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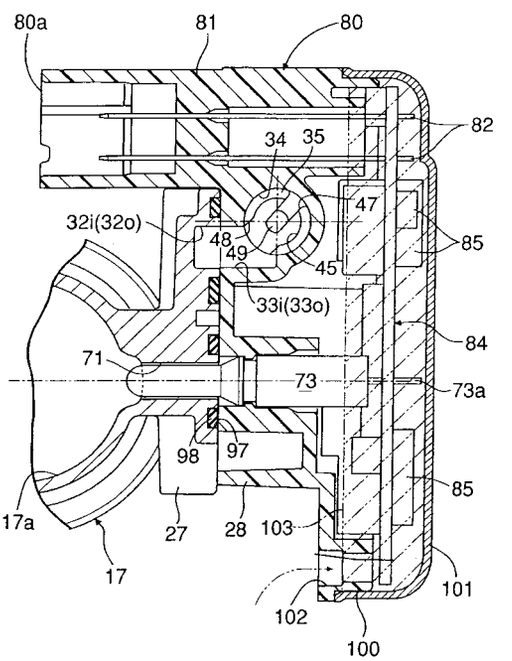
(54) ENGINE SUCTION RATE CONTROLLER

(57) In an intake air-amount control system for an engine, a coupler (80) is integrally formed on a control block (28) coupled to a throttle body (17), and a bypass valve (35), a sensor (64, 73, 76) and an actuator (39) are mounted in the control block (28). An electronic control unit (84) is placed on an outer end face of the control block (28), and a synthetic resin (103) is potted into a cap (101) mounted to the control block (28) to cover the electronic control unit (84), so that the electronic control unit (84) is wrapped, and a mounted portion of the cap (101) is sealed. Thus, the inspection of the functions of the bypass control devices can be carried out before assembling of them to the throttle body, leading to an enhancement in productivity.

FIG.14



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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an improvement in an intake air-amount control system for an engine, comprising a throttle body including a throttle valve disposed in an intake passage leading to an intake port in the engine, a bypass connected to the intake passage around the throttle valve, a bypass valve for controlling the opening degree of the bypass, a sensor for detecting the operational state of the engine, and an actuator for opening and closing the bypass valve in response to a signal output from the sensor.

BACKGROUND ART

[0002] Such an intake air-amount control system for an engine is already known, as disclosed, for example, in Japanese Patent Application Laid-open No. 9-303164.

[0003] In such conventional intake air-amount control system for the engine, all of a bypass valve, unless all of bypass control devices such as a bypass valve, an actuator and a sensor are assembled to a throttle body, the bypass control devices are also not completed, and the inspection of the functions of the bypass control devices can be conducted only after completion of the assembling of the entire system. However, if the bypass control devices fail to pass the inspection, the following troublesome operation is obliged to be carried out: the bypass valve, actuator, sensor and the like are removed from the throttle body and replaced by other components, and the other components are subjected again to the inspection. This is an obstacle to an enhancement in productivity.

DISCLOSURE OF THE INVENTION

[0004] The present invention has been accomplished with such circumstances in view, and it is an object of the present invention to provide an intake air-amount control system of the above-described type for an engine, wherein the inspection of the functions of the bypass control devices can be carried out before assembling of them to the throttle body, thereby enhancing the productivity.

[0005] To achieve the above object, according to a first aspect and feature of the present invention, there is provided an intake air-amount control system for an engine, comprising a throttle body including a throttle valve disposed in an intake passage leading to an intake port in the engine, a bypass connected to the intake passage around the throttle valve, a bypass valve for controlling the opening degree of the bypass, a sensor for detecting the operational state of the engine, and an actuator for opening and closing the bypass valve in response to a signal output from the sensor, characterized in that a coupler which is coupled to an external coupler is integrally formed on a control block coupled to the throttle body; the bypass valve, the sensor and the actuator are mounted in the control block; an electronic control unit is placed on an outer end face of the control block to electrically connect the actuator, the sensor and the coupler to one another; and a synthetic resin is potted into a cap mounted to the control block to cover the electronic control unit, so that the electronic control unit is wrapped, and a mounted portion of the cap is sealed.

[0006] With the first feature, if the bypass valve, the sensor and the actuator are mounted in the control block separately from the throttle body, the inspection of the functions of the actuator, the bypass valve, the sensor, the electronic control unit and the like can be carried out by properly connecting a power source to the coupler integral with the control block. Therefore, only the components passing the inspection are mounted to the throttle body and hence, there is no waste in the assembling operation, which can contribute to an enhancement in productivity.

[0007] In addition, the electronic control unit can be protected from rainwater and a dust and from the vibration by the potted resin in the cap. Especially, the waterproofing and the dust-proofing can be achieved effectively by sealing the portion of the cap mounted to the control block, and the appearance of the control block can be improved by the cap.

[0008] Moreover, the force of coupling of the cap and the control block to each other can be increased by an adhesive force of the potted resin.

[0009] According to a second aspect and feature of the present invention, in addition to the first feature, the cap is socket-fitted over an outer end of the control block, while accommodating the electronic control block therein, and the synthetic resin is potted into the cap turned downwards to near an upper end thereof.

[0010] With the second feature, the protection of the electronic control unit and the coupling of the cap can be achieved effectively with a required minimum amount of the potted resin.

[0011] According to a third aspect and feature of the present invention, in addition to the second feature, a potting port for the synthetic resin is provided at a point in the control block closer to the cap.

[0012] With the third feature, the amount of synthetic resin potted can be regulated easily, while visually observing the state of potting of the synthetic resin into the cap through the potting port.

[0013] According to a fourth aspect and feature of the present invention, in addition to the third feature, a terminal of the sensor is connected directly to a base board of the electronic control unit wrapped by the synthetic resin.

[0014] With the fourth feature, a connection of the terminal of the sensor to the base board of the electronic control unit can be wrapped by the potted resin, whereby the vibration resistance of such connection can be en-

hanced.

[0015] According to a fifth aspect and feature of the present invention, in addition to any of the first to fourth features, the cap is made of an aluminum alloy plate.

[0016] With the fifth feature, the cap having a good appearance can be formed easily by a pressing treatment using the aluminum alloy plate as a material.

[0017] The above and other objects, features and advantages of the invention will become apparent from the following description of the preferred embodiment taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Fig.1 is a side view of a two-wheeled motor vehicle provided with an intake control system according to the present invention; Fig.2 is an enlarged sectional view of a section indicated by 2 in Fig.1; Fig. 3 is a sectional view taken along a line 3-3 in Fig.2; Fig.4 is an exploded perspective view of the intake control system; Fig.5 is a side view of the intake control system; Fig.6 is a view taken in the direction of an arrow 6 in Fig.5; Fig. 7 is a view taken in the direction of an arrow 7 in Fig. 5; Fig. 8 is a view taken in the direction of an arrow 8 in Fig. 7; Fig. 9 is a sectional view taken along a line 9-9 in Fig. 7; Fig. 10 is a sectional view taken along a line 10-10 in Fig.5; Fig.11 is a sectional view taken along a line 11-11 in Fig. 5; Fig. 12 is a sectional view taken along a line 12-12 in Fig. 5; Fig. 13 is an enlarged view of a section around the bypass valve in Fig. 12; Fig. 14 is a sectional view taken along a line 14 -14 in Fig. 5; Fig. 15 is an enlarged sectional view taken along a line 15-15 in Fig. 13; Fig. 16A is a side view of the bypass valve taken from the side of a metering groove; Fig.16B is a side view of the bypass valve taken from the side of a key groove; and Fig. 17 is an enlarged sectional view of a section indicated by 17 in Fig.12.

BEST MODE FOR CARRYING OUT THE INVENTION

[0019] An embodiment of the present invention will now be described with reference to the accompanying drawings.

[0020] Referring first to Figs. 1 to 3, a two-wheeled motor vehicle 1 is formed into a scooter type in which a power unit 4 is disposed immediately below a luggage box 3 which is longer in a longitudinal direction and which is formed with a tandem seat 2 also serving as a lid therefore. The power unit 4 comprises an engine 5 having a cylinder block 6 largely inclined forwards, and a continuously variable transmission 8 having a transmission case 10 extending rearwards and integrally connected to one side of a crankcase 9 of the engine 5. A rear wheel 16 which is pivotally a driven wheel is supported at a rear end of the transmission case 10.

[0021] In a body frame 11 of the two-wheeled motor vehicle 1, upper brackets 12, 12 are provided at connections between a pair of left and right upper frame elements 11a, 11a supporting the luggage box 3 and upward-turned rear ends of a pair of left and right downtubes 11b, 11b extended from a head pipe, and a pair of left and right lower brackets 13, 13 are formed on an upper surface of the crankcase 9 of the engine 5. The lower brackets 13, 13 are swingably carried at an intermediate portion of a crank-shaped engine hanger 14 swingably carried at its opposite ends on the upper brackets 12, 12. In this manner, the power unit 4 is vertically swingably supported on the body frame 11, and a reaction unit 26 for buffering the vertical swinging movement of the power unit 4 is mounted between the rear frame elements 11, 11 and the transmission case 10.

[0022] An intake port 7a is provided in a cylinder head 7 coupled to a front end of the cylinder block 6, so that its upstream end opens in a rearward direction of a vehicle body, and a throttle body 17 having an intake passage 17a leading to the intake port 7a is mounted to the cylinder head 7 with a connecting tube 15 interposed therebetween. In this case, the throttle body 17 is disposed between the luggage box 3 and the engine 5, so that the intake passage 17a extends longitudinally and substantially horizontally (slightly declined forwards in the illustrated embodiment). Therefore, the throttle body 17 is of a horizontal type. An air cleaner 19 is connected to a rear end of the throttle body 17 through an intake duct 18 passing above the engine hanger 14.

[0023] A fuel injection valve 20 for injecting fuel toward a downstream end of the intake port 7a is mounted in the cylinder head 7.

[0024] An intake control system according to the present invention and including the throttle body 17 will be described below in detail.

[0025] As shown in Figs. 4 to 8, a butterfly-type throttle valve 21 is disposed in the intake passage 17a in the throttle body 17 for opening and closing the intake passage 17a, and a valve shaft 22 supporting the throttle valve 21 is rotatably carried on left and right opposite sidewalls of the throttle body 17 to traverse the intake passage 17a horizontally. A throttle drum 23 is secured to one end of the valve shaft 22 protruding to one of sideways directions of the throttle body 17, and a single throttle cable 24 and a return spring 25 for biasing the throttle valve 21 in a closing direction are connected to the throttle drum 23, so that the throttle valve 21 is opened by pulling the throttle cable 24 by a throttle operating member (not shown).

[0026] A connecting flange 27 is integrally formed on the outer sidewall of the throttle body 17 from which the other end of the valve shaft 22 protrudes, so that such flange 27 extends perpendicular to the valve shaft 22 and in parallel to the intake passage 17a, and a control block 28 formed of a synthetic resin separately from the throttle body 17 is detachably coupled to the connecting flange 27 by a plurality of bolts 29. A bypass 30 is defined between the throttle body 17 and the control block 28 to extend around the throttle valve 21, so that it is

connected to the intake passage 17a.

[0027] As clearly shown in Figs.4, 9 and 13, the bypass 30 is comprised of a bypass inlet 31i provided in the throttle body 17 to permit a portion of the intake passage 17a upstream of the throttle valve 21 to communicate with a joint surface of the connecting flange 27, a bypass outlet 31o provided in the throttle body 17 to permit a portion of the intake passage 17a downstream of the throttle valve 21 to communicate with the joint surface of the connecting flange 27, an upstream bypass groove 32i defined in the joint surface of the connecting flange 27 with one end thereof connected to the bypass inlet 31i, a downstream bypass groove 32o defined in the joint surface of the connecting flange 27 with one end thereof connected to the bypass outlet 31o, a valve bore inlet 33i defined in the control block 28 to lead to the other end of the upstream bypass groove 32i, a valve bore outlet 33o defined in the control block 28 to lead to the other end of the downstream bypass groove 32o, and a bottomed cylindrical valve bore 34 defined in the control block 28 in parallel to the intake passage 17a to permit the communication between the valve bore inlet 33i and the valve bore outlet 33o. In this case, the valve bore 34 is disposed above the bypass inlet 31i and the bypass outlet 31o, and the valve bore inlet 33i and the valve bore outlet 33o open into a lower surface of the valve bore 34.

[0028] Referring to Figs. 12 and 13, a piston-shaped bypass valve 35 for controlling the degree of communication between the valve bore inlet 33i and the valve bore outlet 33o is slidably received in the valve bore 34, and a drive member 37 for driving the bypass valve 35 axially is connected to the valve 35 through an Oldham's joint 50 for diametrically displacing movement relative to each other. An output shaft 39a of a step motor 39 is connected to the drive member 37 through a screw mechanism 40. More specifically, the output shaft 39a formed as a threaded shaft is threadedly fitted into a threaded bore 41 in the drive member 37, so that the drive member 37 can be advanced and retracted axially by the rotation of the output shaft 39a, thereby causing the bypass valve 35 to be likewise advanced and retracted through the Oldham's joint 50.

