(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 July 2013 (04.07.20 13)

W I P O | P C T

(10) International Publication Number
WO 2013/097446 Al

(51) International Patent Classification:
F16K 7/17 (2006.01) *F16K 31/126* (2006.01)
F16K 31/06 (2006.01)

(21) International Application Number:
PCT/CN20 12/078496

(22) International Filing Date:
11 July 2012 (11.07.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
201 1110459087.5 31 December 201 1 (31 .12.201 1) CN

(71) Applicant *(for all designated States except US):* **DANFOSS (TIANJIN) LTD.** [CN/CN]; No. 5 Fuyuan Rd, Wuqing Development Zone, Tianjin 301700 (CN).

(72) Inventors; and

(75) Inventors/Applicants *(for US only):* **LIU, Cheng** [CN/CN]; Lin Xin Gong Yu, 2-5-702, Hebei District, Tianjin 300010 (CN). **QIAO, Jinhong** [CN/CN]; Shanghe Yasong, 8-2-1701, Wuqing District, Quanta Rd., Tianjin 301799 (CN). **JIANG, Weiwei** [CN/CN]; Ximing Yuan, 18-5-5, Xiqing District, Zhongbei Town, Tianjin 3001 12 (CN). **WANG, Changdong** [CN/CN]; No. 304 Room 17th Building, Uminli Village, Wuqing District, Tianjin 301799 (CN).

(74) Agent: **CHINA SCIENCE PATENT & TRADEMARK AGENT LTD.;** 25/F., Bldg. B, Tsinghua Tongfang Hi-Tech Plaza, No. l, Wangzhuang Rd., Haidian District, Beijing 100083 (CN).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

[Continued on nextpage]

(54) Title: SOLENOID VALVE

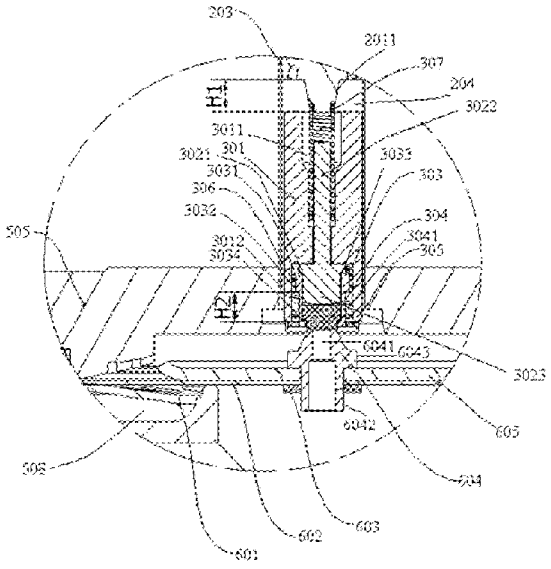

Fig. 2

(57) Abstract: Disclosed is a solenoid valve, the solenoid valve comprises a valve body assembly (500), provided with a valve port (504), a membrane assembly (600), a central portion of which seals the valve port (504), a peripheral portion of which at least partially covers an annular chamber (508) between the valve port (504) and the valve body assembly (500), the annular chamber (508) being communication with an inlet connection pipe (501) of the solenoid valve, and the membrane assembly (600) comprising a pilot valve port member (604), the solenoid valve further comprises a movable core assembly (300), including a movable core (301) and a closing plug (304) interconnected with each other, the movable core (301) pushes the closing plug (304), and the closing plug (304) is moved up with the upward movement of the movable core (301), so as to open the through hole (6041), a upward force of differential pressure will be generated on the membrane assembly (600), resulting in forcing the membrane assembly (600) to move up, thereby opening the valve port (504). The valve can reduce power of a coil and increase travel for opening the valve.

WO 2013/097446 A1

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

SOLENOID VALVE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of Chinese Patent Application No. 201110459087.5 filed on December 31, 2011 in the State Intellectual Property Office of China, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a field of valve control switch, more particularly, to a solenoid valve.

2. Description of the Related Art

In the prior art, an interior armature structure in most solenoid valves typically employs a conventional directly lifting valve arrangement. Specifically, a fixed core is fixed on an upper portion of a sleeve, while a movable core reciprocating up and down is placed on a lower portion of the sleeve. In addition, there is a return spring between the fixed core and the movable core, so that the movable core will drive a piston below it to close a valve port and thus keeps a certain gap from the fixed core. An operational principle of the conventional solenoid valve is as follows: attracting the movable core to move upwards by a magnetic field force generated by energizing a coil, and opening the valve port by overcoming a pressure drop force at the valve port, a force of the return spring and a gravity of the moveable core itself during the upward movement of the movable core. Therefore, such arrangement needs a relatively large power of coil, and has a short gap travel, thereby not facilitating to provide a solenoid valve of a low cost and a small power.

In view of the above, there is indeed a need for a solenoid valve, which can reduce power of a coil and/or can increase travel for opening the valve.

SUMMARY OF THE INVENTION

Bearing in mind of the above shortages in prior arts, an object of the present invention is to alleviate at least one aspect of the above problems and defects.

Accordingly, an object of the present invention is to provide a solenoid valve which can reduce power of a coil.

In addition, another object of the present invention is to provide a solenoid valve which can increase travel for opening the valve.

According to one aspect, there is provided a solenoid valve, comprises:
a valve body assembly provided with a valve port;
a membrane assembly, a central portion of which seals the valve port, a peripheral portion of which at least partially covers an annular chamber between the valve port and the valve body assembly, the annular chamber being in communication with an inlet connection pipe of the solenoid valve, and further comprising a pilot valve port member;
a movable core assembly, including a movable core and a closing plug interconnected with each other; the movable core pushes the closing plug to seal a through hole in the pilot valve port member;
wherein, the closing plug is driven by the movable core to move up, so as to open the through hole; since a flow of fluid flowing from an upper chamber above the membrane assembly into a body outlet chamber below the membrane assembly through the through hole via the valve port, is larger than a flow flowing into the upper chamber from the inlet connection pipe of the solenoid valve, a upward force of differential pressure will be generated on the membrane assembly, resulting in forcing the membrane assembly to move up, thereby opening the valve port.

Preferably, the body assembly includes a valve body, a valve cover fixedly connected to the valve body, the inlet connection pipe and an outlet connection

pipe; wherein the annular valve port is formed by a central step at a central of the valve body; the valve body outlet chamber is in communication with the outlet connection pipe, while a chamber formed between the periphery of the valve port and the valve cover is in communication with the inlet connection pipe.

Preferably, the membrane assembly is disposed on the central step, and covers the annular chamber formed between the central step below it and the valve body.

Preferably, the membrane assembly comprises an air distribution disc arranged in the annular chamber; a membrane placed on the air distribution disc; a gasket, a pilot valve port member, and a tray, wherein an edge of the upper surface of the membrane is at least partially covered by a lower step of the valve cover, while the lower surface of the membrane seals the valve port.

