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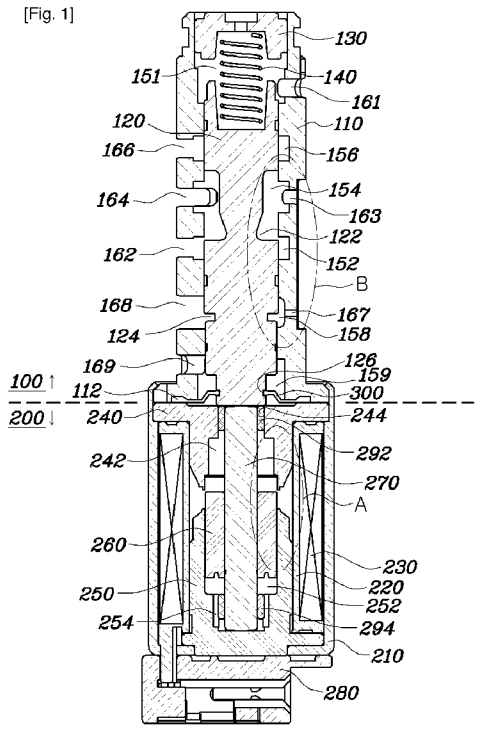
(54) **Title:** SOLENOID VALVE

[Fig. 1]



(57) **Abstract:** Disclosed is a solenoid valve which can minimize foreign materials included in fluid of a valve which flows in a solenoid. The solenoid valve includes a solenoid, a valve operated by the solenoid, and a plate filter disposed between the solenoid and the valve. The valve includes a hollow holder having one or more chambers and ports formed therein, and a spool reciprocating upwards and downwards within the holder by the solenoid. In addition, the plate filter includes an outer ring fixed to the holder, an inner ring fixed to the spool, and a filter membrane formed between the outer ring and the inner ring. The plate filter is disposed between the solenoid and the valve so that foreign matter included in the fluid flowing into the solenoid can be minimized. When a through-hole is formed in the solenoid and a column filter is provided to the solenoid, operational resistance due to change in internal pressure of the solenoid can be reduced and heat can be discharged from the solenoid to the outside during movement of a plunger.

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Description

Title of Invention: SOLENOID VALVE

Technical Field

[1] The present invention relates to a solenoid valve and, more particularly, to a solenoid valve which can minimize foreign matter included in fluid of a valve flowing in a solenoid.

Background Art

[2] In general, a transmission is a gearing apparatus for converting power generated by an engine into a desired rotational force according to speed and transmitting the same. Such transmissions are classified into manual transmissions in which gear shifting is manually performed by a driver and automatic transmissions in which gear shifting is automatically performed according to a certain pattern. The automatic transmission includes a torque converter, an operation mechanism, a planetary gear, a hydraulic control mechanism, and an electrical controller, and a pressure control valve unit is disposed in the hydraulic control mechanism to maintain the pressure in the automatic transmission constant. In addition, a plurality of multi-plate clutches is installed in the automatic transmission, and includes a plurality of clutch plates spline-coupled to a clutch retainer and a plurality of clutch discs coupled to a clutch hub and disposed between the clutch plates. A clutch cylinder is disposed between the clutch plates of the multi-plate clutch and the clutch retainer and urges the clutch plates against the clutch disc to transmit power thereto when hydraulic pressure is applied to the hydraulic cylinder.

[3] A solenoid valve used as the pressure control valve unit is classified into a spool type, a ball type, and a poppet type according to an internal structure thereof. The spool type solenoid valve includes a solenoid in which a plunger is inserted or protruded according to on/off states of power, a holder coupled to the solenoid and having a fluid transfer path formed therein, and a valve installed inside the holder to be moved by the solenoid and including a spool controlling movement of the fluid.

[4] The solenoid valve controls movement of the fluid by moving the spool through reciprocation of the plunger within a yoke when power is applied to the solenoid valve. However, since an existing solenoid valve does not include a component for removing foreign matter between the valve and the solenoid, the solenoid valve is susceptible to reduction in durability by foreign matter in the fluid flowing in the solenoid valve during operation of the solenoid valve.

[5] To solve this problem, a structure for isolating the solenoid from the valve is proposed. However, since the fluid cannot be moved into or from the solenoid, the

structure for isolating the solenoid from the valve causes operational resistance during movement of the plunger. In addition, since inflow and outflow of the fluid into or from the solenoid do not occur, the structure does not allow easy discharge of heat from the solenoid, causing non-smooth operation. Accordingly, this structure has a problem of low response and is likely to cause malfunction.

Disclosure of Invention

Technical Problem

[6] The present invention is conceived to solve the problems of the related art, and an aspect of the present invention is to provide a solenoid valve which can minimize foreign matter in fluid of a valve which flows in a solenoid.

[7] Another aspect of the present invention is to provide a solenoid valve which allows fluid to move into and from a solenoid during movement of a plunger and can prevent inflow of foreign matter in the process of moving the fluid.

Solution to Problem

[8] In accordance with one exemplary embodiment of the invention, a solenoid valve includes: a solenoid; a valve operated by the solenoid; and a plate filter disposed between the solenoid and the valve. At this time, the valve includes: a hollow holder which has one or more chambers and ports formed therein; and a spool reciprocating upwards and downwards within the holder by the solenoid. In addition, the plate filter includes: an outer ring fixed to the holder; an inner ring fixed to the spool; and a filter membrane formed between the outer ring and the inner ring.

[9] In this embodiment, the plate filter is disposed between the solenoid and the valve, thereby minimizing foreign matter in the fluid flowing into the solenoid.

[10] According to another exemplary embodiment, the solenoid valve may include: a solenoid having a through-hole through which fluid flows into or from the solenoid; a column filter provided to the through-hole; and a valve operated by the solenoid.

[11] In this embodiment, since the through-hole is formed in the solenoid to allow the fluid to flow into or from the solenoid, operational resistance caused by a change in the internal pressure of the solenoid can be reduced and heat generated from the solenoid can be discharged to the outside during movement of a plunger.

Advantageous Effects of Invention

[12] According to the embodiments of the invention, the solenoid valve may filter foreign matter in fluid moving from the valve to the solenoid using a plate filter disposed between the solenoid and the valve. Accordingly, it is possible to extend the lifetime of components and prevent malfunction of the solenoid by minimizing the foreign matter included in the fluid which flows into the solenoid.

[13] In addition, the solenoid valve enables inflow and outflow of the fluid through the

through-hole of the solenoid. Accordingly, the solenoid valve according to the embodiments does not undergo operational resistance according to a change in the internal pressure of the solenoid during movement of the plunger and secures excellent response. Moreover, the solenoid valve may improve a cooling effect and operational performance by discharging heat from the solenoid using the fluid flowing into or from the solenoid.

Brief Description of Drawings

[14] Fig. 1 is a sectional view of a solenoid valve according to one exemplary embodiment of the present invention;

[15] Fig. 2 is an enlarged view of Area A in Fig. 1;

[16] Fig. 3 is a sectional view of a yoke of the solenoid valve according to the exemplary embodiment of the present invention;

[17] Figs. 4 and 5 are perspective views of a plate filter of the solenoid valve according to the exemplary embodiment of the present invention;

[18] Fig. 6 is a sectional view of the plate filter of the solenoid valve according to the exemplary embodiment of the present invention;

[19] Figs. 7 and 8 illustrate other examples of the plate filter;

[20] Fig. 9 is an enlarged view of Area A in Fig. 1;

[21] Fig. 10 is a diagram of an output waveform measured in operating of the solenoid valve according to the exemplary embodiment of the present invention;

[22] Fig. 11 is a sectional view of a solenoid valve according to another exemplary embodiment of the present invention;

[23] Fig. 12 is a side view of a holder of the solenoid valve according to the other exemplary embodiment of the present invention;

[24] Fig. 13 is an enlarged view of a part of a solenoid in the solenoid valve according to the other exemplary embodiment of the present invention;

[25] Fig. 14 is a sectional view of a solenoid valve according to another exemplary embodiment of the present invention; and

[26] Figs. 15 and 16 are views of a yoke of a solenoid valve according to the other exemplary embodiment of the present invention.

[27] [Reference Numerals for Major Elements in Drawings]

[28] 100: Valve 110: Holder

[29] 120: Spool 130: Pressure control screw

[30] 140: Spring 152: Supply Chamber

[31] 154: Control Chamber 156: Discharge Chamber

[32] 158: Feedback Chamber 151, 159: Auxiliary Discharge Chamber

[33] 162: Supply Port 164: Control Port

[34] 166: Discharge Port 168: Feedback Port

[35] 161, 169: Auxiliary Discharge Port 163: First Opening

[36] 167: Second Opening 170: Flow path

[37] 200: Solenoid 210: Case

[38] 220: Bobbin 230: Coil

[39] 240: Core 250: Yoke

[40] 260: Plunger 270: Rod

[41] 280: Terminal 300: Plate Filter

[42] 310: Outer Ring 320: Inner Ring

[43] 330: Filter Membrane

Best Mode for Carrying out the Invention

[44] Exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings. In description of the embodiments of the present invention and assignment of reference numerals to elements shown in the drawings, like elements will be denoted by like reference numerals throughout the specification and the drawings.

