(19) Europäisches Patentamt / European Patent Office / Office européen des brevets

(11) EP 2 103 803 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent: **12.05.2010 Bulletin 2010/19**

(51) Int Cl.: ***F02M 51/00*** *(2006.01)* ***F02M 51/06*** *(2006.01)*

(21) Application number: **09154682.0**

(22) Date of filing: **09.03.2009**

(54) **Electromagnetic fuel injection valve**

Elektromagnetisches Kraftstoffeinspritzventil

Injecteur de carburant électromagnétique

(84) Designated Contracting States: **DE FR GB IT**

(30) Priority: **18.03.2008 JP 2008069977**

(43) Date of publication of application: **23.09.2009 Bulletin 2009/39**

(73) Proprietor: **Keihin Corporation Tokyo 163-0539 (JP)**

(72) Inventors:
- **Omura, Tomoyuki Kakuda, Kakuda-shi Miyagi (JP)**
- **Matsuo, Daisuke Kakuda, Kakuda-shi Miyagi (JP)**
- **Sato, Kazuhiko Kakuda, Kakuda-shi Miyagi (JP)**

(74) Representative: **Prechtel, Jörg Weickmann & Weickmann Patentanwälte Postfach 86 08 20 81635 München (DE)**

(56) References cited:
EP-A- 1 719 905
EP-A- 1 755 133
WO-A-99/05412
WO-A-2009/008255
DE-A1-102005 037 319
JP-A- 2005 240 731
US-A- 5 967 419

EP 2 103 803 B1

Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to an electromagnetic fuel injection valve mainly used in a fuel supply system of an internal combustion engine. More particularly, it relates to an improvement of an electromagnetic fuel injection valve including: a valve assembly accommodated in a valve housing having a valve seat in the front end part, and comprising of a valve element operating in cooperation with the valve seat and a movable core connected to the valve element; a stationary core connectingly provided at the rear end of the valve housing to attract the movable core and open the valve element at the time of excitation; a coil assembly disposed at the outer periphery ranging from the valve housing to the stationary core and comprising a bobbin and a coil which is wound around the bobbin to excite the stationary core at the time of current supply; a coupler disposed on one side of the coil assembly to hold a feeding terminal connecting to the coil; and a coil housing disposed at the outer periphery of the coil assembly to provide magnetic connection between the valve housing and the stationary core.

DESCRIPTION OF THE RELATED ART

[0002] Japanese Patent Application Laid-open No. 2005-240731 discloses such an electromagnetic fuel injection valve.

[0003] Conventionally, in such an electromagnetic fuel injection valve, it has been known that a sound insulating resin layer is formed at the outer periphery of a valve housing, a coil assembly, and a stationary core to block operating noise generated when a valve element opens and closes in the valve housing and thereby to obtain quietness.

[0004] In the conventional electromagnetic fuel injection valve, when the sound insulating resin layer is molded, a material resin penetrates into a coil housing and wraps a coil assembly to enhance the strength of the coil assembly. In this case, the coil housing is provided with a plurality of cutouts for promoting the penetration of resin. In order to cause the resin to properly penetrate into the coil assembly, a plurality of large cutouts need to be provided in the coil housing. However, these cutouts are unfavorable in terms of magnetic characteristics of an electromagnetic fuel injection valve because they reduce the cross-sectional area of a magnetic path in the coil housing.

[0005] EP 1 719 905 A shows an electromagnetic fuel injection valve with an air layer formed between resin molded layers in order to suppress transmission of operating noise.

SUMMARY OF THE INVENTION

[0006] The present invention has been made in view of the above circumstances, and accordingly an object thereof is to provide an electromagnetic fuel injection valve in which the strength of a coil assembly can be enhanced while the reduction in cross-sectional area of magnetic path of a coil housing is prevented, and moreover the sound insulating properties are excellent.

[0007] In order to achieve the object, according to a first feature of the present invention, there is provided an electromagnetic fuel injection valve comprising: a valve assembly accommodated in a valve housing having a valve seat in the front end part, and comprising a valve element operating in cooperation with the valve seat and a movable core connected to the valve element; a stationary core connectingly provided at the rear end of the valve housing to attract the movable core and open the valve element at the time of excitation; a coil assembly disposed at the outer periphery ranging from the valve housing to the stationary core and comprising a bobbin and a coil which is wound around the bobbin to excite the stationary core at the time of current supply; a coupler disposed on one side of the coil assembly to hold a feeding terminal connecting to the coil; and a coil housing disposed at the outer periphery of the coil assembly to provide magnetic connection between the valve housing and the stationary core, **characterized in that** a first sound insulating resin layer is formed at the outer periphery of the coil assembly, and the first sound insulating resin layer and the coupler are molded integrally to form the coil assembly with the coupler; the bobbin of the coil assembly with the coupler is fitted onto the outer peripheral surfaces of the valve housing and the stationary core, and a sound insulating air layer is formed between the fitted peripheral surfaces; a coil housing for accommodating the coil assembly with the coupler is fitted and fixed to the valve housing and the stationary core; and a second sound insulating resin layer is formed so as to cover the outer periphery of the valve housing and the outer periphery of the root of the coupler.

[0008] With the first feature of the present invention, the first sound insulating resin layer is formed at the outer periphery of the coil assembly, and the first sound insulating resin layer and the coupler are molded integrally to form the coil assembly with the coupler; the bobbin of the coil assembly with the coupler is fitted onto the outer peripheral surfaces of the valve housing and the stationary core, and the sound insulating air layer is formed between the fitted peripheral surfaces; the coil housing for accommodating the coil assembly with the coupler is fitted and fixed to the valve housing and the stationary core; and the second sound insulating resin layer is formed so as to cover the outer periphery of the valve housing and the outer periphery of the root of the coupler. Therefore, the coil housing need not be provided with a cutout for allowing penetration of the first sound insulating resin layer, and the decrease in the cross-sectional area of magnetic path of the coil housing can be restrained, which can contribute to the improvement in magnetic characteristics of the electromagnetic fuel injection valve. Also, even in the case where a cutout or through hole for resin penetration needs to be provided in the shell part of the coil housing to partially fuse the second sound insulating resin layer with the first sound insulating resin layer when the second sound insulating resin layer is molded, the cutout or through hole may be made small to such a degree as to scarcely exert an influence on the cross-sectional area of magnetic path of the coil housing.

[0009] Also, the sound insulating air layer provided between the valve housing and the stationary core and the coil assembly surrounding these elements greatly decreases the contact area between the valve housing and the stationary core and the coil assembly, and effectively restrains the transmission of vibrating noise to the coil assembly. Moreover, since the hard synthetic resin made first sound insulating resin layer molded integrally with the coupler is formed at the outer periphery of the coil assembly, even if the vibrating noise is transmitted to the coil assembly, the vibrating noise can be absorbed by the first sound insulating resin layer. Therefore, the generation of resonance noise from the coupler can be prevented. Further, the coil housing that is fitted and fixed to the valve housing and the stationary core is disposed at the outer periphery of the first sound insulating resin layer, and the second sound insulating resin layer is formed so as to wrap the coil housing, the root of the coupler, and the outer periphery of a fuel inlet tube. Therefore, even if vibrating noise passing through the first sound insulating resin layer is present, the noise can be insulated by the coil housing and the second sound insulating resin layer, and also the generation of noise radiating from the coil housing and the fuel inlet tube can be restrained. Thereupon, a quiet electromagnetic fuel injection valve can be provided.