[0029] The step motor 39 is inserted into an actuator housing 42 mounted coaxially with the valve bore 34 to open into one side of the control block 28, and is retained by a plug 44 threadedly mounted in an opening of the actuator housing 42 with a seal member 43 interposed therebetween.

[0030] As clearly shown in Figs.16A and 16B, the bypass valve 35 is provided with a relatively deep cylindrical bottomed hollow 45 which opens toward a bottom of the valve bore 34, and a notch-shaped key groove 47 and a metering groove 48 permitting the communication between the inside and outside of the bottomed hollow 45. A key 49 rising from the bottom of the valve bore 34 is engaged into the key groove 47 to prevent the rotation of the bypass valve, while permitting the sliding movement of the bypass valve 35. The metering groove 48 is disposed in correspondence to the valve bore outlet 33o, and comprises a wider portion 48a extending axially of the bypass valve 35 with its groove width constant, and a tapered portion 48b leading to one end of the wider portion 48a with its groove width decreased more at a location farther from the wider portion 48a.

[0031] As shown in Figs.13 and 15, the Oldham's joint 50 is comprised of a first square bore 51 provided in the bypass valve 35 adjacent to the bottomed hollow 45, a joint member 53 fitted in the first square bore 51 for sliding movement in a first transverse direction X, and a second square bore 52 which is provided in the joint member 53 and into which the drive member 37 is fitted for sliding movement in a second transverse direction Y perpendicular to the first transverse direction X. The drive member 37 is formed at a relatively large length enough to extend through the joint member 53, and is provided at one end thereof with a larger flange 37a abutting against one end face of each of the joint member 53 and the bypass valve 35. The joint member 53 is provided at the other end thereof with a smaller flange 37b located in the bottomed hollow 45, and a retaining spring 54 for basing the bypass valve 35 toward the larger flange 37a is mounted under compression between the smaller flange 37b and the bypass valve 35. Therefore, the bypass valve 35 is clamped axially resiliently on the drive member 37 by the larger flange 37a and the retaining spring 54, and axially opposite surfaces of the valve 35 are communicated with each other through the first and second square bores 51 and 52 and through a sliding clearance between the valve 53 and the valve bore 34. The joint member 53 is clamped axially by a step 35a facing to the first square bore 51 in the bypass valve 35 and by the larger flange 37a of the drive member 37.

[0032] As can be seen from Figs.9, 13 and 14, the bypass valve 35 and the step motor 39 arranged in parallel to and coaxially with the intake passage 17a are disposed above the valve shaft 22 disposed horizontally on the throttle valve 21. Moreover, the bypass valve 35 is disposed to face to an upstream side of the intake passage 17a, and the step motor 17a is disposed to face to a downstream side of the intake passage 17a. As a result, the bypass downstream groove 32o is defined longer than the bypass upstream groove 32i.

[0033] The disposition of the valve bore 34 and thus the bypass valve 35 in parallel to the intake passage 17a leads to the compactness of the intake control system. In addition, the step motor 39 and the bypass valve 35 can be disposed with a good balance above the throttle valve shaft 22. This also contributes to the compactness of the intake control system.

[0034] Referring to Figs .12 and 13, the actuator housing 42 has a diameter larger than that of the valve bore 34 coaxially arranged in front of the actuator housing 42 to form an annular step 55 at the border with the valve bore 34. A seal member 57 is clamped between

the annular step 55 and a front end face of the step motor 39 mounted in the actuator housing 42. Namely, the seal member 57 is retained in a fixed position between the front end face and the annular step 55 simultaneously with the mounting of the step motor 39 in the actuator housing 42, leading to a good assemblability.

[0035] The seal member 57 comprises an annular reinforcing plate 58 made of a synthetic resin, and an elastic sheath 59 made of a rubber and mold-coupled to the reinforcing plate 58 to wrap the latter. A pair of front and rear side lips 60, 60 are formed on an outer periphery of the elastic sheath 59, and an inner peripheral lip 61 is formed on an inner peripheral surface of the elastic sheath 59. The side lips 60, 60 are in close contact with the annular step 55 and the front end face of the step motor 39, respectively, and the inner peripheral lip 61 is in close contact with an outer peripheral surface of a root of the output shaft 39a. The side lips 60, 60 and the inner peripheral lip 61 are retained appropriately in sealed attitudes by the reinforcing plate 58 and hence, always can exhibit a good sealing function.

[0036] A plurality of anchoring bores 62 are defined in the reinforcing plate 58, and the elastic sheath 59 is filled in the anchoring bores 62, whereby the force of coupling of the reinforcing plate 58 and the elastic sheath 59 to each other is increased. In addition, a reduction in weight of the seal member 57 is provided by the formation of the reinforcing plate 58 from the synthetic resin.

[0037] Referring to Figs.5, 10 and 11, a throttle sensor 64 for detecting an opening degree of the throttle valve 21 is mounted in the control block 28. The throttle sensor 64 includes a case 66 fitted into a mounting recess 65 defined in the outer surface of the control block 28, a rotor 67 connected to an end of the valve shaft 22 of the throttle valve 21 in the case 66, and a stator 68 secured to the case 66 to detect an angle of rotation of the rotor 67 as the opening degree of the throttle valve 21.

[0038] As shown in Figs. 5, 9 and 14, a first sensor-mounting bore 71 is provided in the throttle body 17 and the control block 28 on one side of the mounting recess 65 in the throttle sensor 64, and opens into an upstream portion of the intake passage 17a, while extending perpendicularly to the connecting flange 27, and an intake temperature sensor 73 for detecting a temperature in the upstream portion of the intake passage 17a is mounted at a side of the control block 28 in the first sensor-mounting bore 71. A boost negative pressure detecting bore 74 is defined in the throttle body 17 to open into a downstream section of the intake passage 17a, and a second sensor-mounting bore 72 is defined in the control block 28 and located immediately above the first sensor-mounting bore 71. A communication passage 75 is defined in the joint surface of the connecting flange 27 as a bent groove extending around below the throttle sensor 64 to permit the communication between the boost negative pressure detecting bore 74 and the second sensor-mounting bore 72. A boost negative pressure sensor 76 for detecting an intake negative pressure in the downstream section of the intake passage 17a, i. e., a boost negative pressure in the engine 5, through the boost negative pressure detecting bore 74 is mounted in the second sensor-mounting bore 72. In this manner, the intake temperature sensor 73 and the boost negative pressure sensor 76 are disposed in proximity to each other.

[0039] The bypass inlet 31i which is an upstream end of the bypass 30 is disposed at a location upstream of the first sensor-mounting bore 71 in the intake passage 17a and in proximity to the first sensor-mounting bore 71. The communication passage 75 is disposed to extend around below the throttle sensor 64, while the bypass downstream groove 32o is disposed to extend around above the throttle sensor 64.

[0040] Referring to Figs.4 to 8 and 14, a vertically flattened coupler 80 is mounted at an upper portion of the control block 28. The coupler 80 comprises a coupler body 81 integrally formed on the control block 28, and a large number of connectors 82 embedded in the coupler body 81. The coupler body 81 extends beyond the connecting flange 27 to immediately above the throttle body 17 with a coupler opening 80a turned in a direction opposite from the control block 28. An external coupler 83 having a wire harness 86 connected thereto and leading to a power source or the like is coupled in the coupler opening 80a.

[0041] The control block 28 having such coupler 80 is of a box type with an outer end face opposite from the connecting flange 27 being opened, and a base board 84a of an electronic control unit 84 is placed on such outer end face. In this case, connected directly to the base board 84a by soldering are the intake temperature sensor 73, the boost negative pressure sensor 76 and a connecting terminal 64a of the throttle sensor 64 as well as inner ends of the connectors 82 of the coupler 80 (see Figs .10 to 12). Reference character 85 designates each of various semiconductor elements mounted on the base board 84a.

[0042] Thus, even if a foreign matter such as fuel drops enters into the boost negative detecting bore 74 through the intake passage 17a in the throttle body 17 of the horizontal type due to an intake air blow-back phenomenon in the engine 5, the foreign matter cannot rise up to the boost negative pressure sensor 76, because a large throw is provided between the boost negative detecting bore 74 and the boost negative pressure sensor 76 located above the bore 74 by the communication passage 75 and moreover, the communication passage 75 is the bent passage having a large flow path resistance. Therefore, it is possible to protect the boost negative pressure sensor 76 from the foreign matter to ensure the function and durability of the boost negative pressure sensor 76.

[0043] In addition, since the intake temperature sensor 73 and the boost negative pressure sensor 76 are disposed concentratedly on one side of the throttle sen-

sor 64, they can be connected concentratedly to the electronic control unit 84, leading to the compactness of the unit 84.

[0044] Further, the groove as the communication passage 75 as well as the bypass upstream and downstream grooves 32i and 32o as main portions of the bypass 30 are defined in the joint surface of the connecting flange 27 of the throttle body 17 and hence, they can be formed simultaneously with the formation of the throttle body 17. Thus, a special processing for forming them is not required, thereby providing an enhancement in productivity.

[0045] Furthermore, since the bypass inlet 31i is disposed in proximity to the first sensor-mounting bore 71 located below the second sensor-mounting bore 72 at the location upstream of the first sensor-mounting bore 71 in the intake passage 17a, the first and second sensor-mounting bores 71 and 72 and the bypass inlet 31i can be disposed concentratedly without interference with one another, which can contribute to the compactness of the control block 28.

[0046] Yet further, since the bypass downstream groove 32o and the communication bore 75 are disposed to surround the throttle sensor 64 from above and below, they can be disposed compactly around the throttle sensor 64 without interference with each other, which can contribute to the further compactness of the control block 28.

[0047] Referring again to Fig. 4, positioning projections 87 are formed at a pair of corners on one of diagonal lines on an outer end face of the control block 28 having the coupler 80, and threaded bores 88 are defined in corners on the other diagonal line. On the other hand, positioning bores 89 corresponding to the positioning projections 87 and machine screw bores 90 corresponding to the threaded bores 88 are provided in the base board 84a, so that the base board 84a is secured in a predetermined position on the control block 28 by fitting the positioning bores 89 into the positioning projections 87 and threadedly inserting machine screws 91 which are inserted through the machine screw bores 90 into the threaded bores 88.

[0048] In the control block 28, a substantially rectangular parallelepiped connector piece 92 made of a synthetic resin is positioned and fixed between the step motor 39 and the base board 84a, as shown in Figs. 12 and 17. A plurality of lead frames 93 are embedded in the connector piece 92. A connecting terminal 93a formed at one end of each of the lead frames 93 is connected directly to the base board 84a by soldering, and a connector bore 94 is defined in the other end of each of the lead frames 93.

[0049] On the other hand, a plurality of connector pins 96 protrude from a front end face of a terminal draw-out portion 95 projectingly provided on the outer surface of the step motor 39 (from a front end face in a direction of insertion of the step motor 39 into the actuator housing 42). The connector pins 96 are fitted into the connector bores 94 simultaneously with the insertion of the step motor 39 into the actuator housing 42.

[0050] The electronic control unit 84 controls the operations of not only the step motor 39 and the fuel injection valve 20 but also an ignition device (not shown) and the like, based on signal output from an engine rotational speed sensor, an engine temperature sensor (both not shown)and the like, in addition to the throttle sensor 64, the boost negative pressure sensor 76 and the intake temperature sensor 73, and the delivery of the signals and an electric power is carried out through the coupler 80 and the external coupler 83 coupled to the coupler 80.

[0051] As shown in Figs.4 and 9, a seal groove 97 is defined in the joint surface of the connecting flange 27 to surround peripheries of the bypass upstream groove 32i, the bypass downstream groove 32o, the first sensor-mounting bore 71, the boost negative pressure detecting bore 74 and the communication passage 75. A seal member 98 is mounted in the seal groove 97 to come into close contact with the control block 28, whereby the bypass upstream groove 32i, the bypass downstream groove 32o and the like are maintained air-tightly.

[0052] As shown in Figs. 4, 11 and 12, a cap 101 made of an aluminum alloy plate for accommodating the electronic control unit 84 is socket-coupled to stepped fitting faces 100 formed on an outer periphery of the outer end of the control block 28 having the coupler 80. In this case, a locking projection 105 and a locking bore 106 (see Figs.4 and 11) formed on the fitting faces are resiliently engaged in each other. The cap 101 is formed by subjecting the aluminum alloy plate to a pressing treatment and is provided with a good appearance free from wrinkles. Therefore, the cap 101 provides a good appearance to the control block 28 and is effective when the control block 28 is exposed to the outside, as in the two-wheeled motor vehicle 1.