Preferably, an upper part of the pilot valve port member is a conical step, while a lower part thereof is a two-stage cylindrical step; the through hole which is used to communicate the upper chamber above the membrane assembly and a lower chamber below the membrane assembly, is disposed within the pilot valve port member, and a diameter of an upper part of the through hole is less than that of a lower part thereof.

Preferably, the lower cylindrical step of the pilot valve port member in sequence passes through a central hole of the tray, a central hole of the membrane and a central hole of a gasket of a circular metal pressing piece; and they are then fixed together by outwardly turning over an edge at the lower part of pilot valve port member.

Preferably, the membrane and the air distribution disc are respectively disposed with a plurality of via holes at their edges to be communicated with each other, an outer edge of the tray is curled upwardly, fluid flows into the upper chamber above

the membrane assembly in turn through the via holes and gaps between the edges of the membrane and the air distribution disc and an inside edge of the valve body.

Preferably, when the valve port is opened, since the upper chamber above the membrane assembly is in a low pressure and the annular chamber below the membrane assembly is in a high pressure due to being communicated with the inlet connection pipe, there is an upward force of differential pressure between the upper chamber and the annular chamber, so that the pilot valve port member is moved up, and the membrane and the tray are driven to move up by the gasket fixed on the pilot valve port member, and then the middle of the membrane is risen up until it abuts against the lower surface of the valve cover in the body assembly; and at this time the valve port between the inlet connection pipe and the outlet connection pipe is completely open.

Preferably, the solenoid valve further comprising

a sleeve assembly fixedly connected to the body assembly;

a movable core assembly disposed in the chamber of the sleeve assembly and being able to move up and down in the chamber; and

a coil disposed outside of the sleeve assembly, for generating magnetic force to attract the movable core in the movable core assembly to move up when being energized.

Preferably, the movable core assembly comprises the movable core, a closing plug, a guide sleeve, a position-limit pin, and an return spring; wherein the movable core is in a cylindrical shape, the upper part of which is provided with a conducting hole; and at least a part of the position-limit pin is placed within the conducting hole, and can move along the conducting hole of the movable core.

Preferably, the closing plug is a cylinder of polyfluortetraethylene with a protrusion, and disposed within the guiding sleeve with the protrusion facing a lower side; and

the guiding sleeve with the closing plug is provided in a pilot hole at a lower part of the movable core.

Preferably, a first step face is disposed at the upper portion of the outer surface of the guiding sleeve, and a compression spring is disposed between the first step face and a blocking sheet at the bottom end of the movable core.

Preferably, a second step face is located at a middle of the outer surface of the guiding sleeve, while the first step face has a larger outer diameter than the second step face; when the movable core is moved up until the blocking sheet makes a contact with the second step face, the closing plug is driven and leaves the pilot valve port member; and then the compression spring can push the closing plug to move up, so as to further move away from the pilot valve port member.

Preferably, the blocking sheet is an annular metal gasket, and provided at an inner side of the bottom of the pilot hole of the movable core; the blocking sheet and the movable core are riveted together by inwardly turning over an edge of the lower part of the movable core; and the blocking sheet is shaped to have a length so that when moving up the movable core, the blocking sheet first makes a contact with the second step face.

Preferably, a bottom step is inwardly protruded and located at the bottom of the guiding sleeve, such that the bottom step cooperates with the protrusion of the closing plug so as to support the closing plug.

Preferably, the upper portion of the position-limit pin is a stem portion while the lower portion thereof is a cylindrical portion; and the position limit pin is provided with a cylindrical step between the cylindrical portion and the stem portion, outwardly protruding from the cylindrical portion.

Preferably, the guiding sleeve further comprises an inner step face on the upper portion thereof, which is cooperated with the cylindrical step of the position limit pin, so that with aid of downward movement of the movable core, the position limit pin and the guiding sleeve together can be pushed to move toward the pilot valve port member, and then they push the closing plug for moving downwardly to seal the through hole of the pilot valve port.

Preferably, the cylindrical portion of the position limit pin is clearance-fitted in the pilot hole and the stem portion of the position limit pin is clearance-fitted in the guiding sleeve, so that when the movable core is moved upwardly toward the fixed core, the position limit pin can be driven by the movable core and the guiding sleeve to move toward the fixed core; and in a case of the movable core being moved and abutted against the fixed core, when the cylindrical step of the position limit pin is moved in the pilot hole and abutted against the movable core, the position limit pin is not any more moved toward the fixed core.

Preferably, when needing to close the valve port, the movable core will push the position limit pin to move down under the effect of its own gravity and the force released by the return spring, and then the position limit pin will push the guiding sleeve and the closing plug to move toward the pilot valve port member, until the closing plug seals the through hole; meanwhile, fluid in the upper chamber above the membrane assembly will stop flowing through the through hole toward the outlet connection pipe of the valve body; the pressure drop between the upper chamber above the membrane assembly and the annular chamber below the membrane assembly will gradually reach to a state in which the pressure of the upper chamber will equal to the pressure of the annular chamber, as the fluid in the annular chamber all flows through edges and/or via holes of the membrane assembly into the upper chamber; the risen middle portion of the membrane will be moved down to seal the valve port when being subjected to the push force of the movable core via the pilot valve port member and the tray.

Preferably, the sleeve assembly comprises a fixed core, a divided magnetic ring and a sleeve, the fixed core is provided with an annular groove at the lower part thereof, the divided magnetic ring is fixed within the annular groove by riveting; the lower part of the fixed core is inserted into the upper part of the sleeve, and the upper end face or the inner periphery of the sleeve can be welded to and fixed with the outer periphery of the lower part of the fixed core.

Preferably, the lower end of the fixed core is disposed with a lug boss, which can be fitted into a conducting hole at an upper part of the movable core, so that an area of magnetic flux can be increased when the movable core and the fixed core are attracted to each other, upon energizing the coil; thereby increasing an attractive force between the moving and fixed cores.

Preferably, the valve cover is in a rectangular shape, and a middle of the rectangular cover is provided with an opening into which the lower end of the sleeve assembly can be inserted, and they are fixed together by welding.

Preferably, the valve body and the valve cover can be fixed by fitting of bolts and threaded holes; and the valve cover and the sleeve assembly are fixed by a silver soldering.

Preferably, the solenoid valve further comprising a seal ring, disposed between an inside step in the upper part of the body and an outside step at the lower part of the valve cover so as to make a seal therebtween.

BRIEF DESCRIPTION OF THE DRAWINGS

Those and/or other aspect and advantages of the present invention can be apparent and readily understood from the following description of the preferred embodiment, in combination with the accompanying drawings, wherein:

Fig.1 schematically shows a sectional view of a solenoid valve in accordance with an embodiment of the present invention;

Fig.2 is a schematic enlarged view of the part indicated by a circle B as shown in Fig.1 ; and

Fig. 3 is a schematic structural view of an air distribution disk as shown in Fig. 2.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The technical solution of the present invention will be further explained in detail, by the following embodiments, with reference to Figs. 1-3. Throughout the specification, the same or similar reference numerals will indicate the same or similar components. The explanation to the implementing of the present invention with reference to the accompanying drawing is intended to interpret the general inventive concept of the present invention, instead of limiting the present invention.