[0010] Further, in manufacturing the electromagnetic fuel injection valve, after the coil assembly with the coupler having been produced in advance has been fitted to the outer peripheries of the valve housing and the stationary core, the coil housing for accommodating the coil assembly is fitted and fixed to a magnetic cylinder and a yoke. Therefore, the coil assembly with the coupler can be fixed simultaneously with the installation of the coil housing, so that the assembling work is easy to perform. In addition, since the coil assembly with the coupler is fixed to the valve housing and the stationary core, the next molding work for the second sound insulating resin layer can be performed easily, so that the electromagnetic fuel injection valve as a whole can be manufactured efficiently.

[0011] According to a second feature of the present invention, in addition to the first feature, the coil housing comprises a shell part covering the outer peripheral surface side of the coil assembly, an annular end wall part bent inward in a radial direction from the front end part of the shell part, and a boss part projecting forward in an axial direction from the inner peripheral end of the annular end wall part and fitted and fixed to the valve housing; and a flange-shaped yoke fitted and fixed to the shell part is formed integrally with the stationary core so as to hold the bobbin from the axial direction in cooperation with the annular end wall part.

[0012] With the second feature of the present invention, the coil assembly can be supported easily and properly by the coil housing and the yoke.

[0013] According to a third feature of the present invention, in addition to the second feature, a plurality of protrusions being in contact with the annular end wall part or the yoke and capable of being compressedly deformed are formed on at least one end face in the axial direction of the bobbin made of a synthetic resin.

[0014] With the third feature of the present invention, the compressed deformation of the protrusions can reliably hold the bobbin without a play by means of the coil housing and the yoke.

[0015] According to a fourth feature of the present invention, in addition to the first feature, a longitudinal hole communicating with the interior of the valve housing is provided in a central part of the stationary core, and a fuel inlet tube for introducing a fuel into the longitudinal hole, having an outside diameter larger than that of the stationary core, is connectingly provided integrally with the yoke.

[0016] With the fourth feature of the present invention, the fuel inlet tube connectingly provided on the flange-shaped yoke of the stationary core is formed so as to have a diameter larger than that of the stationary core. Therefore, the fuel inlet tube contributes to the enhancement in rigidity of the stationary core, and the vibrations of the stationary core caused by the vibrating noise can be restrained.

[0017] The above-mentioned object, other objects, characteristics, and advantages of the present invention will become apparent from the preferred embodiments, which will be described in detail below by reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a longitudinal sectional view of an electromagnetic fuel injection valve related to a first embodiment of the present invention;

FIG. 2 is an enlarged view of portion 2 in FIG. 1;

FIG. 3 is a longitudinal sectional view of only a coil assembly with a coupler of the electromagnetic fuel injection valve; and

FIG. 4 is a sectional view showing a second embodiment of the present invention, corresponding to FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] First, a first embodiment of the present invention shown in FIG. 1 to FIG. 3 is explained.

[0020] In FIG. 1 and FIG. 2, a valve housing 1 of an electromagnetic fuel injection valve I for an internal combustion engine includes a cylindrical valve seat member 2, a magnetic cylinder 4 coaxially joined to the rear end part of the valve seat member 2, and a nonmagnetic cylinder 6 coaxially joined to the rear end of the magnetic cylinder 4.

[0021] A rear half part 2b of the valve seat member 2 is press fitted onto the inner peripheral surface of the front end part of the magnetic cylinder 4, and joined in a fluid-tight manner by laser beam welding. The press fitting and the laser beam welding are described later. The magnetic cylinder 4 and the nonmagnetic cylinder 6 are coaxially joined to each other in a fluid-tight manner by laser beam welding throughout the entire periphery by butting the facing end faces thereof against each other.

[0022] The valve seat member 2 includes a valve hole 7 that is open in the front end surface thereof, a conical valve seat 8 connected to the inner end of the valve hole 7, and a cylindrical guide hole 9 connected to the large-diameter part of the valve seat 8. To the front end surface of the valve seat member 2, a steel sheet made injector plate 10 having a plurality of fuel injection holes 11 communicating with the valve hole 7 is welded in a fluid-tight manner throughout the entire periphery.

[0023] Onto the inner peripheral surface of the nonmagnetic cylinder 6, a cylindrical stationary core 5 is press fitted in a fluid-tight manner from the rear end side thereof and is fixed thereto. At this time, in the front end part of the nonmagnetic cylinder 6, a portion that does not fit to the stationary core 5 is left, and a valve assembly V is accommodated in the valve housing 1 ranging from this portion to the valve seat member 2.

[0024] The valve assembly V includes a valve element 18, which comprises a semispherical valve part 16 for opening and closing the valve hole 7 in cooperation with the valve seat 8 and a stem part 17 for supporting it, and a movable core 12 having a connection hole 13 to which the rear end part of the stem part 17 is fitted and connected. The stem part 17 is fitted thereto until abutting against an end wall part 13a of the connection hole 13. The stem part 17 and the movable core 12 are fixed to each other by welding.

[0025] The movable core 12 is inserted in the magnetic cylinder 4 and the nonmagnetic cylinder 6 in such a manner as to bestride from the magnetic cylinder 4 to the nonmagnetic cylinder 6, and is disposed coaxially with the stationary core 5. The stem part 17 is formed so as to have a diameter smaller than that of the guide hole 9, and at the outer periphery thereof, there is integrally formed a journal part 17a that projects to the outside in the radial direction and is slidably supported on the inner peripheral surface of the guide hole 9. The journal part 17a is provided with a plurality of cutouts for allowing front and rear spaces thereof to communicate with each other.

[0026] The valve assembly V is provided with a longitudinal hole 19 extending from the rear end face of the movable core 12 to a position in front of the valve part 16, and a transverse hole 20 that opens the longitudinal hole 19 to the outer peripheral surface of the stem part 17 between the journal part 17a and the valve part 16. In an intermediate portion of the longitudinal hole 19 in the movable core 12, an annular spring seat 24 directed to the stationary core 5 side is formed.

[0027] In the rear end part of the stationary core 5, a flange-shaped yoke 5y projecting from the outer peripheral surface of the stationary core 5 and a fuel inlet tube 26 having a diameter larger than that of the stationary core 5, which extends to the rear in the axial direction from the yoke 5y, are provided integrally. The stationary core 5 and the fuel inlet tube 26 are provided with a continuous longitudinal hole 21 communicating with the longitudinal hole 19 of the movable core 12, and a fuel filter 27 is mounted in an enlarged-diameter part 21a in which the diameter of the longitudinal hole 21 is enlarged on the inlet side of the fuel inlet tube 26.