[0053] A potting port 102 (see Figs. 8 and 14) is provided in the control block 28 adjacent to an open end face of the cap 101 to communicate with the inside of the cap 101 and to open into a side of the control block 28 opposite from the cap 101. A synthetic resin 103 is potted from the potting port 102 into a cap 101 turned downwards to a socket-coupled portion of the cap 101, whereby the electronic control unit 84 is wrapped, and the socket-coupled portion of the cap 101 is sealed.

[0054] The potted resin 103 protects the electronic control unit 84 from rainwater and a dust and from the vibration. Particularly, the water-proofing and the dust-proofing can be achieved effectively by sealing the socket-coupled portion of the cap 101 to the control block 28. Further, the force of coupling of the cap 101 and the control block 28 to each other can be increased by an adhesive force of the potted resin 103.

[0055] Moreover, the electronic control unit 84 is accommodated in the cap 101; the cap 101 is turned downwards, and the synthetic resin 103 is potted from the

potting port 102 turned to an upper position as a result of the downward turning of the cap 101. Therefore, the protection of the electronic control unit 84 and the coupling of the cap 101 can be achieved efficiently with a required minimum amount of the potted resin 103 and hence, it is possible to prevent the entrance of the synthetic resin 103 into the bypass valve 35 and the step motor 39 above the cap 101.

[0056] In the potting, the amount of synthetic resin potted can be regulated easily, while visually observing the state of potting of the synthetic resin into the cap 101 through the potting port 102. In addition, the potted resin 103 also wraps connections of connecting terminals 64a, 73a, 76a of the sensors 64, 73, 76 and connecting terminal 93a of the connector piece 92 to the base board 84a and hence, the vibration resistances of the connecting terminals 64a, 73a, 76a and 93a can be enhanced.

[0057] Referring again to Figs.3 and 7, the control block 27 including the various sensors 64, 73 and 76 and the electronic control unit 84 is disposed on one of the left and right of the throttle body 17, while the coupler 80 is disposed above the throttle body 17, i.e., between the throttle body 17 and the bottom wall of the luggage box 3. With such dispositions of the various sensors 64, 73 and 76 and the electronic control unit 84 and the coupler 80 in a dispersed manner, they can be disposed easily even in a narrow space around the throttle body 17 in the two-wheeled motor vehicle 1. Particularly, the coupler 80 can be vertically flattened and hence, even if it is disposed above the throttle body 17, the bottom of the luggage box 3 above the coupler 80 may be little moved upwards, and the volume of the luggage box 3 can be increased.

[0058] Moreover, the coupler port 80a of the coupler 80 for coupling of the external coupler 83 is turned to the side opposite from the electronic control unit 84 and hence, the connection of the external coupler 83 to the coupler 80 can be conducted easily without being obstructed by the electronic control unit 84 and the engine 5, leading to a good assemblability and a good maintenance.

[0059] The throttle drum 23 is secured to one end of the valve shaft 22 extending in the lateral direction, which is opposite from the electronic control unit 84, and the throttle cable 24 connected to the throttle drum 23 is disposed to pass through below the coupler port 80a in the coupler 80 (see Fig. 8). This makes it possible to avoid the interference of the throttle cable 24 and the wire harness 86 of the external coupler 83 coupled to the coupler 80 with each other, leading to enhancements in assemblability and maintenance.

[0060] Further, as shown in Figs. 2, 3, 7 and 8, the throttle cable 24 connected to the throttle drum 23 once extends rearwards through a lower portion of the throttle drum 23; is bent in a U-shape within a crank section of the engine hanger 14; then extends forwards along the down-tube 11b on one side of the body frame 11; and is connected to the throttle operating member (not shown) mounted on a steering handlebar 36 (Fig.1).

[0061] Thus, when the power unit 4 is moved upwards or downwards in response to expansion or contraction of the reaction unit 26 during steering of the two-wheeled motor vehicle 1, the throttle body 17 is also swung along with the power unit 4. However, mainly the U-shaped bent portion of the throttle cable 24 is flexed without effort in response to such swinging, whereby an excessive stress can be prevented from being generated in the throttle cable 24 and hence, the durability of the throttle cable can be ensured. Moreover, notwithstanding that the throttle drum 23 and the coupler port 80a in the coupler 80 are disposed on the same side as the throttle body 17, a relatively large working space which is not obstructed by the throttle cable 24 can be ensured around the coupler port 80a in the coupler 80 by arranging the single throttle cable 24 in the above-described manner, thereby facilitating the connection of the external coupler 83 to the coupler port 80a.

[0062] The operation of the intake control system will be described below.

[0063] When the throttle valve 21 is in a fully opened state, the electronic control unit 84 determines operational conditions for the engine such as those during starting of the engine, during a first idling of the engine, during a usual idling of the engine, and during application of an engine brake, based on signals output from the throttle sensor 64, the intake temperature sensor 73, the boost negative pressure sensor 76 and the like, and operates the step motor 39 to rotate or reverse the output shaft 39a in order to provide an opening degree of the bypass valve 35 corresponding to the operational conditions determined.

[0064] When the output shaft 39a is rotated or reversed, the drive member 37 is advanced or retracted axially, whereby the bypass valve 35 is slid forwards or backwards along the valve bore 34 through the joint member 53 to increase or decrease the area of the metering groove 48 opened into the valve bore outlet 33o, i.e., the opening degree of the bypass 30, thereby controlling the flow rate of intake air in the bypass 30. Particularly, the flow rate of the intake air can be controlled finely in a range of from zero to a predetermined maximum value by the tapered portion 48b of the metering groove 48 being advanced and retracted relative to the valve bore outlet 33o. As a result, the starting, the first idling and the usual idling of the engine can be conducted automatically and appropriately.

[0065] In this case, even if the Oldham's joint 50 causes a misalignment between axes of the bypass valve 35 and the output shaft 39a of the step motor 39 due to a manufacture error, such misalignment is absorbed into the movement of the joint member 53 in the first transverse direction X and the movement of the drive member 37 in the second transverse direction Y. Therefore, the smooth sliding movement of the bypass valve 35 can be guaranteed irrespective of such misalignment and at the same time, the vibration of the bypass valve 35 can

be suppressed by the retaining spring 54.

[0066] In the fully closed state of the bypass valve 35, an intake negative pressure in the engine 5 is applied to a side of the bypass valve 35 facing to the valve bore outlet 33o. At that time, however, the Oldham's joint 50 permits the parallel movement of the bypass valve 35 in a direction of application of such intake negative pressure and hence, the bypass valve 35 can be brought reliably into close contact with the periphery of the valve bore outlet 33o to prevent or minimize the leakage of the intake air in the bypass from the valve bore outlet 33o. Therefore, a specially high dimensional accuracy is not required in the valve bore 34 and the bypass valve 35, which can contribute to an enhancement in productivity.

[0067] Further, the axially opposite ends of the bypass valve 35 communicate with each other through the first and second square bores 51 and 52 in the Oldham's joint 50 and the sliding clearance between the valve 35 and the valve bore 34 and hence, even if any pressure is transmitted to the valve bore 34, a difference in pressure is not generated between the axially opposite ends of the bypass valve 35 and therefore, the bypass valve 35 can be operated lightly even by a relatively small output from the step motor 39. This means that a reduction in output from the step motor 39 and further, a reduction in size of the step motor 39 can be realized, while enhancing the responsiveness of the bypass valve 35.

[0068] Yet further, the bypass valve 35 is biased in the direction from the valve bore inlet 33i to the valve bore outlet 33o by the retaining spring 54, and the biasing force is supported by the larger flange 37a of the drive member 37 in which the output shaft 39a of the step motor 39 is threadedly fitted directly. Therefore, particularly, when the output shaft 39a is rotated in a direction to close the bypass valve 35, the drive member 37 pushes the bypass valve 35 in the closing direction directly by the larger flange 37a thereof and hence, the closing speed of the bypass valve 35 can be increased irrespective of the presence of the retaining spring 54.

[0069] On the other hand, if the throttle valve 21 is opened, an amount of intake air depending on an increase in opening degree of the throttle valve 21 is supplied to the engine 5 through the intake passage 17a and thus, the output from the engine 5 can be controlled.

[0070] It should be noted here that in such intake control system, the control block 28 having the coupler 80 and separate from the connecting flange 27 is coupled to the connecting flange 27 of the throttle body 17, and the bypass valve 35, the step motor 39, the intake temperature sensor 73, the boost negative pressure sensor 76, the throttle sensor 64 and the electronic control unit 84 are mounted to the control block 28. Therefore, the processing or working of the throttle body 17 and the fabrication of a control assembly including the control block 28 can be carried out in parallel to each other. Particularly, the functions of the step motor 39, the bypass valve 35, the various sensors 64, 73 and 76, the electronic control unit 84 and the like can be inspected by properly connecting a power source or the like to the coupler 80 before coupling of the control block 28 to the throttle body 17. Therefore, only the components passing the inspection are mounted to the throttle body 17 and hence, there is no waste in the assembling operation, thereby enabling an enhancement in productivity.

[0071] Moreover, the electronic control unit 84 is placed on the outer end face of the control block 28, and the step motor 39, the various sensors 64, 73 and 76 and the coupler 80 are electrically connected to one another through the electronic control unit 84. Therefore, the connection of the step motor 39, the various sensors 64, 73 and 76 and the coupler 80 by wires can be simplified, leading to a further enhancement in assemblability.

[0072] Further, the step motor 39 is provided with the connector pins 96 protruding in the direction of insertion of the step motor 39 into the actuator housing 42, and the connector bores 94 for fitting of the connector pins 96 are provided in the lead frames 93 leading to the coupler 80 on the control block 28. Therefore, the step motor 39 and the coupler 80 are electrically connected to each other simultaneously with the mounting of the step motor 39 to the control block 28 and thus, a special electrically connecting operation is not required, thereby enabling a further enhancement in assemblability.

[0073] Additionally, the lead frames 93 having the connector bores 94 are embedded in the connector piece 92 which is a smaller part positioned and fixed to the control block 28 between the step motor 39 and the electronic control unit 84. Therefore, the embedding is extremely easy and accurate, as compared with a case where they are embedded in the control block 28 which is a larger part. In addition, the connector bores 94 in the lead frames 93 can be disposed accurately in the fixed position by setting the connector piece 92 in the control block 28, and the proper fitting of the connector bores 94 and the connector pins 96 of the step motor 39 is guaranteed.

[0074] Further, the actuator housing 42 for mounting of the step motor 39 therein is mounted to open into the outer peripheral surface of the control block 28, which is different from the outer end face of the control block 28 on which the electronic control unit 84 is placed. Therefore, it is possible to form the control block 28 compactly, and to mount and remove the step motor 39 irrespective of the placement of the electronic control unit 84, thereby conducting the maintenance of the step motor 39 and the bypass valve 35 easily.

[0075] When the operation of the engine 5 is at stoppage, moisture in the air within the valve bore 34 may be condensed on an inner wall of the valve bore 34 in some cases, but water drops resulting from the condensation are inhibited by the seal member 57 disposed between the valve bore 34 and the actuator housing 42 from entering into the step motor 39 and hence, the step motor 39 can be protected, leading to an enhancement

in durability thereof.

[0076] Especially, the seal member 57 is clamped between the step motor 39 and the annular step 55 formed between the valve bore 34 and the actuator housing 42, and has the inner peripheral lip 61 provided in its inner peripheral surface to come into close contact with the outer peripheral surface of the root of the output shaft 39a of the step motor 39. Therefore, the frictional resistance of the inner peripheral lip 61 on the rotational face of the output shaft 39a is extremely small, and an influence to the responsiveness of the bypass valve 35 can be eliminated. Moreover, even in the case of the bypass valve 35 of such a type in which a tip end of the output shaft 39a is exposed to the inside of the valve bore 34, the step motor 39 and the valve bore 34 can be sealed reliably from each other by the single seal member 57. Namely, the structure of the bypass valve 35 is not limited and hence, the seal member 57 is applicable in a wider range.

[0077] In addition, when the operation of the engine 5 is at stoppage, in usual, the bypass valve 35 brings the valve bore outlet 33o into a fully closed state and hence, even if a fuel gas generated in the downstream section of the intake passage 17a enters into a downstream section of the bypass 30, the entrance of the fuel gas into the valve bore 34 is inhibited by the bypass valve 35. Therefore, even if the sealing function of the seal member 57 should be detracted, the step motor 39 can be prevented from being exposed to the fuel gas and thus, the durability of the step motor 39 can be ensured.

