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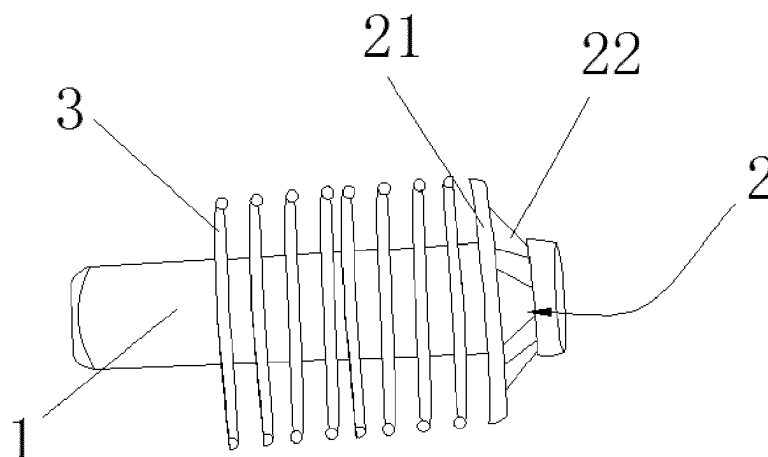
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(54) PLUNGER STRUCTURE AND PLUNGER PUMP

(57) The present disclosure provides a plunger structure and a plunger pump, relating to the technical field of plunger pumps. The plunger structure comprises a plunger body (1) with both ends closed, an engagement groove (11) disposed at the top of the plunger body (1), a plunger cap (2) fixedly connected to the engagement groove (11), and an elastic member having one end fixedly disposed within the plunger cap (2). The plunger body (1) is sleeved in the elastic member. A top end of the plunger body (1) is exposed out from the plunger cap (2), the engagement groove (11) which is depressed inwardly is formed in a circumferential direction of the top of the plunger body,

an inside of the plunger body (1) is in a cavity structure, and the plunger body (1) is an integrally molded part. The present disclosure alleviates the problem that a hollow plunger of the prior art which is made by welding is easily broken at a welded place during working and thereby cannot be used, and even causes damage to the plunger pump in a serious case, and the welding also increases the production processes of the hollow plunger. The present disclosure has the characteristics of simple production and processing procedures, high production efficiency and long service life.

**FIG. 1****EP 3 418 563 A1**

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Chinese Patent Application No. 201710470921.8, filed on June 20, 2017 with the State Intellectual Property Office (SIPO) of the People's Republic of China and entitled "Plunger Structure and Plunger Pump", the contents of which are herein incorporated by reference in their entirety.

Technical Field

[0002] The present disclosure relates to the technical field of plunger pumps, and in particular to a plunger structure (plunger piston structure) and a plunger pump (plunger piston pump).

Background Art

[0003] In industrial manufacturing and daily life, the cleaning and removal of impurities from a device or an article is generally performed by using a high-pressure water gun. Among them, in the high-pressure washer industry, a power component of the washer mostly employs a plunger pump. For the plunger pump, normal operation of a body is achieved by causing a change of the sealed volume depending on a reciprocating movement of a plunger in a cylinder bore. Thus, the plunger is an important part for the normal operation of the plunger pump. The performance of the plunger directly affects the working performance of the plunger pump.

[0004] Prior plungers mainly include solid plungers and open hollow plungers. The solid plunger requires many materials and has high production cost. Moreover, the solid structure causes a heavy overall weight, which results in greater friction between the plunger and the plunger pump during working, reducing the working efficiency of the plunger pump. The open hollow plunger is easily deformed during the production process, and under a working state, the plunger body is subjected to a high-temperature and humid environment so that the inner wall is prone to rust to damage the plunger body, thus the open hollow plunger has short service life, and therefore has the technical problems of low working efficiency and short service life.

Summary

[0005] Embodiments of the present disclosure provide a plunger structure and a plunger pump, to alleviate the technical problem that a hollow plunger of the prior art has low working efficiency and short service life.

[0006] A plunger structure provided in the present disclosure comprises: a plunger body with both ends closed, an engagement groove disposed at the top of the plunger body, a plunger cap fixedly connected with the engagement groove, and an elastic member having one end

fixedly disposed within the plunger cap, wherein the plunger body is sleeved in the elastic member, and the plunger body is an integrally molded part;

a top end of the plunger body is exposed out from the plunger cap, the engagement groove which is depressed inwardly is formed in a circumferential direction of the top of the plunger body, and an inside of the plunger body is in a cavity structure.