[0028] Onto the inner peripheral surface of an intermediate part of the longitudinal hole 21, a pipe-shaped retainer 23 with a slit is fixed so as to be elastically engaged therewith, and a valve spring 22 is provided under compression between the retainer 23 and the spring seat 24 so as to urge the movable core 12 to valve closing side of the valve element 18. At this time, the set load of the valve spring 22 is adjusted by the adjustment of the depth of fitting of the retainer 23 to the longitudinal hole 21.

[0029] In FIG. 1 and FIG. 2, the end faces facing to each other of the stationary core 5 and the movable core 12 are called a stationary side attraction face 35 and a movable side attraction face 36, respectively. The stationary core 5 includes a small-diameter part 5a having the stationary side attraction face 35 and a main part 5b having a diameter larger than that of the small-diameter part 5a, which is connected coaxially to the small-diameter part 5a via an annular step part 5c. The rear half end of the nonmagnetic cylinder 6 is press fitted in the small-diameter part 5a so that the inner peripheral surface of the nonmagnetic cylinder 6 is in close contact with the outer peripheral surface of the front end part of the small-diameter part 5a, and the rear end face of the small-diameter part 5a is caused to abut against the annular step part 5c.

[0030] The movable core 12 is formed so as to have substantially same diameter as the diameter of the small-diameter part 5a of the stationary core 5. In the movable core 12, there is embedded a nonmagnetic stopper collar 28 that projects slightly from the movable side attraction face 36 while being caused to pass through the longitudinal hole 19. The contact of the stopper collar 28 with the stationary side attraction face 35 of the stationary core 5 specifies the operation limit of the movable core 12.

[0031] In order to adjust a clearance produced between the stationary side attraction face 35 and the stopper collar 28 to a predetermined value at the time of valve opening stroke of the valve element 18, that is, at the time when the valve element 18 is closed, the depth of press fitting of the valve seat member 2 with respect to the inner peripheral surface of the magnetic cylinder 4 is adjusted. After this adjustment, a laser beam B fired from a laser torch 40 is applied to the entire periphery of boundary corner between the front end face of the magnetic cylinder 4 and the outer peripheral surface of the valve seat member 2 from the slantwise front side to perform welding, by which the press fitting part is fixed reliably, and the fluid tightness is ensured. The valve seat member 2 is formed of a material having a hardness higher than that of the magnetic cylinder 4 because of its properties. Therefore, in this case, if the welding is performed by offsetting the application point of the laser beam B from the boundary between the valve seat member 2 and the magnetic cylinder 4 to the magnetic cylinder 4 side, direct heat input of the laser beam B to the valve seat member 2 having a high hardness can be avoided, so that the generation of weld cracks in the valve seat member 2 can be prevented.

[0032] A front half part 2a of the valve seat member 2 has a large thickness and a large diameter as compared with the rear half part 2b in which the magnetic cylinder 4 is press fitted in order to enhance the rigidity of the surrounding of the valve seat 8, and a tapered step part 2c the diameter of which decreases toward the rear is formed between the front half part 2a and the rear half part 2b. This tapered step part 2c does not hinder the application of the laser beam B from the laser torch 40 to the weld part.

[0033] As shown in FIG. 2 and FIG. 3, a coil assembly 30 is disposed at the outer periphery of a portion ranging from the magnetic cylinder 4 to the stationary core 5. This coil assembly 30 includes a bobbin 31 fitted to the outer periphery of a portion ranging from the magnetic cylinder 4 to the stationary core 5, and a coil 32 wound around the bobbin 31.

In the rear end flange part of the bobbin 31, there is integrally formed a support arm 33 that projects in the radial direction to support a feeding terminal 34 connecting to the coil 32.

[0034] At the outer periphery of the coil assembly 30, a first sound insulating resin layer 41 consisting of a glass-fiber-filled hard synthetic resin is formed. This first sound insulating resin layer 41 and a coupler 42, which is arranged so as to project to one side of the coil assembly 30 to hold the feeding terminal 34, are molded integrally, by which the coil assembly 30 with the coupler 42 is formed.

[0035] Between the inner peripheral surface of the bobbin 31 of the coil assembly 30 with the coupler 42 and the outer peripheral surface ranging from the rear end part of the magnetic cylinder 4 to the stationary core 5, a cylindrical sound insulating air layer 43 is defined. To define the air layer 43, an annular groove 44 having a depth corresponding to the thickness of the air layer 43 is formed in the outer peripheral surface ranging from the rear end part of the magnetic cylinder 4 to the stationary core 5. This annular groove 44 can be formed easily by cutting.

[0036] The coil assembly 30 with the coupler 42 is accommodated in a magnetic coil housing 45, and is held in the axial direction by an annular end wall part 45b of the coil housing 45 and the yoke 5y at the outer periphery of the stationary core 5. Specifically, the coil housing 45 includes a shell part 45a covering the outer peripheral surface of the coil assembly 30, the annular end wall part 45b that bends inward in the radially direction from the front end of the shell part 45a to cover the front end face of the bobbin 31 of the coil assembly 30, and a cylindrical boss part 45c projecting forward from the front end of the annular end wall part 45b. The boss part 45c is press fitted onto the outer peripheral surface of the magnetic cylinder 4, and at the same time, the shell part 45a is press fitted onto the outer peripheral surface of the yoke 5y. Thus, the coil housing 45 is installed, and the bobbin 31 of the coil assembly 30 with the coupler 42 is held by the annular end wall part 45b and the yoke 5y. At this time, at least one of the front end face and the rear end face of the bobbin 31 is formed with a plurality of protrusions 47. These protrusions 47 are compressedly deformed by a pressure applied by the contact member 45b or 5y.

[0037] In the rear end part of the shell part 45a of the coil housing 45, one cutout for receiving the root of the coupler 42 is provided.

[0038] After the coil housing 45 has been installed, a second sound insulating resin layer 49 covering the outer peripheral surface ranging from the coil housing 45 to the root of the coupler 42 and the intermediate portion of the fuel inlet tube 26 is formed. This second sound insulating resin layer 49 is made of a soft synthetic resin such as thermoplastic polyester elastomer.

[0039] Next, the operation of the first embodiment is explained.

[0040] In the state in which the coil 32 is demagnetized, the valve assembly V is pressed to the front by the urging force of the valve spring 22, and the valve element 18 is seated on the valve seat 8. Accordingly, the fuel sent under pressure from a fuel pump (not shown) to the fuel inlet cylinder 26 is passed through the interior of the pipe-shaped retainer 23, and the longitudinal hole 19 and the transverse holes 20 in the valve assembly V, into in the valve housing 1 for standby.

