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(54) FUEL INJECTION DEVICE AND DIESEL ENGINE

BRENNSTOFFEINSPRITZVORRICHTUNG UND DIESELMOTOR

DISPOSITIF D'INJECTION DE CARBURANT ET MOTEUR DIESEL

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Description

TECHNICAL FIELD

[0001] The present invention relates to a fuel injection device used in internal combustion engines such as a diesel engine, and a diesel engine.

BACKGROUND ART

[0002] Fuel injection devices are provided on a cylinder head of internal combustion engines such as diesel engines, with a tip of a housing of the fuel injection device projecting into a combustion chamber. Fuel injection holes are formed in the tip of the housing, and a needle valve is installed within the housing. The needle valve is separated from a valve seating by an oil pressure of fuel oil supplied within the housing, thereby opening the valve, and fuel oil is supplied to the fuel injection holes. As a result, fuel oil is injected into the combustion chamber from the fuel injection holes. In the combustion chamber, flames are formed by ignition of fuel oil mixed with air, and the flames spread throughout the whole combustion chamber.

[0003] Patent Document 1 discloses a cut-off member provided on a tip of a shaft of a valve, having two cylindrical portions that fit within a central hole within an atomizer. The two cylindrical members include a first cylindrical portion located on the lower side and a second cylindrical portion located on the upper side.

[0004] Another example is given by the document JP 2011 236887 A.

CITATION LIST

Patent Literature

[0005] Patent Document 1: Japanese Unexamined Patent Application Publication (translation of PCT application) No. 2010-512484A

SUMMARY OF INVENTION

Technical Problem

[0006] In the fuel injector described in Patent Document 1, fuel oil is supplied to two groups of nozzle holes located on the top side via a path between the external peripheral face of the two cylindrical portions of the cut-off member and the internal peripheral face of a central hole formed in a core shaft of the atomizer. On the other hand, when a valve spindle is in the closed position, supply of fuel to the two groups of nozzle holes is cut off by the fit of the periphery of the two cylindrical portions within the central hole.

[0007] In the fuel injector described in Patent Document 1, a ring-shaped recess is formed between the first cylindrical portion and the second cylindrical portion. However, when the valve spindle is in the closed position, the ring-shaped recess is in communication with the two groups of nozzle holes. Therefore, even when the valve is closed, fuel oil accumulated in the ring-shaped recess passes through the second nozzle hole, which causes dripping due to supply of fuel oil into the combustion chamber. In other words, the volume sucked by the fuel injector is increased by forming the ring-shaped recess.

[0008] Also, in the fuel injector described in Patent Document 1, when the valve spindle is in the open position, the second cylindrical portion is removed from its fit in the central hole, and only the first cylindrical portion is fixed within the central hole. Therefore, sliding of the valve spindle shaft can become unstable. Also, when the valve spindle moves into the closed position, the second cylindrical portion fits with contact to the internal peripheral face of the central hole, so the shaft can be easily damaged.

[0009] The present invention has been made in view of the above-described circumstances, and has an object to provide a fuel injection device and diesel engine capable of reducing the amount of fuel oil supplied to the combustion chamber when the valve is closed.

SOLUTION TO PROBLEM

[0010] A fuel injection device according to a first aspect of the present invention includes: a housing having a fuel supply path formed in an interior of the housing, and fuel injection holes formed on a tip of the housing; a needle valve that is disposed within the housing, and opens or closes the fuel supply path in accordance with a fuel oil pressure; a spool valve that is provided on a tip of the needle valve, and slides with an external peripheral face of the spool valve

in contact with an internal peripheral face of the housing; and a groove that is formed on the internal peripheral face of the housing in a position different from the fuel injection holes, and is in communication with the fuel supply path, a fuel oil introduction space through which fuel oil flows being formed in the spool valve, upon the fuel supply path being opened, the fuel oil introduction space being in communication with the groove, and, the fuel oil introduction space moving to a position at which the fuel oil introduction space is in communication with the fuel injection holes, and upon the fuel supply path being closed, the external peripheral face of the spool valve facing the fuel injection holes, and the fuel oil introduction space moving to a position at which the fuel oil introduction space is not in communication with the fuel injection holes.

[0011] According to this configuration, when the fuel supply path is opened, fuel oil introduced from the groove is injected from the fuel injection holes via the fuel oil introduction space of the spool valve. On the other hand, when the fuel supply path is closed, the external peripheral face of the needle valve faces the fuel injection holes, and the fuel oil introduction space is not in communication with the fuel injection holes, so fuel is not supplied to the injection holes from the fuel introduction space. Therefore, when the needle valve is closed, dripping caused by fuel oil accumulated in the fuel oil introduction space passing through the fuel injection holes and supplying fuel oil into a combustion chamber does not occur.

[0012] In the invention according to the first aspect as described above, preferably the upper external peripheral face of the spool valve is always in contact with the internal peripheral face of the housing during opening and closing operation of the fuel supply path.

[0013] According to this configuration, when the external peripheral face of the spool valve slides in contact with the internal peripheral face of the housing, during opening and closing operation of the fuel supply path, the external peripheral face of the spool valve located above the fuel oil introduction space is always in contact with the internal peripheral face of the housing. Also, when the fuel supply path is opened, fuel oil is introduced into the fuel oil introduction space of the spool valve from the groove. As a result, even if the fuel oil introduction space is formed in the shape of a recess in the spool valve, the external peripheral face of the needle valve above the fuel oil introduction space is supported by the housing, so the behavior of the needle valve is stabilized. Also, the external peripheral face of the spool valve is always in contact with the internal peripheral face of the housing, so it is difficult for damage to occur due to repeated contact and non-contact.

[0014] In the invention according to the first aspect as described above, the fuel oil introduction space may be formed in a ring shape in the spool valve.

[0015] According to this configuration, the fuel injection holes are provided in a position in the housing that is different from that of the groove, and, the fuel oil introduction space is formed in a ring shape on the outer periphery of the spool valve, so the flow path resistance of fuel oil from the groove via the fuel oil introduction space until it is injected from the injection holes is constant regardless of the rotational position of the needle valve. In other words, even if the needle valve has rotated about the axial line, the flow path resistance of fuel oil does not change, so it is possible to stably inject fuel oil.

[0016] In contrast, a reference example can be considered in which the groove is not formed in the housing, but for example a groove is formed along the axial direction on a shaft of the needle valve, and a through hole is formed in the axial direction in the spool valve, thereby supplying fuel to the fuel oil introduction space. However, in the case of this reference example, the position that fuel oil is introduced to the fuel oil introduction space becomes closer to or distant from the fuel injection holes depending on the rotational position of the needle valve, so the flow path resistance of fuel oil until it is injected from the fuel injection holes varies. On the other hand, in the present invention, the position at which fuel oil is introduced to the fuel oil introduction space (the position of the groove formed in the housing) and the position of the fuel injection holes are constant, so the flow path resistance of fuel oil does not vary.

[0017] In the invention according to the first aspect as described above, the fuel injection holes may be provided as upper fuel injection holes and lower fuel injection holes in the axial direction of the housing, a fuel supply path that supplies fuel to a lower space of the spool valve is formed within the spool valve, and when the fuel supply path is opened, the fuel oil introduction space is in communication with the groove, and, the fuel oil introduction space moves to a position that is in communication with the upper fuel injection holes, and the lower space of the spool valves is in communication with the groove, and, the lower space of the spool valve may be in communication with the lower fuel injection holes.

[0018] According to this configuration, when the fuel supply path is opened, fuel oil introduced from the groove is injected from the upper fuel injection holes via the fuel oil introduction space, and, at the same time, is injected from the lower fuel injection holes via the lower space of the spool valve. The fuel oil introduction space and the lower space of the spool valve are in communication with each other via the groove formed on the internal peripheral face of the housing, so the flow path resistance and the injection pressure can be maintained uniform for fuel oil injected from the upper fuel injection holes and the lower fuel injection holes.

