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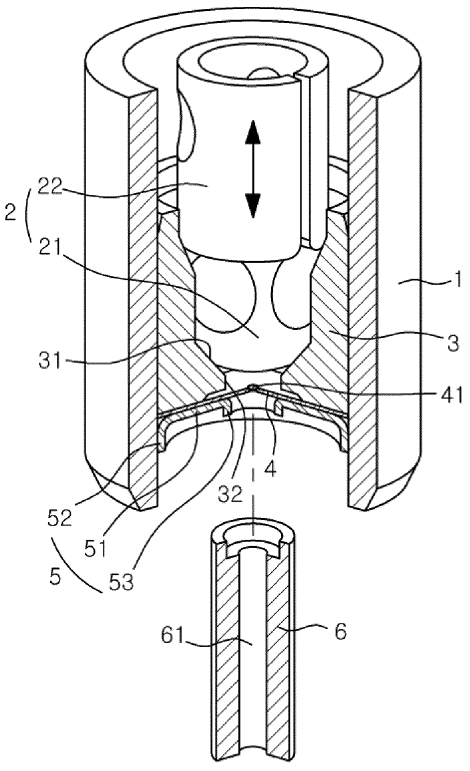
(54) **FUEL INJECTION VALVE**

(57) The disclosure relates to a fuel injection valve. The fuel injection valve for an internal combustion engine includes a needle which moves within a valve housing; a valve seat formed therein with an opening and closing hole which is opened and closed by the needle; an orifice plate which is attached to a lower portion of the valve seat and from which a fuel is injected through an injection hole; a fuel tube being a path through which the fuel injected from the orifice plate is supplied to the internal combustion engine; and a tube adaptor which is installed between the orifice plate and the fuel tube in order to prevent a leakage of the fuel supplied from the orifice plate to the fuel tube.

Fig. 1



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Description

TECHNICAL FIELD

[0001] Exemplary embodiments of the present invention relate to a fuel injection valve, and more particularly, to a fuel injection valve for an internal combustion engine which is provided to intensively inject a fuel to a localized area.

BACKGROUND ART

[0002] In general, a fuel injection valve referred to as an injector is a device to inject a liquid having a pressure from a nozzle. The nozzle is typically an injection nozzle with a built-in solenoid which allows a fuel to be injected when a fuel pressure reaches a set value by a needle valve in a diesel engine, and to be injected by an injection signal sent from a computer in a gasoline engine. The needle valve is integral with a plunger. Thus, when the injection signal is transferred to the fuel injection valve, a ball valve and a valve shaft, which are integral with the magnetized plunger, are pulled by the injection signal, with the consequence that an injection opening is opened and the fuel is injected at the same time. An injection amount of fuel is determined depending on an open time of the needle valve, namely, an energization time of a solenoid coil.

[0003] In such an existing fuel injection valve, since an end of the fuel injection valve and a passage of a fuel tube are assembled in a butting manner, a coupling tolerance occurs between the assembled components. Accordingly, a gap is generated between the end of the fuel injection valve and the fuel tube due to such a coupling tolerance, and thus there is a case in which a fuel leaks to the outside. That is, as shown in Fig. 8, when a coupling tolerance occurs between the fuel tube 106 and an orifice plate 104 which is interposed between a lower surface of a valve seat 103 located at a lower end of the fuel injection valve and an upper end surface of the fuel tube 106, a fuel to be injected into the passage 161 of the fuel tube 106 leaks outside the fuel tube 106 as indicated by the arrows in Fig. 8.

[0004] As such, the fuel leaking to the outside leaves a residual substance on a surface of the fuel injection valve while being evaporated. As such a residual substance deposited on the surface of the fuel injection valve reduces the area of the injection opening of the fuel injection valve, the fuel injection valve has poor performance and a portion of the leaked fuel is discharged outside a vehicle to cause air pollution.

[0005] In addition, since deposits are fixed in the vicinity of the injection opening of the fuel injection valve, cleaning costs are additionally generated to remove the deposits during vehicle maintenance.

[0006] Furthermore, the fuel tube made of a relatively soft material such as Teflon tends to be assembled in a state of being misaligned with the fuel injection valve. Accordingly, assembly properties and a fuel leakage are further deteriorated.

[0007] In addition, when the fuel injected from the fuel injection valve gets out of the passage and is discharged to the outside, there is a problem that vehicle performance such as output and fuel efficiency is also deteriorated.

DISCLOSURE

TECHNICAL PROBLEM

[0008] Accordingly, the present invention has been made in view of the above-mentioned problem, and an object thereof is to provide a fuel injection valve capable of preventing a phenomenon in which a residual substance is deposited on a surface of a nozzle of the fuel injection valve while a fuel discharged through a gap between an orifice plate and a fuel tube is evaporated by mounting a tube adaptor for preventing the generation of the gap between the orifice plate and the fuel tube of the fuel injection valve at an end of the fuel injection valve, thereby preventing an area reduction of an injection opening of the nozzle due to the residual substance and poor performance of the fuel injection valve, suppressing life-shortening of the fuel injection valve due to a fuel leakage, enabling an additional device for preventing the fuel leakage to be removed, and enabling vehicle performance to be improved and air pollution to be prevented.

[0009] In addition, another object of the present invention is to provide a fuel injection valve capable of generating no gap between the fuel injection valve and a fuel tube by assembling a portion of the fuel tube within the fuel injection valve, and doubly preventing a fuel from leaking by interposing an airtightness maintaining member between the fuel tube and a contact surface of a valve housing.

[0010] In addition, a further object of the present invention is to provide a fuel injection valve capable of reducing a manufacturing process or cost of a component for preventing a fuel leakage while actually improving fuel sealing or injection performance without deteriorating the same by compactly producing the component used for doubly preventing the fuel leakage.

TECHNICAL SOLUTION

[0011] In accordance with an aspect of the present invention, a fuel injection valve for an internal combustion engine includes a needle which moves within a valve housing; a valve seat formed therein with an opening and closing hole which is opened and closed by the needle; an orifice plate which is attached to a lower portion of the valve seat and from which a fuel is injected through an injection hole; a fuel tube being a path through which the fuel injected from the orifice plate is supplied to the internal combustion engine; and a tube adaptor which is in-

stalled between the orifice plate and the fuel tube in order to prevent a leakage of the fuel supplied from the orifice plate to the fuel tube.

