exterior thread.

[0066] In some embodiments, as illustrated in Figures 12, 13, and 14 respectively, the valve plug can be spherical or cylindrical. Alternatively, a first end of the valve plug that contacts with the valve seat can be hemispherical and a second end of the valve plug can be cylindrical.

[0067] While the present disclosure has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the present disclosure is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. Any reference signs in the claims should not be construed as limiting the scope. The scope and spirit of the present disclosure is defined by the appended claims.

WHAT IS CLAIMED IS:

1. A split micro-valve, comprising:
 - a valve body having a first valve body section and a second valve body section which are formed separately;
 - the first valve body section defining a valve chamber and having a first end and a second end opposite to the first end, the first valve body section comprising a liquid outlet at the first end; and
 - the second valve body section having a first end and a second end opposite to the first end, the second valve body section comprising a liquid inlet at the first end and defining a valve seat at the second end, and the second valve body section being threadedly coupled to the first valve body through their respective second ends;
 - wherein the split micro-valve further comprises:
 - a valve plug received within the valve chamber, the valve plug being movable between a first position pressed against the valve seat and a second position away from the valve seat, so as to permit or prohibit a liquid flow from the liquid inlet to the liquid outlet.
2. The split micro-valve according to claim 1, further comprising:
 - a spring disposed within the valve chamber for pressing the valve plug against the valve seat.
3. The split micro-valve according to claim 1, wherein the spring has a first end in contact with the valve plug and a second end in contact with a sidewall of the liquid outlet.
4. The split micro-valve according to claim 1, wherein the valve plug is spherically or cylindrically shaped.
5. The split micro-valve according to claim 1, wherein the valve plug has a first end that is hemispherically shaped and a second end that is cylindrically shaped.
6. The split micro-valve according to claim 1, wherein the first valve body section has an inner thread at its second end, and the second valve body section has at its second end an outer thread matable with the outer thread.

7. A split micro-valve, comprising:
a valve body having a first valve body section and a second valve body section which are formed separately;
the first valve body section having a first end and a second end opposite to the first end, the first valve body section comprising a liquid outlet at the first end; and
the second valve body section defining a valve chamber and having a first end and a second end opposite to the first end, the second valve body section comprising a liquid inlet at the first end, the valve chamber defining a valve seat towards the liquid inlet, and the second valve body section being threadedly coupled to the first valve body through their respective second ends;
wherein the split micro-valve further comprises:
a valve plug received within the valve chamber, the valve plug being movable between a first position pressed against the valve seat and a second position away from the valve seat, so as to permit or prohibit a liquid flow from the liquid inlet to the liquid outlet.
8. The split micro-valve according to claim 7, further comprising:
a spring disposed within the valve chamber for pressing the valve plug against the valve seat.
9. The split micro-valve according to claim 7, wherein the spring has a first end in contact with the valve plug and a second end in contact with the second end of the first valve body section.
10. The split micro-valve according to claim 7, wherein the valve plug is spherically or cylindrically shaped.
11. The split micro-valve according to claim 7, wherein the valve plug has a first end that is hemispherically shaped and a second end that is cylindrically shaped.

12. The split micro-valve according to claim 7, wherein the first valve body section has an outer thread at its second end, and the second valve body section has at its second end an inner thread matable with the outer thread.