[45] Fig. 1 is a sectional view of a solenoid valve according to one exemplary embodiment of the present invention.

[46] Referring to Fig. 1, the solenoid valve according to the exemplary embodiment includes a valve 100, a solenoid 200 for operating the valve 100, and a plate filter 300 disposed between the valve 100 and the solenoid 200.

[47] The valve 100 applies control pressure to fluid supplied from an external hydraulic pressure source to supply the control pressure to a clutch (not shown) and is mounted on a valve body (not shown) having a plurality of oil paths. In more detail, the valve includes a holder 110, a spool 120 movably disposed in the holder 110, and a pressure control screw 130 and a spring 140 disposed at an upper portion of the spool 120.

[48] The holder 110 has a cylindrical shape to receive the spool 120 therein, and is formed with a supply chamber 152, a control chamber 154, a discharge chamber 156 and a feedback chamber 158 on an inner wall thereof. The supply chamber 152 receives fluid from the outside and the control chamber 154 applies control pressure to the fluid in the supply chamber 152 to supply the control pressure to a clutch (not shown). In addition, the discharge chamber 156 partially exhausts the remaining pressure, the feedback chamber 158 linearly controls the control pressure by receiving part for the fluid in the control chamber 154. Here, the supply chamber 152 is formed with a supply port 162 connected to an oil source and the control chamber 154 is formed with a control port 164 connected to a clutch (not shown) of a transmission. The discharge chamber 156 is formed with a discharge port 166 and the feedback chamber 158 is

formed with a feedback port 168. The feedback port 168 is closed by a mounting surface of a valve body (not shown) when the valve 100 is mounted on the valve body (not shown). In addition, the control chamber 154 and the feedback chamber 158 are respectively formed with first and second openings 163, 167 into which the fluid flows to for linearly control the control pressure.

[49] Auxiliary discharge chambers 151, 159 are formed at an upper portion of the discharge chamber 156 and a lower portion of the feedback chamber 158, respectively. Auxiliary discharge ports 161, 169 are formed on lateral surfaces of the auxiliary discharge chambers 151, 159, respectively. The auxiliary discharge chambers 151, 159 are spaces for temporarily storing fluid smeared on a surface of the spool 120 and foreign matter included in the fluid. The fluid and the foreign matter temporarily stored in the auxiliary discharge chambers 151, 159 are discharged through the auxiliary discharge ports 161, 169 to the outside during operation of the spool 120.

[50] The spool 120 is movably disposed within the holder 110 and one or more ring-shaped grooves 122 and 124 are formed on an outer periphery thereof. The spool 120 including the ring-shaped grooves 122 and 124 is moved upwards and downwards by the solenoid 200, applies the control pressure to the fluid supplied through the supply port 162, and supplies the fluid to the clutch (not shown) through the control port 164. In addition, the spool 120 changes flow of the fluid and opens or closes the supply port 162, the control port 164, and the discharge port 166.

[51] The pressure control screw 130 is coupled to the opened upper side of the holder 110 and controls the control pressured applied to the clutch (not shown) by controlling movement of the spool 120. A spring 140 for downwardly and elastically supporting the spool 120 and simultaneously absorbing shock upon movement of the spool 120 is disposed between the pressure control screw 130 and the spool 120.

[52] Fig. 2 is an enlarged view of Area A in Fig. 1 and Fig. 3 is a sectional view of a yoke of the solenoid valve according to the exemplary embodiment.

[53] Referring to Figs 1 to 3, the solenoid 200 includes a case 210, a bobbin 220 disposed inside the case 210, a coil 230 would around an outer periphery of the bobbin 220, a core 240 coupled to an upper portion of the bobbin 220, a yoke 250 coupled to a lower portion of the bobbin 220, a vertically movable plunger 260 disposed inside the core 240 and the yoke 250, a rod 270 coupled to the plunger 260 through the core 240, and a terminal 280 connected to the yoke 250.

[54] The bobbin 220 prevents electrical connection between the coil 230 and the core 240 and between the coil 230 and the yoke 250. As described in detail, the bobbin 220 has a spool shape to allow the core 240 and the yoke 250 to be partially inserted into the bobbin 220 through upper and lower sides thereof, and has a coil wound around the bobbin to generate magnetic field when power is applied thereto.

[55] The core 240 is magnetized by the magnetic field generated by the coil 230 to move or secure the plunger 250. A first core hollow 242 on which the magnetic force is concentrated is formed in a portion of the core 240 adjacent to the plunger 260 such that one end of the plunger 260 is partially received in the first core hollow 242. In addition, a second core hollow 244 having a diameter smaller than that of the first core hollow 242 is formed at an upper end of the first core hollow 242 such that an upper end of the rod 270 is received in the second core hollow 244.

[56] The yoke 250 has a shape corresponding to the core 240. Specifically, the yoke 250 is formed with a first yoke hollow 252 near the plunger 260 such that the other end of the plunger 260 is partially inserted into the first yoke hollow 252. In addition, a second yoke hollow 254 having a diameter smaller than that of the first yoke hollow 252 is formed at a lower portion of the first hollow such that a lower end of the rod 270 is inserted into the second yoke hollow 254.

[57] First and second bushings 292, 294 are separated from each other and are press-fitted into the second core hollow 244 of the core 240 and the second yoke hollow 254 of the yoke 250, respectively. The first and second bushings 292, 294 allow smooth vertical reciprocation of the plunger 260 and minimize left and right movement and tilting of the plunger 260.

[58] As shown in Fig. 2, the core 240 and the yoke 250 are separated a predetermined distance D from each other. For example, the distance between the core 240 and the yoke 250 may be in the range of 1.5 to 2.5 mm. If the distance between the core 240 and the yoke 250 exceeds this range, magnetic force is reduced and upward movement of the plunger 260 is not smoothly performed. On the other hand, if the distance is less than this range, a return process of the plunger 260 is not smoothly performed in a power-off state, increasing a possibility of erroneous operation.

[59] Referring to Fig. 3, the yoke 250 has a polygonal cross-section including first to ninth sides S_1 to S_9. A first angle θ_1 is formed between the first and second sides S_1 and S_2, a second angle θ_2 is formed between the second and third sides S_2 and S_3, and a third angle θ_3 is formed between the third and fourth sides S_3 and S_4. In this manner, fourth to eighth angles θ_4~θ_8 are formed between the fourth and fifth sides S_4 and S_5, between the fifth and sixth sides S_5 and S_6, between the sixth and seventh sides S_6 and S_7, between the seventh and eighth sides S_7 and S_8, and between the eighth and ninth sides S_8 and S_9, respectively. At this time, the first side Si, the fourth side S_4, the sixth side S_6, and the ninth side S_9 are formed in parallel to each other. The third side S_3 and the eighth side S_8 are formed in parallel to each other. In addition, the first angle θ_1, the second angle θ_2, the fourth angle θ_4, and the sixth to eighth angles θ_6~θ_8 are bent in a different direction than the third angle θ_3 and the fifth angle θ_5. The first angle θ_1, the second angle θ_2, and the fourth to seventh angles θ_4~θ_7 are formed with obtuse angles

and the third angle θ_3 and the eighth angle θ_8 are formed with right angles.

[60] According to the shape of the yoke 250, a first width Pi between the first side S_1 and the ninth side S_9, a second width P_2 between the fourth side S_4 and the ninth side S_9, and a third width P_3 between the sixth side S_6 and the ninth side S_9 differ from one another. Specifically, the first width P_1, the second width P_2, and the third width P_3 have the following relationship: first width Pi > the second width P_2 > the third width P_3. Accordingly, sufficient magnetic force for controlling high pressure and high flow rate can be secured by the shape and an overlap (i.e., the closed amount of the inflow port/discharge port) can be increased by securing a long stroke.

[61] Figs 4 and 5 are perspective views of a plate filter of the solenoid valve according to the exemplary embodiment of the invention and Fig. 6 is a sectional view of the plate filter of the solenoid valve according to the exemplary embodiment.

[62] The plate filter 300 minimizes the flow of foreign matter (for example, contaminant containing iron components) of the valve 100 into the solenoid 200. Referring to Figs 4 to 6, the plate filter includes an outer ring 310, an inner ring 320 having a diameter smaller than the outer ring 310, and a filter membrane 330 formed between the outer ring 310 and the inner ring 320.

[63] The outer ring 310 is inserted into a first mounting groove 112 (see Fig. 1) formed along a lower end of the holder 110 (see Fig. 1) and is fixed by the holder 110 and the core 240 (see Fig. 1) installed at the lower portion of the holder. In addition, the inner ring 330 is inserted and fixed into a second mounting groove 126 (see Fig. 1) formed along a lower end of the spool 120 (see Fig. 1). The outer ring 310 and the inner ring 330 may be formed of a rubber to have elasticity.

[64] The filter membrane 330 may be formed of a foldable and flexible material so as not to be torn during reciprocation of the spool 120. For example, the filter membrane may include a tetron-mesh which has a plurality of holes formed by weaving and may perform a filtering function. The filter membrane 330 is not limited to the tetron-mesh and may be formed of any flexible material that may perform the filtering function. Further, the holes in the filter membrane 330 may have a circular or slot shape, as shown in Figs. 4 to 6.