[0041] When the coil 32 is excited by current supply, a magnetic flux produced by the excitation runs sequentially from the coil housing 45 to the magnetic cylinder 4, the movable core 12, and the stationary core 5, and the movable core 12 is attracted to the stationary core 5 against the set load of the valve spring 22 by the attraction force caused by a magnetic force generated between the movable side attraction face 36 and the stationary side attraction face 35, so that the valve element 18 separates from the valve seat 8. Therefore, the valve hole 7 is opened, and a high-pressure fuel in the valve seat member 2 comes out of the valve hole 7, and is injected through the fuel injection hole 11 in the injector plate 10 toward the intake valve of the engine.

[0042] At this time, the stopper collar 28 embedded in the movable core 12 comes into contact with the stationary side attraction face 35 of the stationary core 5, by which the valve opening limit of the valve element 18 is specified, and a predetermined air gap is left between the movable side attraction face 36 and the stationary side attraction face 35. Therefore, the direct contact between the movable side attraction face 36 and the stationary side attraction face 35 is avoided. Moreover, since the stopper collar 28 is nonmagnetic, when the coil 32 is de-energized, the residual magnetism between the cores 5 and 12 disappears rapidly, so that the valve closing response of the valve element 18 can be enhanced.

[0043] Due to the contact of the stopper collar 28 with the stationary core 5 and the seating of the valve element 18 on the valve seat 8, vibrating noise is generated. When the vibrating noise is transmitted to the coupler 42 via the valve housing 1 and the stationary core 5, resonance noise is generated from the coupler 42. In the present invention, the sound insulating air layer 43 provided between the valve housing 1 and the stationary core 5 and the coil assembly 30 surrounding these elements greatly decreases the contact area between the valve housing 1 and the stationary core 5 and the coil assembly 30, and effectively restrains the transmission of the vibrating noise to the coil assembly 30. Moreover, since the hard synthetic resin made first sound insulating resin layer 41 molded integrally with the coupler 42 is formed at the outer periphery of the coil assembly 30, even if the vibrating noise is transmitted to the coil assembly 30, the vibrating noise can be absorbed by the first sound insulating resin layer 41. Therefore, the generation of resonance noise from the coupler 42 can be prevented. Also, since the first sound insulating resin layer 41 molded integrally with the coupler 42 is made of a glass-fiber-filled hard synthetic resin, sufficient rigidity can be given to the coupler 42.

[0044] Further, the coil housing 45 that is fitted and connected to the valve housing 1 and the yoke 5y is disposed at the outer periphery of the first sound insulating resin layer 41, and the second sound insulating resin layer 49 is formed so as to wrap the coil housing 45, the root of the coupler 42, and the outer periphery of the fuel inlet tube 26. Therefore, even if vibrating noise passing through the first sound insulating resin layer 41 is present, the noise can be insulated by the coil housing 45 and the second sound insulating resin layer 49, and also the generation of noise radiating from the coil housing 45 and the fuel inlet tube 26 can be restrained. Also, since the second sound insulating resin layer 49 is made of a soft synthetic resin, the second sound insulating resin layer 49 absorbs a shock produced at the time of contact with another object, and therefore can perform a function of protective layer for protecting the electromagnetic fuel injection valve I.

[0045] In manufacturing the electromagnetic fuel injection valve I, after the coil assembly 30 with the coupler 42 having been produced in advance has been fitted to the outer peripheries of the valve housing 1 and the stationary core 5, the coil housing 45 for accommodating the coil assembly 30 is fitted to the magnetic cylinder 4 and the yoke 5y, and the bobbin 31 of the coil assembly 30 is held in the axial direction by the annular end wall part 45b of the coil housing 45 and the yoke 5y. Therefore, the coil assembly 30 with the coupler 42 can be fixed simultaneously with the installation of the coil housing 45, so that the assembling work is easy to perform. In addition, since the coil assembly 30 with the coupler 42 is fixed to the valve housing 1 and the stationary core 5, the next molding work for the second sound insulating resin layer 49 can be performed easily, so that the electromagnetic fuel injection valve I as a whole can be manufactured efficiently.

[0046] At this time, since at least one of the front end face and the rear end face of the bobbin 31 of the coil assembly 30 is formed with the plurality of protrusions 47, and these protrusions 47 are compressedly deformed by a pressure of contact with the annular end wall part 45b or the yoke 5y, the bobbin 31 can be held properly between the annular end wall part 45b and the yoke 5y without a play.

[0047] The shell part 45a of the coil housing 45 disposed at the outer periphery of the first sound insulating resin layer 41 need not be provided with a cutout for allowing penetration of the first sound insulating resin layer 41 except the one cutout 48 for receiving the root of the coupler 42, so that the decrease in the cross-sectional area of magnetic path of the coil housing 45 can be kept to a minimum, which can contribute to the improvement in magnetic characteristics of the electromagnetic fuel injection valve I. Even in the case where a cutout or through hole for resin penetration needs to be provided in the shell part 45a of the coil housing 45 to partially fuse the second sound insulating resin layer 49 with the first sound insulating resin layer 41 when the first sound insulating resin layer 41 is molded, the cutout or through hole may be made small to such a degree as to scarcely exert an influence on the cross-sectional area of magnetic path of the coil housing 45.

[0048] Also, the fuel inlet tube 26 integrally provided at the rear in the axial direction of the flange-shaped yoke 5y of the stationary core 5 is formed so as to have a diameter larger than that of the stationary core 5. This configuration contributes to the enhancement in rigidity of the stationary core 5, and the vibrations of the stationary core 5 caused by the vibrating noise can be restrained.

[0049] Next, a second embodiment of the present invention shown in FIG. 4 is explained.
This second embodiment has the same configuration as

that of the above-described embodiment except that an annular groove 44' is formed in the inner peripheral surface of the bobbin 31 to form the air layer 43 between the bobbin 31 and the outer peripheral surface ranging from the magnetic cylinder 4 to the stationary core 5. Therefore, in FIG. 4, the same symbols are applied to elements corresponding to those of the above-described embodiment, and the duplicated explanation thereof is omitted.

[0050] According to the second embodiment, the annular groove 44' can be formed when the synthetic resin made bobbin 31 is molded. Therefore, the air layer 43 can be formed easily.

[0051] The above is a description of the embodiments of the present invention. The present invention is not limited to the above-described embodiments, and various design changes can be made without departing from the scope of the present invention as defined by the appended claims. For example, in forming the air layer 43, both of the annular groove 44 on the stationary core 5 side of the first embodiment and the annular groove 44' on the bobbin 31 side of the second embodiment can also be adopted.