[0007] Further, the plunger cap comprises a skirt portion and a plurality of triangular claws which extend upwardly and are formed along a top edge of the skirt portion;

the plurality of triangular claws are circumferentially disposed at equal intervals around a centerline of the skirt portion, and the plurality of the triangular claws are all engaged with the engagement groove.

[0008] Further, the plurality of triangular claws all converge toward the centerline of the skirt portion, and an aperture size of an opening delimited (defined) by the plurality of triangular claws is equal to a diameter size of the engagement groove.

[0009] Further, the elastic member is a spring, and one end of the spring is engaged within the skirt portion.

[0010] Further, the plunger body is a part integrally molded by cold forging.

[0011] The beneficial effects of the present disclosure are as follows:

The plunger structure in the present disclosure comprises a plunger body with both ends closed and an engagement groove disposed at the top of the plunger body, wherein the engagement groove is formed by recessing inwardly in a circumferential direction of the top of the plunger body, and an inside of the plunger body is in a cavity structure. Since the inside of the plunger body is in a cavity structure, the weight of the plunger body is reduced, thereby reducing the inertia of the plunger structure during its operation within the plunger pump, increasing the rotational speed of the plunger pump, and increasing the self-priming property of the plunger pump, thereby improving the working efficiency of the plunger pump. Here, the plunger with an internal cavity structure also saves processing materials, thereby reducing the production cost of the plunger structure.

[0012] Moreover, according to the characteristics of sound transmission, when sound is transmitted from one medium to the next medium, if two adjacent media are made of different materials, there is a great difference in resonance frequency between the media, and then a loss of sound energy will be caused. When the plunger body is working, noise generated during the movement of the plunger body is transmitted from one side of the plunger body to air in the hollow inside, and then transmitted to the other side of the plunger body. During the process, the media adjacent to each other are different, thus the energy of sound is greatly lost, and the noise generated when the plunger structure works is reduced.

[0013] In addition, the plunger body is an integrally molded part, which prevents the plunger body from being

broken under a strong working state of the plunger structure, prolongs the service life of the plunger structure, and thereby also allows a plunger pump to work more stably, improving the working efficiency of the plunger pump, and enabling good practicability and functionality.

[0014] The present disclosure provides a plunger pump having the plunger structure described above.

[0015] Further, the plunger pump further comprises a pump body and a motor actuating movement of the pump body, the pump body is fixedly connected with an inlet pipe and an outlet pipe sequentially, and an overflow valve is disposed between the inlet pipe and the outlet pipe.

[0016] Further, the pump body is provided therein with a piston ring configured to be connected with the plunger body, the piston ring comprises a piston ring body, a plunger sleeve positioned inside the piston ring body, and a reinforcing rib positioned between an outer wall of the plunger sleeve and an inner wall of the piston ring body, and both the plunger sleeve and the piston ring body are fixedly connected with the reinforcing rib.

[0017] Further, a sealing gasket is disposed wherein the pump body is connected with the plunger sleeve.

[0018] Further, the plunger pump further comprises a controller, a buzzer for alarm, a switch provided with a solenoid valve, a current overload protector configured to detect a current, and a temperature sensor configured to detect a temperature of the pump body, wherein the buzzer, the switch, the overload protector, and the temperature sensor are all electrically connected with the controller.

[0019] The beneficial effects of the present disclosure are as follows:

The plunger pump has the same advantages as those of the plunger structure described above, which will not be described repeatedly here.

Brief Description of Drawings

[0020] For illustrating technical solutions of specific embodiments of the present disclosure or of the prior art more clearly, drawings required for use in the description of the specific embodiments or the prior art will be introduced briefly below. Obviously, the drawings below are merely illustrative of some embodiments of the present disclosure. It would be understood by those of ordinary skill in the art that other relevant drawings could also be obtained from these drawings without using inventive efforts.

FIG. 1 is a structural schematic view of a plunger structure according to embodiments of the present disclosure;

FIG. 2 is a structural schematic view showing connection between a plunger body and a plunger cap of the plunger structure in FIG. 1;

FIG. 3 is a sectional view of a plunger body of the plunger structure in FIG. 1;

FIG. 4 is a structural schematic view showing connection between a piston ring and a plunger structure positioned within a plunger pump according to embodiments of the present disclosure.

