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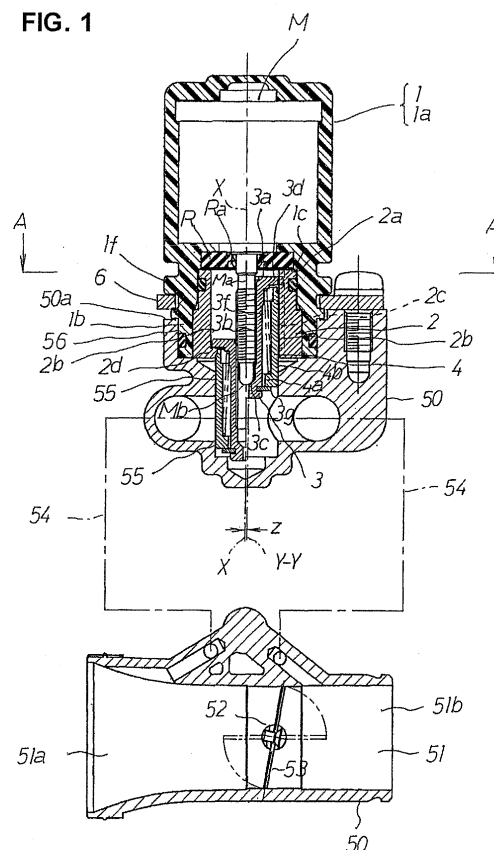
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(54) **IDLE AIR CONTROL DEVICE OF FUEL INJECTION DEVICE**

(57) In an idle air control device in which an air valve is driven by a motor, the air valve is accurately disposed concentrically with an air valve guide hole provided in a throttle body to improve the dynamic characteristics of the air valve. The motor (M) is disposed in a motor case (1a), a cylindrical collar (2) is fixedly disposed in an insertion tube portion (1b) formed integrally with the motor case (1a), and a motor output shaft (Ma) is projectedly disposed in the collar (2). A slider (3) is screwed to the outer periphery of the motor output shaft (Ma), and the air valve (4) is disposed between the outer peripheral portion (3f) of the slider (3) and the inner peripheral portion (2b) of the collar (2). The slider is formed such that its rotation is suppressed by the collar (2) and its axial movement only is allowed. The air valve (4) is disposed so as to be elastically pressed toward the locking step portion (3g) of the slider (3) by an air valve spring (5). The slider (3) is moved in an axial direction according to the rotation of the motor (M), and the air valve (4) is also moved in an axial direction synchronously with the movement of the slider (3) to control the opening of a bypass air passage (54) opening in the air valve guide hole (55).

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a fuel injection device in which fuel within a fuel tank is boosted by a fuel pump, the boosted fuel is injected and supplied to an engine via a fuel injection valve, and more particularly to an idle air control device controlling an amount of idle air supplied toward the engine at a time of an idling operation of the engine or at a time of an off-idling operation.

Background Art

[0002] A conventional idling air control device in a fuel injection device is shown in Fig. 4.

[0003] Describing with reference to Fig. 4, reference numeral 50 denotes a throttle body in which an intake passage 51 is provided so as to pass through an inner portion. The intake passage 51 is controlled so as to be opened and closed on the basis of a rotation of a butterfly type throttle valve 53 attached to a throttle valve shaft 52.

[0004] Further, the intake passage 51 is sectioned into an intake path 51a in an upstream side from the throttle valve 53, and an intake path 51b in a downstream side from the throttle valve 53, by the throttle valve 53, the upstream side intake path 51a is connected to an air cleaner (not shown), and the downstream side intake path 51b is connected to an engine via an intake pipe.

[0005] Reference numeral 54 denotes a bypass air passage. One end of the bypass air passage 54 is open to the upstream side intake path 51a, and the other end thereof is open to the downstream side intake path 51b. The bypass air passage 54 connects the upstream side with the downstream side of the intake passage 51 while bypassing the throttle valve 53.

[0006] Reference numeral 55 denotes an air valve guide hole continuously provided in the bypass air passage 54. One end of the air valve guide hole 55 is open to one end 50a of the throttle body 50 via an insertion hole 56.

[0007] Further, an idle air control device 60 is structured as follows. A wax case 61 is provided with a PTC heater 62 and a wax element 63, in which a thermal expansion and contraction material is sealed in an inner portion, in an inner side, electrodes of the PTC heater 62 are connected to connectors 64a and 64b within a direct coupler portion 61a integrally formed within the wax case 61, and lead wires L1 and L2 are connected to the connectors 64a and 64b.

[0008] Further, a male thread formed in an outer periphery of a tube portion 61b extending to a lower side of the wax case 61 is engaged with a female thread formed in an inner periphery of an upper tube portion 65a of a tubular formed insertion tube portion 65, whereby the insertion tube portion 65 is integrally attached to a lower side of the wax case 61. Reference numeral 66 denotes a cup-shaped actuation body movably arranged in an

inner side of the wax case 61 and the insertion tube portion 65, and an inner bottom portion of the actuation body 66 is energized in such a manner as to be brought into contact with a leading end of an output shaft 63a of the wax element 63 by a spring force of a spring 67.

[0009] In other words, one end of the spring 67 is locked on a locking step portion 65b formed in an inner side of the insertion tube portion 65, and the other end is locked to an upper collar portion 66a of the actuation body 66.