[0012] The tube adaptor may include an attachment portion which is attached on a lower surface of the orifice plate, and an outer side bent portion which is bent downward at an outer side of the attachment portion.

[0013] The tube adaptor may further include an inner side bent portion which is bent downward at an inner side of the attachment portion.

[0014] The inner side bent portion may be inserted and fixed, at an outer peripheral surface thereof, on an inner peripheral surface of a circular groove formed so as to be connected with a passage of the fuel tube at a central portion of an upper surface of the fuel tube, or the inner side bent portion may be press-fitted, at an inner peripheral surface thereof, to a step formed on an outer peripheral surface of the upper surface of the fuel tube.

[0015] The fuel tube may be provided with a flange portion which is formed to protrude at an upper end of the fuel tube and attached on a lower surface of the orifice plate.

[0016] An outer peripheral surface of the flange portion may be attached on or detached from an inner peripheral surface of the valve housing.

[0017] When the outer peripheral surface of the flange portion is attached on the inner peripheral surface of the valve housing, a sealing member may be interposed on an attachment surface therebetween.

[0018] When the outer peripheral surface of the flange portion is detached from the inner peripheral surface of the valve housing, a surface of the orifice plate may be attached to an inner peripheral surface of the valve housing adjacent to a lower surface of the valve seat.

[0019] The outer side bent portion of the tube adaptor may be welded and coupled to an inner peripheral surface of the valve housing.

[0020] In accordance with another aspect of the present invention, a fuel injection valve for an internal combustion engine includes a needle which moves within a valve housing; a valve seat formed therein with an opening and closing hole which is opened and closed by the needle; a fuel tube being a path through which the fuel injected from the valve housing is supplied to the internal combustion engine; and a tube adaptor which is interposed between the valve seat and the fuel tube, thereby injecting the fuel through an injection hole and preventing the fuel injected from the injection hole from leaking between the fuel tube and the valve seat.

[0021] The tube adaptor may include an attachment portion which is attached on a lower surface of the valve seat, an outer side bent portion which is bent downward at an outer side of the attachment portion, and an inner side bent portion which protrudes downward at an inner side of the attachment portion so as to be inserted into a passage of the fuel tube and attached on a surface of the passage.

[0022] The inner side bent portion may be formed as a conical inclined portion so that an inner diameter thereof is gradually decreased toward the injection hole.

[0023] The inner side bent portion may have a truncated conical shape which is constituted of an inclined portion which extends along an inclined surface of the passage up to a lower end of the inclined surface of the passage; and a flat portion which extends to be perpendicular to an axis of the passage at a lower end of the inclined portion.

BRIEF DESCRIPTION OF DRAWINGS

[0024] Fig. 1 is an exploded perspective view illustrating a state of separating a fuel tube from a fuel injection valve according to a first embodiment of the present invention.

[0025] Fig. 2 is a side cross-sectional view illustrating a coupled state of the fuel tube to the fuel injection valve.

[0026] Fig. 3 is a side cross-sectional view illustrating a coupled state of a fuel tube to a fuel injection valve according to a second embodiment of the present invention.

[0027] Fig. 4 is a side cross-sectional view illustrating a coupled state of a fuel tube to a fuel injection valve according to a third embodiment of the present invention.

[0028] Fig. 5 is a side cross-sectional view illustrating a coupled state of a fuel tube to a fuel injection valve according to a fourth embodiment of the present invention.

[0029] Fig. 6 is a side cross-sectional view illustrating a coupled state of a fuel tube to a fuel injection valve according to a fifth embodiment of the present invention.

[0030] Fig. 7 is a side cross-sectional view illustrating a coupled state of a fuel tube to a fuel injection valve according to a sixth embodiment of the present invention.

[0031] Fig. 8 is a view illustrating a coupled state of a fuel tube to a fuel injection valve according to the related art.

BEST MODE FOR INVENTION

[0032] Reference will now be made in detail to embodiments of a fuel injection valve of the present invention with reference to the accompanying drawings.

[0033] [First Embodiment]

[0034] As shown in Figs. 1 and 2, a fuel injection valve according to the present embodiment includes a valve housing 1, a needle 2, a valve seat 3, an orifice plate 4, a tube adaptor 5, and a fuel tube 6.

[0035] The needle 2 is installed within a longitudinal opening of the valve housing 1 so that the valve housing 1 constitutes a magnetic passage during the energization of a solenoid coil.

[0036] The needle 2 is provided within the valve housing 1 and moves in a longitudinal direction thereof by an electromagnetic circuit during the application of electric power. The needle 2 includes a ball valve 21 and a valve shaft 22.

[0037] The ball valve 21 is formed, at a lower surface thereof, with a closure surface 21a. The valve shaft 22 is mutually coupled to an upper end of the ball valve 21 by welding and the like, and moves along the longitudinal direction of the valve housing 1.

[0038] The valve seat 3 is provided within the valve housing 1. The valve seat 3 is formed, at an inner lower end thereof, with a contact surface 31 which is attached on or detached from the closure surface 21a of the ball valve 21. The valve seat 3 is formed with an opening and closing hole 32 which is connected from the contact surface 31 to the bottom of the valve seat.

[0039] In this case, when the closure surface 21a of the ball valve 21 comes into complete contact with the contact surface 31 connected with the opening and closing hole 32, the supply of a fuel stops. On the other hand, when the closure surface 21a of the ball valve 21 is spaced apart from the contact surface 31, the fuel is supplied. Accordingly, a supply amount of the fuel is adjusted depending on a clearance level of the closure surface 21a and the contact surface 31.

[0040] The orifice plate 4 has a disk shape and is tightly installed at a lower end of the valve seat 3. The orifice plate 4 is formed, at a central portion thereof, with an injection hole 41 for measuring and adjusting a flow rate of the fuel during the passing thereof.

[0041] Here, although the present embodiment is illustrated in which one injection hole 41 is formed at the central portion of the orifice plate 4, one injection hole may be formed in a slit shape or a plurality of injection holes may have a hole or slit shape and be formed to be arranged at equal intervals along a circumferential direction of the orifice plate.

[0042] As such, when the injection hole 41 is plurally formed along the circumferential direction, the injection hole 41 may be located inward of an inner side bent portion 53 of the tube adaptor 5. The injection hole 41 may have a significantly decreased diameter by decreasing a thickness of the orifice plate 4 to further promote the atomization of fuel particles.