[0021] Reference numerals: 1- plunger body; 2- plunger cap; 3- spring; 4- piston ring; 11-engagement groove; 21- skirt portion; 22- triangular claw; 41- piston ring body; 42-plunger sleeve; 43- reinforcing rib.

Detailed Description of Embodiments

[0022] The technical solutions of the present disclosure will be described below clearly and completely with reference to the accompanying drawings. It is apparent that the embodiments to be described are some, but not all of the embodiments of the present disclosure. All the other embodiments obtained by those of ordinary skill in the art in light of the embodiments of the present disclosure without inventive efforts would fall within the scope of the present disclosure as claimed.

[0023] In the description of the present disclosure, it should be noted that orientation or positional relations indicated by the terms such as "center", "up", "down", "left", "right", "vertical", "horizontal", "inside", "outside", etc. are the orientation or positional relations shown based on the figures, and these terms are intended only to facilitate the description of the present disclosure and simplify the description, but not intended to indicate or imply that the referred devices or elements must be in a particular orientation or constructed or operated in the particular orientation, and therefore should not be construed as limiting the present disclosure. In addition, terms such as "first", "second", and "third" are used only for descriptive purpose, and should not be understood as indicating or implying to have importance in relativity.

[0024] In the description of the present disclosure, it should also be noted that unless otherwise expressly specified or defined, terms "mounted", "coupled", and "connected" should be understood broadly. For example, connection may be fixed connection or detachable connection or integral connection, may be mechanical connection or electric connection, or may be direct coupling or indirect coupling via an intermediate medium or internal communication between two elements. The specific meanings of the above-mentioned terms in the present disclosure could be understood by those of ordinary skill in the art according to specific situations.

Embodiment 1

[0025] As shown in FIG. 1, FIG. 2 and FIG. 3, the present embodiment provides a plunger structure comprising: a plunger body 1 with both ends closed, an engagement groove 11 disposed at the top of the plunger body 1, a plunger cap 2 fixedly connected with the engagement groove 11, and an elastic member having one end fixedly disposed within the plunger cap 2, wherein

the plunger body 1 is sleeved (sheathed) in the elastic member, and the plunger body 1 is an integrally molded part.

[0026] A top end of the plunger body 1 is exposed out from the plunger cap 2, the engagement groove 11 which is depressed inwardly is formed in a circumferential direction of the top of the plunger body 1, and an inside of the plunger body 1 is in a cavity structure.

[0027] The plunger structure in the present embodiment comprises a plunger body 1 with both ends closed and an engagement groove 11 disposed at the top of the plunger body 1. The engagement groove 11 which is depressed inwardly is formed in a circumferential direction of the top of the plunger body 1, and an inside of the plunger body 1 is in a cavity structure. Since the inside of the plunger body 1 is in a cavity structure, the weight of the plunger body 1 is reduced, thereby reducing the inertia of the plunger structure during its operation within the plunger pump, increasing the rotational speed of the plunger pump, and increasing the self-priming property of the plunger pump, thereby improving the working efficiency of the plunger pump. Here, the plunger with an internal cavity structure also saves processing materials, thereby reducing the production cost of the plunger structure.

[0028] Moreover, according to the characteristics of sound transmission, when sound is transmitted from one medium to the next medium, if two adjacent media are made of different materials, there is a great difference in resonance frequency between the media, and then a loss of sound energy will be caused. When the plunger body 1 is working, noise generated during the movement of the plunger body 1 is transmitted from one side of the plunger body 1 to air in the hollow inside, and then transmitted to the other side of the plunger body 1. During the process, the media adjacent to each other are different, thus the energy of sound is greatly lost, and the noise generated when the plunger structure works is reduced.

[0029] In addition, the plunger body 1 is an integrally molded part, which prevents the plunger body 1 from being broken under a strong working state of the plunger structure, prolongs the service life of the plunger structure, and thereby also allows a plunger pump to work more stably, improving the working efficiency of the plunger pump, and enabling good practicability and functionality.