[65] According to this embodiment, since the plate filter 300 is disposed between the valve 100 and the solenoid 200, introduction of foreign matter can be minimized when the fluid of the valve 100 flows into the solenoid 200. In addition, since the fluid flows through the holes of the filter membrane 330, resistance to the fluid flowing though the plate filter 300 by addition of the plate filter 300 can be minimized.

[66] Figs. 7 and 8 illustrate other examples of the plate filter.

[67] In Figs. 7 and 8, the plate filter 300 includes the outer ring 310, the inner ring 320 having the diameter smaller than the diameter of the outer ring 310, and the filter

membrane 330 between the outer ring 310 and the inner ring 320. In addition, the filter membrane 330 is formed with a curved surface portion 332 around the inner ring 320 and a plane portion 334 between the curved surface portion 332 and the outer ring 310. Here, the outer ring 310, the inner ring 320, and the curved surface portion 334 are made of a rubber having flexibility and the plane portion 334 is made of a foldable and flexible material.

[68] As such, when the curved surface portion 332 is made of a rubber, the plate filter 300 has improved flexibility, so that the filter membrane 330 is not torn or damaged during reciprocation of the spool 120 (see Fig. 1). In addition, the plate filter provides improves performance of the solenoid valve by preventing influence on movement of the spool 120.

[69] Fig. 9 is an enlarged view of Area A in Fig. 1 and Fig. 10 is a diagram of an output waveform measured in operating of the solenoid valve according to the exemplary embodiment of the present invention.

[70] A flow path 170 through which the control chamber 154 communicates with the feedback chamber 158 is formed on an outer periphery of one side of the holder 110. Namely, the flow path 170 connects the control chamber 154 with the feedback chamber 158 by connecting the first opening 163 of the control chamber 154 with the second opening 167 of the feedback chamber 158. As shown in Fig. 9, the flow path 170 is open at one side thereof, and is closed by the valve body when the solenoid valve is mounted on the valve body (not shown).

[71] The second opening 167 formed in the feedback chamber 158 of the first and second openings 163, 167 has a diameter R of 0.5 to 1.5 mm and a thickness T of 1.5 to 2.5 mm. With this configuration of the second opening 167, the overlap can be extended during operation of the solenoid valve. As shown in Fig. 10, when the overlap is extended, it is possible to prevent shift shock by instantaneous change of clutch force and to enhance durability of the automatic transmission through improvement of a response speed and removal of influence due to undershoot.

[72] Fig. 11 is a sectional view of a solenoid valve according to another exemplary embodiment of the invention, Fig. 12 is a side view of a holder of the solenoid valve according to this exemplary embodiment, and Fig. 13 is an enlarged view of a part of a solenoid in the solenoid valve according to this exemplary embodiment.

[73] Here, like components will be denoted by like reference numerals and a description thereof will be omitted or simply explained.

[74] The solenoid valve according to this embodiment includes a valve 100, a solenoid 200 for operating the valve 100, and a plate filter 300 disposed between the valve 100 and the solenoid 200.

[75] The valve 100 includes a ribbon-shaped filter 150 in the holder 110. The ribbon-

shaped filter 150 serves to filter foreign matter which is introduced into a supply port 162 and a control port 164 of the holder 110. In more detail, the ribbon-shaped filter 150 has a C-shaped structure and includes a plurality of holes through which the fluid flows. Further, as shown in Fig. 12, installation grooves R1 and R12 are formed on an outer periphery of the holder 110 such that in which a first ribbon-shaped filter 152 and a second ribbon-shaped filter 154 can be installed thereon. More specifically, the installation grooves R_1, R_{12} are formed near the supply port 162 and the control port 164 of the outer periphery of the holder 110. At this time, both ends of the first ribbon-shaped filter 152 and the second ribbon-shaped 154 may be bent at a predetermined angle to be fixed on the installation grooves R_1, R_{12}.

[76] Referring to Fig 13, the solenoid 200 includes a guide 290 for integrating the core 240 and the yoke 250. The guide 290 has a hollow cylinder shape which partially surrounds the core 240 and the yoke 250. In addition, steps for mounting the guide 290 are formed on outer peripheries of the core 240 and the yoke 250.

[77] As such, the guide 290 is additionally installed to integrate the core 240 and the yoke 250, so that the solenoid valve is prevented from being deformed by external force, thereby improving durability.

[78] Fig. 14 is a sectional view of a solenoid valve according to a further exemplary embodiment, and Figs. 15 and 16 are views of a yoke of a solenoid valve according to this exemplary embodiment.

[79] Referring to Figs 14 to 16, the solenoid valve according to the third embodiment of the present invention will be described in detail. Here, like components will be denoted by like reference numerals and a description thereof will be omitted or simply explained.

[80] The solenoid valve according to this embodiment includes a valve 100, a solenoid 200 for operating the valve 100, and a plate filter 300 disposed between the valve 100 and the solenoid 200. In this embodiment, the plate filter 300 can be omitted.

[81] The solenoid 200 includes a case 210, a bobbin 220 disposed within the case 210, a coil 230 wound around an outer periphery of the bobbin 220, a core 240 coupled to an upper portion of the bobbin 220, a yoke 250 coupled to a lower portion of the bobbin 220, a plunger 260 movable upwards and downwards inside the core 240 and the yoke 250, a rod 270 coupled to the plunger 260 through the core 240, and a terminal 280 connected to the yoke 250.

[82] The yoke 250 has a through-hole 256 formed on an outer periphery thereof. The through-hole 256 is configured to all fluid to flow from or flow into the yoke 250 therethrough during movement of the plunger 260. The through-hole 256 is connected to a second yoke hollow 254 of the yoke 250 such that the fluid is discharged from the second yoke hollow 254 therethrough during downward movement of the plunger 260

and such that the fluid flows into the second yoke hollow 254 therethrough during upward movement of the plunger 260. The fluid flowing through the through-hole 256 may be a gas or liquid such as oil and the like.

[83] When the through-hole 256 is formed in the yoke 250, the plunger 260 undergoes operational resistance by compensating for the change in pressure of the second yoke hollow 254 during movement of the plunger 260, so that the solenoid 200 has improved response, thereby preventing erroneous operation. In particular, when the fluid is discharged or received through the through-hole 256, heat is discharged from the solenoid 200 to the outside via the fluid, thereby improving the cooling effect for the solenoid 200. In addition, when the fluid flows between the yoke 250 and the plunger 260, the solenoid valve has improved lubrication effect, thereby enhancing operational performance.

[84] The yoke 250 may have a single through-hole 256 on the outer periphery thereof and the through-hole 256 may have a diameter of about 2.2 mm. It should be understood that the number and dimensions of the through-hole 256 are not limited thereto and may be changed according to the size of the solenoid and the amount of fluid for cooling and lubrication.

[85] A filter 400 is disposed to prevent inflow of foreign matter when discharging and receiving the fluid. The filter 400 may be a sintered filter obtained by compressing and heating powder. The sintered filter may be formed in various shapes and sizes and exhibits high corrosion resistance and heat resistance when formed using bronze or stainless steel powder. The filter 400 is not limited to the bronze or stainless steel powder and may be formed of any material that provides high corrosion resistance and heat resistance.

[86] In this embodiment, the through-hole 256 and the filter 400 are illustrated as being provided to the yoke but may be provided to the case 210 or the core 240 according to the structure of the solenoid 200. That is, when the case 210 performs the functions of the core and/or the yoke in the solenoid, the through-hole and the filter may be provided to the case 210. When the core is coupled to the lower portion of the bobbin in the solenoid, the through-hole and the filter may be provided to the core. Particularly, in the structure wherein the yoke 250 is inserted into the lower portion of the bobbin 220 as in the embodiment described above, separation of the filter 400 may be prevented without an additional fixture since the bobbin 220 is positioned around the yoke 250.

[87] Although some embodiments have been described herein, it should be understood by those skilled in the art that these embodiments are given by way of illustration only, and that various modifications, variations, and alterations can be made without departing from the spirit and scope of the invention. Therefore, the scope of the

invention should be limited only by the accompanying claims and equivalents thereof.

Claims

[Claim 1] A solenoid valve comprising:
a solenoid;
a valve operated by the solenoid; and
a plate filter disposed between the solenoid and the valve.

[Claim 2] The solenoid valve of claim 1, wherein the valve comprises a hollow holder having one or more chambers and ports formed therein, and a spool reciprocating upwards and downwards within the holder by the solenoid, and the plate filter comprises an outer ring fixed to the holder, an inner ring fixed to the spool, and a filter membrane formed between the outer ring and the inner ring.

[Claim 3] The solenoid valve of claim 2, wherein the filter membrane comprises a curved surface portion formed around the inner ring and a plane portion formed between the curved surface portion and the outer ring.

[Claim 4] The solenoid valve of claim 3, wherein the outer ring and the inner ring are formed of a rubber.

[Claim 5] The solenoid valve of claim 4, wherein the curved surface portion is formed of a rubber.

[Claim 6] The solenoid valve of claim 2, wherein the solenoid comprises a core, a yoke separated a predetermined distance from the core, and a plunger reciprocated by the core and the yoke to operate the valve, the outer ring is positioned at a first mounting groove formed along an edge of the holder and is fixed by a combination of the core and the holder, and the inner ring is fixed to a second mounting groove formed along an edge of the spool.