[0019] In the invention according to the first aspect as described above, a plurality of the grooves may be formed on the internal peripheral face of the housing, and the plurality of grooves is provided at equal spacing on the internal

peripheral face of the housing.

[0020] According to this configuration, when the needle valve is subjected to a reaction force of fuel oil introduced into the grooves, because the grooves are provided uniformly, it is difficult for the position of the needle valve to be tilted. Therefore, it is possible to reduce the potential for the spool valve to be pressed against the internal peripheral face of the housing, and cause damage to the sliding surface.

[0021] In the invention according to the first aspect as described above, the groove and the fuel injection hole may be formed providing a spacing therebetween of not less than the diameter of the fuel injection hole.

[0022] According to this configuration, it is possible to reduce the potential for fuel oil, in the portion between the groove and the fuel injection holes, to flow out from the fuel injection holes through the gap between the internal peripheral face of the housing and the external peripheral face of the spool valve, when the needle valve is closed.

[0023] The diesel engine according to a second aspect of the present invention includes the fuel injection device as described above provided in a cylinder head.

[0024] According to this configuration, the fuel injection device is provided in the cylinder head of the diesel engine, and when the fuel supply path is opened, the fuel injection device injects fuel oil introduced from the groove from the fuel injection holes via the fuel oil introduction space of the spool valve. On the other hand, when the fuel supply path is closed, the external peripheral face of the needle valve faces the fuel injection holes, and the fuel oil introduction space is not in communication with the fuel injection holes, so fuel is not supplied to the injection holes from the fuel introduction space. Therefore, when the needle valve is closed, this configuration prevents dripping of fuel oil accumulated in the fuel oil introduction space from supplying to the combustion chamber through the fuel injection holes.

Advantageous Effects of Invention

[0025] According to the present invention, it is possible to reduce the amount of fuel oil supplied to the combustion chamber when the valve is closed.

Brief Description of Drawings

[0026]

FIG. 1 is a schematic view and vertical cross-sectional view of a fuel injection device according to a first embodiment of the present invention, illustrating a state when a needle valve is closed.
FIG. 2 is a vertical cross-sectional view of the fuel injection device according to the first embodiment of the present invention, illustrating a state when the needle valve is opened.
FIG. 3 is a horizontal cross-sectional view sectioned at the line C-C in FIG. 1.
FIG. 4 is a horizontal cross-sectional view sectioned at the line D-D in FIG. 1.
FIG. 5 is a horizontal cross-sectional view sectioned at the line C-C in FIG. 2.
FIG. 6 is a horizontal cross-sectional view sectioned at the line D-D in FIG. 2.
FIG. 7 is a horizontal cross-sectional view sectioned at the line E-E in FIG. 2 or FIG. 10, illustrating one example of a vertical groove.
FIG. 8 is a horizontal cross-sectional view sectioned at the line E-E in FIG. 2 or FIG. 10, illustrating another example of the vertical groove.
FIG. 9 is a vertical cross-sectional view of a fuel injection device according to a second embodiment of the present invention, illustrating a state when a needle valve is closed.
FIG. 10 is a vertical cross-sectional view of the fuel injection device according to the second embodiment of the present invention, illustrating a state when the needle valve is opened.
FIG. 11 is a horizontal cross-sectional view sectioned at the line C-C in FIG. 9.
FIG. 12 is a horizontal cross-sectional view sectioned at the line D-D in FIG. 9.
FIG. 13 is a horizontal cross-sectional view sectioned at the line C-C in FIG. 10.
FIG. 14 is a horizontal cross-sectional view sectioned at the line D-D in FIG. 10.

Description of Embodiments

[0027] An embodiment of the present invention will now be described with reference to the drawings.

[First Embodiment]

[0028] The following is a description of a fuel injection device 10 according to a first embodiment of the present invention. The fuel injection device 10 is applied to, for example, an internal combustion engine such as a large two

cycle marine diesel engine.

[0029] The fuel injection device 10 includes a cylindrical housing 14 that is installed on a cylinder head 12 of the internal combustion engine. FIG. 1 is a schematic view and vertical cross-sectional view of the fuel injection device according to the first embodiment of the present invention, illustrating the state when a needle valve 26 is closed. FIG. 2 illustrates the state when the needle valve 26 is closed.

[0030] As illustrated in FIG. 1, an oil pump 38 is connected to a cylinder 34 via an oil path 36. The cylinder 34 is connected to a first end of an oil path 32, and a second end of the oil path 32 is connected to a fuel supply path 18 formed in the housing 14. A piston 40 that is made to reciprocate by a cam 42 is provided within the cylinder 34. Fuel oil is supplied from the oil pump 38 to the cylinder 34, and fuel oil within the cylinder 34 is supplied to the fuel supply path 18 by the rising of the piston 40.

[0031] A plurality of fuel injection holes is provided in a tip portion 14a of the housing 14. The tip portion 14a projects from a bottom surface 12a of a cylinder head 12 into a combustion chamber 11. A cylindrical central hole 21 is formed along the axial line in the housing 14, and the needle valve 26 is housed within the central hole 21. As an example, the central hole 21 in the housing 14 is cylindrical, but this is not a limitation, and for example it may be a rectangular cylindrical shape.

[0032] The fuel supply path 18 is formed from the top portion toward the bottom portion of the housing 14, and the fuel supply path 18 is in communication with a chamber 20. A valve seating 22 is formed on the bottom surface of the chamber 20, and a fuel supply path 24 is formed on the inside of the valve seating 22. A coil spring 30 is installed above the needle valve 26, and the elastic force of the coil spring 30 is applied to the top surface of the needle valve 26. In this way, when fuel oil is not supplied to the fuel supply path 18, a conical surface 28 of the needle valve 26 is pressed against the valve seating 22, and the fuel supply path 24 provided below the chamber 20 is closed. The needle valve 26 moves upwards in accordance with the oil pressure of fuel oil supplied to the fuel supply path 18, and the fuel supply path 18 and the fuel supply path 24 are linked.

[0033] A spool valve 44 is formed at the tip of the needle valve 26. A fuel supply hole 440 is provided on the axial line of the spool valve 44. The fuel supply hole 440 communicates with the fuel supply path 24 and a space 25 formed below the spool valve 44. The spool valve 44 includes an upper large diameter portion 442 located on the upper side and a lower large diameter portion 444 located on the lower side and separated from the upper large diameter portion 442. A small diameter portion 446 is formed between the upper large diameter portion 442 and the lower large diameter portion 444. The upper large diameter portion 442, the lower large diameter portion 444, and the small diameter portion 446 have, for example, a cylindrical shape. The upper large diameter portion 442, the lower large diameter portion 444, and the small diameter portion 446 may have a rectangular cylindrical shape to suit the shape of the central hole 21 within the housing 14.

[0034] The upper large diameter portion 442 and the lower large diameter portion 444 fit within the central hole 21 of the housing 14, and slide along the internal peripheral face of the central hole 21. When the needle valve 26 closes the fuel supply path 24, the upper large diameter portion 442 closes upper fuel injection holes 16a, 16b, and the lower large diameter portion 444 closes lower fuel injection holes 16c, 16d, as illustrated in FIGS. 1, 3, and 4.