[0052] An object of the present invention is to provide an electromagnetic fuel injection valve in which the strength of a coil assembly can be enhanced while the reduction in cross-sectional area of magnetic path of a coil housing is prevented, and moreover the sound insulating properties are excellent. In an electromagnetic fuel injection valve, a first sound insulating resin layer 41 is formed at the outer periphery of a coil assembly 30, and the first sound insulating resin layer 41 and a coupler 42 are molded integrally to form the coil assembly 30 with the coupler 42; a bobbin 31 of the coil assembly 30 with the coupler 42 is fitted onto the outer peripheral surfaces of a valve housing 1 and a stationary core 5, and a sound insulating air layer 43 is formed between the fitted peripheral surfaces; a coil housing 45 for accommodating the coil assembly 30 with the coupler 42 is fitted and fixed to the valve housing 1 and the stationary core 5; and a second sound insulating resin layer 49 is formed so as to cover the outer periphery of the valve housing 1 and the outer periphery of the root of the coupler 42.

Claims

1. An electromagnetic fuel injection valve comprising:

    a valve assembly (V) accommodated in a valve housing (1) having a valve seat (8) in the front end part, and comprising a valve element (18) operating in cooperation with the valve seat (8) and a movable core (12) connected to the valve element (18);

    a stationary core (5) connectingly provided at the rear end of the valve housing (1) to attract the movable core (12) and open the valve element (18) at the time of excitation;

    a coil assembly (30) disposed at the outer periphery ranging from the valve housing (1) to the stationary core (5) and comprising a bobbin (31) and a coil (32) which is wound around the bobbin (31) to excite the stationary core (5) at the time of current supply;

    a coupler (42) disposed on one side of the coil assembly (30) to hold a feeding terminal (34) connecting to the coil (32); and

    a coil housing (45) disposed at the outer periphery of the coil assembly (30) to provide magnetic connection between the valve housing (1) and the stationary core (5),

    characterized in that

    a first sound insulating resin layer (41) is formed at the outer periphery of the coil assembly (30), and the first sound insulating resin layer (41) and the coupler (42) are molded integrally to form the coil assembly (30) with the coupler (42);

    the bobbin (31) of the coil assembly (30) with the coupler (42) is fitted onto the outer peripheral surfaces of the valve housing (1) and the stationary core (5), and a sound insulating air layer (43) is formed between the fitted peripheral surfaces;

    the coil housing (45) for accommodating the coil assembly (30) with the coupler (42) is fitted and fixed to the valve housing (1) and the stationary core (5); and

    a second sound insulating resin layer (49) is formed so as to cover the outer periphery of the valve housing (1) and the outer periphery of the root of the coupler (42).

2. The electromagnetic fuel injection valve according to claim 1, wherein
   the coil housing (45) comprises a shell part (45a) covering the outer peripheral surface side of the coil assembly (30), an annular end wall part (45b) bent inward in a radial direction from the front end part of the shell part (45a), and a boss part (45c) projecting forward in an axial direction from the inner peripheral end of the annular end wall part (45b) and fitted and fixed to the valve housing (1); and
   a flange-shaped yoke (5y) fitted and fixed to the shell part (45a) is formed integrally with the stationary core (5) so as to hold the bobbin (31) from the axial direction in cooperation with the annular end wall part (45b).

3. The electromagnetic fuel injection valve according to claim 2, wherein
   a plurality of protrusions (47) being in contact with the annular end wall part (45b) or the yoke (5y) and capable of being compressedly deformed are formed on at least one end face in the axial direction of the bobbin (31) made of a synthetic resin.

4. The electromagnetic fuel injection valve according to claim 1, wherein
a longitudinal hole (21) communicating with the interior of the valve housing (1) is provided in a central part of the stationary core (5), and a fuel inlet tube (26) for introducing a fuel into the longitudinal hole (21), having an outside diameter larger than that of the stationary core (5), is connectingly provided integrally with the yoke (5y).

Patentansprüche

1. Elektromagnetisches Kraftstoffeinspritzventil, umfassend:

eine Ventilanordnung (V), die in einem Ventilgehäuse (1) aufgenommen ist, das im vorderen Endteil einen Ventilsitz (8) aufweist, und die ein Ventilelement (18), das im Zusammenwirken mit dem Ventilsitz (8) arbeitet, sowie einen mit dem Ventilelement (18) verbundenen beweglichen Kern (12) umfasst;
einen stationären Kern (5), der im Anschluss an dem Hinterende des Ventilgehäuses (1) vorgesehen ist, um während der Erregung den beweglichen Kern (12) anzuziehen und das Ventilelement (18) zu öffnen; eine Wicklungsanordnung (30), die am von dem Ventilgehäuse (1) zum stationären Kern (5) reichenden Außenumfang angeordnet ist und eine Spule (31) und eine um die Spule (31) herumgewickelte Wicklung (32) aufweist, um während der Stromzufuhr den stationären Kern (5) anzuregen;
eine Kupplung (42), die an einer Seite der Wicklungsanordnung (30) angeordnet ist, um einen mit der Wicklung (32) verbundenen Speiseanschluss (34) zu halten; und
ein Wicklungsgehäuse (45), das am Außenumfang der Wicklungsanordnung (30) angeordnet ist, um eine magnetische Verbindung zwischen dem Ventilgehäuse (1) und dem stationären Kern (5) herzustellen,
dadurch gekennzeichnet, dass eine erste schallisolierende Harzschicht (41) am Außenumfang der Wicklungsanordnung (30) ausgebildet ist, und die erste schallisolierende Harzschicht (41) und die Kupplung (42) integral geformt sind, um die Wicklungsanordnung (30) mit der Kupplung (42) auszubilden;
die Spule (31) der Wicklungsanordnung (30) mit der Kupplung (42) auf die Außenumfangsflächen des Ventilgehäuses (1) und des stationären Kerns (5) aufgesetzt ist und eine schallisolierende Luftschicht (43) zwischen den zusammengesetzten Umfangsflächen gebildet wird;
das Wicklungsgehäuse (45) zur Aufnahme der Wicklungsanordnung (30) mit der Kupplung (42) an dem Ventilgehäuse (1) und dem stationären Kern (5) sitzt und dort fixiert ist; und
eine zweite schallisolierende Harzschicht (49) so ausgebildet ist, dass sie den Außenumfang des Ventilgehäuses (1) und den Außenumfang der Basis der Kupplung (42) abdeckt.

2. Das elektromagnetische Kraftstoffeinspritzventil gemäß Anspruch 1, worin das Wicklungsgehäuse (45) ein Hüllenteil (45a), das die Außenumfangsflächen-Seite der Wicklungsanordnung (30) abdeckt, ein ringförmiges Endwandteil (45b), das in radialer Richtung von dem vorderen Endteil des Hüllenteils (45a) einwärts gebogen ist, sowie ein Nabenteil (45c), das in axialer Richtung vom Innenumfangsende des ringförmigen Endwandteils (45b) nach vorne vorsteht und an dem Ventilgehäuse (1) sitzt und dort fixiert ist, umfasst; und
ein flanschförmiges Joch (5y), das an dem Hüllenteil (45a) sitzt und dort fixiert ist, integral mit dem stationären Kern (5) ausgebildet ist, um im Zusammenwirken mit dem ringförmigen Endwandteil (45) die Spule (31) von der axialen Richtung her zu halten.