[0030] In the present embodiment, the plunger body 1 is sleeved in the elastic member. When the plunger pump is working, the plunger body 1 moves downward. Since one end of the elastic member is fixedly disposed within the plunger cap 2, and the plunger cap 2 is fixedly connected with the engagement groove 11, the plunger body 1 drives the plunger cap 2 to move downward synchronously. During the movement, the plunger cap 2 compresses the elastic member so that the elastic member is deformed, and at the same time, the volume in the plunger pump is reduced during the downward movement of the plunger body 1, and a liquid such as water

or oil or the like is conveyed out under the action of pressure difference so as to achieve the purpose of conveying the liquid such as water or oil or the like. When the plunger body 1 moves to the farthest position, since the elastic member is deformed, the plunger body 1 returns to the initial position under the action of an elastic force generated after the deformation of the elastic member, that is, one reciprocating movement of the plunger body 1 is completed. Here, the plunger cap 2 and the plunger body 1 are fixedly connected together through the engagement groove 11. This structure is simple and is detachable conveniently, and a damaged plunger cap 2 or elastic member can be easily replaced. The elastic member is fixedly disposed within the plunger cap 2, the elastic member is compressed when the plunger body 1 drives the plunger cap 2 to move, and the plunger body 1 rebounds to the initial position under the elastic force generated after the deformation of the elastic member to complete the operation of the plunger pump. This is an ingenious design with a reasonable structure, and this further improves the functionality and practicality of the plunger structure.

[0031] As shown in FIG. 1 and FIG. 2, specifically, the plunger cap 2 comprises a skirt portion 21 and a plurality of triangular claws 22 which extend upwardly and are formed along a top edge of the skirt portion 21.

[0032] The plurality of triangular claws 22 are disposed circumferentially at equal intervals around a centerline of the skirt portion 21, and the plurality of triangular claws 22 are all engaged with the engagement groove 11.

[0033] In the present embodiment, the plunger cap 2 comprises a skirt portion 21 and a plurality of triangular claws 22 which extend upwardly and are formed along a top edge of the skirt portion 21. The plurality of triangular claws 22 can be engaged with the engagement groove 11, and the elastic member is fixedly disposed within the skirt portion 21. When the plunger body 1 drives the plunger cap 2 to move downward synchronously, the skirt portion 21 compresses the elastic member so that the elastic member is deformed, and at the same time, the elastic member gives the skirt portion 21 an upward acting force, thereby allowing tight abutment of the plurality of triangular claws 22 against the engagement groove 11, to ensure that the plunger cap 2 and the plunger body 1 are firmly connected together, and to prevent the plunger cap 2 from being disengaged from the engagement groove 11 during the movement of the plunger body 1, thereby further improving the functionality and practicality of the plunger body 1.

[0034] Continuing referring to FIG. 1 and FIG. 2, here in the present embodiment, the plurality of triangular claws 22 all converge toward the centerline of the skirt portion 21, and an aperture size of an opening delimited by the plurality of triangular claws 22 is equal to a diameter size of the engagement groove 11. Since the aperture size of the opening delimited by the plurality of triangular claws 22 is equal to the diameter size of the engagement groove 11, when the plurality of triangular

claws 22 are engaged with the engagement groove 11, the plurality of triangular claws 22 all have the tendency of expanding outwardly, that is, the plunger cap 2 is tightly fixed together with the engagement groove 11 under the action of a tension generated by the triangular claws 22, further improving the firmness of the connection between the plunger cap 2 and the plunger body 1 and preventing the plunger cap 2 from being disengaged from the plunger body 1 during the reciprocating movement of the plunger body 1.

[0035] Specifically, the elastic member is a spring 3, and one end of the spring 3 is engaged within the skirt portion 21. During the movement of the plunger body 1, the plunger cap 2 compresses the spring 3 so that the spring 3 is deformed, and at the same time, the plunger body 1 presses the cavity in the plunger pump so that the volume in the plunger pump is reduced, thereby achieving the purpose of conveying a medium. When the plunger body 1 moves to the farthest position, since the elastic member is deformed, the plunger body 1 returns to the initial position under the action of an elastic force generated after the deformation of the elastic member, that is, one reciprocating movement of the plunger body 1 is completed. In addition, the spring 3 is a mechanical part that works using elastic property, and has a characteristic that it deforms under the action of an external force and restores its original shape after the external force is removed. With such characteristic of the spring 3, the movement of the mechanism can be well controlled to realize the function of returning to an initial position of the mechanism.

[0036] Specifically, in the present embodiment, the plunger body 1 is a part integrally molded by cold forging. Cold forging molding can realize large-scale production and has the characteristics of short processing period, simple operation, and low manufacturing cost. Moreover, the cold forging molding enables one-step molding of a product during processing of the product, avoiding the deformation of the product caused by heat during the production process.