[Claim 7] A solenoid valve comprising:
a solenoid having a through-hole through which fluid flows into or from the solenoid;
a column filter provided to the through-hole; and
a valve operated by the solenoid.

[Claim 8] The solenoid valve of claim 7, wherein the solenoid comprises a plunger reciprocating within a case of the solenoid and the through-hole is formed in the case.

[Claim 9] The solenoid valve of claim 7, wherein the solenoid comprises a yoke and a core separated from each other within a case of the solenoid and a plunger reciprocating within the yoke and the core, and the through-hole is formed in the yoke.

[Claim 10] The solenoid valve of claim 9, wherein a bobbin is disposed around the yoke and has a coil wound around the bobbin.

[Claim 11] The solenoid valve of claim 7, wherein the solenoid comprises a yoke and a core separated from each other within a case of the solenoid and a plunger reciprocating within the yoke and the core, and the through-hole is formed in the core.

[Claim 12] The solenoid valve of claim 11, wherein a bobbin is disposed around the core and has a coil wound around the bobbin.

[Claim 13] The solenoid valve of claim 7, wherein the filter is a sintered filter formed by compressing and heating powder.

[Claim 14] The solenoid valve of claim 13, wherein the powder is a bronze or stainless steel powder.

[Claim 15] A solenoid valve, comprising:
a solenoid having a through-hole through which fluid flows into or from the solenoid;
a valve operated by the solenoid;
a plate filter disposed between the solenoid and the valve; and
a column filter provided to the through-filter.

[Claim 16] The solenoid valve of claim 15, wherein the valve comprises a hollow holder having one or more chambers and ports formed therein, and a spool reciprocating upwards and downwards within the holder by the solenoid, and the plate filter comprises an outer ring fixed to the holder, an inner ring fixed to the spool, and a filter membrane formed between the outer ring and the inner ring.

[Claim 17] The solenoid valve of claim 16, wherein the filter membrane comprises a curved surface portion formed around the inner ring and a plane portion formed between the curved surface portion and the outer ring.

[Claim 18] The solenoid valve of claim 17, wherein the outer ring and the inner ring are formed of a rubber.

[Claim 19] The solenoid valve of claim 18, wherein the curved surface portion is formed of a rubber.

[Claim 20] The solenoid valve of claim 16, wherein the solenoid comprises a core, a yoke separated a predetermined distance from the core, and a plunger reciprocated by the core and the yoke to operate the valve, the outer ring is positioned at a first mounting groove formed along an edge of the holder and is fixed by a combination of the core and the holder, and the inner ring is fixed to a second mounting groove formed along an edge of the spool.

[Claim 21] The solenoid valve of claim 15, wherein the solenoid comprises a plunger reciprocating within a case of the solenoid and the through-hole is formed in the case.

[Claim 22] The solenoid valve of claim 15, wherein the solenoid comprises a yoke and a core separated from each other within a case of the solenoid and a plunger reciprocating within the yoke and the core, and the through-hole is formed in the yoke.

[Claim 23] The solenoid valve of claim 22, wherein a bobbin is disposed around the yoke and has a coil wound around the bobbin.

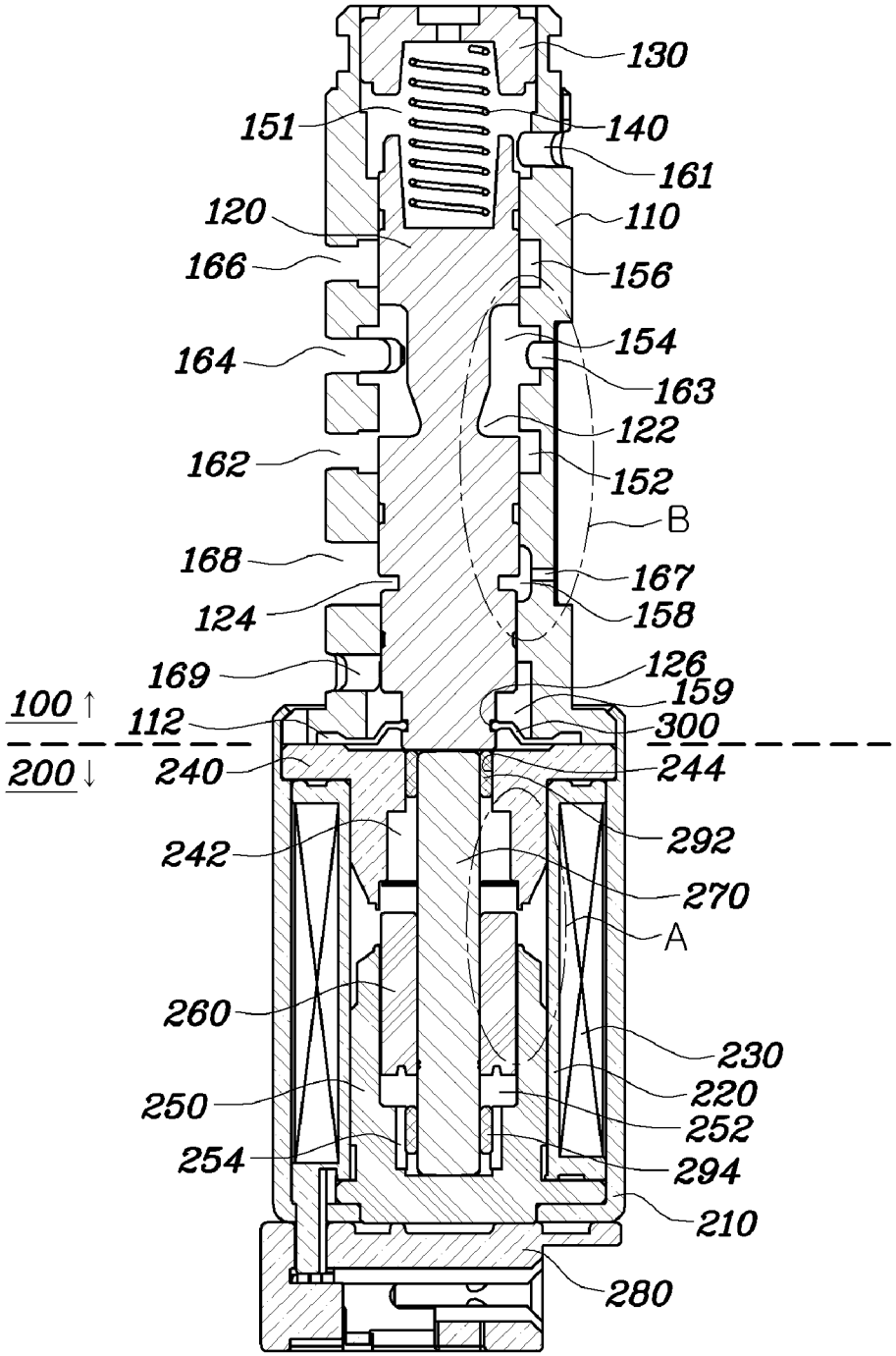
[Claim 24] The solenoid valve of claim 15, wherein the solenoid comprises a yoke and a core separated from each other within a case of the solenoid and a plunger reciprocating within the yoke and the core, and the through-hole is formed in the core.

[Claim 25] The solenoid valve of claim 24, wherein a bobbin is disposed around the core and has a coil wound around the bobbin.

[Claim 26] The solenoid valve of claim 15, wherein the filter is a sintered filter formed by compressing and heating powder.

[Claim 27] The solenoid valve of claim 26, wherein the powder is a bronze or stainless steel powder.