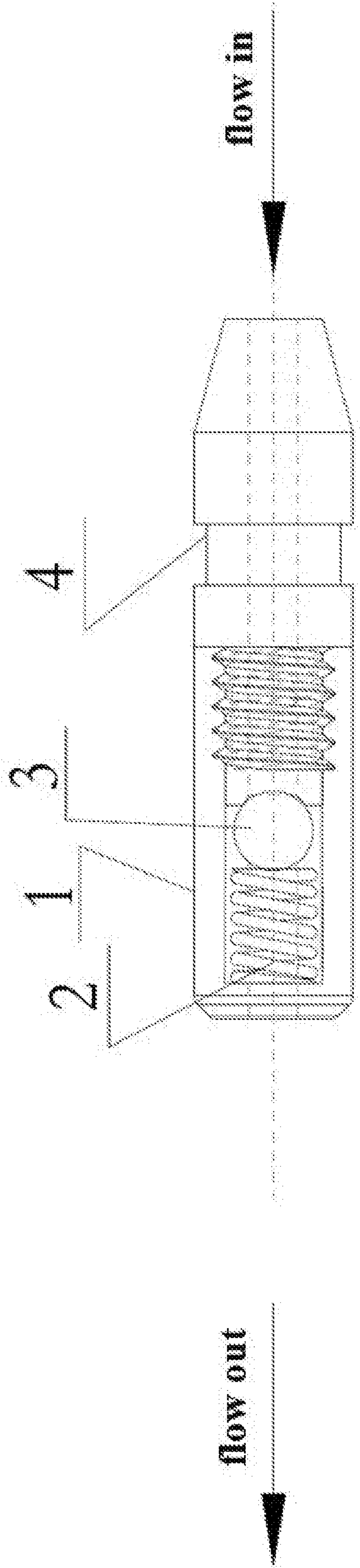


Fig. 1

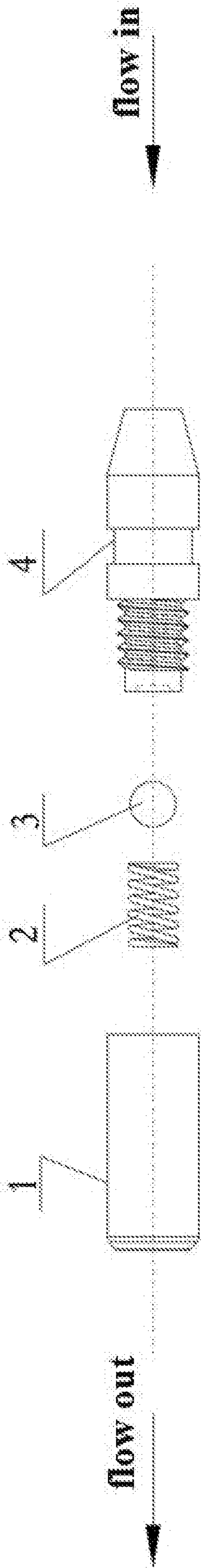


Fig. 2

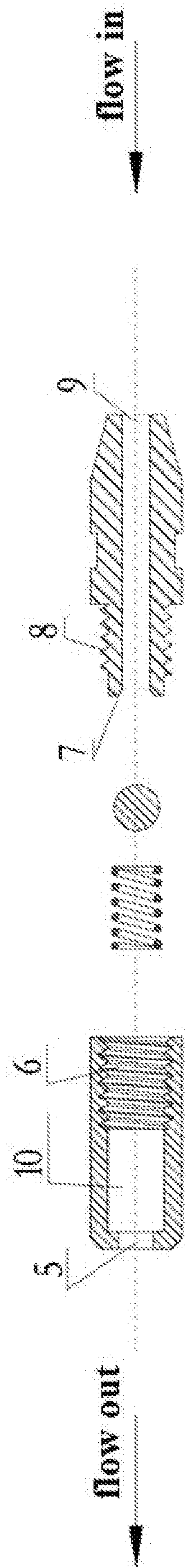


