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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 July 2006 (27.07.2006)

PCT

(10) International Publication Number
WO 2006/078140 A1

(51) International Patent Classification:
F16K 31/06 (2006.01)

(21) International Application Number:
PCT/KR2006/000232

(22) International Filing Date: 20 January 2006 (20.01.2006)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2005-0005387 20 January 2005 (20.01.2005) KR

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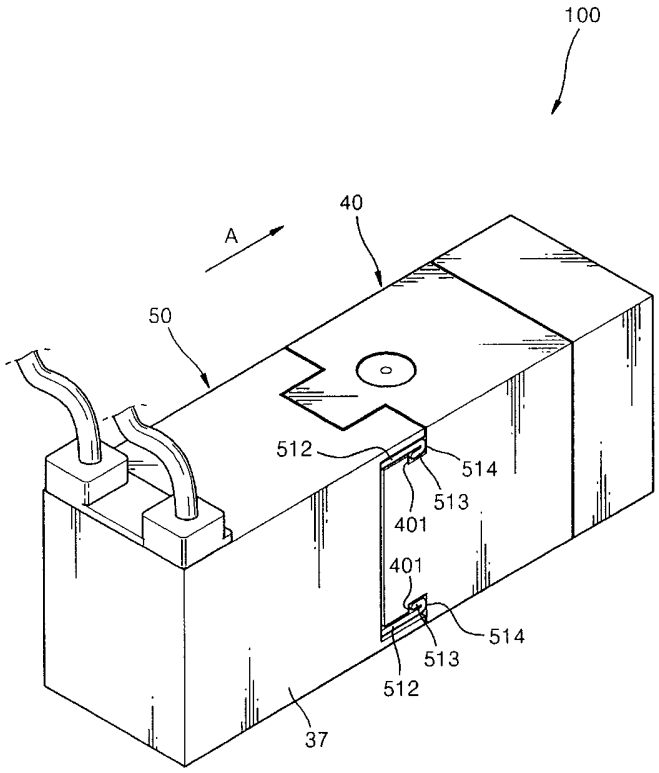
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LC, LK,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

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** SOLENOID VALVE



(57) **Abstract:** Provided is a solenoid valve, and more particularly, to a solenoid valve having an improved structure in which a valve housing and a solenoid can be easily combined with each other. According to the present invention, the solenoid and the valve housing can be assembled using a simple method by which the combining parts of the case are inserted in the hitches of the valve housing so that the combining parts of the case can be caught in the hitches. Thus, easy assembling can be implemented and assembling costs and time are reduced.

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SOLENOID VALVE

Technical Field

The present invention relates to a solenoid valve, and more particularly, to a solenoid valve having an improved structure in which a valve housing and a solenoid can be easily combined with each other.

Background Art

Valves having a plurality of ports are installed along a conduit line or in a container to control the volume and pressure of a fluid and have been widely used in many industrial fields. An example of solenoid valves having a solenoid is shown in FIGS. 1 through 3.

Referring to FIGS. 1 through 3, the three-port solenoid valve 1 includes a valve housing 10 having a plurality of ports R, A, and P through which a fluid flows in and out and a valve chamber 11 connected to the ports R, A, and P, a valve body 20 installed in the valve chamber 11 to open and close the ports R, A, and P, and a solenoid 30 for driving the valve body 20. The solenoid 30 includes a case 31, a solenoid coil 33 supported in the case 31, and a plunger 32 that can move to the case 31 by a driving force generated by a current flowing through the solenoid coil 33 and is connected to the valve body 20 to open and close the ports R, A, and P together with the movement. An outer surface of the case 31 is covered with a solenoid cover 37 formed of an insulating material, such as plastics.

The solenoid valve 1 having the above structure can operate repetitively by controlling an electrical signal in the solenoid coil 33. The process where the solenoid valve 1 operates in an initial state illustrated in FIG. 3 is as follows.

In the initial state illustrated in FIG. 3, one end 21 of the valve body 20 sticks to a supply port valve seat 12 of the valve chamber 11 and clogs a valve port 13 of the supply port valve seat 12. The other end part 22 of the valve body 20 is separated from an exhaust port valve seat 14 so that a valve port 15 of the exhaust port valve seat 14 can be opened. The flow of fluid (compressed air) passing through the valve chamber 11 is as indicated in the drawing by an arrow. Even in this case, if an electrical signal is applied to the solenoid coil 13 and a driving force or an electric thrust is generated, the plunger 32 is pulled out towards

a fixed iron core 36 while the plunger 32 compresses a plunger spring 35, the valve body 20 of the valve chamber 11 moves due to the elasticity of the valve spring 16, the one end 21 of the valve body 20 opens the valve port 13 of the supply port valve seat 12, and the other end part 22 of the valve body 20 sticks to the exhaust port valve seat 14 so that the valve port 15 of the exhaust port valve seat 14 can be blocked. Therefore, the exhaust port R of the valve chamber 11 is blocked, and the supply port P and the loading port A are connected to each other through the valve chamber 11.