[0035] At the position corresponding to the small diameter portion 446 between the upper large diameter portion 442 and the lower large diameter portion 444, a ring-shaped fuel oil introduction space 27 is formed. The fuel oil introduction space 27 is formed in a recess toward the center side from the external peripheral face of the spool valve 44, for distributing fuel oil. When the needle valve 26 opens the fuel supply path 24, and the fuel supply path 18 is in communication with the fuel supply path 24, the fuel oil introduction space 27 faces the upper fuel injection holes 16a, 16b, and the fuel oil introduction space 27 is in communication with the upper fuel injection holes 16a, 16b, as illustrated in FIGS. 2 and 5. Also, the space 25 that is formed below the spool valve 44 faces the lower fuel injection holes 16c, 16d, so the space 25 is in communication with the fuel injection holes 16c, 16d, as illustrated in FIGS. 2 and 6. Note that the fuel oil introduction space 27 may be ring shaped, but is not limited to a circular ring shape.

[0036] The four fuel injection holes 16a to 16d are disposed divided into two injection hole rows A and B, provided at different positions in the axial direction of the housing 14. The upper injection hole row A is configured from the fuel injection holes 16a and 16b, and the lower injection hole row B is configured from the fuel injection holes 16c and 16d. As illustrated in FIGS. 3 to 6, each of the fuel injection holes 16a to 16d is formed, for example, in a radiation direction with respect to the axial line of the housing 14. The number of fuel injection holes is not limited to four, for example, three may be formed in the upper injection hole row A, and three may be formed in the lower injection hole row B, and the number of fuel injection holes formed in the upper injection hole row A and the lower injection hole row B need not be the same.

[0037] A vertical groove 23 is formed along the axial direction on the internal peripheral face of the central hole 21 of the housing 14. In the housing 14, the vertical groove 23 is provided at a position that is different from the fuel injection holes 16a, 16b, as illustrated in FIGS. 3 and 5. The vertical groove 23 is formed with a length so that regardless of the vertical position of the needle valve 26, it is always in communication with the fuel supply path 24 and the ring-shaped fuel oil introduction space 27. In this way, fuel oil fills the fuel oil introduction space 27 even when the needle valve 26

closes the fuel supply path 24.

[0038] As illustrated in FIGS. 7 and 8, a plurality of vertical grooves 23 may be formed on the internal peripheral face of the housing 14. The plurality of vertical grooves 23 is provided at equal spacing on the internal peripheral face of the housing. For example, as illustrated in FIG. 7, when an even number of vertical grooves 23 such as 2 is provided, the two vertical grooves 23 are formed in relative positions facing each other. Also, as illustrated in FIG. 8, when an odd number of vertical grooves 23 such as 3 is provided, each of the vertical grooves 23 is provided at equal spacing. The needle valve 26 is subjected to a reaction force from fuel oil that is pressurized and introduced into the vertical grooves 23. At this time, because the vertical grooves 23 are provided uniformly, it is difficult for the position of the needle valve 26 to become tilted. Therefore, it is possible to reduce the potential for the spool valve 44 to be pressed against the internal peripheral face of the housing 14, and cause damage or stick to the sliding surface.

[0039] Preferably, the distance L between the vertical grooves 23 and each of the fuel injection holes 16a, 16b is formed so that a spacing of the diameter d of the injection hole or greater is maintained. In this way, it is possible to reduce the potential for fuel oil, in the portion between the vertical groove 23 and the fuel infection holes 16a, 16b, to flow out from the fuel infection holes 16a, 16b through the gap between the internal peripheral face of the housing 14 and the external peripheral face of the spool valve 44, when the needle valve 26 is closed.

[0040] Next, the action of the fuel injection device 10 according to the present embodiment is described.

[0041] When fuel oil is not supplied from the oil path 32 to the fuel supply path 18, the needle valve 26 is seated on the valve seating 22 and closes the fuel supply path 18.

[0042] When fuel oil is supplied from the oil path 32 to the fuel supply path 18, the needle valve 26 is raised against the elastic force of the coil spring 30 in accordance with the oil pressure of fuel oil, and the fuel supply path 24 is opened. In other words, the needle valve 26 does not rise until the oil pressure of fuel oil is equal to or greater than a certain oil pressure, and the fuel supply path 24 is closed.

[0043] In this way, fuel oil arrives at the lower space 25 through the fuel supply path 18, the fuel supply path 24, and the fuel supply hole 440. Also, fuel oil arrives at the fuel oil introduction space 27 via a different path, namely, through the fuel supply path 18, the fuel supply path 24, and the vertical groove 23.

[0044] The spool valve 44 that is integral with the needle valve 26 is also raised and lowered in accordance with the raising and lowering of the needle valve 26. The injection hole row A and the injection hole row B are opened and closed in accordance with the position of the spool valve 44. When the needle valve 26 is raised and the needle valve 26 is opened, the fuel oil introduction space 27 is in communication with the vertical groove 23, and, the fuel oil introduction space 27 is moved to a position at which the fuel oil introduction space 27 is in communication with the fuel injection holes 16a, 16b of the injection hole row A. Also, the lower large diameter portion 444 of the spool valve 44 opens the fuel injection holes 16c, 16d of the injection hole row B. Therefore, when the spool valve 44 is raised, all of the fuel injection holes 16a to 16d of the injection hole row A and the injection hole row B are opened.

[0045] On the other hand, when fuel oil is not supplied from the oil path 32, the needle valve 26 is lowered onto the valve seating 22, and the fuel supply path 24 is closed. When the needle valve 26 is seated on the valve seating 22, all of the fuel injection holes 16a to 16d of the injection hole row A and the injection hole row B are closed by the external peripheral face of the spool valve 44, in other words, the upper large diameter portion 442 or the lower large diameter portion 444. At this time, the fuel oil introduction space 27 moves to a position at which the fuel oil introduction space 27 is not in communication with the fuel injection holes 16a to 16d.

[0046] According to the present embodiment, when the needle valve 26 is opened, fuel oil introduced from the vertical groove 23 is injected from the fuel injection holes 16a, 16b via the fuel oil introduction space 27 of the spool valve 44. At the same time, fuel oil that reaches the lower space 25 through the fuel supply hole 440 is injected from the fuel injection holes 16c, 16d via the lower space 25 of the spool valve 44.

[0047] On the other hand, when the needle valve 26 is closed, the external peripheral face of the needle valve 26 (the upper large diameter portion 442 and the lower large diameter portion 444) faces the fuel injection holes 16a to 16d, and the fuel oil introduction space 27 is not in communication with the fuel injection holes 16a to 16d, so fuel from the fuel introduction space is not supplied to the fuel injection holes 16a to 16d. Therefore, when the needle valve 26 is closed, this configuration prevents dripping of fuel oil accumulated in the fuel oil introduction space 27 from supplying to the combustion chamber through the fuel injection holes 16a to 16d.

[0048] The external peripheral face 442a of the spool valve 44 located above the fuel oil introduction space 27, in other words, the external peripheral face 442a of the upper large diameter portion 442 is always in contact with the internal peripheral face of the central hole 21 of the housing 14 during opening and closing operation of the needle valve 26.

[0049] In this way, when the external peripheral face of the spool valve 44 slides in contact with the internal peripheral face of the central hole 21 of the housing 14 during opening and closing operation of the needle valve 26, the external peripheral face 442a of the upper large diameter portion 442 is always in contact with the internal peripheral face of the central hole 21 of the housing 14. Also, when the needle valve 26 is opened, fuel oil is introduced into the fuel oil introduction space 27 from the vertical groove 23. As a result, even if the fuel oil introduction space 27 is formed in the shape of a recess in the spool valve 44, the needle valve 26 is supported by the external peripheral face 442a of the

upper large diameter portion 442 to the housing 14, so the behavior of the needle valve 26 is stabilized. Also, the external peripheral face of the spool valve 44 is always in contact with the internal peripheral face of the central hole 21 of the housing 14, so it is difficult for damage to occur due to repeated contact and non-contact.

[0050] Also, the fuel oil introduction space 27 is formed in a ring shape on the outer periphery of the spool valve 44 as illustrated in FIG. 5.