[0078] Further, the length of a section of the bypass 30 downstream from the valve bore 34 is set at a sufficiently large value and hence, the fuel gas generated in the downstream section of the intake passage 17a is difficult to pass through the sufficiently long downstream section of the bypass. Therefore, it is possible to prevent the entrance of the fuel gas into the valve bore 34 to further contribute to the protection of the step motor 39.

[0079] Additionally, since the valve bore inlet 33i and the valve bore outlet 33o occupying positions higher in level than the bypass inlet 31i and the bypass outlet 31o in the bypass 30 open into the lower surface of the valve bore 34, a foreign matter such as a dust and the like is hard to enter into the valve bore 34 from the valve inlet 33i and the valve bore outlet 33o and hence, it is possible to avoid the failure of the operation of bypass valve 35 due to the entering foreign matter.

[0080] The present invention is not limited to the above-described embodiment, and various modifications in design may be made without departing from the subject matter of the invention. For example, the bypass upstream groove 32i, the bypass downstream groove 32o and the communication passage 75 may be defined in a surface of the control block 28 coupled to the connecting flange 27.

Claims

1. An intake air-amount control system for an engine, comprising a throttle body (17) including a throttle valve (21) disposed in an intake passage (17a) leading to an intake port (7a) in the engine (5), a bypass (30) connected to said intake passage (17a) around said throttle valve (21), a bypass valve (35) for controlling the opening degree of said bypass (30), a sensor (64, 73, 76) for detecting the operational state of the engine (5), and an actuator (39) for opening and closing the bypass valve (35) in response to a signal output from said sensor (64, 73, 76),

characterized in that a coupler (80) which is coupled to an external coupler (83) is integrally formed on a control block (28) coupled to the throttle body (17); said bypass valve (35), said sensor (64, 73, 76) and said actuator (39) are mounted in said control block (28); an electronic control unit (84) is placed on an outer end face of said control block (28) to electrically connect said actuator (39), said sensor (64, 73, 76) and said coupler (80) to one another; and a synthetic resin (103) is potted into a cap (101) mounted to said control block (28) to cover said electronic control unit (84), so that said electronic control unit (84) is wrapped, and a mounted portion of said cap (101) is sealed.

2. An intake air-amount control system for an engine according to claim 1, wherein

said cap (101) is socket-fitted over an outer end of said control block (28), while accommodating said electronic control block (28) therein, and the synthetic resin (103) is potted into said cap (101) turned downwards to near an upper end thereof.

3. An intake air-amount control system for an engine according to claim 2, wherein

a potting port (102) for the synthetic resin (103) is provided at a point in said control block (28) closer to said cap (101).

4. An intake air-amount control system for an engine according to claim 3, wherein

a terminal (64a, 73a, 76a) of said sensor (64, 73, 76) is connected directly to a base board (84a) of said electronic control unit (84) wrapped by the synthetic resin (103).

5. An intake air-amount control system for an engine according to any of claims 1 to 4, wherein

said cap (101) is made of an aluminum alloy plate.

6. An intake air-amount control system for an engine according to any of claims 1 to 4, wherein

said sensor is at least one of a throttle sensor

(64) for detecting an opening degree of said throttle valve (21), a boost negative pressure sensor (76) for detecting a boost negative pressure in the engine (5), and an intake temperature sensor (73) for detecting a temperature within said intake passage (17a).