[0010] Further, an upper end of an air valve 68 is locked to a leading end of a shaft portion 66b extending to a lower side from an inner bottom portion of the actuation body 66 via a spring 69.

[0011] As mentioned above, the wax case 61 and the insertion end portion 65 are integrally attached, the PTC heater 62, the wax element 63, the actuation body 66 and the air valve 68 are arranged in the inner side thereof so as to be directed to the lower side from the upper side in Fig. 4, and the actuation body 66 to which the air valve 68 is locked is arranged so as to be elastically brought into contact with the output lever 63a of the wax element 63 on the basis of the spring force of the spring 67, whereby the idle air control device 60 is formed.

[0012] Further, a lower tube portion 65c of the insertion tube portion 65 of the idle air control device is inserted into the insertion hole 56 open to one end 50a of the throttle body 50, and the air valve 68 is arranged so as to be inserted into the air valve guide hole 55. Further, the idle air control device 60 is arranged so as to be fixed to the throttle body 50 by screwing the insertion tube portion 65 into the throttle body 50 by a fixing member (not shown) under the state mentioned above.

[0013] In accordance with the conventional idle air control device mentioned above, since the thermal expansion and contraction material within the wax element 63 is contracted at a time of starting the engine, and the protruding amount of the output shaft 63a is small, the air valve 68 exists at the upper position so as to largely open the bypass air passage 54 and supply the air in correspondence to the opening of the bypass air passage 54 toward the engine, whereby the engine is started.

[0014] On the other hand, a current is supplied to the PTC heater 62 from an ECU or a battery (not shown) in synchronous with the engine start, whereby the PTC heater 62 generates heat so as to heat the wax element 63.

[0015] Since the wax element 63 is heated, the internal thermal expansion and contraction material is expanded so as to increase the protruding amount of the output shaft 63a gradually. The air valve 68 narrows the opening of the bypass air passage 54 gradually in synchronous with the increase of the protruding amount of the output shaft 63a, and can reduce the amount of the air supplied into the downstream side intake path 51b from the bypass air passage 54 in correspondence to an increase of an engine temperature, thereby changing the operation from the engine warm-up to the normal idling operation.

Disclosure of the Invention

[0016] In accordance with the conventional idle air control device, the wax element 63 depends upon not only the heat of the PTC heater 62 but also an ambient temperature. In this case, a protruding characteristic of the output shaft 63a of the wax element 63 is adapted to a temperature state of the engine, and a difference is generated from a protruding characteristic of the output shaft 63a with respect to the ambient temperature.

[0017] For example, in a state in which the ambient temperature is high, there is a tendency that the protruding amount of the output shaft 63a becomes large and the air valve 68 closes the opening of the bypass air passage 54, and there is a case that it is impossible to supply a sufficient air at a time of starting the engine.

[0018] Further, the protruding amount of the output shaft 63a is varied via the heat generation of the PTC heater 62, the heating of the wax element 63 by the PTC heater 62, and a volume change of the thermal expansion and contraction material within the wax element 63, a response speed of the output shaft 63a is slow, and it is impossible to control a small air amount.

[0019] The present invention is made by taking the problems mentioned above into consideration, and an object of the present invention is to provide an idle air control device in a fuel injection device which can securely absorb an eccentricity between an output shaft of a motor and an air valve at a time of changing a movable body driving an air valve from a wax element to a motor so as to accurately arrange the air valve coaxially with an air valve guide hole, and can use a cylindrical air valve arranged in the conventional air valve guide hole having a circular transverse section so as to be compatible with the conventional idle air control device.

[0020] In order to achieve the object mentioned above, in accordance with a first aspect of the present invention, there is provided an idle air control device in a fuel injection device in which a throttle valve is arranged in an intake passage provided within a throttle body, an intake passage in an upstream side of the throttle valve and an intake passage in a downstream side of the throttle valve are connected by a bypass air passage bypassing the throttle valve, and a bypass air amount flowing through the bypass air passage is controlled by an air valve movably arranged within an air guide hole continuously provided in the bypass air passage, wherein the idle air control device comprises:

- a case main body in which a motor case surrounding a motor, and an insertion tube portion formed so as to be open toward a lower side from the motor case are integrally formed by being out molded;
- a tubular collar arranged so as to be fixed to an inner side of the insertion tube portion of the case main body;
- a slider screwed to an outer periphery of a motor output shaft protruding toward an inner side of the

collar from the motor; and

an air valve provided between an inner periphery of the collar and an outer periphery of the slider, arranged so as to be locked in an axial direction and slidably guided by an air valve guide hole, wherein the slider screwed to the motor output shaft is arranged in such a manner that a rotation is suppressed and a movement in an axial direction is allowed by the collar, and wherein the air valve is moved in an axial direction in synchronous with the slider, and an opening of the bypass air passage open to the air valve guide hole is controlled by the air valve.

[0021] Further, in accordance with a second aspect of the present invention, there is provided an idle air control device in a fuel injection device as recited in the first aspect mentioned above, wherein the air valve is arranged so as to be pressed toward a locking step portion provided in an outer periphery of a lower end of a slider by an air valve spring arranged between the locking step portion and a locking collar portion provided in an upper end of the slider and arranged in a compressed manner in an outer periphery of the slider, and a gap which is larger than an amount of eccentricity between an axial core in a longitudinal direction of the motor output shaft and an axial core in a longitudinal direction of the air valve guide hole is formed between an inner peripheral portion of the air valve and an outer peripheral portion of the slider, and between the outer peripheral portion of the air valve and an inner peripheral portion of the collar.