[Fig. 1]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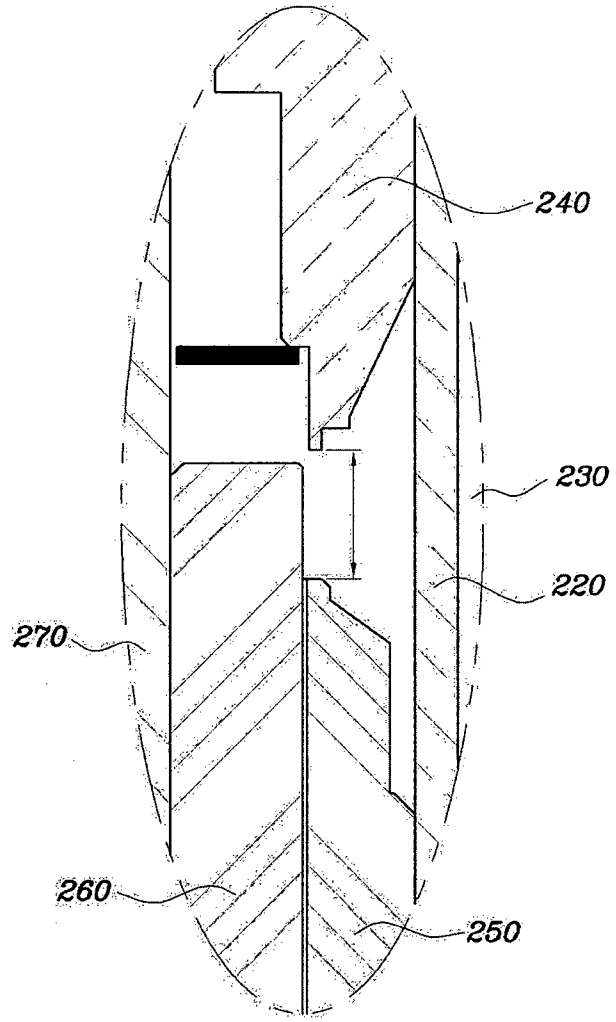
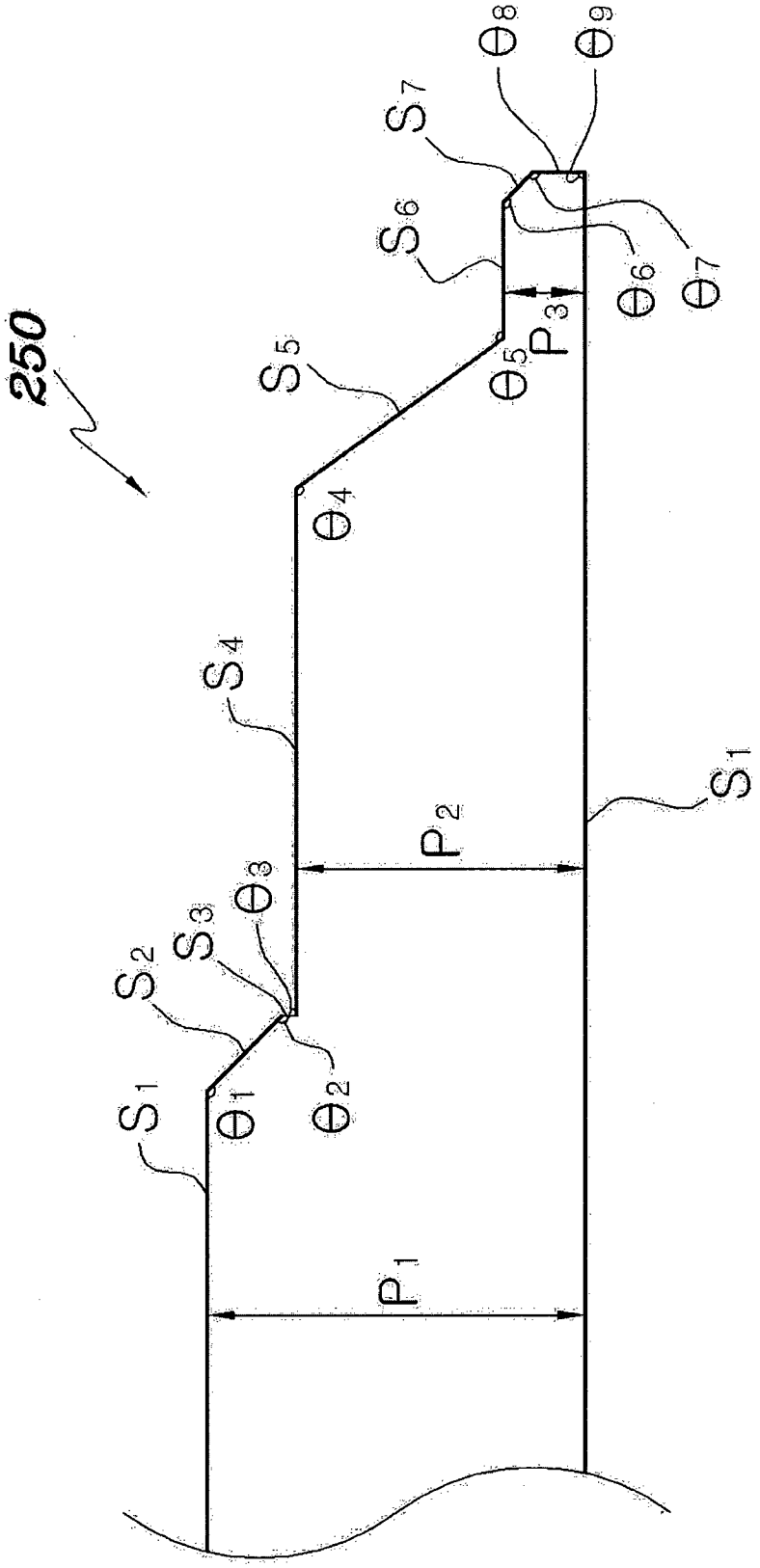
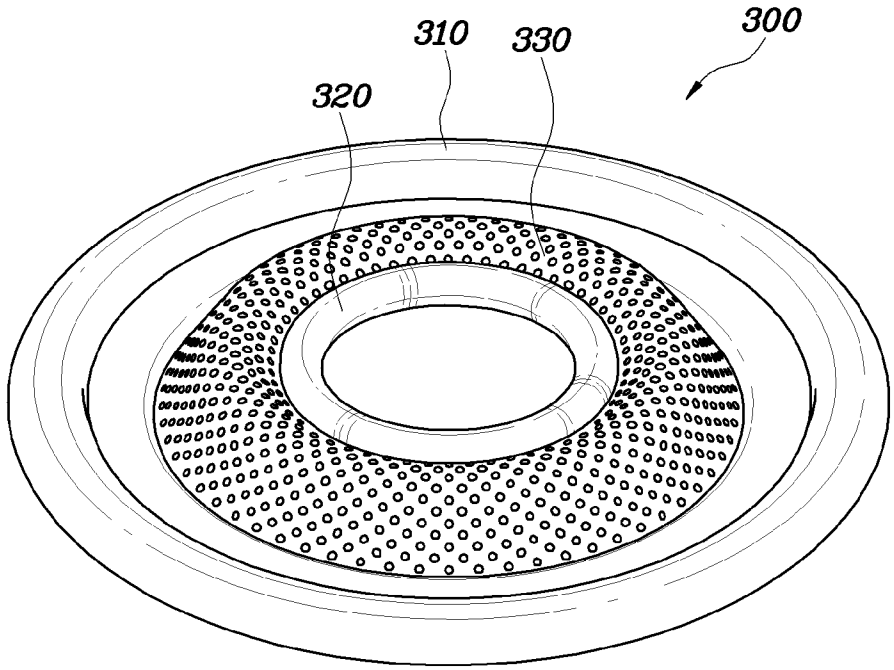
[Fig. 2]



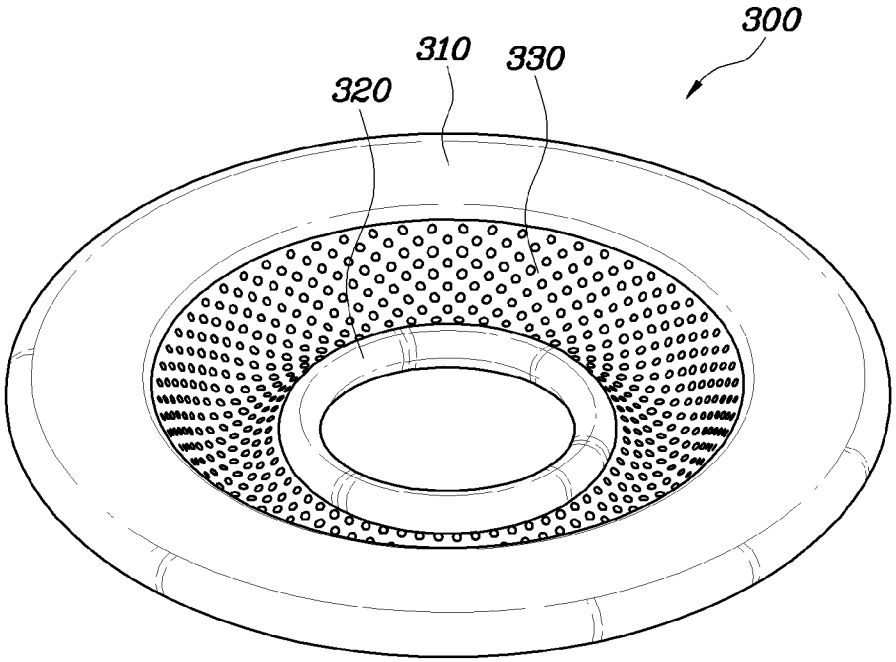
[Fig. 3]



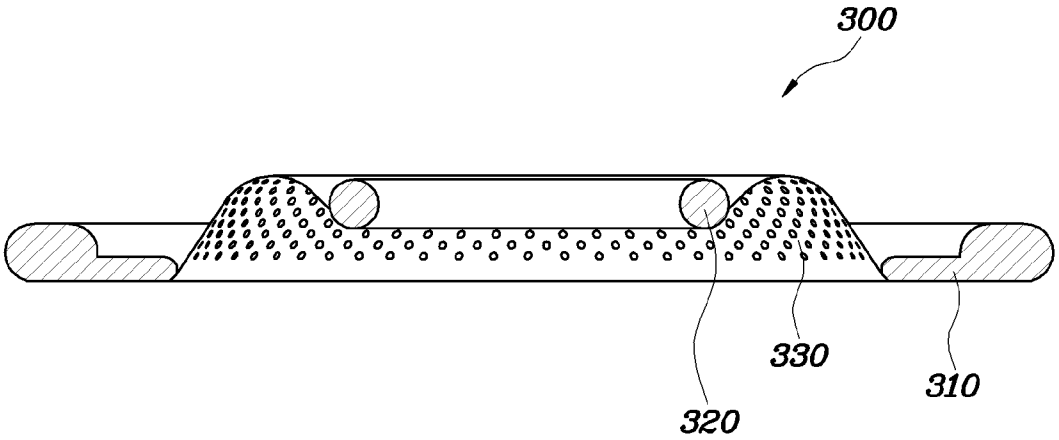
[Fig. 4]