[0051] In this way, the fuel injection holes 16a to 16d, in the housing 14, are provided in positions that are different from the vertical groove 23, and, the fuel oil introduction space 27 is formed in a ring shape on the outer periphery of the spool valve 44, so the flow path resistance of fuel oil flowing from the vertical groove 23 via the fuel oil introduction space 27 until it is injected from the injection holes is constant regardless of the rotational position of the needle valve 26. In other words, even if the needle valve 26 has rotated about the axial line, the flow path resistance of fuel oil does not change, so it is possible to stably inject fuel oil.

[0052] In contrast, a reference example can be considered in which the vertical groove 23 is not formed on the housing 14, but for example a groove is formed along the axial direction on the shaft of the needle valve 26, and a through hole is formed in the axial direction in the spool valve 44, to supply fuel to the fuel oil introduction space 27. However, in the case of this reference example, the position at which fuel oil is introduced to the fuel oil introduction space 27 becomes closer to or distant from the fuel injection holes 16a to 16d depending on the rotational position of the needle valve 26, so the flow path resistance until fuel oil is injected from the fuel injection holes 16a to 16d varies. On the other hand, in the present embodiment, the position at which fuel oil is introduced to the fuel oil introduction space 27 (the position of the vertical groove 23 formed in the housing 14) and the position of the fuel injection holes 16a to 16d are constant, so the flow path resistance of fuel oil does not vary.

[Second Embodiment]

[0053] Next, a fuel injection device 10 according to a second embodiment of the present invention is described with reference to FIGS. 9 to 14.

[0054] The vertical groove in the present embodiment differs from that of the first embodiment, and the rest of the configuration is the same, so duplication of description is omitted.

[0055] In the first embodiment as described above, when the needle valve 26 is opened, the vertical groove 23 is not in communication with the lower space 25 of the spool valve 44. In this case, the fuel oil path to the fuel injection holes 16a, 16b of the injection hole row A and the fuel oil path to the fuel injection holes 16c, 16d of the lower injection hole row B are separated. Therefore, the flow path resistance of the two are different.

[0056] In the present embodiment, as illustrated in FIGS. 10 and 14, a vertical groove 29 is formed to a position at which the vertical groove 29 is in communication with the lower space 25 of the spool valve 44 even when the needle valve 26 is opened.

[0057] According to the present embodiment, when the needle valve 26 is opened, fuel oil introduced from the vertical groove 29 is injected from the upper fuel injection holes 16a, 16b via the fuel oil introduction space 27, and at the same time, is injected from the lower fuel injection holes 16c, 16d via the lower space 25 of the spool valve 44.

[0058] The fuel oil introduction space 27 and the lower space 25 of the spool valve are in communication via the vertical groove 29 formed on the internal peripheral face of the housing 14, so the flow path resistance and the injection pressure can be maintained uniform for fuel oil injected from the upper fuel injection holes 16a, 16b and the lower fuel injection holes 16c, 16d.

Reference Signs List

[0059]

10	Fuel injection device
11	Combustion chamber
12	Cylinder head
14	Housing
16a, 16b, 16c, 16d	Fuel injection hole
18, 24	Fuel supply path
23	Vertical groove (groove)
26	Needle valve
27	Fuel oil introduction space
44	Spool valve

Claims

1. A fuel injection device (10), comprising:

   a housing (14) having a fuel supply path (18) formed in an interior of the housing, and fuel injection holes (16) formed on a tip (14a) of the housing;
   a needle valve (26) that is disposed within the housing, and opens or closes the fuel supply path in accordance with a fuel oil pressure;
   a spool valve (44) that is provided on a tip of the needle valve (26), and slides with an external peripheral face of the spool valve in contact with an internal peripheral face (21) of the housing; and
   a groove (23) that is formed on the internal peripheral face of the housing in a position different from the fuel injection holes, and is in communication with the fuel supply path;
   a fuel oil introduction space (27) through which fuel oil flows being formed in the spool valve;
   upon the fuel supply path being opened, the fuel oil introduction space being in communication with the groove, and, the fuel oil introduction space moving to a position at which the fuel oil introduction space is in communication with the fuel injection holes; and
   upon the fuel supply path being closed, the external peripheral face of the spool valve facing the fuel injection holes, and the fuel oil introduction space moving to a position at which the fuel oil introduction space is not in communication with the fuel injection holes.

2. The fuel injection device according to claim 1, wherein the upper external peripheral face of the spool valve is always in contact with the internal peripheral face of the housing during opening and closing operation of the fuel supply path.

3. The fuel injection device according to claim 1 or 2, wherein the fuel oil introduction space is formed in a ring shape on the spool valve.

4. The fuel injection device according to any one of claims 1 to 3, wherein the fuel injection holes are provided as upper fuel injection holes and lower fuel injection holes in an axial direction of the housing,
   a fuel supply path that supplies fuel to a space below the spool valve is formed within the spool valve, and
   upon the fuel supply path being opened, the fuel oil introduction space is in communication with the groove, and, the fuel oil introduction space moves to the position at which the fuel oil introduction space is in communication with the upper fuel injection holes, and the space below the spool valve is in communication with the groove, and, the space below the spool valve is in communication with the lower fuel injection holes.

5. The fuel injection device according to any one of claims 1 to 4, wherein the plurality of grooves is formed on the internal peripheral face of the housing, and the plurality of grooves is provided at equal spacing on the internal peripheral face of the housing.

6. The fuel injection device according to any one of claims 1 to 5, wherein the groove and the fuel injection hole are formed providing a spacing therebetween of not less than a diameter of the fuel injection hole.

7. A diesel engine, comprising the fuel injection device described in any one of claims 1 to 6 provided on a cylinder head.

Patentansprüche

1. Kraftstoffeinspritzvorrichtung (10) umfassend:

   ein Gehäuse (14) mit einem Kraftstoffzufuhrpfad (18), der im Inneren des Gehäuses gebildet ist,
   und Kraftstoffeinspritzlöcher (16), die an einer Spitze (14a) des Gehäuses gebildet sind;
   ein Nadelventil (26), das innerhalb des Gehäuses angeordnet ist und den Kraftstoffzufuhrpfad gemäß einem Kraftstofföldruck öffnet oder schließt;
   ein Schieberventil (44), das an einer Spitze des Nadelventils (26) vorgesehen ist und mit einer äußeren Umfangsfläche des Schieberventils in Kontakt mit einer inneren Umfangsfläche (21) des Gehäuses gleitet; und
   eine Nut (23), die an der inneren Umfangsfläche des Gehäuses an einer Stelle gebildet ist, wo keines der Kraftstoffeinspritzlöcher vorgesehen ist, und in Kommunikation mit dem Kraftstoffzufuhrpfad steht;
   ein in dem Schieberventil gebildeter Kraftstofföl-Einführraum (27), durch welchen Kraftstofföl fließt;
   wobei nach Öffnen des Kraftstoffzufuhrpfads der Kraftstofföl-Einführraum in Kommunikation mit der Nut steht

und der Kraftstofföl-Einführraum sich in eine Position bewegt, in welcher der Kraftstofföl-Einführraum in Kommunikation mit den Kraftstoffeinspritzlöchern steht; und
wobei nach Schließen des Kraftstoffzufuhrpfades die äußere Umfangsfläche des Schieberventils den Kraftstoffeinspritzlöchern zugewandt ist, und der Kraftstofföl-Einführraum sich in eine Position bewegt, in welcher der Kraftstofföl-Einführraum nicht mit den Kraftstoffeinspritzlöchern in Kommunikation steht.

2. Kraftstoffeinspritzvorrichtung nach Anspruch 1, wobei die obere äußere Umfangsfläche des Schieberventils immer in Kontakt mit der inneren Umfangsfläche des Gehäuses während des Öffnens und Schließens des Kraftstoffzufuhrpfads ist.