[0022] Further, in accordance with a third aspect of the present invention, there is provided an idle air control device in a fuel injection device as recited in the first aspect mentioned above, wherein a bottom portion of a female thread hole of the slider with which the motor output shaft is screwed is provided with a contraction side stopper portion to which a lower end of the motor output shaft is locked, and an inner bottom portion of the collar is provided with an expansion side stopper portion to which the upper locking step portion of the slider is locked.

[0023] Further, in accordance with a fourth aspect of the present invention, there is provided an idle air control device in a fuel injection device as recited in the first aspect mentioned above, wherein a seal is arranged between an inner bottom portion of the insertion tube portion of the case main body and an upper end of the collar, and a lip portion formed in an inner side of the seal is brought into slidable contact with the outer periphery of the motor output shaft.

[0024] In accordance with the first aspect of the present invention, when the motor is driven and the motor output shaft is rotated in one direction, the slider is suppressed its rotation by the collar and is held, thereby moving in a downward direction, and the air valve is moved in a downward direction in synchronous with the slider. At this time the air valve is moved in the downward di-

rection while being guided by the air valve guide hole, and the bypass air passage open to the inner side of the air valve guide hole is closed by the air valve in correspondence to the amount of rotation in one direction of the motor.

[0025] Further, if the motor output shaft is rotated to the maximum in one direction, the slider is moved most in the downward direction, and the air valve fully closes and holds the bypass air passage open to the inner side of the air valve guide hole.

[0026] On the other hand, if the motor output shaft is rotated in the other direction, the slider is suppressed its rotation by the collar so as to be held, thereby moving in the upward direction, and the air valve is moved in the upward direction in synchronous with the slider. On the basis of the movement in the upward direction of the air valve, the bypass air passage open to the inner side of the air valve guide hole is opened by the air valve in correspondence to a rotating amount of the motor in the other direction. If the motor output shaft is rotated to the maximum in the other direction, the slider is moved most in the upward direction, and the air valve holds the bypass air passage open to the inner side of the air valve guide hole in a full open state.

[0027] In accordance with the first aspect mentioned above, the slider screwed to the motor output shaft is suppressed its rotation by the collar, and is allowed to move in the axial direction. On the other hand, the air valve is locked to the slider in the axial direction.

[0028] Accordingly, the air valve can move within the air valve guide hole in synchronous with the slider, and can control the opening of the bypass air passage open to the inner side of the air valve guide hole. Since the rotation of the slider is suppressed with respect to the collar, it is unnecessary that a rotation suppressing means is provided in the air valve, so that a transverse sectional shape of the air valve can be formed in a round shape. In accordance with this structure, it is possible to use the air valve guide hole having the circular transverse cross sectional shape used in the idling control device employing the conventional wax element, and the idling control device in accordance with the present invention can be easily installed to the conventional throttle body so as to be compatible.

[0029] Further, since the motor case surrounding the outer periphery of the motor and the insertion tube portion extending to the lower side are formed by a single case main body, it is possible to form the insertion tube portion on the basis of the motor output shaft at a time of out molding the case main body. Accordingly, it is possible to enhance precision of concentricity between the axial core in the longitudinal direction of the motor output shaft and the axial core in the longitudinal direction of the insertion tube portion. This is preferable for concentrically arranging the air valve in the air valve guide hole.

[0030] Further, it is effective for reducing the number of the parts that the motor case and the insertion tube portion are integrally formed by the case main body.

[0031] Further, in accordance with the second aspect of the present invention, the air valve is arranged between the locking step portion in the lower end of the slider and the locking collar portion in the upper end of the slider and is arranged so as to be elastically pressed toward the locking step portion in the lower end by the air valve spring.

[0032] Further, the gap which is larger than the amount of eccentricity between the axial core in the longitudinal direction of the motor output shaft and the axial core in the longitudinal direction of the air valve guide hole is formed between the inner peripheral portion of the air valve and the outer peripheral portion of the slider, and between the outer peripheral portion of the air valve and the inner peripheral portion of the collar.

[0033] In accordance with the structure mentioned above, when inserting the insertion tube portion of the case main body into the insertion hole of the throttle body so as to fixedly arrange, it is possible to coaxially arrange the air valve within the air valve guide hole, and it is possible to obtain a smooth dynamic characteristic of the air valve.

[0034] In other words, since the air valve is elastically pressed by the air valve spring without being mechanically fixed to the slider, and the gap is formed, the air valve can move to the side along the air valve guide hole, and an improved coaxial state can be maintained.

[0035] Further, in accordance with the third aspect of the present invention, the air valve is fixed in the contraction side thereof in such a manner that the lower end of the motor output shaft is brought into contact with the contraction side stopper portion provided in the bottom portion of the female thread hole of the slider, and the air valve is fixed in the expansion side in such a manner that the upper collar portion of the slider is brought into contact with the expansion side stopper portion provided in the inner diameter portion of the collar.

[0036] Accordingly, it is possible to initialize the air valve from whichever contact positions.