FIG.1

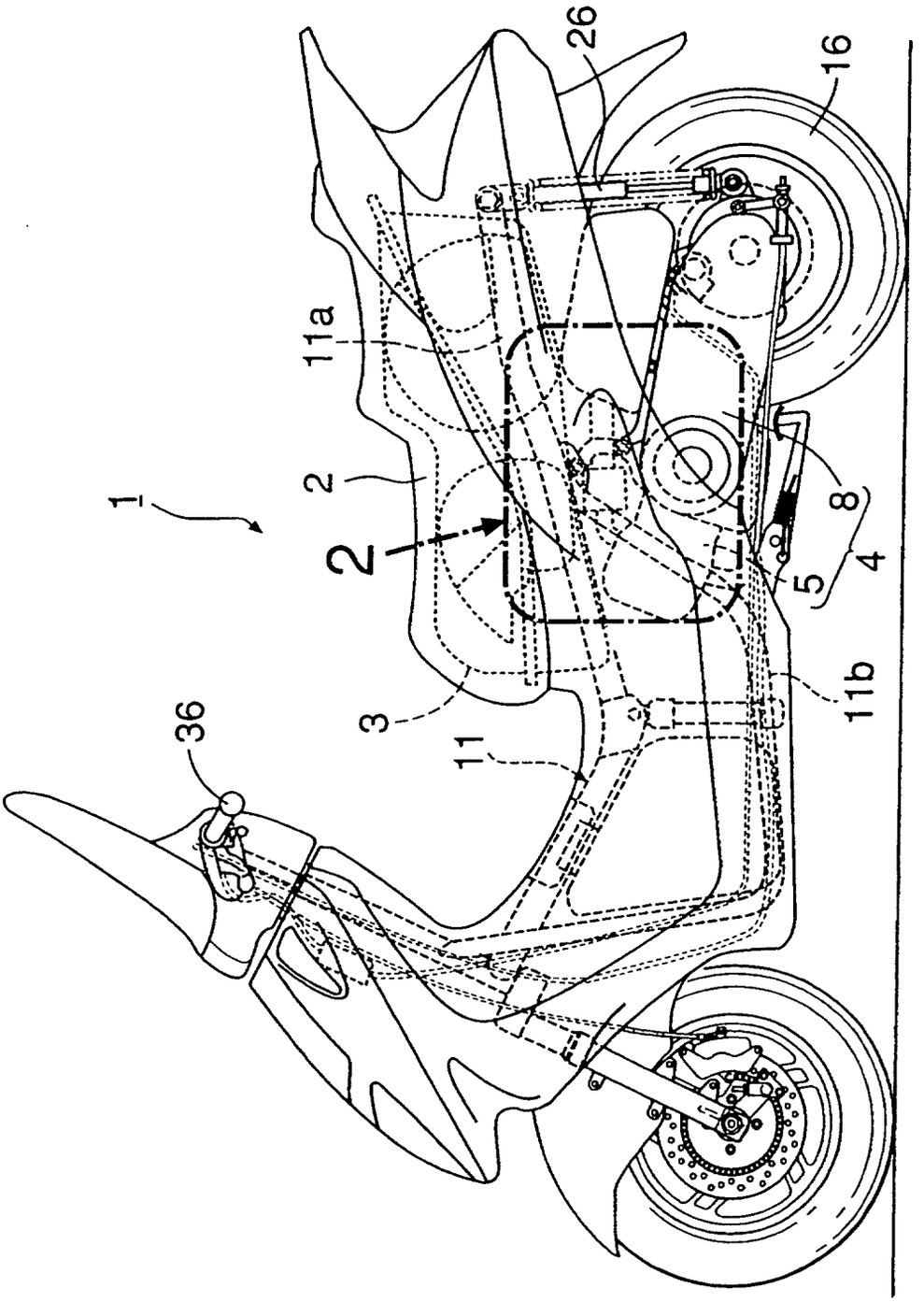


FIG.2

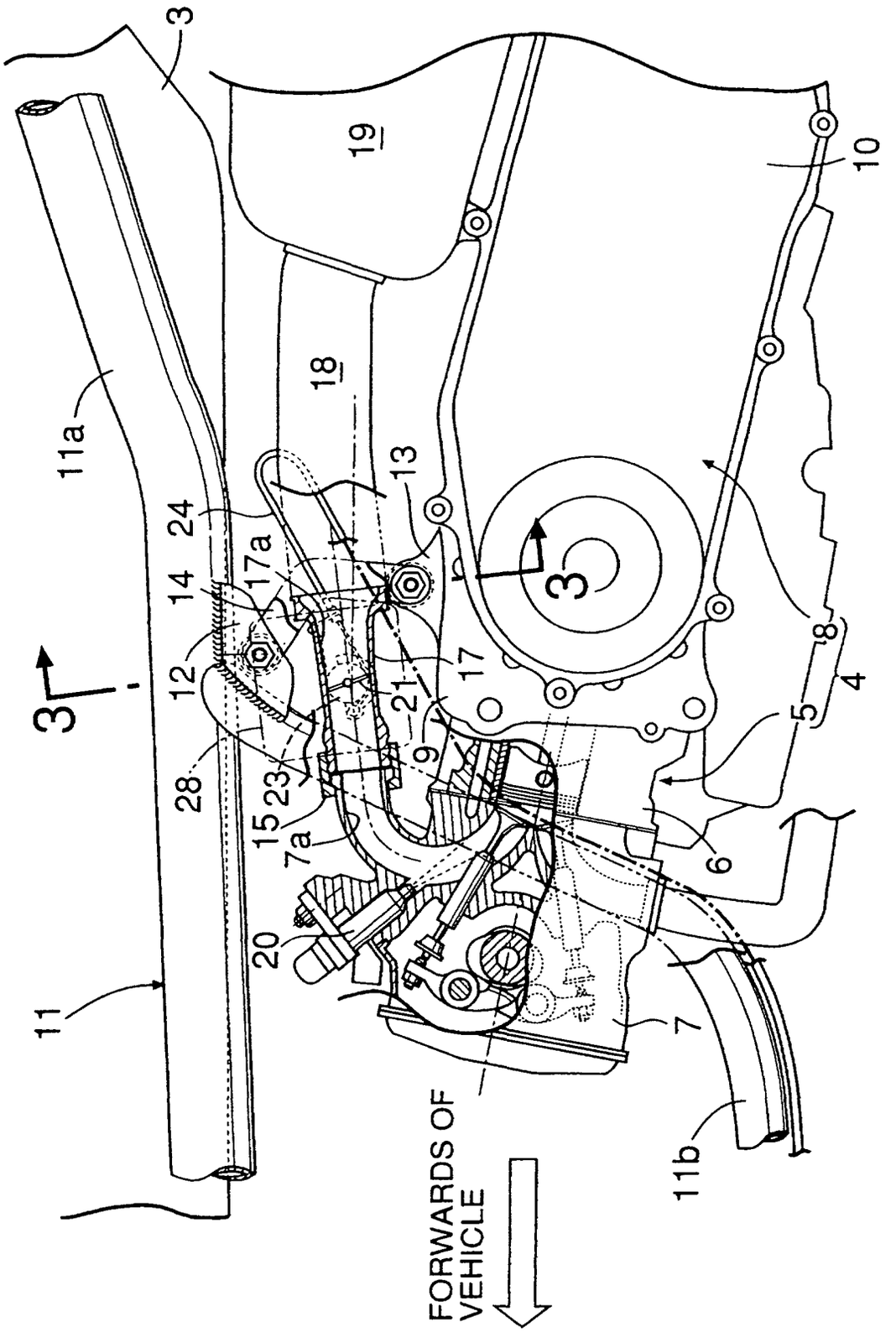

3
19
10
11a
18
13
24
14
17a
12
3
3
8
4
17
21
5
9
28
23
15
7a
6
20
11
7
FORWARDS OF VEHICLE
11b

FIG.3

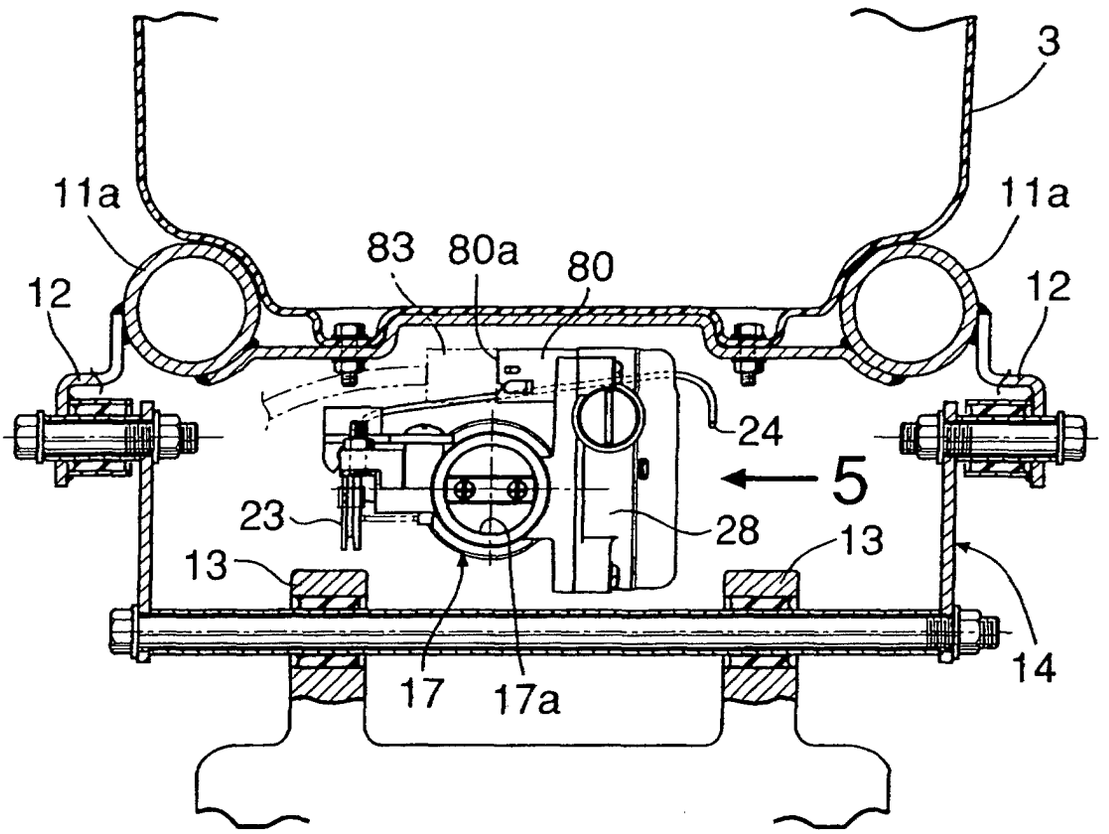


FIG.4

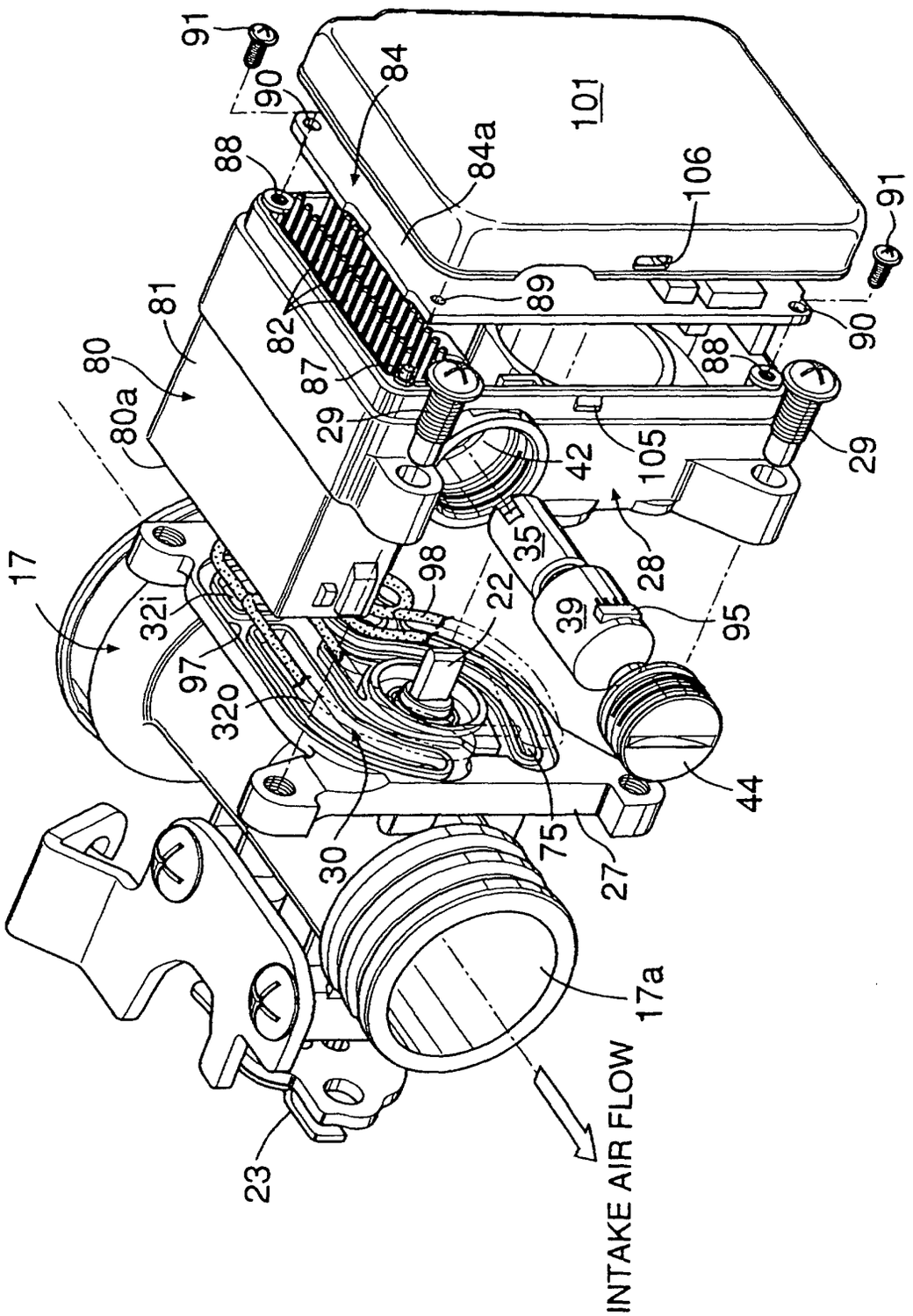

91
90
84
101
88
84a
106
91
81
89
82
87
88
90
80
80a
29
42
105
29
17
35
98
22
28
32i
39
95
97
320
30
75
27
44
17a
23
INTAKE AIR FLOW

FIG.5

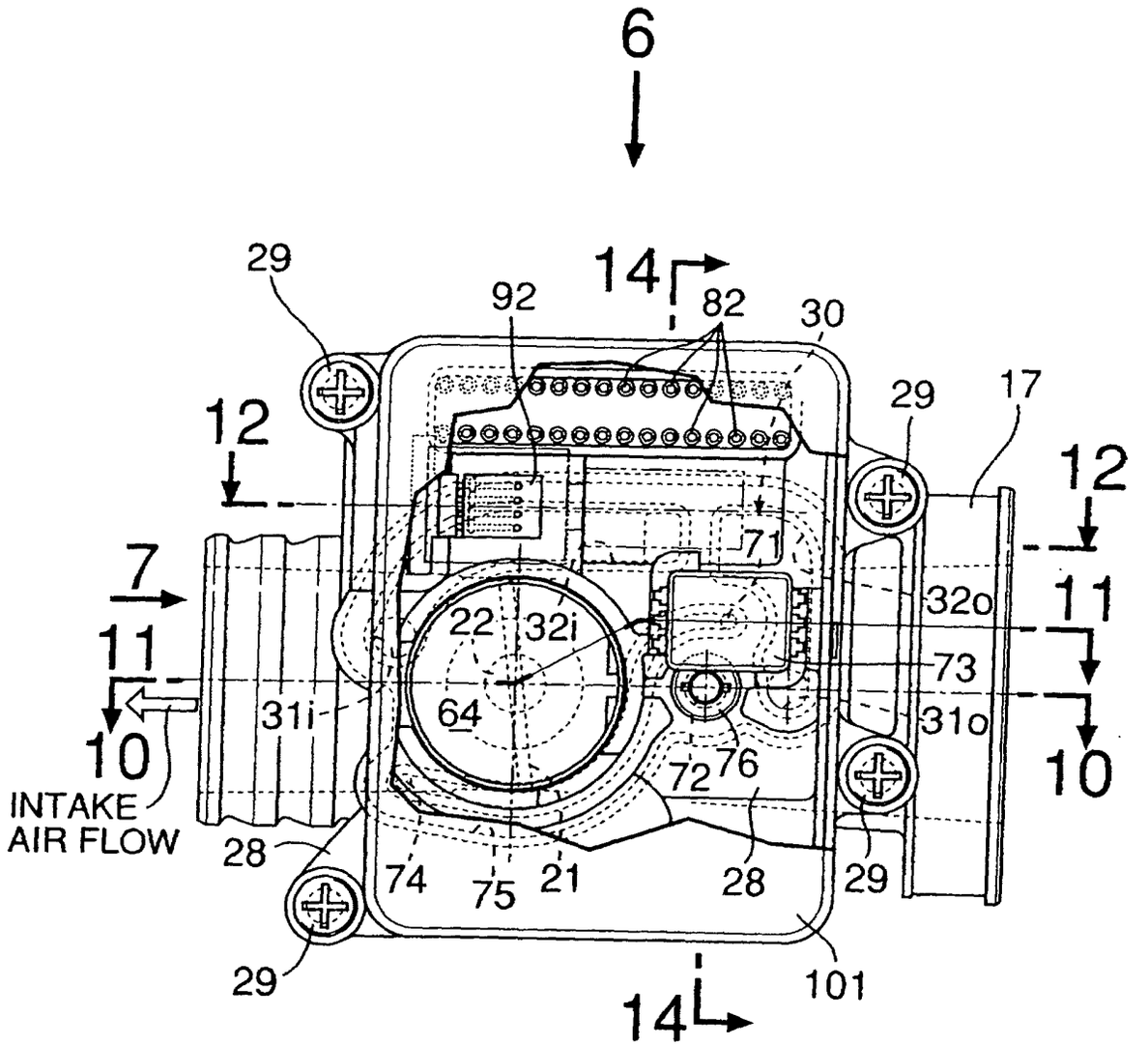

6
29
14
92
82
30
29
17
12
12
7
11
11
22
32i
32o
71
73
31i
64
31o
10
10
INTAKE
AIR FLOW
72
76
28
74
75
21
28
29
29
101
14