Fig. 3

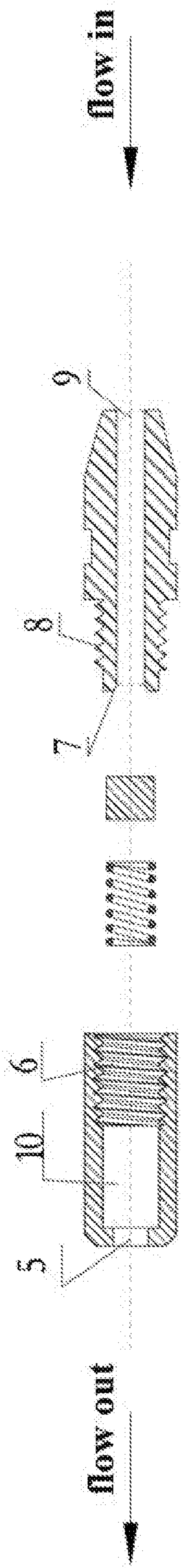


Fig. 4

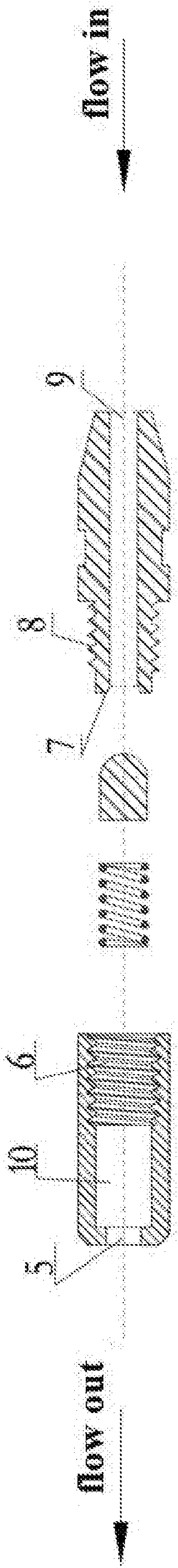


Fig. 5