[0037] Further, in accordance with the fourth aspect of the present invention, since the lip portion of the seal is arranged in the outer periphery of the motor output shaft at a time when a carbon or the like generated by the engine makes an intrusion into the inner side of the collar from the bypass air passage, the carbon or the like does not make an intrusion into the motor, and it is possible to stably use the motor for a long time period.

[0038] Further, since the seal is formed in an annular shape, and is fixedly arranged between the inner bottom portion of the insertion tube portion and the upper end of the collar, it is not necessary that any special member for fixing the seal is provided.

Brief Description of the Drawings

[0039]

Fig. 1 is a vertical sectional view showing an embod-

iment of an idle air control device in a fuel injection device in accordance with the present invention;

Fig. 2 is an enlarged half vertical sectional view of a main portion of a slider and an air valve portion in Fig. 1;

Fig. 3 is an enlarged half cross sectional view of a main portion along a line A-A in Fig. 1; and

Fig. 4 is a vertical sectional view of an idle air control device in a conventional fuel injection device.

Best Mode for Carrying Out the Invention

[0040] A description will be given of an embodiment of an idle air control device in a fuel injection device in accordance with the present invention.

[0041] Fig. 1 is a vertical sectional view of a main body of an idle air control device including a throttle body, Fig. 2 is an enlarged vertical sectional view of a main portion of an air valve portion in Fig. 1, and Fig. 3 is an enlarged cross sectional view along a line A-A in Fig. 1.

[0042] In this case, the same reference numerals are used in the same constituting parts as those in Fig. 4.

[0043] Reference symbol M denotes a step motor (hereinafter, referred simply to as a motor). A periphery of the step motor M is surrounded by a motor case 1a made of a synthetic resin material, a cylindrical insertion tube portion 1b is formed from a lower end of the motor case 1a toward a lower side, and the motor case 1a and the insertion tube portion 1b are integrally formed so as to structure the case main body 1.

[0044] The case main body 1 is formed by out molding the motor M at a time of injection molding with the synthetic resin material, and a motor output shaft Ma of the motor M is arranged so as to protrude toward an inner side of the insertion tube portion 1b and is arranged coaxially with the insertion tube portion 1b. Further, a male thread is formed in an outer periphery of the motor output shaft Ma.

[0045] Reference numeral 2 denotes a ring-shaped collar fixedly arranged in an inner side of the insertion tube portion 1b. The collar 2 is pressure inserted to an inner side of the insertion tube portion 1b from an opening in a lower end of the insertion tube portion 1b. At this time, an upper end 2a of the collar 2 is arranged toward an inner bottom portion 1c of the insertion tube portion 1b in a contact manner, and a ring-shaped seal R arranged in the upper end 2a of the collar 2 is fixedly supported toward the motor M side, and a lip portion Ra formed in an inner side of the seal R is arranged so as to be brought into slidable contact with an outer periphery of the motor output shaft Ma.

[0046] Further, a regulating protrusion portion 2c extending toward a downward direction from the upper end 2a in Fig. 1 is formed in the inner peripheral portion 2b of the collar 2 so as to protrude to an inner side. The regulating protrusion portion 2c is shown well in Fig. 3.

[0047] Further, a flat expansion side stopper portion 2d extending further toward the inner side from the inner

peripheral portion 2b is formed near a lower end of the inner peripheral portion 2b of the collar 2.

[0048] Reference numeral 3 denotes a slider screwed with the male thread of the motor output shaft Ma. A female thread hole 3b is provided toward a lower side from an upper end 3a, and a contraction side stopper portion 3c is formed in a lower end of the female thread hole 3b.

[0049] Further, a locking collar portion 3d extending to the side is formed in an upper end of the slider 3, and a groove 3c, to which the regulating protrusion portion 2c of the collar 2 is inserted, is provided through in a vertical direction in the locking collar portion 3d.

[0050] In this case, the slider 3 is structured such that the female thread hole 3b is screwed with the male thread of the motor output shaft Ma and is arranged in the inner side of the inner peripheral portion 2b of the collar 2, however, the inner peripheral portion 2b of the collar 2 does not regulate the movement in the vertical direction of the slider 3.

[0051] Reference numeral 4 denotes a cylindrical air valve arranged between an outer peripheral portion 3f of the slider 3 and the inner peripheral portion 2b of the collar 2.

[0052] A lower end of the air valve 4 is arranged on a locking step portion 3g arranged in an outer periphery of a lower end of the slider 3, and an upper end of the air valve 4 is arranged so as to face to a lower surface of the locking collar portion 3d.

[0053] Reference numeral 5 denotes an air valve spring provided in a compressed manner in the outer peripheral portion 3f of the slider 3. A lower end of the air valve spring 5 is locked to an inner bottom portion of the air valve 4, and an upper end thereof is locked to the locking collar portion 3d of the slider 3.

[0054] In accordance with the structure mentioned above, the air valve 4 is held in a state of being pressed toward the locking step portion 3g by a spring force of the air valve spring 5, and the air valve 4 is moved in the vertical direction in synchronous with the slider 3.

[0055] Further, the insertion tube portion 1b of the case main body 1 provided with the structure mentioned above is inserted into an insertion hole 56 open to one end 50a of a throttle body 50, and the case main body 1 is fixed to the throttle body 50 by a fixing member 6 fitted to the outer peripheral groove 1f of the insertion tube portion 1b.