In the meantime, the process where the valve housing 10 and the solenoid 30 are combined with each other is as follows. After an adaptor plate 34 of the solenoid 30 contacts an end of the valve housing 10, ends of the case 31 of the solenoid 30 are bent and the bent portions 311 are caught in hitches 101 of the valve housing 10. Thus, the solenoid valve 30 is prevented from separating from the valve housing 10 in a direction opposite to a direction in which the solenoid 30 is combined with the valve housing 10.

However, as described above, there is a problem in that, when the solenoid 30 is combined with the valve housing 10, a process of bending the case 31 of the solenoid 30 is necessary and an additional device for the bending process has to be provided and accordingly, it is not easy to assemble the solenoid 30 and the valve housing 20 and assembling costs and time increase.

In the meantime, in order to reduce assembling costs and time, when the ends of the case 31 of the solenoid 30 are previously bent at 90° and then the solenoid 30 and the valve housing 20 are assembled, as illustrated in FIG. 2, the bent portions 311 are caught in the valve housing 10 and the assembling process is complicated.

Disclosure of the Invention

The present invention provides a solenoid valve having an improved structure in which a valve housing and a solenoid can be easily combined with each other such that assembling costs and time are reduced.

According to the present invention, the solenoid and the valve housing can be assembled using a simple method by which the combining parts of the case are inserted in the hitches of the valve housing so that the combining parts of the case

can be caught in the hitches. Thus, easy assembling can be implemented compared to the prior art and assembling costs and time can be reduced.

According to an aspect of the present invention, there is provided a solenoid valve, the solenoid valve including: a valve housing having a plurality of ports through which a fluid flows in and out, and a valve chamber connected to the ports; a valve body installed in the valve chamber to open and close the ports; and a solenoid having a case, a solenoid coil supported in the case, and a plunger that can move to the case by a driving force generated by a current flowing through the solenoid coil and is connected to the valve body to open and close the ports together with the movement, wherein hitches are formed in the valve housing, and wherein the case of the solenoid comprises: a main body supporting the solenoid coil; extension parts extending from the main body in a direction in which the solenoid is combined with the valve housing; and combining parts extending from the extending parts in a direction opposite to the combining direction, the combining parts being caught in the hitches so that the solenoid can be prevented from the separating from the valve housing in the direction opposite to the combining direction.

According to another aspect of the present invention, there is provided a solenoid valve, the solenoid including: a valve housing having a plurality of ports through which a fluid flows in and out, and a valve chamber connected to the ports; a valve body installed in the valve chamber to open and close the ports; and a solenoid having a case, a solenoid coil supported in the case, and a plunger that can move to the case by a driving force generated by a current flowing through the solenoid coil and is connected to the valve body to open and close the ports together with the movement, wherein grooves are formed in the valve housing, and wherein the case of the solenoid is formed of an elastically-deformable material, and the case of the solenoid comprises: a main body supporting the solenoid coil; extension parts extending from the main body in a direction in which the solenoid is combined with the valve housing; and hitches extending from the extending parts in a direction that intersects the combining direction, the hitches being caught in the grooves so that the solenoid can be prevented from the separating from the valve housing in the direction opposite to the combining direction.

Brief Description of the Drawings

The above and other aspects and advantages of the present invention will become more apparent by describing in detail an exemplary embodiment thereof with reference to the attached drawings in which:

FIG. 1 is a schematic perspective view of a conventional solenoid valve;

FIG. 2 is a schematic front view of a combining structure of a valve housing and a solenoid of the solenoid valve illustrated in FIG. 1;

FIG. 3 is a schematic longitudinal cross-sectional view of an internal structure of the solenoid valve illustrated in FIG. 1;

FIG. 4 is a schematic perspective view of a solenoid valve according to an embodiment of the present invention;

FIG. 5 is a schematic perspective view of a case of a solenoid illustrated in FIG. 4;

FIG. 6 is a schematic longitudinal cross-sectional view of an internal structure of the solenoid valve illustrated in FIG. 4;

FIG. 7 is a front view for explaining a process of combining the solenoid of FIG. 4 with a valve housing;

FIG. 8 is a schematic perspective view of a solenoid valve according to another embodiment of the present invention;

FIG. 9 is a schematic perspective view of a case of a solenoid illustrated in FIG. 8; and

FIG. 10 is a front view for explaining a process of combining the solenoid of FIG. 8 with a valve housing.