[0043] The tube adaptor 5 is interposed between the orifice plate 4 and the fuel tube 6 to allow the injection hole 41 of the orifice plate 4 to come into tight contact with a passage 61 of the fuel tube 6 without a gap therebetween. Accordingly, the fuel is prevented from leaking outside the passage 61.

[0044] In this case, the tube adaptor 5 includes an attachment portion 51 having a disk shape, an outer side bent portion 52 which is formed to be bent downward at an outer side edge of the attachment portion 51, and an inner side bent portion 53 by which a hole is defined at a central portion of the attachment portion 51 and which is simultaneously formed to be bent downward at an inner side edge of the hole.

[0045] That is, the tube adaptor 5 has a coupling structure that is constituted of the attachment portion 51 which is inserted into the valve housing 1 and joined on a lower surface of the orifice plate 4 without interference with the injection hole 41, the outer side bent portion 52 which is formed to be bent downward at the outer side edge of the attachment portion 51, and the inner side bent portion 53 which is bent downward at a lower surface of the central portion of the attachment portion 51 to be coupled with the fuel tube 6 while being inserted and fixed, at an outer peripheral surface thereof, to an inner peripheral surface of the passage 61 of the fuel tube 6.

[0046] In particular, since the inner side bent portion 53 of the tube adaptor 5 is bent downward, a circular groove 64 is formed at a central portion of an upper surface of the fuel tube 6 so as to correspond to a shape of the inner side bent portion 53 and be connected with the passage 61. Since the outer peripheral surface of the inner side bent portion 53 of the tube adaptor 5 is inserted and fixed to an inner peripheral surface of the circular groove formed at the central portion of the upper surface of the fuel tube 6, the inner side bent portion 53 and the circular groove 64 may be easily coupled by such an insertion manner.

[0047] Furthermore, an outer peripheral surface of the outer side bent portion 52 of the tube adaptor 5 is welded and coupled on an inner peripheral surface of the valve housing 1 by heat applied from the outside of the valve housing 1.

[0048] The fuel tube 6 is a path through which the fuel injected from the injection hole 41 of the orifice plate 4 is supplied to an internal combustion engine (not shown in the drawings). The fuel tube 6 is attached, at an upper end thereof, on the lower surface of the orifice plate 4 by the tube adaptor 5 while being connected, at a lower end thereof, to the internal combustion engine.

[0049] Therefore, in the embodiment, the fuel injection valve and the fuel tube 6 may be easily separated from each other for maintenance without the generation of a gap therebetween by the tube adaptor 5.

MODE FOR INVENTION

[0050] [Second Embodiment]

[0051] As shown in Fig. 3, a fuel injection valve according to the present embodiment includes a valve housing 1, a needle 2, a valve seat 3, an orifice plate 4, a tube adaptor 5a, and a fuel tube 6. Since each of the valve housing 1, the needle 2, the valve seat 3, and the orifice plate 4 has the same structure and function as the configuration of the first embodiment, no description thereof will be given.

[0052] The tube adaptor 5a is interposed between the orifice plate 4 and the fuel tube 6 to allow the injection hole 41 of the orifice plate 4 to come into tight contact with the passage 61 of the fuel tube 6 without a gap therebetween. Accordingly, the fuel is prevented from leaking outside the passage 61.

[0053] In this case, the tube adaptor 5a includes an attachment portion 51a having a disk shape, an outer side bent portion 52a which is formed to be bent downward at an outer side edge of the attachment portion 51a,

and an inner side bent portion 53a by which a hole is defined at a central portion of the attachment portion 51a and which is simultaneously formed to be bent downward at an inner side edge of the hole.

[0054] Particularly, unlike the first embodiment, the inner side bent portion 53a is press-fitted, at an inner peripheral surface thereof, on an outer peripheral surface of the fuel tube 6, thereby improving a coupling force with the fuel tube 6.

[0055] Since the inner side bent portion 53a of the tube adaptor 5a is bent downward, a step 65 is formed at an upper outer peripheral surface of the fuel tube 6 so as to correspond to an inner diameter shape of the inner side bent portion 53a.

[0056] In addition, an outer peripheral surface of the outer side bent portion 52a of the tube adaptor 5a is welded and coupled on the inner peripheral surface of the valve housing 1 by heat applied from the outside of the valve housing 1.

[0057] Therefore, in the embodiment, since the upper end of the fuel tube 6 is press-fitted in the fuel injection valve, the fuel injection valve and the fuel tube 6 may be easily separated from each other for maintenance without the generation of a gap therebetween, and have a mutually improved coupling force.

[0058] [Third Embodiment]

[0059] As shown in Fig. 4, a fuel injection valve according to the present embodiment includes a valve housing 1, a needle 2, a valve seat 3, an orifice plate 4, a tube adaptor 5b, and a fuel tube 6. Since each of the valve housing 1, the needle 2, and the valve seat 3 has the same structure and function as the configuration of the first and second embodiments, no description thereof will be given.

[0060] The orifice plate 4 is formed, at a central portion thereof, with an injection hole 41 for measuring and adjusting a flow rate of the fuel during the passing thereof. The orifice plate 4 includes a valve seat attachment surface 4a which comes into contact with the lower end of the valve seat 3, and a valve housing contact bent portion 4b which is formed to be bent downward at an edge of the valve seat attachment surface 4a and is installed to come into tight contact with the inner peripheral surface of the valve housing 1 adjacent to the lower end of the valve seat 3.

[0061] The tube adaptor 5b is provided to be attached on a lower surface of a flange portion 62 formed at the upper end of the fuel tube 6 and the inner peripheral surface of the valve housing 1 and allows the flange portion 62 of the fuel tube 6 to be attached to the orifice plate 4. Accordingly, the fuel is prevented from leaking outside the passage.

[0062] Furthermore, the tube adaptor 5b is formed with a through hole so that an upper surface of the tube adaptor 5b comes into contact with the lower surface of the flange portion 62 of the fuel tube 6 which passes through a central portion of an attachment portion 51a attached on the lower surface of the valve seat 3.

[0063] Since the valve housing contact bent portion 4b is provided at the edge of the orifice plate 4 as described above, the fuel tube 6 is provided in a state in which the flange portion 62 is spaced apart from the inner peripheral surface of the valve housing 1.