3. Kraftstoffeinspritzvorrichtung nach Anspruch 1 oder 2, wobei der Kraftstofföl-Einführraum ringförmig an dem Schieberventil gebildet ist.

4. Kraftstoffeinspritzvorrichtung nach einem der Ansprüche 1 bis 3, wobei die Kraftstoffeinspritzlöcher als obere Kraftstoffeinspritzlöcher und untere Kraftstoffeinspritzlöcher in axialer Richtung des Gehäuses vorgesehen sind,
ein Kraftstoffzufuhrpfad, der Kraftstoff zu einem Raum unterhalb des Schieberventils zuführt, innerhalb des Schieberventils gebildet ist,
und
nach dem Öffnen des Kraftstoffzufuhrpfads der Kraftstofföl-Einführraum in Kommunikation mit der Nut steht und der Kraftstofföl-Einführraum sich in die Position bewegt, in welcher der Kraftstofföl-Einführraum in Kommunikation mit den oberen Kraftstoffeinspritzlöchern steht und der Raum unterhalb des Schieberventils in Kommunikation mit der Nut steht und der Raum unterhalb des Schieberventils in Kommunikation mit den unteren Kraftstoffeinspritzlöchern steht.

5. Kraftstoffeinspritzvorrichtung nach einem der Ansprüche 1 bis 4, wobei die Mehrzahl von Nuten an der inneren Umfangsfläche des Gehäuses gebildet ist und die Mehrzahl von Nuten in gleichem Abstand an der inneren Umfangsfläche des Gehäuses vorgesehen ist.

6. Kraftstoffeinspritzvorrichtung nach einem der Ansprüche 1 bis 5, wobei die Nut und das Kraftstoffeinspritzloch so gebildet sind, dass ein Raum zwischen diesen von nicht weniger als einem Durchmesser des Kraftstoffeinspritzloches vorgesehen ist.

7. Dieselmotor umfassend die Kraftstoffeinspritzvorrichtung, die in einem der Ansprüche 1 bis 6 beschrieben ist und an einem Zylinderkopf vorgesehen ist.

Revendications

1. Dispositif d'injection de carburant (10), comprenant :

un carter (14) comportant un passage d'alimentation en carburant (18) formé dans un intérieur du carter et des trous d'injection de carburant (16) formés sur une pointe (14a) du carter ;
une soupape à pointeau (26) qui est disposée à l'intérieur du carter, et qui ouvre ou ferme le passage d'alimentation en carburant en fonction d'une pression de combustible ;
un distributeur à tiroir cylindrique (44) qui est prévu sur une pointe de la soupape à pointeau (26), et qui coulisse tandis qu'une face périphérique externe de la soupape à pointeau est en contact avec une face périphérique interne (21) du carter ; et
une gorge (23) qui est formée sur la face périphérique interne du carter en une position différente de celles des trous d'injection de carburant, et qui est en communication avec le passage d'alimentation en carburant ;
un espace d'introduction de combustible (27) au travers duquel un combustible s'écoule étant formé dans le distributeur à tiroir cylindrique ;
suite à l'ouverture du passage d'alimentation en carburant, l'espace d'introduction de combustible est en communication avec la gorge, et l'espace d'introduction de combustible se déplace jusqu'à une position à laquelle l'espace d'introduction de combustible est en communication avec les trous d'injection de carburant ; et
suite à la fermeture du passage d'alimentation en carburant, la face périphérique externe du distributeur à tiroir cylindrique fait face aux trous d'injection de carburant, et l'espace d'introduction de combustible se déplace jusqu'à une position à laquelle l'espace d'introduction de combustible n'est pas en communication avec les trous d'injection de carburant.

2. Dispositif d'injection de carburant selon la revendication 1, dans lequel la face périphérique externe supérieure du distributeur à tiroir cylindrique est toujours en contact avec la face périphérique interne du carter pendant une opération d'ouverture et de fermeture du passage d'alimentation en carburant.

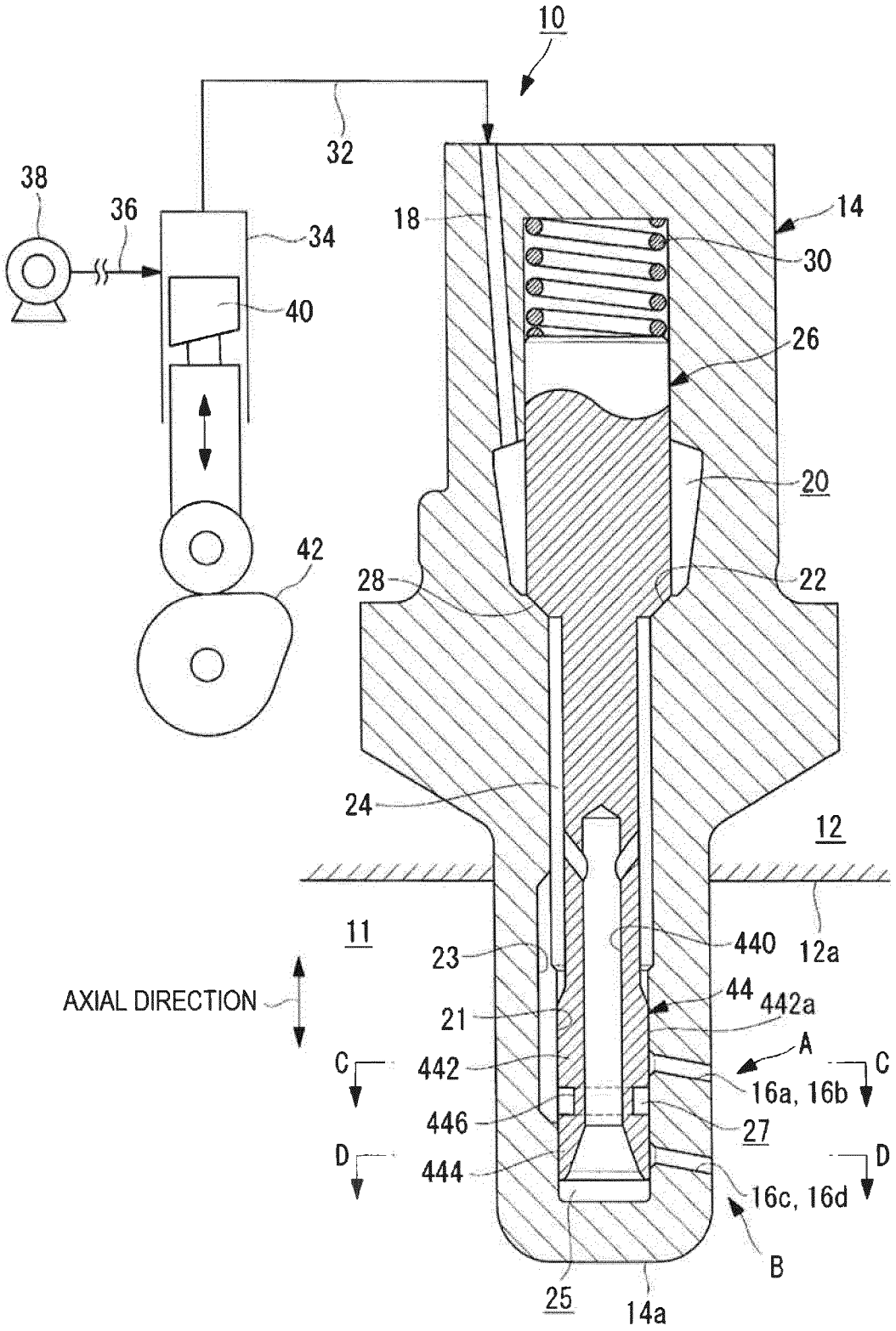
3. Dispositif d'injection de carburant selon la revendication 1 ou 2, dans lequel l'espace d'introduction de combustible est formé selon une forme de bague sur le distributeur à tiroir cylindrique.