Best Mode for Carrying out the Invention

The present invention will now be described more fully with reference to the accompanying drawings, in which an exemplary embodiment of the invention is shown.

FIG. 4 is a schematic perspective view of a solenoid valve according to an embodiment of the present invention, FIG. 5 is a schematic perspective view of a case of a solenoid illustrated in FIG. 4, FIG. 6 is a schematic longitudinal cross-sectional view of an internal structure of the solenoid valve illustrated in FIG. 4,

and FIG. 7 is a front view for explaining a process of combining the solenoid of FIG. 4 with a valve housing.

Referring to FIGS. 4 through 7, like in the conventional solenoid valve 1 illustrated in FIGS. 1 through 3, the solenoid valve 100 also includes a valve housing 40 having a plurality of ports R, A, and P through which a fluid flows in and out and a valve chamber 11 connected to the ports R, A, and P, a valve body 20 installed in the valve chamber 11 to open and close the ports R, A, and P, and a solenoid 50 for driving the valve body 20. In addition, like in the conventional solenoid valve 1 illustrated in FIGS. 1 through 3, the solenoid 50 includes a case 51, a solenoid coil 33 supported in the case 51, and a plunger 32 that can move to the case 51 by a driving force generated by a current flowing through the solenoid coil 33 and is connected to the valve body 20 to open and close the ports R, A, and P together with the movement. In addition, the solenoid valve 100 can operate repetitively by controlling an electrical signal in the solenoid coil 33.

According to the current embodiment of the present invention, a structure for combining the solenoid 50 with the valve housing 40 is different from that of the conventional solenoid valve 1 illustrated in FIGS. 1 through 3, which will now be described in details.

Hitches 401 are formed in the valve housing 40. A pair of hitches 401 are respectively disposed on two opposite sides of the valve housing 40. According to the current embodiment of the present invention, a pair of hitches 401 are disposed on upper and lower sides of the valve housing 40, respectively.

The case 51 of the solenoid 50 is formed of an elastically-deformable material, for example, metal such as aluminum (Al). The case 51 includes a main body 511, extension parts 512, combining parts 513, and connection parts 514.

The main body 511 supports elements for forming the solenoid 50, such as a fixed iron core 36, a solenoid coil 33, a plunger 32, an adaptor plate 34, and a plunger spring 35.

Each of the extension parts 512 extends from the main body 511 in a direction A in which the solenoid 50 is combined with the valve housing 40. A pair of extension parts 512 are respectively disposed on two opposite sides of the main body 511. According to the current embodiment of the present invention, a pair of extension parts 512 are disposed on upper and lower sides of the main

body 511, respectively. Outer surfaces of the main body 511 and the extension parts 512 are covered with a solenoid cover 37, as illustrated in FIG. 4. The solenoid cover 37 is formed of an insulating material, such as plastics, which can be elastically deformed.

Each of the combining parts 513 extends from an end of each extension part 512 in a direction opposite to the combining direction A. Each of the combining parts 513 may be formed by bending ends of the extension parts 512. The combining parts 513 are caught in the hitches 401 of the valve housing 40 in the state where the solenoid 50 and the valve housing 40 are combined with each other, such that the solenoid 50 can be prevented from separating from the valve housing 40 in the direction opposite to the combining direction A.

Each of the connection parts 514 has a circular arc shape. Each of the connection parts 514 is connected to each extension part 512 and each combining part 513. Since the connection parts 514 are formed in a circular arc shape, the combining parts 513 can be slid on the surface of the valve housing 40 when the solenoid 50 is combined with the valve housing 40.

According to the current embodiment of the present invention, the main body 511, the extension parts 512, the combining parts 513, and the connection parts 514 may be formed in a single unit by press-working a metallic plate, for example, by bending a metallic plate.

An example of a method of combining the solenoid 50 with the valve housing 40 in the solenoid valve 100 illustrated in FIGS. 4 through 7 will now be described.