[0064] Therefore, in the embodiment, since the flange portion 62 formed at the upper end of the fuel tube 6 is assembled in the fuel injection valve, a gap is not generated between the fuel injection valve and the fuel tube 6.

[0065] In the embodiment, primarily, since the flange portion 62 formed at the upper end of the fuel tube 6 is attached to the orifice plate 4 by the tube adaptor 5b, the fuel is prevented from leaking outside the passage. Also, secondarily, since an outer side bent portion 52b of the tube adaptor 5b is welded and coupled on the inner peripheral surface of the valve housing 1, the fuel is prevented from leaking outside the passage.

[0066] [Fourth Embodiment]

[0067] As shown in Fig. 5, a fuel injection valve according to the present embodiment includes a valve housing 1, a needle 2, a valve seat 3, an orifice plate 4, a tube adaptor 5c, and a fuel tube 6. Since each of the valve housing 1, the needle 2, the valve seat 3, and the orifice plate 4 has the same structure and function as the configuration of the first and second embodiments, no description thereof will be given.

[0068] The tube adaptor 5c is located so that an upper surface thereof comes into contact with the lower surface of flange portion 62 of the fuel tube 6. A sealing member 63 such as an O-ring is interposed between an outer peripheral surface of the flange portion 62 and the inner peripheral surface of the valve housing 1, thereby preventing the leakage of the fuel.

[0069] In this case, the tube adaptor 5c includes an attachment portion 51c having a disk shape, and an outer side bent portion 52c which is formed to be bent downward at an edge of the attachment portion 51c. The attachment portion 51c is formed, at a central portion thereof, with a through hole through which the fuel tube 6 passes so that an upper surface of the tube adaptor 5c comes into contact with the lower surface of the flange portion 62.

[0070] The fuel tube 6 is provided in a state in which the outer peripheral surface of the flange portion 62 is attached on the inner peripheral surface of the valve housing 1. The fuel tube 6 is further provided with the sealing member 63 such as an O-ring between the outer peripheral surface of the flange portion 62 and the inner peripheral surface of the valve housing 1.

[0071] In the embodiment, primarily, since the flange portion 62 formed at the upper end of the fuel tube 6 is attached to the orifice plate 4 by the tube adaptor 5b, the fuel is prevented from leaking outside the passage. Secondarily, since the outer side bent portion 52c of the tube adaptor 5b is welded and coupled on the inner peripheral surface of the valve housing 1, the fuel is prevented from leaking outside the passage. Thirdly, the fuel is prevented

from leaking outside the passage by the sealing member 63 provided on the outer peripheral surface of the flange portion 62 of the fuel tube 6.

[0072] [Fifth Embodiment]

[0073] As shown in Fig. 6, a fuel injection valve according to the present embodiment includes a needle 2, a valve seat 3, a fuel tube 6, and a tube adaptor 5. Since each of the needle 2, the valve seat 3, and the fuel tube 6 has, except for a portion thereof, mostly the same configuration as the first to fourth embodiments, no description thereof will be given. In particular, as shown in Fig. 6, functions of the orifice plates and the tube adaptors of the other embodiments are incorporated in one tube adaptor 5 in the fuel injection valve according to the present embodiment.

[0074] The tube adaptor 5 is interposed between the valve seat 3 and the fuel tube 6 and injects the fuel through the injection hole 41, thereby preventing the fuel injected from injection hole 41 being leaking between the valve seat 3 and the fuel tube 6. For this reason, as shown in Fig. 6, the tube adaptor 5 is manufactured in a washer shape bending a thin plate, and includes an attachment portion 51, an outer side bent portion 52, and an inner side bent portion 53.

[0075] First, the attachment portion 51 is a portion attached on the lower surface of the valve seat 3, similarly to the orifice plates of the above other embodiments. The attachment portion 51 has a disk shape of a coin form which is circularly recessed at a central portion of the attachment portion 51 due to the inner side bent portion 53. The outer side bent portion 52 is formed to be bent downward at an outer side edge of the attachment portion 51, similarly to the outer side bent portions of the tube adaptors of the above other embodiments. An outer peripheral surface of the outer side bent portion 52 is welded and coupled on the inner peripheral surface of the valve housing 1 by heat applied from the outside of the valve housing 1. Lastly, the inner side bent portion 53 is formed to be recessed by bending an inner side edge of a circular portion formed at the central portion of the attachment portion 51 in the downward direction. As shown in Fig. 6, the inner side bent portion 53 is inserted into the passage 61 of the fuel tube 6 and attached on a passage surface of the passage 61. Here, the inner side bent portion 53 may be formed in various shapes, and may be formed in a nozzle shape protruding toward the fuel tube 6 as shown in Fig. 6. In this case, the inner side bent portion 53 is formed as a conical inclined portion having a tapered shape so that an inner diameter thereof is gradually decreased toward the injection hole 41 below.

[0076] Accordingly, according to the above embodiment, since the tube adaptor and the orifice plate are incorporated as one component, the total number of processes is reduced and thus a cost reduction is realized. Moreover, the tube adaptor 5 is deeply inserted into the passage 61 and is automatically aligned to be centered due to conical properties converging on the center. Consequently, the coupling force between the fuel injection valve and the fuel tube 6 is increased and the sealing performance between the tube adaptor 5 and the fuel tube 6 is improved.

[0077] [Sixth Embodiment]

[0078] Meanwhile, Fig. 7 illustrates a fuel injection valve according to the present embodiment. Similarly to the fifth embodiment, functions of the orifice plate and the tube adaptor are incorporated in one tube adaptor 5 in the fuel injection valve according to the present embodiment. The tube adaptor 5 includes an attachment portion 51, an outer side bent portion 52, and an inner side bent portion 53.

[0079] As shown in Fig. 7, in the tube adaptor 5 applied to the present embodiment, the inner side bent portion 53 is again constituted of two portions which are an inclined portion 53-1 and a flat portion 53-2. The inclined portion 53-1 has a truncated conical shape so as to be seated along an inclined surface from an upper end corner of the inclined surface of the upper end of the passage 61 to lower end corner which is an ending portion of the inclined surface. The flat portion 53-2 is bent at a lower end of the inclined portion 53-1 and evenly extends to be perpendicular to an axis of the passage 61.