4. Dispositif d'injection de carburant selon l'une quelconque des revendications 1 à 3, dans lequel les trous d'injection de carburant sont constitués en tant que trous d'injection de carburant supérieurs et en tant que trous d'injection de carburant inférieurs dans une direction axiale du carter,
un passage d'alimentation en carburant qui alimente du carburant jusqu'à un espace au dessous du distributeur à tiroir cylindrique est formé à l'intérieur du distributeur à tiroir cylindrique ; et
suite à l'ouverture du passage d'alimentation en carburant, l'espace d'introduction de combustible est en communication avec la gorge, et l'espace d'introduction de combustible se déplace jusqu'à la position à laquelle l'espace d'introduction de combustible est en communication avec les trous d'injection de carburant supérieurs, et l'espace au dessous du distributeur à tiroir cylindrique est en communication avec la gorge, et l'espace au dessous du distributeur à tiroir cylindrique est en communication avec les trous d'injection de carburant inférieurs.

5. Dispositif d'injection de carburant selon l'une quelconque des revendications 1 à 4, dans lequel les gorges de la pluralité de gorges sont formées sur la face périphérique interne du carter, et les gorges de la pluralité de gorges sont ménagées selon des espacements égaux sur la face périphérique interne du carter.

6. Dispositif d'injection de carburant selon l'une quelconque des revendications 1 à 5, dans lequel la gorge et le trou d'injection de carburant sont formés en prévoyant un espacement entre non inférieur à un diamètre du trou d'injection de carburant.

7. Moteur diesel, comprenant le dispositif d'injection de carburant décrit selon l'une quelconque des revendications 1 à 6 installé sur une culasse.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AXIAL DIRECTION
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442a
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16a, 16b
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16c, 16d
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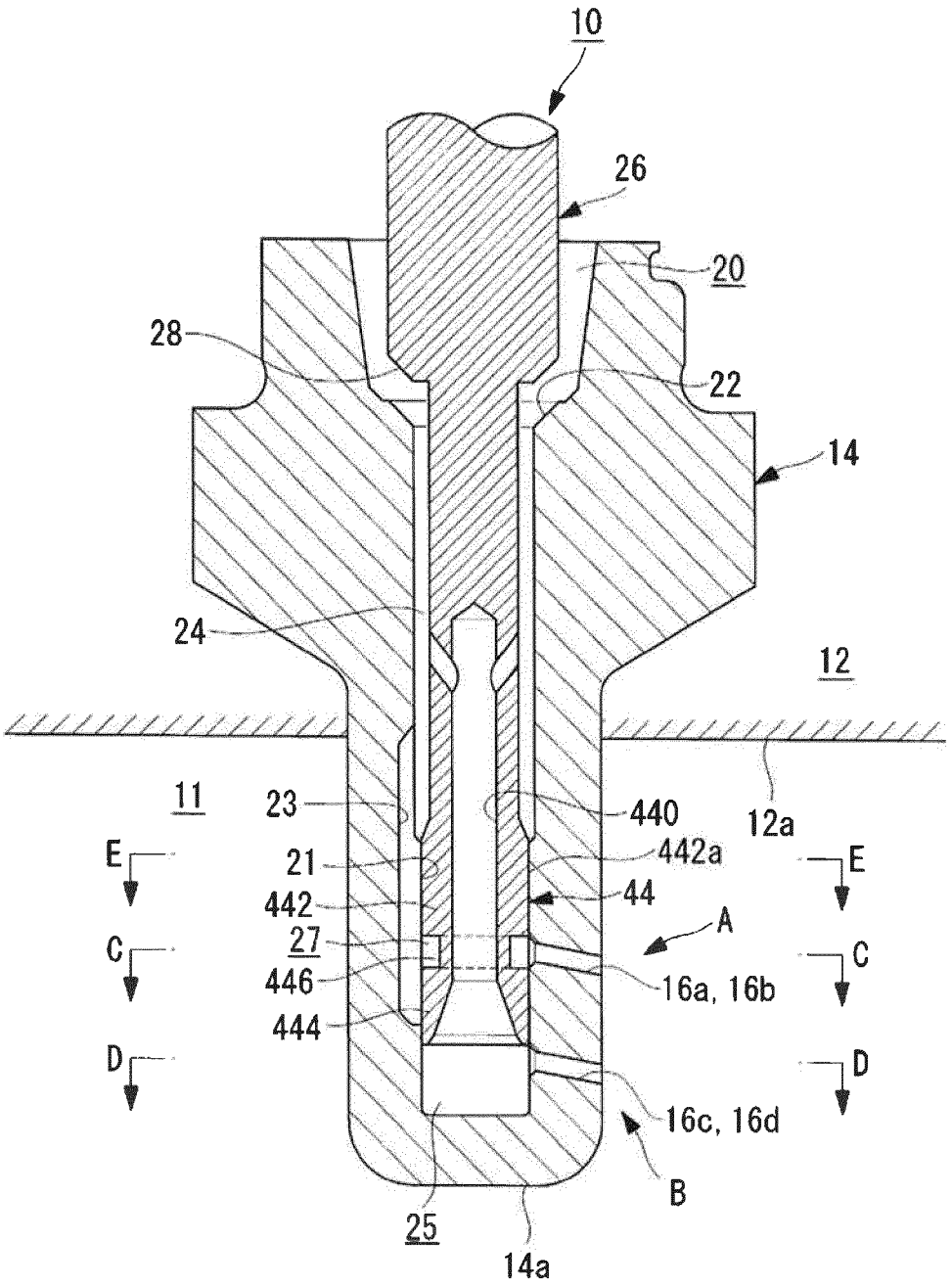
14a

FIG. 1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16a, 16b
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D
D
16c, 16d
B
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14a