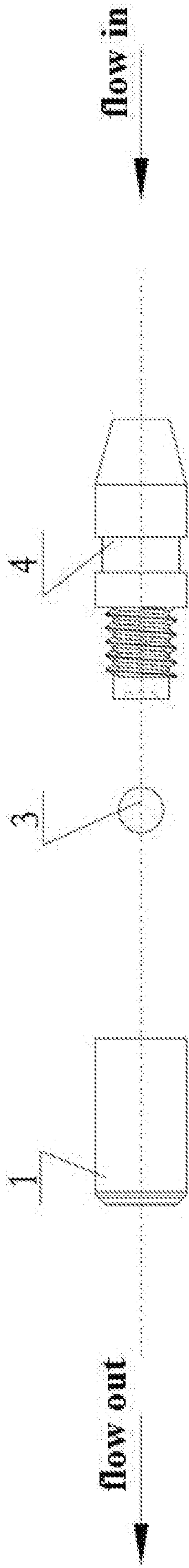


Fig. 6

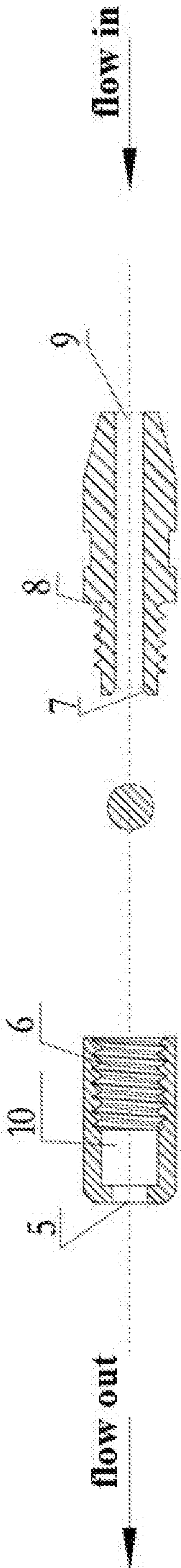
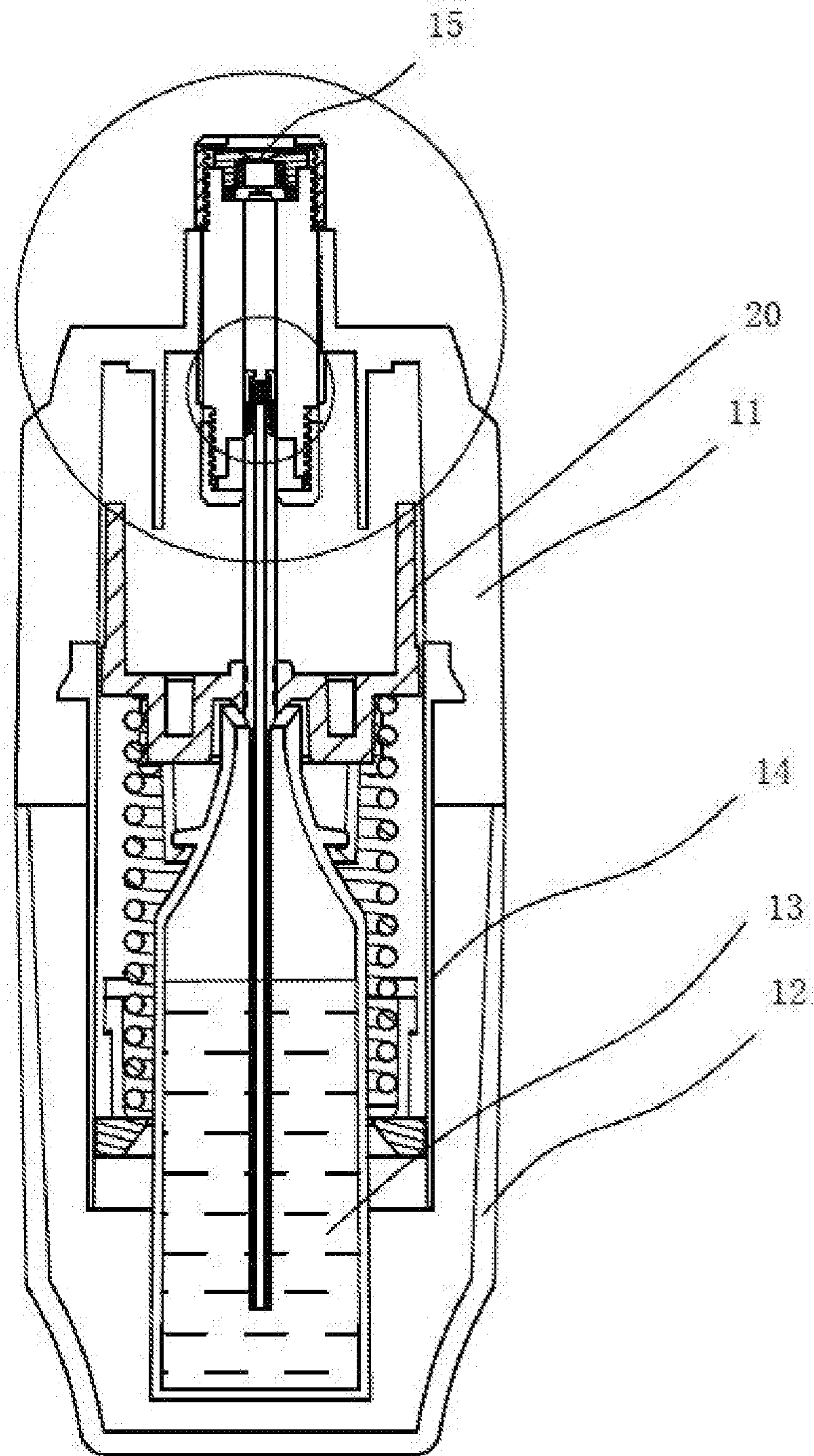