A solenoid valve in accordance with the present invention is now explained with referring to the accompanying drawings.

As shown in Figs. 1 and 2, in one embodiment, there is provided a solenoid valve, comprising:

a valve body assembly 500 provided with a valve port 504; and a membrane assembly 600, a central portion of which seals the valve port 504, a peripheral portion of which at least partially covers an annular chamber 508 disposed between the valve port 504 and the valve body assembly 500, the annular chamber 508 being communication with an inlet connection pipe 501 of the solenoid valve, and further comprising a pilot valve port member 604.

Moreover, the solenoid valve further comprises a movable core assembly 300, which includes a movable core 301 and a closing plug 304 interconnected with each other. The movable core 301 pushes the closing plug 304 to seal a through hole 6041 in the pilot valve port member 604; and the closing plug 304 is driven by

the movable core 301 , to moved up so as to open the through hole 6041 . Since a flow of fluid flowing from an upper membrane chamber 507 into a body outlet chamber 509 below the membrane assembly 600 through the through hole 6041 via the valve port 504, is larger than a flow flowing into the upper membrane chamber 507 from the inlet connection pipe 501 of the solenoid valve, a upward force of differential pressure will be generated on the membrane assembly 600. This upward force will force the membrane assembly 600 to move up, thereby opening the valve port 504. It should be understood that the annular chamber 508 can be shaped to have a certain inclination angle or curvature at a bottom and/or two sides thereof.

Please see Fig.2, the main parts of the solenoid valve, for example, a coil 100, a sleeve assembly 200, a movable core assembly 300, a body assembly 500, a membrane assembly 600 and a seal ring 700 and so on, will be described in detail below. The sleeve assembly 200 is fixedly connected to the body assembly 500. The coil 100 is disposed outside of the sleeve assembly 200. When being energized, the coil 100 can generate a magnetic force so as to attract the movable core 301 of the movable core assembly 300 to move up. Typically, the movable core assembly 300 is disposed within a chamber of the sleeve assembly 200 so that it can move up and down in the chamber. Specifically, the movable core 301 of the movable core assembly 300 is moved up and down within the chamber of the sleeve assembly 200.

The sleeve assembly 200 includes a fixed core 201 , a divided magnetic ring 202 and a sleeve 203. The fixed core 201 is provided with an annular groove at the lower part thereof. The divided magnetic ring 202 is fixed within the annular groove by riveting. It can be seen from Fig. 1 that the annular groove is located at or near a bottom of the fixed core 201 . Further, an outer periphery of the lower part of the fixed core 201 is inserted into an inner periphery of the upper part of the sleeve 203 by a certain distance, so that the upper end face or the inner periphery of the sleeve 203 can be welded to and fixed with the outer periphery of the lower part of

the fixed core 201 .

Preferably, the lower end of the fixed core 201 may be disposed with a lug boss 2011 . The lug boss 2011 can be fitted into a conducting hole 3011 at an upper part of the movable core 301 , so that an area of magnetic flux can be increased when the movable core 301 and the fixed core 201 are attracted to each other, upon energizing the coil 100; thereby increasing an attractive force between the moving and fixed cores 301 and 201 . In other words, when the movable core 301 and the fixed core 201 are cooperating with each other, the attractive force therebetween can be increased by means of partial insert fitting. Specifically, as shown in Figs. 1 and 2, when the movable core 301 and the fixed core 201 are not attracted relative to each other, there is a distance H1 or a gap 204 between them. When the movable core 301 is completely attracted to the fixed core 201 , the distance H1 between them becomes zero or there is no gap 204 between them.

The movable core assembly 300 includes the movable core 301 , a position-limit pin 302, a guide sleeve 303, a closing plug 304, a blocking sheet 305, a compression spring 306 and a return spring 307, which are cooperated with each other. The movable core 301 is in a cylindrical shape, the upper part of which is provided with a conducting hole 3011 . At least a part of the position-limit pin 302 (i.e., the upper portion thereof as shown in Fig.2) is placed within the conducting hole 3011 , and can freely move up and down along the conducting hole 3011 of the movable core 301 . That is, in the present embodiment, the upper part of the position-limit pin 302 is fitted into a central chamber of the movable core 301 , and the top thereof is protruded into the conducting hole 3011 from the central chamber.

The closing plug 304 is a cylinder of polyfluortetraethylene with a protrusion 3041 , and disposed within the guiding sleeve 303 of the movable core 301 with the protrusion 3041 facing the lower side. The protrusion 3041 of the closing plug 304 is insert fit or clearance fit with a bottom step 3034 of the guiding sleeve 303. Specifically, the protrusion 3041 is clasped or hooked by the bottom step 3034 to

support the closing plug 304. The guiding sleeve 303 with the closing plug 304 can be placed within a pilot hole 3012 at the lower part of the movable core 301 .

As describe above, the bottom step 3034 is preferably inwardly protruded and located at the bottom of the guiding sleeve 303, such that the bottom step 3034 can cooperate with the protrusion 3041 of the closing plug so as to support the closing plug 304.

A first step face 3031 is disposed at the upper portion of the outer surface of the guiding sleeve 303, and the compression spring 306 is disposed between the first step face 3031 and the blocking sheet 305 at the bottom end of the movable core 301 . When being subjected to the magnetic force, the movable core 301 can move toward the fixed core 201 against the gravity thereof, and the spring forces of the compression spring 306 and the return spring 307. In one embodiment, the blocking sheet 305 is disposed so that it can inwardly protrude a certain length from the inner surface of the movable core 301 . Thus, after moving up a distance, the blocking sheet 305 can first make a contact with a second step face 3032 as described later.

In particular, the second step face 3032 is located at a middle of the outer surface of the guiding sleeve 303, while the first step face 3031 has a larger outer diameter than the second step face 3032. When the movable core 301 is moved up until the blocking sheet 305 makes a contact with the second step face 3032, the closing plug 304 will be driven and leave the pilot valve port member 604 (since the closing plug is hooked by the bottom step 3034 of the guiding sleeve 303); and then the compression spring 306 can push the closing plug 304 to move up, so as to further move away from the pilot valve port member 604. The upper portion of the position-limit pin 302 is a stem portion 3022 while the lower portion thereof is a cylindrical portion 3023. In addition, the position limit pin 302 is provided with a cylindrical step 3021 between the cylindrical portion 3023 and the stem portion 3022, outwardly protruding from the cylindrical portion 3023. It can be apparent from Fig. 2 that the

cylindrical step 3021 is protruded from the middle of the position-limit pin 302, or the outer diameter of the cylindrical step 3021 is larger than those of the upper portion and the lower portion of the position limit pin 302. In other words, the cylindrical step 3021 is disposed as the most outward protrusion of the position limit pin 302.