FIG. 2

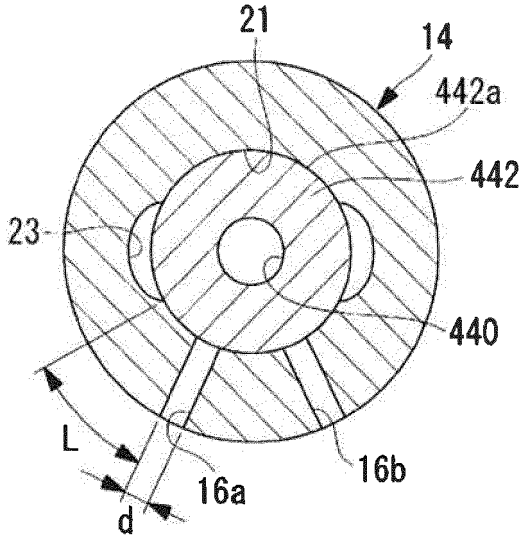


FIG. 3

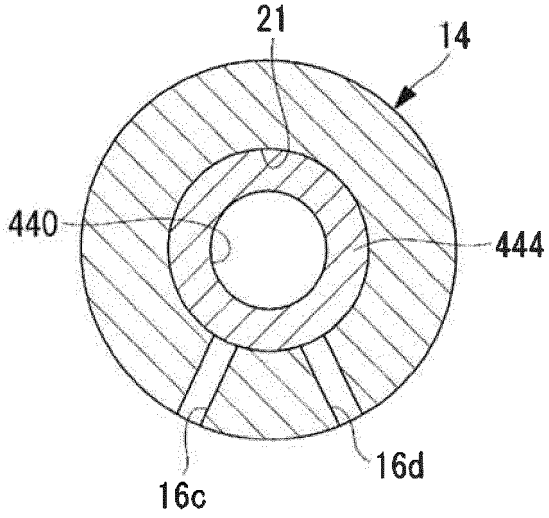


FIG. 4

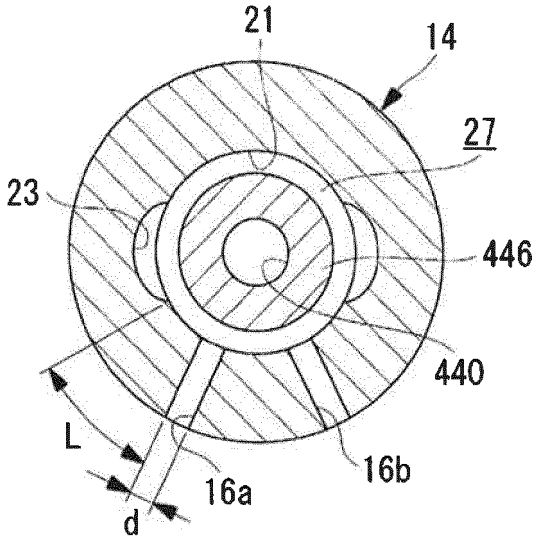


FIG. 5

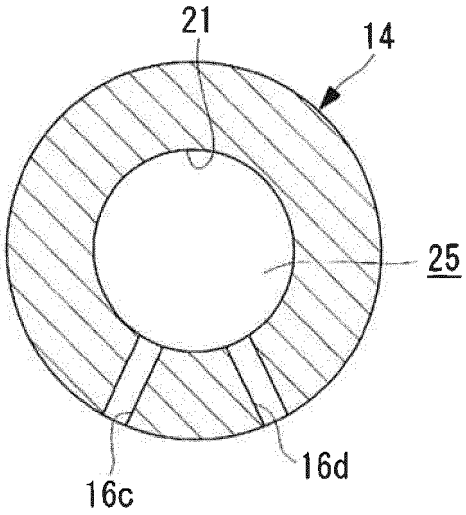


FIG. 6

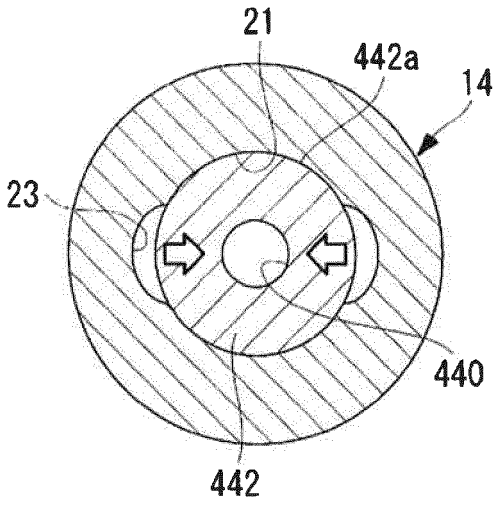


FIG. 7

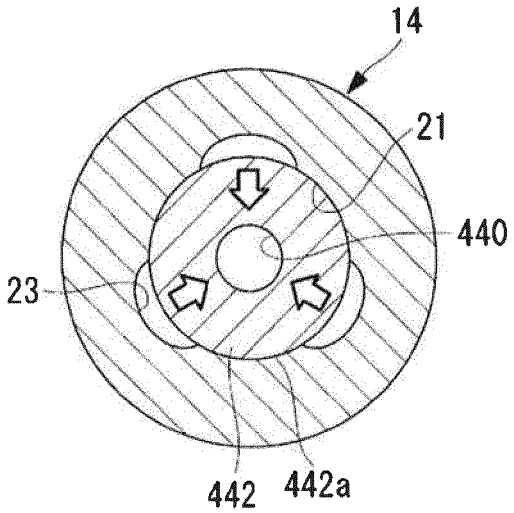
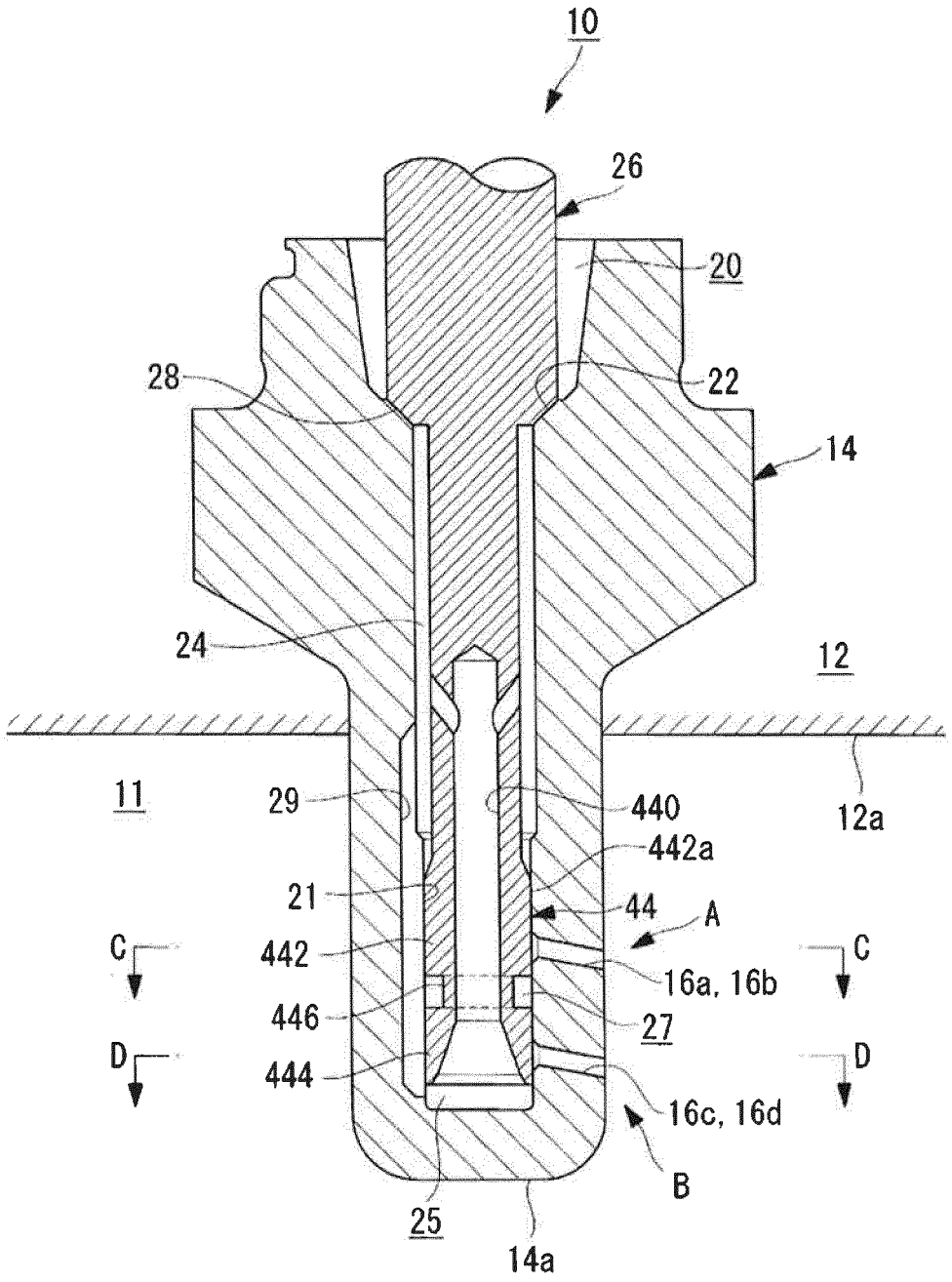