FIG.6

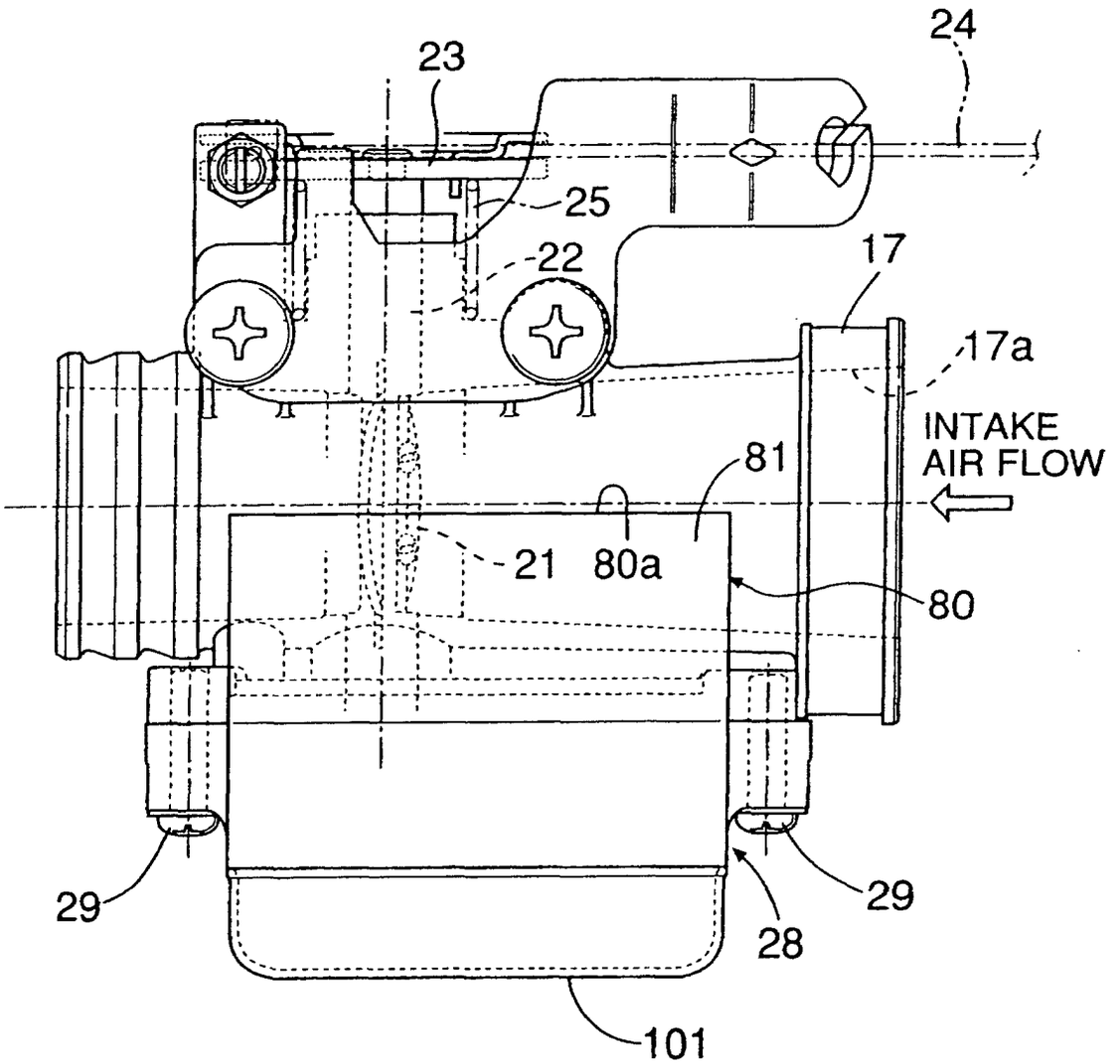


FIG.7

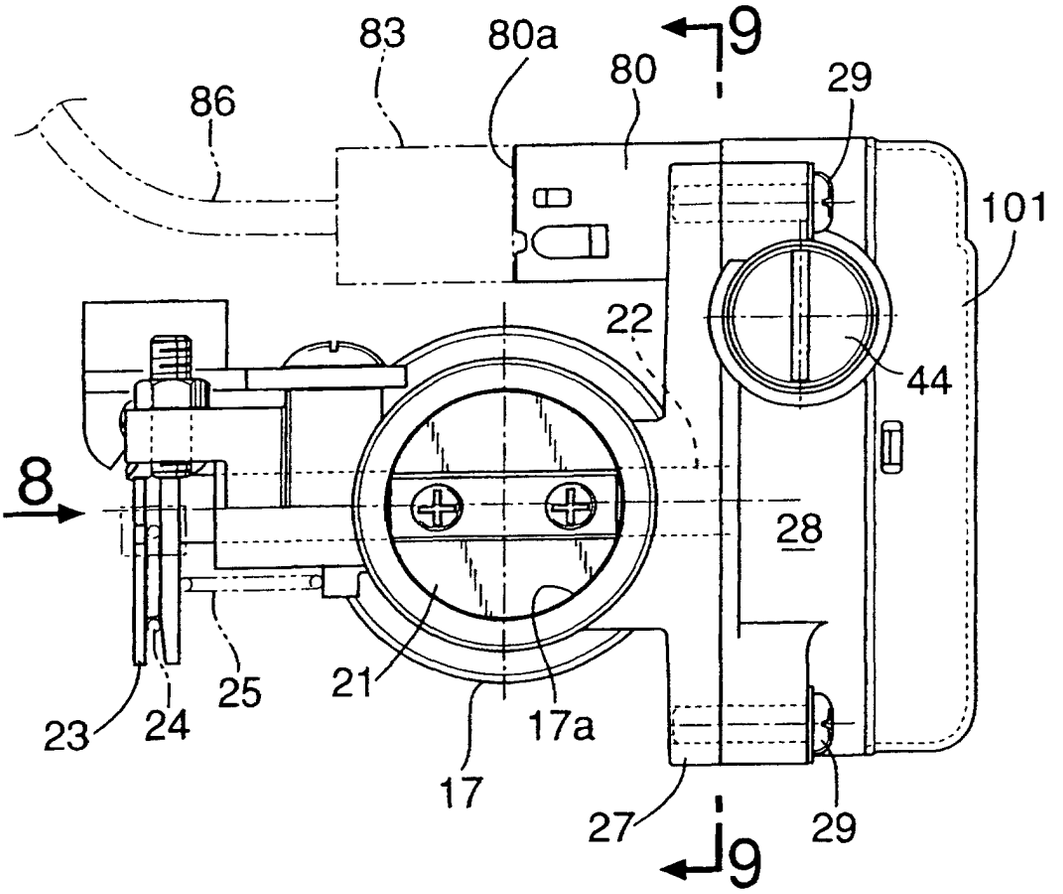


FIG.8

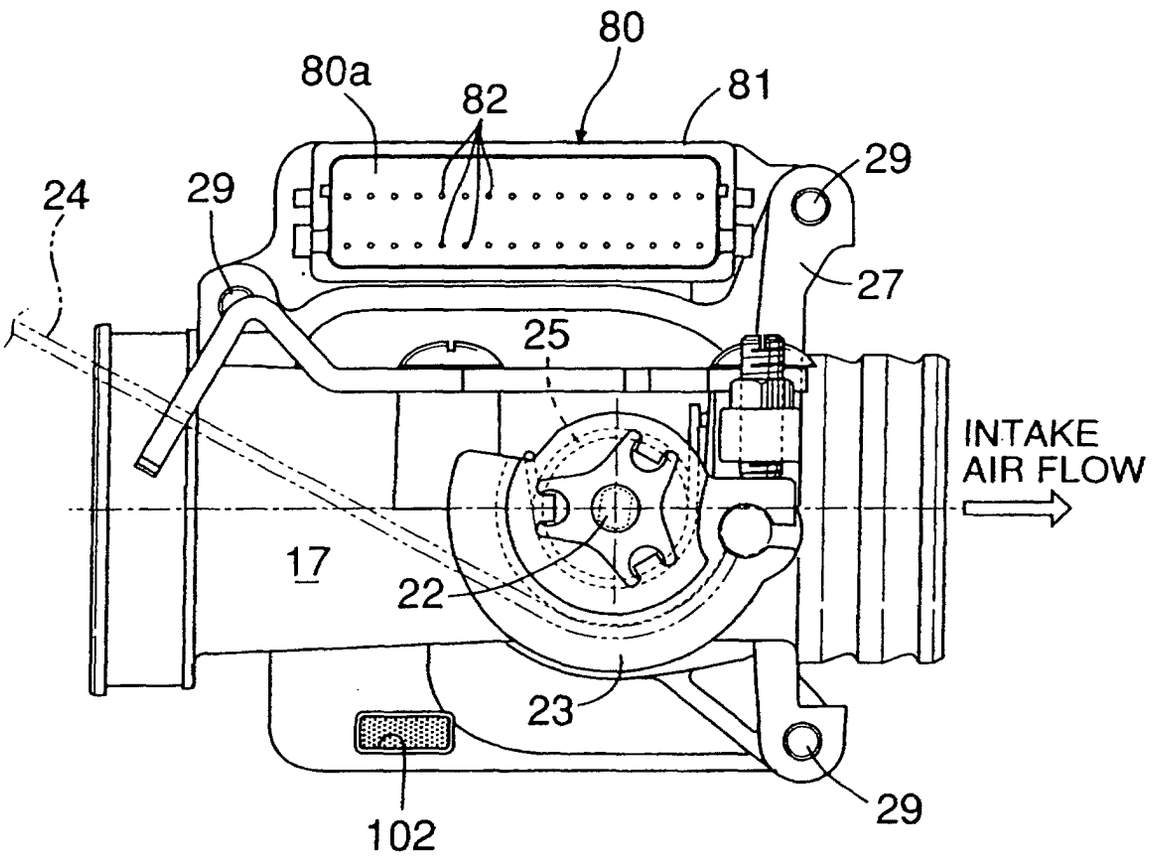
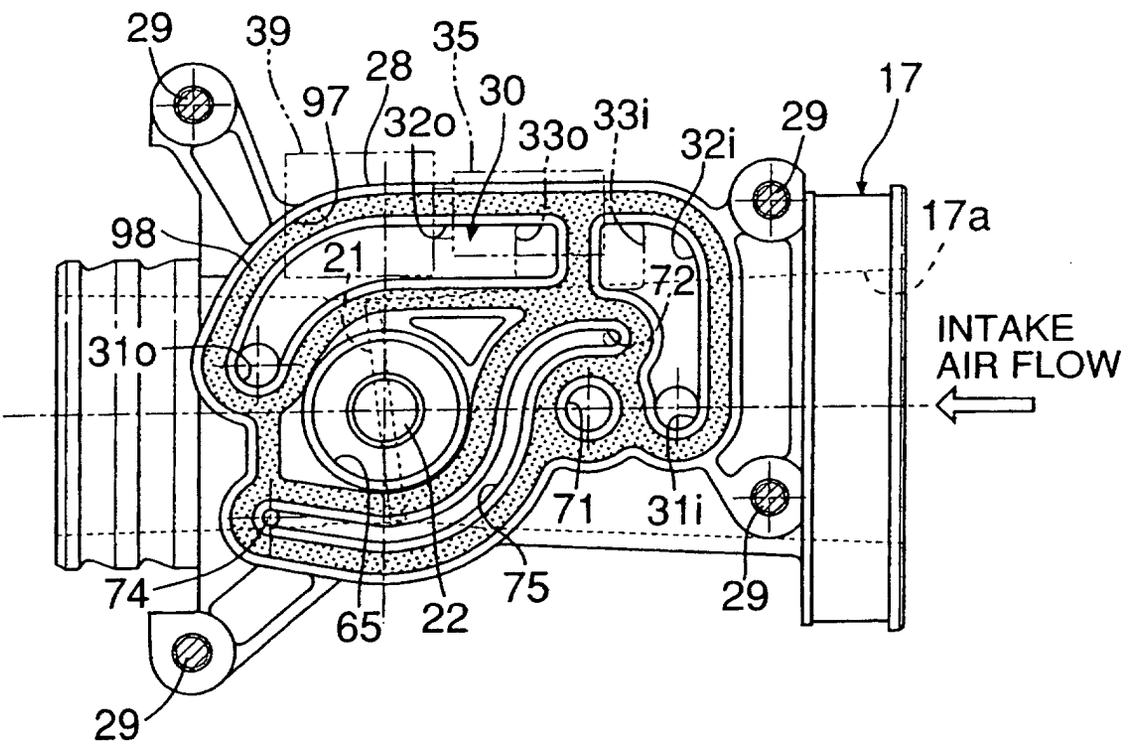


FIG.9


29
39
35
28
97
32o
30
33o
33i
32i
29
17
17a
98
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72
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INTAKE
AIR FLOW
71
31i
74
65
22
75
29
29