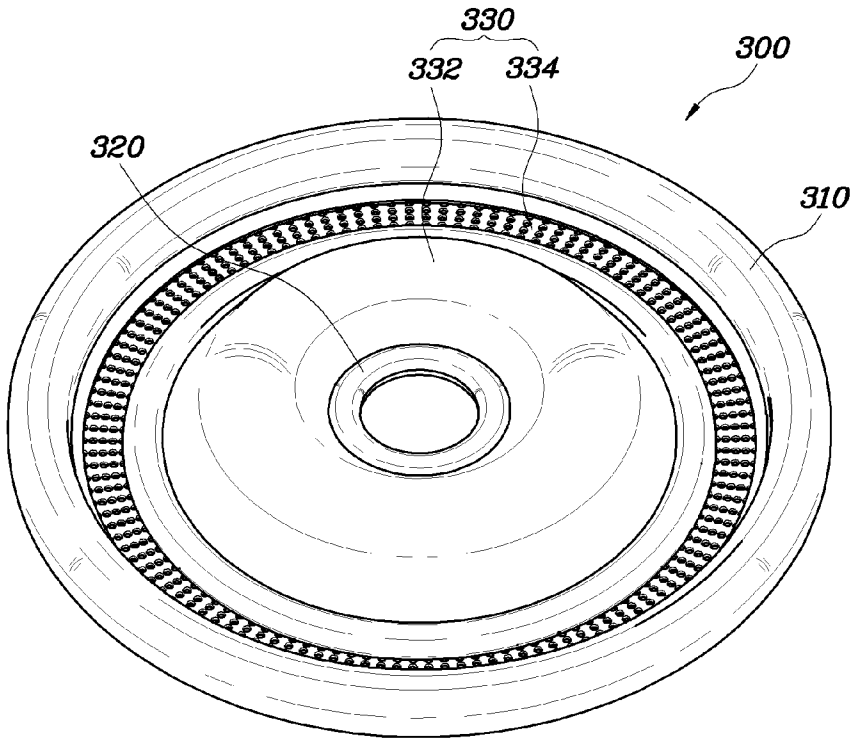
[Fig. 5]



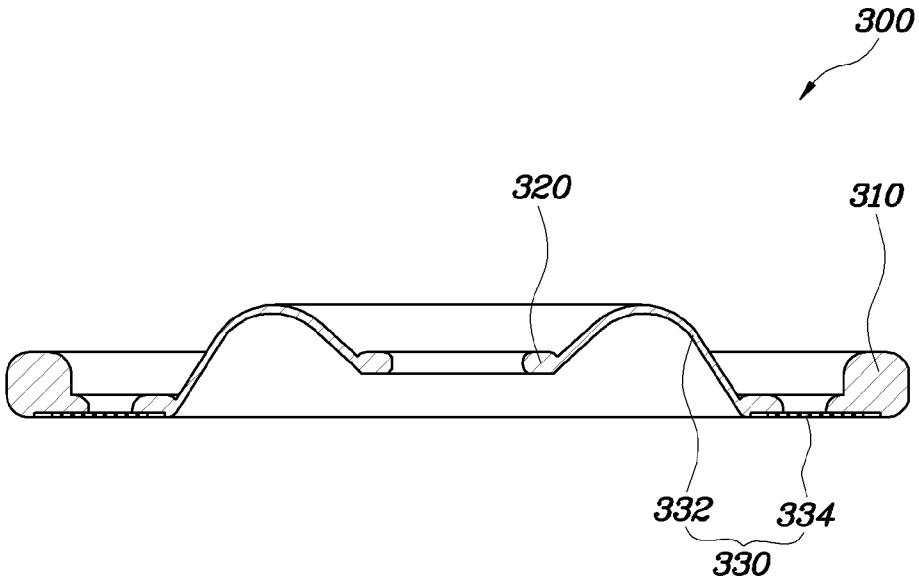
[Fig. 6]



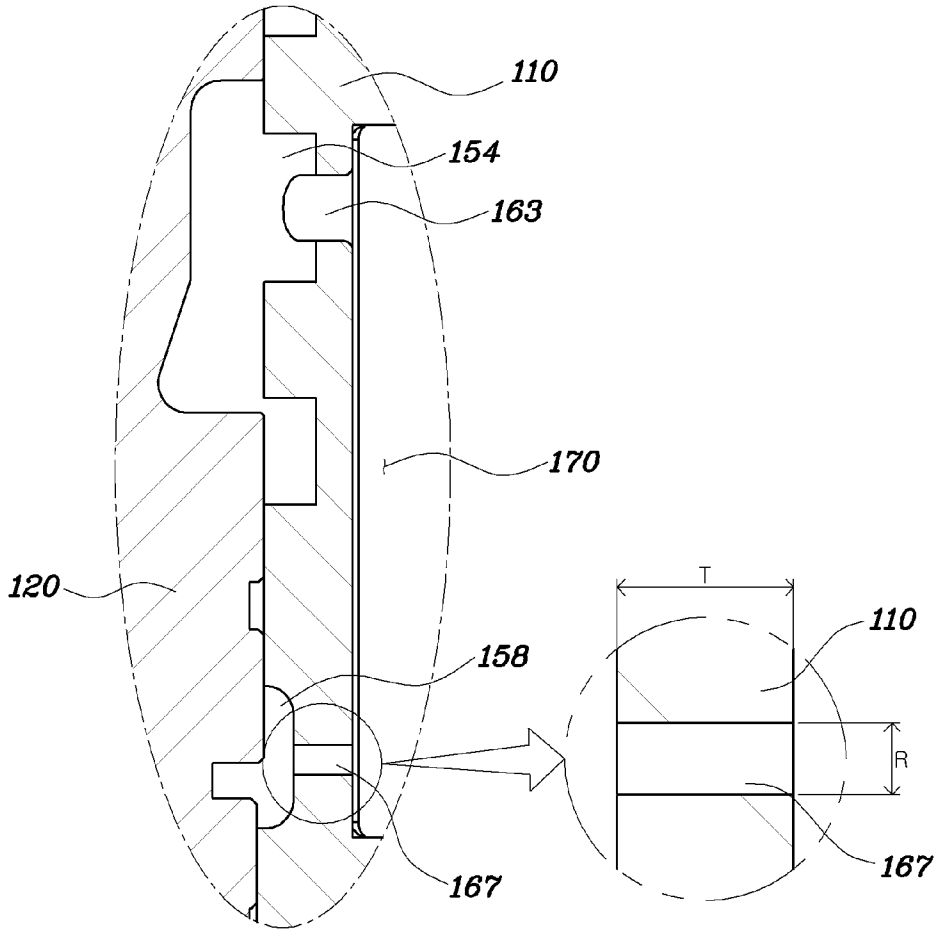
[Fig. 7]



[Fig. 8]