3. Das elektromagnetische Kraftstoffeinspritzventil gemäß Anspruch 2, worin eine Mehrzahl von Vorsprüngen (47), die mit dem ringförmigen Endwandteil (45b) oder dem Joch (5y) im Kontakt stehen und unter Druck verformbar sind, an zumindest einer Endfläche in der axialen Richtung der aus Kunstharz hergestellten Spule (31) ausgebildet sind.

4. Das elektromagnetische Kraftstoffeinspritzventil gemäß Anspruch 1, worin ein Langloch (21), das mit dem Innenraum des Ventilgehäuses (1) in Verbindung steht, in einem Mittelteil des stationären Kerns (5) vorgesehen ist, und ein Kraftstoffeinlassrohr (56) zum Einführen von Kraftstoff in das Langloch (21), dessen Außendurchmesser größer ist als jener des stationären Kerns (5), im Anschluss integral mit dem Joch (5y) vorgesehen ist.

Revendications

1. Soupape électromagnétique d'injection de carburant, comprenant :

un ensemble de soupape (V) logé dans un boîtier de soupape (1) ayant un siège de soupape (8) dans la partie d'extrémité avant et comprenant un élément de soupape (18) fonctionnant en coopération avec le siège de soupape (8) et un noyau mobile (12) raccordé à l'élément de soupape (18) ;
un noyau fixe (5) prévu par raccordement au niveau de l'extrémité arrière du boîtier de soupape (1) pour attirer le noyau mobile (12) et

ouvrir l'élément de soupape (18) au moment de l'excitation ;
un ensemble de spire (30) disposé au niveau de la périphérie externe allant du boîtier de soupape (1) jusqu'au noyau fixe (5) et comprenant une bobine (31) et une spire (32) qui est enroulée autour de la bobine (31) pour exciter le noyau fixe (5) au moment de l'alimentation en courant ;
un dispositif de couplage (42) disposé d'un côté de l'ensemble de spire (30) pour maintenir une borne d'alimentation (34) se raccordant à la spire (32) ; et
un boîtier de spire (45) disposé au niveau de la périphérie externe de l'ensemble de spire (30) pour fournir un raccordement magnétique entre le boîtier de soupape (1) et le noyau fixe (5),

caractérisée en ce que :

une première couche de résine d'isolation sonore (41) est formée au niveau de la périphérie externe de l'ensemble de spire (30), et la première couche de résine d'isolation sonore (41) et le dispositif de couplage (42) sont moulés de manière solidaire pour former l'ensemble de spire (30) avec le dispositif de couplage (42) ;
la bobine (31) de l'ensemble de spire (30) avec le dispositif de couplage (42) est montée sur les surfaces périphériques externes du boîtier de soupape (1) et du noyau fixe (5), et une couche d'air d'isolation sonore (43) est formée entre les faces périphériques ajustées ;
le boîtier de spire (45) pour loger l'ensemble de spire (30) avec le dispositif de couplage (42) est ajusté et fixé sur le boîtier de soupape (1) et le noyau fixe (5) ; et
une seconde couche de résine d'isolation sonore (49) est formée afin de recouvrir la périphérie externe du boîtier de soupape (1) et la périphérie externe de la base du dispositif de couplage (42).

2. Soupape électromagnétique d'injection de carburant selon la revendication 1, dans laquelle :

le boîtier de spire (45) comprend une partie de coque (45a) recouvrant le côté de surface périphérique externe de l'ensemble de spire (30), une partie de paroi d'extrémité annulaire (45b) fléchie vers l'intérieur dans une direction radiale à partir de la partie d'extrémité avant de la partie de coque (45a) et une partie de bosse (45c) faisant saillie vers l'avant dans une direction axiale à partir de l'extrémité périphérique interne de la partie de paroi d'extrémité annulaire (45b) et ajustée et fixée sur le boîtier de soupape (1) ; et une fourche en forme de rebord (5y) ajustée et fixée sur la partie de coque (45a) est formée de manière solidaire avec le noyau fixe (5) afin de maintenir la bobine (31) à partir de la direction axiale en coopération avec la partie de paroi d'extrémité annulaire (45b).

3. Soupape électromagnétique d'injection de carburant selon la revendication 2, dans laquelle :

une pluralité de saillies (47) en contact avec la partie de paroi d'extrémité annulaire (45b) ou la fourche (5y) et pouvant être déformées par compression, est formée sur au moins une face d'extrémité dans la direction axiale de la bobine (31) réalisée avec une résine synthétique.

4. Soupape électromagnétique d'injection de carburant selon la revendication 1, dans laquelle :

un trou longitudinal (21) communiquant avec l'intérieur du boîtier de soupape (1) est prévu dans une partie centrale du noyau fixe (5) et un tube d'entrée de carburant (26) pour introduire un carburant dans le trou longitudinal (21) ayant un diamètre externe supérieur à celui du noyau fixe (5), est prévu par raccordement de manière solidaire avec la fourche (5y).