[0056] In accordance with the structure mentioned above, the air valve 4 is movably arranged within the air valve guide hole 55, and this state is shown in Fig. 1.

[0057] Next, a description will be given of an operation of the idle air control device in accordance with the present invention.

[0058] A description will be given of a starting time in a state in which a temperature of an engine or an ambient atmosphere is low.

[0059] If the engine starting operation is executed, an electric signal in correspondence to a low temperature state is output to the motor M from the ECU in synchronous with the engine starting operation, whereby the mo-

tor M is rotated in one direction at a fixed range on the basis of the signal mentioned above.

[0060] On the basis of the rotation in one direction of the motor output shaft Ma, the slider 3 is largely pulled up in an upward direction, and the air valve 4 is also largely pulled up in an upward direction within the air valve guide hole 55 in synchronous with the slider 3, and widely opens the bypass air passage 54.

[0061] In accordance with the structure mentioned above, it is possible to supply a lot of air for starting the engine toward the engine from the bypass air passage 54, and it is possible to well start the engine in the low temperature state mentioned above.

[0062] In this case, it is possible to pull up the slider 3 in the upward direction on the basis of the rotation in one direction of the motor output shaft Ma as mentioned above, because the regulating protrusion portion 2c of the collar 2 fixed to the case main body 1 is inserted into the groove 3e of the slider 3, and the rotation of the slider 3 is suppressed.

[0063] When the engine start is next executed and the warm-up operation of the engine is executed, the temperature of the engine is increased gradually, and the ECU outputs the electric signal in correspondence to the temperature increase toward the motor M.

[0064] The motor output shaft Ma is rotated in the other direction corresponding to an opposite direction to the one direction, on the basis of the electric signal mentioned above, whereby the slider 3 moves in a downward direction in the drawing, and the air valve 4 moves in the downward direction within the air valve guide hole 55 in synchronous with the slider 3, and reduces the opening of the bypass air passage 54 gradually in correspondence to the increase of the temperature.

[0065] Accordingly, it is possible to reduce the amount of the air supplied to the engine gradually in synchronous with the elapse of the warm-up operation of the engine, and it is possible to execute a good engine warm-up operation without unnecessarily increasing the rotation of the engine.

[0066] Further, in a state in which the warm-up operation of the engine is completely finished, the slider 3 is arranged in the lowest position of the collar 2, and the air valve 4 is arranged at the lowest position of the air valve guide hole 55 in synchronous therewith, whereby it is possible to close the opening of the bypass air passage 54, and it is possible to finish the engine start and the engine warm-up operation.

[0067] In this case, the description is given above of the operation from the engine start to the end of the warm-up operation in the state in which the ambient temperature and the engine temperature are low, however, since the electric signal in correspondence to the temperature state is input to the motor M from the ECU, the motor M can operate in correspondence to the electric signal, and it is possible to set a most suitable opening degree of the air valve 4 in correspondence to the temperature state.

[0068] In this case, in accordance with the idle air con-

trol device on the basis of the present invention, since the groove 3e and the regulating protrusion portion 2c are provided between the slider 3 and the collar 2 so as to suppress the rotation of the slider 3 and allow the movement in the axial direction of the slider 3, the air valve 4 having the circular transverse sectional shape which is similar to the conventional air valve can be employed. Accordingly, the idle air control device in accordance with the present invention can be used as it is for the conventional idle air control device using the wax element.

[0069] Further, since the motor case 1a surrounding the outer periphery of the motor M and the insertion tube portion 1b to the insertion hole 56 of the throttle body 50 are integrally formed as the case main body 1, it is possible to reduce the number of the parts and achieve a compact structure, and it is possible to improve a mounting characteristic to the structure having the limited accommodating space, particularly such as the motor cycle.

[0070] Further, it is possible to securely coaxially arrange the air valve 4 within the air valve guide hole 55 at a time of assembling the idle air control device in the throttle body 50, by making a gap S1 formed between the outer peripheral portion 3f of the slider 3 and the inner peripheral portion 4a of the air valve 4 and a gap S2 formed between the outer peripheral portion 4b of the air valve 4 and the inner peripheral portion 2b of the collar 2 larger than an amount of eccentricity Z between an axial core X-X in a longitudinal direction of the motor output shaft Ma and an axial core Y-Y in a longitudinal direction of the air valve guide hole 55 so that excellent dynamic characteristics of the air valve can be maintained.

[0071] In this case, the air valve 4 can be coaxially arranged within the air valve guide hole 55, because the gaps S1 and S2 are provided with respect to the amount of eccentricity Z, and the air valve 4 is allowed to move in a diametrical direction while being elastically pressed by the air valve spring 5, without being mechanically fixed to the slider 3.

[0072] Further, the movement of the slider 3 in the contraction side (the movement in the upward direction in the drawing) is fixed by the contraction side stopper portion 3c provided in the bottom portion of the female thread hole 3b being brought into contact with a lower end Mb of the motor output shaft Ma. This state is shown by a right portion from a center line in Fig. 1.

[0073] On the other hand, the movement of the slider 3 in the expansion side (the movement in the downward direction in the drawing) is fixed by the lower surface of the locking collar portion 3d provided in the upper side of the slider 3 being brought into contact with the expansion side stopper portion 2d provided in the inner bottom portion of the collar 2. This state is shown by a left side portion from the center line in Fig. 1.