[0037] In the present embodiment, the plunger body 1 is processed by the following procedures. Firstly, a plunger blank is molded in one step by a cold forging process and an open hollow plunger blank is formed; after the hollow plunger blank is molded, an opening of the plunger blank is subjected to sealing treatment by performing high-frequency or intermediate-frequency localized heating and roller-extrusion sealing process (i.e. a process of high-frequency or intermediate-frequency localized heating, roller extruding and sealing) at one end of the plunger blank having the opening; and after the sealing treatment of the opening of the plunger body 1 is completed, an engagement groove 11 is processed at the top of the plunger blank by a turning process, so as to complete the processing and manufacture of the final molded plunger body 1.

Embodiment 2

[0038] The present embodiment provides a plunger pump which has the plunger structure described in the above Embodiment 1.

[0039] The plunger pump has the same advantages as those of the above plunger structure, which will not be described repeatedly here.

[0040] Specifically, the plunger pump further comprises a pump body and a motor actuating movement of the pump body. The pump body is fixedly connected with an inlet pipe and an outlet pipe sequentially, and an overflow valve is disposed between the inlet pipe and the outlet pipe.

[0041] In the present embodiment, when the plunger pump is working, the medium flows from the inlet pipe, through the pump body and then out of the outlet pipe. Here, an overflow valve is disposed between the inlet pipe and the outlet pipe. The overflow valve has a unidirectional flowing characteristic, thus a liquid such as water or oil or the like cannot be flow back from the outlet pipe into the pump body. This prevents damage to the pump body caused by the backflow of the liquid such as water or oil or the like, and at the same time, ensures the outflow of all the liquid such as water or oil or the like through the outlet pipe and improves the working efficiency of the pump body.

[0042] As shown in FIG. 4, here, the pump body is provided therein with a piston ring 4 for being connected to the plunger body 1. The piston ring 4 comprises a piston ring body 41, a plunger sleeve 42 positioned inside the piston ring body 41, and a reinforcing rib 43 positioned between an outer wall of the plunger sleeve 42 and an inner wall of the piston ring body 41. Both the plunger sleeve 42 and the piston ring body 41 are fixedly connected with the reinforcing rib 43.

[0043] In the present embodiment, when the plunger pump is working, the plunger body 1 can move downward along the plunger sleeve 42 and drive the plunger cap 2 to move downward synchronously. During the downward movement of the plunger body 1, the skirt portion 21 compresses the spring 3 so that the spring 3 is deformed, and the plunger sleeve 42 can ensure that the plunger body 1 does not deviate from the movement track, and at the same time can prevent swinging of the plunger body 1 during the movement, thereby improving the operation stability and working efficiency of the plunger pump. Here, the reinforcing rib 43 can improve the strength of the entire piston ring 4 and prolong the service life of the entire piston ring 4.

[0044] Here, in the present embodiment, the pump body and the plunger sleeve 42 are connected with each other at a position where a sealing gasket is disposed. The sealing gasket can ensure the airtightness at a position where the pump body is connected with the plunger sleeve 42, so as to ensure enough pressure inside the pump body during working of the plunger pump to prevent the situation that outflowing amount of the liquid such as

water or oil or the like at the outlet pipe is relatively small due to insufficient internal pressure during the working of the pump body, thereby further improving the working efficiency of the plunger pump.

[0045] In the present embodiment, the sealing gasket is a silicone gasket. The silicone gasket has good ductility, airtightness, and non-toxic and odorless characteristics, is low-carbon and environmentally friendly, has a very clean and sanitary surface, is cheap in price, and has a wide range of sources available in the market.

[0046] Specifically, the plunger pump further comprises a controller, a buzzer for alarm, a switch provided with a solenoid valve, a current overload protector for detecting the current, and a temperature sensor for detecting the temperature of the pump body. The buzzer, the switch, the overload protector, and the temperature sensor are all electrically connected with the controller.

[0047] In the present embodiment, when the plunger pump is working, the maximum current value that can be tolerated when the plunger pump works is set in the current overload protector. When the current in the circuit exceeds the set value in the current overload protector, the current overload protector sends a signal to the controller, and the controller receives the corresponding signal and then takes an action. The controller controls the solenoid valve to be closed so as to cut off a power switch of the plunger pump to prevent overburning of the pump body which may cause a fire accident in a serious case, thereby improving the safety of the plunger pump.