In the present invention, when the movable core 301 is moving up toward the fixed core 201, with the aid of driving action of the movable core 301 and the guiding sleeve 303, the position limit pin 302 can be moved toward the fixed core 201. Meanwhile, in a case of the movable core 301 being moved until it is abutted against the fixed core 201, and the cylindrical step 3021 of the position limit pin 302 being moved in the pilot hole 3012 until it is abutted against the movable core 301 (or the bottom of the pilot hole 3012 in the movable core 301), the position limit pin 302 will not move toward the fixed core 201 any more.

In this embodiment, the pilot hole 3012 is larger than the conducting hole 3011. The cylindrical portion 3023 of the position limit pin 302 is clearance-fitted into the pilot hole 3012 and the stem portion 3022 of the position limit pin 302 is clearance-fitted into the conducting hole 3011. Thus, in this case, when the movable core 301 is moved toward the fixed core 201, the position limit pin 302 can move toward the fixed core 201. Therefore, the person skilled in the art can understand that the specific form of the position limit pin 302 is not limited to those as described above, and other forms can be employed as long as having the same function as in the present invention. In the present embodiment, the upper part of the position limit pin 302 is a cylindrical stem portion 3023, and of course the shape of the stem portion can also be a square or rectangular shape. The lower part of the position limit portion 302 is a cylindrical body portion, and of course the shape thereof can be a square or rectangular shape.

The guiding sleeve 303 further includes an inner step face 3033 on the upper portion thereof, which is cooperated with the cylindrical step 3021 of the position

limit pin 302, so that with affect of downward movement of the movable core 301, the position limit pin 302 and the guiding sleeve 303 together can be pushed to move toward the pilot valve port member 604, and then they can push the closing plug 304 for moving downwardly to seal the through hole 6041.

The return spring 307 is disposed at the upper part of the movable core 301, and in particular in the conducting hole 3011 of the movable core 301. As shown in Fig.2, in one embodiment of the present invention, one end of the return spring 307 is fixedly connected to the top of the lug boss 2011 of the fixed core 201, while the other end of the return spring 307 is connected to the bottom of the lower step hole of the conducting hole 3011 and disposed around the stem portion in the upper part of the position limit pin 302, so that when energizing the coil 100 and generating the magnetic force, the lug boss 2011 can be fitted into the upper step hole of the conducting hole 3011, to compress the return spring 307. As such, when the lug boss 2011 loses the magnetic force due to de-energizing the coil 100, the return spring 307 can push the movable core 301 to move down or toward the valve port 504 by the spring force released by it.

The blocking sheet 305 is an annular metal gasket, and provided at an inner side of the lower part of the pilot hole 3012 of the movable core 301. The blocking sheet 305 and the movable core 301 can be riveted together by inwardly turning over an edge of the lower part of the movable core 301. As previously described, the blocking sheet 305 can be shaped to have a length so that when moving up the movable core 301, the blocking sheet 305 will first make a contact with the second step face 3032.

As described above, when the valve port 504 is opened, since at this time the upper chamber 507 above the membrane assembly 600 is in a low pressure, while the annular chamber 508 below the membrane assembly 600 is in a high pressure due to communication to the inlet connection pipe 501, there is a force of differential pressure between the upper chamber 507 and the annular chamber 508,

which enables the pilot valve port member 604 to move up, and then a membrane 602 and a tray 605 are driven by a gasket 603 to move up together, so that the middle of the membrane 602 will rise up until it abuts against the lower surface of a valve cover 505 in the body assembly 500. Meanwhile, the valve port 504 between the inlet connection pipe 501 and the outlet connection pipe 503 is completely open.

When needing to close the valve port 504, the movable core 302 will push the position limit pin 302 to move down under the effect of its own gravity and the force released by the return spring 307, and then the position limit pin 302 will push the guiding sleeve 303 and the closing plug 304 to move toward the pilot valve port member 604, until the closing plug 304 seals the through hole 6041 . Meanwhile, fluid in the upper chamber 507 above the membrane assembly 600 will stop flowing through the through hole 6041 toward the outlet connection pipe 503 of the valve body 502. The pressure drop between the upper chamber 507 above the membrane assembly 600 and the annular chamber 508 below the membrane assembly 600 will gradually reach to a state in which the pressure of the upper chamber 507 will equal to the pressure of the annular chamber 508, as the fluid in the annular chamber 508 all flows through edges and via holes of the membrane assembly 600 into the upper chamber 507. The risen middle portion of the membrane 602 will be moved down to seal the valve port 504 when being subjected to the push force of the movable core 301 via the pilot valve port member 604 and the tray 605.

As shown in Fig. 2, the body assembly 500 includes the inlet connection pipe 501 , the outlet connection pipe 503, the valve body 502 and the valve cover 505. The valve cover 505 is fixedly connected to the valve body 502. Four threaded holes (not shown) are disposed within the upper periphery of the valve body 502. The annular valve port 504 is formed by a central step 506 at the central of the valve body 502. The outlet chamber 509 of the valve body is in communication with the outlet connection pipe 503, while a chamber 507 formed between the periphery of the valve port 504 and the valve cover 505 is in communication with the inlet

connection pipe 501 .

Specifically, the valve cover 505 is in a rectangular shape, and four corners of the cover are respectively disposed with a hole. Thus, the valve body 502 and the valve cover 505 can be fixed by fitting of the four bolts and threaded holes. A central of the rectangular cover 505 is provided with an opening into which the lower end of the sleeve assembly 200 can be inserted by a certain length. In one embodiment, the sleeve assembly 200 can be fixed with the valve cover 505 by welding, preferably, a silver soldering.

The sealing ring 700 is in a circle shape, and preferably made of a rubber material. The sealing ring 700 is clamped between an inside step 5021 in the upper part of the body 502 and an outside step 5051 at the lower part of the valve cover 505, so as to ensure a sealing property between the valve body 502 and the valve cover 505.

As shown in Fig. 2, the membrane assembly 600 is located on the central step 506 of the valve body assembly 500, so that it completely or partially covers the annular chamber 508 formed between the central step 506 and the valve body 502. In other words, the membrane assembly 600 is placed at the central step 506, so that it can cover the annular chamber 508 formed between the central step 506 below the membrane assembly and the valve body 502.

The membrane assembly 600 includes an air distribution disc 601 , a membrane 602, a gasket 603, a pilot valve port member 604 and a tray 605. The air distribution disc 601 is arranged in the annular chamber 508 formed between the central step 506 of the body 502 and the valve body 502. The membrane 602 is placed on the air distribution disc 601 and an edge of the upper surface of the membrane 602 is at least partially covered by the lower step 5051 of the valve cover 505 in the valve body assembly 500, while the lower surface of the membrane 602 seals the valve port 504. It can be known from the above that the edge of the upper surface of the membrane 602 is typically covered by the lower

step 5051 with a gap therebetween, so that the fluid can flow into the upper chamber 507 above the membrane 602 from the inlet connection pipe 501 .