[0074] In accordance with the structure mentioned above, it is possible to initialize from whichever fixed positions.

[0075] Further, since the lip portion Ra of the seal R is

arranged so as to be brought into slidable contact with the outer periphery in the upper portion of the motor output shaft Ma, the carbon or the like making an intrusion into the inner side of the collar 2 from the bypass air passage 54 does not make an intrusion into the motor M from the outer periphery of the motor output shaft Ma, and it is possible to stably use the motor M for a long time period.

[0076] In this case, the structure in which the periphery of the motor M is surrounded by the motor case 1a also contributes to the stability in addition to the matter mentioned above. Further, the seal R is held by the step portion within the motor case 1a and the upper end 2a of the collar 2, it is not necessary to prepare any special member for fixing the seal R.

Claims

1. An idle air control device in a fuel injection device in which a throttle valve is arranged in an intake passage provided within a throttle body, an intake passage in an upstream side of the throttle valve and an intake passage in a downstream side of the throttle valve are connected by a bypass air passage bypassing the throttle valve, and a bypass air amount flowing through the bypass air passage is controlled by an air valve movably arranged within an air guide hole continuously provided in said bypass air passage, wherein said idle air control device comprises:
 - a case main body (1) in which a motor case (1a) surrounding a motor (M), and an insertion tube portion (1b) formed so as to be open toward a lower side from the motor case (1a) are integrally formed by being out molded;
 - a tubular collar (2) arranged so as to be fixed to an inner side of the insertion tube portion (1b) of the case main body (1);
 - a slider (3) screwed to an outer periphery of a motor output shaft (Ma) protruding toward an inner side of the collar (2) from the motor (M); and
 - an air valve (4) provided between an inner periphery of the collar (2) and an outer periphery of the slider (3), arranged so as to be locked in an axial direction and slidably guided by an air valve guide hole (55),
 wherein the slider (3) screwed to said motor output shaft is arranged in such a manner that a rotation is suppressed and a movement in an axial direction is allowed by the collar (2), and wherein said air valve is moved in an axial direction in synchronous with the slider (3), and an opening of the bypass air passage (54) open to the air valve guide hole (55) is controlled by the air valve (4).
2. An idle air control device in a fuel injection device as claimed in claim 1, wherein said air valve is arranged so as to be pressed toward a locking step portion (3g) provided in an outer periphery of a lower end of a slider (3) by an air valve spring (5) arranged between the locking step portion (3g) and a locking collar portion (3d) provided in an upper end of the slider (3) and arranged in a compressed manner in an outer periphery of the slider (3), and a gap (S1, S2) which is larger than an amount of eccentricity (Z) between an axial core (X-X) in a longitudinal direction of the motor output shaft (Ma) and an axial core (Y-Y) in a longitudinal direction of the air valve guide hole (55) is formed between an inner peripheral portion (4a) of the air valve (4) and an outer peripheral portion (3f) of the slider (3), and between the outer peripheral portion (4b) of the air valve (4) and an inner peripheral portion (2b) of the collar (2).
3. An idle air control device in a fuel injection device as claimed in claim 1, wherein a bottom portion of a female thread hole (3b) of the slider (3) with which said motor output shaft is screwed is provided with a contraction side stopper portion (3c) to which a lower end (Mb) of the motor output shaft (Ma) is locked, and an inner bottom portion of the collar (2) is provided with an expansion side stopper portion (2d) to which the upper locking step portion (3d) of the slider (3) is locked.
4. An idle air control device in a fuel injection device as claimed in claim 1, wherein a seal (R) is arranged between an inner bottom portion of the insertion tube portion (1b) of said case main body and an upper end (2a) of the collar (2), and a lip portion (Ra) formed in an inner side of the seal (R) is brought into slidable contact with the outer periphery of the motor output shaft (Ma).