[0048] Moreover, the plunger pump further comprises a temperature sensor, wherein the highest temperature value at which the plunger pump works is set in the temperature sensor. When the temperature value of the pump body exceeds the set value of the temperature sensor, the temperature sensor sends a signal to the controller, and the controller receives the corresponding signal and then takes an action. The controller instructs the buzzer to give an alarm for warning and alerting to prevent damage to the pump body due to an excessive temperature so as to further improve the practicability and functionality of the plunger pump.

[0049] Finally, it should be noted that the above embodiments are only intended to illustrate, but not limit, the technical solutions of the present disclosure. Although the present disclosure has been described in detail with reference to the foregoing embodiments, it should be understood by those of ordinary skill in the art that it is still possible to modify the technical solutions described in the foregoing embodiments or equivalently replace some or all of the technical features; and these modifications or substitutions do not cause the essence of the corresponding technical solutions to depart from the scope of the technical solutions of the embodiments of the present disclosure.

Claims

1. A plunger structure, **characterized by** comprising a plunger body (1) with both ends closed, an engagement groove (11) provided at a top of the plunger body (1), a plunger cap (2) fixedly connected with the engagement groove (11), and an elastic member having one end fixedly provided within the plunger cap (2), wherein the plunger body (1) is sleeved in the elastic member, and the plunger body (1) is an integrally molded part; and a top end of the plunger body (1) is exposed out from the plunger cap (2), the engagement groove (11) which is depressed inwardly is formed in a circumferential direction of the top of the plunger body (1), and an inside of the plunger body (1) is in a cavity structure.
2. The plunger structure according to claim 1, **characterized in that** the plunger cap (2) comprises a skirt portion (21) and a plurality of triangular claws (22) which extend upwardly and are formed along a top edge of the skirt portion (21); the plurality of triangular claws (22) are circumferentially disposed at equal intervals around a centerline of the skirt portion (21), and the plurality of the triangular claws (22) are all engaged with the engagement groove (11).
3. The plunger structure according to claim 2, **characterized in that** the plurality of triangular claws (22) all converge toward the centerline of the skirt portion (21), and an aperture size of an opening delimited by the plurality of triangular claws (22) is equal to a diameter of the engagement groove (11).
4. The plunger structure according to claim 3, **characterized in that** the elastic member is a spring (3), and one end of the spring (3) is engaged within the skirt portion (21).
5. The plunger structure according to any one of claims 3 to 4, **characterized in that** the plunger body (1) is a part that is integrally molded by cold forging.
6. A plunger pump, **characterized by** comprising the plunger structure according to any one of claims 1 to 5.
7. The plunger pump according to claim 6, **characterized by** further comprising a pump body and a motor configured for actuating movement of the pump body, wherein the pump body is fixedly connected with an inlet pipe and an outlet pipe sequentially, and an overflow valve is disposed between the inlet pipe and the outlet pipe.
8. The plunger pump according to claim 7, **character-**

ized in that the pump body is provided with a piston ring (4) connected to the plunger body (1), the piston ring (4) comprises a piston ring body (41), a plunger sleeve (42) positioned inside the piston ring body (41), and a reinforcing rib (43) positioned between an outer wall of the plunger sleeve (42) and an inner wall of the piston ring body (41), and both the plunger sleeve (42) and the piston ring body (41) are fixedly connected with the reinforcing rib (43).

9. The plunger pump according to any one of claims 7 to 8, **characterized in that** the pump body and the plunger sleeve (42) are connected with each other at a position where a sealing gasket is provided.

10. The plunger pump according to claim 9, **characterized by** further comprising a controller, a buzzer for alarm, a switch provided with a solenoid valve, a current overload protector configured to detect a current, and a temperature sensor configured to detect a temperature of the pump body, wherein the buzzer, the switch, the overload protector, and the temperature sensor are all electrically connected with the controller.