An upper part of the pilot valve port member 604 is a conical step, while the lower part thereof is a two-stage cylindrical step. The two-stage cylindrical step includes an upper cylindrical step 6043 and a lower cylindrical step 6042 being interconnected with each other. The pilot valve port through hole 6041 which is used to communicate the upper chamber 507 above the membrane 602 and the body outlet chamber 509 below the membrane 602, is disposed within the pilot valve port member 604. Specifically, in one embodiment, the diameter of the upper part of the through hole 6041 is less than that of the lower part thereof. It should be understood that disposing the diameter of the upper part of through hole 6041 to be smaller, and that of the lower part thereof to be larger, and arranging the upper part of the pilot valve port member 604 to be a conical step, all are used to reduce the weight of the pilot valve port member 604 as possible as it can, in the case of ensuring a circulation ability of the through hole 6041 . In addition, the lower part of the through hole 6041 is arranged to have a large diameter so that the edge of the bottom thereof can be outwardly turned over to fix the components such as the gasket 603, the membrane 602 and the tray 605.

When the solenoid valve is in a close state, one end of the through hole 6041 is sealed by the closing plug 304, and the other end thereof is communicated with the valve port 504.

The lower cylindrical step 6042 of the pilot valve port member 604 can in sequence pass through a central hole of the tray 605, a central hole of the membrane 602 and a central hole of the gasket 603. And then, they can be fixed together by outwardly turning over an edge (not shown) at the lower part of the pilot valve port member 604.

The membrane 602 and the air distribution disc 601 are respectively disposed with a plurality of via holes at their edges. In particular, as shown in Fig. 3, the air

distribution disc 601 has a plurality of via holes 6012 spaced apart and located along a circumference close to its outer circumference. The membrane 602 has at least two spaced via holes located along a circumference close to its outer circumference. Therefore, when the air distribution disc 601 and the membrane 602 are assembled as shown in Fig.2, via holes of the membrane 602 can be aligned (communicated) with via holes 6012 of the air distribution disk 601. An outer edge of the tray 605 is curled upwardly. Fluid can flow into the upper chamber 507 above the membrane assembly 600 through via holes 6012 and gaps between the edges of the membrane 602 and the air distribution disc 601 and the inside edge of the body assembly 500.

Specifically, in one embodiment, the membrane 602 can be a circular plastic plate. The central of the membrane 602 is arranged with a central hole and the circumference thereof close to the edge of the membrane 602 can be disposed with at least one small via hole (not shown). Preferably, the membrane 602 is made of a polyfluortetraethylene material. Of course, the interior of the membrane 602 can be added with glass fibers so as to enhance its performance.

As shown in Fig. 3, the air distribution disc 601 is a circular pressing piece. The central of the air distribution disc 601 can be provided with a central hole 6011, and an edge of an annular surface is uniformly distributed with a plurality of via holes 6012. This air distribution disc 601 is placed below the membrane 602.

It should be noted that there are two chambers below the membrane assembly 600: the annular chamber 508 near the periphery thereof and the valve body outlet chamber 509 at the valve port 504.

Structures of the solenoid valve of the present invention are in detail explained hereinabove. The principle of its operation will be described now, so as to enable the person skilled in the art to better understand the disclosure of the present invention.

Valve Port from Close State to Open State

After the fluid flowing into the valve body 502 from the inlet connection pipe 501, the fluid pressure of the upper chamber 507 above the membrane 602 will equal to the fluid pressure of the annular chamber 508 below the membrane 602. Since the return spring 307 is compressed between the fixed core 201 and the movable core 301, the spring force of the return spring 307 will push the movable core assembly 300 to move down via the guiding sleeve 303 and/or the position limit pin 302 so that the closing plug 304 will press the pilot valve port member 604, and the membrane assembly 600 will be pushed downwardly to enable the lower surface of the membrane 602 to cover the valve port 504. The valve port 504 now is in a close state. Therefore, it can be apparent that a distance or travel H1 of the upper surface of the movable core 301 from the lower surface of the fixed core 201 is larger than a distance H2 of the middle step or second step 3032 of the guiding sleeve 303 from the upper surface of the blocking sheet 305 (i.e., H1>H2).

When energizing the coil 100, the magnetic force generated by the coil 100 will attract the movable core 301 to move up against its own gravity and the spring force of the return spring 307. Since the closing plug 304 is subjected to the adsorption of the pressure drop at the inlet and outlet, the closing plug 304 temporally presses and covers the pilot valve port member 604. The lower step 3034 of the guiding sleeve 303 cannot be moved up either, due to hooking the closing plug 304. Therefore, the upward movement of the movable core 301 also needs to overcome the spring force of the compression spring 306. When the movable core 301 moves up against its own gravity and two spring forces of the return spring 307 and the compression spring 306, until the upper surface of the blocking sheet 305 contacts the second step face 3032 of the guiding sleeve 303 (H2=0), the attracting force of the coil 100 becomes approximately the biggest value. Meanwhile, the movable core 301 will have acceleration, since it is attracted to move upwardly. Therefore, thereafter, the blocking sheet 305 will push the guiding sleeve 303 to move upwardly, and then the guiding sleeve 303 will get a

pushing force to hook the closing plug 304 and leave the surface in which the pilot valve port member 604 is located, against the pressure drop at the pilot valve port member 604. When the upper surface of the movable core 301 reaches to the lower surface of the fixed core 201 (i.e., H1=0), the closing plug 304 has left away the pilot valve port member 604 a certain distance (i.e., H1-H2). The fluid in the upper chamber 507 above the membrane 602 will flow into the valve body outlet chamber 509 or the outlet connection pipe 503 of the body 502 through the through hole 6041 of the pilot valve port member 604. Thus, the pressure drop subjected by the closing plug 304 will be greatly unloaded. Since the closing plug 304 will be subjected to the force released by the compression spring 306, it will be pushed up and further move away from the pilot valve port member 604. This results in the through hole 6041 of the pilot valve port member 604 completely open and increasing the flow of the fluid in the upper chamber 507 above the membrane 602 into the outlet connection pipe 503. In this case, the pressure of the upper chamber 507 above the membrane 602 will begin to become low. However, because the flow of the fluid from the annular chamber 508 below the membrane 602 into the upper chamber 507 via a gap between it and the inside edge of the valve body 502 and the via holes therein is less than the flow of fluid from the upper chamber 507 into the body outlet chamber 509 below the membrane assembly 600 through the through hole 6041 , the annular chamber 508 will have a larger pressure than the upper chamber 507, thereby a upward force of differential pressure will be generated on the membrane 602. Under the effect of the upward force of differential pressure between the annular chamber 508 and the upper chamber 507, the middle of the membrane 602 will begin to leave away the valve port 504, and rise up to the lower surface of the valve cover 505 (that is, when the valve port 504 is opened, due to the upward force of differential pressure between the upper chamber 507 and the annular chamber 508, the pilot valve port member 604 will be moved up, and then the membrane 602 and the tray 605 will be moved up together by the driving of the gasket 603 on the pilot valve port member 604. Further, the middle of the membrane 602 will be risen up until it is abutted against the lower

surface of the valve cover 505). Immediately, the valve port 504 between the inlet connection pipe 501 and the outlet connection pipe 503 will be entirely open, while the coil 100 will be kept on energizing. Therefore, the pilot valve port member 604 and the valve port 504 will always be in an entire open state.