FIG.1

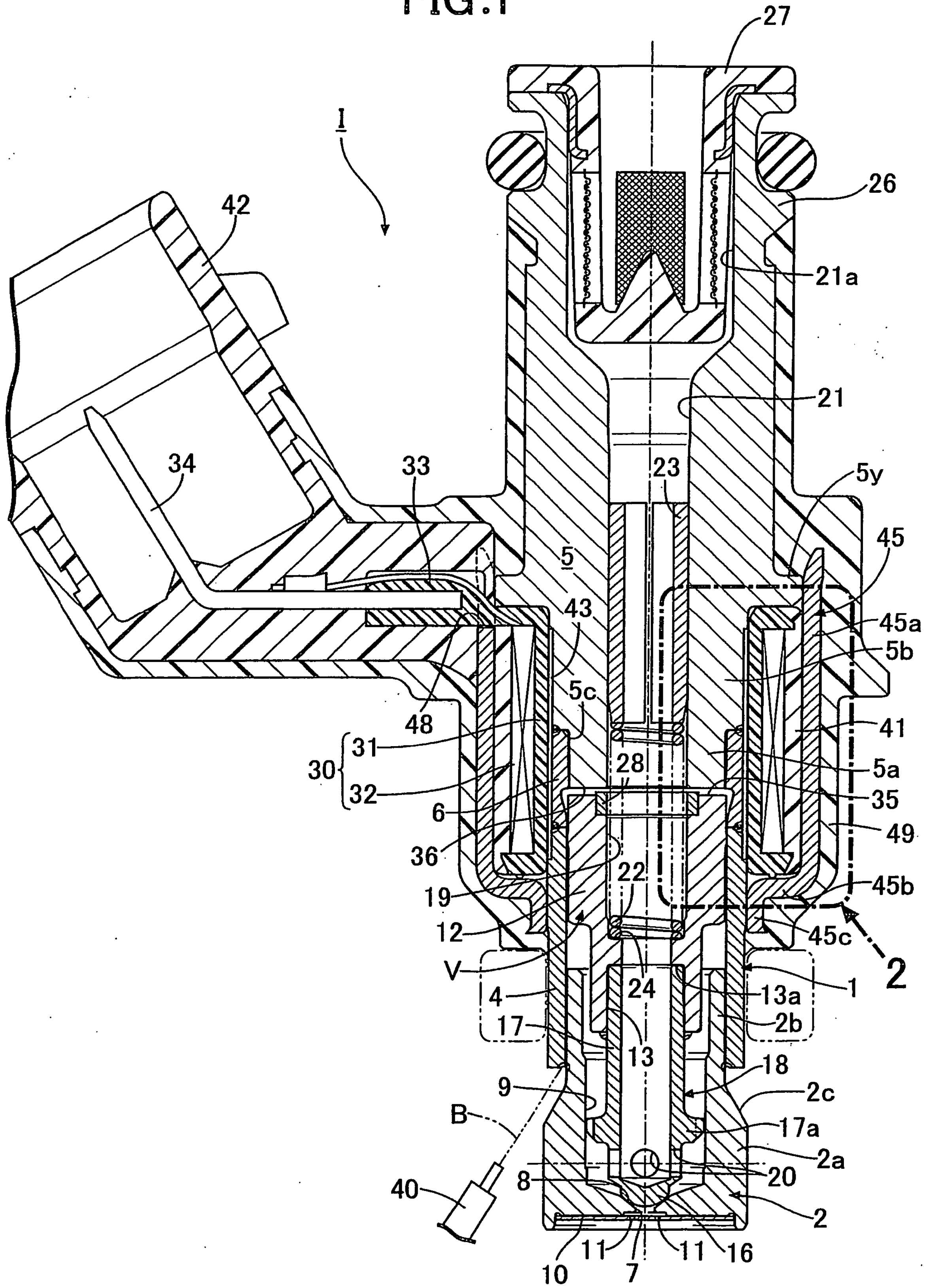

27
26
21a
21
I
42
34
33
23
5y
45
45a
5b
5
43
48
5c
41
5a
35
49
30
31
32
28
6
36
22
19
12
45b
45c
V
24
4
13a
1
2
17
13
2b
18
9
2c
B
17a
2a
20
8
40
2
10
11
7
11
16