[0080] As a result, according to the above embodiment, since the tube adaptor and the orifice plate are incorporated as one component, the total number of processes may be reduced and a cost reduction may be realized. In addition, the coupling force between the fuel injection valve and the fuel tube 6 may be increased and the sealing performance between the tube adaptor 5 and the fuel tube 6 may be improved due to truncated conical properties of the inclined portion. In addition, since the injection hole 41 passes through the flat portion 53-2, the processability of the injection hole 41 may be improved during mass production and the injection stability of the fuel injected into the passage 61 through the injection hole 41 may be improved.

[0081] Although the present invention has been described with respect to the illustrative embodiments, it will be apparent to those skilled in the art that various variations and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

INDUSTRIAL APPLICABILITY

[0082] A fuel injection valve according to the present invention has effects of being capable of preventing a phenomenon in which a residual substance is deposited on a surface of a nozzle of the fuel injection valve while a fuel discharged through a gap between an orifice plate and a fuel tube is evaporated by mounting a tube adaptor for preventing the generation of the gap between the orifice plate and the fuel tube of the fuel injection valve at an end of the fuel injection valve, thereby preventing an area reduction of an injection opening of the nozzle due to the residual substance and poor performance of the fuel injection valve, preventing life-shortening of the fuel

injection valve due to a fuel leakage, enabling an additional device for preventing the fuel leakage to be removed, and enabling vehicle performance to be improved and air pollution to be prevented.

[0083] In addition, the fuel injection valve has effects of being capable of generating no gap between the fuel injection valve and the fuel tube by assembling a portion of the fuel tube within the fuel injection valve, and doubly preventing the fuel from leaking by interposing an air-tightness maintaining member between the fuel tube and a contact surface of a valve housing.

[0084] Furthermore, the tube adaptor and the orifice plate are incorporated in one tube adaptor to allow a manufacturing process and thus a manufacturing cost to be decreased, and improvement of the injection stability of the fuel injected into the fuel tube may be realized while the coupling force and sealing performance between the fuel injection valve and the fuel tube are also improved.

Claims

1. A fuel injection valve for an internal combustion engine, comprising:

   a needle which moves within a valve housing;
   a valve seat formed therein with an opening and closing hole which is opened and closed by the needle;
   an orifice plate which is attached to a lower portion of the valve seat and from which a fuel is injected through an injection hole;
   a fuel tube being a path through which the fuel injected from the orifice plate is supplied to the internal combustion engine; and
   a tube adaptor which is installed between the orifice plate and the fuel tube in order to prevent a leakage of the fuel supplied from the orifice plate to the fuel tube.

2. The fuel injection valve according to claim 1, wherein the tube adaptor comprises:

   an attachment portion which is attached on a lower surface of the orifice plate; and
   an outer side bent portion which is bent downward at an outer side of the attachment portion.

3. The fuel injection valve according to claim 2, wherein the tube adaptor further comprises an inner side bent portion which is bent downward at an inner side of the attachment portion.

4. The fuel injection valve according to claim 3, wherein the inner side bent portion is inserted and fixed, at an outer peripheral surface thereof, on an inner peripheral surface of a circular groove formed so as to be connected with a passage of the fuel tube at a central portion of an upper surface of the fuel tube, or the inner side bent portion is press-fitted, at an inner peripheral surface thereof, to a step formed on an outer peripheral surface of the upper surface of the fuel tube.

5. The fuel injection valve according to claim 1, wherein the fuel tube is provided with a flange portion which is formed to protrude at an upper end of the fuel tube and attached on a lower surface of the orifice plate.

6. The fuel injection valve according to claim 5, wherein an outer peripheral surface of the flange portion is attached on or detached from an inner peripheral surface of the valve housing.

7. The fuel injection valve according to claim 6, wherein when the outer peripheral surface of the flange portion is attached on the inner peripheral surface of the valve housing, a sealing member is interposed on an attachment surface therebetween.

8. The fuel injection valve according to claim 6, wherein when the outer peripheral surface of the flange portion is detached from the inner peripheral surface of the valve housing, a surface of the orifice plate is attached to the inner peripheral surface of the valve housing adjacent to a lower surface of the valve seat.

9. The fuel injection valve according to claim 2, wherein the outer side bent portion of the tube adaptor is welded and coupled to the inner peripheral surface of the valve housing.

10. A fuel injection valve for an internal combustion engine comprising:

    a needle which moves within a valve housing;
    a valve seat formed therein with an opening and closing hole which is opened and closed by the needle;
    a fuel tube being a path through which the fuel injected from the valve housing is supplied to the internal combustion engine; and
    a tube adaptor which is interposed between the valve seat and the fuel tube, thereby injecting the fuel through an injection hole and preventing the fuel injected from the injection hole from leaking between the fuel tube and the valve seat.

11. The fuel injection valve according to claim 10, wherein the tube adaptor comprises:

    an attachment portion which is attached on a lower surface of the valve seat;
    an outer side bent portion which is bent downward at an outer side of the attachment portion; and

an inner side bent portion which protrudes downward at an inner side of the attachment portion so as to be inserted into a passage of the fuel tube and attached on a surface of the passage.

12. The fuel injection valve according to claim 11, wherein the inner side bent portion is formed as a conical inclined portion so that an inner diameter thereof is gradually decreased toward the injection hole.

13. The fuel injection valve according to claim 12, wherein the inner side bent portion has a truncated conical shape which is comprised of:

an inclined portion which extends along an inclined surface of the passage up to a lower end of the inclined surface of the passage; and
a flat portion which extends to be perpendicular to an axis of the passage at a lower end of the inclined portion.