Fig. 7

**Fig. 8**

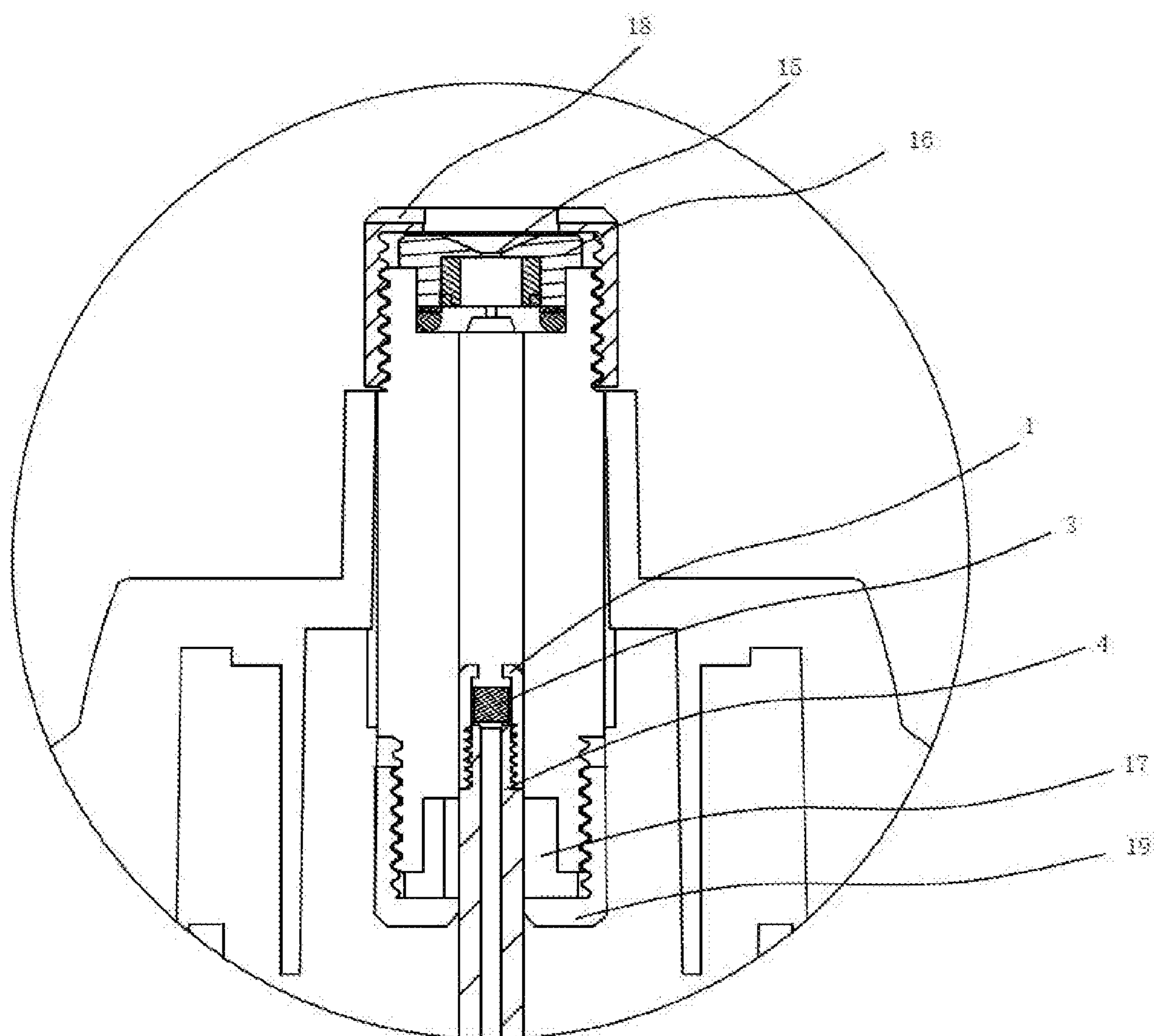


Fig. 9

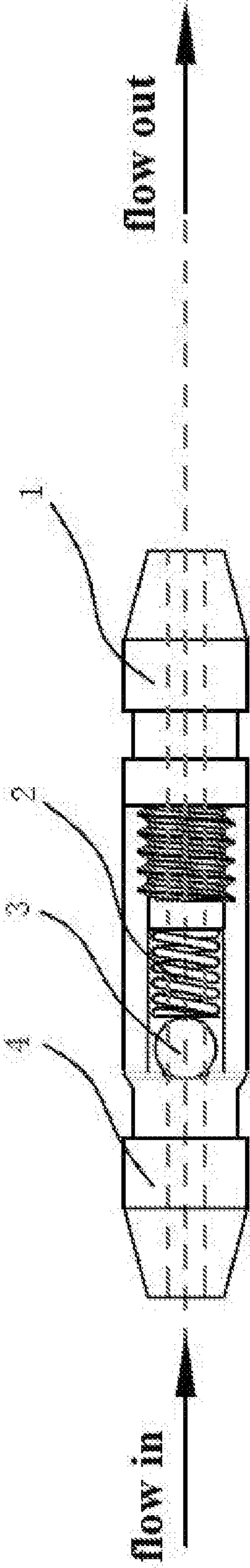


Fig. 10

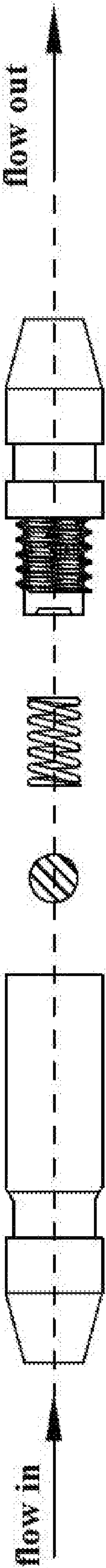


Fig. 11