Valve Port from Open State to Close State

After the coil 100 is de-energized, the magnetic force generated by the coil 100 will disappear or lose, the movable core 301 will push the position limit pin 302 to move down under the effect of its own gravity and the release force of the return spring 307. In turn, the position limit pin 302 will push the closing plug 304 to move down, until the lower surface of the closing plug 304 covers the upper surface of the pilot valve port member 604. At that time, the fluid in the upper chamber 507 above the membrane 602 will stop from flowing to the outlet connection pipe 503 of the valve body 502. As all of the fluid in the annular chamber 508 will gradually flow into the upper chamber 507 via the edge of the membrane 602 and the via holes therein, the pressure drop between the upper chamber 507 above the membrane 602 and the annular chamber 508 will be arranged so that the upper chamber 507 and the annular chamber 508 will have equal pressure. The risen middle portion of the membrane 602 will be moved down under the effect of the pushing force of the movable core 301 via the pilot valve port member 604 and the tray 605, so as to cover the valve port 504. Lastly, the fluid in the valve body 502 will stop from flowing from the inlet to the outlet. Finally, the solenoid valve will again in a close state.

Although some embodiments of the general inventive concept are illustrated and explained, it would be appreciated by those skilled in the art that modifications and variations may be made in these embodiments without departing from the principles and spirit of the general inventive concept of the disclosure, the scope of which is defined in the claims and equivalents thereof.

What the claims is:

1. A solenoid valve, comprises:

a valve body assembly, provided with a valve port;

a membrane assembly, a central portion of which seals the valve port, a peripheral portion of which at least partially covers an annular chamber between the valve port and the valve body assembly, the annular chamber being in communication with an inlet connection pipe of the solenoid valve, and further comprising a pilot valve port member;

a movable core assembly, including a movable core and a closing plug interconnected with each other; the movable core pushes the closing plug to seal a through hole in the pilot valve port member;

wherein, the closing plug is driven by the movable core to move up, so as to open the through hole; since a flow of fluid flowing from an upper chamber above the membrane assembly into a valve body outlet chamber below the membrane assembly through the through hole via the valve port, is larger than a flow flowing into the upper chamber from the inlet connection pipe of the solenoid valve, a upward force of differential pressure will be generated on the membrane assembly, forcing the membrane assembly to move up, thereby opening the valve port.

2. The solenoid valve of claim 1, characterized in that,

the body assembly includes a valve body, a valve cover fixedly connected to the valve body, the inlet connection pipe and an outlet connection pipe; wherein the annular valve port is formed by a central step at a central of the valve body; the valve body outlet chamber is in communication with the outlet connection pipe, while a chamber formed between the periphery of the valve port and the valve cover is in communication with the inlet connection pipe.

3. The solenoid valve of claim 2, characterized in that,

the membrane assembly is disposed on the central step, and covers the annular chamber formed between the central step below it and the valve body.

4. The solenoid valve of claim 3, characterized in that,

the membrane assembly comprises an air distribution disc arranged in the annular chamber; a membrane placed on the air distribution disc; a gasket, a pilot valve port member, and a tray, wherein an edge of the upper surface of the membrane is at least partially covered by a lower step of the valve cover, while the lower surface of the membrane seals the valve port.

5. The solenoid valve of claim 4, characterized in that,

an upper part of the pilot valve port member is a conical step, while a lower part thereof is a two-stage cylindrical step; the through hole which is used to communicate the upper chamber above the membrane assembly and a lower chamber below the membrane assembly, is disposed within the pilot valve port member, and a diameter of an upper part of the through hole is less than that of a lower part thereof.

6. The solenoid valve of claim 5, characterized in that,

the lower cylindrical step of the pilot valve port member in sequence passes through a central hole of the tray, a central hole of the membrane and a central hole of a gasket of a circular metal pressing piece; and they are then fixed together by outwardly turning over an edge at the lower part of pilot valve port member.

7. The solenoid valve of claim 6, characterized in that,

the membrane and the air distribution disc are respectively disposed with a plurality of via holes at their edges to be communicated with each other, an outer edge of the tray is curled upwardly, fluid flows into the upper chamber above the membrane assembly in turn through the via holes and gaps between the edges of the membrane and the air distribution disc and an inside edge of the valve body .

8. The solenoid valve of claim 7, characterized in that,

when the valve port is opened, since the upper chamber above the membrane assembly is in a low pressure and the annular chamber below the membrane assembly is in a high pressure due to being communicated with the inlet connection pipe, there is an upward force of differential pressure between the upper chamber and the annular chamber, so that the pilot valve port member is moved up, and the membrane and the tray are driven to move up by the gasket fixed on the pilot valve port member, and then the middle of the membrane is risen up until it abuts against the lower surface of the valve cover in the body assembly; and at this time the valve port between the inlet connection pipe and the outlet connection pipe is completely open.

9. The solenoid valve of any one of claims 1-8, characterized in further comprising

a sleeve assembly fixedly connected to the body assembly;

a movable core assembly disposed in the chamber of the sleeve assembly and being able to move up and down in the chamber; and

a coil disposed outside of the sleeve assembly, for generating magnetic force to attract the movable core in the movable core assembly to move up when being energized.

10. The solenoid valve of claim 9, characterized in that,

the movable core assembly comprises the movable core, a closing plug, a guide sleeve, a position-limit pin, and an return spring; wherein the movable core is in a cylindrical shape, the upper part of which is provided with a conducting hole; and at least a part of the position-limit pin is placed within the conducting hole, and can move along the conducting hole of the movable core.

11. The solenoid valve of claim 10, characterized in that,

the closing plug is a cylinder of polyfluortetraethylene with a protrusion,

and disposed within the guiding sleeve with the protrusion facing a lower side; and the guiding sleeve with the closing plug is provided in a pilot hole at a lower part of the movable core.

12. The solenoid valve of claim 11, characterized in that,

a first step face is disposed at the upper portion of the outer surface of the guiding sleeve, and a compression spring is disposed between the first step face and a blocking sheet at the bottom end of the movable core.

13. The solenoid valve of claim 12, characterized in that,

a second step face is located at a middle of the outer surface of the guiding sleeve, while the first step face has a larger outer diameter than the second step face; when the movable core is moved up until the blocking sheet makes a contact with the second step face, the closing plug is driven and leaves the pilot valve port member; and then the compression spring can push the closing plug to move up, so as to further move away from the pilot valve port member.

14. The solenoid valve of claim 12, characterized in that,

the blocking sheet is an annular metal gasket, and provided at an inner side of the bottom of the pilot hole of the movable core; the blocking sheet and the movable core are riveted together by inwardly turning over an edge of the lower part of the movable core; and the blocking sheet is shaped to have a length so that when moving up the movable core, the blocking sheet first makes a contact with the second step face.