Fig. 1

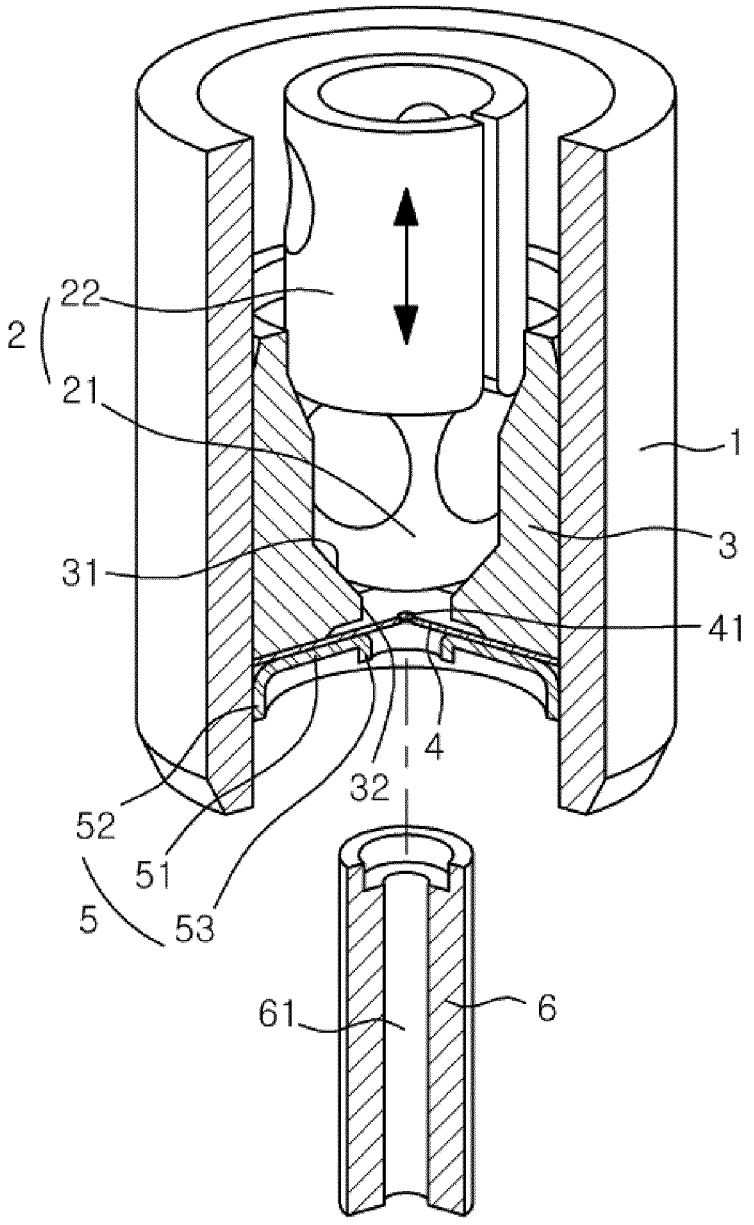

Fig. 2

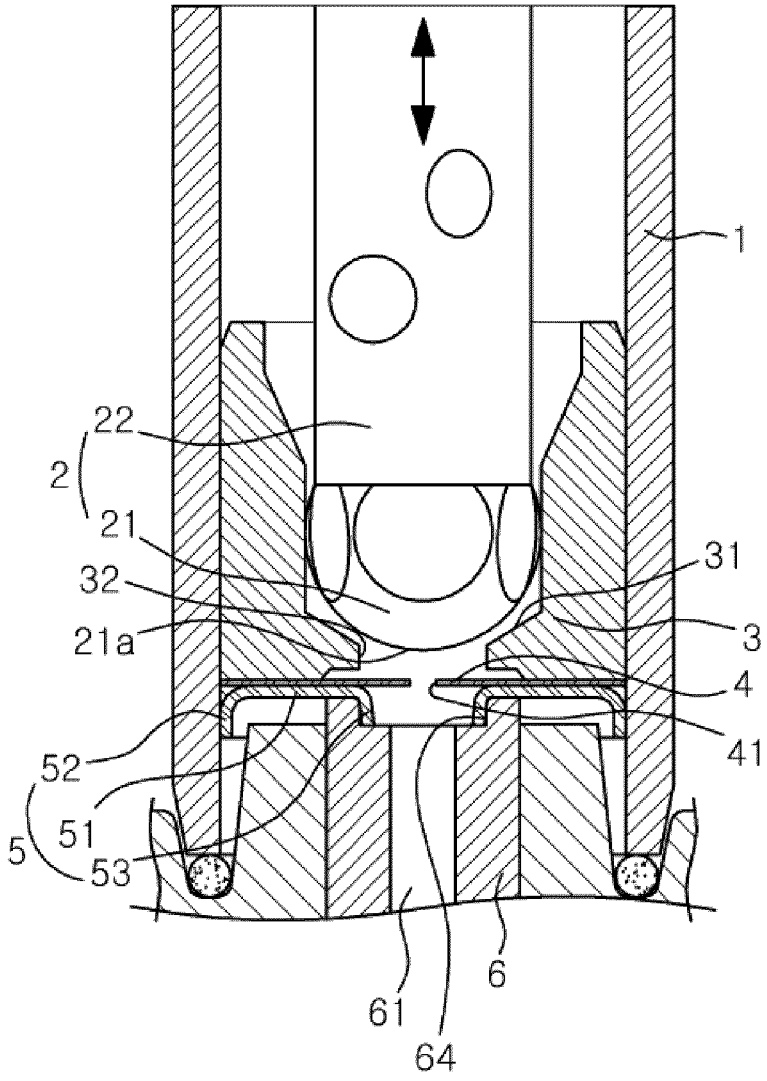

Fig. 3