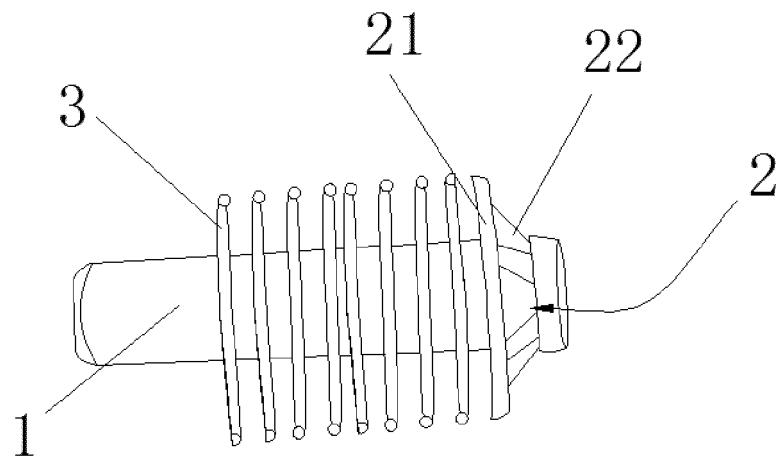


FIG. 1

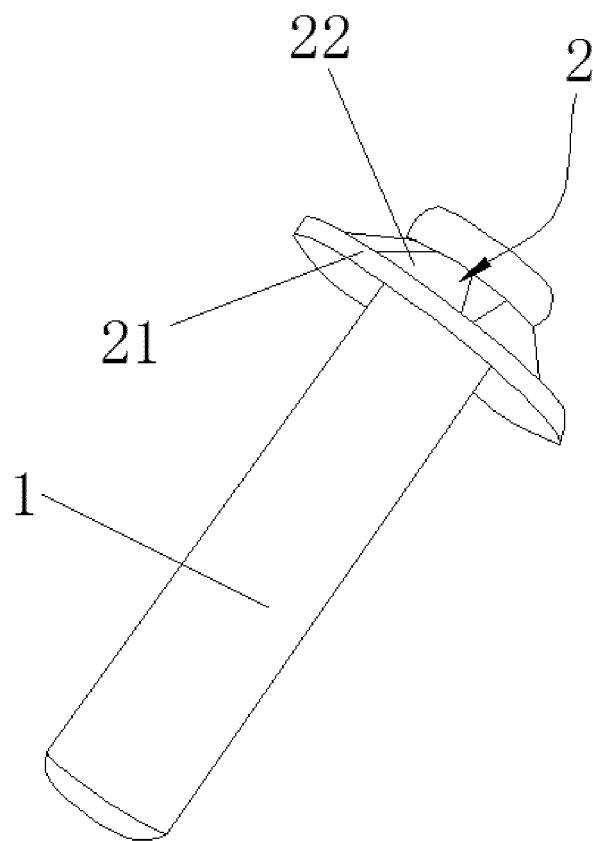


FIG. 2

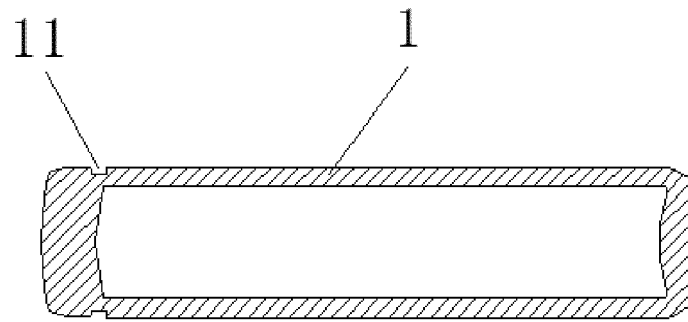


FIG. 3

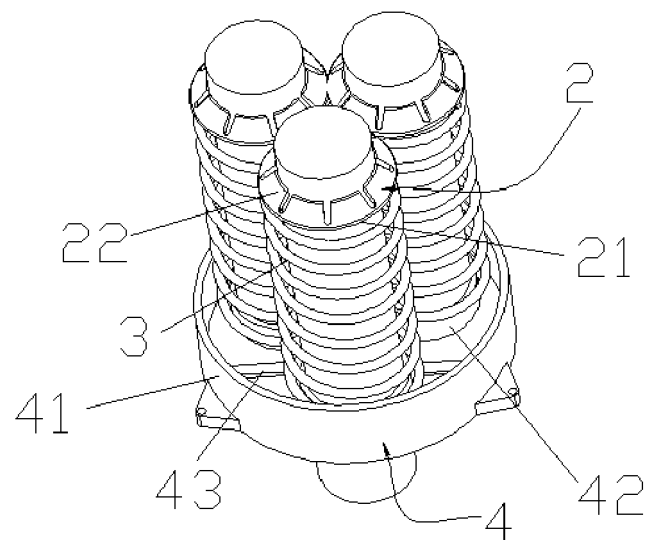


FIG. 4



EUROPEAN SEARCH REPORT

Application Number
EP 18 17 0349

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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