FIG. 1

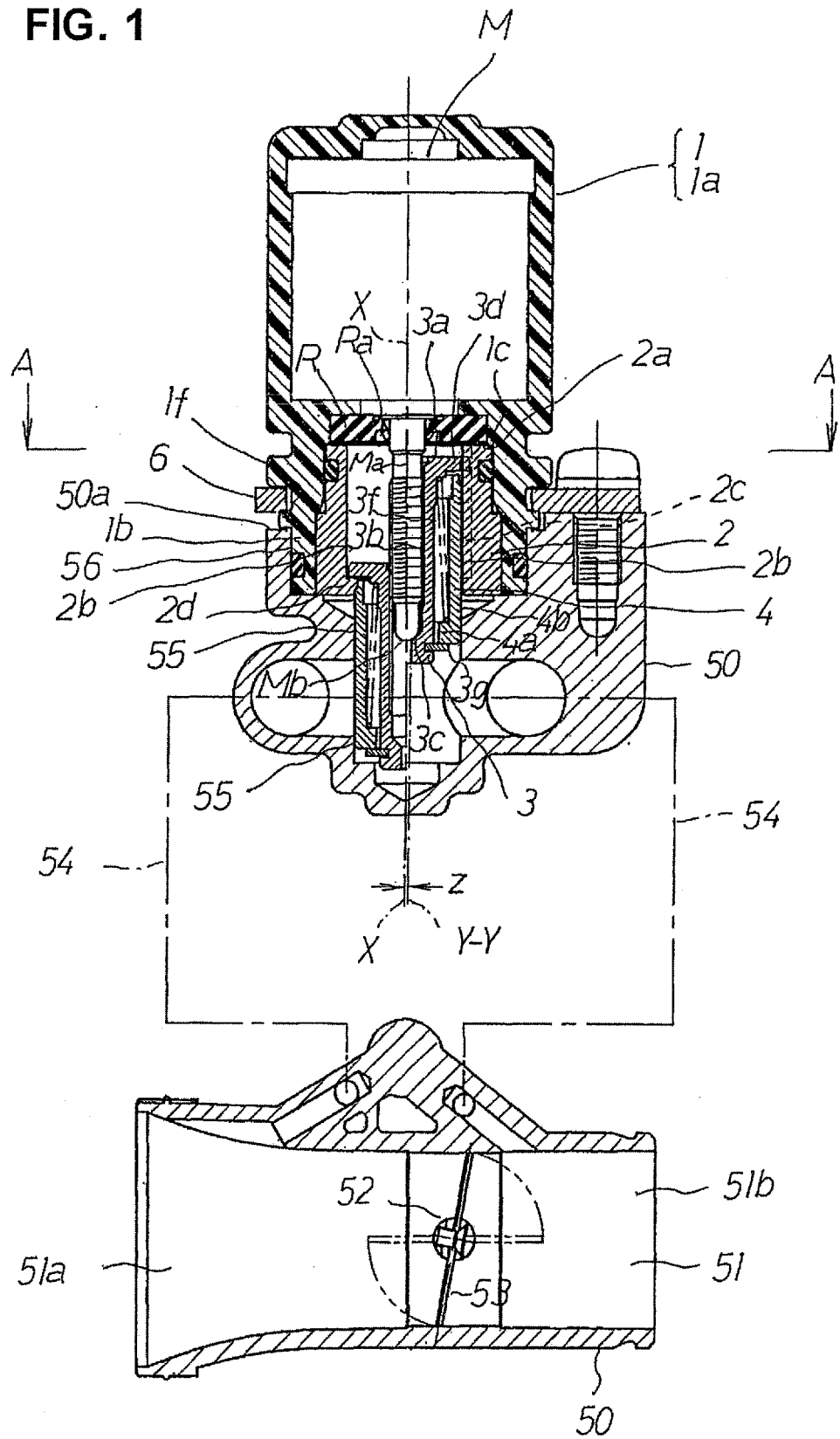


FIG. 2

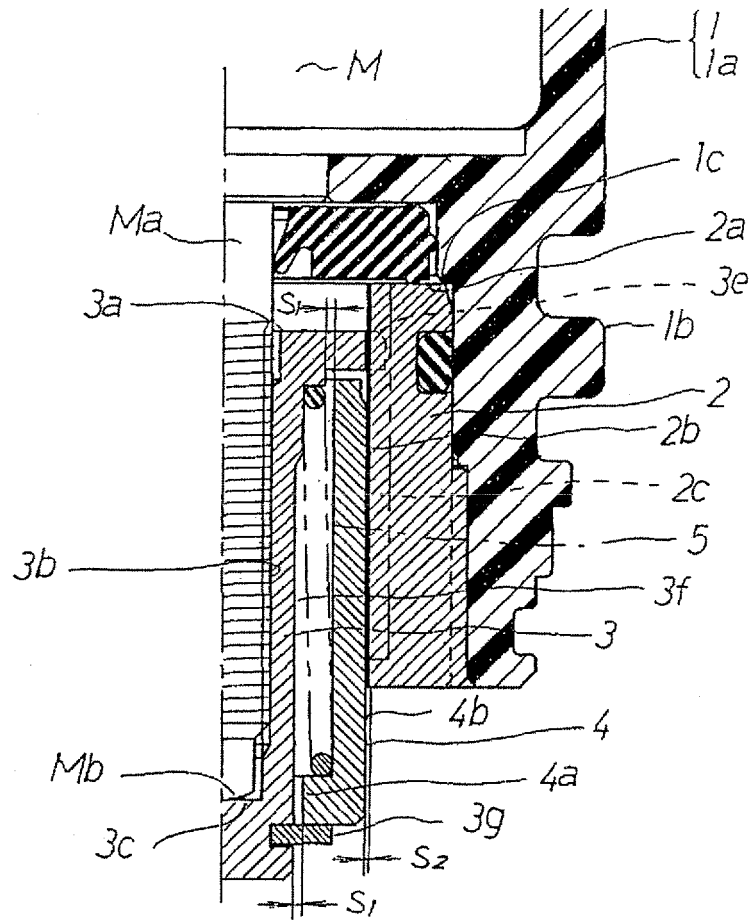


FIG. 3

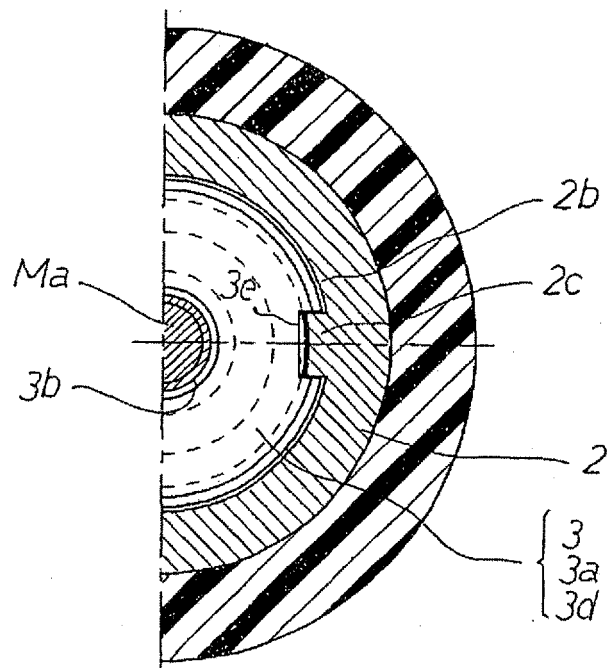
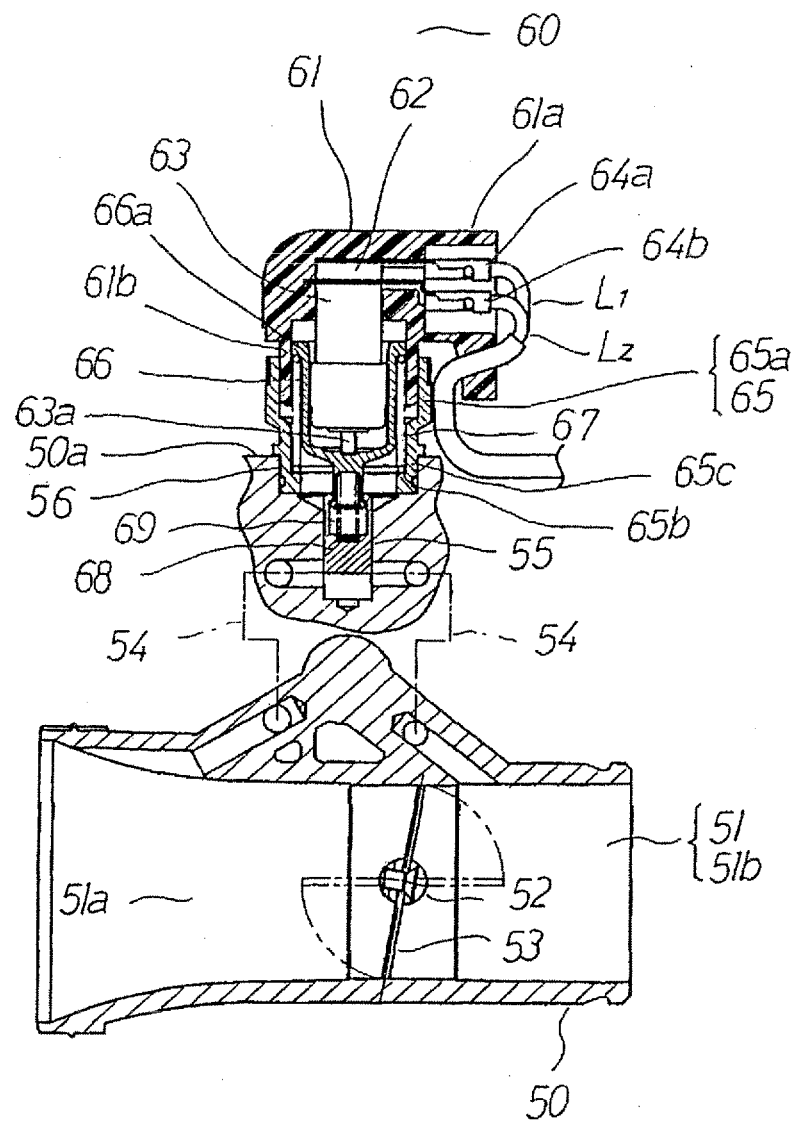


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/006560

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl.⁷ F02D9/14, 9/02, F02M69/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl.⁷ F02D9/14, 9/02, F02M69/32

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2005
Kokai Jitsuyo Shinan Koho	1971-2005	Toroku Jitsuyo Shinan Koho	1994-2005

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 30619/1985 (Laid-open No. 146667/1986) (Tokyo Sokuhan Kabushiki Kaisha), 10 September, 1986 (10.09.86), Page 2, lines 8 to 11; page 4, lines 5 to 17; page 8, line 18 to page 13, line 2; Figs. 1 to 3 (Family: none)	1, 3, 4 2
Y	JP 07-81545 B2 (Mitsubishi Electric Corp.), 30 August, 1995 (30.08.95), Page 2, right column, lines 18 to 19; Fig. 2 (Family: none)	1, 3, 4

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
19 April, 2005 (19.04.05)Date of mailing of the international search report
10 May, 2005 (10.05.05)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/006560

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-286843 A (Aisan Industry Co., Ltd., Toyota Motor Corp.), 10 October, 2003 (10.10.03), Par. No. [0027]; Figs. 3, 7 to 9 & US 2003/136357 A1 Par. No. [0040]; Figs. 3, 7 to 9 & DE 10302629 A	4
A	JP 8-93605 A (Magneti Marelli France), 09 April, 1996 (09.04.96), Par. No. [0028]; Fig. 1 & US 5497746 A Page 5, left column, lines 12 to 22; Fig. 1 & FR 676543 A & DE 69501671 C & FR 2718490 A & ES 2113716 T & BR 9501452 A	2

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