15. The solenoid valve of claim 12, characterized in that,

a bottom step is inwardly protruded and located at the bottom of the guiding sleeve, such that the bottom step cooperates with the protrusion of the closing plug so as to support the closing plug.

16. The solenoid valve of claim 10, characterized in that,

the upper portion of the position-limit pin is a stem portion while the lower portion thereof is a cylindrical portion; and the position limit pin is provided with a cylindrical step between the cylindrical portion and the stem portion, outwardly protruding from the cylindrical portion.

17. The solenoid valve of claim 16, characterized in that,

the guiding sleeve further comprises an inner step face on the upper portion thereof, which is cooperated with the cylindrical step of the position limit pin, so that with aid of downward movement of the movable core, the position limit pin and the guiding sleeve together can be pushed to move toward the pilot valve port member, and then they push the closing plug for moving downwardly to seal the through hole of the pilot valve port.

18. The solenoid valve of claim 16, characterized in that,

the cylindrical portion of the position limit pin is clearance-fitted in the guiding sleeve and the stem portion of the position limit pin is clearance-fitted in the conducting hole, so that when the movable core is moved upwardly toward the fixed core, the position limit pin can be driven by the movable core and the guiding sleeve to move toward the fixed core; and in a case of the movable core being moved and abutted against the fixed core, when the cylindrical step of the position limit pin is moved in the pilot hole and abutted against the movable core, the position limit pin is not any more moved toward the fixed core.

19. The solenoid valve of claim 17, characterized in that,

when needing to close the valve port, the movable core will push the position limit pin to move down under the effect of its own gravity and the force released by the return spring, and then the position limit pin will push the guiding sleeve and the closing plug to move toward the pilot valve port member, until the closing plug seals the through hole; meanwhile, fluid in the upper chamber above

the membrane assembly will stop flowing through the through hole toward the outlet connection pipe of the valve body; the pressure drop between the upper chamber above the membrane assembly and the annular chamber below the membrane assembly will gradually reach to a state in which the pressure of the upper chamber will equal to the pressure of the annular chamber, as the fluid in the annular chamber all flows through edges and/or via holes of the membrane assembly into the upper chamber; the risen middle portion of the membrane will be moved down to seal the valve port when being subjected to the push force of the movable core via the pilot valve port member and the tray.

20. The solenoid valve of claim 9, characterized in that,

the sleeve assembly comprises a fixed core, a divided magnetic ring and a sleeve, the fixed core is provided with an annular groove at the lower part thereof, the divided magnetic ring is fixed within the annular groove by riveting; the lower part of the fixed core is inserted into the upper part of the sleeve, and the upper end face or the inner periphery of the sleeve can be welded to and fixed with the outer periphery of the lower part of the fixed core.

21. The solenoid valve of claim 20, characterized in that,

the lower end of the fixed core is disposed with a lug boss, which can be fitted into a conducting hole at an upper part of the movable core, so that an area of magnetic flux can be increased when the movable core and the fixed core are attracted to each other, upon energizing the coil; thereby increasing an attractive force between the moving and fixed cores.

22. The solenoid valve of claim 2, characterized in that,

the valve cover is in a rectangular shape, and a middle of the rectangular cover is provided with an opening into which the lower end of the sleeve assembly can be inserted, and they are fixed together by welding.

23. The solenoid valve of claim 22, characterized in that,

the valve body and the valve cover can be fixed by fitting of bolts and threaded holes; and the valve cover and the sleeve assembly are fixed by a silver soldering.

5

24. The solenoid valve of claim 2, characterized in

further comprising a seal ring, disposed between an inside step in the upper part of the body and an outside step at the lower part of the valve cover so as to make a seal therebtween.

10

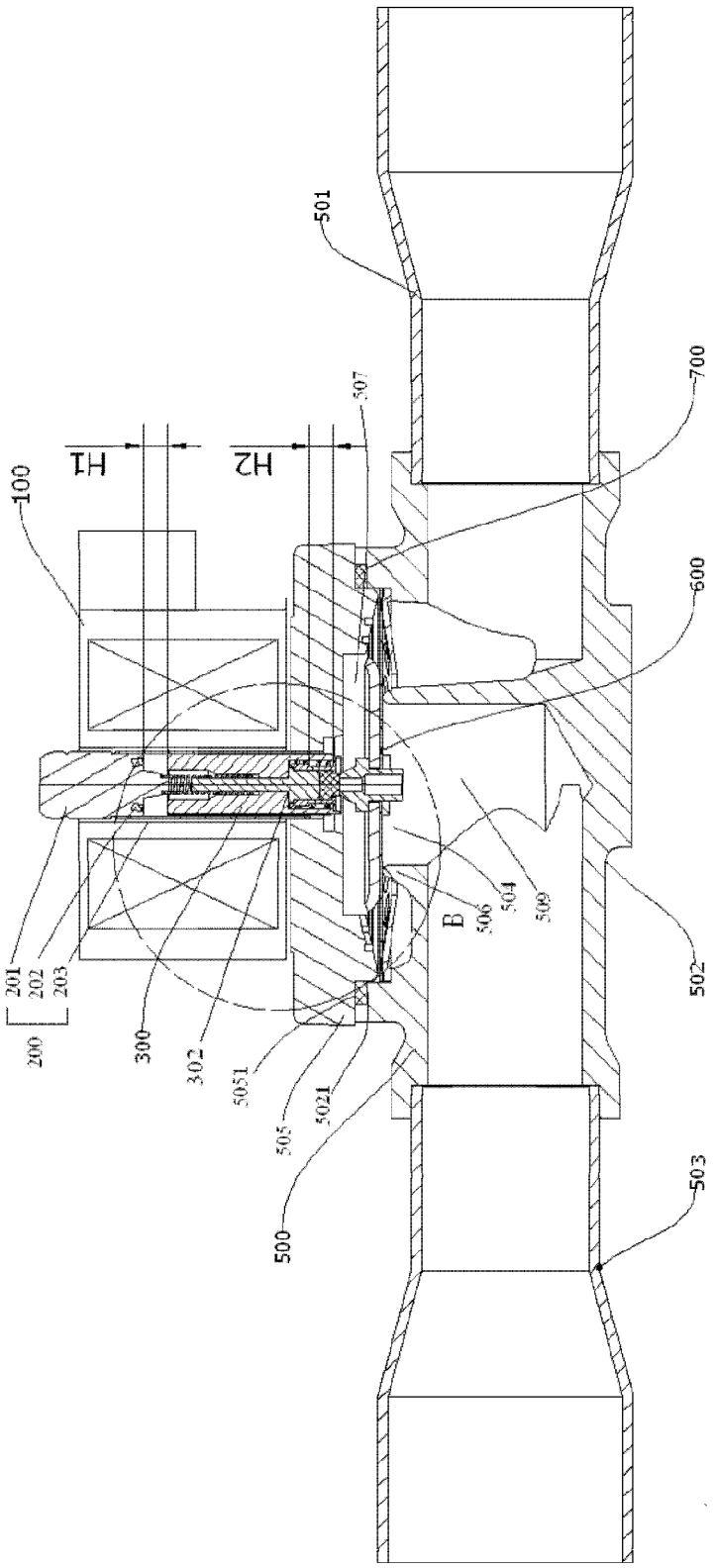
501
700
507
H1
H2
100
600
B
506
504
509
201
202
203
200
300
302
5051
505
5021
500
502
503