FIG.2

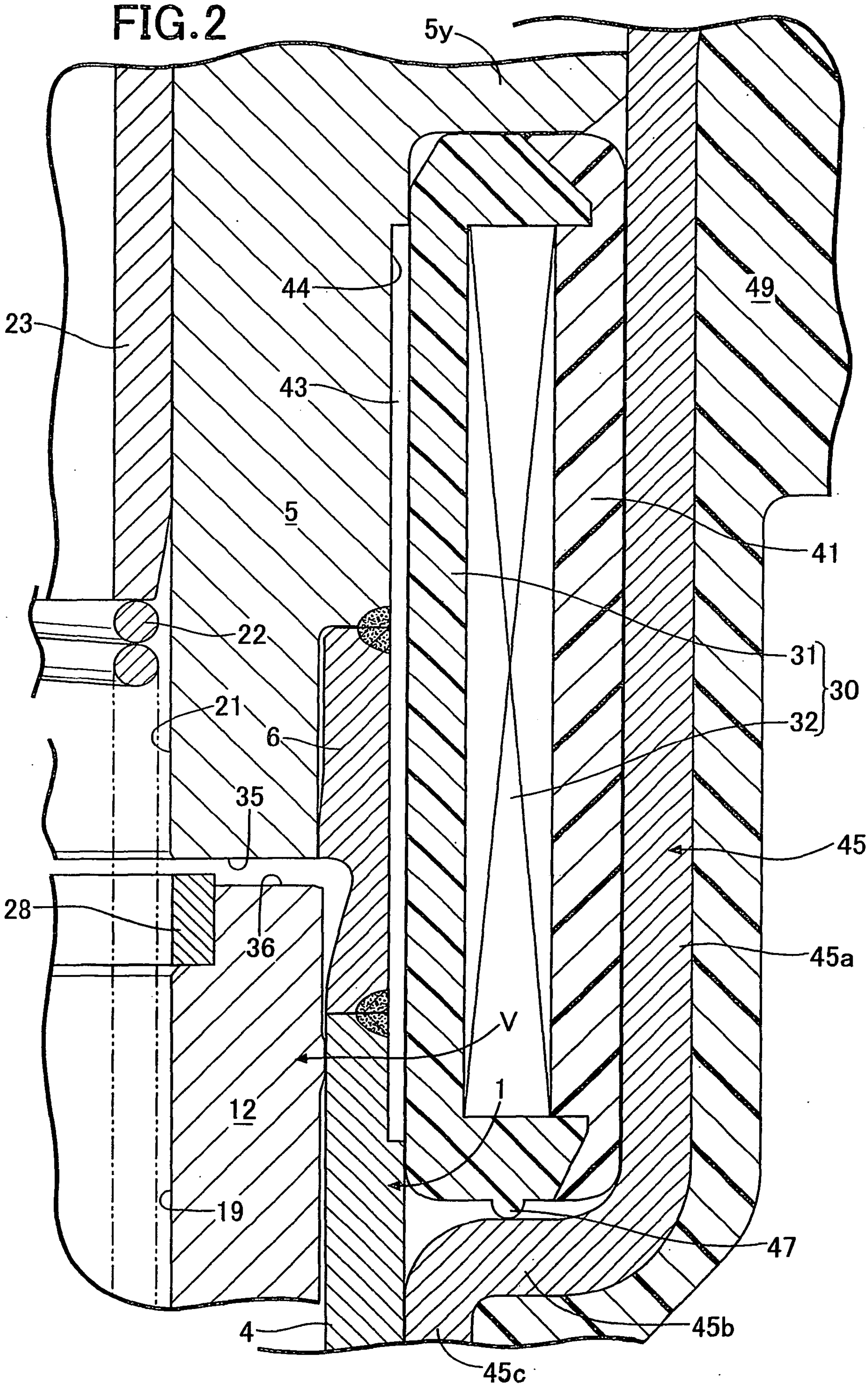

5y
44
49
23
43
5
41
22
31
30
21
6
32
35
45
28
36
45a
V
12
1
19
47
4
45b
45c

FIG.3

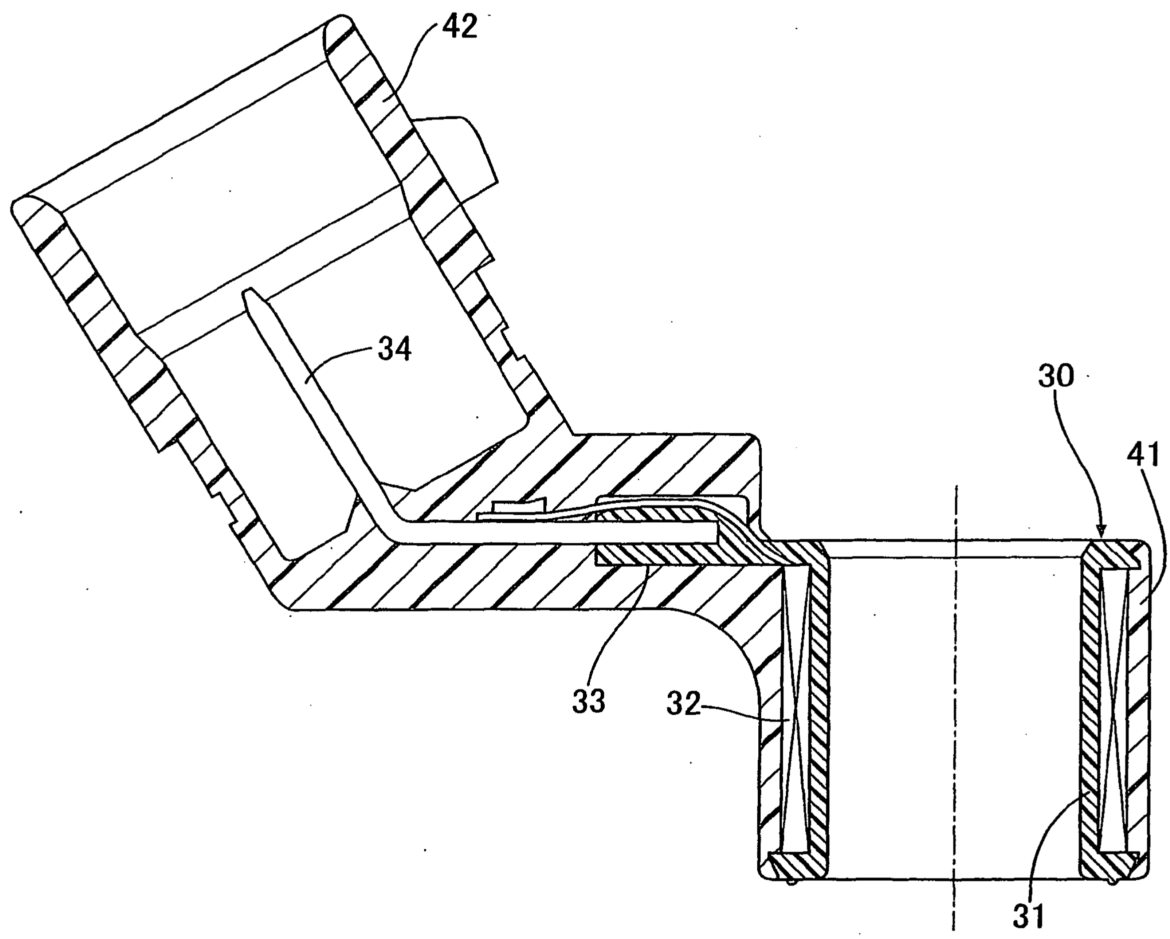
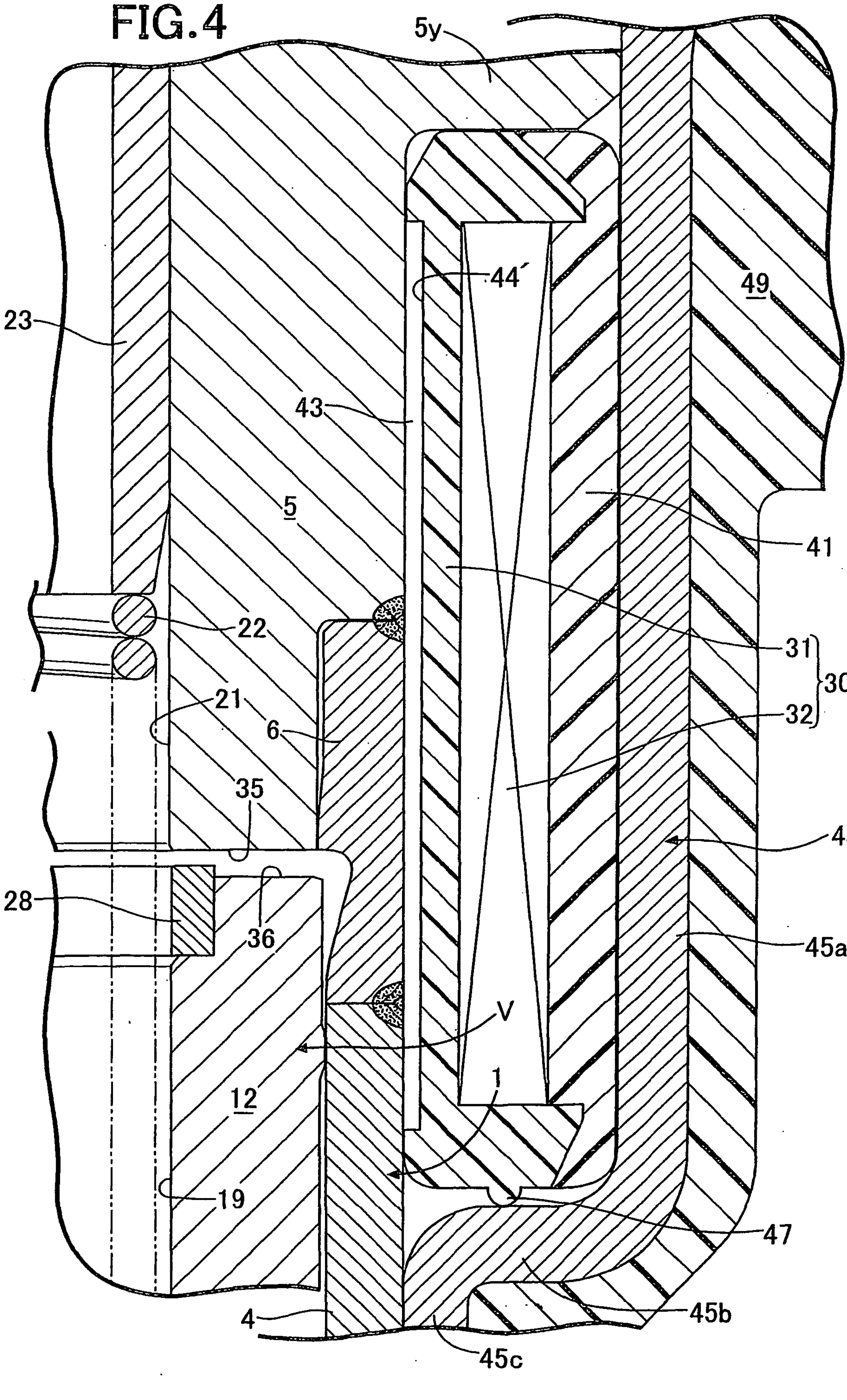


FIG.4


5y
23
44´
49
43
5
41
22
31
30
21
6
32
35
45
28
36
45a
V
12
1
19
47
45b
4
45c

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2005240731 A **[0002]**
- EP 1719905 A **[0005]**