[Fig. 9]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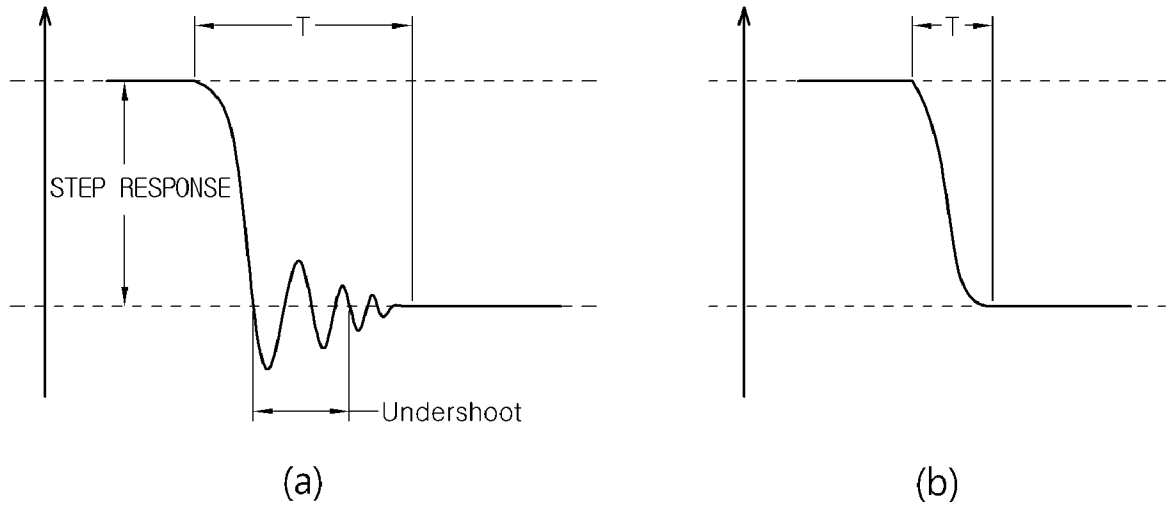
[Fig. 10]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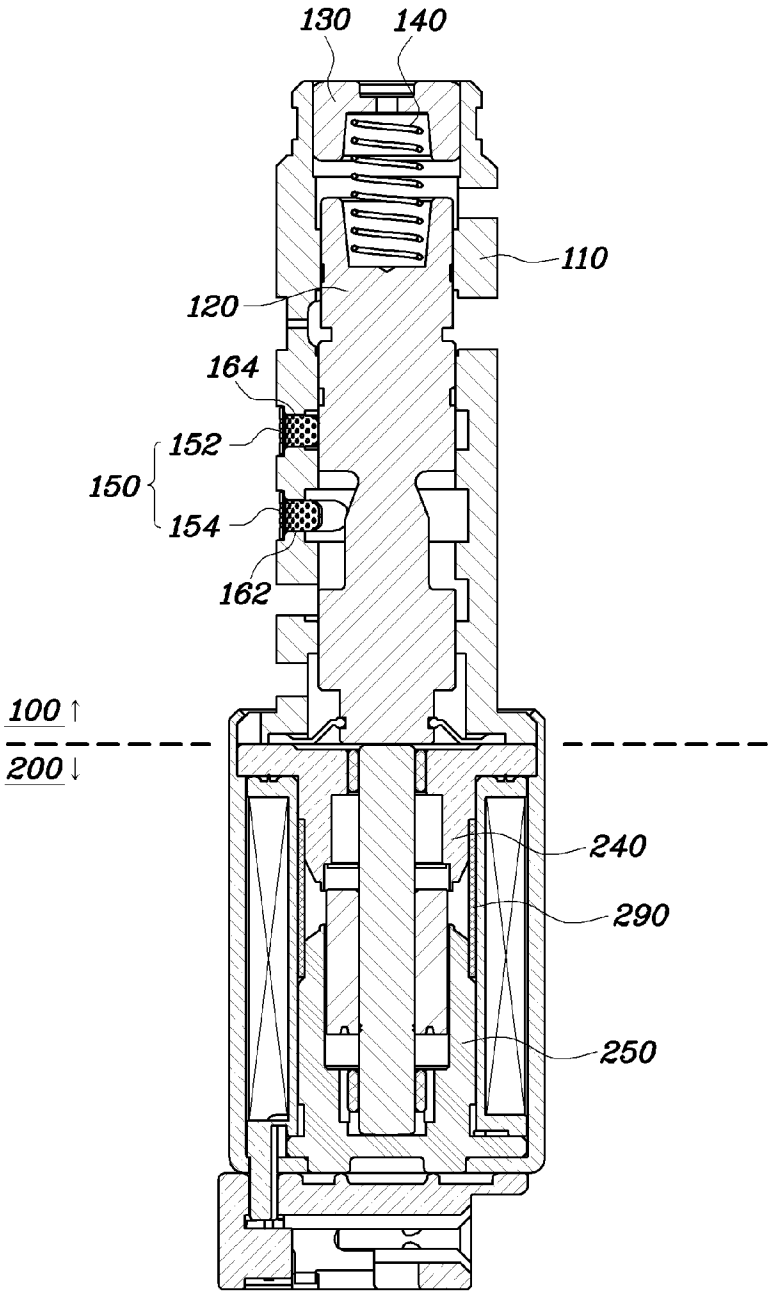
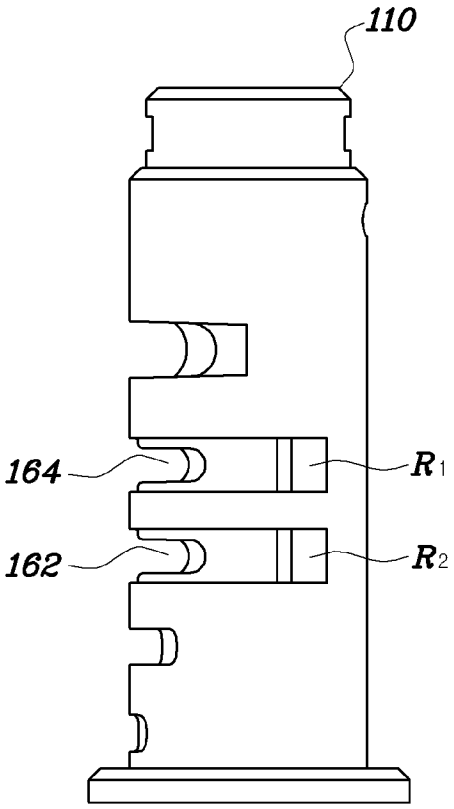
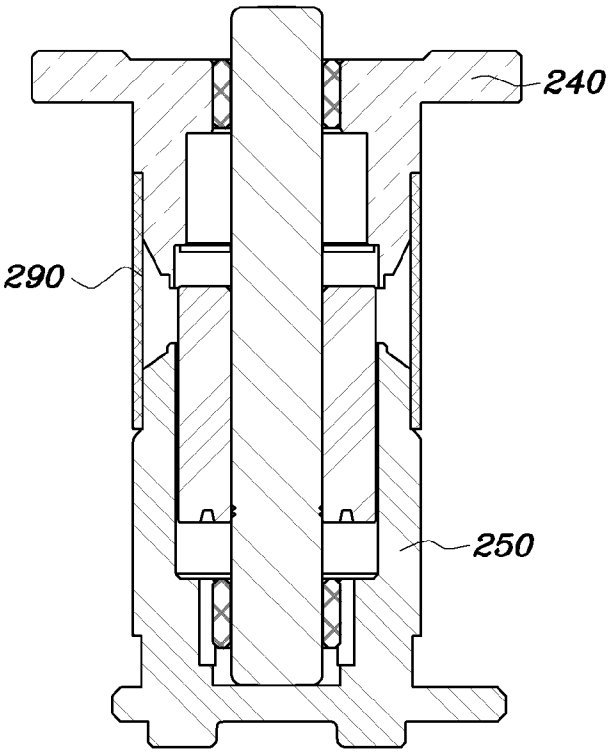
[Fig. 11]



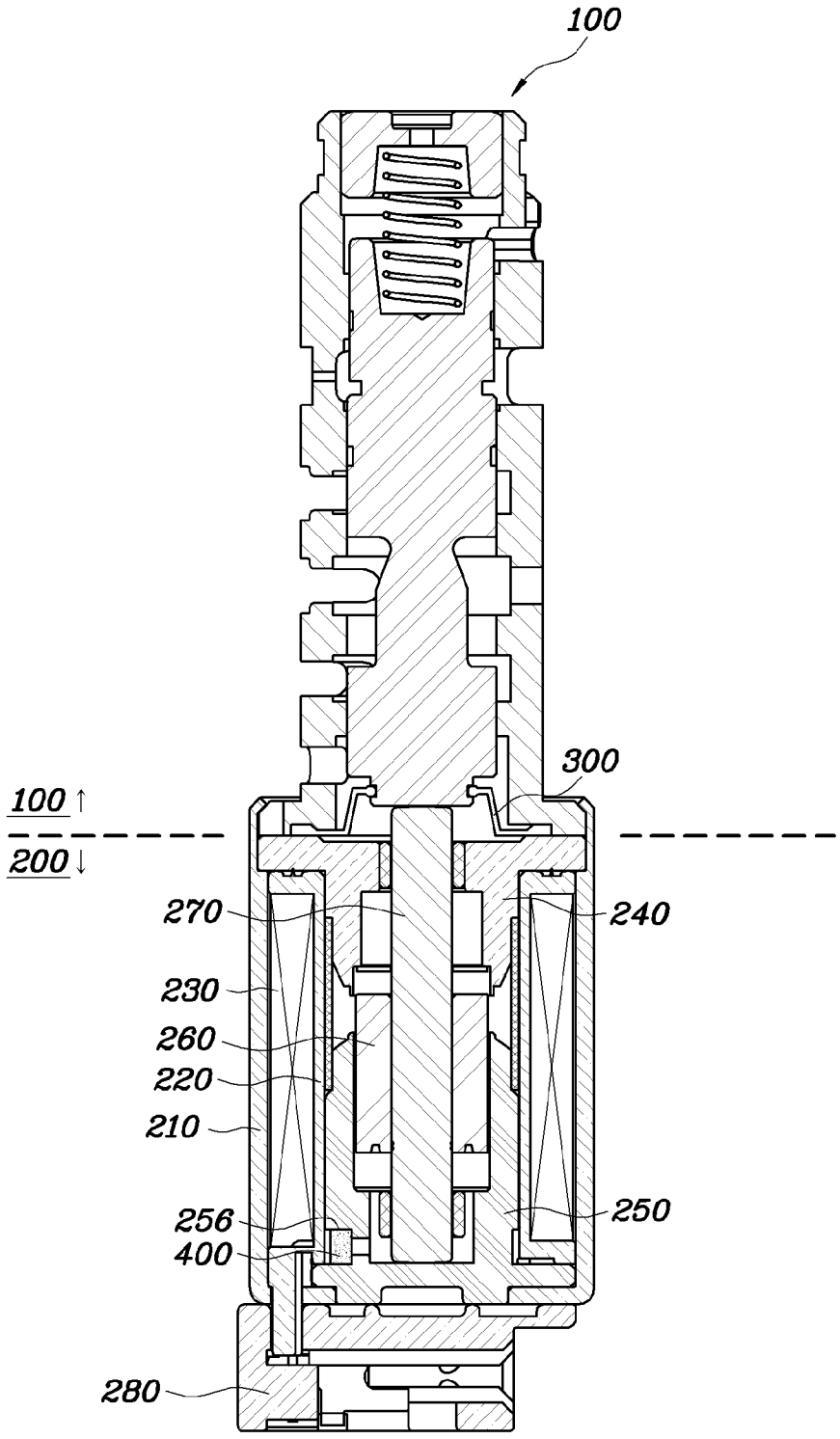
[Fig. 12]