FIG.10

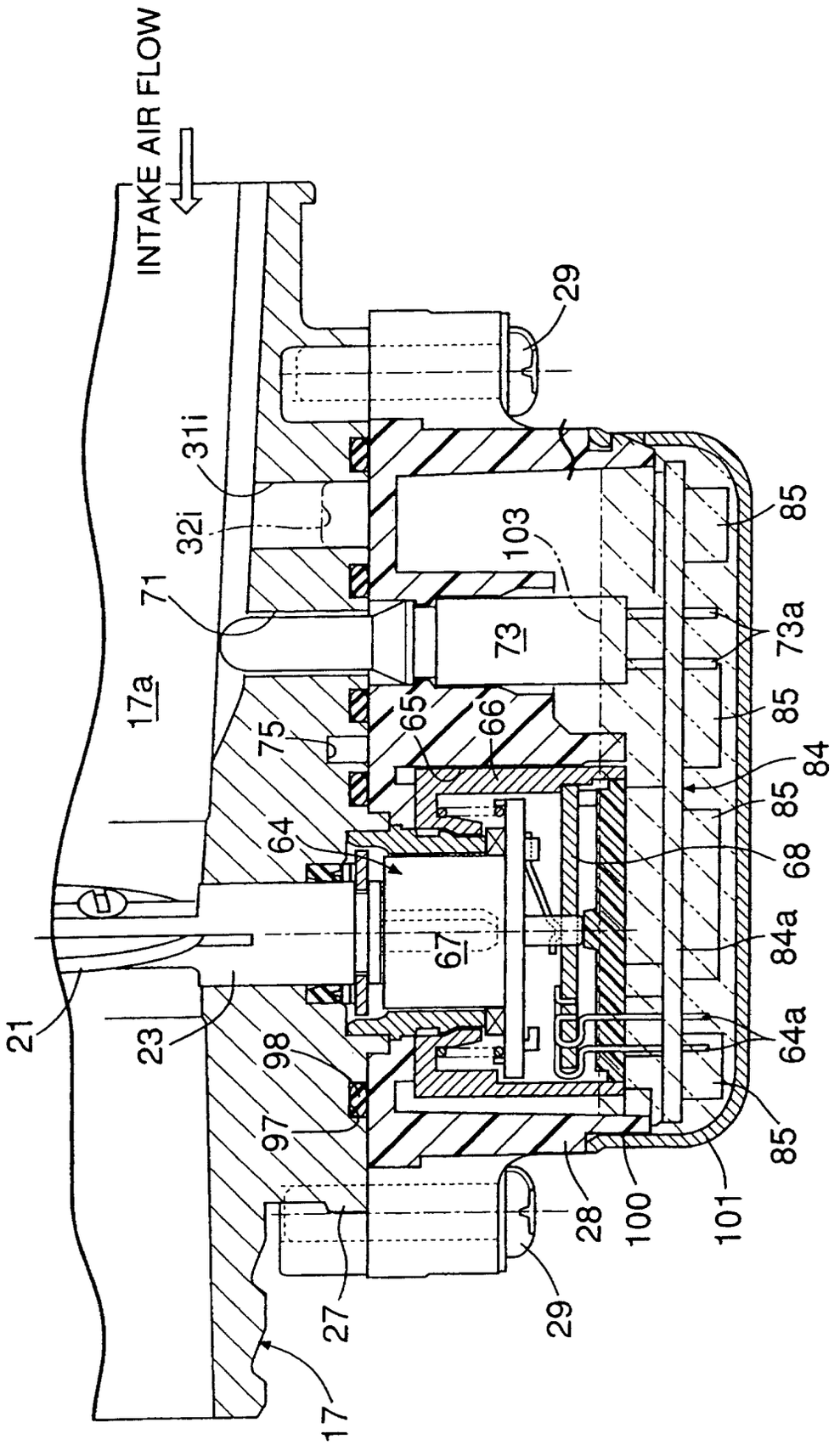
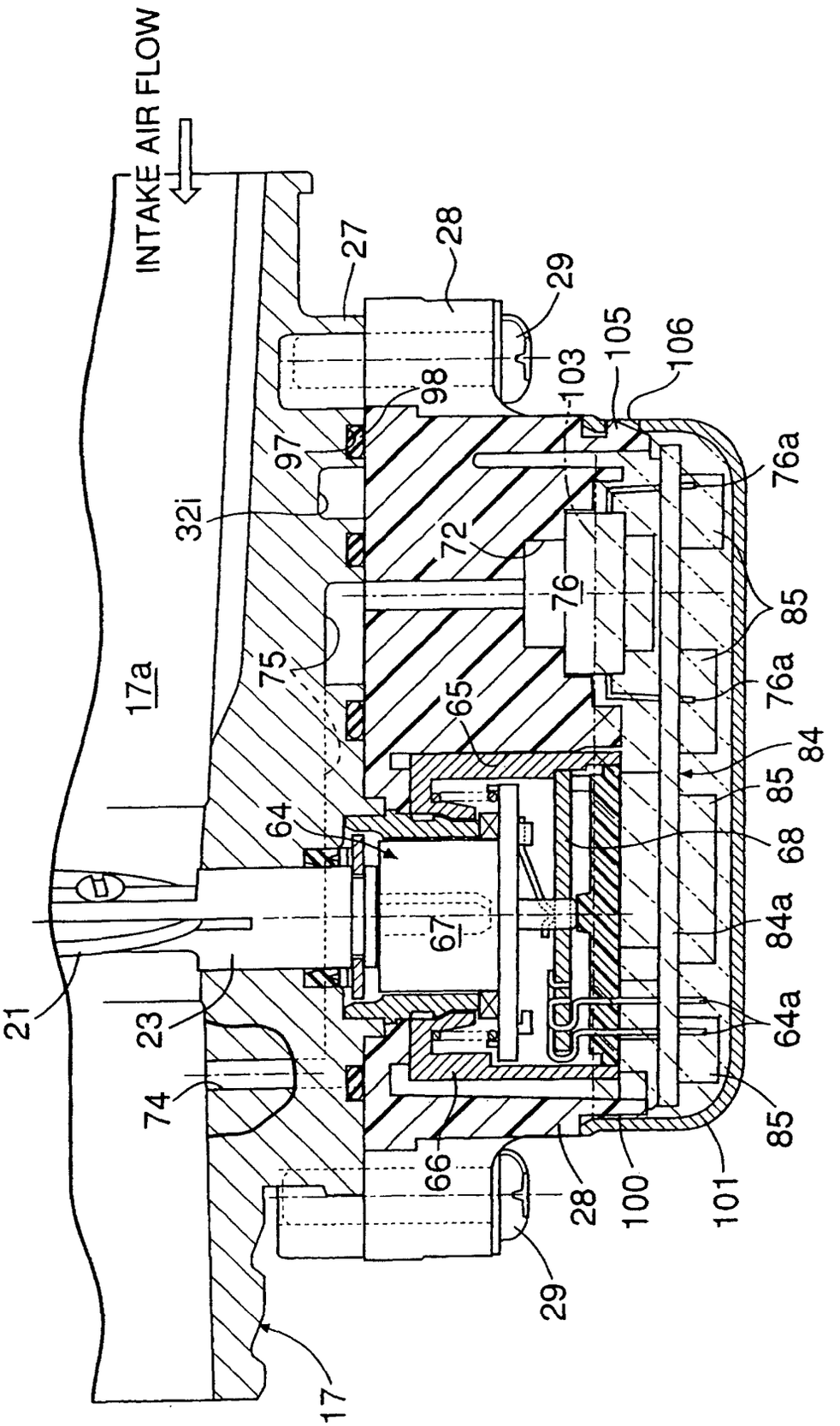

INTAKE AIR FLOW
29
31i
32i
71
103
85
73
73a
17a
75
65
66
84
64
68
67
84a
21
23
98
64a
97
85
28
100
101
27
29
17

FIG.11


INTAKE AIR FLOW
17a
21
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74
17
64
67
65
75
32i
97
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84
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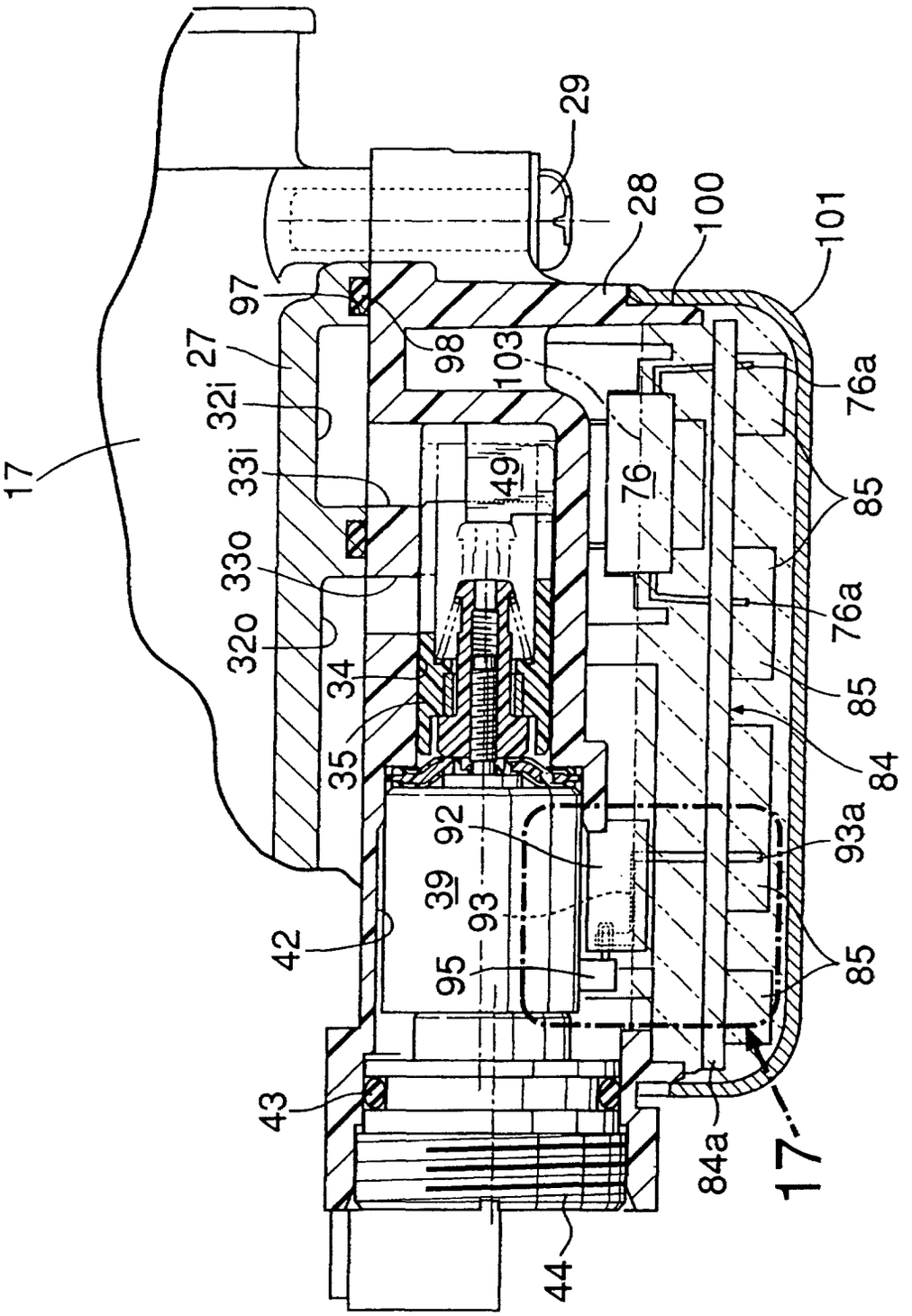
84a
64a
66
100
101

FIG.12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100
101
97
98
103
27
32i
33i
17
49
76
76a
85
33o
32o
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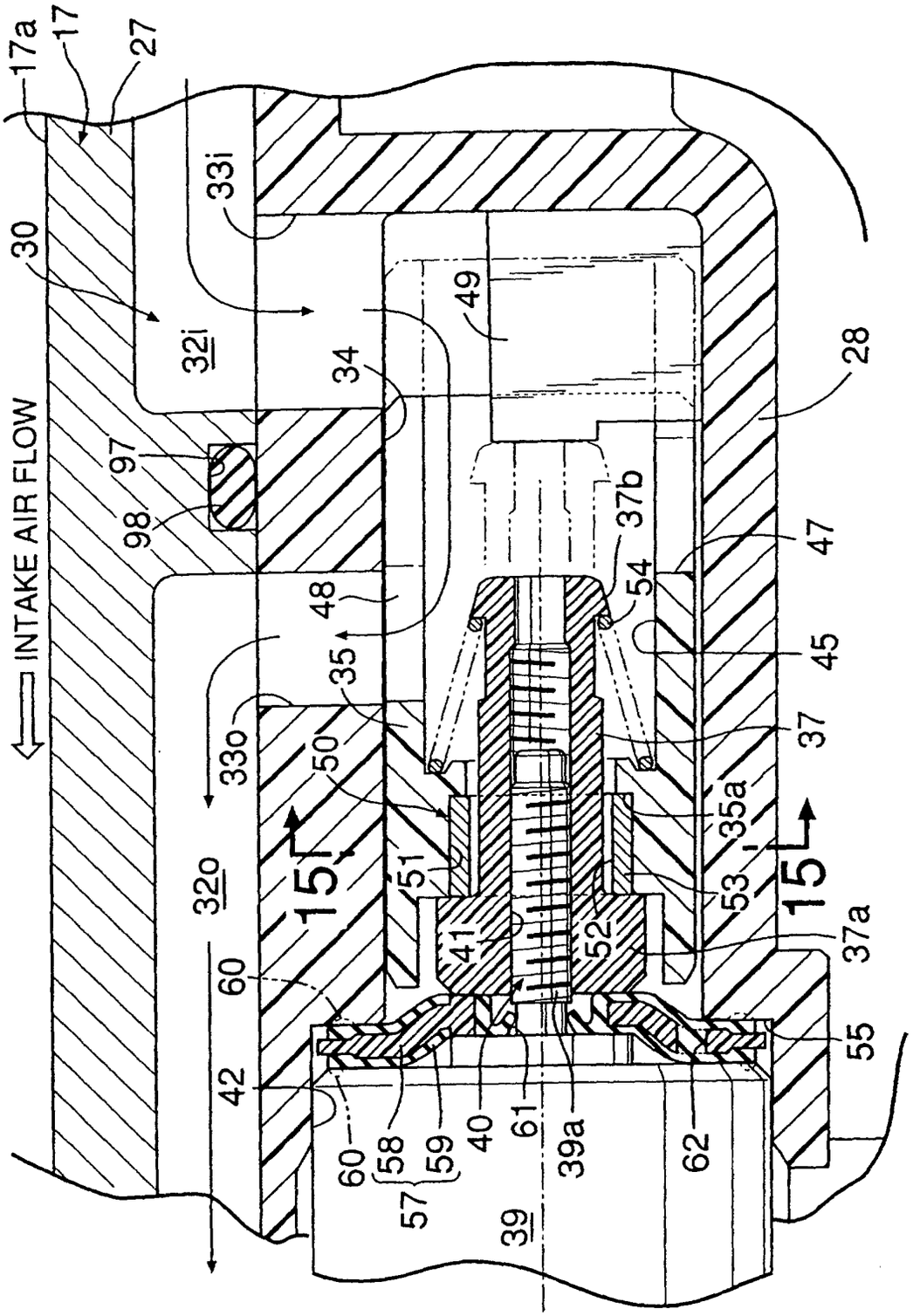
39
93
42
95
43
84a
17
44