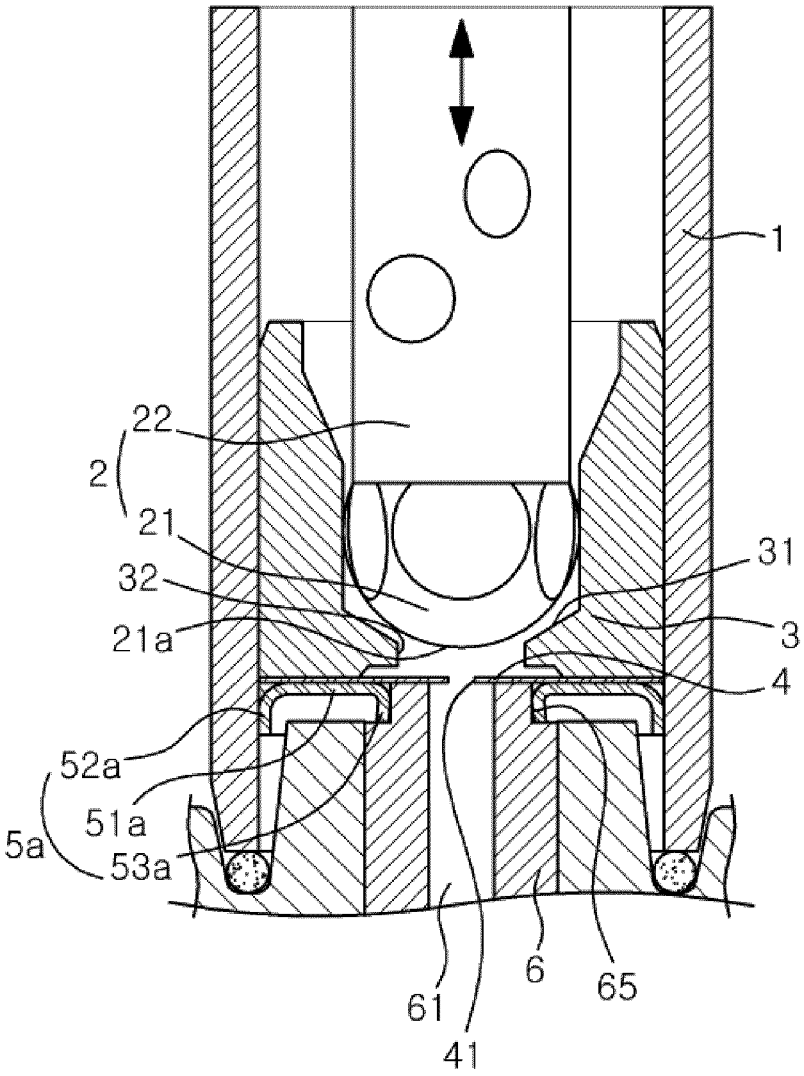

Fig. 4

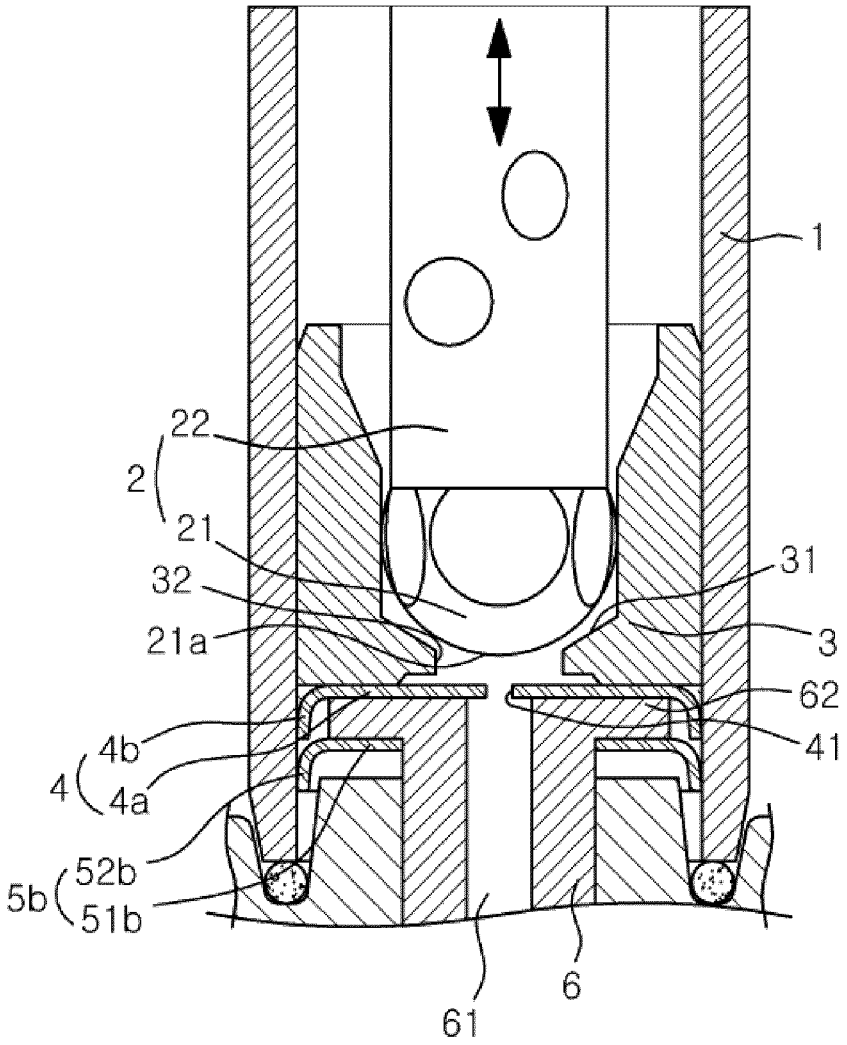

Fig. 5

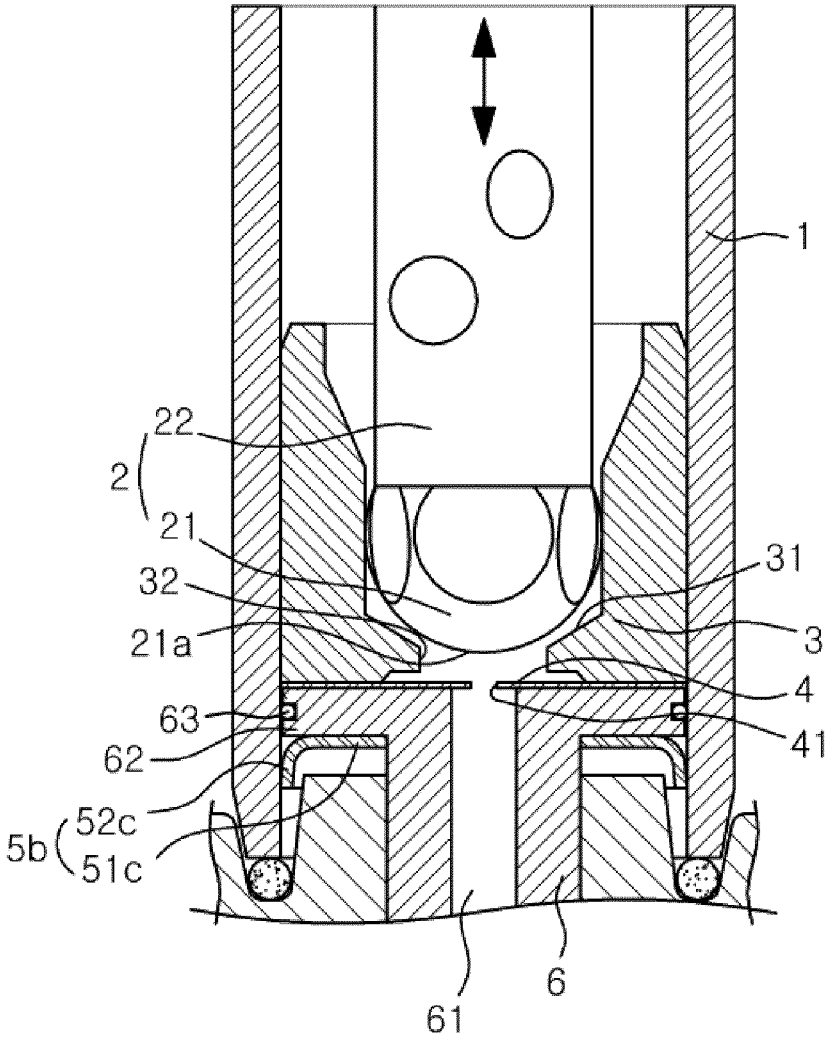