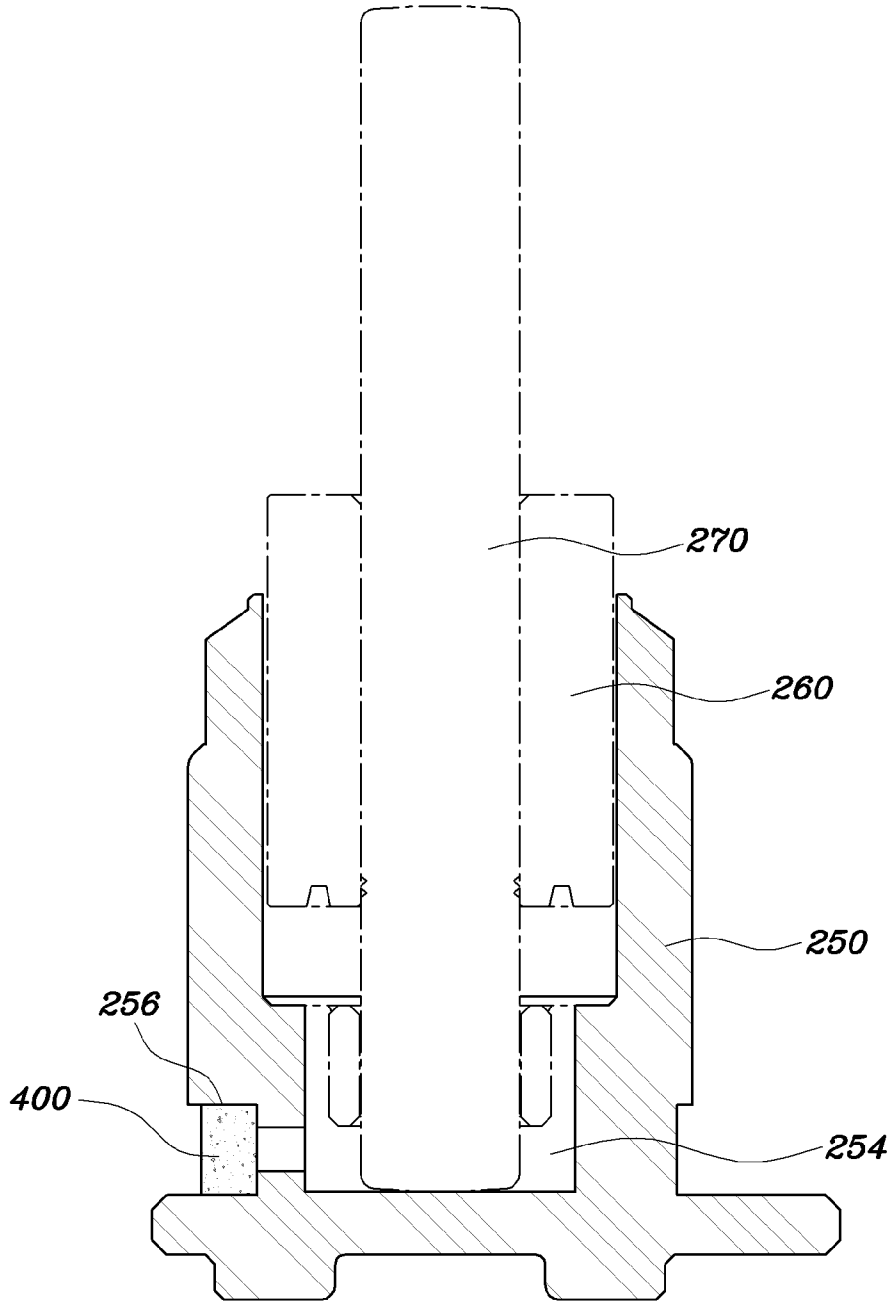
[Fig. 13]



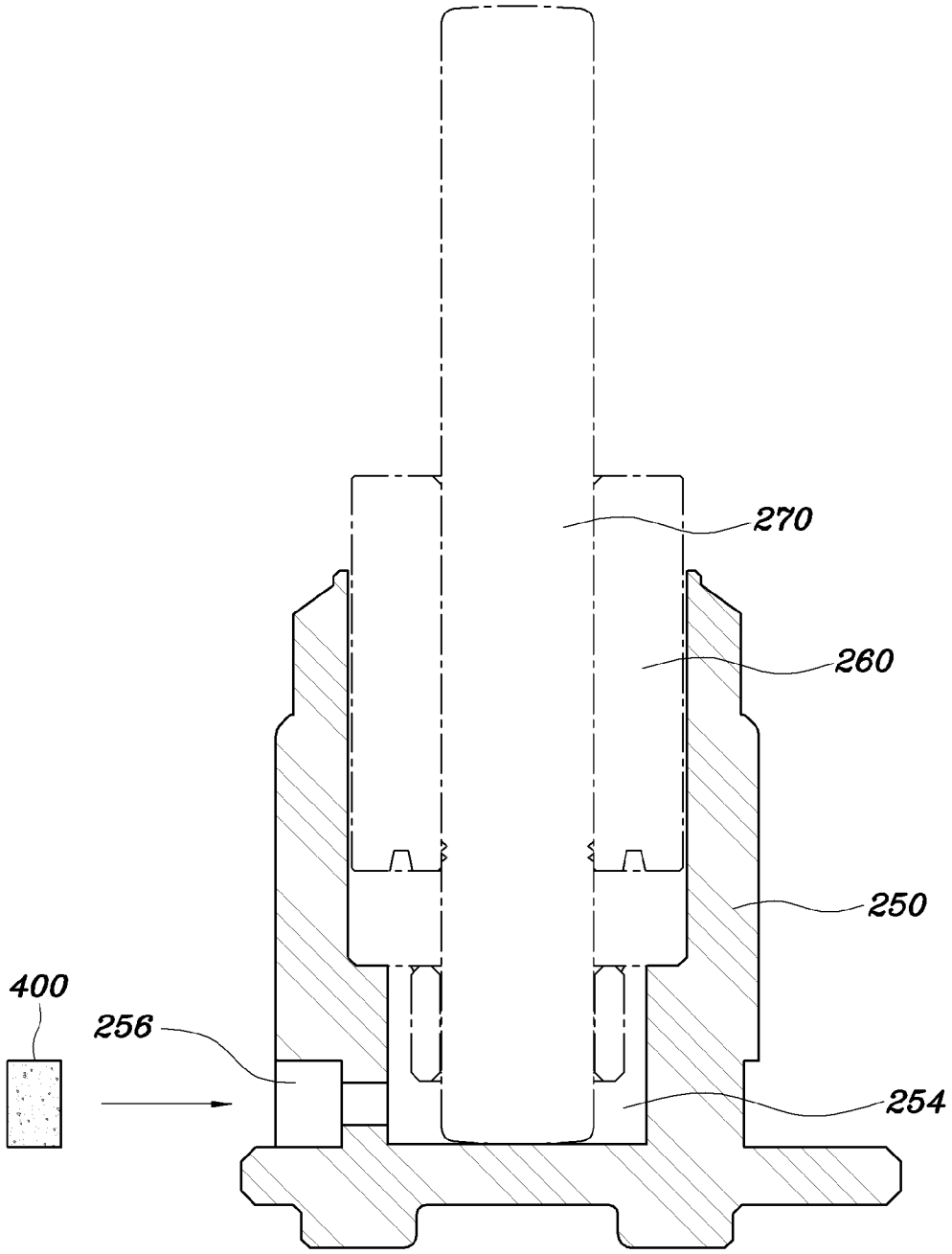
[Fig. 14]



[Fig. 15]



[Fig. 16]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR20 11/006097

A. CLASSIFICATION OF SUBJECT MATTER

F16K 31/06(2006.01)i, H01F 7/16(2006.01)1

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)

F16K 31/06; B60T 8/36; F16K 51/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: solenoid, filter, ring, washer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000-205433 A (FUJI K0KI CORP) 25 July 2000 See description page 3, figures 3-5.	1-27
A	JP 2007-145127 A (DENS0 CORP) 14 June 2007 See description pages 3-4, figures 1-4.	1-27
A	JP 08-277965 A (TOSOK CORP et al.) 22 October 1996 See description page 3, figures 1-2.	1-27
A	JP 2004-340324 A (HITACHI UNISIA AUTOMOTIVE LTD) 02 December 2004 See description page 3, figures 1-3.	1-27

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

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 MARCH 2012 (08.03.2012)	**08 MARCH 2012 (08.03.2012)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daej eon, 189 Cheongsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer JUNG, JIN SOO Telephone No. 82-42-481-3380

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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