FIG.13


INTAKE AIR FLOW
17a
17
27
30
33i
32i
34
49
28
97
98
37b
47
54
48
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35
33o
50
37
35a
32o
51
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42
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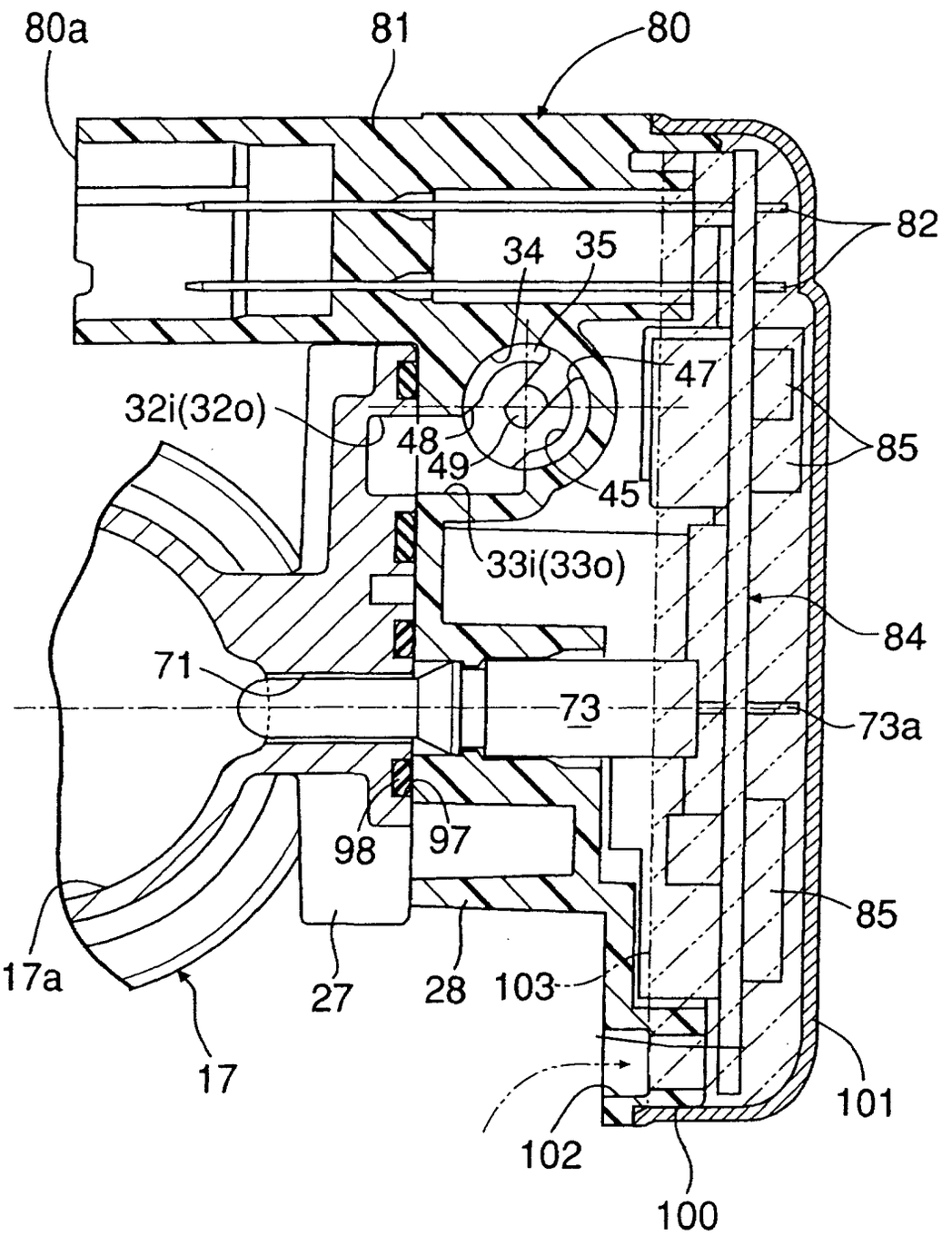
58
59
40
61
39a
62
57
39

FIG.14


80a
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80
82
34
35
47
32i(32o)
48
49
45
85
33i(33o)
84
71
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73a
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17a
27
28
103
17
101
102
100

FIG.15

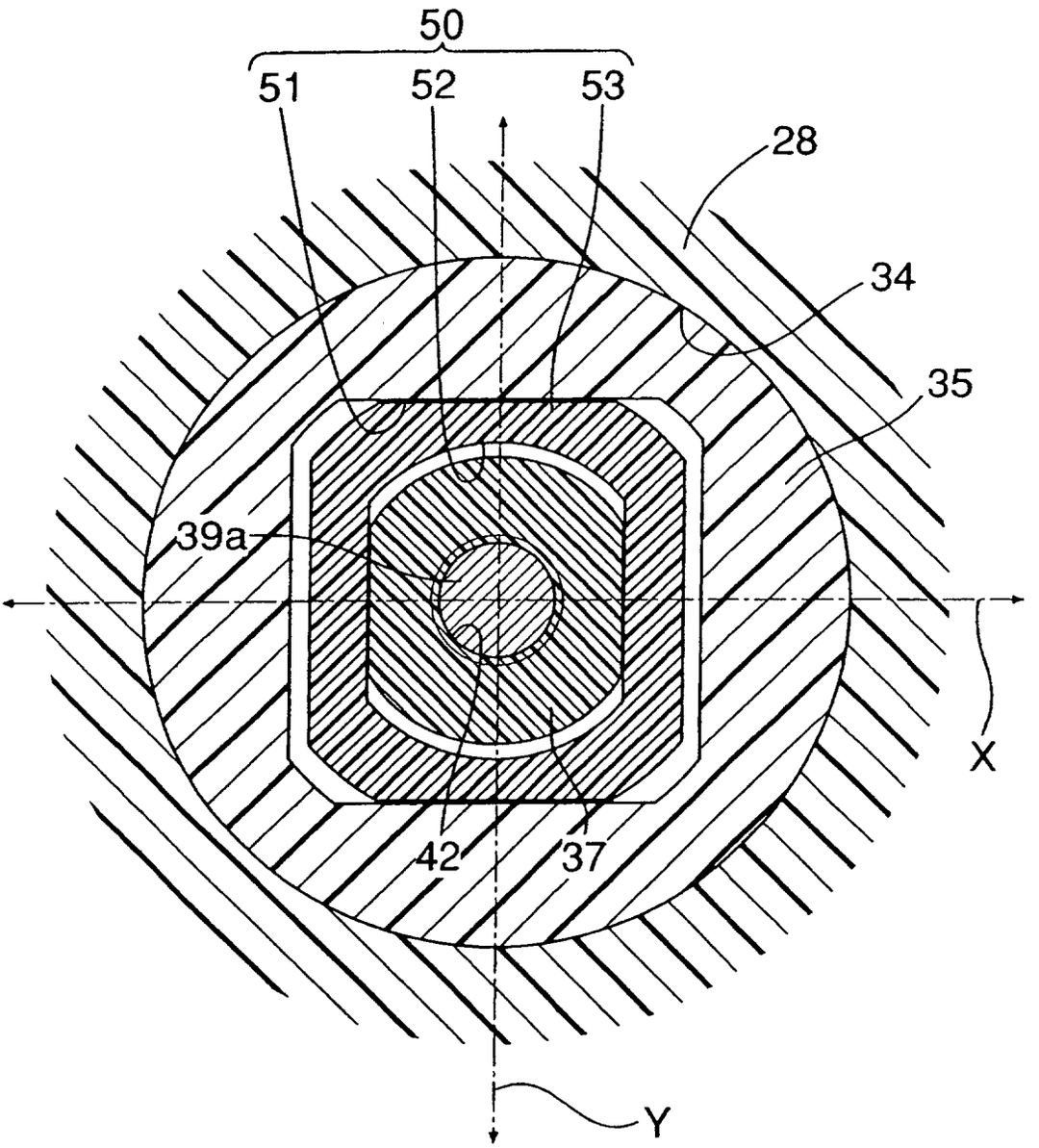


FIG.16A

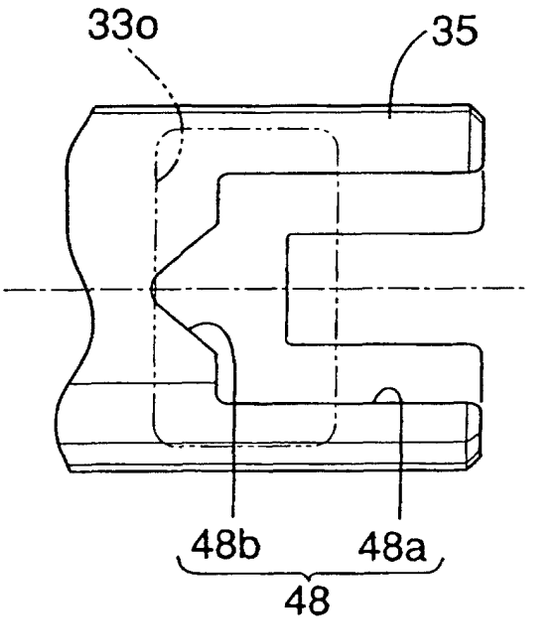


FIG.16B

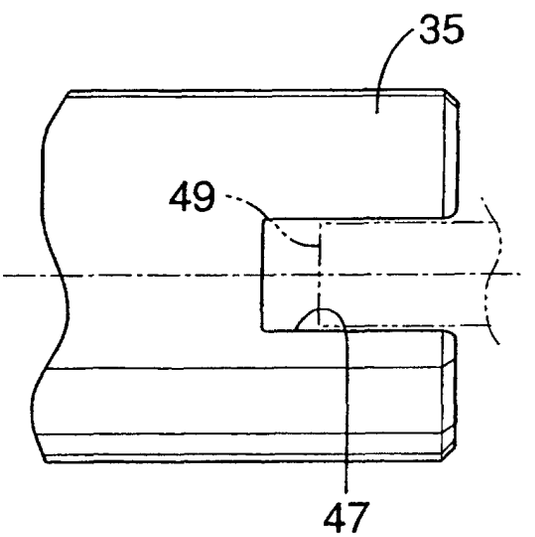
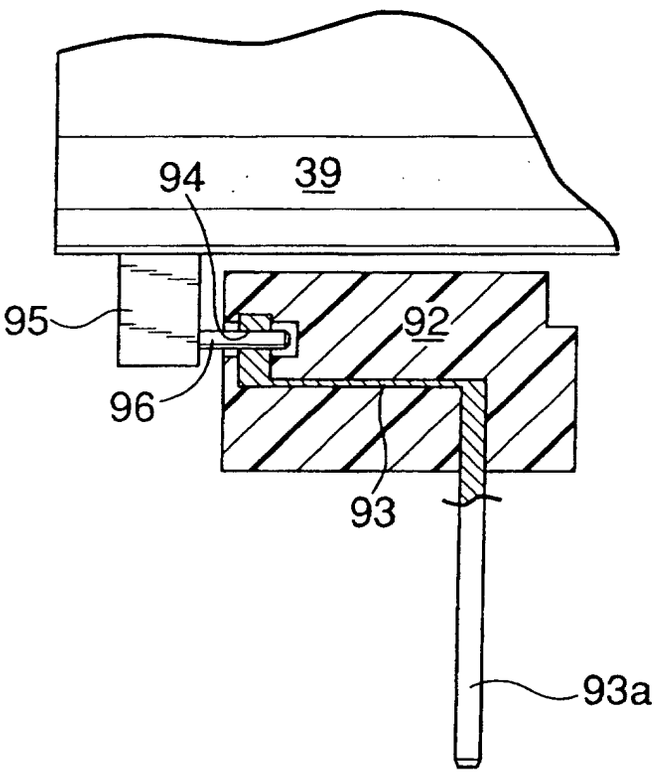


FIG.17



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/08676

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F02D9/02, F02B77/00, F02D9/10, F02D33/00

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] F02D9/02, F02B77/00, F02D9/10, F02D41/00-41/40, F02D33/00

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	1996-2002
Kokai Jitsuyo Shinan Koho	1971-2002	Toroku Jitsuyo Shinan Koho	1994-2002

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.
A	JP 09-303164 A (Hitachi, Ltd.), 25 November, 1997 (25.11.97), Full text; all drawings (Family: none)	1-6
A	JP 11-044265 A (Mitsubishi Electric Corp.), 16 February, 1999 (16.02.99), Full text; all drawings (Family: none)	1-6
A	US 5996543 A (NAKAYAMA et al.), 07 December, 1999 (07.12.99), Full text; all drawings & JP 10-274111 A	1-6

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 November, 2002 (22.11.02)	10 December, 2002 (10.12.02)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/08676

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 11-270394 A (Kehin Corp.), 05 October, 1999 (05.10.99), Full text; all drawings (Family: none)	1-6
A	JP 57-102537 A (Nippondenso Co., Ltd.), 25 June, 1982 (25.06.82), Full text; all drawings (Family: none)	1-6
A	JP 63-113761 U (Mikuni Kogyo Kabushiki Kaisha), 22 July, 1988 (22.07.88), Full text; all drawings (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (July 1998)