Fig. 6

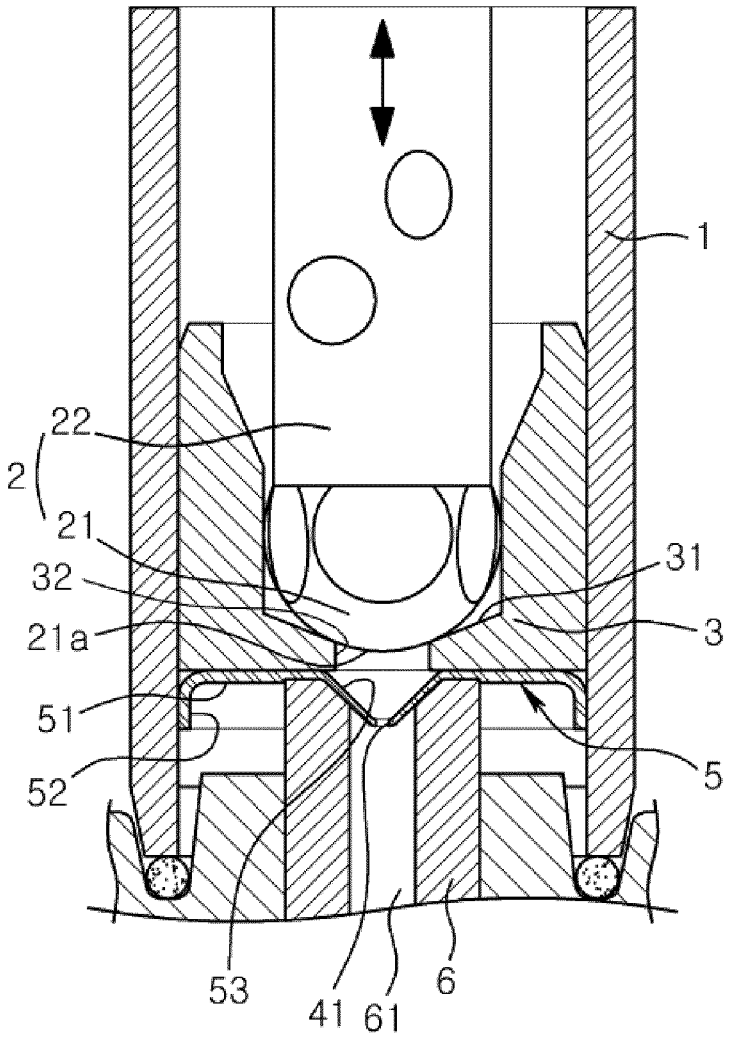

Fig. 7

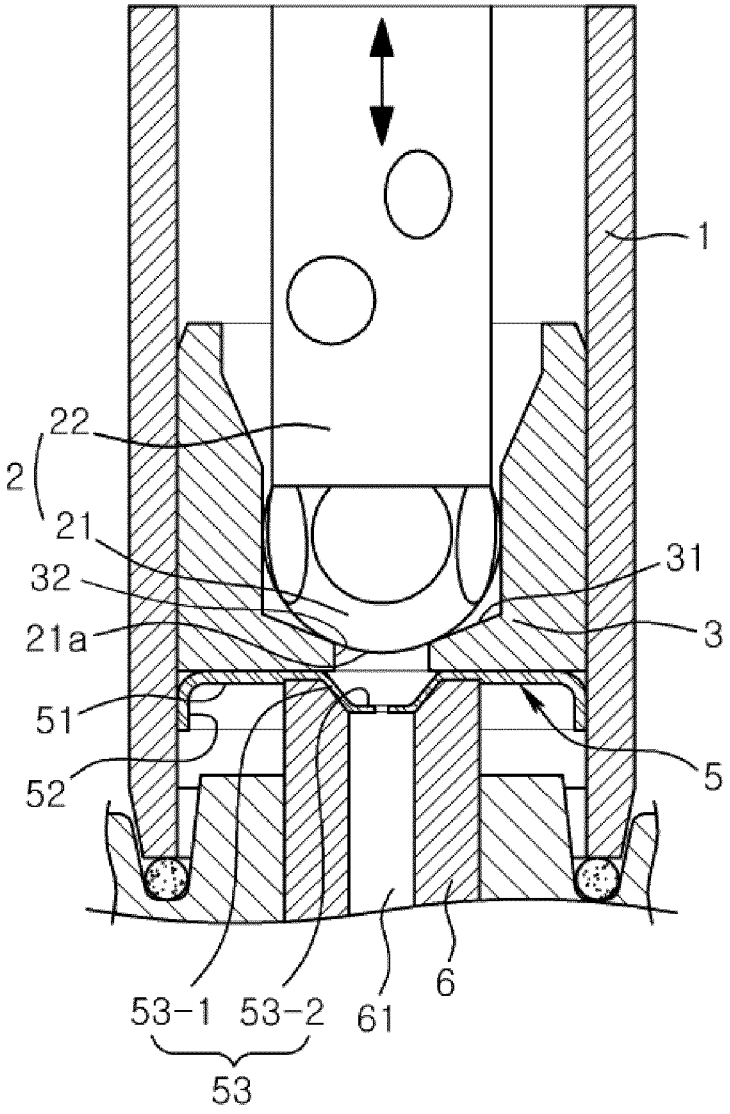

Fig. 8