First, the valve housing 40 in which the valve body 20 is installed, and the solenoid valve 50 are prepared. After that, as illustrated in FIG. 7, the solenoid 50 is caught in the hitches 401 by inserting the combining parts 513 disposed on a lower side of the case 51 of the solenoid 50 in the hitches 401 of the valve housing 40, and the combining parts 513 disposed on an upper side of the case 51 of the solenoid 50 contact the valve housing 40. In this state, if the solenoid 50 is clockwise rotated around the combining parts 513 disposed on the lower side of the case 51, the connection parts 514 disposed on the upper side of the case 51 are smoothly slid on the valve housing 40, and the combining parts 513 disposed on the upper side of the case 51 contact the valve housing 40 and are pushed out.

Accordingly, the extension parts 512 of the case 51 are elastically deformed and the solenoid 50 is rotated. At this time, portions of the solenoid cover 37 opposing the extension parts 512 of the case 51 are together elastically deformed without disturbing elastic deformation of the extension parts 512. While the solenoid 50 is rotated in this way, the extension parts 512 of the case 51 and the portions of the solenoid cover 37 are restored to the original state and accordingly, the combining parts 513 disposed on the upper side of the case 51 are inserted in the hitches 401 disposed on the upper side of the valve housing 40 and caught in the hitches 401. Thus, the solenoid 50 is prevented from separating from the valve housing 40 in the direction opposite to the combining direction A.

According to the present invention, unlike the conventional solenoid valve, the solenoid 50 and the valve housing 40 can be assembled using a simple method by which the combining parts 513 of the case 51 are inserted in the hitches 401 of the valve housing 40 so that the combining parts 513 of the case 51 can be caught in the hitches 401. Thus, easy assembling can be implemented compared to the prior art and assembling costs and time are reduced. In addition, unlike the prior art, an additional device is not required when assembling.

A solenoid valve 200 according to another embodiment of the present invention is illustrated in FIGS. 8 through 10. The solenoid valve 200 includes a case 61 of a solenoid 60 having a different structure from that of the solenoid valve 100 illustrated in FIGS. 4 through 7. A description of the same portions of the solenoid valve 200 as those of the solenoid valve 100 illustrated in FIGS. 4 through 7 is repeated and thus omitted, and only different portions will now be described.

A plurality of main bodies 611 and extension parts 612 having the same structure as those of the case 51 of the solenoid 50 are disposed in the case 61 of the solenoid 60. However, combining parts 613 having a different structure from that of the case 51 of the solenoid 50 are disposed in the case 61 of the solenoid 60. Each of the combining parts 613 extends from each of the extension parts 612 in a direction that intersects a direction A in which the solenoid 60 is combined with the valve housing 40. Each of the combining parts 613 may be formed by bending a body portion of each extension part 612, as illustrated in FIG. 9. For example, each of the combining parts 613 may be easily formed by press-working,

such as blanking. The combining parts 613 are caught in the hitches 401 of the valve housing 40 in the state where the solenoid 60 and the valve housing 40 are combined with each other, such that the solenoid 60 can be prevented from separating from the valve housing 40 in the direction opposite to the combining direction A.

An example of a method of combining the solenoid 60 with the valve housing 40 in the solenoid valve 200 illustrated in FIGS. 8 through 10 will now be described.

First, if the solenoid 60 is pressurized in the combining direction A and moved after the solenoid 60 contacts an end of the valve housing 40, the case 61 of the solenoid 60 is inserted in an outer surface of the valve housing 40 while the extension parts 612 and the combining parts 613 of the case 61 are elastically deformed, as illustrated in FIG. 10. At this time, the portions of the solenoid cover 37 opposing the extension parts 612 of the case 61 are together elastically deformed without disturbing elastic deformation of the extension parts 612. While the solenoid 60 is further moved in the combining direction A, the extension parts 612 of the case 61 and the portions of the solenoid cover 37 are restored to the original state and accordingly, the combining parts 613 of the case 61 are inserted in the hitches 401 of the valve housing 40 and caught in the hitches 401. Thus, the solenoid 60 is prevented from separating from the valve housing 40 in the direction opposite to the combining direction A.

Industrial Applicability

While this invention has been particularly shown and described with reference to an exemplary embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

For example, the case of the solenoid may not be formed of an elastically-deformable material. In this case, the extension parts of the case of the solenoid and the portions of the solenoid cover opposing the extension parts are instantaneously deformed and restored to the original state and the extension parts of the case are caught in the hitches of the valve housing at a time interval

between the instantaneous deformation and the restoration, such that the solenoid and the valve housing can be combined with each other.

In addition, the solenoid is assembled in the state where the case of the solenoid is covered with the solenoid cover. However, the case of the solenoid may be covered with the solenoid cover after the case of the solenoid is assembled in the valve housing.