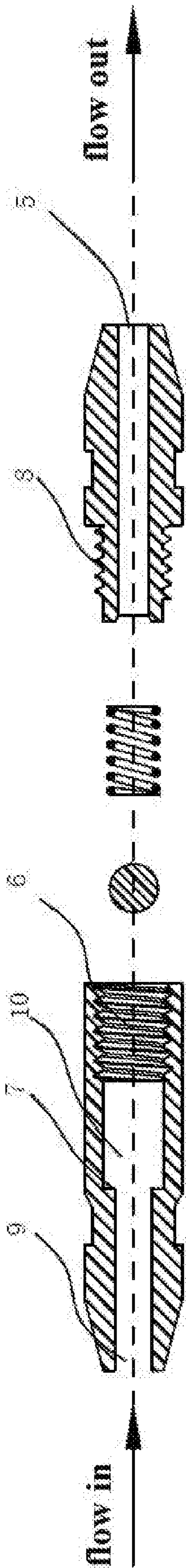


Fig. 12

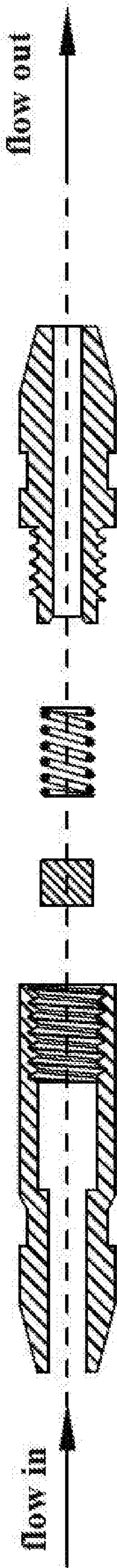


Fig. 13

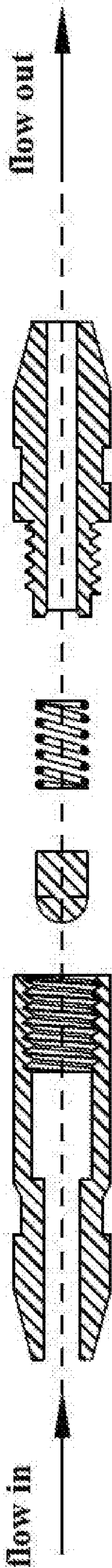


Fig. 14

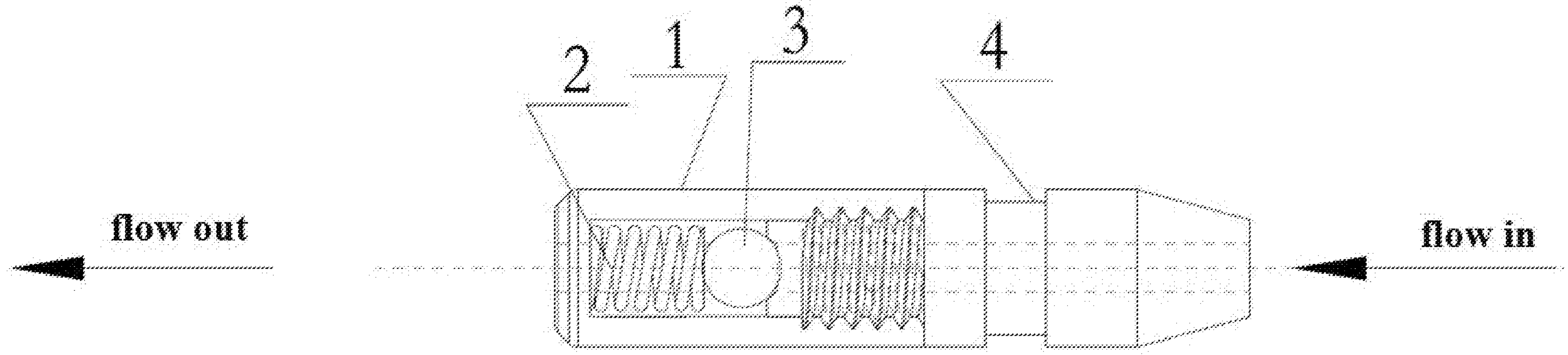


Fig. 1