FIG. 8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16a, 16b
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27
D
444
D
16c, 16d
B
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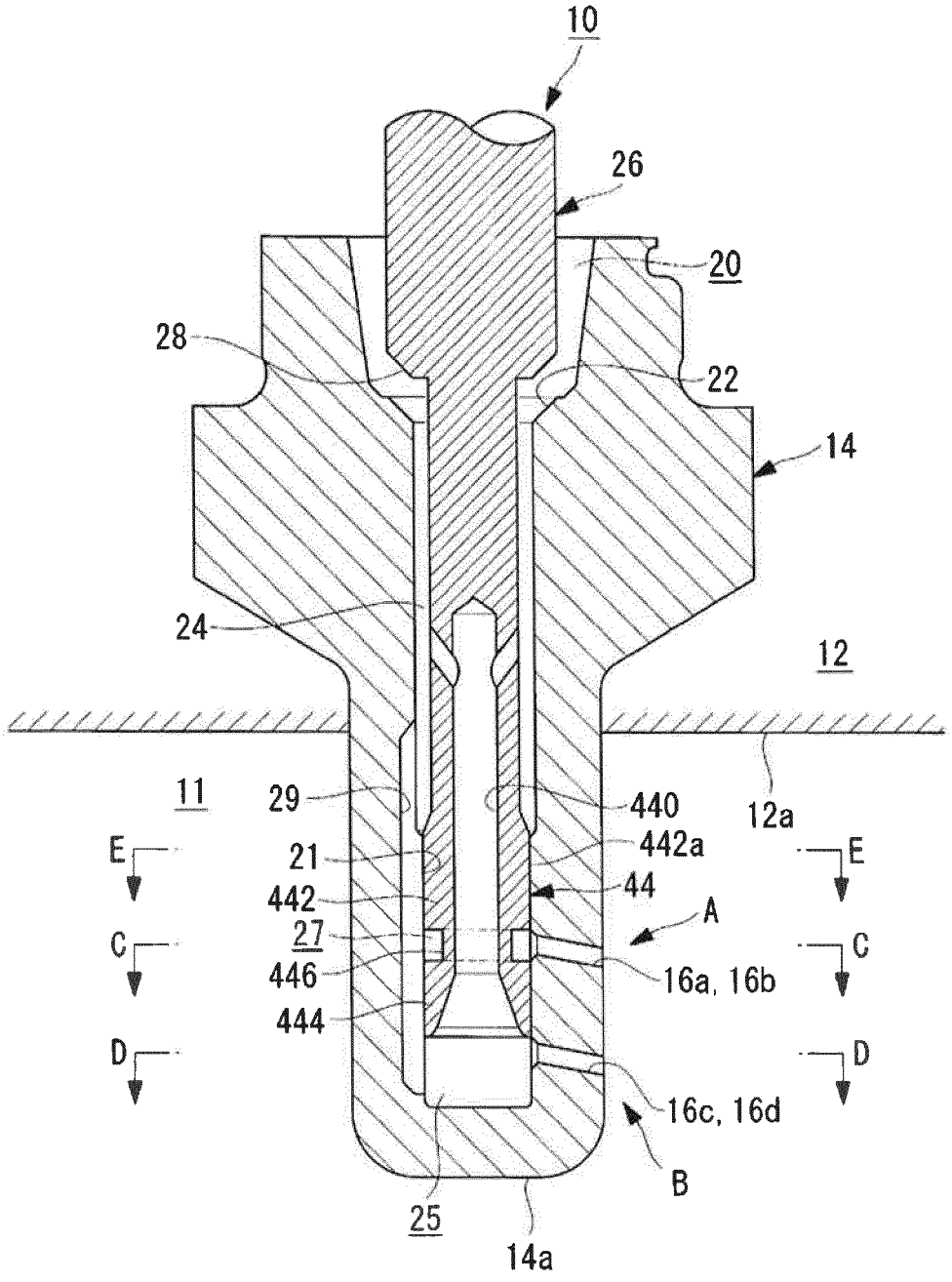
14a

FIG. 9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16a, 16b
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16c, 16d
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14a

FIG. 10

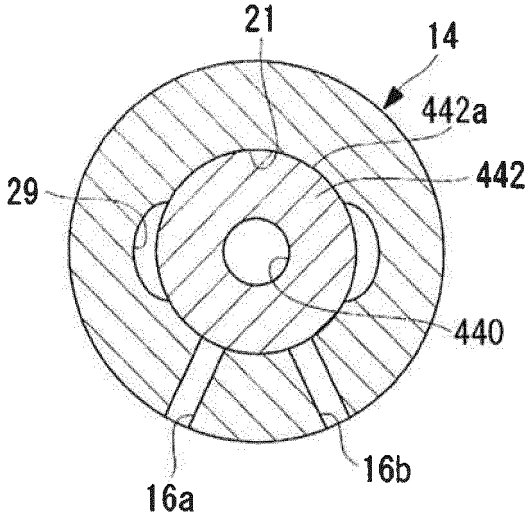

FIG. 11

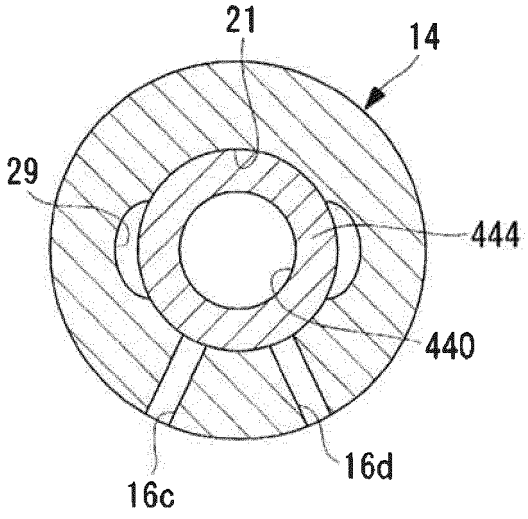

FIG. 12

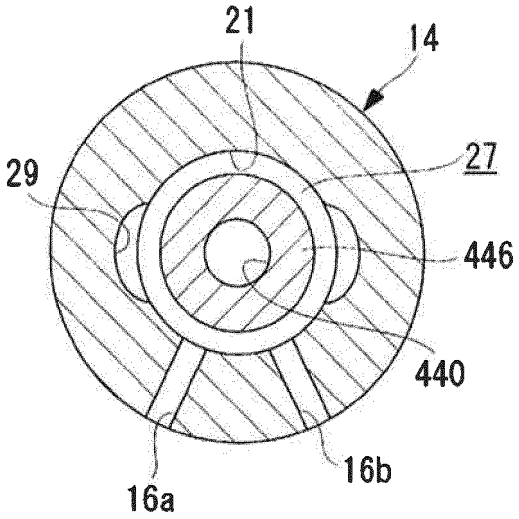

FIG. 13

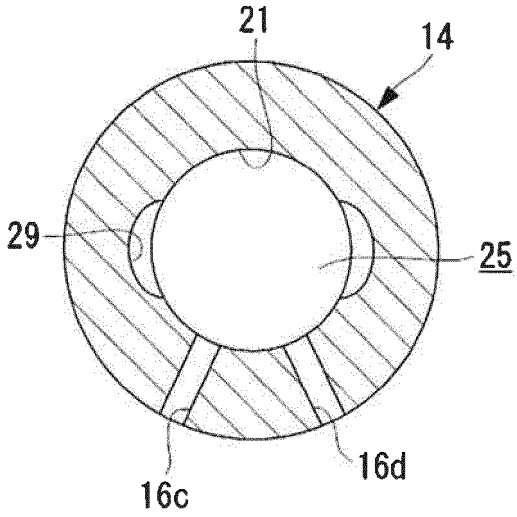

FIG. 14

REFERENCES CITED IN THE DESCRIPTION

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- JP 2010512484A PCT **[0005]**