In addition, according to an embodiment of the present invention, the solenoid is rotated to be assembled. However, like in another embodiment described above, the solenoid can be straightly moved in a direction in which the solenoid is combined with the valve housing.

In addition, the hitch is one side of a groove, but the hitch may be formed as a jaw formed in the valve housing.

What is claimed is:

1. A solenoid valve comprising:

a valve housing having a plurality of ports through which a fluid flows in and out, and a valve chamber connected to the ports;

a valve body installed in the valve chamber to open and close the ports; and

a solenoid having a case, a solenoid coil supported in the case, and a plunger that can move to the case by a driving force generated by a current flowing through the solenoid coil and is connected to the valve body to open and close the ports together with the movement,

wherein hitches are formed in the valve housing, and

wherein the case of the solenoid comprises:

a main body supporting the solenoid coil;

extension parts extending from the main body in a direction in which the solenoid is combined with the valve housing; and

combining parts extending from the extending parts in a direction opposite to the combining direction, the combining parts being caught in the hitches so that the solenoid can be prevented from the separating from the valve housing in the direction opposite to the combining direction.

2. The solenoid valve of claim 1, wherein the combining parts of the case are formed by bending ends of the extension parts.

3. The solenoid valve of claim 2, wherein the extension parts and the combining parts are connected using circular-arc-shaped connection parts.

4. The solenoid valve of claim 1, wherein a pair of hitches are disposed on two opposite sides of the valve housing, respectively, and

a pair of extension parts are disposed on two opposite sides of the main body, and

four combining parts are disposed and each of the combining parts extends from an end of each of the extension parts.

5. The solenoid valve of claim 1, wherein the case of the solenoid is formed of an elastically-deformable material.

6. A solenoid valve comprising:

a valve housing having a plurality of ports through which a fluid flows in and out, and a valve chamber connected to the ports;

a valve body installed in the valve chamber to open and close the ports; and

a solenoid having a case, a solenoid coil supported in the case, and a plunger that can move to the case by a driving force generated by a current flowing through the solenoid coil and is connected to the valve body to open and close the ports together with the movement,

wherein grooves are formed in the valve housing, and

wherein the case of the solenoid is formed of an elastically-deformable material, and

the case of the solenoid comprises:

a main body supporting the solenoid coil;

extension parts extending from the main body in a direction in which the solenoid is combined with the valve housing; and

hitches extending from the extending parts in a direction that intersects the combining direction, the hitches being caught in the grooves so that the solenoid can be prevented from the separating from the valve housing in the direction opposite to the combining direction.

7. The solenoid valve of claim 1, wherein the hitches are formed by bending body portions of the extension parts.

FIG. 1 (PRIOR ART)

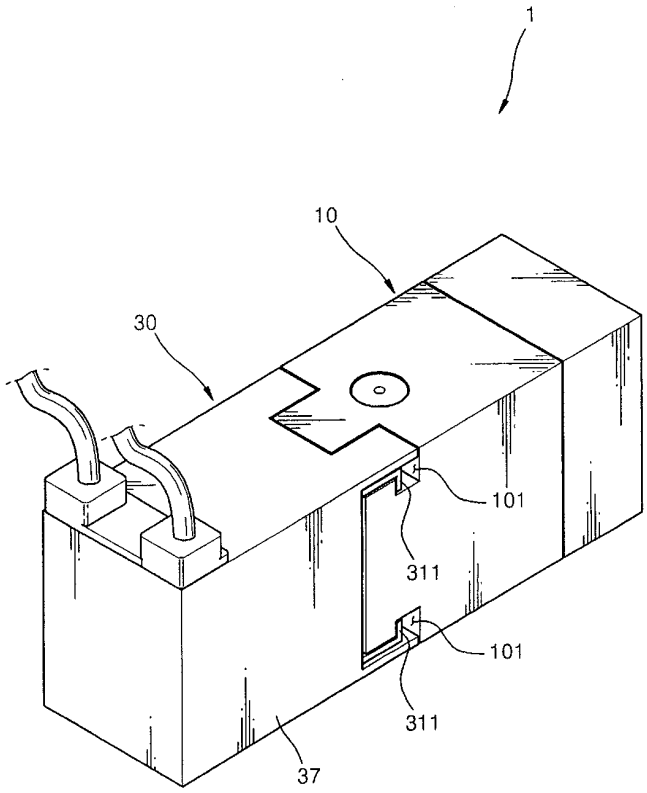


FIG. 2 (PRIOR ART)