Fig. 1

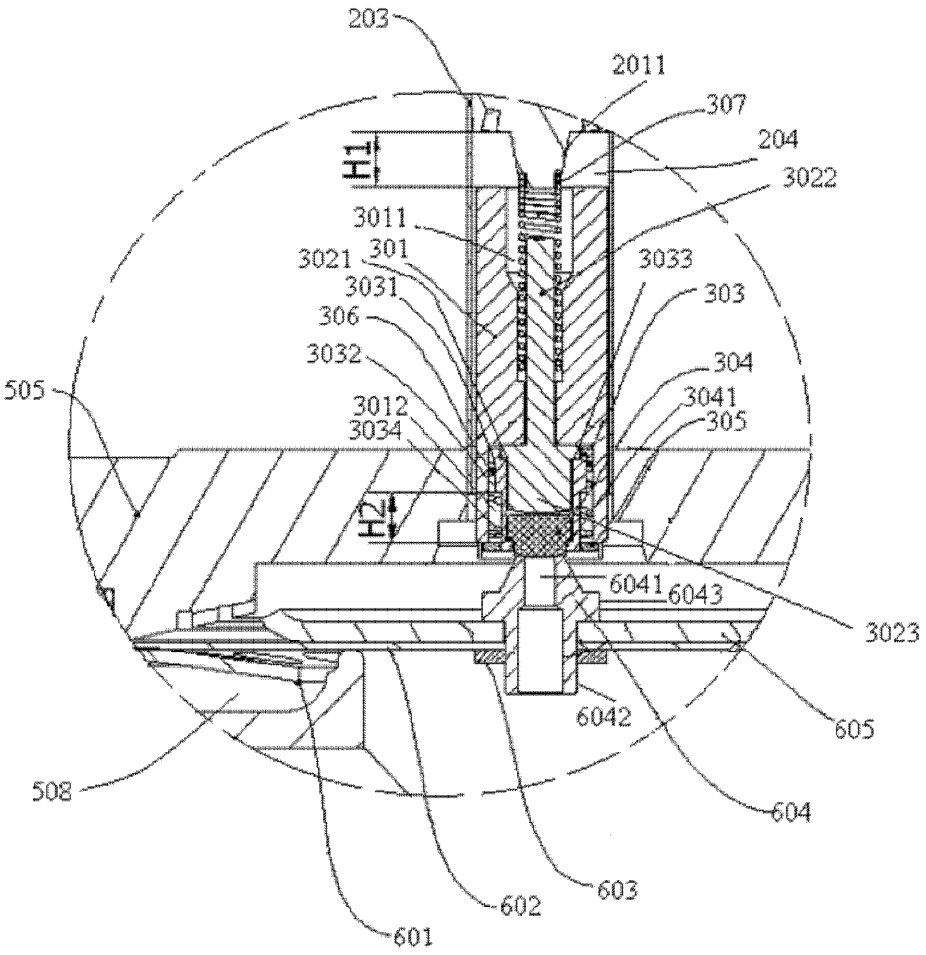
203
2011
307
204
3022
H1
3011
3021
301
3031
306
3032
3033
303
304
3041
305
505
3012
3034
H2
6041
6043
3023
6042
605
604
508
603
602
601

Fig. 2

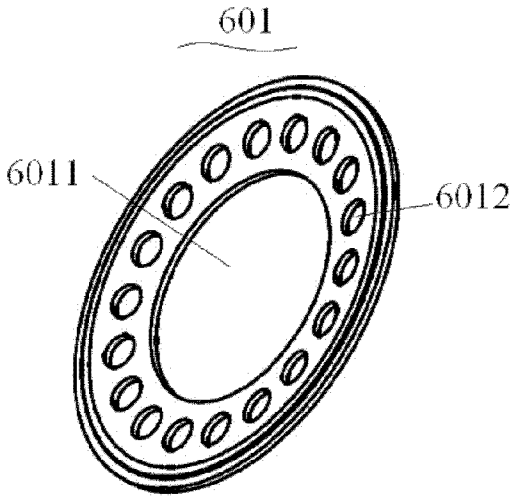

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/078496

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC,CNPAT: electromagnetic, solenoid, valve?, diaphragm?, film?, membrane?, annular, annulus, ring, loop, chamber?, cavit+, plug?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN200949680Y (LU, Baohong) 19 Sep. 2007(19.09.2007) see line 21 page 2-line 23 page 3 in the description, figure 1	1-3, 9, 20-24
Y		4-8
Y	CN201627933U (ZHEJIANGAMYPARTS CO., LTD.) 10 Nov. 2010(10.11.2010) see paragraphs 11-12 in the description, figures 1-2	4-8
X	CN101949461A (ZHEJIANG SANHUA CLIMATE & APPL) 19 Jan. 2011(19.01.2011) see paragraphs 37-46 in the description, figures 1-4	1-3, 22-24

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 Sep. 2012(11.09.2012)	**04 Oct. 2012 (04.10.2012)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer CHEN, Fei Telephone No. (86-10)62085141

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/078496

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y		4-8
A		10-19
X	CN2872002Y (SANHUA CO., LTD., ZHEJIANG) 21 Feb.2007(21 .02.2007)	1-3, 9, 20-24
	see line 15 page 3-line 7 page 4 in the description, figures 1-4	
Y		4-8
X	CN2620803Y (SHENLIN ELECTRONIC CO., LTD., HANG) 16 Jun. 2004(16.06.2004)	1-3, 22-24
	see lines 10-20 page 5 in the description, figures1^1	
Y		4-8
X	CN2064450U (GUANGZHOU JINXING INSTR FACTO) 24 Oct. 1990(24.10.1990)	*1*-4、9, 20-24
	see lines 2-18 page 2 in the description, figures 1-3	
Y		3-8
X	JP2002-71046A (TECHNO EXCEL CO., LTD.) 08 Mar. 2002(08.03.2002)	1-3, 22-24
	see paragraphs 1-14 in the description, figures 1-2	
Y		4-8

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/078496

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN200949680Y	19.09.2007	None	
CN201627933U	10.11.2010	None	
CN101949461A	19.01.2011	EP2273167A	12.01.2011
		KR20110005644A	18.01.2011
CN2872002Y	21.02.2007	None	
CN2620803Y	16.06.2004	None	
CN2064450U	24.10.1990	None	
JP2002-71046A	08.03.2002	JP3605631B2	22.12.2004

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/078496

Continuation of :

second sheet

A. CLASSIFICATION OF SUBJECT MATTER

F16K 7/17 (2006.01) i

F16K 31/06 (2006.01) i

F16K 31/126 (2006.01) i