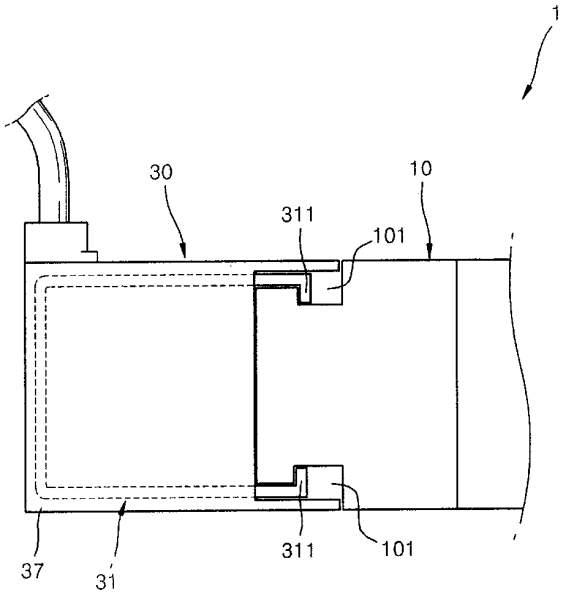


FIG. 3 (PRIOR ART)

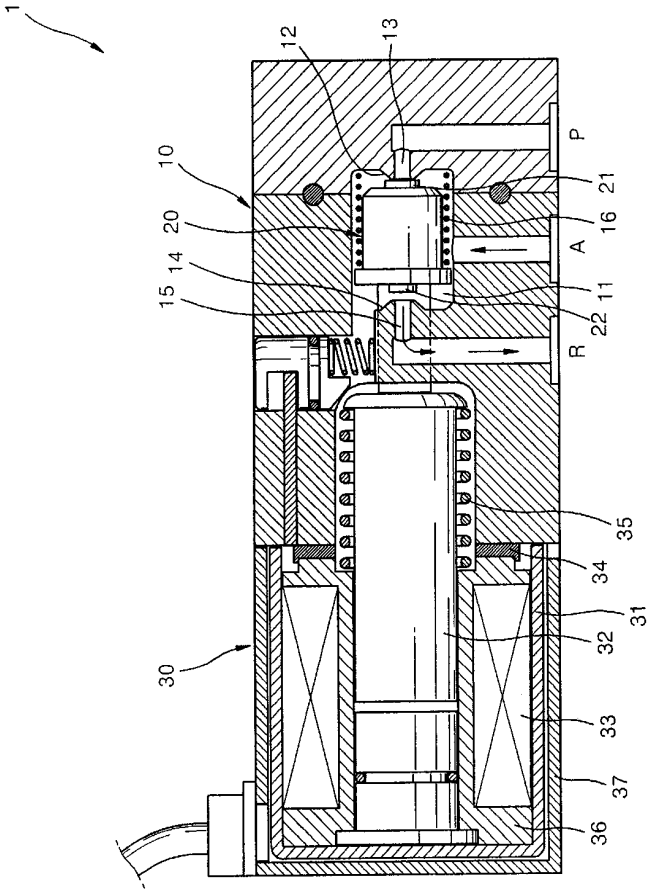


FIG. 4

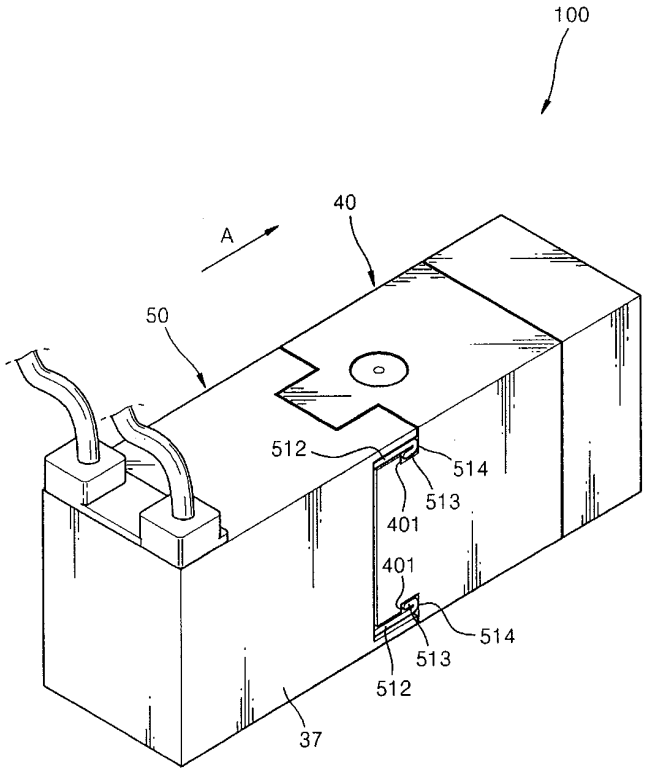


FIG. 5

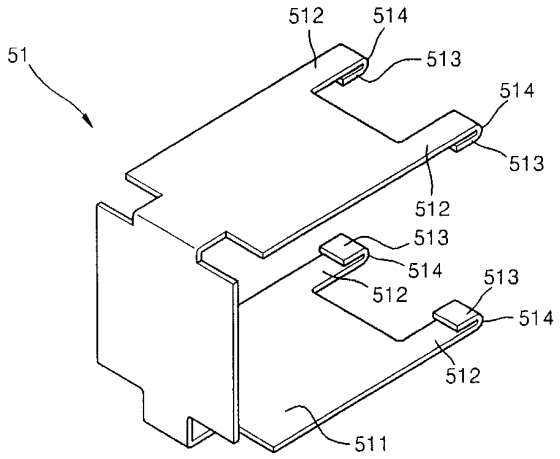


FIG. 6

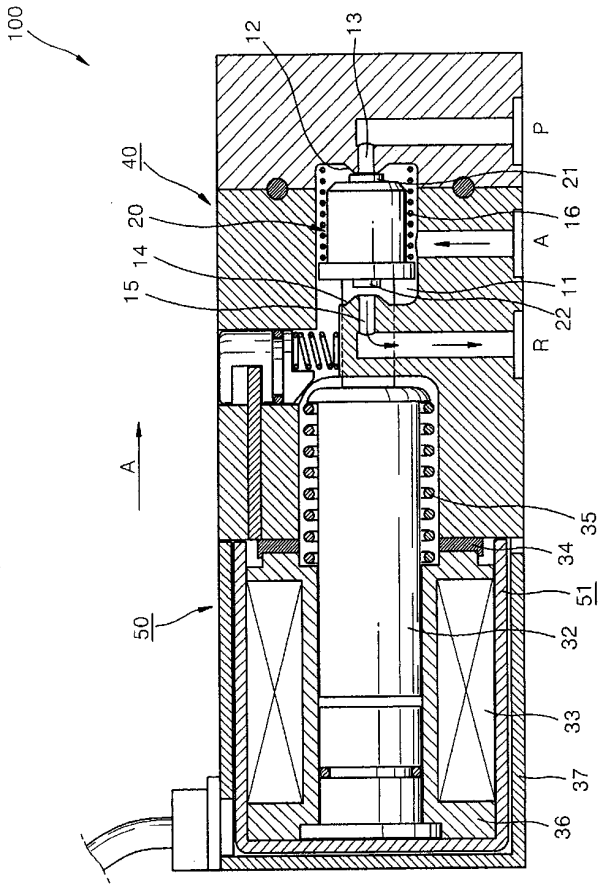


FIG. 7

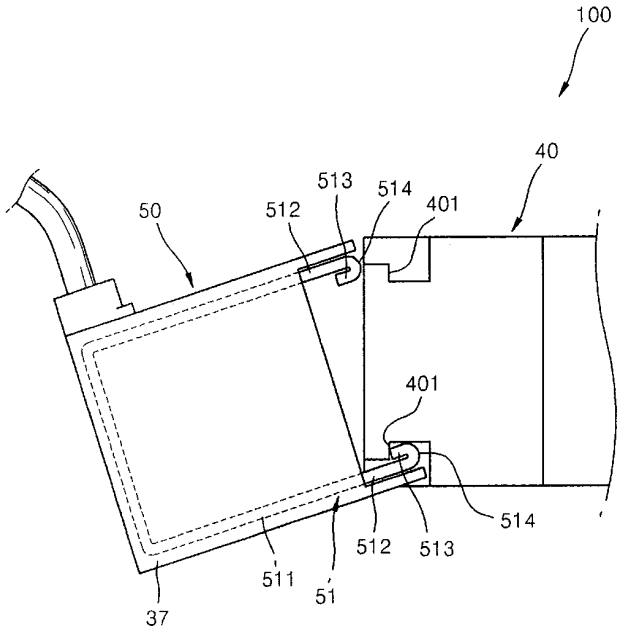


FIG. 8

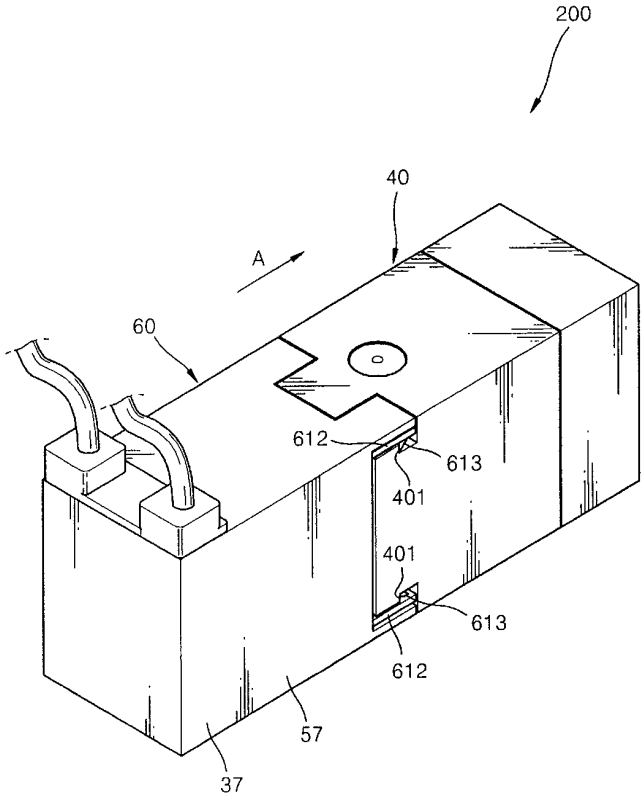


FIG. 9

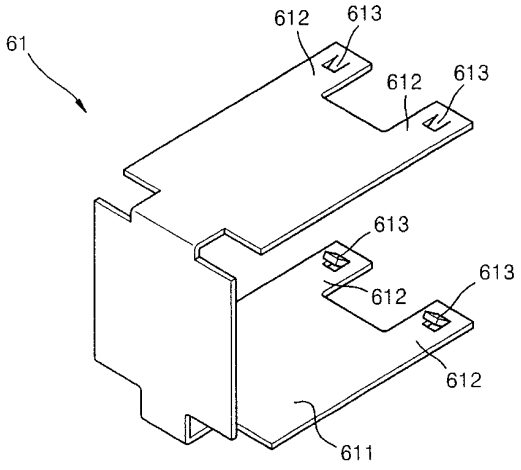
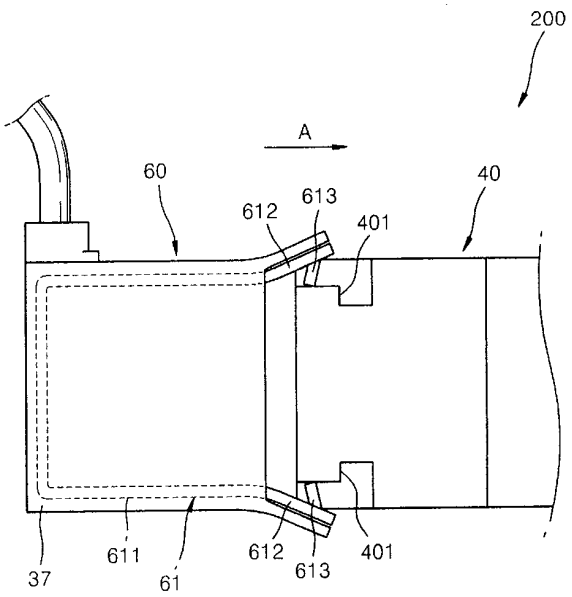


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/000232

A. CLASSIFICATION OF SUBJECT MATTER

F16K 31/06(2006.01)i

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)

IPC8 F16K 31/05, 31/06

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

KR, JP : IPC as above

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

KIPO eKIPASS System

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2003-278929 A (SMC Corporation) 2 Oct 2003 (See the Fig. 1, [8], [9] and [10])	1-7
A	US 4,884,782 A (Siemens-Bendix Automotive Electronics L.P.) 5 Dec 1989 (See the Fig. 1, 2)	1-7
A	JP 2004-11857 A (SMC Corporation) 15 Jan 2004 (See the Fig. 1, 5)	1-7
A	JP 2004-156709 A (SMC Corporation) 3 Jun 2004 (See the Fig. 1)	1-7

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
26 APRIL 2006 (26.04.2006)	**26 APRIL 2006 (26.04.2006)**

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Authorized officer

LEE, Jin Hyung

Telephone No. 82-42-481-5462

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2006/000232

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